WRI-97-RO23

PROVIDING SOLUTIONS
TO
ENERGY AND ENVIRONMENTAL
PROBLEMS

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FOR
APRIL 1, 1997 THROUGH JUNE 30, 1997

ON

COOPERATIVE AGREEMENT DE-FC21-93MC30127--18
JOINTLY SPONSORED RESEARCH PROGRAM

FOR THE

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER
MORGANTOWN, WEST VIRGINIA

BY

WESTERN RESEARCH INSTITUTE
LARAMIE, WYOMING

JULY 1997

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Cumulative JSRP Funding Summarized by Technology Area

More than \$18 million for energy programs emphasizing enhanced oil recovery, coal beneficiation and upgrading, coalbed methane recovery and renewable energy resources

\$4.1 million for technology enhancement activities encompassing resource characterization studies, improved environmental monitors and sensors, and improved dispersion modeling techniques

\$8.9 million for technology to clean underground oily wastes, mitigate acid mine drainage, and demonstrate uses for CCT and PFBC waste solids

Cooperative Agreement DE-FC21-93MC30127
Status of Total Approved Projects on July 1, 1997

***WRI's JSR Program is Focused on Technology Development
to Meet National and Regional Needs***

Goals of WRI's Jointly Sponsored Research Program

Increase the production of U.S. and western energy resources: low-sulfur coal, natural gas, oil, and renewable energy resources

Enhance the competitiveness of U.S. and western energy technologies in international markets and assist in technology transfer

Reduce the nation's dependence upon foreign energy supplies and strengthen the U.S. and regional economies

Minimize the impact of energy production and utilization on the environment

**SUMMARY
OF
APPROPRIATIONS,
OBLIGATIONS
&
EXPENDITURES
BY
TASK**

Executive Summary

Jointly Sponsored Research Program

The Jointly Sponsored Research Program emphasizes technology commercialization and continues to be highly successful and supported strongly and enthusiastically by WRI's industrial clientele. All of the available Department of Energy (USDOE) funding for each of the first seven years has been committed to projects. All available FY 97 funding was obligated in June 1997. The demand for funds continues to outstrip available monies and an additional \$3 million per year in USDOE funding could easily be accommodated. As summarized in Table 1, since the program's inception in 1990, \$19,140,754 in USDOE funds have been obligated and committed against an industrial match of \$25,446,281.

Table 1
Summary of JSRP Funding for FY 1990-97

Fiscal Year	Funds Available	Funds Committed	No. of Projects	New Starts
1997	2,050,754	2,096,213	22	2
1996	2,220,000	2,174,541	20	2
1995	2,800,000	2,800,000	18	1
1994	2,411,000	2,411,000	17	3
1993	2,437,000	2,437,000	14	9
1992	2,442,000	2,442,000	17	10
1991	2,489,000	2,489,000	11	5
1990	2,291,000	2,291,000	14	14
Total	\$19,140,754	\$19,140,754		

Since entering into a new JSRP cooperative agreement with the Department of Energy on March 26, 1993 (Cooperative Agreement DE-FC21-93MC30127), WRI has put into place projects utilizing a total of \$13,082,477 in USDOE funds. These funds have been matched against \$18,342,205 in industrial funds to produce a program valued at \$31,424,682. Letters of commitment have already been obtained which envision utilizing more than \$5 million in FY 98 funds. As a result of this strong demand for program participation, unless additional funding is available, WRI may not be able to work in a significant fashion with any new JSRP participants until FY 98 or beyond. In fact, we estimate that \$6.5 million would be needed in FY 98 to adequately meet present demand. As Table 1 clearly indicates, new program participants can only be added in those instances where existing money can be reobligated.

Table 2
Tasks Approved for Funding Through Fiscal Year 1997

Task	Project	Previous Commitments			FY 97 Commitment			Total Commitment		
		USDOE	Sponsor	Total	USDOE	Sponsor	Total	USDOE	Sponsor	Total
Energy Programs										
1	Electric Downhole Steam Generator	1,282,785	1,315,200	2,745,985				1,282,785	1,315,200	2,745,985
2	Wetting Behavior of Crude Oil/Brine/Rock Systems	1,132,356	1,220,793	2,353,149				1,132,356	1,220,793	2,353,149
3	Kerr Coal Product Market Study	57,039	60,000	117,039				57,039	60,000	117,039
7	Optimization of FMC Carbonizer	48,418	45,000	93,418				48,418	45,000	93,418
9	Demonstration of the "Series C" Process	2,456,205	2,588,800	5,045,005	548,527	932,500	1,481,027	3,004,732	3,521,300	6,526,032
14	"Series B" Pilot Plant Tests	8,668	10,092	18,760				8,668	10,092	18,760
6	Enhanced Recovery of Coalbed Methane	1,135,900	1,716,270	2,852,170				1,135,900	1,716,270	2,852,170
16	Demonstration of a Wood-Fired Gas Turbine System	1,416,234	2,303,984	3,720,218				1,416,234	2,303,984	3,720,218
Subtotal Energy Programs		7,537,605	9,260,139	16,797,744	548,527	932,500	1,481,027	8,086,132	10,192,639	18,278,771

