Base Program on Energy Related Research

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EXECUTIVE SUMMARY

Introduction

The Base Research Program at Western Research Institute (WRI) is planned to develop technologies to a level that will attract industrial sponsors for continued development under the Jointly Sponsored Research (JSR) Program. In many instances, a potential JSR cosponsor has been identified but additional laboratory or bench-scale data are necessary to assess the utility of the technology prior to cosponsor investment. Both peer and management review are employed prior to proposing Base projects to the U.S. Department of Energy (DOE).

The goals of the Base Research Program are in support of those of the JSR Program, which are designed to:

- Increase the production of United States and western energy resources, particularly low-sulfur coal, natural gas, oil, and renewable energy resources
- Enhance the competitiveness of United States and western energy technologies in international markets and assist in technology transfer
- Reduce the nation's dependence on foreign energy supplies and strengthen both the United States and regional economies
- Minimize environmental impacts of energy production and utilization.

The goals of the JSR and Base Programs are accomplished by focusing research, development, demonstration, and commercialization in three major technology areas:

- **ENERGY PROGRAMS** emphasize the increased production and utilization of domestic energy resources and include enhanced oil recovery, coal bonification and upgrading, coalbed methane recovery, and renewable energy resources.
- **ENVIRONMENTAL PROGRAMS** minimize the impact of energy production and utilization by providing technology to clean underground oily wastes, mitigate acid mine drainage, and demonstrate uses for Clean Coal Technology (CCT) and pressurized fluidized bed combustion (PFBC) waste solids.
- **TECHNOLOGY ENHANCEMENT** activities encompass resource characterization studies, the development of improved environmental monitors and sensors, and improved techniques and models for predicting the dispersion of hazardous gas releases.

Interactions between the Base and the JSR Programs are dynamic and continuous, as commercialization of promising new technologies is the driving force for both. The Base Program explores innovative concepts that will attract industrial sponsors for continued development under the JSR Program. In many instances, a potential JSR cosponsor has been identified, but additional laboratory or bench-scale data are necessary to verify the process or product concept. Once done, the project moves to the JSR stage where the objective is to develop and demonstrate the technology sufficiently for sound and prudent commercialization decisions to be made.

Not infrequently the reverse occurs. A project will demonstrate considerable promise at the JSR stage but require a supplemental Base Program activity to complete the applied research required for process optimization and a thorough technical understanding of the phenomena being exploited. As a result, the two programs are tightly integrated and complementary components of the overall development process.

In a high-technology global economy, technology development is crucial to the preservation and growth of the American economy and standard of living. Much of this technology and growth will come from companies that were small or non-existent just a decade ago. Unlike the large multinational companies with captive research and development facilities, these companies must rely upon creative and innovative contractors such as the Western Research Institute to assist with their process and product development activities. It is a tribute to the wisdom and the foresight of the United States Department of Energy and the Morgantown Energy Technology Center that activities such as the Cooperative Agreement Programs exist to meet this crucial national need.

The Base Cooperative Agreement (DE-FC21-93MC30126) was initiated on February 2, 1993. Since that time, total funding of \$6,460,884 has been authorized both through the original agreement and subsequent modifications. An additional \$526,000 should be authorized soon.

A summary of funding and the number of projects is shown in Table 1.

Table 1. Summary of Base Funding for FY 1993-1996

Fiscal Year	Funding	Number of Projects	New Starts
1996	250,000 (776,000)*	21	2
1995	1,077,976	19	4
1994	3,132,908	15	5
1993	1,950,000	10	10
TOTAL 6,460,884 (6,986,884)*			

*Funding to be authorized soon. Subsequent financial reports assume this funding level.

Significant Accomplishments Under the Base Research Program

Subtask 1.2 Miscible-Immiscible Gas Injection Processes

WRI is currently developing a predictive model for miscible-immiscible gas injection processes with emphasis on use of CO₂. Physical simulations are in progress using the GEM95.00 simulator developed by the Computer Modeling Group. Personnel at METC have made this simulator available for use by WRI researchers. Initial efforts with the simulator are encouraging. The GEM simulator has been leased by WRI, and the project leader was trained in its use in February.

Subtask 1.4 Tank Bottom Waste Processing Using the TaBoRR® Process

WRI developed the Tank Bottom Recovery and Remediation (TaBoRR®) process to address the problem of tank bottom wastes. The method results in separation of water, a light hydrocarbon stream, a heavy hydrocarbon stream, and an inert, non-leaching, liquid-free solid. For this invention, WRI was granted U.S. Patent No. 5,259,945. Filings are proceeding under the Patent Cooperation Treaty in several other countries. A process development unit (PDU) has been constructed to provide data for economic evaluation, numerical modeling of the process, and environmental analyses. The PDU is capable of processing 1 to 2 barrels per day of tank bottom wastes. This PDU is being used to support field mitigation work.

Subtask 2.1 Development and Optimization of a Process for the Production of a Premium Solid Fuel from Western U.S. Coals

WRI has developed technology that results in a dried coal with a decreased tendency to spontaneously combust. This technology, called COMPCOAL™ (Compliance Coal), is the subject of a patent, U.S. Patent No. 5,322,530. Recent evaluations under the Base Program have reaffirmed that the low-temperature ignition characteristics of the COMPCOAL products are similar to those of the raw coals. Work is continuing to obtain cosponsorship for a pilot-scale demonstration of the technology.

Subtasks 3.1-3.4 Other Environmental Technologies

WRI is working on four environmental technologies, each of which appears to have significant potential for application. WRI is currently assessing the patent position of these technologies, so this is a sensitive time for detailed discussion of results. Invention disclosures have been written on all four.

One subtask (3.1) evaluates fundamental properties of solid wastes (conventional and clean coal technology ashes) from coal combustion to determine the economic and technical viability of their productive use in cement or other materials. A related subtask (3.3) determines the economic and technical feasibility of using power plant ashes to produce synthetic aggregate in the Syn-Ag™ process. Work on the Haz-Flote™ process (under subtask 3.2) is designed for ex-situ decontamination of materials with hydrocarbon content. It will be a valuable complement to CROW™. WRI's Maxi-Acid™ process (under subtask 3.4) addresses in-situ treatment of precursors to acid mine drainage to quickly mitigate and treat acid formation. A JSR application is planned in Montana with the Montana Bureau of Mines and Geology.

