Jointly Sponsored Research Program

**Annual Report
January - December 1995**

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March 1996

Work Performed Under Contract No.: DE-FC21-93MC30098

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

By
University of North Dakota
Energy & Environmental Research Center
P.O. Box 9018
Grand Forks, North Dakota 58202-9018

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Office of Fossil Energy
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, West Virginia 26507-0880

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SECTION A

STATEMENT OF

TECHNICAL PROGRESS

TABLE A-1

SUMMARY OF ALL PROJECTS APPROVED FOR FUNDING
UNDER COOPERATIVE AGREEMENT DE-FC21-93MC30098

Task No.	Title	DOE Share		Cosponsor Share
		Prior Years	FY95	
Task 1	Multiple-Use Marketing of Lignite	\$ 20,000	\$ 0	\$ 20,000
Task 2	Seventeenth Biennial Low-Rank Fuels Symposium	\$ 35,000	\$ 0	\$ 35,000
Task 3	Slagging and Fouling Assessment of Coal and Coal Chars	\$ 15,175	\$ 0	\$ 15,175
Task 4	Chlorine Analysis and Removal from Products of Thermally Recycled Plastics	\$ 131,101	\$ 0	\$ 131,113
Task 5	Sorbent Regeneration from Circulating Fluidized-Bed Combustors (FBCs)	\$ 44,956	\$ 0	\$ 44,966
Task 7	Development of Methods to Predict Agglomeration and Deposition in Fluidized-Bed Combustors	\$ 440,000	\$ 0	\$ 440,000
Task 8	Development of a Fireside Performance Index: Convective Pass Fouling and Fly Ash Collectibility	\$ 370,000	\$ 0	\$ 370,000
Task 10	Timing of the Deposition of Uppermost Cretaceous and Paleocene Coal-Bearing Deposits in the Greater Glendive Area, Montana and North Dakota	\$ 33,980	\$ 0	\$ 33,980
Task 11	Coal Agglomeration Consortium	\$ 100,000	\$ 0	\$ 100,000
Task 13	Phenol Purification Studies	\$ 22,000	\$ 0	\$ 22,000
Task 14	Effect of Ethanol Denaturant on Gasoline Reid Vapor Pressure	\$ 49,978	\$ 0	\$ 49,981
Task 15	Process Development Unit Test Program for Thermally Recycled Plastics	\$ 630,000	\$ 0	\$ 809,120
Task 16	Bench-Scale Preparation and Combustion Testing of Refuse-Derived Fuel-Coal Slurry Fuels	\$ 95,000	\$ 0	\$ 135,000
Task 17	Enhanced Air Toxics Control	\$ 464,507	\$ 139,090	\$ 634,923
Task 18	Coal Ash Resources Research Consortium	\$ 115,000	\$ 83,900	\$ 268,350
Task 19	The Application of Fluidized-Bed Combustion Residues for High-Volume Utilization Options	\$ 160,000	\$ 0	\$ 160,000
Task 20	FT-IR Spectroscopic Investigation of Fireside Deposits in a Pilot Plant Combustor	\$ 45,000	\$ 0	\$ 45,000
Task 21	Sour Gas Plant Subsurface Remediation Technology Research and Demonstration Project	\$ 285,250	\$ 95,000	\$ 502,250
Task 22	Evaluation of Supercritical Fluid Extraction for Analysis of Petroleum Industry Wastes	\$ 100,000	\$ 0	\$ 100,000

TABLE A-1 (continued)

Task No.	Title	DOE Share		Cosponsor Share
		Prior Years	FY95	
Task 23	Gas Industry Groundwater Research Program	\$ 782,974	\$ 243,083	\$ 1,026,303
Task 24	Utilization of Western Coals in Bituminous Boilers – Pilot Plant Assessment of Blend Properties and Their Impact on Critical Utility Power Plant Components	\$ 15,881	\$ 0	\$ 195,000
Task 25	Physical Cleaning of Lignite	\$ 30,000	\$ 0	\$ 30,000
Task 26	Remote-Site Power Generation Opportunities for Alaska	\$ 250,000	\$ 0	\$ 271,400
Task 27	Alaskan Low-Rank Coal–Water Fuel Environmental Attributes and Combustion Test Marketing	\$ 50,000	\$ 0	\$ 62,000
Task 28	An Assessment of the Subsurface Fate of Monoethanolamine at Sour Gas Processing Plant Sites	\$ 59,890	\$ 47,000	\$ 159,672
Task 29	Mitigation of Air Toxics from Lignite Generation Facilities	\$ 100,000	\$ 0	\$ 100,000
Task 30	Hot-Gas Filter Ash Characterization Project	\$ 230,000	\$ 320,000	\$ 670,000
Task 31	Formal Evaluation of Flue Gas Chemical Measurement Methods Phase I – Verification of Mercury Speciation by EPA (Draft) Method 29	\$ 287,090	\$ 422,510	\$ 1,173,765
Task 32	Organic Sulfur Removal from Coal with Super- and Subcritical Water	\$ 70,218	\$ 90,000	\$ 198,527
Task 33	Upgraded North Dakota Lignite – Production of Test Quantities	\$ 25,000	\$ 0	\$ 40,000
Task 34	Coal Quality Expert Fouling and Slagging Algorithm Development	\$ 40,000	\$ 0	\$ 60,000
Task 35	Evaluation of Field Analytical Techniques for Mercury in Soil	\$ 0	\$ 40,000	\$ 89,500
Task 36	Combustion Characterization of Carbonized RDF from Temperature Optimization Tests	\$ 0	\$ 200,000	\$ 304,096
Task 37	Recent Advances in Research on Ash Deposition in Utility Boilers: Practical Applications for the Electric Power and Coal Industries	\$ 0	\$ 60,331	\$ 90,502
Task 38	Mercury Remediation Technology Research and Demonstration	\$ 0	\$ 40,000	\$ 60,500
Task 39	Preparation and Gasification of Thailand Coal–Water Fuels	\$ 0	\$ 49,771	\$ 75,000
Task 40	Mercury Sorbent Evaluation	\$ 0	\$ 60,350	\$ 89,650

TABLE A-1 (continued)

Task No.	Title	DOE Share		Cosponsor Share
		Prior Years	FY95	
Task 41	Lignite Resource Characterization and Evaluation for Mitigation of Ash Deposition	\$ 0	\$ 152,000	\$ 228,000
Task 42	Holocene Cyclicality in Western North Dakota—Climate Change Interpreted from Fluctuations in Alluvial Sedimentation	\$ 0	\$ 64,972	\$ 99,964
Task 43	Oxidation of North Dakota Scrubber Sludge for Soil Amendment and Production of Gypsum	\$ 0	\$ 40,000	\$ 80,000
Task 44	Pilot Plant Assessment of Fly Ash Agglomeration	\$ 0	\$ 209,993	\$ 318,007
Task 45	Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters	\$ 0	\$ 200,000	\$ 600,000
Total		\$ 5,098,000	\$ 2,558,000	\$ 9,938,744

PROJECT DESCRIPTIONS AND STATUS

Task 1	Multiple-Use Marketing of Lignite	Status: Complete
Cosponsors	Knife River Coal Mining Company; J.R. Simplot Company; North Dakota Industrial Commission	
Summary The objective of this program was to provide a market feasibility study for the multiple uses of lignite in the city of Grand Forks, North Dakota. Lignite and sulfur-capture additives were used to clean agriculture wastewater. Lignite was also used after wastewater cleanup to generate steam and produce lignite briquettes. Various combinations of lignite, waste lime sludge, lime, and an additive have been used to produce clear, essentially odor-free water from potato wastewater. Collected residue containing starch material and lignite has been successfully briquetted. A major expense in the upgrading of lignite (drying) is the capital and operating cost of dust-handling equipment. Preliminary tests indicate these costs may be reduced by proper pretreatment of the coal. Information has been collected on the economics of the multiple-use marketing of lignite used in cogeneration or steam generation, wastewater cleaning, and/or briquettes, including possible waste solids disposal costs in Grand Forks. The most environmentally acceptable coal-to-steam process is fluidized-bed combustion. No multiple-use scheme was found that would make North Dakota lignites more economically acceptable than subbituminous coals. The final report was issued in September 1993.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	20,000	20,000

Task 2	Seventeenth Biennial Low-Rank Fuels Symposium	Status: Complete
Cosponsors	BNI Coal, Ltd.; Northern States Power Company; Minnesota Power; American Coal Ash Association; N-R-G Energy, Inc.; Knife River Coal Mining Company; MDU Resources Group, Inc.; Minnkota Power Cooperative, Inc.; North American Coal Corporation; Otter Tail Power Company; Utility Fuels, Inc.	
Summary The goal of the Low-Rank Fuels Symposium is to provide a forum for industry, government, and academia to allow the exchange of information that can be used to develop efficient technologies to utilize low-rank fuels in an environmentally acceptable manner. The symposium, held May 10-13, 1993, in St. Louis, Missouri, was organized in a manner to provide for the discussion, communication, and dissemination of recent information on low-rank fuel utilization. Participants in the symposium consisted of a multidisciplinary blend of representatives from industry, research organizations, government agencies, and universities. The conference proceedings were issued in May 1994.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	35,000	35,000

PROJECT DESCRIPTIONS AND STATUS

Task 3	Slagging and Fouling Assessment of Coal and Coal Chars	Status: Complete
Cosponsor	Illinois State Geological Survey	
Summary Eastern utility boilers now firing high-sulfur, high-volatile bituminous Illinois coal must consider alternatives to meet the 1995 emission guidelines of 2.5 lb of SO ₂ /MMBtu. Alternatives include coal switching, blending coals, or retrofitting with costly scrubbers. Another alternative is to use a low-sulfur char produced from the mild gasification of Illinois coal and subsequent low-temperature oxidation of the char. This char could be burned exclusively or blended with the parent coal to reduce emissions. An Illinois Basin coal and two coal-char blends were submitted by the Illinois State Geological Survey for evaluation of their fouling and slagging propensity. Laboratory tests and calculations indicated that one blend, prepared from char produced under high-temperature conditions with the addition of hydrated lime, would cause severe slagging, high-temperature fouling, and, possibly, low-temperature fouling problems. The second blend, prepared from char produced under low-temperature conditions, exhibited slagging and fouling behavior similar to the Illinois coal itself and is seen as an attractive feedstock because of a lower sulfur content and higher Btu content than the parent coal. All laboratory testing, analysis, and interpretation of the results have been completed. The final report for the project was submitted to the Illinois State Geological Survey (ISGS) and to the U.S. Department of Energy in September 1993.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	15,175	15,175

PROJECT DESCRIPTIONS AND STATUS

Task 4	Chlorine Analysis and Removal from Products of Thermally Recycled Plastics	Status: Complete
Cosponsor	American Plastics Council and 3M Company	
Summary <p>Plastics account for nearly 20%, by volume, of the material entering a landfill. Public pressures to recycle products and, correspondingly, to reduce the amount of material landfilled have prompted investigation of practicable means of plastics recycling. Some plastics (e.g., high-density polyethylene [HDPE]) are easily isolated and recycled by existing mechanical methods. Other types are difficult to recycle by traditional methods for a variety of reasons. Thermal depolymerization, or thermal cracking, breaks down plastics to liquids and gaseous products similar to the petroleum-based starting materials used in plastics manufacturing. These products are then reintroduced to a petroleum refinery, where they will be used for new plastics production and for the production of other petroleum products.</p> <p>A key aspect of any plastics recycling process is the removal of chlorine, present primarily from polyvinyl chloride (PVC). All currently envisioned end uses for recycled plastics have tolerance levels for chlorine. Earlier work at the Energy & Environmental Research Center using sorbents for chlorine capture in the process was very successful. This program examined the potential for using a postreactor fixed sorbent bed for chlorine removal from postconsumer plastics. Variables investigated included fixed-bed temperature, sorbent particle size, and chlorine loading. In addition to the fixed-bed study, an analytical development effort was completed, which examined the detection limits and accuracy of the gas chromatograph-atomic emission detector (GC-AED) technique used at the Energy & Environmental Research Center to quantitate organic chlorine content of the product liquids. Analysis of the liquids indicated total organic chlorine could be reduced to 20 ppm with a feed stream of 2%-5% PVC, which was the goal of the program. The final report was submitted in December 1994.</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	131,101	131,113

PROJECT DESCRIPTIONS AND STATUS

Task 5	Sorbent Regeneration from Circulating Fluidized-Bed Combustors (FBCs)	Status: Complete
Cosponsor	Community Energy Alternatives Inc.	
Summary Circulating fluidized-bed combustion (CFBC) is an efficient method for burning high-sulfur fuels to meet stringent SO ₂ emission level requirements. One concern when high-sulfur coal is burned is the high usage of limestone and, consequently, the relatively large amounts of solid waste for disposal. The large amount of limestone is a result of utilizing only 30%–50% of the available calcium in a once-through system. In this project, a sorbent regenerator was coupled with the Energy & Environmental Research Center CFBC pilot plant system to study the regeneration and recycling of the spent sorbent. The first series of combustion tests has been completed on the Energy & Environmental Research Center pilot-scale circulating fluidized-bed combustor. During this testing, the performance of pelletized fly ash from the baghouse of a full-scale circulating fluidized-bed combustor was compared to that of fresh limestone. Based on these results, the limestone feed and subsequent solid waste disposal could be reduced by approximately 25% with pelletization and recycle of the fly ash alone. Further testing coupling the fly ash pelletization with the regeneration of the bottom ash resulted in limestone usage being reduced by a maximum of 84.5%. There appears to be significant potential for better optimizing and integrating the operations of the fly ash pelletization and the bottom ash regeneration processes with the circulating fluidized-bed combustor operation to meet the original goal of a greater than 90% reduction in limestone usage. This would likely require some detailed bench-scale studies of the pelletization and regeneration processes before proceeding with further pilot-scale testing. The final report for the project was submitted to sponsors in May 1994.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	44,956	44,966

PROJECT DESCRIPTIONS AND STATUS

Task 7	Development of Methods to Predict Agglomeration and Deposition in Fluidized-Bed Combustors (FBCs)	Status: Ongoing
Cosponsors	Ahlstrom Pyropower, Inc.; Riley Stoker Corporation; Northern States Power Company; Electric Power Research Institute; North Dakota Industrial Commission	

Summary

The focus of this project is to develop a method to predict agglomeration and deposition in fluidized-bed combustors (FBCs). The basic mechanisms of agglomeration and deposition have been developed from the detailed analysis performed on samples from the Montana-Dakota Utilities' Heskett Station and Northern States Power Black Dog Station. A simple model based on ash chemistry has been developed that may be able to predict agglomerating tendencies.

The bench-scale test matrix, in which operating conditions, sorbent type, and additives were varied, has been completed. The data from these tests are being incorporated into the agglomeration mechanisms. The testing has identified a number of bed material/sorbents that greatly reduce the agglomeration tendency.

A computer model designed to predict deposition in pulverized coal-fired units is being adapted to predict deposition in FBCs. Using the information generated from the full-scale and bench-scale systems, combined with work on the fundamental chemistry and physics of the deposited materials, methods for predicting the onset of deposition and agglomeration, and possible mitigating measures will be developed during the remainder of the project.

A final report for this 3-year project will be completed February 1996.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY93	240,000	240,000	
FY94	200,000	200,000	

PROJECT DESCRIPTIONS AND STATUS

Task 8	Development of a Fireside Performance Index: Convective Pass Fouling and Fly Ash Collectibility	Status: Ongoing
Cosponsors	Northern States Power Company; Minnesota Power; Electric Power Research Institute; Union Electric, Inc.; Kansas City Power & Light	

Summary

A performance index to provide utilities and coal companies with a quick method to assess coal performance has been developed. Work began on the project in October 1992 and was completed by July 31, 1995.

Work has been completed using a drop-tube furnace for the purpose of carrying out bench-scale fouling and slagging combustion tests to refine existing fouling and slagging indices that are based on computer-controlled scanning electron microscopy. Four field tests were conducted at Union Electric's Labadie Station, Minnesota Power's Clay Boswell Station, Northern States Power's Sherburne County Station, and Kansas City Power & Light's Iatan and Hawthorn Stations to verify the performance indices. Mineralogical data and other pertinent information obtained for over 50 different coals were used to develop the performance indices. Final algorithms were developed and packaged as a software product for predicting low-temperature fouling, high-temperature fouling, slagging, slag tapping, grindability, ash erosion, ash collectibility-opacity, and sootblowing indices using the coal database and the empirical combustion performance information from the laboratory and the field. Beta versions of the software were sent out in February 1995 and a final version of the software was distributed, along with a training seminar, in June 1995.