Table 2 (Continued)
Tasks Approved for Funding Through Fiscal Year 1997

Task	Project	Previous Commitments			FY 97 Commitment			Total Commitment		
		USDOE	Sponsor	Total	USDOE	Sponsor	Total	USDOE	Sponsor	Total
Technology Enhancement Programs										
8	Chemical Sensor and Field Screening Technology	749,900	749,900	1,499,800				749,900	749,900	1,499,800
10	Remote Chemical Sensor Development	355,000	232,081	587,081				355,000	232,081	587,081
12	NMR Analysis of Matured Kerogens	30,192	15,000	45,192				30,192	15,000	45,192
17	NMR Analysis of Mowry Formation Shales	60,064	60,000	120,064	20,000	20,000	40,000	80,064	80,000	160,064
19	PERF Phase II Demonstration	502,124	945,330	1,447,454				502,124	945,330	1,447,454
21	Validation of a New VOC Sampler	50,541	62,500	113,041	149,762	187,500	337,262	200,303	250,000	450,303
Subtotal Technology Enhancement		1,747,821	2,064,811	3,812,632	169,762	207,500	377,262	1,917,583	2,272,311	4,189,894

Table 2 (Continued)
Tasks Approved for Funding Through Fiscal Year 1997

Task	Project	Previous Commitments			FY 97 Commitment			Total Commitment		
		USDOE	Sponsor	Total	USDOE	Sponsor	Total	USDOE	Sponsor	Total
Environmental Programs										
4	Impact of CCT Waste Leachate on the Stability of Clay Liners	231,043	259,580	490,623				231,043	259,580	490,623
11	Market Assessment Study of PFBC Ash Use	447,638	603,500	1,051,138				447,638	603,500	1,051,138
13	CROW Field Demonstration Bell Lumber and Pole	120,800	541,396	662,196	23,000	36,000	59,000	143,800	577,396	721,196
15	In Situ Treatment of MPG Contaminated Soils	405,289	1,360,523	1,765,812				405,289	1,360,523	1,765,812
18	Acid-Mine Drainage Prevention and Control	211,068	210,845	421,913				211,068	210,845	421,913
20	Field Testing of the TaBoRR Process	285,000	285,415	570,415	1,282,287	2,500,000	3,782,287	1,567,287	2,785,415	4,352,702
22	Market Assessment Study of PFBC Ash Use from Lignite				72,637	79,996	152,633	72,637	79,996	152,633
Subtotal, Environ. Programs		1,700,838	3,261,259	4,962,097	1,377,924	2,615,996	3,993,920	3,078,762	5,877,255	8,956,017
Total, All Programs		10,986,264	14,586,209	25,572,473	2,096,213	3,755,996	5,852,209	13,082,477	18,342,205	31,424,682

Current Expenditures

Table 3
Expenditures on Contract DE-FC21-93MC30127

<i>Task</i>	<i>Budget</i>	<i>Expended Prior Periods</i>	<i>April 1997</i>	<i>May 1997</i>	<i>June 1997</i>	<i>Total</i>
1	\$1,282,785	\$1,270,742		Completed		\$1,297,451
2	1,132,356	1,161,421		Completed		1,161,421
3	57,039	56,989		Completed		56,989
4	231,043	232,574		Completed		232,574
5				Withdrawn		
6	1,135,900	948,847	12,273	10,590	14,056	965,766
7	48,418	36,974		Completed		36,974
8	749,900	711,139	11,250	7,917	10,635	740,941
9	3,004,732	2,100,585	20,456	81,397	21,523	2,223,960
10	355,000	354,182		Completed		354,182
11	447,638	402,201	14,441	17,004	18,913	452,559
12	30,192	30,780		Completed		30,780
13	143,800	110,994	4,069	2,574	3,766	121,403
14	8,668	8,668		Completed		8,668
15	405,289	389,195		Completed		396,235
16	1,416,234	1,282,013				1,282,013
17	80,064	54,003	551	4,441	165	59,160
18	211,068	172,677	3,302	5,233	4,910	186,122
19	502,124	513,995	(185,241)			328,755
20	1,567,287	971,051	70,127	65,814	163,871	1,270,863
21	200,303	37,693	8,626	7,336	4,248	57,903
22	72,637					
Total	\$13,082,477	\$10,846,722	(\$23,523)	\$213,352	\$248,169	\$11,284,719

Technical Highlights

On Task 008 EPA approval of the soil test kit method was obtained by a statement from EPA that the new ASTM method will be referenced in the fourth update of the RCRA SW-846 methods compendium. A prototype test kit was used successfully by an engineering firm in Vermont to determine the areas of a tank farm site that will require remediation.

Shakedown activities for the KFx 500,000 tpy commercial plant (Task 009) are progressing steadily. The replacement of the heater damaged by fire last December is nearly complete.

A paper was presented at the 14th International Conference on Fluidized Bed Combustion held in Vancouver, B.C. May 11-14, 1997. (Task 011). The paper was entitled "Hydration Reaction Chemistry Associated with Management of Pressurized Fluidized Bed Combustion Ash" co-authored by A. E. Bland and T. H. Brown. Two papers covering the construction ash use options and the soil amendment ash use options were published in the latest volume of the international journal **FUEL**.

On Task 013, the phase-one, full-scale remediation at the Bell Lumber and Pole Site in New Brighton, Minnesota is operating with over 20,000 gal of organics recovered. This is nearly 10 times higher than the projected pump-n-treat volume. A new heat exchanger to produce the heated injection fluid was identified and ordered. The heat exchanger installation was completed in early April. For 1997, there have been 84 continuous operating days with over 1.4 million gallons of 130- 165°F hot water injected and 1.8 million gallons of fluid extracted. To date, 32,500 gallons of organics have been recovered.

