Base Program on Energy Related Research

Quarterly Report

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Office of Fossil Energy
Morgantown Energy Technology Center
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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 nonexistent 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 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, nonleaching, 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 under way 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 May Through July 1996

Task 1.0

A physical simulation apparatus was constructed, and shakedown was completed for evaluation of Miscible/immiscible Gas Injection Processes for oil production (Subtask 1.2).

Numerous industrial contacts were made relative to the TaBoRR® process (Subtask 1.4). More samples of tank bottoms were obtained, and the samples are being analyzed for chemical and physical properties as received.

Task 2.0

Subtask 2.1 (Production of a Premium Solid Fuel from Western U.S. Coals) was completed this quarter.

Subtask 2.6 (Support for the Commercialization of the Koppelman Series C Process) was completed this quarter.

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 U.S. 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 2nd Quarter, 4th Year

Subtask	Budget Prior years	Budget Yr 4	Total Budget	Expenses to 4/30/96	Expenses			Total Expenses	Balance
					May	June	July		
4th Year Subtasks									
1.2	254,500	199,200	453,700	164,954	11,926	18,280	14,769	209,929	243,771
1.4	588,275	159,200	747,475	517,622	63,398	97,018	(61,290)	616,749	130,726
2.7	0	194,200	194,200	0	53	14	0	67	194,133
3.7	0	174,200	174,200	2,839	39,489	81,767	18,995	143,088	31,112
4.2	81,447	49,200	130,647	80,421	319	29	0	80,769	49,878
x Subtotals	924,222	776,000	1,700,222	765,836	115,185	197,108	(27,526)	1,050,602	649,620
1.3	316,841	0	316,841	158,939	428	43	0	159,410	157,431
2.1	127,835	0	127,835	123,144	1,255	193	0	124,592	3,243
2.5	66,145	0	66,145	63,585	0	1,709	0	65,294	851
3.1	691,998	0	691,998	685,124	(20,929)	15,532	1,076	680,803	11,195
3.2	442,074	0	442,074	378,958	13,406	13,961	9,514	415,839	26,235
3.3	183,521	0	183,521	75,029	3,318	1,708	806	80,861	102,660
3.4	231,057	0	231,057	93,261	715	3,549	(308)	97,217	133,840
3.5	186,539	0	186,539	184,233	610	239	225	185,307	1,232
3.6	16,400	0	16,400	1,259	0	0	0	1,259	15,141
4.1	278,282	0	278,282	277,978	263	0	0	278,241	41
6.1	1,534,884	0	1,534,884	1,238,151	52,862	68,920	38,923	1,398,856	136,028
Subtotals	4,075,576	0	4,075,576	3,279,645	51,928	105,854	50,236	3,487,663	587,913
Other ⁽¹⁾	1,211,086	0	1,211,086	1,211,416	0	0	0	1,211,416	(330)
Totals	6,210,884	776,000	6,986,884	5,256,897	167,107	302,966	22,711	5,749,681	1,237,203

⁽¹⁾ Completed subtasks (1.1, 2.2, 2.3, 2.4, 2.6)

Task 3.0

Work on a final topical report on Subtask 3.1 (Solid Waste Management) continued. Evaluation of potential patent applications is in progress.

Mercury removal from contaminated soils was continued at high efficiency using the Haz-Flote™ (Subtask 3.2) process. A patent search for this area was initiated this quarter.

Under Subtask 3.3 (Syn-Ag™: Coal Combustion Ash Management), invention disclosures have been written, and patent applications are being prepared.

A final topical report on the Subtask 3.5 (Spill Test Data Base) will be submitted soon.

Data on about 1,200 chemicals have been entered into the data base for chemical, physical, and toxicological properties. Data have also been verified under Subtask 3.7 (Evaluation of Dense Gas Dispersion).

Task 4.0

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 submitted. Work funded during the 4th year has not been initiated yet.

Federal Assistance Management Summary Reports (Substitute DOE Form F 4600.5) are included for active subtasks on pages 28–42.

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 for WRI-developed technologies appears to be with the independent operators.

Areas currently being targeted are:

1. Development of a predictive model for miscible/immiscible gas injection and verification of the model through physical simulations (Subtask 1.2)
2. Development of a portable data acquisition system and coalbed methane generator (Subtask 1.3)
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

May -July 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

- 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.

ACCOMPLISHMENTS

The numerical simulator to be used in the subtask was selected based on availability and on the presence of the various capabilities desirable for the simulations. The simulator selected is the GEM 96.00 simulator offered by the Computer Modeling Group (CMG). A copy of this simulator resides at METC, and METC personnel are familiar with it.