A report summarizing the first phase of the work was submitted to the sponsor in July 1993. A final draft topical report was completed in November 1995 that details the work performed during the second phase of the project, as well as comprehensive results for the entire duration of the project. After comments have been received, the final version of the topical report will be sent out along with a finalized and updated first version of the software.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY93	160,000	160,000	
FY94	210,000	210,000	

PROJECT DESCRIPTIONS AND STATUS

Task 10	Timing of the Deposition of Uppermost Cretaceous and Paleocene Coal-Bearing Deposits in the Greater Glendive Area, Montana and North Dakota	Status: Ongoing
Cosponsor	The Research Foundation of the State University of New York at Stony Brook; National Geographic Society	
Summary <p>This research concerns determination of the timing of coal deposition in the Fort Union Coal Region, as developed in the Glendive and adjacent areas in Montana and North Dakota. The project objective is to develop a time framework that allows for the temporal comparison of coal deposits and thus coal-forming conditions through the transition from non-coal-bearing to coal-bearing deposits in the Fort Union Coal Region. Such a regional coal chronostratigraphic (time-rock) framework permits local and regional interpretations of environments of coal deposition controlling coal quality and thickness, contributing significantly to effective resource evaluation and utilization.</p> <p>This research is part of a larger program designed to provide information on the timing of deposition of coal beds in the Fort Union Coal Region. Temporal characterization of coal-bearing strata is especially critical in considerations specific to nonstrippable coal, which represents the bulk of North Dakota coal resources, in which there will be increasing interest as more accessible resources are depleted. Thus this study provides information of value to secure future energy supplies by expanding the recoverable coal resource through an understanding of when and how the peat forming the coal deposit accumulated.</p> <p>Final paleontologic field studies were conducted during the summer of 1995. The results of this and previous field and laboratory studies are being compiled and final reports are being prepared for the National Geographic Society (State University of New York-Stony Brook and Energy & Environmental Research Center) and the U.S. Department of Energy (Energy & Environmental Research Center).</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	33,980	33,980

PROJECT DESCRIPTIONS AND STATUS

Task 11	Coal Agglomeration Consortium	Status: Negotiating with commercial sponsors
Cosponsor	Bennett Industries of Alabama, Inc.; Custom Coals Corporation; North American Coal; BNI Coal	
Summary The Energy & Environmental Research Center has developed a prospectus for a Coal Agglomeration Consortium in order to advance briquetting and other agglomeration technologies. It aims to provide cost-effective methods to produce strong, stable, and high-performance compacts, having an increased value from high-rank coal fines or low-rank coal. Binders, other additives including organic waste (e.g., biomass) materials, and key aggregating machines will be examined. The consortium direction and work plan will each have major contributions from the sponsors of the consortium. The overall objective is to develop new briquetting technologies to produce coal briquettes that will achieve environmental compliance. The specific aims are to 1) conduct briquette formulation tests on a minimum of four coals per year selected by consortium members; 2) evaluate the strength, stability, and combustion/gasification reactivity of the briquettes; 3) begin developing correlations between fundamental coal properties and briquetting parameters; and 4) perform an economic assessment of briquetting processes. A work plan will be determined at the first and subsequent meetings of the sponsors. Negotiations for sponsors are still in progress. Interest has been shown in the consortium, but companies are delaying decisions on commitment.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	100,000	100,000

Task 13	Phenol Purification Studies	Status: Complete
Cosponsor	Dakota Gasification Company (DGC)	
Summary Phenolics are major liquid products obtained during the gasification of coals. Unfortunately they are not recovered as pure compounds, but contain a wide range of contaminants, including neutral oils and basic nitrogen compounds. On the open market, the cost and purity of the phenol dictate the marketability of the product. Dakota Gasification Company has a strong interest in reducing the cost of upgrading to produce purer phenol that can be more readily marketed. The Energy & Environmental Research Center performed tests on a number of possible purification methods and parametric studies on methods that showed promise. Selected catalysts would destroy certain reactive impurities but at the expense of producing higher-molecular-weight polymers. The project was completed and final report was submitted in October 1994.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	22,000	22,000

PROJECT DESCRIPTIONS AND STATUS

Task 14	Effect of Ethanol Denaturant on Gasoline Reid Vapor Pressure	Status: Complete
Cosponsor	National Corn Growers Association	
Summary <p>The mainstay of current ethanol utilization is as an oxygen additive and octane enhancer for gasoline. The significant reduction in carbon monoxide emissions by the use of oxygenated fuels has won wide support for the practice of oxygen addition to gasoline. As attention is brought to bear on other air pollutants, particularly oxides of nitrogen (NO_x), the benefits of ethanol have been questioned.</p> <p>It is commonly accepted that when ethanol is added to a gasoline, the Reid vapor pressure (RVP) of the feedstock fuel is increased. For a 10% ethanol-blended fuel (E10), this increase is usually reported as 1 pound per square inch. The tendency of ethanol to increase RVP has caused it to be labeled by some as a polluting fuel. The U.S. Environmental Protection Agency has proposed to control NO_x emissions by reducing RVP and capping oxygen levels.</p> <p>Following established laboratory protocols, in all nine cases where water was added to an E10 blend, RVP increased. Additionally, the four ethanol denaturants studied produced significantly different final RVPs. It can be concluded that the RVP increase currently attributed to ethanol may be an ethanol-denaturant-water effect. This possibility increases the strategies to reduce the RVP of E10 blends. A nontechnical final report has been completed, issued, and approved by sponsors.</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	49,978	49,981

PROJECT DESCRIPTIONS AND STATUS

Task 15	Process Development Unit Test Program for Thermally Recycled Plastics	Status: Ongoing
Cosponsor	The American Plastics Council	

Summary

Plastics account for nearly 20% by volume of the material entering a landfill. Public pressures to recycle products and, correspondingly, to reduce the amount of material landfilled, have prompted investigation of practicable means of plastics recycling. Some plastics (e.g., high-density polyethylene [HDPE]) are easily isolated and recycled by existing mechanical methods. Other types are difficult to recycle by traditional methods for various reasons. Thermal depolymerization, or thermal cracking, breaks down plastics to liquid and gaseous products similar to the petroleum-based starting materials used in plastics manufacturing. These products are then reintroduced to a petroleum refinery, where they will be used for new plastics production and for the production of other petroleum products.

A year-long scoping study of the thermal depolymerization characteristics of several plastics typically found in postconsumer streams has recently been completed at the Energy & Environmental Research Center (EERC). Because of the success of this program, a scale-up program was funded, whose purpose was to evaluate the viability of a commercial-scale thermal depolymerization process. This evaluation was based upon a series of tests using the EERC's 100-lb/hr fluid-bed process development unit (PDU). Goals of the program include the generation of liquid and gaseous products for end-user evaluation and familiarity with and the collection of product yield data and of scalable engineering data. The data can be used to perform an economic assessment of the process. Tests conducted in the PDU indicated liquid yields from postconsumer plastics similar to those seen in bench-scale tests. Bench-scale tests were also conducted to determine olefin versus liquid yields. Testing has been completed.

Liquid products have been characterized and were determined to be an acceptable refinery feedstock. All process streams have been analyzed and found to be nonhazardous. Results from the product characterizations were presented in a workshop involving officials from U.S. Environmental Protection Agency headquarters, the state of North Dakota, local municipalities, and industries. Results from the bench-scale testing indicate that olefin yields coupled with olefin prices appear to make a more attractive option over liquid production in locations where an olefin plant is located.

Other results indicated the most important process conditions in order of importance are temperature, gas residence time, bed material, and solids residence time. Sufficient data have been produced to perform a detailed commercial economic and process design.

A final report on the PDU Test program will be available in the fourth quarter of 1995. A draft of the report has been completed and will be available in December.

Three additional tasks have been added to the program. These include upgrades to the PDU, creating a database for accessing general test information, and writing a comprehensive summary of the work that has been funded by the APC, 3M, and the U.S. Department of Energy. This will include a summary of liquid production, olefin production, terephthalic and benzoic acid production, and chlorine capture.

Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	250,000	250,000
FY94	380,000	559,120

PROJECT DESCRIPTIONS AND STATUS

Task 16	Bench-Scale Preparation and Combustion Pressure of Refuse-Derived Fuel-Coal Slurry Fuels	Status: Complete
Cosponsor	EnerTech Environmental, Inc.	

Summary

As public concern grows and government regulations become increasingly strict, numerous municipalities and industries face exorbitant costs for solid waste disposal that run head-on into bottom-line profits. Concurrently, markets for lignite coal have been limited primarily because of its high moisture content, which results in a low heating value per unit weight and high transportation costs per unit energy. In addition, most of the North Dakota lignite reserves have sulfur contents that exceed the Clean Air Act Amendments Phase II emission limits for power plants of 1.2 lb SO₂ per MMBtu. EnerTech Environmental, Inc., and the Energy & Environmental Research Center have developed a slurry carbonization technology that efficiently converts low-sulfur solid waste materials such as municipal solid waste, municipal sludge, and pulp and paper sludge into clean, homogeneous, high-energy slurry fuels. The goal of blending the solid waste with lignite was to reduce the SO₂ emissions from combustion of the carbonized slurry fuel and also to provide a much better means of utilizing the potential energy from the solid waste.

The objective of this research program was to assess the feasibility of blending RDF with a lignite coal and thermally treating the mixture in an aqueous phase (slurry carbonization). Batch slurry carbonization experiments were conducted with three different slurries: a RDF slurry, a North Dakota lignite slurry, and a blend of North Dakota lignite and RDF. After the slurry carbonization treatment, all three slurries were concentrated and combusted in a bench-scale pressurized fluidized-bed combustion (PFBC) unit.

Slurry performance tests conducted on the feed and carbonized RDF slurry indicated an increase in solids loading, from 10 to over 45 wt% solids. In addition, chloride concentrations were reduced by over 80 wt% in the carbonized RDF slurry. Slurry carbonization studies for lignite indicated that the slurry heating value was increased by over 60%, with an achievable solids concentration over 55 wt%. Also, sulfur concentrations were reduced from 1.8 to 1.3 wt% (moisture-free) for the carbonized lignite slurry. Results from the blended carbonized RDF and lignite slurry indicated a compliance fuel that could be slurried to approximately 57 wt%, a 220% increase in energy density. PFBC combustion results indicated that all three fuels obtained excellent combustion efficiencies, exceeding 99.0%. Sulfur dioxide emissions were significantly lower for the carbonized RDF slurry (0.10 lb/MMBtu) than for the carbonized lignite slurry (0.62 lb/MMBtu). A final report was issued in November 1994.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY93	75,000	75,000	
FY94	20,000	60,000	

PROJECT DESCRIPTIONS AND STATUS

Task 17	Enhanced Air Toxics Control	Status: Ongoing
Cosponsor	Electric Power Research Institute	
Summary The primary goal of this project is to determine the potential to control air toxic emissions in conventional particulate control devices. Since many of the toxic heavy metals are more concentrated in fine fly ash particles, a method of superior control of these air toxic emissions is simply to collect them in a particulate control device. For elements that are entirely in the solid state, effective control is dependent on achieving a high collection efficiency for the particle sizes where the air toxic elements are primarily concentrated. In the case of volatile elements, such as mercury, effective control may depend greater on the surface adsorption properties of the fly ash or added sorbents. Introduction of small amounts of a high-surface-area material, such as activated carbon, ahead of a particulate control device may provide effective mercury control. Parametric pilot tests were conducted, evaluating independent variables such as sorbent type, sorbent concentration, temperature, coal type, and particulate control method. Task 6 was added to the project in March 1995, extending the project duration by 9 months. The objective of Task 6 is to determine the effect of mercury and chlorine spiking on mercury speciation and sorbent effectiveness. The Electric Power Research Institute has granted a no-cost extension to the project to facilitate further funding. The new completion date is June 30, 1996. An interim report is being compiled at this time. Future work will focus on pilot-scale tests and the effects of process conditions on mercury sorbent effectiveness. The exact nature of the tests will depend on the results from bench-scale tests.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	257,907	258,323
FY94	206,600	206,600
FY95	139,090	170,000

PROJECT DESCRIPTIONS AND STATUS

Task 18	Coal Ash Resources Research Consortium (CARRC)	Status: Ongoing
Cosponsors	Otter Tail Power Company; Cooperative Power; Contech-J.W. Brett, Inc.; Northern States Power Company; National Minerals Corporation	

Summary

CARRC performs research on coal by-products, with emphasis on the scientific understanding of the behavior of these materials in utilization applications and various disposal conditions.

The primary goal of CARRC is to work with industry to solve ash-related problems and promote the environmentally safe, economical utilization and disposal of these highly complex materials. Secondary goals include the generation of scientific and engineering information regarding regulations and specifications for coal combustion fly ash, the development of improved characterization methods for coal by-products, the demonstration of new or improved coal ash use applications, and technology commercialization.

The Coal Ash Properties Database has been updated with leaching and computer-controlled scanning electron microscopy (CCSEM) results, as well as standard test results from fly ash samples submitted through the year. A laboratory procedure for determining the rate of heat of hydration was developed and applied to several coal fly ash samples. Results of the heat of hydration procedure are under evaluation. Cluster analysis was performed on results of CCSEM. Ternary diagrams developed using CCSEM and clustering results are being used to determine relative cementitious properties of coal fly ash and to predict expected hydration reaction. Laboratory testing of high-volume fly ash concrete was performed to evaluate durability and strength. CARRC researchers also helped in development of an American Society for Testing and Materials standard guideline for the use of coal fly ash structural fill.

This year's CARRC activities include demonstration-scale and commercial coal ash utilization projects, which potentially include the construction of sidewalks, parking lots, curbs and gutters, dumpster pads, and parking lot barriers. Other research areas include the quantitation of coal ash reactivity, behavior of coal ash in products, environmental evaluation of coal ash and coal ash products, and the maintenance and expansion of the coal ash properties database.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY93	70,000	70,000	
FY94	45,000	70,000	
FY95	83,900	128,350	

PROJECT DESCRIPTIONS AND STATUS

Task 19	The Application of Fluidized-Bed Combustion Residues for High-Volume Utilization Options	Status: To be canceled
Cosponsors		
Summary Large volumes of residual bed material and fly ash are barriers to commercialization of advanced fluidized-bed combustion (FBC) technologies and contribute to the nation's growing solid waste problems. Utilization options can be identified and demonstrated to make these FBC residues commercially marketable. Since a wide range of FBC residues and related end-use products can be produced from different fuels and processing conditions, it will be advantageous to investigate a variety of these materials for physical, chemical, mineralogical, and environmental characteristics. By employing a combined materials science and engineering approach, the University of North Dakota Energy & Environmental Research Center was to move the investigation beyond the largely empirical approach used in most past projects to enhance utilization options for FBC residuals. We believe that a greatly increased understanding of the materials and processes involved is vital to identify and demonstrate realistic utilization options that are technically, economically, and environmentally feasible under institutional and regulatory constraints applying in the real world.		
Unfortunately, after submitting this project to the U.S. Department of Energy, the Energy & Environmental Research Center was unable to attract sufficient nonfederal funding to match U.S. Department of Energy funds. As a result, this project will be canceled, and the U.S. Department of Energy funds will be used to fund an alternate project.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	160,000	160,000

PROJECT DESCRIPTIONS AND STATUS

Task 20	FT-IR Spectroscopic Investigation of Fireside Deposits in a Pilot Plant Combustor	Status: Complete
Cosponsor	Electric Power Research Institute	
Summary <p>Successful operation of current, as well as advanced, coal combustion systems depends on controlling and minimizing the development of ash fouling and slagging, i.e., fireside deposits. The development of these deposits depends not only on the combustion design and operating conditions, but also on the composition and quantity of the inorganic species in the coal. The increasing demand for control and mitigation of ash deposition in combustion boilers necessitates refined and advanced technologies. To optimize control strategies, a distinct need exists to obtain improved and faster identification of imminent ash deposition. New advanced spectroscopic techniques offer the potential to achieve this goal.</p> <p>An accessory for a Fourier transform infrared (FT-IR) spectrometer was designed to monitor deposit formation in the convective pass of a pilot-scale combustor. The accessory, the infrared emission sampling probe (IESP), provides a means to monitor infrared emissions produced inside the furnace duct. The probe is designed to fit into a standard optical access while still providing operator viewing through the port.</p> <p>Tests involving the collection of emission spectra of ash deposits on the furnace duct and deposition probes under coal-fired operating conditions of the combustor were conducted on two coals using the IESP. The IR monitoring of ash deposits was evaluated using Antelope subbituminous and Illinois No. 6 bituminous coals.</p> <p>Data collected using the IESP indicate that the current instrument configuration offers promise in application as a deposit thickness monitor. No information was obtainable on deposit chemistry during formation using this configuration of the IESP; however, several improvements in the instrument can be made that will make it more effective in the measurement of deposit chemistry.</p> <p>The capability of FT-IR for remotely monitoring deposit thickness has been demonstrated. After some refinement of the optical interface and development of turnkey software, further investigation of the infrared emissions of ash deposits can be done. The development of the FT-IR technique coupled with the IESP can be continued to advance capabilities for the determination of deposit chemistries in situ.</p> <p>In addition, for the application of remote IR measurements to deposit thickness, a simple optical instrument can be developed using the concept of a two-wavelength measurement. The new instrument will be much less complicated to construct and operate than an FT-IR spectrometer. A unit could be built as a hand-held device similar to an optical pyrometer.</p> <p>This project is complete and the final report will be submitted in December 1995.</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	45,000	45,000