Operation of the Pennsylvania Power and Light's Brodhead Creek Site at Stroudsburg, Pennsylvania (Task 015) was terminated in early June 1996 when EPA treatment criteria had been met. The property owner estimated that the CROW process reduced the cost of remediation of the site by over \$1.3 million dollars.

On Task 020, plant shakedown activities have continued and nearly all of the 340 barrels of material obtained from Pease Oil Field Services has been processed. Modifications to the flash system have provided better control and near-flawless operation. Approximately 236 barrels of high water content material have arrived from Wallace Energy, Inc. and this material is now being processed. The pyrolyzer has arrived on-site and is undergoing shakedown.

On Task 021 Susan Sorini attended the meeting of ASTM Committee D-34 on Waste Management in St Louis in April. She was appointed chairman of ASTM Task Group D-34.01.01 on Environmental Monitoring and Sampling, under which the new draft practice titled "Standard Practice for Using a Coring Tube for Sampling and Storing Soil for Volatile Organic Analysis" will be developed.

**SUMMARY
OF
OBJECTIVES
&
ACCOMPLISHMENTS
BY
TASK**

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Task 2	Wetting Behavior of Selected Crude Oil/Brine/Rock Systems	Status Completed
<p align="center">Sponsors</p> <p><i>ARCO, British Petroleum, Chevron, Conoco, Dagang (China), ELF (France), Exxon, Marathon, Mobil, NorskHydro (Norway), Phillips, Shell (The Netherlands), Statoil (Norway), and the University of Wyoming</i></p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Fluid distribution and the displacement of oil by water or other fluids in an oil reservoir are governed by the fluid-solid interactions (wettability) of that system. Wettability governs interface shapes, which determine the mechanisms and efficiency of oil displacement from reservoir rocks. Because water flooding accounts for more than half of the oil production in the United States, understanding the effect of wettability on oil recovery is of great importance. To this end, WRI has undertaken a study of crude oil/brine/rock interactions for several selected crude oils, including oil from Prudhoe Bay. Special attention is being given to the possibility of increasing the efficiency of waterfloods through selection or adjustment of the composition of the injected brine.</i></p> <p align="center">Status</p> <p align="center"><i>The project has been completed.</i></p>		

Task 3	Coal Gasification, Power Generation, and Product Market Study	Status Completed
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**Sponsor
Kerr Coal Company**

Reporting Period: April 1 through June 30, 1997

Background

The primary use of western low-sulfur coal is for power generation. Other potential uses of this coal need to be evaluated. This study is to perform a market survey of potential products and alternate technologies that may produce high-value products from coal obtained from the Kerr Company coal mine in Walden, Colorado.

Status

The project has been completed.

Task 4	<i>The Impact of Leachate from Clean Coal Technology Waste on the Stability of Clay Liners</i>	<i>Status Completed</i>
<i>Sponsor Public Service Company of Colorado</i>		
<i>Reporting Period: April 1 through June 30, 1997</i>		
<p><i>Background</i></p> <p><i>Wastes generated from clean coal technologies have much different physical and chemical characteristics than the wastes generated from conventional power plants. These wastes can have significantly different impacts on the permeability of a clay liner, which can affect the active lifetime of the liner. This study is evaluating the influence that clean coal technology waste materials will have on the stability of clay liners. Specifically, an understanding of the chemical and physical interactions will be determined between clay liners and waste leachates. The findings of the study will provide industry with valuable information for the management of wastes generated by the implementation of clean coal technology programs.</i></p> <p><i>Status</i></p> <p><i>The project has been completed.</i></p>		

Task 5	<i>Investigation of Coprocessing Heavy Oil, Automobile Shredder Residue, and Coal</i>	<i>Status Withdrawn</i>
<i>Sponsor Environmental Recovery Systems, Inc.</i>		
<i>Reporting Period: April 1 through June 30, 1997</i>		
<i>Background</i> <p><i>A major environmental problem today is the disposal of automobile shredder residue (ASR). This residue is composed of plastic, rubber, foam rubber, wood, glass, dirt, oil, and other fluids. WRI is developing a low-temperature coprocessing concept for conversion of ASR, heavy oils, and coal into gasoline and diesel fuel distillates. This concept is being explored to alleviate the problems associated with ASR disposal and to generate useful product streams.</i></p> <i>Status</i> <p><i>This project was withdrawn due to the sponsor's inability to provide matching funds.</i></p>		

Task 6	<i>Injection into Coal Seams for Simultaneous CO₂ Mitigation and Enhanced Recovery of Coalbed Methane</i>	<i>Status Ongoing</i>
<p align="center">Sponsors <i>Amoco, Conoco, Resource Enterprises Inc., and New Mexico Petroleum Recovery Research Center</i></p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>This study is evaluating the technical feasibility of injecting CO₂, a byproduct of methane recovery from some coalbeds, into the coalbeds as both a technique of mitigating the level of CO₂ emissions from the production of methane from the coalbeds and as a technique for enhancing the recovery of methane from the coalbeds. The evaluation will be based on the operation and results of a two-well field pilot test in northwestern New Mexico.</i></p>		