Subtask 4.1 Heavy Oil/Plastics Co-Processing

WRI has developed a method to co-process plastic mixtures with a variety of heavy oils. This method not only reduces the volume of landfill material but also produces low yields of char plus gas, and high yields of liquids that show potential for use as fuels. Based on this invention, WRI has applied for patents in the United States, Canada, and Mexico, and has also filed under the Patent Cooperation Treaty (PCT) Process. Further work is underway to define scale-up parameters at bench scale for economic evaluation and improvement of process efficiency.

The authorized subtasks and the corresponding funding is provided in Table 2. A summary of budgets, expenses prior to the quarter, expenses by month for this quarter, and remaining balances is provided in Table 3.

Overview of Accomplishments During February Through April 1996

Task 1.0

Training was completed on the GEM 96.00 numerical simulator from the Computer Modeling Group in Calgary. A preliminary design for the physical simulator and an outline of the testing procedure has been developed for evaluation of Miscible/Immiscible Gas Injection Processes for oil production (Subtask 1.2).

Related to the coalbed methane research (Subtask 1.3), the evaluation version of the SIMED (Australian Petroleum Cooperative Research Centre) simulator was shown to neglect two important aspects: the ability to invoke point-centered grids for both radial and Cartesian configuration, and the ability to specify diffusion-controlled absorption of injected gases.

Several more samples of tank bottoms were obtained and analyzed as potential feedstocks for the TaBoRR® process (Subtask 1.4). All lab data was compiled prior to design of a pyrolyzer for the field demonstration unit.

Table 2. Subtasks Approved for Funding Through FY 96

Subtask	Project	Years 1-3 Funding	FY 96 Funding	Total Funding
1.1	CROW™ Process Modeling	471,163	0	471,163
1.2	Miscible/Immiscible Gas Injection	254,500	199,200	453,700
1.3	Coalbed Methane Simulator	316,841	0	316,841
1.4	Development of TaBoRR® Process	588,275	159,200	747,475
2.1	Premium Solid Fuel from Western US Coals	127,835	0	127,835
2.2	On-line Alkali Monitoring Probe	107,250	0	107,250
2.3	Recycle Oil Process for Eastern Oil Shale	119,350	0	119,350
2.4	Support for Compcoal™	146,250	0	146,250
2.5	Eastern Oil Shale as an Asphalt Additive	66,145	0	66,145
2.6	Support for Koppelman Series C	108,405	0	108,405
2.7	Coal-Fired Gas Turbine	0	194,200	194,200
3.1	Solid Waste Management	691,998	0	691,998
3.2	Haz-Flote™ Remediation of Contaminated Soils	442,074	0	442,074
3.3	Syn-Ag™ Use of Coal Combustion Wastes	183,521	0	183,521
3.4	Maxi-Acid™ Treatment of Acid Mine Drainage	221,057	0	221,057
3.5	Spill Test Facility Data Base	186,539	0	186,539
3.6	Attenuation of Ammonium in Aquifer	16,400	0	16,400
3.7	Dense Gas Dispersion	0	174,200	174,200
4.1	Heavy Oil/Plastics Co-Processing	278,282	0	278,282
4.2	Fossil Fuel Conversion With Hydrogen Plasmas	81,447	49,200	130,647
6.1	North Site Cleanup	1,534,884	0	1,534,884
TOTALS		6,210,884	776,000	6,986,884

TABLE 3**CONTRACT STATUS REPORT**

Contract No. DE-FC93MC30126
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Reporting Period: Through 1st Quarter, 4th Year

Subtask	Budget Prior years	Budget Yr 4	Total Budget	Expenses to 1/31/96	Expenses			Total Expenses	Balance
					February	March	April		
4th Year Subtasks									
1.2	254,500	199,200	453,700	93,907	24,588	28,743	17,716	164,954	288,746
1.4	588,275	159,200	747,475	486,719	2,064	16,524	12,315	517,622	229,853
2.7	0	194,200	194,200	0	0	0	0	0	194,200
3.7	0	174,200	174,200	0	0	0	2,839	2,839	171,361
4.2	81,447	49,200	130,647	78,231	304	1,475	411	80,421	50,226
Subtotals	924,222	776,000	1,700,222	658,857	26,956	46,742	33,281	765,836	934,386
Other Active Subtasks									
1.3	316,841	0	316,841	157,522	1,330	73	14	158,939	157,902
2.1	127,835	0	127,835	114,534	4,792	2,611	1,207	123,144	4,691
2.5	66,145	0	66,145	58,096	582	4,892	15	63,585	2,560
2.6	108,405	0	108,405	23,893	56,999	27,509	0	108,401	4
3.1	691,998	0	691,998	636,017	12,180	22,417	14,510	685,124	6,874
3.2	442,074	0	442,074	341,301	11,239	15,255	11,163	378,958	63,116
3.3	183,521	0	183,521	63,992	1,768	3,323	5,946	75,029	108,492
3.4	231,057	0	231,057	85,116	123	5,736	2,286	93,261	137,796
3.5	186,539	0	186,539	149,101	5,482	17,238	12,412	184,233	2,306
3.6	16,400	0	16,400	0	0	1,259	0	1,259	15,141
4.1	278,282	0	278,282	245,929	20,648	10,885	516	277,978	304
6.1	1,534,884	0	1,534,884	1,142,253	27,881	35,264	32,753	1,238,151	296,733
Subtotals	4,183,981	0	4,183,981	3,017,754	143,024	146,462	80,806	3,388,046	795,935
Other ⁽¹⁾	1,102,681	0	1,102,681	1,103,416	0	0	(401)	1,103,015	(334)
Totals	6,210,884	776,000	6,986,884	4,780,027	169,979	193,204	113,687	5,256,897	1,729,987

⁽¹⁾ Completed subtasks (1.1, 2.2, 2.3, 2.4, 5.1)

Task 2.0

The Alex Smith method for measuring oxygen adsorbed into processed coal by pressure measurements in a sealed flask was set up and used to develop a data base to supplement adiabatic calorimetry and equilibrium moisture determinations for measurement of self-heating in coal (Subtask 2.1—Production of a Premium Solid Fuel from Western U.S. Coals).

A final topical report on Subtask 2.6 (Support for the Commercialization of the Koppelman Series C Process) was drafted.

Task 3.0

A final topical report on Subtask 3.1 (Solid Waste Management) was initiated. This work is sensitive at this point until a decision is made about possible patent applications.