PROJECT DESCRIPTIONS AND STATUS

Task 21	Sour Gas Plant Subsurface Remediation Technology Research and Demonstration Project	Status: Ongoing
Cosponsor	Canadian Association of Petroleum Producers	
Summary <p>This project involves a number of interdependent research components related to the development and/or application of remediation technologies to address soil and groundwater contamination at natural gas processing facilities. Continuing research activities include a pilot-scale evaluation of bioventing to assess its potential in cold climates, a pilot-scale evaluation of ex situ bioremediation of groundwater, and a prototype field demonstration of freeze crystallization for the remediation of contaminated groundwater. New activities involve the evaluation of air sparging to address in situ bioremediation of volatile organic compounds from both groundwater and the vadose zone.</p> <p>Bioventing trials have indicated a relatively high degree of bioactivity, as measured by oxygen depletion in the subsurface, throughout the colder months when subsurface temperatures have dropped to as low as 4°C. Observed oxygen depletion rates have been decreasing with time, suggesting the removal of hydrocarbon contaminants. Confirmatory subsurface sampling and analysis are scheduled for the last quarter of 1996.</p> <p>Ex situ bioremediation of groundwater was discontinued in October 1995 due to inclement (freezing) weather. At the time of shutdown, the levels of benzene, toluene, ethylbenzene, and total xylenes were all being reduced to less than 1µg/L. However, nitrification was not apparent at the colder temperatures (2°C) observed in the recirculating water. System operation will be reestablished in the spring of 1996.</p> <p>Freeze crystallization field testing was postponed because of subcontractor scheduling conflicts and will be conducted at the gas plant site in the spring of 1996.</p> <p>An evaluation of air sparging will be conducted during the winter, spring, and early summer of 1996. Sparging trials will be conducted using a series of vertical wells rather than a single horizontal well, because of the excessive costs estimated to successfully install a horizontal well in the gravel and cobbles in the subsurface at the gas plant site.</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	131,250	131,250
FY94	154,000	231,000
FY95	95,000	140,000

PROJECT DESCRIPTIONS AND STATUS

Task 22	Evaluation of Supercritical Fluid Extraction for Analysis of Petroleum Industry Wastes	Status: Complete
Cosponsor	American Petroleum Institute (API)	
Summary A previous joint venture project with API was completed in March 1993. The first project investigated using supercritical fluid extraction (SFE) to extract gasoline and diesel-range hydrocarbons from soils and included a successful field demonstration of the technique. Extraction of pollutants from waste petroleum sludges and preliminary investigations to define "quantitative" extractions for complex samples were performed. The results of these studies were sufficiently encouraging that a second project with API was started in March 1993 to develop on-line methods for BTEX (benzene, toluene, ethylbenzene, and xylene) determinations as well as to extend SFE methods to heavier hydrocarbons. A number of publications were produced to summarize the methods developed and analytical results from the project. General categories of activities and advances include total petroleum hydrocarbons (TPH) and BTEX determinations in the gasoline and diesel range; TPH determinations for heavy hydrocarbons and polycyclic aromatic hydrocarbons (PAH), including fuel evaluations; and theoretical factors controlling "quantitative" aspects of SFE. Methods developed include SFE coupled with gas chromatography (GC), SFE-infrared (SFE-IR) spectrometry, SFE with carbon dioxide and oxyonic modifiers, quantitative SFE methods, and use of drying agents. The project final report was submitted in August 1994.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	50,000	50,000
FY94	50,000	50,000

PROJECT DESCRIPTIONS AND STATUS

Task 23	Gas Industry Groundwater Research Program	Status: Ongoing
Cosponsor	Gas Research Institute	
Summary The objectives of this research program are to develop a comprehensive study to evaluate soil and groundwater contamination at natural gas industry sites and to assess cleanup options. Years 1 and 2 of the program focused on the collection and assessment of background information and data necessary to conduct long-term laboratory and field studies. Year 3 activities included the instrumentation of four gas industry field study sites in New Mexico and Pennsylvania and associated laboratory studies. Contamination from elemental mercury has been the focus of these initial field and laboratory studies. During Year 4, two additional mercury field sites were instrumented in Louisiana. Four quarters of groundwater sampling were completed during Year 5. A total of fourteen GRI topical reports have been published, including eight which are related to mercury. In addition, a risk-based screening model (HgSCREEN™) was developed for prioritizing sites for mercury remediation. During Year 6, a workshop focused on mercury contamination at oil and gas industry sites was held, in New Orleans, Pittsburgh, and San Diego. A total of 145 attendees included representatives from the energy industry, regulatory agencies, environmental consulting firms, and universities. The focus of the program has shifted from mercury to other contaminants at gas industry facilities, such as glycols and amines. It is anticipated that this effort will continue for several years and will include a major effort addressing the remediation of sites contaminated from past practices.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	499,994	500,000
FY94	282,980	400,000
FY95	243,083	126,303

PROJECT DESCRIPTIONS AND STATUS

Task 24	Utilization of Western Coals in Bituminous Boilers – Pilot Plant Assessment of Blend Properties and Their Impact on Critical Utility Power Plant Components	Status: Complete
Cosponsors	Electric Power Research Institute; Consol; Empire State Electric Energy Research Corporation; Ziegler Coal Company	
Summary The objective of this program was to assess the impact on boiler performance of blending eastern and western coals. Flame stability testing, high-temperature (2000° and 2200°F) fouling tests, and low-temperature (1500°F) fouling tests were completed for two subbituminous coals and one bituminous coal. Mill performance tests, performed by Consol, Inc., were also completed. The final project report was submitted in December 1994. Results indicate that blending of Powder River Basin (PRB) coals with bituminous coals is an effective strategy for reducing SO ₂ emissions from pulverized coal-fired boilers. The presence of the subbituminous coal will result in a number of operational impacts to a bituminous-design boiler. Mill testing indicated thermal load derates between 25% and 55% of the maximum input of bituminous coal when the higher-moisture subbituminous coals are ground. High-temperature and low-temperature fouling of boiler heat-transfer surfaces can also be expected to increase as the percentage of PRB coal in the blend is increased; conversely, levels of unburned carbon may be expected to decrease. This was confirmed during flame stability testing, which indicated as good or better flame stability as the percentage of PRB in the blend was increased.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	15,881	195,000

Task 25	Physical Cleaning of Lignite	Status: Complete
Cosponsors	Knife River Coal Mining Company; North Dakota Industrial Commission	
Summary The purpose of this study was to elucidate the feasibility for producing from select North Dakota lignites a stable lump fuel with reduced sulfur, moisture, and sodium oxide contents. For this study, a single North Dakota lignite was crushed, sized, and then treated by bench-scale washability testing. The reduction of sulfur and inorganic contents as a function of coal size was estimated for commercial physical cleaning methods. The sized coal was also subjected to a novel water classification process to separate clean coal from inorganic-laden coal fines. Ion exchange using carbonated water (carbonic acid) was investigated as a method for reducing the coal sodium content to improve fouling characteristics. Commercial dry coal-cleaning methods, such as a high-gradient magnetic separation, were investigated for sulfur reduction using various coal size fractions. An EERC-developed oil agglomeration process was investigated for selective rejection of minerals from fine lignite coal (-100 mesh) and as a method to aggregate fine coal produced during water classification experiments. Pellets were prepared using conventional binders or novel binders, e.g., coal gasification-derived tar oil. A recommendation was prepared concerning the processing methodology required to produce larger quantities of lump fuel. This study demonstrated that lignite could be physically cleaned to reduce ash content from 9 to 6 wt% moisture-free and sulfur emissions from 2.0 to 0.9 lb SO ₂ /MM Btu. Low-moisture briquettes with heating values near 10,000 Btu/lb were successfully produced using low-cost waste wheat and newspaper binders. A final report was submitted to the sponsors in September 1994.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY93	30,000	30,000

PROJECT DESCRIPTIONS AND STATUS

Task 26	Remote-Site Power Generation Opportunities for Alaska	Status: Ongoing
Cosponsors	Alaska Science & Technology Foundation; Usibeli Coal Mine, Inc.; Placer Dome U.S. Inc.; ENPAC Energy Pacific Company; Major International; Power Engineers; International Coal Preparation Consultants Limited; University of Alaska Fairbanks	
Summary The U.S. Department of Energy (DOE) together with the Alaska Division of Energy (ADE) and a number of the native corporations has undertaken a project to develop alternative small-scale power generation technology options for application in remote villages of Alaska. The Energy & Environmental Research Center (EERC) is working with the DOE Morgantown Energy Technology Center (METC) to assess options for using the tremendous reserves of fossil fuels found in Alaska for small-scale power units. Typically, remote villages in Alaska use diesel generators fueled with expensive fuel oil for electricity production. The high cost of diesel power in Alaska is heavily subsidized by the state through the Power Cost Equalization program (PCE), which amounts to about \$20 million annually. Fuel oil is used extensively for residential and public building heating. The goal of this activity will be to reduce the use of fuel oil in Alaskan villages by developing small, low-cost power generation applications. A Small Alternative Power Generation Workshop was held in Anchorage, Alaska, in May 1994 as a first step in the development of safe, reliable, and efficient energy systems throughout the state. The workshop was a success: it established good three-way communication among government policy makers, suppliers of technology, and end users, the rural Alaskans. As a result of the interactive presentations and breakout discussion groups during the workshop, the needs of the Alaskans were heard, and a number of technology options were offered that could meet their needs. A second workshop was held in Seattle, WA, in September 1995 to share the result of activities undertaken to meet the energy needs of remote villages in Alaska. Additionally, this workshop was used to explore the opportunity to commercialize the technologies and transfer the information to other indigenous communities. The EERC is continuing to work with METC, the Alaska Department of Community and Regional Affairs, Doyon, Ltd., and other groups in Alaska to move the most promising technologies toward demonstration.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	250,000	271,400

PROJECT DESCRIPTIONS AND STATUS

Task 27	Alaskan Low-Rank Coal-Water Fuel Environmental Attributes and Combustion Test Marketing	Status: Ongoing
Cosponsor	Alaska Division of Energy (ADE)	
Summary This work is proposed as a means to expedite a project to demonstrate at a commercial scale the production and utilization of coal-water fuel (CWF) made from hot-water-dried Alaskan subbituminous coal. Its objectives include developing low-rank coal-water fuel (LRCWF) combustion test programs with selected potential end users, defining the environmental benefits of replacing heavy oil with CWF, and updating the marketing video prepared with the Alaska Energy Authority, now the Division of Energy. The work plan was completed and approved in October 1995. A final report and other deliverables will be sent to DOE in December 1995.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	50,000	62,000

PROJECT DESCRIPTIONS AND STATUS

Task 28	An Assessment of the Subsurface Fate of Monoethanolamine at Sour Gas Processing Plant Sites	Status: Ongoing
Cosponsor	Canadian Association of Petroleum Producers, Canadian Occidental Petroleum Ltd., Environment Canada, National Energy Board (Canada) (other cosponsors are being sought)	

Summary

Monoethanolamine (MEA) is one of the most commonly used chemicals for the removal of hydrogen sulfide, carbon dioxide, and other acid gases from the natural gas in which they occur. At gas processing plants that use alkanolamines for acid gas removal, spills and the on-site management of wastes containing alkanolamines and their thermal reaction products have commonly resulted in subsurface contamination that is the focus of some environmental concern. This project is investigating the natural attenuation processes that control the fate of MEA.

Project activities have thus far accomplished the following:

- Series of samples for project activities has been obtained from a presently inactive sour gas processing plant site in Alberta.
- Experiments designed to determine the effects of temperature and concentration of MEA on the rate of MEA biodegradation in soil/sediment have been completed.
- Experiments designed to estimate the biodegradability of organic compounds in soil/sediment exposed to MEA-containing "sweetening" wastes have been completed.
- Experiments designed to determine whether high concentrations of MEA are toxic or inhibitory to microorganisms in soil/sediment have been completed.
- Experiments designed to estimate the biodegradability of MEA under anaerobic conditions have been completed.
- Experiments designed to assess the role of interactions between MEA and soil/sediment by the determination of distribution coefficients (K_d values) have been completed.
- Available ion chromatography (IC) capabilities have been adapted for the quantitation of MEA in liquids at levels down to 10 ppb. Some work has also been done on adapting these capabilities for the quantitation of MEA thermal reaction products in liquids at ppm levels.
- An effective method for the extraction of MEA from soil, sediment, and solid experimental residues for IC analysis has been developed.
- A joint effort with the National Hydrology Research Institute to examine the use of IC and liquid chromatography/mass spectrometry methods for the detailed analysis of MEA and MEA-related compounds in selected liquid samples has been completed.
- The final report on the experimental activities completed thus far is in the process of being finalized.
- Selected analytical support has been provided to other investigators that are more comprehensively evaluating the toxic effects of subsurface contaminants at the noted sour gas processing plant site.
- Experiments designed to estimate the biodegradability of an apparently recalcitrant fraction of organic nitrogenous compounds are under way.
- The experimental design has been completed for an assessment of the biodegradability of selected MEA-related thermal reaction products.
- The experimental design has been completed for a preliminary evaluation of the effectiveness of landfarming as a remediation technique for soils/sediments with MEA-related contamination.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY94	59,890	89,672	
FY95	47,000	70,000	

PROJECT DESCRIPTIONS AND STATUS

Task 29	Mitigation of Air Toxics from Lignite Generation Facilities	Status: Complete
Cosponsor	Lignite Research Council; Electric Power Research Institute (EPRI); Montana-Dakota Utilities Company; Minnesota Power; Basin Electric Power Cooperative; Cooperative Power Association	

Summary

Concerns over emissions of trace metals, considered air toxics, from coal-fired power plants are increasing. The Amendments to the Clean Air Act of 1990 list 189 substances as potential hazardous air pollutants. Further, the Amendments established a schedule under which the U.S. Environmental Protection Agency (EPA) is required to establish maximum achievable control technology standards for existing major sources of hazardous pollutants. A major source is any source that emits (or has the potential to emit) more than 10 tons per year of any one listed pollutant, or 25 tons per year or more of any combination of listed pollutants. Coal combustion is thought to be a significant source for eleven metals on the list of 189 substances (antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium).

The purpose of this project is to determine the applicability of using sorbents to control the emissions of trace elements during the combustion of lignite and Powder River Basin (PRB) coals. Research activities performed under this project will supplement and complement other research projects currently under way at the Energy & Environmental Research Center.

The Big Sky PRB coal was analyzed using atomic absorption (AA) and inductively coupled argon plasma spectroscopy (ICAP) to determine the concentrations of antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium. Along with the trace element analysis, standard bulk chemistry analyses were performed.

Lime and activated carbon-based sorbents were selected for testing based on results from a complementary project currently funded by EPA, the North Dakota Industrial Commission, and industry. The selected precombustion (lime) and postcombustion (activated carbon) sorbents were tested separately in a pilot-scale 550,000-Btu/hr particulate test combustor (PTC) equipped with an electrostatic precipitator and baghouse. Both particulate and gas samples were obtained during the tests to determine their trace element contents. Particulate and gas samples were collected and analyzed using currently accepted EPA methods. Results from the PTC testing were compiled to determine the reduction in trace element emissions as a result of the mitigation technologies tested. Most of the trace elements, with the exception of Hg and Se, were in the solid phase and collected in the baghouse. Precombustion and postcombustion sorbents do not appear to be effective for comparing Hg or Se. The ashes from the tests were tested for their leachability, which may impact their potential disposal. The pre- and postcombustion sorbents tested do not appear to have any detrimental effect of ash utilization and disposal.

A final report was completed and submitted to DOE in October 1995.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY94	100,000	100,000	

PROJECT DESCRIPTIONS AND STATUS

Task 30	Hot-Gas Filter Ash Characterization Project	Status: Ongoing
Cosponsors	Electric Power Research Institute (EPRI); Westinghouse; Lurgi Lentjes Babcock (Germany); PowerGen; Schumacher Filters America; Electricité de France, ECN/NOVEM (Netherlands); Electric Power Development Corporation (Japan); ABB-Carbon (Sweden)	

Summary

The Electric Power Research Institute has organized a consortium to fund research to be performed at the Energy & Environmental Research Center to determine the coal- and system-related factors that lead to the formation of ash that blinds and bridges hot-gas cleanup filters. The objectives are threefold: 1) to determine the mechanisms by which difficult-to-clean ash is formed and how it blinds or bridges hot-gas filters; 2) to develop a method to determine the rate of blinding or bridging based on analyses of the feed coal and sorbent and on the operating conditions; and 3) to provide suggestions for preventing blinding and bridging. The work will encompass field sampling and laboratory-, bench-, and pilot-scale testing. The main deliverable will be a computer model and database that could be used to optimize energy system operating conditions, choose coals and sorbents, or design the cleanup system.

To date, over a dozen sets of samples, including coal, sorbent, bed material, and ashes, have been received from the American Electric Power Tidd plant and are being analyzed by advanced scanning electron microscope and surface science techniques. Samples have also been received and analyzed from the Grimethorpe pressurized fluidized-bed combustor, the British Coal filter development rig, and the British Coal gas utilization facility filter. In addition, a high-temperature powder tensile strength tester has been constructed, and thermochemical equilibrium modeling is being performed with the University of Montreal FACT code. Five 500-hour cake sintering tests have been performed, and bench-scale testing simulating Tidd operating conditions has begun to determine factors affecting the final size and composition distribution of filter ash particles. Also, pilot-scale sampling of entrained ashes and gas entering the filter vessel of the EERC transport reactor development unit has been performed.

Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	230,000	230,000
FY95	320,000	440,000

PROJECT DESCRIPTIONS AND STATUS

Task 31	Formal Evaluation of Flue Gas Chemical Measurement Methods Phase I – Verification of Mercury Speciation by EPA (Draft) Method 29	Status: Ongoing
Cosponsor	Electric Power Research Institute	
Summary The original overall objective of the work was to determine whether EPA Method 29 can reliably quantify and speciate mercury in the flue gas from coal-fired boilers. However, recent results indicated that it was necessary to expand the project to include alternate mercury speciation methods. The methods currently being tested at the Energy & Environmental Research Center’s pilot-scale combustor include the mercury speciation adsorption method (MESA), the Ontario Hydro Method, and an acetate buffer method developed by Radian Corporation. Test results have shown that when elemental mercury is spiked into the flue gas stream while a medium-sulfur bituminous coal is being fired, >60% of the spiked elemental mercury is captured in the peroxide solutions of EPA Method 29 using alternative methods for mercury sampling. It appears that the conversion of mercury occurs in the flue gas; however, the results show that differences exist between methods. Bench-scale tests are currently under way to determine the cause of these differences.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	287,090	447,852
FY95	422,510	725,913

PROJECT DESCRIPTIONS AND STATUS

Task 32	Organic Sulfur Removal from Coal with Super- and Subcritical Water	Status: Ongoing
Cosponsor	Illinois Clean Coal Institute	

Summary

The main objective of this investigation is to develop an economically feasible method for the removal of organic sulfur and selected hazardous air pollutants (HAPs) from Illinois Basin high-sulfur coals for clean coal and niche-market applications. Super- and subcritical water will be used as an extraction fluid rather than the traditional organic liquid solvents. This work will take advantage of supercritical (temperature $> 374^{\circ}\text{C}$, pressure > 218 atm) and subcritical water for the removal of organic sulfur and selected HAPs by simply controlling the extraction temperature and pressure.

Extraction of Illinois bituminous coals under both super- and subcritical conditions was performed on raw IBC-101 bituminous coal to establish the baseline extraction conditions for organic sulfur removal. After the baseline conditions using raw IBC-101 were established, extractions were performed on raw and physically cleaned IBC-101 coal to evaluate the extraction conditions required for and the extent of organic sulfur removal. Preliminary data indicate that supercritical water extraction removed nearly three-fourths of the pyritic sulfur and one-half of the "organic" sulfur.

Extracted coal that would produce < 1.2 lb SO_2 /MMBtu (compliance fuel) was obtained from IBC-102 using the multigram unit. First attempts at catalytic desulfurization of the tar collected from the effluent water resulted in 0.6 wt% sulfur in tar from IBC-102 and 0.8 wt% sulfur in tar from IBC-101 with quantitative recovery of the tar. During the coming year, on-line desulfurization of tar is to be tested to make use of available hydrogen (nearly 2 mole% of the gas) and heat and pressure from the extraction system.

In addition to organic sulfur removal, the second year of the current research program is expanded to include the investigation of selected HAPs (e.g., mercury) removal from coal with super- and subcritical water.

The scheduled completion date of the second-year investigation is August 31, 1996.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY94	70,218	108,527	
FY95	90,000	90,000

PROJECT DESCRIPTIONS AND STATUS

Task 33	Upgraded North Dakota Lignite – Production of Test Quantities	Status: Complete
Cosponsor	North Dakota Industrial Commission	
Summary <p>The objective of this project was to produce two 1-ton quantities of upgraded North Dakota lignite that would subsequently be subjected to test burns (in a separate project) as a potential blend stock for pulverized coal combustion.</p> <p>Two selected North Dakota lignites were subjected to size reduction and classification and then treatment by wet dense-media (magnetite) physical cleaning to reduce the inorganic (mineral) and pyrite contents. One cleaned lignite was treated by the Energy & Environmental Research Center hot-water-drying (HWD) technology. This technology effectively reduced the moisture content of the coal, precluding reabsorption and, as well, diminished the alkali content. The treated coals were aggregated via briquetting. Thermal treatment with superheated N₂ was used to reduce the moisture content and increase the heating value of one briquetted lignite. The products met target specifications for theoretical sulfur emissions, moisture level and heat content, sodium content, size, and ash content.</p> <p>The final technical report was submitted in November 1994.</p>		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	25,000	40,000

Task 34	Coal Quality Expert (CQE) Fouling and Slagging Algorithm Development	Status: Ongoing
Cosponsor	Black & Veatch	
Summary Task 1 – Code Completion. This task will concentrate on completing/enhancing the previously developed codes so that no programming or concept errors remain. The work is nearly complete for both the fouling and the slagging code. Specific work to be completed includes development of slagging deposit removal mechanisms, integration of all algorithms into a time and temperature history algorithm, and output of all data into the CQE main program. This work includes completing all of the coding aspects as required by Black & Veatch for complete integration into the CQE code. All of the programming guidelines that were outlined by Black & Veatch in the past work will be continued. Task 2 – Testing and Validation. This task will entail cooperation between the Energy & Environmental Research Center and Black & Veatch in "tuning" the fouling and slagging codes for optimum performance. Although these codes are state-of-the-art, they do contain a significant number of parameters for which experimental data are lacking. The codes will need to be designed to run under expected situations and conditions. Only a limited amount of validation will be performed with currently existing experimental results because of the lack of available quantitative data. An alpha and beta version of both the fouling and slagging codes have been provided to Black & Veatch. Validation of the codes are being performed with Black & Veatch. The final versions of the codes will be delivered in the first quarter of 1996.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY94	40,000	60,000

PROJECT DESCRIPTIONS AND STATUS

Task 35	Evaluation of Field Analytical Techniques for Mercury in Soil	Status: Ongoing
Cosponsor	Gas Research Institute, NOVA Corporation of Alberta, General Electric, BioNebraska, Spectrace	
Summary Within the natural gas industry there exists a need for fast, reliable analytical techniques for the quantitation of mercury in soils. These techniques could potentially be used in initial investigations at mercury spill sites, as guidance in site remediation activities, and for confirmation in postclosure monitoring. Within the last 2 years, several techniques have been developed and refined that may be able to provide this capability. However, no detailed comparison of these techniques to one another and to standard methods of analysis has been undertaken. The objective of this project is to compare the accuracy and precision of four analytical techniques for the quantitation of mercury in various soil types. Two of the techniques are commercially available, and the other two are under development, including one being developed at Oak Ridge National Laboratory. Preliminary results indicate that several of the field-transportable analytical techniques have significant potential to provide fast, reliable data for the quantitation of mercury in soil. One of the project cosponsors, NOVA Corporation, has slightly modified one of the techniques and has been utilizing the modified technique for field analysis with promising results. The final report has been delayed until first quarter 1996 so that the Nova Corporation results can be incorporated.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	40,000	89,500

Task 36	Combustion Characterization of Carbonized RDF from Temperature Optimization Tests	Status: Ongoing
Cosponsor	EnerTech Environmental Incorporated, City of Grand Forks	
Summary A refuse-derived fuel (RDF) obtained locally was converted through the Energy & Environmental Research Center (EERC)-EnerTech carbonization process to a pumpable slurry fuel for use in a pilot-scale combustion test. The fuel was fired at a rate sufficient to maintain a furnace exit gas temperature of 2000°F at an excess air near 25%. Results indicated excellent combustion efficiency, as more than 99.5% of the carbon was converted to CO ₂ and water. The fuel exhibited a very low ash fouling potential, and fly ash resistivity measurements indicated that adequate collection could be achieved using an electrostatic precipitator. The fly ash was also tested to determine the degree to which toxic trace elements would be leached from the fly ash in a disposal or reuse scenario. Analyses indicated that these toxic trace elements would not be leached from the fly ash above current standards. The EERC is currently negotiating a development program that will include demonstration of an alternate method of dealing with municipal solid waste (MSW) involving presorting MSW followed by slurry carbonization to produce an energy-rich slurry fuel. This fuel will then be fired in EERC's test furnaces to demonstrate its technical and environmental viability. A preliminary engineering assessment of a full-scale facility to meet the future needs of the city of Grand Forks will also be included. The program is projected to start in January 1996.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	200,000	304,096

PROJECT DESCRIPTIONS AND STATUS

Task 37	Recent Advances in Research on Ash Deposition in Utility Boilers: Practical Applications for the Electric Power and Coal Industries	Status: Ongoing
Cosponsor	Multiclients	
Summary Over the course of the past several years, significant advances have been made at the Energy & Environmental Research Center (EERC) in the understanding of ash behavior. These advances in understanding are leading to the development of new methods to predict and mitigate ash-related problems. The advanced methods are much more complex than those based on American Society for Testing and Materials (ASTM) analyses. The approach to the problem involves a more quantitative understanding of the inorganic composition of the coal and the processes involved in the formation of ash and ash deposits. The complexity of the problem creates a natural void between the researcher and the practical engineer, operator, and designer. One of the most important issues is the need to develop better communication among the researcher, coal company, boiler manufacturer, and utility. Common ground between each of these members of the coal community must be established to facilitate the transfer of information essential for solving ash-related problems. The objective of this program is to transfer technical information concerning ash formation and ash deposition in utility boilers through the use of a short course. To date, short courses have been presented in Orlando, Chicago, and Minneapolis. Additional short courses are scheduled to be held in Petten (The Netherlands), Bismarck, Charleston, and Denver in 1996.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	60,331	90,502

Task 38	Mercury Remediation Technology Research and Demonstrations	Status: Ongoing
Cosponsor	Gas Research Institute	
Summary This project involves research and demonstrations of commercial mercury remediation technologies for treating gas industry-contaminated soils. This work will be done at sites where commercial soil remediation activities are currently ongoing. Two companies recently began offering mercury remediation technologies specifically designed to treat gas industry mercury-contaminated soils. The two companies are Earth Treatment Technologies (ETT), operating in Ohio, and Mercury Recovery Services (MRS), operating in New Mexico. ETT is using a combination of physical separation and chemical leaching (soil washing) to remove mercury from gas-industry soils that were shipped to this facility (a RCRA Part B treatment, storage, and disposal facility). MRS is using thermal retorting and has processed over 5000 tons of mercury-contaminated soil at their client's site. One ton of elemental mercury has been recovered for recycling. Both operations have been witnessed and sampled by EERC personnel. The final report is currently being written.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	40,000	60,500

PROJECT DESCRIPTIONS AND STATUS

Task 39	Preparation and Gasification of Thailand Coal-Water Fuels	Status: Ongoing
Cosponsor	Department of Mineral Resources, Thailand	
Summary The project objective is to evaluate the technical feasibility of employing coal beneficiation techniques to upgrade Thai lignite to generate a coal-water fuel. This fuel will then be gasified in an existing system at the Energy & Environmental Research Center. The gasification efficiency and heat energy content of the gas will be determined from various measurements on the product gas and residual solids. Approximately 600 kg of 6 in. x 0 lignite was received in mid-October. The coal was sized and processed using bench-scale cleaning and hydrothermal equipment. Cleaning resulted in a 70% reduction in ash, but only a moderate reduction in sulfur content. Hydrothermal tests were conducted at three temperatures using raw coal ground to two different particle-size distributions. Initial results indicate that a hydrothermally treated lignite can produce a coal-water fuel with over 50 wt% solids, which translates to a 60% improvement in energy density. The first training session is with Thai personnel scheduled for mid-December during which time pilot-scale cleaning and hydrothermal testing will be performed. Gasification tests are planned for February 1996.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	49,771	75,000

Task 40	Mercury Sorbent Evaluation	Status: Ongoing
Cosponsor	Electric Power Research Institute (EPRI)	
Summary The proposed project is a pilot-scale activity that will be conducted in an existing facility at the Energy & Environmental Research Center (EERC). The purpose of the proposed project is to evaluate the mercury control ability of new sorbents that will be selected after discussions among U.S. Department of Energy, EPRI, and the EERC. Task 1 (the first year's work) has been modified. The focus of the program has switched from pilot- to bench-scale tests to evaluate sorbents for mercury control. EPRI has approved the purchase of an on-line mercury analyzer with Year 1 funds. The remainder of the funds will be used to develop a sorbent evaluation protocol using a fixed-bed bench-scale system. In Year 2, the work will continue with a focus on process conditions and their effect on the sorbents.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	60,350	89,650

PROJECT DESCRIPTIONS AND STATUS

Task 41	Lignite Resource Characterization and Evaluation for Mitigation of Ash Deposition	Status: Ongoing
Cosponsor	Montana-Dakota Utilities; Knife River Coal Mining Company; North Dakota Industrial Commission	

Summary

The Energy & Environmental Research Center (EERC) has prepared a coordinated research program to evaluate and optimize both mine coal quality and utility boiler operation at the Knife River Coal Mining Company (KRCMC) Beulah mine and the minemouth plant Montana-Dakota Utilities (MDU) Coyote Station, respectively. The Coyote Station has experienced severe ash fouling and slagging in the past, which decreases power production efficiency and threatens the continued economical utilization of a vast lignite resource. The program involves a detailed examination of the coal currently being mined and slated for mining, as well as a concurrent examination of the plant's operating characteristics and devising methods to blend different mine reserves in a way that minimizes ash fouling and slagging. In conjunction with the coal quality assessment, methods will be devised to minimize ash fouling and slagging in the boiler by optimizing boiler operating procedures. Technologies and methods developed through this project have the potential to be implemented by similar mine and power plant operations with the end result of stabilizing use of low-rank coals.

Coal samples have been acquired and analyzed from the Beulah Mine and an initial site visit at the Coyote Station has been completed. A shell of the computer program that will drive the predictive capabilities for mine planning has been developed. Two field tests at the Coyote Station will be conducted, and more coal analyses will be made to verify the predictive capabilities of the computer program being developed. The project is scheduled to continue until December 1996.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY95	152,000	228,000	

Task 42	Holocene Cyclicity in Western North Dakota—Climate Change Interpreted from Fluctuations in Alluvial Sedimentation	Status: Negotiating with commercial sponsor
Cosponsor	Electric Power Research Institute	

Summary

This project will interpret a portion of the postglacial climatic history of the northern plains by examining the alluvial record in badlands terrain. Examination of this record for short-term cycles has not been previously attempted. Knowing, however, the close connection between cycles of erosion and deposition and climate in semiarid landscapes suggests this approach may prove very useful in interpreting paleoclimates and, hopefully, the cycles of change in the recent past. Such interpretations would provide a new approach to examining climatic variability in the past, reflecting periods of extended dry and moist conditions, and result in the development of a more rigorous context for interpreting human interactions with both their physical and biotic surroundings.

Funding Profile	DOE Share, \$	Nonfederal Share, \$	
FY95	64,972	99,964	

PROJECT DESCRIPTIONS AND STATUS

Task 43	Oxidation of North Dakota Scrubber Sludge for Soil Amendment and Production of Gypsum	Status: Ongoing
Cosponsor	Cooperative Power Associates, North Dakota Industrial Commission	
Summary The project for oxidation of North Dakota scrubber sludge will proceed in two phases. Phase I will focus on the production of an agricultural soil amendment. The type of soil amendment to be produced is generally referred to as agricultural gypsum; however, it is actually a mixture of calcium sulfate in several hydration states with a small percentage of calcium hydroxide-carbonate. The actual gypsum content is less important than the oxidation of sulfite in the original material to calcium sulfate. This material must be produced at a cost that allows it to compete in the agriculture market. Phase II of this project will build on the processes developed and information gained in Phase I. Providing the production of an agricultural soil amendment is economically viable, the actual gypsum production process will be optimized for other markets such as wallboard production. The requirements for gypsum used in wallboard production are much more stringent than for agricultural use; once again, the economic viability of the process will be evaluated. Phase I of this project is under way and the sampling at Cooperative Power's Coal Creek Station has begun. Six samples have been received and are being tested for key parameters and to evaluate consistency. Sampling protocol is being established with the Coal Creek Station personnel based on the sample purity and consistency.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	40,000	80,000

Task 44	Pilot Plant Assessment of Fly Ash Agglomeration	Status: Ongoing
Cosponsor	Thermal Energy Systems, Inc. (TESI)	
Summary The objective of this project is to evaluate the potential of the TESI in-furnace ionizer system and the Flaerex gas conditioner/TESI ionization system to agglomerate fine particles and improve particulate collection efficiency by electrostatic precipitation when applied to coal-fired boilers. A contract was executed with TESI during October of this year and design of the ionization systems and associated flue gas sampling systems has begun. A project kickoff meeting was held at the EERC on October 16 and 17 to discuss project goals and begin design of the ionizer systems. To accommodate the in-furnace ionizer, a new burner design is required for the EERC's combustion test facility. TESI is working toward completing the burner design, which will be constructed at the EERC. EERC activities to this point have centered on redesign of the furnace exit and associated flue gas heat-transfer piping. Construction activities are scheduled to begin in December. When the flue gas piping and ionization systems have been constructed, system shakedown will begin. Four weeks of shakedown are planned, followed by four weeks of testing, two weeks each for the in-furnace ionizer and the reverse-polarity ionizer preceding the electrostatic precipitator.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	209,993	318,007

PROJECT DESCRIPTIONS AND STATUS

Task 45	Small-Scale Demonstration of the Freeze-Thaw Evaporation Process to Treat Oil and Gas Produced Waters	Status: Ongoing
Cosponsor	Gas Research Institute; AMOCO Production Company	
Summary The freeze-thaw evaporation (FTE) demonstration project is being conducted to evaluate the economical coupling of the freeze crystallization water purification process with evaporation in order to reduce the volumes of oil- and gas-related produced waters that ultimately require disposal in Class II injection wells, as well as to evaluate the freeze crystallization process to produce a reusable quality of purified water. Project activities completed to date (November 1995) have included the acquisition of regulatory approval from the State of New Mexico's Oil Conservation Division and the construction and installation of equipment at the technology demonstration facility. Hydrostatic testing of the piping, pumps, tanks, and related instrumentation has also been conducted. Operation of the freezing process is scheduled to begin in late November 1995 and will continue as long as freezing conditions (sub 32°F temperatures) exist at the demonstration facility. This will be followed by the observation of the evaporation process during the spring and summer months of 1996, followed by evaluation of data for the coupled FTE process and final report preparation.		
Funding Profile	DOE Share, \$	Nonfederal Share, \$
FY95	200,000	600,000