Agreements have been finalized with CMG to secure the executables of the GEM 96.00 simulator for use at WRI. The agreement includes a training session at CMG facilities for WRI personnel and access to CMG personnel for troubleshooting and modification of the computer code.

A literature survey has been conducted to assist in the design of the physical simulations. Emphasis of the survey was non-intrusive capillary pressure and three-phase saturations measurements during conduction of the physical simulations, methods to seal the core samples, and type of core to use. A preliminary design for the physical simulation system has been developed and the equipment specifications are being developed. 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 solid material, core or sand, in the reactor tubes is being evaluated. It appears that the use of a bismuth alloy because of its low melting point and its expansion characteristic when cooled would be used with core material. Methods to prevent slippage around sand packs are also being evaluated.

The physical simulation apparatus has been constructed and shakedown completed. Methods for packing the reactor tubes with sand to produce various permeabilities are being evaluated.

ACTIVITIES NEXT QUARTER

- Finalize the design for the physical simulation testing program.
- Complete evaluation of the reactor tube packing protocol and begin actual testing.
- Continue familiarization with the CMG miscible\immiscible gas injection simulator.

PROCEDURES

This subtask will be comprised of four parts:

1. The selection of a numerical simulator followed by the acquisition or arrangements for use of the simulator.
2. 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.
3. 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.
4. 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 a comparative purpose.

RESULTS

The numerical simulator selected for use in this subtask is GEM 96.00 developed by CMG. The simulator was selected because its capability of taking into consideration the solubility of CO₂ in the aqueous phase and to allow for relative permeability hysteresis. Based on discussions with personnel at METC, the initial simulations using the CMG simulator was conducted by WRI personnel at the METC facilities, since the simulator is available there. Initial use of the simulator was positive. An experimental plan for the physical simulations is being developed using initial simulations conducted with GEM.

Agreements have been finalized with CMG for the use of the GEM 96.00 simulator at WRI's facilities during this subtask. The agreement also includes training for WRI personnel on the simulator at CMG facilities. This training has been conducted.

Literature surveys identified methods for the use 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 as has been the construction and shakedown of the apparatus. An outline for the testing procedure has been developed. Methods to seal the solid material the reactor tubes have been identified and are being evaluated.

CONCLUSIONS

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 an 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 that 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.

Sand packed reactor tubes are being evaluated to provide the desired range of contrasting permeabilities desired for the physical simulations.

SUBTASK 1.3

DEVELOPMENT OF A PORTABLE DATA ACQUISITION SYSTEM AND COALBED METHANE SIMULATOR

Charles G. Mones

May-July 1996

OBJECTIVES

WRI is currently involved in a Jointly Sponsored Research (JSR) program with Amoco Production Company regarding the enhanced recovery of methane from coal beds by the injection of CO₂. Enhanced coalbed methane processes use an injected gas to stimulate the production of methane from coal beds 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 coal beds.

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

No work was 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

May-July 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:

- Sample identified 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
- Continue the numerical modeling effort
- Continue work on the topical report

ACCOMPLISHMENTS

- Numerous industrial contacts were made and six more samples were obtained.
- Samples were analyzed as they were received to determine their chemical and physical properties.
- The design constraints were completed for the pyrolyzing unit, and manufacturers are being contacted for costs and design constraints.
- Work is continuing on the modeling effort.
- Work is continuing on the topical report.

OBJECTIVES FOR NEXT QUARTER

The following activities are planned for next quarter:

- Sample other sources of tank bottom wastes.
- Characterize sampled tank bottom wastes.
- Complete the numerical modeling effort.
- Complete the topical report.

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).
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.
3. 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

May-July 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 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

May-July 1996

OBJECTIVE

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

ACCOMPLISHMENTS

This task was completed during the February to April 1996 quarter.

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

May-July 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 objective for the quarter was to prepare a final topical report for U.S. DOE METC on the project and prepare patent applications.

ACCOMPLISHMENTS

WRI has initiated patent applications related to the results of the project. A public version of the final report that does not compromise the patent applications has been initiated. An industrial cosponsor has been selected for demonstration of the flowable fill material under the jointly sponsored research (JSR) program, and proposals are being prepared.

ACTIVITIES FOR NEXT QUARTER

- Continue work on a final topical report for U.S. DOE METC and continue patent applications.