Mercury removal from contaminated soils was >95% efficient using the Haz-Flote™ (Subtask 3.2) process. This work is also being considered for patent protection.

Additional coal combustion ashes from the Tri-State Craig Plant and the Basin Electric Laramie River Station were evaluated for synthetic aggregate production (Subtask 3.3—Syn-Ag™: Coal Combustion Ash Management). Invention disclosures have been written, and patent applications are under consideration.

Spoil materials with high potential acidity were tested for their reactivity with reagents used in the Maxi-Acid™ process (Subtask 3.4) for in-situ control of acid mine drainage. This work is also being reviewed for patenting.

A final topical report on the Subtask 3.5 (Spill Test Data Base) is being prepared.

Task 4.0

The draft final topical report on Subtask 4.1 (Heavy Oil/Plastics Co-Processing) is being submitted for DOE approval at this time. Accomplishments were reported in prior quarterly reports.

A draft topical report on work funded in prior years for Subtask 4.2 (Fossil Fuel and Hydrocarbon Conversion Using Hydrogen-Rich Plasmas) was also completed.

Federal Assistance Management Summary Reports (Substitute DOE Form F 4600.5) are included for active subtasks on pages 26–40.

TASK 1.0 OIL AND GAS

BACKGROUND

Conventional petroleum resources in the United States continue to diminish, resulting in our continued dependence on foreign sources. The development and application of methods to increase and support production from domestic resources is important to the nation's independence and well-being. A related area of environmental concern is the cleanup of oil waste materials. Numerous sites exist throughout the country where oily materials have been deposited and pose the threat of contamination to the environment. Effective methods for cleanup of these materials need to be developed for remediation of such sites.

LONG-TERM OBJECTIVES

The long-term objective of this task is to develop efficient processes that can be economically applied by independent, as well as major, oil producers. The present market area for WRI-developed technologies appears to be the independent operators.

Areas currently being targeted are (1) the development of a predictive model for miscible/immiscible gas injection and verification of the model through physical simulations (Subtask 1.2), (2) the development of a portable data acquisition system and coalbed methane generator (Subtask 1.3), and (3) technology support, development of a lab process unit, numerical modeling, and economic analysis for the TaBoRR® process (Subtask 1.4).

Funding was approved for continuations of Subtasks 1.2 and 1.4 in the fourth year of Cooperative Agreement DE-FC21-93MC30126.

SUBTASK 1.2

MISCIBLE\IMMISCIBLE GAS INJECTION PROCESSES

Lyle A. Johnson
Francis M. Carlson

February – April 1996

OBJECTIVE

The objective of this subtask is to demonstrate a predictive model for the miscible\immiscible gas injection process with emphasis on the use of CO₂ as the injected gas. Data for the verification of the model will be obtained through the conduct of physical simulations designed with the use of the numerical simulator.

QUARTER OBJECTIVES

The objectives for this quarter were:

- to develop the experimental plans for the physical simulations and to further familiarize project personnel with the selected miscible\immiscible gas injection simulator.
- to attend a training session on the Computer Modeling Group (CMG) simulator at the CMG facilities

ACCOMPLISHMENTS

The GEM 96.00 numerical simulator offered by CMG was selected for use in the subtask, and agreements have been finalized with CMG to secure the executables of the simulator for use at WRI. This choice was based on availability and the simulator's capability to take into consideration the solubility of CO₂ in the aqueous phase and to allow for relative permeability hysteresis. A copy of this simulator resides at METC, and METC personnel are familiar with it. The agreement with CMG also includes training for WRI personnel on the simulator at CMG facilities and access to CMG personnel for troubleshooting and modification of the computer code. The training has been conducted.

A literature survey has been conducted to assist in the design of the physical simulations. Emphasis of the survey was on non-intrusive capillary pressure and three-phase saturation measurements during conduct of the physical simulations, methods to seal the core samples, and type of core to use. The literature survey identified methods for the non-intrusive measurement of capillary pressure and three-phase saturations, but these methods appear to be cost prohibitive.

A preliminary design for the physical simulator has been completed and an outline for the testing procedure developed. The equipment specifications are being developed. Core material for testing has been identified from information available in the literature, and the availability of the material is being investigated. Presently, the method to seal the cores in the reactor tubes appears to be the use of a bismuth alloy because of its low melting point and its expansion characteristic when cooled.

OBJECTIVES FOR NEXT QUARTER

- Finalize the design for the physical simulation testing program for verification of the model.
- Begin construction of the physical simulation testing system, including procurement of the selected core material.
- Continue to become familiar with the CMG miscible/immiscible gas injection simulator.

PROCEDURES

This subtask will be conducted in four parts.

- The selection of a numerical simulator followed by the acquisition or arrangements for use of the simulator.
- The conduct of physical simulations to provide detailed data for the validation of the simulator. The numerical simulator will be used to develop the experimental plan and operational procedures for the physical simulations.
- The validation of the numerical simulator using history matching of the physical simulations. The model will be modified, if possible, to provide the necessary history matches.
- The documentation of the numerical and physical simulations in a final topical report.

In a parallel effort, work is being conducted to evaluate the ability of the UTCOMP simulator to perform the required simulations for this project. A copy of this simulator is available for WRI use. The use of both the GEM and UTCOMP simulators is being considered for comparative purposes.

CONCLUSIONS

The initial simulations were conducted by WRI personnel at the METC facilities, since the simulator is available there. Initial use of the simulator was positive. The GEM 96.00 numerical simulator appears to be capable of performing the necessary simulations based on preliminary runs. However, the simulator has some problems handling a oil-wet system such as the one WRI is looking at. GEM 96.00 does not allow for the appropriate treatment of rock properties for oil-wet systems but does allow for hysteresis in capillary pressure and gas-oil permeability for water-wet systems. Consequently, the physical simulations will involve reversing the phases so that the wetting phase (water) will be displaced by the nonwetting phase (oil). In this manner, GEM 96.00 can be used to make predictions of the physical simulations which are consistent with its capabilities. CMG personnel have indicated that GEM 96.00 may be updated during the course of our work to permit more flexibility with the rock properties.