SECTION B
PROJECTS PROPOSED
FOR FY96 FUNDING

TABLE B-1

CURRENTLY FUNDED JSRP PROJECTS THAT WILL RECEIVE ADDITIONAL JSRP FUNDING IN FY96

Task No.	Title	Planned FY96 DOE Funding, \$	Planned FY96 Commercial Funding, \$
17	Enhanced Air Toxics Control Cosponsor - Electric Power Research Institute (EPRI)	120,000	180,000
18	Coal Ash Resources Research Consortium (CARRC) 1994-1995 Research Cosponsors - Otter Tail Power Company, Cooperative Power, Contech, J.W. Brett, Inc., Northern States Power Company, Nebraska Ash, and TransAlta Utilities Corporation	85,000	125,000
20	FT-IR Spectroscopy Investigation of Fireside Deposits in a Pilot Plant Combustor Cosponsor - Electric Power Research Institute	60,000	90,000
23	Gas Industry Groundwater Research Program Cosponsor - Gas Research Institute	400,000	400,000
28	An Assessment of the Subsurface Fate of Monoethanolamine at Sour Gas Processing Plant Sites Cosponsors - Canadian Association of Petroleum Producers and Canadian Occidental Petroleum Ltd.	50,000	75,000
30	Hot Gas Filter Ash Characterization Project Cosponsor - Electric Power Research Institute	275,000	335,000
31	Formal Evaluation of Flue Gas Chemical Measurement Methods Phase I - Verification of Mercury Speciation by EPA (Draft) Method 29 Cosponsor - Electric Power Research Institute	300,000	450,000
40	Mercury Sorbent Evaluation Cosponsor - Electric Power Research Institute	64,000	96,000
TOTAL		1,354,000	1,751,000

TABLE B-2

PROPOSED NEW JSRP PROJECTS

Project No.	Title	FY96 DOE Funding, \$	Nonfederal Funding, \$	Future DOE Funding, \$	
				FY97	FY98
Projects for Which Proposals Have Been Submitted to DOE					
96-1	Training and Support for Hot-Gas Filter Testing Cosponsors – 3M, Industrial Filter & Pump, and Paul Advanced Filters	20,539	20,539	0	0
96-2	Development of a Coal Combustion Byproducts (CCBs) Database System Cosponsor – American Coal Ash Association	19,800	29,700	0	0
Projects for Which Proposals Have Been Submitted to Commercial Sponsors					
96-3	Coal Ash Behavior in Reducing Environments (CABRE) II Cosponsors – Destec, Texaco, Demkolec, Krupp-Koppers, Electric Power Research Institute and NOVEM	118,000	242,000	118,000	118,000
96-4	Utilization of Petroleum Coke for Power Production Cosponsors – Mobil and Electric Power Research Institute	44,000	66,000	44,000	44,000
Projects for Which the EERC is Ready to Write Proposals with Commercial Sponsors					
96-5	Development of Hydrothermal Treatment for Wastewater and Economic Development Cosponsor – EESI (a small business concern in New Mexico)	40,000	60,000	0	0
96-6	Removal of Hazardous Heavy Metals from Wastewater with Activated Carbons Cosponsors – Lewis Environmental Services, Inc. and 3M	60,000	90,000	0	0
Projects under Discussion with Commercial Sponsors					
96-7	Investigation of the Effects of Low-NO _x Burner Technologies on Coal Combustion Byproducts and Resulting Utilization Characteristics Cosponsors – Tennessee Valley Authority, Cinergy, Northern Indiana Public Service Company, Edison Electric Institute, and American Electric Power	80,000	120,000	80,000	80,000
96-8	Mercury Sorbent Consortium Cosponsors – Dravo Lime, Calgon, Alcoa, American Norit, and other carbon/sorbent manufacturers	100,000	150,000	0	0
96-9	Optimizing Coal Utilization, Cleaning, and Blending at the Mine Level Cosponsors – Coal companies, utilities, and Electric Power Research Institute (consortium)	150,000	225,000	150,000	150,000
96-10	Fuel Quality Advisor Cosponsors – Coal companies, utilities, and Electric Power Research Institute (consortium)	200,000	300,000	200,000	200,000
96-11	Advanced Analytical Information System Cosponsors – Utilities, coal companies, and Electric Power Research Institute	180,000	270,000	180,000	0

TABLE B-2 (continued)

Project No.	Title	FY96 DOE Funding, \$	Nonfederal Funding, \$	Future DOE Funding, \$	
				FY97	FY98
96-12	Field Demonstration of SPME-IR Spectroscopy Field Screening of Soil Contaminated by Hazardous Waste and Toxic Chemical Spills Cosponsors - Gas Research Institute, American Petroleum Institute, Petroleum Environmental Research Forum, Amoco, and Boreem	40,000	60,000	100,000	0
96-13	Circulating Fluidized-Bed Combustion (CFBC) of Low-Grade Fuels Cosponsors - Boiler vendors, biomass groups, and industrial boiler operators	80,000	120,000	120,000	120,000
96-14	Evaluation of Natural Clay Liners for Produced Water Impoundments Cosponsors - Gas Research Institute, American Petroleum Institute, Petroleum Environmental Research Forum, and Amoco	100,000	300,000	20,000	0
96-15	Adsorbed Natural Gas (ANG) Vehicle Fueling Cosponsors - Gas Research Institute, Northern States Power Company, Amoco, Brunswick Composites, New Flyer of America, and various activated carbon producers	53,000	80,000	0	0
96-16	Fouling and Slagging Assessment of an Upgraded North Dakota Lignite Cosponsors - North Dakota Industrial Commission, University of Southern Illinois, and Sargent & Lundy	46,970	70,455	0	0
96-17	Development of a Catalyst-Coated Fabric Filter for Simultaneous No _x and Particulate Control Cosponsor - Owens-Corning	100,000	150,000	50,000	50,000
96-18	Utilization of Paper Mill Sludge in Pulverized Coal-Fired Boilers Cosponsor - Rainy River Corporation	32,000	48,000	0	0
Projects for Which the EERC is Developing the Idea Internally					
96-19	Refining the Application of FT-IR Spectroscopy for Monitoring Combustor Deposits Cosponsors - Electric Power Research Institute and Clean Air Engineering	34,000	50,000	34,000	0
96-20	Evaluating the Efficiency of Selected Sorbents for Removing Mercury from Natural Gas Reservoirs Cosponsors - Central Environmental Inc., Gas Research Institute, and other oil and gas companies	140,000	210,000	140,000	0
96-21	Development of an Infrared-Based Instrument for Measuring Combustion Deposit Thickness Cosponsors - Electric Power Research Institute, Diamond Power, and other electrical utilities	80,000	120,000	0	0
96-22	Effect of Dust Properties on Particulate Control Cosponsors - BHA Group Inc., W.L. Gore, particulate control vendors, and other fabric vendors	80,000	120,000	80,000	0

TABLE B-2 (continued)

Project No.	Title	FY96 DOE Funding, \$	Nonfederal Funding, \$	Future DOE Funding, \$	
				FY97	FY98
96-23	Upgrading Coal Fines with Nonrecyclable Wastes Cosponsors - Coal companies, American Plastics Council (APC), Electric Power Research Institute, North Dakota Industrial Commission, waste companies, and industrial boiler owners	40,000	60,000	80,000	0
96-24	Minimizing Opacity Using In-Furnace Ash Agglomeration Cosponsors - Minnesota Power, Thermal Energy Systems, Inc., and Westmoreland Resources	20,000	30,000	100,000	100,000
Projects for Which the Basic Idea Exists					
96-25	Catalytic Hydrothermal Treatment for Fuel Cell Applications Cosponsors - Fuel cell vendors, coal companies, biomass groups, and municipalities	40,000	60,000	100,000	0
TOTAL		1,898,309	3,051,694	1,596,000	862,000

Totals	Federal Funding, \$	Commercial Funding, \$
Currently Funded Projects That Will Receive Additional Funding in FY96	1,354,000	1,751,000
Proposed New Projects	1,898,309	3,051,694
Grand Total	3,252,309	4,802,694

JOINT VENTURE PROPOSAL PROJECT SUMMARY

PROJECT TITLE Training and Support for Hot-Gas Filter Testing		1995 JV LIST NUMBER NA
		CA TASK NUMBER NA
SUGGESTED PERFORMANCE MONITOR Richard Dennis	EERC PROJECT MANAGER Michael Mann	CONTROL NUMBER 96-1
PROJECT PERIOD Start: 11-1-95 End: 3-31-96		SUBMISSION DATE 10-30-95
PARTICIPANTS 3M, Industrial Filter & Pump, and Paul Advanced Filters		

<p>WORK DESCRIPTION (SUMMARY)</p> <p>The University of North Dakota Energy & Environmental Research Center is proposing a program entitled "Training and Support for Hot-Gas Filter Testing" as part of the Jointly Sponsored Research Program. The overall goal of this program is to maximize the exchange of information during the upcoming 200-hour filter test on the transport reactor development unit. Specifically, the Energy & Environmental Research Center would assist vendors witnessing the test in obtaining photos, samples, and hard data documenting the test; expand reporting and report distribution; provide training activities on start-up, operation, and troubleshooting; and allow for testing of four different filter types, rather than three.</p>
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YEAR	FY96			
TOTAL FUNDING:	41,078			
NONFEDERAL FUNDING				
Contract Award--Cash				
In-Kind Contribution	20,539			
DOE FUNDING:	20,539			
FUNDS REQUESTED THIS ACTION:	20,539			

EERC 10/95

JOINT VENTURE PROPOSAL PROJECT SUMMARY

PROJECT TITLE Development of a Coal Combustion Byproducts (CCBs) Database System		1995 JV LIST NUMBER NA
		CA TASK NUMBER NA
SUGGESTED PERFORMANCE MONITOR	EERC PROJECT MANAGER Erin O'Leary	CONTROL NUMBER 96-2
PROJECT PERIOD Start: 10-1-95 End: 9-30-97		SUBMISSION DATE 11-8-95
PARTICIPANTS American Coal Ash Association		

<p>WORK DESCRIPTION (SUMMARY)</p> <p>Develop a computer database and application program to contain analytical and engineering information on coal combustion byproducts. Data will be collected from American Coal Ash Association members and input to the database. A complete database application, manual, and final report will be delivered to American Coal Ash Association and U.S. Department of Energy .</p>
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YEAR	FY96			
TOTAL FUNDING:	49,500			
NONFEDERAL FUNDING				
Contract Award--Cash	29,700			
In-Kind Contribution				
DOE FUNDING:	19,800			
FUNDS REQUESTED THIS ACTION:	19,800			

EERC 10/95

Project Title Coal Ash Behavior in Reducing Environments (CABRE) II	
Potential Partner(s) Destec, Texaco, Demkolec, Krupp-Koppers, Electric Power Research Institute, and NOVEM	
Project Objectives <ul style="list-style-type: none"> To advance the current fundamental understanding of ash formation and deposition in entrained-flow gasification systems by correlating them with an applied engineering understanding To propose and test methods of deposit mitigation for the different types of deposition present in entrained-flow gasification systems To develop a series of indices for predicting the potential for deposition in an entrained-flow gasification system as a function of coal properties, system configuration, and operating parameters 	Target Start Date February 1996
	Contact Person(s) Tom Erickson or David Brekke
	Project Maturity (Check one) <ul style="list-style-type: none"> ☒ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Applicability to Fossil Energy Objectives <p>The successful design and operation of coal gasification and advanced combustion systems depends on the ability to control and mitigate ash-related problems. The economic and environmental implications of slag flow control, slag attack on refractory, ash deposition on heat-transfer surfaces, corrosion and erosion of system materials, and emissions control are well documented. Minimizing the potential for these ash-related problems is a fundamental objective in designing and operating entrained-flow gasifiers and advanced combustion systems. The CABRE II project will provide evaluation tools for design engineers and operators of these systems to aid in the assessment of fuel requirements and operating conditions.</p>	
Project Description <p>The CABRE II program is a 3-year multiclient program set in four tasks. The overall purpose of Task 1 is to advance the current fundamental understanding of ash formation by correlating ash characteristics in large-scale systems with their operational parameters. Ash formation and decomposition will be assessed on the effects of an H₂S atmosphere, short residence time transformations, and the formation of submicron or aerosol particles, largely through the use of a pressurized entrained-flow gasification simulator. Task 2 will focus on the incorporation of engineering and systems applications designed to best mimic the deposition attributes of large-scale systems. This will involve field discussions and sample collection at large-scale sites, laboratory testing of strength and growth rates in bench-scale units, and viscosity modeling of ash and deposits. Task 3 will use the information gained from CABRE I and CABRE II to develop a series of deposition indices that will aid designers and operators in the mitigation of ash-related problems. Demonstrations of the models on sponsor systems will be performed. Task 4 is the management and reporting functions of the program.</p>	

	FY96	FY97	FY98
Federal Funds, \$	118,000	118,000	118,000
Nonfederal Funds, \$	242,000	242,000	242,000
Total Funds, \$	360,000	360,000	360,000

Project Title Utilization of Petroleum Coke for Power Production	
Potential Partner(s) Mobil and EPRI	
Project Objective The objective for the proposed project is to determine the impacts of using petroleum coke as a primary or blended fuel for conventional coal-fired power systems on system performance, efficiency, and emissions.	Target Start Date December 1995
	Contact Person Chris Zygarlicke
	Project Maturity (Check one) ☒ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Applicability to Fossil Energy Objectives This project satisfies the Fossil Energy goals and objectives in relation to broadening fossil fuel end-use applications and reducing the environmental impact of waste products from fossil fuel combustion. Improved strategies for the clean and efficient use of petroleum coke as a fuel will result from this project. Information on slagging, fouling, and air toxic emissions and on fly ash utilization as related to petroleum coke combustion will lead to environmental and economic gains for the energy industry.	
Project Description The purpose of this project is to provide a sound technological characterization of the system and environmental impacts in utilizing petroleum coke or coke-coal blends for conventional coal combustion applications. Several cokes would be selected, and standard analyses and innovative methods would be employed to determine the inorganic content of coke and the association of the minerals and organically bound organics. Combustion tests would then be performed on the cokes using bench- and pilot-scale furnaces. Laminar flow drop-tube furnaces would be used to screen coke-coal blends for optimum blend ratios that minimize fouling, slagging, and SO ₂ emissions. Optimal coke-coal blends would then be fired in the Energy & Environmental Research Center Combustion Test Facility (CTF) reactor to evaluate the performance of the fuel in a more realistic system. The Combustion Test Facility system would also produce enough fly ash to perform ash utilization assessments. Overall issues of handling and feeding petroleum coke into a full-scale boiler would also be addressed. Final verification of optimum coke-coal blend ratios and firing modes would be performed in collaboration with a host utility.	

	FY96	FY97	FY98
Federal Funds, \$	44,000	44,000	44,000
Nonfederal Funds, \$	66,000	66,000	66,000
Total Funds, \$	110,000	110,000	110,000

Project Title Development of Hydrothermal Treatment for Wastewater and Economic Development				
Potential Partner(s) EESI (a small business concern in New Mexico)				
Project Objective To provide a quick, simple means of cleaning contaminated water for immediate return to the environment.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;"> Target Start Date July 1, 1996 </td> </tr> <tr> <td style="padding: 2px 5px;"> Contact Person Peter Louie </td> </tr> <tr> <td style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☒ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date July 1, 1996	Contact Person Peter Louie	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☒ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Target Start Date July 1, 1996				
Contact Person Peter Louie				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☒ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives Over the past 100+ years, the use of fossil fuel liquids (petroleum products and coal oil) has been the most popular form of energy production. Along with the combustion of the fuels came the necessity of handling larger and larger quantities of their liquids. In the handling process, fuel spillages, container leakages and tank overflows have been common, resulting in contaminated soils. In addition, electrical transformer Polychlorinated Biphenyls spills, transmission oil leaks, and heavy grease losses from lubricated mechanical parts resulted in deposits in soils. Pesticide deposits and industrial and household waste deposits in soil are common. Water leaches these contaminants along with hazardous metals; these must be removed from the water prior to its release back to the environment. Development of the proposed technology will provide a quick and relatively easy means to clean up this wastewater, providing a cleaner environment and encouraging economic development.				
Project Description The versatility of hydrothermal treatment as an organic destruction method is gaining recognition. In general, hydrothermal treatment refers to the redox reactions of chemical compounds in aqueous streams under supercritical or near-critical conditions. One important application of hydrothermal treatment is the destruction of organics in aqueous wastes. The reaction is carried out entirely in an enclosed pressure vessel and in dilute concentration, so that the heat of the reaction is adsorbed by the solvent, and the temperature can be maintained at any desirable level, typically in the range of 300°-550°C. The objective of the proposed research and development project is to demonstrate an innovative hydrothermal boiler system that can accomplish the following: <ul style="list-style-type: none"> • Treat hazardous wastes from coal gasification plants and fuel, pesticide, and industrial organic spillages • Remove inorganics and organics for the protection of energy recovery equipment and production of clean water • Develop a skid-mounted hydrothermal boiler system that can be demonstrated at customer sites • Be readily licensable under Resource Conservation Recovery Act Boiler and Industrial Furnace Rules The Energy & Environmental Research Center is interested in playing an active role in developing the proposed waste treatment process with EESI (a small business concern in New Mexico). In particular, the Energy & Environmental Research Center is interested in the Phase I bench-scale organic reforming to vapor for energy recovery and organic separation from inorganics for heterogeneous wastes portion of the work scope.				