SUBTASK 3.2

REMEDIATION OF CONTAMINATED SOILS (Haz-Flote™)

Terry H. Brown

May-July 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:

- Test materials with varying characteristics using the procedures developed
- Modify the procedures as needed

ACCOMPLISHMENTS

Testing has been completed for several other mercury contaminated materials with success equal to that achieved with the initial sample tested.

ACTIVITIES FOR NEXT QUARTER

- Complete a patent and literature search to determine if a patent application should be filed.
- Dispose of the mercury contaminated waste using a contract waste disposal operation.

SUBTASK 3.3

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

Alan E. Bland

May-July 1996

OBJECTIVES

Project objectives are to develop and demonstrate the technical process 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.**

SUBTASK 3.4

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

Terry H. Brown

May–July 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

- No research work was accomplished during this period.
- Work plans were developed.

ACTIVITIES FOR THE NEXT QUARTER

- Construct the leaching pad.
- Initiate depletion studies.

SUBTASK 3.5

SPILL TEST FACILITY DATA BASE

David Sheesley

May-July 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 by users of fuels and other chemicals.

QUARTER OBJECTIVE

The objective for the quarter was to complete a final report on the project.

ACCOMPLISHMENTS

The topical (final) report is complete.

OBJECTIVE FOR NEXT QUARTER

The project is complete.

SUBTASK 3.7

EVALUATION OF DENSE GAS DISPERSION

David Sheesley

May-July 1996

OBJECTIVES

The overall objective of this task is to provide industry and the public with a data base on simulated accidental releases of fuels and chemicals. Specific objectives for the data base are to:

- Archive spill test facility results from the U.S. Department of Energy Liquefied Gaseous Fuels Spill Test Facility (LGFSTF), located at the Nevada National Test Site, hereinafter called Spill Test Facility (STF)
- Through the WRI chemical spills technology programs for industry, develop data to aid in the prediction and mitigation of hydrocarbon and other chemical spills
- Update spill control technology documents and data
- Archive and monitor significant hazardous spill incidents reported in the literature
- Transfer this information to the public, including the participants of the Petroleum Environmental Research Forum (PERF) and researchers implementing the Clean Air Act Amendments (CAAA) section 103 (f) through the U.S. Environmental Protection Agency, EPA Contract Number 68D30018 "Research Program for the Development of Emergency Response Technologies," other federal and state agencies, and HazMat teams.

BACKGROUND

In 1983, Congress appropriated funds with public law PL 97-377 to provide the nation with the \$7.9 MM Liquefied Gaseous Fuels Spill Test Facility where emergency management technologies could be tested and evaluated by industry and government. The intent of Congress in writing portions of the Superfund Amendments and Reauthorization Act (SARA) or Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA, PL 99-499) was to direct DOE to continue to provide the nation with a program using this facility and to make it available to industry. The intent was to improve health and safety engineering research, reduce industry liability, and help U.S.

technology remain competitive. The program and facility produces data on accidental releases of fuels and other chemicals. These experimentally verified data can then be used (and they are being used) by more and more people to test technology that will help save lives through accident prevention and emergency response. The data will also help society with the development of chemical spill worst-case scenarios to aid in compliance with the new Risk Management Plan rule promulgated by the Environmental Protection Agency (EPA) on June 20, 1996. More specifically, experimentally verified data bases will aid in the improvement of predictive modeling technology.

The 1986 Title III SARA language directed DOE to develop a data base transfer system as part of the technology transfer of the LGFSTF facility related activities. The SARA-mandated data on spill technology also includes the DOE STF data base. In addition, these laws direct EPA to work with the U.S. Department of Energy to test and evaluate technologies that may be used to respond to spills of liquefied gaseous fuels and other hazardous substances that threaten public health and the environment.

An example of how the STF data base has been used is the WRI jointly sponsored research (JSR) project with the petroleum industry, PERF project 93-16. Designed by WRI and the test sponsors, PERF project 93-16 simulated typical industrial site conditions in field tests at the STF and generated a new data base called "Kit Fox." The project began under a Cooperative Research and Development Agreement (CRADA) with EPA, in which wind tunnel experiments were conducted with WRI. In wind tunnel test activities, the approximately 1:10 industrial site scale was developed. The DOE STF data base supported the design of the project. The design was developed by WRI using data from wind tunnel testing conducted in Colorado and data from field testing conducted by WRI at the STF.

The data from preliminary analyses are expected to improve understanding of dense gas dispersion with three different roughness heights in the Kit Fox dispersion grid under neutral to stable meteorological conditions. WRI fabricated the obstacles making up the EPA homogeneous roughness array and a WRI-PERF equivalent roughness pattern (ERP) using data from the site and the STF bibliography. Future research needs of current related programs can be met with the Kit Fox data base to lend insight for simulating dense gas dispersion effects from a CO₂ release source system and or source.