SUBTASK 1.3

DEVELOPMENT OF A PORTABLE DATA ACQUISITION SYSTEM AND COALBED METHANE SIMULATOR

Charles G. Mones

February – April 1996

OBJECTIVES

WRI is currently involved in a Jointly Sponsored Research (JSR) program with Amoco Production Company regarding the enhanced recovery of methane from coalbeds by the injection of CO₂. Enhanced coalbed methane processes use an injected gas to stimulate the production of methane from coalbeds and potentially reduce the production of water. For purposes of this JSR project, WRI has modeled reservoir performance with Amoco's Generalized Compositional Simulator (GCOMP). Involvement with Amoco's leading edge, enhanced recovery technologies and GCOMP simulator has given WRI direct experience in the area of coalbed methane recovery. In addition, WRI has gained experience with several problems associated with the recovery of methane from coalbeds.

WRI intends to market its expertise in coalbed methane recovery to commercial developers. Our marketability as reservoir engineers depends on WRI having access to a coalbed methane simulator. Based on our experience with Amoco, a simulator is needed to perform proof-of-concept studies, evaluate reservoir design options, and predict recovery (thus determine economics). Virtually no enhanced coalbed methane recovery simulators are available for purchase.

The objectives of this subtask are:

- Develop a self-contained, portable data acquisition system
- Develop an enhanced coalbed methane recovery simulator
- Laboratory work to improve model physics and gain a competitive advantage.

QUARTER OBJECTIVE

The objective for this quarter was to evaluate the SIMED coalbed methane simulator with a variety of coalbed methane recovery problems (both primary recovery and enhanced recovery).

ACCOMPLISHMENTS

Little work has been performed on this subtask during this quarter as a result of our inability to construct a data set suitable for evaluating the performance of SIMED. SIMED is a commercially available coalbed methane simulator that can describe enhanced recovery processes. The Australian Petroleum Cooperative Research Centre (APCRC) supplied WRI with an evaluation version of SIMED with reduced capabilities to allow us to investigate the possibility of purchasing this model rather than undertaking in-house model development.

In analyzing results from Amoco's pilot test, we have identified two capabilities that are needed to simulate enhanced coalbed methane recovery pilots, neither of which is available with SIMED. These are:

- The ability to invoke point-centered grids for both radial and Cartesian model configurations. Pilot tests in coal beds may consist of short-term, single-well injection and production sequences. Under these transient conditions, point-centered grids more accurately portray pressure responses at a well. In comparison, cell-centered grids (employed by SIMED) average pressures for the grid block containing the well.
- The ability to specify diffusion controlled absorption of injected gas. It may be necessary to incorporate the effects of diffusion to accurately simulate the performance of short-term pilot studies that evaluate enhanced recovery methods. In transient, single-well tests, diffusion effects may dominate the pressure and gas composition response.

OBJECTIVES FOR NEXT QUARTER

The objectives for the next quarter are:

- Determine if an alternative GCOMP evaluation study is available for comparison with SIMED that requires three (or fewer) coal regions.
- Perform simulations with SIMED and compare results with those from GCOMP.
- If no GCOMP simulation is available, search the literature to find an alternative simulation problem. This alternative is less attractive since it does not allow a precise evaluation of model capabilities.

SUBTASK 1.4

TANK BOTTOM WASTE PROCESSING USING THE TABORR™ PROCESS

Robert M. Satchwell

February – April 1996

OBJECTIVE

The objective of this project is to develop information for use in the successful deployment of WRI's patented TaBoRR™ technology. To accomplish this objective, work is being conducted in areas of technology support, design and operation of a laboratory process unit, numerical modeling of the process, and economic analysis.

QUARTER OBJECTIVES

The objectives for the quarter were to:

- Analyze other sources of tank bottom wastes
- Complete numerical modeling of the process
- Complete a topical report

ACCOMPLISHMENTS

- Samples of other tank bottom wastes were obtained.
- Samples were analyzed to determine their chemical and physical properties.
- The 300 B/D field demonstration unit was moved to WRI's facilities.
- Laboratory data was compiled to aid in the design of a pyrolyzing unit for the field demonstration unit.

OBJECTIVES FOR NEXT QUARTER

Neither the numerical modeling nor the topical report was finished during the quarter because all computer data was lost. The lost data includes results from both the laboratory and field tests. These objectives will be completed after data has been reconstructed and assimilated. In addition to completing these, the following activities are planned for next quarter:

- Sample sources of tank bottom wastes
- Characterize sampled tank bottom wastes
- Perform pilot tests using sampled tank bottom wastes
- Complete design of the pyrolyzing reactor for the field demonstration unit

TASK 2.0 ADVANCED SYSTEMS APPLICATIONS

BACKGROUND

Western U.S. coals and oil shale are quite different from their eastern counterparts. Eastern coals are typically higher in rank, heating value, and sulfur content than western coals. Conversely, western coals contain more moisture, higher volatile matter, and higher alkali and alkaline earth elements as ash. Therefore, combustion and conversion processes developed for eastern coals are often neither compatible with nor appropriate for the western coals.

Coal production is one of the most significant sources of revenue in the West. Over the last decade, the consumption of coal by electric utilities has grown at a faster rate than the consumption of either petroleum or natural gas. Energy development processes using coal are of interest to the state of Wyoming and the Rocky Mountain region.

Previous coal research at WRI has concentrated on the development and testing of coal drying and mild gasification technologies, as well as the tailoring and adaptation of advanced coal utilization concepts for low-rank western coals. These coals have several advantages over eastern coals. For example, because of their low sulfur content, they can be utilized in conventional PC boilers with relatively little emissions control equipment. Similarly, because of their low sulfur content, their use in advanced combustion systems requires less capital investment.

Current work at WRI is concentrating on design, assembly, and testing of a bench-scale fuel preparation and delivery system for pressurized application using coal fines. The results from this study will be used to design a fuel preparation and delivery system to be interfaced with WRI's solid fuel-fired gas turbine pilot unit.

LONG-TERM OBJECTIVES

The long-term objectives of this activity are to optimize and adapt the emerging coal-based technologies to Powder River Basin coals by exploiting some of the coals' unique properties, while removing technical barriers.

Current work involves (1) production of a premium solid fuel from western U.S. coals (Subtask 2.1) and (2) support for commercialization of the Koppelman Series C process (Subtask 2.6). A final topical report for Subtask 2.4, (Process Support and Development for Compcoal™), is in preparation. A new subtask, Subtask 2.7 (Development and Testing of a Coal-Fired Gas Turbine) will be initiated next quarter under fourth-year funding.