	FY96	FY97	FY98
Federal Funds, \$	40,000	0	0
Nonfederal Funds, \$	60,000	0	0
Total Funds, \$	100,000	0	0

Project Title Removal of Hazardous Heavy Metals from Wastewater with Activated Carbons				
Potential Partner(s) Lewis Environmental Services, Inc. and 3M				
Project Objective The selective segmental adsorption by activated carbon derived from coal and other sorbent materials will be used to remove hazardous heavy metals from contaminated wastewater to levels that meet existing EPA discharge limits and regulations.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;"> Target Start Date July 1, 1996 </td> </tr> <tr> <td style="padding: 2px 5px;"> Contact Person Peter Louie </td> </tr> <tr> <td style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☒ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date July 1, 1996	Contact Person Peter Louie	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☒ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
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Applicability to Fossil Energy Objectives The coal-derived activated carbon represents new applications of coal for wastewater treatment applications.				
Project Description <p>The system proposed involves a series of four modules in which each has a specific purpose in the remediation process. In Module 1, we will use activated carbon to remove the organic compounds most commonly found in aqueous mixed waste streams. We will then, in Modules 2 and 3, use chemically treated activated carbon to remove moderate-to-high concentrations of hazardous heavy metals (e.g., eight Resource Conservation Recovery Act elements). Module 4, the final polishing step, will use selective carbon-based sorbent materials to handle low-concentration heavy metals-contaminated waste streams. An electrolytic recovery process developed by Lewis Environmental Services, Inc., will then recycle the heavy metals into a recyclable and saleable end product. Thus minimum waste generation will be achieved.</p> <p>The project will involve further refinement of the Lewis Environmental Services, Inc. process, and develop a predictive model for the heavy metals removal process. We propose to conduct our investigation through a series of bench-scale tests using bench-scale module provided by Lewis Environmental Services, Inc. within a 12-month program schedule at the Energy & Environmental Research Center. Bench scale (1-gal/min) investigation will involve treatment of coal-derived aqueous waste streams.</p>				

	FY96	FY97	FY98
Federal Funds, \$	60,000	0	0
Nonfederal Funds, \$	90,000	0	0
Total Funds, \$	150,000	0	0

Project Title Investigation of the Effects of Low-NO _x Burner Technologies on Coal Combustion Byproducts and Resulting Utilization Characteristics				
Potential Partner(s) Tennessee Valley Authority, Cinergy, Northern Indiana Public Service Company, Edison Electric Institute, and American Electric Power				
Project Objective To determine mechanisms of inorganic transformations under low-NO _x combustion conditions, determine the impact of low-NO _x combustion on coal combustion byproducts, and develop byproduct management strategies.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date April 1, 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person Debra Pflughoeft-Hassett</td> </tr> <tr> <td style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date April 1, 1996	Contact Person Debra Pflughoeft-Hassett	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
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Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives Fulfills U.S. Department of Energy objectives in the area of disposition or use of solid wastes. The project will provide information and recommendations that will facilitate the utilization of coal combustion by-products produced under full-scale low-NO _x combustion conditions.				
Project Description Utility coal combustion fly ash and bottom ash samples from a variety of sources utilizing low-NO _x burners will be collected and evaluated for select properties related to utilization and disposal requirements. Bench-scale combustion tests will be performed to evaluate operational parameters relative to improving ash quality for potential utilization and determining the trace element transformations in low-NO _x combustion. Carbon separation techniques will be applied to samples as a potential beneficiation procedure. Specific recommendations for operational parameters and carbon separation will be made.				

	FY96	FY97	FY98
Federal Funds, \$	80,000	80,000	80,000
Nonfederal Funds, \$	120,000	120,000	120,000
Total Funds, \$	200,000	200,000	200,000

Project Title Mercury Sorbent Consortium	
Potential Partner(s) Dravo Lime, Calgon, Alcoa, American Norit, and other carbon/sorbent manufacturers	
Project Objective To determine what sorbents have the best potential for mercury control for coal combustion flue gas streams.	Target Start Date February 1, 1996
	Contact Person Dennis Laudal
	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Applicability to Fossil Energy Objectives Finding cheap, efficient mercury sorbents for coal combustion systems is a high priority with the U.S. Department of Energy Fossil Energy program.	
Project Description The sorbents would be tested using a protocol that is currently being developed by the Energy & Environmental Research Center, Radian Corporation, and Electric Power Research Institute. All sorbents would be initially tested at the bench-scale level and the most promising sorbents tested at the pilot-scale.	

	FY96	FY97	FY98
Federal Funds, \$	100,000	0	0
Nonfederal Funds, \$	150,000	0	0
Total Funds, \$	250,000	0	0

Project Title Optimizing Coal Utilization, Cleaning, and Blending at the Mine Level	
Potential Partner(s) Coal companies, utilities, and Electric Power Research Institute (consortium)	
Project Objective To develop and demonstrate an integrated system to support the optimization of fuel selection at the mine level through the following: <ul style="list-style-type: none"> Developing a system to interpret advanced and conventional coal characterization data in three dimensions and convey those results to managers, operators, and plant engineers. Demonstrating the ability of a data visualization system and an expert predictive system to interpolate between limited amounts of advanced characterization data. Integrating the currently existing coal quality algorithms for fouling, slagging, opacity, coal processing and handling, and others as a basis for determining mining, cleaning, and blending strategies of coal prior to excavation. 	Target Start Date June 1, 1996
	Contact Person(s) Dave Brekke, Wes Peck, or Tom Erickson
	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Applicability to Fossil Energy Objectives The clean and efficient use of fossil fuel has long been the major goal of the Fossil Energy program. This project is designed to improve the efficiency of coal combustion systems by optimizing the mining, selection, cleaning, and blending of various fuels and to provide for a cleaner environment by environmentally mitigating both air and land emissions.	
Project Description This project involves the creation of a computerized system for plotting out the coal quality parameters of a coal mine and interpreting those properties for their effects on plant performance (fouling, slagging, opacity, erosion, etc.). The computer program could be used to optimize the mining strategy used to produce fuels for multiple clients and to aid in producing a better fuel through cleaning and blending strategies. The project would be broken into three tasks: analytical characterization, database, and performance indices. The project would be demonstrated at a sponsor-chosen site.	

	FY96	FY97	FY98
Federal Funds, \$	150,000	150,000	150,000
Nonfederal Funds, \$	225,000	225,000	225,000
Total Funds, \$	375,000	375,000	375,000

Project Title Fuel Quality Advisor	
Potential Partner(s) Coal companies, utilities, and Electric Power Research Institute (consortium)	
Project Objective To develop and validate an overall strategy for managing the problems associated with inorganic constituents (ash) during the combustion of coal through the following: <ul style="list-style-type: none"> • Consolidate the various computer programs to predict fouling, slagging, opacity, erosion, and other problems into a single program. • Enhance the existing models based on experimental data. • Verify/validate these models at multiple full-scale utilities. • Integrate an advanced data generator for providing the detailed analytical characterization necessary. • Integrate an information management system for tracking coal quality and plant performance. 	Target Start Date June 1, 1996 Contact Person(s) Tom Erickson, Sean Allan, or Chris Zygarlicke Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Applicability to Fossil Energy Objectives The clean and efficient use of fossil fuel has long been the major goal of the Fossil Energy program. This project is designed to improve the efficiency of coal combustion systems by optimizing the selection, cleaning, and blending as well as provide for a cleaner environment by environmentally mitigating both air and land emissions.	
Project Description The various programs developed at the Energy & Environmental Research Center (as well as other openly available models) to predict the problems associated with inorganic constituents during coal combustion will be combined into a single program. These models will be modified and enhanced based on past experimental data and data generated within the program. The models will also be integrated with a coal quality tracking system and a plant performance tracking system. The tracking systems will have the option of being integrated with the models for tuning and optimizing the models on-line. All of these components will be packaged into a powerful computer interface capable of outputting the produced information in various formats as requested by the user. The overall program will be broken into five tasks for efficient management: Interface Development, Model Integration, Experimental Support, Validation Testing, and Reporting and Management. A major thrust of this program will be to test the model on full-scale facilities to ensure acceptance of the model as fully functional at the conclusion of the project.	

	FY96	FY97	FY98
Federal Funds, \$	200,000	200,000	200,000
Nonfederal Funds, \$	300,000	300,000	300,000
Total Funds, \$	500,000	500,000	500,000

Project Title Advanced Analytical Information System							
Potential Partner(s) Utilities, coal companies, and Electric Power Research Institute							
Project Objective To develop a system for the storage, retrieval, formatting, and generation of advanced analytical information necessary for the operation of the advanced ash models being developed by the Energy & Environmental Research Center, Electric Power Research Institute, PSI, Sandia and other organizations.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">June 1, 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person(s)</td> <td style="padding: 2px 5px;">Tom Erickson, Chris Zygarlicke, or Erin O'Leary</td> </tr> <tr> <td style="padding: 2px 5px;">Project Maturity (Check one)</td> <td style="padding: 2px 5px;"> ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	June 1, 1996	Contact Person(s)	Tom Erickson, Chris Zygarlicke, or Erin O'Leary	Project Maturity (Check one)	☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Target Start Date	June 1, 1996						
Contact Person(s)	Tom Erickson, Chris Zygarlicke, or Erin O'Leary						
Project Maturity (Check one)	☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists						
Applicability to Fossil Energy Objectives The clean and efficient use of fossil fuels has long been the major goal of the Fossil Energy program. Many organizations are developing advanced systems for the prediction and mitigation of ash-related problems within coal combustion systems. These advanced systems require advanced analytical information, which is scarce and variable in quality because of the development of advanced techniques over the last 5 years. Providing quality advanced analytical data for these systems will allow them to better optimize the efficiency and environmental impacts of coal combustion facilities.							
Project Description A system will be developed to allow the efficient storage and retrieval of advanced analytical information. Data currently available will be scrutinized for its inclusion in this system, and new coal samples will be analyzed as chosen by sponsors. The analytical information will include computer-controlled scanning electron microscopy, chemical fractionation, proximate-ultimate, x-ray fluorescence, and other information as desired by the sponsors. A system will also be integrated to generate (predict) advanced analytical information for a given geographical location and a base amount of analytical information. The project will be broken into four tasks: Database, Analytical Characterization, Advanced Data Generation, and Reporting and Management.							

	FY96	FY97	FY98
Federal Funds, \$	180,000	180,000	0
Nonfederal Funds, \$	270,000	270,000	0
Total Funds, \$	450,000	450,000	0

Project Title Field Demonstration of SPME-IR Spectroscopic Field Screening of Soil Contaminated by Hazardous Waste and Toxic Chemical Spills				
Potential Partner(s) Gas Research Institute, American Petroleum Institute, Petroleum Environmental Research Forum, Amoco, and Borealis				
Project Objective This project will demonstrate the capabilities of solid-phase microextraction (SPME) with infrared (IR) spectroscopic detection for on-site screening of soil contamination by hazardous wastes and toxic chemical spills. The proposed work will demonstrate the commercial viability of the SPME-IR field screening technique.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> Target Start Date July 1, 1996 </td> </tr> <tr> <td style="padding: 2px;"> Contact Person Ames Grisanti </td> </tr> <tr> <td style="padding: 2px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date July 1, 1996	Contact Person Ames Grisanti	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Target Start Date July 1, 1996				
Contact Person Ames Grisanti				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives The SPME-IR field screening technique is applicable to detection of petroleum hydrocarbons as well as chlorinated hydrocarbons and other industrial solvents and wastes generated as a result of petroleum product refining and other fossil fuel-related industrial processes.				
Project Description The project will involve the refinement of a prototype SPME-IR device currently under development. The SPME-IR system will be laboratory-tested and be field demonstrated at a real-world site. Refinement of the SPME-IR technique will take place during Year 1 of the proposed project. Year 2 will be a demonstration of the technology at oil and gas industry sites.				

	FY96	FY97	FY98
Federal Funds, \$	40,000	100,000	0
Nonfederal Funds, \$	60,000	150,000	0
Total Funds, \$	100,000	250,000	0

Project Title Circulating Fluidized-Bed Combustion (CFBC) of Low-Grade Fuels							
Potential Partner(s) Boiler vendors, biomass groups, and industrial boiler operators							
Project Objective The objective of the proposed work us to provide fluid-bed vendors with the information they need to competitively bid and build units to fire low-grade fuels. To accomplish this, the specific goal is to resolve operational issues related to the use of low-grade fuels in circulating fluid-bed combustion. The issues to be resolve include fouling, agglomeration, corrosion, and emissions.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">July 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person</td> <td style="padding: 2px 5px;">Mike Mann</td> </tr> <tr> <td colspan="2" style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	July 1996	Contact Person	Mike Mann	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists	
Target Start Date	July 1996						
Contact Person	Mike Mann						
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists							
Applicability to Fossil Energy Objectives This project fits into the overall goals of expanding the use of U.S. technology for meeting energy needs both in the United States and abroad. It also is applicable to goals to utilize low-grade and waste fuels.							
Project Description The Energy & Environmental Research Center has developed an extensive database on the circulating fluidized-bed combustion using a variety of coals under a consortium project that included the U.S. Department of Energy. The results from this work are highly referenced by boiler vendors and engineering firms. Two vendors have approached the Energy & Environmental Research Center to expand the test base to waste fuels, including coal wastes, biomass, and tires. The vendors feel that they cannot bid on a number of projects because they lack information on how to design a system to deal with the problems related to these fuels. The proposed work would involve testing at the bench and pilot scale, using a suite of fuels selected by the sponsoring agencies. Operating conditions and/or design configurations would be varied to minimize the problems associated with that particular fuel. The main product would be design information and recommendations on how the selected fuels can be fired in the circulating fluidized-bed combustion.							

	FY96	FY97	FY98
Federal Funds, \$	80,000	120,000	120,000
Nonfederal Funds, \$	120,000	180,000	180,000
Total Funds, \$	200,000	300,000	300,000

Project Title Evaluation of Natural Clay Liners for Produced-Water Impoundments				
Potential Partner(s) Gas Research Institute, American Petroleum Institute, Petroleum Environmental Research Forum, and Amoco				
Project Objective Determination of the feasibility of the use of natural clay (nonsynthetic) liners for use as produced-water impoundments.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;"> Target Start Date April 1996 </td> </tr> <tr> <td style="padding: 2px 5px;"> Contact Person John Harju </td> </tr> <tr> <td style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date April 1996	Contact Person John Harju	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
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Contact Person John Harju				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives Produced water is the highest-volume waste stream generated in the oil and gas industry. Natural clay liners may provide a cost-effective barrier to the migration of produced waters.				
Project Description A facility would be constructed with leachate collection and moisture-sensing devices such that the integrity of the liner would be monitored. Periodic sampling and analyses would also be conducted on any leachate collected. The facility would be constructed by Amoco, under design criteria by the Energy & Environmental Research Center, and all monitoring devices, sampling, etc., would be conducted by the Energy & Environmental Research Center.				

	FY96	FY97	FY98
Federal Funds, \$	100,000	20,000	0
Nonfederal Funds, \$	300,000	40,000	0
Total Funds, \$	400,000	60,000	0

Project Title Adsorbed Natural Gas (ANG) Vehicle Fueling							
Potential Partner(s) Gas Research Institute, Northern States Power Company, Amoco, Brunswick Composites, New Flyer of America, and various activated carbon producers							
Project Objective The primary objective of this project will be to enhance the competitiveness of natural gas as a transportation fuel. Reducing the pressure of gas storage (from 3600 or 3000 psig to 500 psig) using specially prepared microporous carbon sorbents without greatly reducing the fuel tank volume of stored natural gas would reduce fueling equipment and vehicle fuel system component costs associated with the higher pressures.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">June 1, 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person(s)</td> <td style="padding: 2px 5px;">Mark Musich or Tim Gerlach</td> </tr> <tr> <td colspan="2" style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	June 1, 1996	Contact Person(s)	Mark Musich or Tim Gerlach	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists	
Target Start Date	June 1, 1996						
Contact Person(s)	Mark Musich or Tim Gerlach						
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists							
Applicability to Fossil Energy Objectives This project will be partially sponsored by Gas Research Institute through funds available to the U.S. Department of Energy Clean Cities program. The Energy & Environmental Research Center is coordinating the Grand Forks Region Clean Cities Program, which enables the Energy & Environmental Research Center to be eligible for this Gas Research Institute backing. In keeping with U.S. Department of Energy Fossil Energy goals and objectives, the adsorbed natural gas development work seeks to broaden the end-use applications for natural gas and to advance alternative transportation fuel technology. Because fleet managers are and will continue to rely heavily on natural gas vehicles to meet requirements of the Clean Air Act Amendments of 1990, the continued improvement of natural gas vehicle technology is of utmost importance.							
Project Description The competitiveness of natural gas vehicles could be greatly improved by reducing the costs associated with gas storage. Two hurdles facing the widespread use of natural gas vehicles are their reduced range and higher cost. The goal of this project: reduce the pressure of current gas storage (from 3600 or 3000 psig to approximately 500 psig) without greatly reducing the volume of stored gas using specially prepared microporous carbon sorbents. If successful, future project phases will include demonstration of an adsorbed natural gas-fueled vehicle. Tasks to be performed include compilation of current natural gas vehicle technology and research, selection of activated carbon sorbents and natural gas vehicle fuel tanks, evaluation of the sorbent efficiency in autoclave and actual natural gas vehicle fuel tank tests, and comprehensive economic and practical comparisons of adsorbed natural gas to compressed natural gas technologies.							