Task Objectives

The overall objective of this task is to test the technical viability of injecting CO₂ into the Fruitland Coal to displace methane from the coal and to mitigate CO₂ emissions which are a consequence of primary coalbed methane production from surrounding wells in the area. To evaluate this technical viability, a field test was conducted and the test is being interpreted using data measured in WRI's laboratory, as well as using Amoco's state-of-the art coalbed methane simulator. Also, a second pilot of the process is being evaluated using the simulator. Ultimately, the technology developed will be applied to a Wyoming coal. The task is divided into five subtasks:

- Subtask 6.1: Two-Well Pilot Test of CO₂ Injection
- Subtask 6.2: CO₂/N₂ Laboratory Tests in the Fruitland Coal
- Subtask 6.3: Modeling of Two-Well Pilot Test
- Subtask 6.4: Allison Unit CO₂ Pilot Study and
- Subtask 6.5: CO₂/N₂ Laboratory Tests in Wyoming Coals.

Quarter Objectives

- Present the results of the Allison Unit modeling study to Amoco and Burlington Resources early in the quarter and prepare a final document on the Allison Unit study.
- Revise, finalize and bind the document on subtask 1.
- Bind the documents on subtasks 2 and 3.

Accomplishments

Subtask 6.1-Two-Well Pilot Test of CO₂ Injection

Because of the controversy concerning many conclusions drawn by WRI in draft documents describing the pilot, WRI did a thorough literature survey on the geological conditions of the San Juan Basin, particularly as relates to the area of the pilot. Results of this survey have been included in a new draft of the final report that is being prepared.

Subtask 6.2-CO₂/N₂ Laboratory Tests in the Fruitland Coal

A final review of the draft document was made, revisions were completed and the document was sent to WRI's Publications Coordinator early in the quarter for publication.

Subtask 6.3-Modeling of Two-Well Pilot Test

A final review of the draft document was made, revisions were completed and the document was sent to WRI's Publications Coordinator early in the quarter for publication.

Subtask 6.4-Design of Phase II CO₂ Injection

WRI presented results of the modeling study in Farmington, New Mexico on April 11, 1997 to representatives from Amoco and Burlington Resources, Inc. The presentation received very favorable remarks. A new outline was written for the final document.

Subtask 6.5 CO₂/N₂ Laboratory Tests in Wyoming Coals

A potential contact list was prepared identifying coalbed methane operators in Wyoming. Western Gas Resources, Inc. (Western) in Denver heads this list. Western and other operators are currently involved in a big coalbed methane play in the

Powder River Basin where six hundred to one thousand new wells are planned to be drilled over the next five years (Oil and Gas Journal, March 10, 1997, page 78). According to the article, most of the gas is thought to be of biogenic origin that is different from most coalbed methane resources. Thus, the emphasis on this part of the project is further justified because enhanced coalbed methane recovery has not been studied for biogenically derived coals.

Activities for Next Quarter

- Complete the revised draft of the final document and submit it to Amoco in July for one last review. If that review takes place in a timely fashion, send the document for publication to WRI's Publication Coordinator.
- Bind the documents on subtasks 2 and 3.
- Complete the draft of the final report on the modeling study for subtask 4 and submit it to Amoco for review.
- Contact Wyoming coalbed methane operators, obtain coal samples from these operators and begin laboratory testing of the samples.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 006 INJECTION INTO COAL SEAMS FOR SIMULTANEOUS CO ₂ MITIGATION AND ENHANCED RECOVERY OF COALBED METHANE	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING	812,639	1,701,789
FY 1994 FUNDING		
FY 1995 FUNDING	323,261	14,481
FY 1996 FUNDING		
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	1,135,900	1,716,270
TOTAL PROJECT VALUE \$2,852,170

COSPONSOR FUNDING IN FY 95 CONSISTED OF \$14,481 CASH
COSPONSOR FUNDING IN FY 93 CONSISTED OF \$41,389 CASH AND \$1,660,400 IN-KIND

Signature of Recipient and Date LEE E BRECHY 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 7	Optimization of Carbonizer Operations in the FMC Coke Process	Status Completed
<p align="center">Sponsor University of Wyoming Western Coal Consortium</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Operation of the FMC coking process to date has resulted in insufficient production of heavy tar materials that serve as the binder in the coke production. Laboratory tests were conducted by WRI, in conjunction with the University of Wyoming, to develop the optimum operating conditions for the carbonizer to maximize the amount of tar produced for binder and to investigate the applicability of the process to other western coals.</i></p> <p align="center">Status</p> <p align="center"><i>The project has been completed.</i></p>		

Task 8	Chemical Sensor and Field Screening Technology Development	Status Ongoing
Sponsor In-Situ Incorporated		
Reporting Period: April 1 through June 30, 1997		
<p align="center">Background</p> <p><i>The determination or screening of environmental contaminants in the field using portable analytical methodologies or down-hole real time in-situ measurements is an area of great interest in the environmental industry. WRI is expanding its efforts into new technology areas for the development and commercialization of these technologies.</i></p>		

Task Objectives

Western Research Institute is expanding its effort with a corporate sponsor, In-Situ Inc. (ISI) to develop additional methodology and prototype devices for down-hole or field applications using various technologies for monitoring chemical species of environmental importance.

Quarter Objectives

Soil Fuel Test Kit

- Continue to assist the corporate co-sponsor towards the goal of releasing the soil fuel test kit to manufacturing. Pursue EPA acceptance of the method as a new RCRA SW-846 method.