SUBTASK 2.1

DEVELOPMENT AND OPTIMIZATION OF A PROCESS FOR THE PRODUCTION OF A PREMIUM SOLID FUEL FROM WESTERN U.S. COALS

Norm Merriam

February – April 1996

OBJECTIVE

This subtask is part of a WRI long-range program to develop a process for the production of an economically attractive and environmentally sound premium fuel from low-rank western coal. The objective for this task is to improve WRI capability for measuring spontaneous combustion characteristics of processed low-rank coal by adapting a method for recording the reduction of pressure in a sealed flask containing a sample of the dried coal.

QUARTER OBJECTIVES

The objective for this quarter was to measure the oxygen adsorbed into processed coal particles by correlating the pressure in a sealed flask (the Alex Smith method).

ACCOMPLISHMENTS

This quarter we completed the shakedown and measured the pressure reduction of several samples of raw coal and several samples of dried coal. We recorded the pressure-versus-time profiles in data files, which are reported as graphs. The new "sealed flask" method is now completely operational, and we have a small amount of background data to compare with future test results. We will use this test to supplement our capabilities with adiabatic calorimetry and equilibrium moisture as measure of self-heating in coal and products produced by processing coal. **This subtask was completed during the February to April quarter.**

SUBTASK 2.6

WRI SUPPORT FOR THE COMMERCIALIZATION OF THE KOPPELMAN SERIES C PROCESS

Norm Merriam

February – April 1996

OBJECTIVE

The objective for this subtask is to support the continued development and commercialization of the Koppelman Series C Process.

QUARTER OBJECTIVES

The objective for this quarter was to complete the final report for this activity, which is part of the WRI support for development of the Koppelman Series C Process.

ACCOMPLISHMENTS

This quarter we completed the final report for this subtask. A draft of the report has been prepared and has completed the WRI technical review process. The report will be submitted to DOE in the next few weeks. **This subtask is now complete.**

TASK 3.0 ENVIRONMENTAL TECHNOLOGIES

BACKGROUND

Environmental issues in the United States have focused on ensuring clean air and water. The implementation of the Clean Air Act (CAA) and its amendments has indirectly resulted in an additional emphasis on solid waste management. The volume of solid waste is increasing from the fossil fuel production and consumption sectors, and the character of these wastes is also changing. The remediation of contaminated sites in the United States still remains a high priority. However, efforts to speed the cleanup of these sites are being hampered by the lack of effective high-volume treatment processes. Effective means of mitigating the environmental consequences related to energy development and utilization and the remediation of contaminated sites are needed today.

LONG-TERM OBJECTIVES

The Environmental Technologies task is designed to provide a range of environmental waste management services and research and development activities. The scope of the program includes developing waste management options for fossil fuel related industries and regulatory agencies. The long-term objectives of this task are to develop technologies that improve solid waste management practices, remediate hazardous waste and contaminated soils, and provide predictive models for environmental technologies.

Current areas of work include (1) solid waste management to evaluate conditioning and hydration reactions associated with clean coal technology ash disposal/utilization (Subtask 3.1), (2) remediation of contaminated soils using the Haz-Flote™ process (Subtask 3.3), (3) development and evaluation of the Syn-Ag™ process for coal combustion ash utilization (Subtask 3.3), (4) in-situ amelioration of acid mine drainage using the Maxi-Acid™ process (Subtask 3.4), (5) verification of the Spill Test Data Base (Subtask 3.5), (6) attenuation of ammonium contaminate in an aquifer (Subtask 3.6), and (7) evaluation of a series of dense gas dispersion tests (Subtask 3.7). There was no appreciable activity on Subtasks 3.6 and 3.7 during the quarter, thus no report is included for them. Subtask 3.7 is a new project initiated under fourth-year funding.

SUBTASK 3.1

CONDITIONING AND HYDRATION REACTIONS ASSOCIATED WITH CLEAN COAL TECHNOLOGY ASH DISPOSAL/UTILIZATION

Alan E. Bland
Terry H. Brown

February – April 1996

OBJECTIVES

Project objectives are to generate the required fundamental data and to develop technologies with which industry can assess and implement economical and technically viable ash management strategies and plans for CCT ashes.

QUARTER OBJECTIVES

The objectives for the quarter were:

- Complete the geotechnical and hydration chemistry testing of fluidized bed combustion (FBC) ashes
- Prepare a final topical report on the project for U.S. DOE METC.

ACCOMPLISHMENTS

WRI completed testing on the four circulating fluidized bed combustion (CFBC) and two pressurized fluidized bed combustion (PFBC) ashes used in the project. Geotechnical testing included moisture-density relationships (Proctors), unconfined compressive strength, and dimensional stability. Hydration reaction chemistry for the ashes has also been completed. A presentation of the results of the project was given to U.S. DOE METC in January, 1996. Testing led to patent disclosures and the preparation of patent applications. Testing of the use of alternative water sources for FBC ashes is complete. This testing evaluated strength and expansion differences, as well as any possible hydration chemical differences. Testing of the use of FBC ash in the formulation of controlled density

flowable fill has also been completed. An industrial cosponsor has been selected for demonstration of the material under the jointly sponsored research (JSR) program.

ACTIVITIES FOR NEXT QUARTER

- Prepare a final topical report for U.S. DOE METC and prepare patent applications.

PROCEDURES

Standard ASTM procedures for the geotechnical testing are to be used, including ASTM D-698 and 1557 for moisture-density relationship, ASTM C-109 (modified) for unconfined compressive strength, and ASTM C-157 for dimensional stability (expansion/shrinkage) testing. Chemical characterization used ASTM wet chemical methods, as well as standard ICAP, XRF, TGA, DSC, SEM and XRD techniques.

RESULTS

Activity 3.1.1 - Evaluation of the Chemical, Physical and Geotechnical Properties of Various CCT Ashes

Four FBC ashes and two PFBC ashes were evaluated as part of the project. Geotechnical testing included moisture-density relationships (Proctors), unconfined compressive strength, and dimensional stability. Hydration reaction chemistry for the ashes has been completed. The geotechnical properties, such as strength and expansion, can be correlated with hydration reaction products in the ash.