PERF participants included Allied Signal Corporation; Amoco Corporation; Chevron Research and Technology Co.; CITGO Petroleum Corporation, Clark Oil and Refining Co., Exxon Research and Engineering Co.; Marathon Corporation; Mobil Research and Development Co.; Phillips Petroleum Co.; and Shell Research & Development Co.

ACCOMPLISHMENTS

The data processing outlined in Figure 1 includes activities undertaken with DOE, industry, EPA, DOT, and other stakeholders to convert the DOE data base to a form that can be interactive and accessed by the public. The general data management in this project has involved capturing the simulated spill or gas release data together with meteorological conditions from all the tests performed at the STF. Having the two sets together means the data can be more widely used than if either set was only available individually. This quarter, WRI has maintained DOE data files from past tests, data files to be generated in future tests, and results of the EPA/DOE CAAA-STF collaborative research and development program, including limited work in preparation for the subject-indexed bibliography. Quality control for archiving and management of national spill test facility field test demonstrations has required comparison with known and accepted standards.

During this reporting period, the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE), Vapor Cloud Subcommittee reviewed the STF data base on the electronic bulletin board system (BBS) supported under a separate contract. The chairman of the Vapor Cloud Subcommittee advised WRI of corrections that need to be made to a Chlorosilanes data base generated at the STF for Chlorosilane Fire and Vapor Suppression Project conducted in 1989-90. The Chlorosilanes data base was removed from the BBS until WRI is informed of what corrections are required.

Chemical, physical, and toxicological properties data have also been entered into an interim-use data base. Verification to ensure data quality for about 1200 chemicals has been accomplished. Chemical properties that have been reviewed include flashpoint, autoignition temperature, lower explosion limit (LEL), upper explosion limit (UEL), boiling point, melting point, vapor density, vapor pressure, specific gravity of liquid, molecular weight, immediate danger to life and health limits (IDLH), threshold limit values for short-term and longer term limits, chemical abstract numbers, and National Fire Protection Association classifications for different chemicals.

The data sources that have been reviewed in addition to STF related data include: NIOSH, NFPA Fire protective information for hazardous materials response, additional chemical information data sheets, and material safety data sheets (MSDS). The chemical property data base for material safety data sheets from CD ROMs to go with STF data was manipulated using the data from the Department of Defense (DOD). The information is being processed to convert values to a uniform and consistent set of units. The CRC press reportedly will have a more consistent set of chemical properties available in late 1996 for use in comparisons to the data management and archival for the national spill test facility results.

Figure 1. Process for Data Base Commercialization

WRI has sought funding to complete the Kit Fox data processing and analyses and will obtain a determination about public release of these data and documents generated from the cost-shared DOE, WRI, PERF 93-16, and EPA project. The data from this project is significant for the development of a scientific and engineering basis for developing regulations that will affect more than 100,000 facilities.

Additional data from an eight-level tower has been collected and is archived in Nevada but has not been made available in the data base this quarter because of the suspension of funding of the EPA Contract Number 68D30018 "Research Program for the Development of Emergency Response Technologies." These data have improved the capability to determine atmospheric stability and obtain good estimates for the vertical fluxes of heat and momentum during chemical release tests at the STF.

Some discrepancies have been identified between atmospheric stability determined from vertical heat flux data from the eight-level tower and that based on less rigorous weather observations. This was a typical practice at the STF before the dense gas dispersion tests designed by WRI were initiated in 1993. Given confidence in these data, WRI's objective is to compare the eight-level tower data to Kit Fox data to determine values of the surface-roughness length, which is a major consideration in the prediction of dense cloud dispersion location in time and space.

WRI has maintained the spill test facility related bibliography so that it is current through 1995. The bibliography activity has been further defined because of related activity under a separate DOE contract. WRI has accumulated citations for the bibliography with the idea of publishing and distributing it as widely as possible where the papers will be read by industry. Also in this quarter, WRI has collected copies of reports, published and unpublished. WRI is attempting to obtain and incorporate any publications received from the Health and Safety Executive, Great Britain, or other international organizations, as a result of an exchange arrangement.

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 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, only a short progress report is included.

TASK 4.2

FOSSIL FUEL AND HYDROCARBON CONVERSION USING HYDROGEN-RICH PLASMAS

Francis P. Miknis and Will Grimes

May-July 1996

TASK OBJECTIVE

The objective of this subtask is to develop a novel and innovative, noncatalytic method for directly converting fossil fuel materials to hydrogen-rich fuels while simultaneously reducing the heteroatom contents.