VOC Probes

- Compile the response curve data generated for a series of VOC standards.

Other Probes and Sensors

- Assist the corporate co-sponsor in evaluating chemical monitoring probes, such as for pH and conductivity, as requested.

Accomplishments

A draft final report summarizing activities on this task and listing relevant publications and presentations was prepared.

Soil Fuel Test Kit

- A soil test kit prototype continues to be used by Dr. Seth Frisbie at the Johnson Company in Vermont at his request. He is eager to buy final kits when they are available. He sent data describing the successful use of the kit to make remediation decisions at a tank farm site. We prepared a draft manuscript describing this effort for publication in a trade journal.
- A soil test kit prototype was sent to En Chem, Inc. of Green Bay, Wisconsin for evaluation. En Chem is heavily involved in underground storage tank (UST) remediation support and their feedback on the kit will be very useful.
- Work continued towards gaining EPA acceptance of the soil test kit method for an upcoming revision of the RCRA SW-846 methods compendium. Gail Hansen at EPA indicated that the method would indeed be referenced in the upcoming 4th update of SW-846. Thus, the goal of

obtaining EPA approval has been reached. This adds significant value to the kits.

- A description of the new soil test method appeared in the June 5, 1997 issue of the Brownfield Report, a newsletter geared towards environmental cleanup executives and professionals.
- The galley proofs of the article titled "Development and Precision Testing of a Standard Test Method for Screening Fuels in Soils" which will be published in the July issue of the Journal of Testing and Evaluation were reviewed. Changes were made and faxed to ASTM.

VOC Probes

- All of the calibration curves for VOCs in water obtained using an electrooptical probe and laboratory sparger apparatus were compiled into a single volume and provided to the corporate co-sponsor.

Other Probes and Sensors

- There was no activity in this area this quarter.

Activities for Next Quarter

The final report summarizing activities on this task will be finalized. A manuscript describing the use of the soil test kit will be submitted to a trade journal for publication. This task will end early in the third quarter, 1997.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 008 CHEMICAL SENSOR AND FIELD SCREENING TECHNOLOGY DEVELOPMENT	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING	196,396	217,217
FY 1994 FUNDING	166,743	151,806
FY 1995 FUNDING	247,761	214,352
FY 1996 FUNDING	119,000	166,525
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	749,900	749,900
TOTAL PROJECT VALUE \$1,499,800

COSPONSOR FUNDING IN FY 96 CONSISTED OF \$73,153 CASH AND \$93,372 IN-KIND
 COSPONSOR FUNDING IN FY 95 CONSISTED OF \$3,709 CASH AND \$210,643 IN-KIND
 COSPONSOR FUNDING IN FY 94 CONSISTED OF \$49,394 CASH AND \$102,412 IN-KIND
 COSPONSOR FUNDING IN FY 93 CONSISTED OF \$23,744 CASH AND \$193,473 IN-KIND

SIGNATURE OF RECIPIENT AND DATE LEE E Bredy 7/21/97	SIGNATURE OF USDOE REVIEWING REPRESENTATIVE AND DATE
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Task 9	Demonstration of the Koppelman "Series C" Process Using a Batch Test Unit with Powder River Basin Coal as Feed	Status Ongoing
<p align="center">Sponsor K-Fuel Incorporated</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Although having the desirable characteristic of being low in sulfur, most western coals are comparatively low in heating value. Bench-scale tests have been successfully conducted using the Koppelman "Series C" process in which subbituminous Powder River Basin coal has been converted to a higher value product having the characteristics of a low-sulfur bituminous coal. WRI is working with K-Fuel Inc. to construct and operate a large-scale batch unit that will provide the design basis for a commercial plant and to evaluate the product samples and process emissions from the unit.</i></p>		

Task Objectives

- (Phase I) Demonstrate the feasibility of the Koppelman Series C process by constructing a 1,000 lb. batch test unit; conducting tests to further develop the design basis for a commercial plant; and producing samples of the product for testing and evaluation.
- (Phase II) Improve the process economics by designing, constructing and testing a low-cost, high-efficiency version of the processor.
- Characterize the gaseous and water emissions from the process by determining the quantity and composition of those respective emissions.
- (Phase III) Support the design and operation of the 500,000 ton per year commercial plant now being constructed by KFx and Thermo Ecotek.
- Expand the market for the products by testing high sulfur U.S. coals and foreign coals.
- Increase the product density by developing an extrusion system, and

- Reduce the costs of future plants using the Koppelman Series C process by developing a feed-coal preheater along with an inverted processor.

Quarter Objectives

Continue to support the startup activities of the commercial plant and conducting bench-scale tests and tests using the Series C pilot plant. Complete the NO_x emissions study and prepare an annual technical report describing activities during the first year of Phase III.

Accomplishments

This quarter we continued bench-scale testing of foreign and domestic coal and participated in conducting several tests in the Series C pilot plant. We also completed our study of the NO_x emissions to be expected by burning product from the Series C tests in utility boilers.