Activity 3.1.2 - General Nature of Hydration Reactions

The reaction products from CCT ashes were examined, and they appear to be sensitive to a number of geochemical conditions. Evaluation of methods for the identification and/or quantification of the appropriate hydration phases was also conducted. Ettringite synthesized in the laboratory has been analyzed using a number of techniques, of which advanced high-resolution TGA appears the most promising for quantification purposes.

Activity 3.1.3 - Development of Process for Stable Ash Disposal or Use

Several methods for the stabilization of CCT ashes have been developed, and appropriate invention disclosures written. **The nature of these processes and their disclosures are therefore confidential and restricted to U.S. DOE and WRI only. No proprietary information is included in this report.** Copies of the disclosures have been filed with the U.S. DOE Patent Office. Activities are also under way to write and file the appropriate patent applications. A presentation to U.S. DOE (METC) was given in January, 1996 to selected METC staff.

Activity 3.1.4 - Effect of Conditioning Media on Properties of Ashes

The use of alternative water sources for conditioning CFBC ashes could provide relief for often scarce fresh water supplies. Testing was conducted on two ashes using two different water sources.

Activity 3.1.5 - Production of CLSFFM from CCT Ash

Tests were completed using conventional and FBC ash-based controlled density flowable fill material developed at WRI. The generator of the FBC ash has asked WRI for assistance in the demonstration and marketing of the flowable fill under the JSR program.

SUBTASK 3.2

REMEDIATION OF CONTAMINATED SOILS (Haz-Flote™)

Terry H. Brown

February – April 1996

OBJECTIVES

The primary objective of this subtask is to develop physical and chemical treatments to remove inorganic and organic compounds from contaminated materials. The project is divided into four areas of work:

- Acquisition of equipment and materials for the construction of the soil washing systems to be used in the remediation tests
- Preliminary evaluation of washing and remediation techniques for materials contaminated with metals and hydrocarbons
- Determination of physical and chemical treatment options for remediating mercury-contaminated soils associated with oil and gas pipeline locations
- Technical project management and reporting.

QUARTER OBJECTIVES

The objectives for this quarter were:

- Complete the testing of the mercury-contaminated materials using combinations of reagents and reagent concentrations, reactor time, and temperature
- Initiate detailed testing of the system, fine-tuning the chemistry and physics of removing mercury from the extraction solution

ACCOMPLISHMENTS

The desorption testing has been completed using various combinations of reagents for removal of mercury from the contaminated materials. The most efficient combination of reagents resulted in >95% removal of mercury from the contaminated soil. This research shows that we can successfully remove mercury from a soil where a significant portion of the mercury is associated with the organic and possibly the clay fraction.

Tests conducted have resulted in approximately 99% removal of the mercury from the contaminated solution. This work indicates that the process developed is very efficient for the specific solution tested.

OBJECTIVES FOR NEXT QUARTER

- Complete the desorption portion of the studies
- Initiate detailed testing of the system, fine-tuning the chemistry and physics of removing mercury from the extraction solution.

SUBTASK 3.3

THE SYN-AG™ PROCESS: COAL COMBUSTION ASH MANAGEMENT OPTION

Alan E. Bland

February – April 1996

OBJECTIVES

Project objectives are to develop and demonstrate the technical feasibility and economic viability of the Syn-Ag process for aggregate production using power plant ashes. The specific objectives are:

- develop and document the Syn-Ag process
- verify the properties of the aggregate produced from the Syn-Ag process
- determine the process costs, including capital and operating costs, for the Syn-Ag process.

QUARTER OBJECTIVES

The objective for the quarter was to continue testing of normal weight and lightweight aggregate production using the Syn-Ag process.

ACCOMPLISHMENTS

Disclosures have been written and patent applications are being prepared. Copies of the disclosures have been supplied to the U.S. DOE Patent Office. **As a result, all information about the Syn-Ag process remains confidential to WRI, and therefore not available to the public and protected therein. No proprietary information is included in this report.**

PROCEDURES

Standard ASTM procedures for the geotechnical testing were used, including ASTM D-698 and 1557 for moisture-density relationship, ASTM C-109 (modified) for unconfined compressive strength, and

ASTM C-157 for dimensional stability (expansion/shrinkage) testing. Los Angeles (LA) abrasion resistance procedures follow ASTM C-131. Soundness testing followed ASTM C-88. Chemical characterization used ASTM wet chemical methods, as well as standard ICAP, XRF and XRD techniques.

ACTIVITIES FOR NEXT QUARTER

- Continue testing the production of lightweight Syn-Ag product.

RESULTS

Work was conducted on the following activities during the reporting period.

- **Activity 3.3.1 - Development Tests for Range of Coal Combustion Ashes**
- **Activity 3.3.2 - Evaluation of Process Curing Conditions**
- **Activity 3.3.3 - Verification of the Syn-Ag Process**
- **Activity 3.3.4 - Economic Assessment of the Syn-Ag Process**

Because the Syn-Ag process is proprietary, the results are not publicly available.

SUBTASK 3.4

THE MAXI-ACID™ PROCESS: IN-SITU AMELIORATION OF ACID MINE DRAINAGE

Terry H. Brown

February – April 1996

OBJECTIVE

The objective of this subtask is to develop a method for the in-situ amelioration of acid mine drainage problems. The subtask includes the following work:

- Laboratory simulation and method development
- Design and modeling of the processes including a containment system
- Application of the technology in a field trial.

QUARTER OBJECTIVES

The objectives for the quarter were:

- Continue evaluations of the influence of environmental conditions on acid and alkalinity production
- Design and construct the leaching pad

ACCOMPLISHMENTS

Spoil materials that contain high levels of potential acidity were subjected to chemical treatment in a circulating flow-through system that would simulate flow in an underground mine. The pyritic material continued to form acid throughout the testing period.

OBJECTIVES FOR NEXT QUARTER

- Initiate studies to determine if the potential acidity of the study materials can be controlled to prevent acid formation
- Design and construct the leaching pad

SUBTASK 3.5

SPILL TEST FACILITY DATA BASE

David Sheesley

February – April 1996

OBJECTIVE

The objective of this subtask is to develop an experimentally verified technical data base that will aid in the prevention, mitigation, and cleanup of environmental effects of accidental release of fuels and other chemicals.

QUARTER OBJECTIVE

- To complete a final report on the project

ACCOMPLISHMENTS

- The topical (final) report is currently in preparation.