	FY96	FY97	FY98
Federal Funds, \$	53,000	0	0
Nonfederal Funds, \$	80,000	0	0
Total Funds, \$	133,000	0	0

Project Title Fouling and Slagging Assessment of an Upgraded North Dakota Lignite				
Potential Partner(s) North Dakota Industrial Commission, University of Southern Illinois, and Sargent & Lundy				
Project Objective To assess the fouling, slagging, and fly ash collection properties of a baseline ND lignite and its upgraded product. An assessment of the effects of processing on air toxics will also be performed.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> Target Start Date March 1, 1996 </td> </tr> <tr> <td style="padding: 2px;"> Contact Person Jay Gunderson </td> </tr> <tr> <td style="padding: 2px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date March 1, 1996	Contact Person Jay Gunderson	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Target Start Date March 1, 1996				
Contact Person Jay Gunderson				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives The upgrading process is expected to reduce the sodium content, ash content, sulfur content, and moisture content of a North Dakota lignite to expand its use commercially as a fuel for power production and steam generation. High sodium, high ash, moderate sulfur, and high moisture contents in North Dakota lignites are currently impediments to penetrating the marketplace for power production as a compliance fuel.				
Project Description The Energy & Environmental Research Center will be a subcontractor to Sargent & Lundy and will perform the combustion tests required to assess improvements to the coal's fouling/slagging/electrostatic precipitator performance as a result of the upgrading process. The two-phase project will assess the fouling and slagging propensity for an upgraded North Dakota lignite. Drop-tube furnace tests will be used in conjunction with standard and advanced coal analyses to provide an assessment during Phase I work. Phase II work will be performed on the EERC's Combustion Test Facility to verify fouling propensity and determine effects of the upgrading process on fly ash collectibility by electrostatic precipitation. In each phase, the upgraded lignite will be compared to results obtained on the parent fuel. Eleven trace elements will be determined in the two coals and the resulting fly ash.				

	FY96	FY97	FY98
Federal Funds, \$	46,970	0	0
Nonfederal Funds, \$	70,455	0	0
Total Funds, \$	117,425	0	0

Project Title Development of a Catalyst-Coated Fabric Filter for Simultaneous NO _x and Particulate Control											
Potential Partner(s) Owens-Corning											
Project Objective The objective of the project is to demonstrate performance improvements (increased NO _x reduction and reduced ammonia slip) for a catalyst-coated fabric filter at the pilot scale. Specific goals include verifying bench-scale results achieved in the last year, >80% NO _x reduction, and <10 ppm ammonia slip.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> </tr> <tr> <td style="padding: 2px 5px;">Proposal Submission: Jan.-Mar. 1996 Initiate project: April-June 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person</td> </tr> <tr> <td style="padding: 2px 5px;">Greg Weber</td> </tr> <tr> <td style="padding: 2px 5px;">Project Maturity (Check one)</td> </tr> <tr> <td style="padding: 2px 5px;">☐ Proposal submitted to commercial sponsor(s)</td> </tr> <tr> <td style="padding: 2px 5px;">☐ Ready to write proposal to commercial sponsor(s)</td> </tr> <tr> <td style="padding: 2px 5px;">☒ Discussing with potential sponsor(s)</td> </tr> <tr> <td style="padding: 2px 5px;">☐ Developing idea internally</td> </tr> <tr> <td style="padding: 2px 5px;">☐ Basic idea exists</td> </tr> </table>	Target Start Date	Proposal Submission: Jan.-Mar. 1996 Initiate project: April-June 1996	Contact Person	Greg Weber	Project Maturity (Check one)	☐ Proposal submitted to commercial sponsor(s)	☐ Ready to write proposal to commercial sponsor(s)	☒ Discussing with potential sponsor(s)	☐ Developing idea internally	☐ Basic idea exists
Target Start Date											
Proposal Submission: Jan.-Mar. 1996 Initiate project: April-June 1996											
Contact Person											
Greg Weber											
Project Maturity (Check one)											
☐ Proposal submitted to commercial sponsor(s)											
☐ Ready to write proposal to commercial sponsor(s)											
☒ Discussing with potential sponsor(s)											
☐ Developing idea internally											
☐ Basic idea exists											
Applicability to Fossil Energy Objectives Current Fossil Energy objectives include reductions in emissions as specific and integral elements of new technology development. Individual program areas propose reductions in emissions of sulfur dioxide, nitrogen oxides, and particulates to levels ranging from 25% to 10% of the levels permitted by current New Source Performance Standards. In order to meet these objectives for a broad spectrum of technology applications, the development of a number of technology options will be necessary. The catalytic fabric filter concept is a technology option that can play a role in meeting the emission reduction objectives if the technology can be demonstrated to effectively control the emission of nitrogen oxides (>80%) and particulates (>99.95%) with a resulting ammonia slip of <10 ppm.											
Project Description The scope of the project will include the completion of 2 or 3 weeks of pilot-scale (130 to 150 scfm) tests to verify bench-scale NO _x reduction and ammonia slip data. The scope of work may also include evaluating the durability of the catalyst-coated fabric as a function of time (several thousand hours) in a small commercial- or pilot-scale baghouse. A review of the catalytic fabric filter economics may be considered based on recent information indicating that the cost of catalyst-coated bags is only 50% of the cost used in previous estimates.											

	FY96	FY97	FY98
Federal Funds, \$	100,000	50,000	50,000
Nonfederal Funds, \$	150,000	125,000	125,000
Total Funds, \$	250,000	175,000	175,000

Project Title Utilization of Paper Mill Sludge in Pulverized Coal-Fired Boilers				
Potential Partner(s) Rainy River Corporation				
Project Objective The objective of the project is to examine the effects of combusting blends of paper mill sludge and coal in a pulverized coal-fired utility boiler. If feasible, this would result in the utilization of the waste sludge in a cost-effective and environmentally safe manner.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> Target Start Date February 1996 </td> </tr> <tr> <td style="padding: 2px;"> Contact Person(s) Don McCollor or Chris Zygarlicke </td> </tr> <tr> <td style="padding: 2px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date February 1996	Contact Person(s) Don McCollor or Chris Zygarlicke	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists
Target Start Date February 1996				
Contact Person(s) Don McCollor or Chris Zygarlicke				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☒ Discussing with potential sponsor(s) ☐ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives This project satisfies the Fossil Energy goals and objectives in relation to broadening fossil fuel end-use applications and reducing the environmental impact of fossil fuel combustion. Improved strategies for the clean and efficient use of low-sulfur, high-calcium Powder River Basin coal in combination with a renewable fuel will result from this project. Information on the slagging, fouling, and emissions control as related to burning a Powder River Basin coal-paper mill wastepaper sludge blend will result in environmental and economic gains for the energy industry by conserving fossil fuel resources and reducing production of greenhouse gases.				
Project Description The project would involve bench-scale combustion tests of a series of blends comprised of paper mill sludge and coal. Assessment would be made of blend reactivity, fouling and slagging propensity, and emissions. Emissions measurements would focus on sulfur, chlorine, and trace elements associated with the paper sludge. The blends, as well as the fly ash and ash deposits would be characterized and predictive models used to estimate the optimum blend ratio for use.				

	FY96	FY97	FY98
Federal Funds, \$	32,000	0	0
Nonfederal Funds, \$	48,000	0	0
Total Funds, \$	80,000	0	0

Project Title Refining the Application of FT-IR Spectroscopy for Monitoring Combustor Deposits							
Potential Partner(s) Electric Power Research Institute and Clean Air Engineering							
Project Objective To determine the effects of physical characteristics of deposits on correlating Fourier transform infrared (FT-IR) spectral radiation with specific chemical species.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">July 1, 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person(s)</td> <td style="padding: 2px 5px;">Brian Young or Ames Grisanti</td> </tr> <tr> <td colspan="2" style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	July 1, 1996	Contact Person(s)	Brian Young or Ames Grisanti	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists	
Target Start Date	July 1, 1996						
Contact Person(s)	Brian Young or Ames Grisanti						
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists							
Applicability to Fossil Energy Objectives Fourier transform infrared spectroscopy has potential applicability to monitoring and controlling deposit formation in coal combustion systems. Reducing the buildup of deposits in combustor convective passes will improve the efficiency and cost of operating coal-fired systems.							
Project Description Our recently completed investigation monitoring deposits in a coal-fired combustor has pointed to the need to determine the relative impacts of physical characteristics, such as layering, particle size, and surface roughness on the emission spectra arising from hot mineral deposits. Although some spectral correlations with mineral species have been made, uncertainty in data interpretation exists as a consequence of physical effects. This investigation will involve identifying the nature and extent of the physical effects to enhance the application of Fourier transform infrared spectroscopy in combustion system monitoring.							

	FY96	FY97	FY98
Federal Funds, \$	34,000	34,000	0
Nonfederal Funds, \$	50,000	50,000	0
Total Funds, \$	84,000	84,000	0

Project Title Evaluating the Efficiency of Selected Sorbents for Removing Mercury from Natural Gas Reservoirs				
Potential Partner(s) Central Environmental Inc., Gas Research Institute, and other oil and gas companies				
Project Objective To determine the efficiency of selected sorbents for removing mercury from deep-well sources of natural gas.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;"> Target Start Date June 1, 1996 </td> </tr> <tr> <td style="padding: 2px 5px;"> Contact Person(s) Brian Young, John Harju, or Ed Olson </td> </tr> <tr> <td style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date June 1, 1996	Contact Person(s) Brian Young, John Harju, or Ed Olson	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists
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Contact Person(s) Brian Young, John Harju, or Ed Olson				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives Natural gas is increasingly being used as a clean combustion fuel. However, natural gas contains certain contaminants, in particular, mercury vapor, that need to be removed to prevent their deposition into the environment and deleterious effects on gas processing equipment.				
Project Description Selected carbon and treated inorganic sorbents have been shown to remove mercury from flue gas streams under specific conditions. The effectiveness of these materials depends on the nature of the sorbents, their pretreatment, and the constituents and the temperature of the gas stream. This project will involve simulating natural gas reservoir conditions and testing selected carbon- and silica-based sorbents for mercury uptake. The efficiency of sorption will be determined and the conditions for enhanced sorption examined.				

	FY96	FY97	FY98
Federal Funds, \$	140,000	140,000	0
Nonfederal Funds, \$	210,000	210,000	0
Total Funds, \$	350,000	350,000	0

Project Title Development of an Infrared-Based Instrument for Measuring Combustion Deposit Thickness				
Potential Partner(s) Electric Power Research Institute, Diamond Power, and other electrical utilities				
Project Objective To develop a simple instrument based on infrared emission to measure thickness of deposits in coal-fired combustion boiler.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> Target Start Date July 1, 1996 </td> </tr> <tr> <td style="padding: 2px;"> Contact Person(s) Brian Young or Ames Grisanti </td> </tr> <tr> <td style="padding: 2px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date July 1, 1996	Contact Person(s) Brian Young or Ames Grisanti	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists
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Contact Person(s) Brian Young or Ames Grisanti				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives Deposit buildup in coal-fired combustion boilers has deleterious effects on the combustion efficiency and is periodically, but not efficiently, controlled by sootblowers. In addition, poor control can lead to boiler tube erosion and shutdowns. The results of this project have the potential to improve the control of sootblowers and hence increase the overall energy efficiency.				
Project Description Based on recent work investigating the applicability of Fourier transform infrared spectroscopy to monitoring deposit buildup, it is planned to develop and evaluate a hand-held infrared monitor for determining the thickness of deposits in a coal-fired combustion boiler. This monitor will use the concept of ratioing the intensities of two specific wavelengths under clean and deposit-building conditions.				

	FY96	FY97	FY98
Federal Funds, \$	80,000	0	0
Nonfederal Funds, \$	120,000	0	0
Total Funds, \$	200,000	0	0

Project Title Effect of Dust Properties on Particulate Control							
Potential Partner(s) BHA Group Inc., W.L. Gore, particulate control vendors, and other fabric vendors							
Project Objective To evaluate the effect of ash properties on fine-particle collection efficiency and to develop models that relate these properties to particulate collection.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">May 1, 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person</td> <td style="padding: 2px 5px;">Stan Miller</td> </tr> <tr> <td colspan="2" style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	May 1, 1996	Contact Person	Stan Miller	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists	
Target Start Date	May 1, 1996						
Contact Person	Stan Miller						
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists							
Applicability to Fossil Energy Objectives Relates directly to the need to minimize air toxic emissions to the atmosphere using the most economical approach.							
Project Description Project would consist of five tasks as follows: <ul style="list-style-type: none"> • Collection of samples from full-scale baghouses and electrostatic precipitators • Measurement of physical and chemical properties of ash samples • Determine pore-bridging ability of samples in bench-scale tests • Add new data to existing database and further develop existing models relating cohesive properties of ash to fine-particle emissions and flow resistance. • Initiate development of a standard for quantifying cohesive properties of ash in cooperation with other groups such as American Society for Testing and Materials 							

	FY96	FY97	FY98
Federal Funds, \$	80,000	80,000	0
Nonfederal Funds, \$	120,000	120,000	0
Total Funds, \$	200,000	200,000	0

Project Title Upgrading Coal Fines with Nonrecyclable Wastes							
Potential Partner(s) Coal companies, American Plastic Council, Electric Power Research Institute, North Dakota Industrial Commission, waste companies, and industrial boiler owners							
Project Objective To produce an enhanced-Btu briquetted fuel from coal fines using unrecovered nonrecyclables (contaminated paper, cardboard, plastics) as a low-cost binder and sulfur-diluting agent. The objective is to produce a usable product (briquetted fuel) from two waste materials (coal fines and nonrecyclable wastes)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">Target Start Date</td> <td style="padding: 2px 5px;">July 1996</td> </tr> <tr> <td style="padding: 2px 5px;">Contact Person</td> <td style="padding: 2px 5px;">Chris Anderson</td> </tr> <tr> <td colspan="2" style="padding: 2px 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date	July 1996	Contact Person	Chris Anderson	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists	
Target Start Date	July 1996						
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Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists							
Applicability to Fossil Energy Objectives This program applies to U.S. Department of Energy goals in coal upgrading and processing coal byproducts. One of the problems with many coal-upgrading facilities is fines production. Ponds of coal fines represent an environmental challenge. This project represents a method to deal with these coal-related problems while offering a partial solution to the solid-waste problems that also plague this nation.							
Project Description Both thermally treated plastic and carbonized municipal solid waste will be blended with coal fines from an operating washery(s) and fines generated from coal-drying processes. The blends will be compacted in a manually operated pellet press; the pellet feedstock will be heated as necessary to activate the residual plastic and facilitate binding during the compaction process. The prepared pellets will be subjected to chemical, mechanical, and stability analysis. One product will be selected for further evaluation in a pilot-scale stoker system. This evaluation will involve determining the combustion and environmental performance of the briquettes. A first-level engineering assessment will be made of the overall cost of this process.							

	FY96	FY97	FY98
Federal Funds, \$	40,000	80,000	0
Nonfederal Funds, \$	60,000	120,000	0
Total Funds, \$	100,000	200,000	0

Project Title Minimizing Opacity Using In-Furnace Ash Agglomeration				
Potential Partner(s) Minnesota Power, Thermal Energy Systems, Inc., and Westmoreland Resources				
Project Objective The objective of the two-phase project is to determine the effect of Thermal Energy Systems, Inc.'s in-furnace ionization system on the agglomeration of fine particulate resulting from the combustion of a Montana Powder River Basin coal at pilot scale and at full scale.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> Target Start Date August 1996 </td> </tr> <tr> <td style="padding: 2px;"> Contact Person(s) Chris Zygarlicke or Jay Gunderson </td> </tr> <tr> <td style="padding: 2px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists </td> </tr> </table>	Target Start Date August 1996	Contact Person(s) Chris Zygarlicke or Jay Gunderson	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists
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Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☒ Developing idea internally ☐ Basic idea exists				
Applicability to Fossil Energy Objectives The process is expected to improve the environmental performance, especially for fine particulate emissions, of a coal-fired utility boiler.				
Project Description The first phase will use the existing Thermal Energy Systems, Inc. ionization system developed under a separate project to evaluate the process at pilot scale. Testing will be accomplished over two 100-hr test periods to determine the effects of various operating parameters on the agglomerating properties of the Powder River Basin fly ash. If successful, a full-scale demonstration will be performed at Minnesota Power's Clay Boswell station in Cohasset, MN. Once the full-scale system is operational, an 8-week test program may be adequate to document the full-scale performance of the ionization system.				