Activities for Next Quarter

Continue to support the startup activities of the commercial plant and continue bench-scale testing and testing using the Series C pilot plant. Complete the NO_x emissions study and prepare an annual technical report describing activities during the first year of Phase III.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 009 DEMONSTRATION OF THE KOPPELMAN "SERIES C" PROCESS USING A BATCH TEST UNIT WITH POWDER RIVER BASIN COAL AS FEED	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING	604,999	634,200
FY 1994 FUNDING	851,206	954,600
FY 1995 FUNDING		
FY 1996 FUNDING	1,000,000	1,000,000
FY 1997 FUNDING	548,527	932,500
PROJECT FUNDING TO DATE	3,004,732	3,521,300
TOTAL PROJECT VALUE \$6,526,032

COSPONSOR FUNDING IN FY 97 CONSISTED OF \$932,500 IN-KIND
 COSPONSOR FUNDING IN FY 96 CONSISTED OF \$250,000 CASH AND \$750,000 IN-KIND
 COSPONSOR FUNDING IN FY 94 CONSISTED OF \$175,000 CASH AND \$779,600 IN-KIND
 COSPONSOR FUNDING IN FY 93 CONSISTED OF \$634,200 IN-KIND

Signature of Recipient and Date LEE & BREDA 7/21/97	Signature of USDOE Reviewing Representative and Date
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**Task
10
(Old
5.25)**

Remote Chemical Sensor Development

**Status
Completed**

**Sponsor
In-Situ Incorporated**

Reporting Period: April 1 through June 30, 1997

Background

The detection and monitoring of groundwater and soil contaminants is essential to environmental mitigation efforts. WRI is continuing work begun under the earlier cooperative agreement on the development of needed instruments for accurate measurements of chemical materials with easy-to-use, portable equipment and for in-situ, real-time monitoring. This includes development of a new field test kit for measurement of diesel and other fuels in soils and a downhole monitoring device for volatile organic compounds. The work involves optimizing soil extraction chemistry, exploring optimal design and configuration of the fuel test kit photometer, and constructing prototype instruments for downhole VOC monitoring.

Status

The project has been completed.

Footnote

This task completed work begun as Task 5.25 under the previous cooperative agreement. Total USDOE and cosponsor funding was \$575,000 each for a project total of \$1,150,000.

Task 11	Market Assessment and Technical Feasibility Study of PFBC Ash Use	Status Ongoing
Sponsor Electric Power Research Institute		
Reporting Period: April 1 through June 30, 1997		
<p align="center">Background</p> <p><i>The chemical characteristics of pressurized fluidized bed combustion (PFBC) ash are quite different from other Clean Coal Technology (CCT) ashes. These characteristics may make the PFBC ash more amenable to options for its use than other CCT ashes. This study is to make a market assessment of potential uses of PFBC ash, evaluate the technical feasibility of these uses, and develop plans for full-scale demonstrations of the most promising options.</i></p>		

Task Objective

The objective of this task is to determine the market and technical use options for PFBC ash.

Quarter Objectives

- Finish geotechnical testing as related to structural fill and soil stabilization applications.
- Conduct synthetic aggregate production testing of the ash blend.
- Conduct soil amendment testing via greenhouse studies.
- Present paper at the 14th International Conference on Fluidized Bed Combustion in Vancouver, B.C.
- Prepare manuscript and presentation on the geotechnical properties of PFBC ash as related to ash use in construction and soil amendment applications to the Advanced Coal-Based Power and Environmental Systems '97 Conference.
- Initiate the preparation of the final report. Project continuation with Foster Wheeler Energy International, Inc. related to the

MacIntosh PFBC project in Florida was not selected for funding by WRI.

Accomplishments

- Geotechnical testing continued on the ash from pilot circulating PFBC tests at the Foster Wheeler Energia Oy facility in Karhula Finland. ASTM D-1557 specimens were made for strength and expansion testing. Freeze-thaw and wet-dry cycle durability tests were completed for both ASTM D-698 and D-1557 conditioned and compacted PFBC ashes. Hydration phase analysis composition determination as a function of curing conditions are nearing completion. The soil amendment greenhouse study was initiated using each of the PFBC ashes and both Meadow Foxtail Grass and Common Bermuda Grass. Germination studies were completed and plant production studies were initiated. Synthetic aggregate production testing was completed. This testing examined lime enhancement for aggregate properties. Crush strength, LA abrasion, and soundness testing is being conducted.

- WRI presented a paper at the 14th International Conference on Fluidized Bed Combustion held in Vancouver, B.C. May 11-14, 1997. The paper was entitled "Hydration Reaction Chemistry Associated with Management of Pressurized Fluidized Bed Combustion Ash" co-authored by A. E. Bland and T. H. Brown. The paper summarized the hydration reaction chemistry associated with the management of PFBC ashes from Foster Wheeler Energia Oy circulating PFBC and the AEP Tidd bubbling bed PFBC. Dr. Bland chaired the Session on Ash Behavior.
- WRI prepared a manuscript and presentation on the geotechnical properties of PFBC ash as related to ash use in construction and soil amendment applications for presentation at the Advanced Coal-Based Power and Environmental Systems '97 Conference to be held in July 22-24, 1997. The presentation focuses on the geotechnical properties of the PFBC ash as related to construction and soil amendment applications. The presentation addresses

the high and low sulfur derived circulating PFBC ash from the Foster Wheeler Energia Oy pilot facility in Karhula Finland, as well as the AEP Tidd bubbling bed PFBC ash from Brilliant, Ohio.

- Preparation of the final report was initiated. The topical report is being modified to include the results of the Karhula high sulfur coal tests.