OBJECTIVE FOR NEXT QUARTER

- To complete the final report on the project

TASK 4.0 APPLIED ENERGY SCIENCE

BACKGROUND

In general, the reason alternative fossil fuels such as coal and oil shale have not found their way into the marketplace as sources for the production of transportation fuels is the high cost of the recovery and conversion of these resources to useful products. In addition, the refining of crude oils to transportation fuels is becoming more costly because the amounts of heavy crude oils in the feedstock that must be refined is gradually increasing. Work on a different type of resource has recently been conducted that demonstrates that a light distillate can be produced that contains very little heteroatomic species. In addition, it is estimated that the cost of recovering this resource is not as great as producing a syncrude from oil or oil shale. The feedstocks for this process are waste motor oil and waste plastics that are normally discarded into landfills.

Preliminary results have also been obtained using hydrogen-rich plasmas to convert solid or high boiling fossil fuels to liquid products with low heteroatomic content.

Resources that can potentially be investigated under these subtasks include not only the more conventional resources, such as heavy crude oils, coal and coal-derived liquids, but also waste plastics and other streams that may potentially be converted into useful products. The successful conversion of the latter resources to useful products also has the potential of making a significant impact on our demand for foreign oil. In addition, the utilization of waste streams also helps resolve an impending problem with the status of landfills in the United States. Legislation is being enacted in many states that will severely limit the types of wastes that can be disposed of in a landfill.

LONG-TERM OBJECTIVE

The long-term objective of this task is to conduct basic science research to better understand and evaluate various applied energy technologies as they pertain to different feedstocks. This can be accomplished either through a better understanding of the nature and impact of the composition of different fossil fuels during the application of current processes or through the development of new processes.

During the last quarter, a final topical report was drafted for Subtask 4.1 (Heavy Oil/Plastics Co-Processing); therefore no quarterly report is included for this subtask. A topical report was also drafted for Subtask 4.2 (Fossil Fuel and Hydrocarbon Conversion Using Hydrogen-Rich Plasmas) for work funded in prior years. The project was scheduled to restart but was delayed by lack of authorization for FY 96 funding; therefore, no quarterly report is included for this subtask.

TASK 6.0 REMEDIATION

Task 6.0 has Subtask 6.1 as the only activity. This subtask was included in Cooperative Agreement DE-FC21-93MC30126 for convenience. This subtask was not anticipated in the original work plan for the Cooperative Agreement.

SUBTASK 6.1

NORTH SITE REMEDIATION

Norm Merriam

February – April 1996

OBJECTIVES

The overall objectives of this subtask are to clean up the WRI north site in a cost-effective and environmentally sound manner. The objectives for the individual phases are:

Phase I– Definition of waste streams

Phase II–Disposal of hazardous wastes

Phase III–Disposal of nonhazardous wastes

Phase IV–Sampling of soil and removal of buried wastes

Phase V–Decontamination and removal of equipment

Phase Va–Groundwater monitoring

Phase VI–Preparation of a materials inventory data base

QUARTER OBJECTIVES

Objectives for this quarter were to:

- Collect another set of groundwater samples to analyze for three constituents that are not yet proven acceptable for domestic use.

- Obtain review comments on the Phase II final topical report and make revisions as necessary.

ACCOMPLISHMENTS

- Phase I is complete.
- Phase II is about 99% complete. A revised draft of the final topical report was submitted to DOE in January. It was accepted during this quarter.
- Phase III is about 98% complete. A draft of the final report is nearly ready to be submitted to DOE.
- Phase IV is complete.
- Phase V is about 90% complete.
- Phase Va—Groundwater monitoring is about 95% complete. Analyses of another set of water samples indicated that one of three questionable constituents resulted from a detection limit problem, and the other two were artifacts. A final topical report on groundwater analyses is in preparation.
- Phase VI—Materials inventory database is about 20% complete.
- Monthly reports were submitted.
- Topical reports have been prepared as phases are completed.

OBJECTIVES FOR NEXT QUARTER

- Continue preparation of the Phase II final topical report
- Proceed with arrangements to transfer radioactive materials to an organization that will recycle the materials

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Johnson, L.
 Project Title: Subtask 1.2 - Miscible-Immiscible Gas Injection Processes
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Year - 254,500)	264,500	334,500	404,500	453,700
Expenditures (Prior Year - 93,907)	71,047	-	-	-
Remaining Budget	288,746	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Doname 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Mones, C.
 Project Title: Subtask 1.3 - Development of a Portable Data Acquisition System and Coalbed Methane Simulator
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address
Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	316,841	316,841	316,841	316,841
Expenditures (Prior Years - 157,522)	1,417	-	-	-
Remaining Budget	157,902	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-1.3 Coalbed Methane Simulator					
96-1.3A Topical Report					
96-1.3B, C, D Quarterly Reports					

Feb 1 May 1 Aug 1 Nov 1 1996 Feb 1 1997

Signature of Recipient and Date

Jim Doneme

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Satchwell, R.
 Project Title: Subtask 1.4 - Tank Bottom Remediation
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years - 588,275)	593,275	668,275	713,275	747,475
Expenditures (Prior Years - 486,719)	30,903	-	-	-
Remaining Budget	229,853	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Doname

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Merriam, N.
 Project Title: Subtask 2.1 - Development and Optimization of a Process for the
 Production of Premium Solid Fuel from Western U.S. Coals
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	127,835	127,835	127,835	127,835
Expenditures (Prior Years - 114,534)	8,610	-	-	-
Remaining Budget	4,691	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-2.1 Production of Premium Solid Fuel from Western Coals					
96-2.1A Final Topical Report					
96-2.1B Quarterly Report					

Feb 1 May 1 Aug 1 Nov 1 1996 Feb 1 1997

Signature of Recipient and Date

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5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Thomas, K.
 Project Title: Subtask 2.5 - Eastern Shale Oil Residue as an Asphalt Additive
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	66,145	66,145	66,145	66,145
Expenditures (Prior Years - 58,096)	5,491	-	-	-
Remaining Budget	2,560	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-2.5 Eastern Shale Oil as an Asphalt Additive					
95-2.5A Final Topical Report					

Feb 1 May 1 Aug 1 Nov 1 1996 Feb 1 1997

Signature of Recipient and Date

Jim Dorence

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Merriam, N.
 Project Title: Subtask 2.6 - Support for Development of the Koppelman Series C Process to Produce High BTU Fuel from Low Rank Coals
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	108,405	108,405	108,405	108,405
Expenditures (Prior Years - 23,893)	84,508	-	-	-
Remaining Budget	4	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-2.6 Support for Koppelman Series C Process					
96-2.6A Quarterly Report					