	FY96	FY97	FY98
Federal Funds, \$	20,000	100,000	100,000
Nonfederal Funds, \$	30,000	150,000	150,000
Total Funds, \$	50,000	250,000	250,000

Project Title Catalytic Hydrothermal Treatment for Fuel Cell Applications				
Potential Partner(s) Fuel cell vendors, coal companies, biomass groups, and municipalities				
Project Objective Hydrothermal treatment of coals, biomass, and other wastes produces a homogenous slurry fuel. However, a considerable amount of the volatiles are evolved as a gas. The objective of this project is to perform hydrothermal treatment using a catalyst to produce a gas of sufficient quality for a fuel cell in addition to a slurry fuel, thereby greatly improving the efficiency and economics of the hydrothermal treatment process.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;"> Target Start Date September 1996 </td> </tr> <tr> <td style="padding: 5px;"> Contact Person Mike Mann </td> </tr> <tr> <td style="padding: 5px;"> Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☒ Basic idea exists </td> </tr> </table>	Target Start Date September 1996	Contact Person Mike Mann	Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☒ Basic idea exists
Target Start Date September 1996				
Contact Person Mike Mann				
Project Maturity (Check one) ☐ Proposal submitted to commercial sponsor(s) ☐ Ready to write proposal to commercial sponsor(s) ☐ Discussing with potential sponsor(s) ☐ Developing idea internally ☒ Basic idea exists				
Applicability to Fossil Energy Objectives This project meshes with U.S. Department of Energy goals for the development of high-efficient, of modular energy systems.				
Project Description Several low-rank coals and biomass materials will be chosen for evaluation based on their propensity to generate a relatively large amount of gas during the hydrothermal treatment process. Baseline tests will qualify the amount and type of gases produced from each material. Several catalysts known to promote hydrogen formation will be tested with each material to determine the quality of fuel gas produced. The EERC will work with a fuel cell vendor to evaluate the effectiveness of the gas in their fuel cell. The fuel quality of the residual char will also be evaluated. Initial work will be performed on the autoclave, with a verification test of the most promising combination of feedstock and catalyst at the pilot level.				

	FY96	FY97	FY98
Federal Funds, \$	40,000	100,000	0
Nonfederal Funds, \$	60,000	150,000	0
Total Funds, \$	100,000	250,000	0

SECTION C

ADMINISTRATIVE

Budgets removed at

ASSURANCES — NON-CONSTRUCTION PROGRAMS

Note: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.
2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.
3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.
4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.
5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§ 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the nineteen statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).
6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§ 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. § 794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§ 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§ 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. § 3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.
7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.
8. Will comply with the provisions of the Hatch Act (5 U.S.C. §§ 1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.
9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§ 276a to 276a-7), the Copeland Act (40 U.S.C. § 276c and 18 U.S.C. §§ 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 327-333), regarding labor standards for federally assisted construction subagreements.

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10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is \$10,000 or more.
11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§ 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 176(c) of the Clear Air Act of 1955, as amended (42 U.S.C. § 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended, (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended, (P.L. 93-205).
12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§ 1271 et seq.) related to protecting components of potential components of the national wild and scenic rivers system.
13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).
14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.
15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.
16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§ 4801 et seq.) which prohibits the use of lead based paint in construction or rehabilitation of residence structures.
17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1984.
18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL		TITLE
Director Office of Research and Program Development	
APPLICANT ORGANIZATION		DATE SUBMITTED	
Energy & Environmental Research Center University of North Dakota		December 1, 1995	

CERTIFICATIONS REGARDING LOBBYING; DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS; AND DRUG-FREE WORKPLACE REQUIREMENTS

Applicants should refer to the regulations cited below to determine the certification to which they are required to attest. Applicants should also review the instructions for certification included in the regulations before completing this form. Signature of this form provides for compliance with certification requirements under 34 CFR Part 82, "New Restrictions on Lobbying," and 34 CFR Part 85, "Government-wide Debarment and Suspension (Nonprocurement) and Government-wide Requirements for Drug-Free Workplace (Grants)." The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Education determines to award the covered transaction, grant, or cooperative agreement.

1. LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 34 CFR Part 82, for persons entering into a grant or cooperative agreement over \$100,000, as defined at 34 CFR Part 82, Sections 82.105 and 82.110, the applicant certifies that:

- (a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the making of any Federal grant, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;
- (b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions;
- (c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts) and that all subrecipients shall certify and disclose accordingly.

2. DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

As required by Executive Order 12549, Debarment and Suspension, and implemented at 34 CFR Part 85, for prospective participants in primary covered transactions, as defined at 34 CFR Part 85, Sections 85.105 and 85.110 -

A. The applicant certifies that it and its principals:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

3. DRUG-FREE WORKPLACE (GRANTEES OTHER THAN INDIVIDUALS)

As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 -

A. The applicant certifies that it will or will continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an on-going drug-free awareness program to inform employees about-

(1) The dangers of drug abuse in the workplace;

(2) The grantee's policy of maintaining a drug-free workplace;

(3) Any available drug counseling, rehabilitation, and employee assistance programs; and

(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will-

(1) Abide by the terms of the statement; and

(2) Notify the employer in writing of his or her conviction of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(e) Notifying the agency, in writing, within 10 calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W. (Room 3124, GSA Regional Office

Building No. 3), Washington, DC 20202-4571. Notice shall include the identification number(s) of each affected grant;

(f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted—

(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e), and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

15 North 23rd Street

Grand Forks, Grand Forks County, North Dakota 58202

Check ☐ if there are workplaces on file that are not identified here.

DRUG-FREE WORKPLACE (GRANTEES WHO ARE INDIVIDUALS)

As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 —

A. As a condition of the grant, I certify that I will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant; and

B. If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, I will report the conviction, in writing, within 10 calendar days of the conviction, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W. (Room 3124, GSA Regional Office Building No. 3), Washington, DC 20202-4571. Notice shall include the identification number(s) of each affected grant.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above certifications.

NAME OF APPLICANT		PR/AWARD NUMBER AND/OR PROJECT NAME
Energy & Environmental Research Center University of North Dakota		DE-FC21-93MC30098
PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE		
Dr. Kenneth J. Dawes, Director, Office of Research and Program Development		
SIGNATURE	DATE
12-1-95	

1. Type of Federal Action: ☒ a. contract ☐ b. grant ☐ c. cooperative agreement ☐ d. loan ☐ e. loan guarantee ☐ f. loan insurance	2. Status of Federal Action: ☒ a. bid/offer/application ☐ b. initial award ☐ c. post-award	3. Report Type: ☒ a. initial filing ☐ b. material change For Material Change Only: year _____ quarter _____ date of last report _____
4. Name and Address of Reporting Entity: ☒ Prime ☐ Subawardee Tier _____, if known: University of North Dakota Energy & Environmental Research Center Box 9018 Grand Forks ND 58202 Congressional District, if known: _____		5. If Reporting Entity in No. 4 is Subawardee, Enter Name and Address of Prime: Congressional District, if known: _____
6. Federal Department/Agency: United States Department of Energy		7. Federal Program Name/Description: Jointly Sponsored Research Program Continuation Application CFDA Number, if applicable: <u>81,089</u>
8. Federal Action Number, if known:		9. Award Amount, if known: \$ <u>2,500,000.00</u>
10. a. Name and Address of Lobbying Entity (if individual, last name, first name, MI): Greystone Group Sara Garland Associates 312 Mass Ave NE Washington DC 20002		b. Individuals Performing Services (including address if different from No. 10a) (last name, first name, MI): Garland, Sara
(attach Continuation Sheet(s) SF-LLL-A, if necessary)		
11. Amount of Payment (check all that apply): \$ <u>200.00/month</u> ☒ actual ☐ planned		13. Type of Payment (check all that apply): ☒ a. retainer ☐ b. one-time fee ☐ c. commission ☐ d. contingent fee ☐ e. deferred ☐ f. other; specify: _____
12. Form of Payment (check all that apply): ☒ a. cash ☐ b. in-kind; specify: nature _____ value _____		
14. Brief Description of Services Performed or to be Performed and Date(s) of Service, including officer(s), employee(s), or Member(s) contacted, for Payment Indicated in Item 11: see attached		
(attach Continuation Sheet(s) SF-LLL-A, if necessary)		
15. Continuation Sheet(s) SF-LLL-A attached: ☐ Yes ☒ No		
16. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.		Signature: <u> </u> Print Name: <u>Lyle Beiswenger</u> Title: <u>Vice President for Finance</u> Telephone No.: <u>(701) 777-4151</u> Date: <u>12-1-95</u>
Federal Use Only:		Authorized for Local Reproduction Standard Form - LLL

**DISCLOSURE OF LOBBYING ACTIVITIES
CONTINUATION SHEET**Approved by OMB
0340-0046Reporting Entity: University of North DakotaPage 2 of 2

University of North Dakota lobbying activity relating to the Department of Energy Joint Venture Agreement consisted of meetings with the North Dakota Congressional delegation and their staffs, meetings with House and Senate Appropriations Committee staff, and conversations with officials at the Department of Energy. Information was provided to these individuals describing activities resulting from prior year appropriations for this initiative.

Lobbying activity was initiated and continued throughout the consideration of the Fiscal Year 1996 Interior Appropriations legislation, commencing in February 1995, and will conclude with the enactment into law of this legislation.

Contacts included the following individuals:

Senator Byron Dorgan
Senator Kent Conrad
Congressman Earl Pomeroy
Doug Norell, aide to Sen. Dorgan
Allen Huffman, aide to Sen. Dorgan
Niles Godes, aide to Sen. Conrad
Craig May, aide to Sen. Conrad
Kent Hall, aide to Sen. Conrad
Bart Chilton, aide to Rep. Pomeroy
Mike Smart, aide to Rep. Pomeroy
Bruce Evans, Senate Appropriations Committee
Sue Masica, Senate Appropriations Committee
Loretta Beaumont, House Appropriations Committee
Barbara Wainman, aide to Rep. Ralph Regula

U.S. Department of Energy
Assurance of Compliance
Nondiscrimination in Federally Assisted Programs

OMB NO.
1910-0400

OMB Burden Disclosure Statement

Public reporting for this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Office of Information Resources Management Policy, Plans, and Oversight; Records Management Division, HR-422-GTN, Paperwork Reduction Project (1910-0400), U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, DC 20585, and to the Office of Management and Budget (OMB), Paperwork Reduction Project (1910-0400), Washington, D.C. 20503.

University of North Dakota (Hereinafter called the "Applicant") HEREBY AGREES to comply with Title VI of the Civil Rights Act of 1964 (Pub. L. 88-352), Section 16 of the Federal Energy Administration Act of 1974 (Pub. L. 93-275), Section 401 of the Energy Reorganization Act of 1974 (Pub. L. 93-438), Title IX of the Education Amendments of 1972 as amended (Pub. L. 92-318, Pub. L. 93-588 and Pub. L. 94-482), Section 504 of the Rehabilitation Act of 1973 (Pub. L. 93-112), the Age Discrimination Act of 1975 (Pub. L. 94-135), Title VIII of the Civil Rights Act of 1968 (Pub. L. 90-284), the Department of Energy Organization Act of 1977 (Pub. L. 95-91), and the Energy Conservation and Production Act of 1976 as amended (Pub. L. 94-385), and Title 10, Code of Federal Regulations, Part 1040. In accordance with the above laws and regulations issued pursuant thereto, the Applicant agrees to assure that no person in the United States shall on the ground of race, color, national origin, sex, age, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity in which the Applicant receives Federal assistance from the Department of Energy.

Applicability and Period of Obligation

In the case of any service, financial aid, covered employment, equipment, property, or structure provided, leased, or improved with Federal Assistance extended to the Applicant by the Department of Energy, this assurance obligates the Applicant for the period during which Federal Assistance is extended. In the case of any transfer of such service, financial aid, equipment, property, or structure, this assurance obligates the transferee for the period during which Federal assistance is extended. If any personal property is so provided, this assurance obligates the Applicant for the period during which it retains ownership or possession of the property. In all other cases this assurance obligates the Applicant for the period during which the Federal assistance is extended to the Applicant by the Department of Energy.

Employment Practices

Where a primary objective of the Federal assistance is to provide employment or where the Applicant's employment practices affect the delivery of services in programs or activities resulting from Federal assistance extended by the Department, the Applicant agrees not to discriminate on the ground of race, color, national origin, sex, age, or handicap in its employment practices. Such employment practices may include, but are not limited to, recruitment, recruit advertising, hiring, layoff or termination, promotion, demotion, transfer, rates of pay, training, and participation in upward mobility programs or other forms of compensation and use of facilities.

Subrecipient Assurance

The Applicant shall require any individual, organization, or other entity with whom it subcontracts, subgrants, or subleases for the purpose of providing any service, financial aid, equipment, property, or structure to comply with laws cited above. To this end, the subrecipient shall be required to sign a written assurance form, however, the obligation of both recipient and subrecipient to ensure compliance is not relieved by the collection or submission of written assurance forms.

Data Collection and Access to Records

The Applicant agrees to compile and maintain information pertaining to programs or activities developed as a result of the Applicant's receipt of Federal assistance from the Department of Energy. Such information shall include, but is not limited to the following: (1) the manner in which services are or will be provided and related data necessary for determining whether any persons are or will be denied such services on the basis of prohibited discrimination; (2) the population eligible to be served by race, color, national origin, sex, age, and handicap; (3) data regarding covered employment including use or planned use of bilingual public contact employees serving beneficiaries of the program where necessary to permit effective participation by beneficiary unable to speak or understand English; (4) the location of existing or proposed facilities connected with the program and related information adequate for determining whether the location has or will have the effect of unnecessarily denying access to any person on the basis of prohibited discrimination; (5) the present or proposed membership by race, color, national origin, sex, age, and handicap in any planning or advisory body which is an integral part of the program; and (6) assure compliance by recipients with laws cited in the first paragraph of this assurance.

The Applicant agrees to submit requested data to the Department of Energy regarding programs and activities developed by the Applicant from the use of Federal assistance funds extended by the Department of Energy. Facilities of the Applicant (including the physical plants, buildings, or other structures) and all records, books, accounts, and other sources of information pertinent to the Applicants compliance with the civil rights laws shall be made available for inspection during normal business hours on request of an officer or employee of the Department of Energy specifically authorized to make such inspections. Instructions in this regard will be provided by the Directors Office of Equal Opportunity, U.S. Department of Energy.

This assurance is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts (excluding procurement contracts), property discounts, or other Federal assistance extended after the date hereto, to the Applicants by the Department of Energy, including installment payments on account after such data of application for Federal Assistance which are approved before such date. The Applicant recognizes and agrees that such Federal assistance will be extended in reliance upon the representations and agreements made in this assurance and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, as well as the persons whose signatures appear below and who are authorized to sign this assurance on behalf of the Applicant.

Applicant Certification

The Applicant certifies that it has complied, or that, within 90 days of the date of the grant, it will comply with all applicable requirements of 10 C.F.R. § 1040.5 (a copy will be furnished to the Applicant upon written request to DOE).

Designated Responsible Employee

Dr. Kenneth J. Dawes, Director

Name and Title (Printed or Typed)

Signature

(701) 777-4278

Telephone Number

Date

Energy & Environmental Research Center

University of North Dakota

Applicant's Name

15 North 23rd Street

Grand Forks, North Dakota 58202

Address

(701) 777-5000

Telephone Number

PRE-AWARD PATENT INFORMATION SHEET

AGREEMENT NO.:

AMENDMENT NO.:

THE PARTICIPANT IS:

☒ A University or other institution of higher education or an organization of the type described in section 501 (c) (3) or the Internal revenue Code of 1954 (26 USC 501 (c)) and exempt from taxation under section 501 (a) of the Internal Revenue Code (26 USC 501 (a)); or

☐ A nonprofit scientific or educational organization qualified under a State nonprofit organization statute. Please identify the statute.

☐ A small business concern as defined at section 2 of Public Law 85-536 (15 USC 632) and implementing regulations of the administrator of the Small Business Administration.

☐ None of the above

Participants who have checked NONE OF THE ABOVE have the right to request, in advance of or within 30 days after execution of the cooperative agreement, in accordance with applicable statutes and DOE Procurement Regulations (9-9.109-6), a waiver of all or any part of the rights of the United States in Subject Inventions. If the Participant intends to request a Waiver to such invention rights pursuant to DOE PR 9-9.109-6, please indicate:

☐ We intend to request an advance waiver in accordance with DOE PR 9-9.109-6.

☐ We do not intend to request an advance waiver.

RIGHTS IN PROPOSAL DATA

It is DOE policy for a cooperative agreement award based on a proposal that, in consideration of the award, the Government shall obtain unlimited rights in the technical data contained in the proposal unless the participants marks those portions of the technical information which he asserts as "proprietary data" or specifies those portions of such technical data which are not directly related to or will not be utilized in the work to be funded under the cooperative agreement. Accordingly, please indicate:

☒ No restriction on Government rights in the proposal technical data; or

☐ The following identified technical data is proprietary or is not directly related to or will not be utilized in the work to be funded under the cooperative agreement:

IDENTIFICATION OF TECHNICAL DATA WHICH IS PROPRIETARY

The Rights in Technical Data clause proposed to be used for this cooperative agreement may not permit the utilization of proprietary data in the agreement work or, if the use of proprietary data is permitted, may not be adequate to meet programmatic requirements. Use of data which is proprietary may prevent you from meeting the data requirements of the agreement (including delivery of data). Your attention is particularly drawn to the use of LICENSED COMPUTER SOFTWARE.

Please indicate that you have reviewed the requirements in the technical scope of work and to the best of your knowledge:

☒ No proprietary data will be utilized.

☐ Proprietary data as follows will be utilized:

☒ No LICENSED COMPUTER SOFTWARE will be utilized.

☐ LICENSED COMPUTER SOFTWARE as follows will be utilized:

University of North Dakota

Organization Name

Signature

12-1-95

Date

Dr. Kenneth J. Dawes, Director
Office of Research and Program Development

Name and Title of Authorized Representative