Activities for Next Quarter

- Continue soil amendment testing via greenhouse studies.
- Present a paper on the geotechnical properties of PFBC ash as related to ash use in construction and soil amendment applications to the Advanced Coal-Based Power and Environmental Systems '97 Conference.
- Continue preparation of the final report.

Program/Project Identification No. DE-FC2 I-93MC30 I 27	Program/Project Title TASK 011 MARKET ASSESSMENT AND TECHNICAL FEASIBILITY STUDY OF PFBC ASH USE	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING	99,998	100,000
FY 1994 FUNDING		
FY 1995 FUNDING	147,640	303,500
FY 1996 FUNDING	200,000	200,000
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	447,638	603,500
TOTAL PROJECT VALUE \$1,051,138

COSPONSOR FUNDING IN FY 96 CONSISTED OF \$200,000 IN-KIND
 COSPONSOR FUNDING IN FY 95 CONSISTED OF \$303,500 IN-KIND
 COSPONSOR FUNDING IN FY 93 CONSISTED OF \$100,000 IN-KIND

Signature of Recipient and Date Lee E. Bredy 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 12	Solid State Nuclear Magnetic Resonance (NMR) Analysis of Naturally and Artificially Matured Kerogens	Status Completed
<p align="center">Sponsor University of Wyoming--EPSCoR</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>As part of the University of Wyoming research project to develop new approaches and supporting technology for oil and gas exploration in the United States, pressure compartmentalization is being modeled. To do so, fundamental data are required on the natural and artificial maturation of petroleum source rocks. WRI is performing solid-state NMR measurements to provide a significant part of the required data.</i></p>		
<p align="center">Status</p> <p align="center"><i>The project has been completed.</i></p>		

Task 13 (Old 5.6)	Contained Recovery of Oily Wastes (CROW™) Field Demonstration with Bell Lumber and Pole	Status Ongoing
Sponsor Bell Lumber and Pole		
Reporting Period: April 1 through June 30, 1997		
<p align="center">Background</p> <p>Operation of a pole and tie treatment plant in New Brighton, Minnesota for a number of years resulted in contamination of soils at the site with organic materials. WRI is using the CROW process to demonstrate remediation of the site. The process displaces and recovers part of the contaminating materials. This is followed by in-situ bioremediation of the residual oily substances.</p> <p align="center">Footnote</p> <p>This task completes work begun as Task 5.6 under the previous cooperative agreement. Total USDOE funding is \$587,644 and total cosponsor funding is \$2,024,955 for a project total of \$2,612,599.</p>		

Task Objectives

The objective of this task is to design, construct, and operate a field demonstration of the CROW™ process technology to treat a site contaminated with organic wastes from the wood treatment process.

Quarter Objective

Continue the phase-one, full-scale field demonstration.

Accomplishments

Since February 26, 1996 the operation of the CROW system has been an on/off proposition because of different mechanical problems with the cosponsor's equipment. In 1996, approximately 4.3 million gallons of water had been injected and over 20,000 gallons of oil have been recovered. Bell Lumber and Pole continues to use a portion of the recovered product in their pole treatment operation. Maximum hot-water injection temperatures have averaged 180°F, however, failures of the hot-water heat exchanger has resulted in non-continuous hot water injection.

Between hot water injection times, 70°F water is injected.

A new heat exchanger to produce the heated injection fluid was identified and ordered. The heat exchanger installation was completed in early April. For 1997, there have been 84 continuous operating days with over 1.4 million gallons of 130-165°F hot water injected and 1.8 million gallons of fluid extracted. To date, 32,500 gallons of organics have been recovered.

Activities for Next Quarter

Operation of the phase-one, full-scale remediation will continue next quarter. Replacement of the existing hot-water heat exchanger will be a high priority item.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 013 CONTAINED RECOVERY OF OILY WASTES (CROW™) FIELD DEMONSTRATION WITH BELL LUMBER AND POLE	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

	USDOE	SPONSOR(S)
FY 1993 FUNDING	90,800	
FY 1994 FUNDING		207,396
FY 1995 FUNDING		250,000
FY 1996 FUNDING	30,000	84,000
FY 1997 FUNDING	23,000	36,000
PROJECT FUNDING TO DATE	143,800	577,396
TOTAL PROJECT VALUE \$721,196

THE PROJECT COSPONSOR HAS ADDED AN ADDITIONAL \$541,396 CASH TO THE PROJECT RAISING THEIR TOTAL CONTRIBUTION FROM \$1,940,955 TO \$2,482,351
 COSPONSOR FUNDING IN FY 97 CONSISTED OF \$36,000 CASH

Signature of Recipient and Date Lee & Bradley 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 14	"B Series" Pilot Plant Tests	Status Completed
Sponsor Heartland Fuels Corporation		
Reporting Period: April 1 through June 30, 1997		
Background <i>In a previous JSRP task, WRI participated with Heartland Fuels Corporation in conducting pilot-scale tests of the "B" series process using three different coals. The present study determined the characteristics of the process condensate when operated at lower temperatures than previously tested. Seven tests were conducted in the pilot plant and samples of the condensate were collected and analyzed.</i>		
Status <i>The project has been completed.</i>		

**Task
15
(Old 5.26)**

**In Situ Treatment
of Manufactured Gas Plant Contaminated Soils
Demonstration Program**

**Status
Complete**

Sponsors

**Pennsylvania Power and Light, US Environmental Protection Agency, Gas Research Institute,
and Electric Power Research Institute**

Reporting Period: April 1 through June 30, 1997

Background

The process of manufacturing gas from coal years ago resulted in the contamination of soils with carcinogenic materials. One such site that is presently being cleaned is the Brodhead Creek Site in Stroudsburg, Pennsylvania. WRI is using its CROW process in conjunction with in-situ biotreatment to demonstrate remediation of the site. The overall steps in the study are to design the application of the CROW process to the site, obtain permits, construct and operate the field demonstration test and evaluate the results.