Feb 1 May 1 Aug 1 Nov 1 1996 Feb 1 1997

Signature of Recipient and Date

Sm Doneme 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Bland, A.
 Project Title: Subtask 3.1 - Solid Waste Management
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	691,998	691,998	691,998	691,998
Expenditures (Prior Years - 636,017)	49,107	-	-	-
Remaining Budget	6,874	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
95-3.1.1 Testing of CCT Ashes	██████████	██████████	██████████		
95-3.1.2 Hydration Reaction Testing	██████████	██████████	██████████		
95-3.1.3 Effect of Cond. Media	██████████	██████████	██████████		
95-3.1.4 CLSFFM Development	██████████	██████████	██████████		
95-3.1A Topical Report				▽	
96-3.1A Final Topical Report					▽
96-3.1B Quarterly Report					▽

Signature of Recipient and Date

Jim Donance

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Brown, T.
 Project Title: Subtask 3.2 - Remediation of Contaminated Soils (Haz-Flote)
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	442,074	442,074	442,074	442,074
Expenditures (Prior Years - 341,301)	37,657	-	-	-
Remaining Budget	63,116	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Doreme 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126

Client: U.S. Department of Energy

Contract Start: February 2, 1993

Contract Complete: February 1, 1998

Subtask Manager: Bland, A.

Project Title: Subtask 3.3 - Syn-Ag Process: Coal Combustion Ash Management Option

Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	183,521	183,521	183,521	183,521
Expenditures (Prior Years - 63,992)	11,037	-	-	-
Remaining Budget	108,492	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Am Doneme 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
Client: U.S. Department of Energy

Contract Start: February 2, 1993

Contract Complete: February 1, 1998

Subtask Manager: Brown, T.

Project Title: Subtask 3.4 - Maxi-Acid Process: In-Situ Amelioration of Acid Mine Drainage Problems

Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	231,057	231,057	231,057	231,057
Expenditures (Prior Years - 85,116)	8,155	-	-	-
Remaining Budget	137,796	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Dorence

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Sheesley, D.
 Project Title: Subtask 3.5 - Spill Test Facility Data Base
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	186,539	186,539	186,539	186,539
Expenditures (Prior Years - 149,101)	35,132	-	-	-
Remaining Budget	2,306	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

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5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Brown, T.
 Project Title: Subtask 3.6 - Attenuation of Ammonium Concentrate in an Aquifer
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	16,400	16,400	16,400	16,400
Expenditures (Prior Years - 0)	1,259	-	-	-
Remaining Budget	15,141	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-3.6 Attenuation of Ammonium Concentrate					
96-3.6A Final Topical Report					
96-3.6B Quarterly Report					

Feb 1 May 1 Aug 1 Nov 1 Feb 1
1996 1997

Signature of Recipient and Date

Sm Daneme 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Guffey, F.
 Project Title: Subtask 4.1 - Heavy Oil/Plastics Coprocessing
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	278,282	278,282	278,282	278,282
Expenditures (Prior Years - 245,929)	32,049	-	-	-
Remaining Budget	304	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
95-4.1 Heavy Oil/Plastics Recycling	██████████				
95-4.1A Final Topical Report				▽	
95-4.1D Quarterly Report				▽	

Feb 1 May 1 Aug 1 Nov 1 Feb 1
1996 1997

Signature of Recipient and Date

Sam Donenue 5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Miknis, F.
 Project Title: Subtask 4.2 - Fossil Fuel and Hydrocarbon Conversion Using Hydrogen-Rich Plasmas
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address

Western Research Institute
 365 North Ninth Street
 Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years - 81,447)	96,447	111,447	126,447	130,647
Expenditures (Prior Years - 78,231)	2,190	-	-	-
Remaining Budget	50,226	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Am Dorene

5/31/96

Signature of USDOE Reviewing Representative and Date

FEDERAL ASSISTANCE MANAGEMENT SUMMARY REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Subtask Manager: Merriam, N.
 Project Title: Subtask 6.1 - North Site Remediation
 Reporting Period: February 2, 1996 - May 1, 1996

Name and Address
Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

CUMULATIVE ACCRUED EXPENDITURES (\$)

	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Approved Budget (Prior Years)	1,534,884	1,534,884	1,534,884	1,534,884
Expenditures (Prior Years - 1,142,253)	95,898	-	-	-
Remaining Budget	296,733	-	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Donenue

5/31/96

Signature of USDOE Reviewing Representative and Date

CONTRACT STATUS REPORT

Contract No:	DE-FC21-93MC30126
Client:	U.S. Department of Energy
Contract Start:	February 2, 1993
Contract Complete:	February 1, 1998
Reporting Period:	1st Quarter, Year 4

CUMULATIVE ACCRUED EXPENDITURES, YEAR 4 (\$)

	<u>Quarter 1</u>	<u>Quarter 2</u>	<u>Quarter 3</u>	<u>Quarter 4</u>
Approved Budget	137,000	387,000	607,000	776,000
Expenditures (Cumulative)	2,839	—	—	—
Remaining Budget	773,161	—	—	—

EXPENDITURES VERSUS APPROVED BUDGET

CONTRACT STATUS REPORT

Contract No: DE-FC21-93MC30126
 Client: U.S. Department of Energy
 Contract Start: February 2, 1993
 Contract Complete: February 1, 1998
 Reporting Period: Cumulative Through 1st Quarter, 4th Year

APPROVED BUDGET

Year 1 (3/93)	Year 1 (12/93) Cleanup	Year 2 (4/94)	Year 2 (9/94) Cleanup	Year 3 (2/95)	Year 3 (9/95) Cleanup	Year 4 (4/96)
\$ 1,950,000	\$ 828,000	\$ 1,750,000	\$ 604,908	\$ 976,000	\$ 101,976	\$ 776,000

Total Approved Budget: \$ 6,986,884
 Total Expenditures Through 4/96: \$ 5,256,897
 Remaining Budget: \$ 1,729,987

EXPENDITURES VERSUS APPROVED BUDGET

DISCLAIMER

Mention of specific brand names or models of equipment is for information only and does not imply endorsement of any particular brand.