ACCOMPLISHMENTS

A topical report describing the work performed during the previous year was written and submitted to DOE. A portion of the work has been extended under the FY96 Base Cooperative Agreement. However, no work was done during the quarter because personnel were assigned to other projects during this period.

ACTIVITIES FOR NEXT QUARTER

Begin work on plasma desulfurization of heavy oils.

TASK 6.0 REMEDIATION

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

SUBTASK 6.1

NORTH SITE REMEDIATION

Norm Merriam

May-July 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:

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

ACCOMPLISHMENTS

- Phase I is complete.
- Phase II is complete.
- Phase III is complete. A draft of the final report was submitted to DOE during the quarter.
- Phase IV is complete.
- Phase V is complete. A draft of the final report was submitted to DOE during the quarter.
- Phase Va, groundwater monitoring, is complete. A draft of the final report was submitted to DOE during the quarter.
- Site revegetation and surface water control were completed.
- Phase VI, materials inventory database, is complete.
- Monthly reports were submitted.
- Topical reports have been prepared as phases are completed.

OBJECTIVES FOR NEXT QUARTER

- Prepare an overall final report
- Submit the final report to DOE in September.

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: May 2, 1996 - August 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	40,975	-	-
Remaining Budget	288,746	243,771	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Donenue

8-29-96

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: May 2, 1996 - August 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	471	-	-
Remaining Budget	157,902	157,431	-	-

EXPENDITURES VERSUS APPROVED BUDGET

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

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

Signature of Recipient and Date

Sm Lawrence

8-29-96

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: May 2, 1996 - August 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	99,127	-	-
Remaining Budget	229,853	130,726	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Doneme 8-29-96

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: May 2, 1996 - August 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	1,448	-	-
Remaining Budget	4,691	3,243	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Donenue

8-27-96

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: May 2, 1996 - August 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	1,709	-	-
Remaining Budget	2,560	851	-	-

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 Feb 1
1996 1997

Signature of Recipient and Date

Sm Doname

8-29-96

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: Sethi, V.
 Project Title: Subtask 2.7 - Development and Testing of a Coal-Fired Gas Turbine System
 Reporting Period: May 2, 1996 - August 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	67,000	112,000	157,000	194,200
Expenditures	0	67	-	-
Remaining Budget	194,200	194,133	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Milestones	Planned	Actual	Progress	Scheduled	Delivered
96-2.7 Development and Testing					
96-2.7A Equipment Selection					
96-2.7B Complete Assembly					
96-2.7C Topical Report					
96-2.7D, Quarterly Reports E, F					

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

Signature of Recipient and Date

Sm Donenue

8-29-96

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: May 2, 1996 - August 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	(4,321)	-	-
Remaining Budget	6,874	11,195	-	-

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					

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

Signature of Recipient and Date

Sm Doneme

8-29-96

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: May 2, 1996 - August 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	36,881	-	-
Remaining Budget	63,116	26,235	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Donenue

8-29-96

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: May 2, 1996 - August 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	5,832	-	-
Remaining Budget	108,492	102,660	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

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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: May 2, 1996 - August 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	3,956	-	-
Remaining Budget	137,796	133,840	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Donenue

8-29-96

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: May 2, 1996 - August 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	1,074	-	-
Remaining Budget	2,306	1,232	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Doname

8-29-96

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: May 2, 1996 - August 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	0	-	-
Remaining Budget	15,141	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

Jim Doname

8-29-96

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 3.7 - Evaluation of Dense Gas Dispersion
 Reporting Period: May 2, 1996 - August 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	40,000	85,000	130,000	174,200
Expenditures	2,839	140,249	-	-
Remaining Budget	171,361	31,112	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Jim Donenue

8-29-96

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: May 2, 1996 - August 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	263	-	-
Remaining Budget	304	41	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Doneme 8-29-96

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: May 2, 1996 - August 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	348	-	-
Remaining Budget	50,226	49,878	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Doneme 8-29-96

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: May 2, 1996 - August 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	160,705	-	-
Remaining Budget	296,733	136,028	-	-

EXPENDITURES VERSUS APPROVED BUDGET

Signature of Recipient and Date

Sm Doreme 8-29-96

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:	2nd 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	171,629	—	—
Remaining Budget	773,161	604,371	—	—

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 2nd 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 7/96: \$ 5,749,681

Remaining Budget: \$ 1,237,203

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.