Footnote

This task completes work begun as Task 5.26 under the previous cooperative agreement. Total USDOE funding is \$518,689 and total cosponsor funding is \$1,360,523 for a project total of \$1,879,212.

Status

The project has been completed and awaits EPA approval for site closure.

Task 16	Development and Demonstration of a Wood-Fired Gas Turbine System	Status On Stand-by
<p align="center">Sponsors Power Generating Inc. and Office of Conservation and Renewable Energy, US Department of Energy</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Development of a means to use inexpensive solid fuels for electrical power generation and thermal energy has the double benefit of providing low-cost energy and utilization of an otherwise possibly unused resource. Power Generating Inc. has patented a unique, direct-fired gas turbine power system that could be operated on such fuels. The system is expected to operate at thermal efficiencies in excess of 70% through full utilization of the electrical and thermal energy generated. Problems generally inherent in such systems are overcome by the unique design of this system and by close control of fuel specifications and operating procedures. WRI is working on the detailed design of a demonstration unit. When designed, a 425 kilowatt power system will be constructed and tested on a clean wood fuel. Immediately following the wood testing, the system will be reconfigured and operated on a low-ash coal.</i></p>		

Task Objectives

The goal of this project is to confirm the technical and economic viability of operating a direct-fired gas turbine power system on solid fuel. Specific objectives are:

- Refine and finalize the engineering design for the prototype PGI Power System.
- Prove the conceptual and technical feasibility of operating a direct-fired gas turbine power system on solid fuels.
- Confirm the operating characteristics of the PGI Power System.
- Verify the efficiency and economic potential of the PGI Power System.
- Evaluate the potential environmental impact of the PGI Power System.

- Develop recommendations for additional R&D work on the use of solid fuels in direct-fired gas turbine power systems.

Quarter Objective

Maintain the plant in cold standby until PGI can secure funds for continuation of the project.

Accomplishments

The plant is being kept in cold standby while the industrial partner attempts to raise the funds for continuation of the project.

Activities for Next Quarter

When required funds are made available, the plant will be restarted and testing will resume.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 016 DEVELOPMENT AND DEMONSTRATION OF A WOOD-FIRED GAS TURBINE SYSTEM	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING		
FY 1994 FUNDING	673,434	1,313,584
FY 1995 FUNDING	742,800	990,400
FY 1996 FUNDING		
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	1,416,234	2,303,984
TOTAL PROJECT VALUE \$3,720,218

COSPONSOR FUNDING IN FY 95 CONSISTED OF \$840,200 CASH AND \$150,200 IN-KIND
COSPONSOR FUNDING IN FY 94 CONSISTED OF \$832,584 CASH AND \$481,000 IN-KIND

Signature of Recipient and Date LEE E Bredy 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 17	Solid State NMR Analysis of Mowry Formation Shale from Different Sedimentary Basins	Status Ongoing
<p align="center">Sponsors University of Wyoming and Gas Research Institute</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>New approaches and supporting technology are needed to reverse the diminishing returns from oil and gas exploration in the United States. The discovery of subsurface fluid or pressure chambers has the potential to delineate a new class of hydrocarbon traps, thereby revitalizing interest in domestic exploration. The University of Wyoming has a research project to develop a conceptual model of the formation, distribution, and destruction of pressure chambers and seals in sedimentary basins. A key to understanding the diagenetic and maturational behavior is knowledge of the organic carbon structure of the kerogen in petroleum source rocks and how the kerogen structure changed during petroleum generation. As a part of this project, WRI is performing solid-state NMR measurements to provide information on the diagenesis and maturation of petroleum source rocks. The material being studied in this task is Mowry Formation shale from sedimentary basins.</i></p>		

Task Objective

The objectives of this JSR project are to use solid-state nuclear magnetic resonance (NMR) methods to study the maturation of source rocks from different sedimentary basins brought about naturally by depth of burial and artificially by hydrous pyrolysis experiments.

Quarter Objective

FETC approval for continuation of the JSR project was granted late in the quarter. No objectives were established for this quarter.

Accomplishments

FETC approval for continuation of the JSR project was granted late in the quarter. Consequently, no work was performed during this quarter.

Activities for Next Quarter

Acquire samples for NMR study. Submit abstract for presentation at the International Gas Research Conference (IGRC98) to be held in San Diego, CA in November 1998.

Program/Project Identification No. DE-FC2 I-93MC30 I 27	Program/Project Title TASK O I 7 ANALYSIS OF MOWRY FORMATION SHALE FROM DIFFERENT SEDIMENTARY BASINS	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING		
FY 1994 FUNDING	30,064	30,000
FY 1995 FUNDING	30,000	30,000
FY 1996 FUNDING		
FY 1997 FUNDING	20,000	20,000
PROJECT FUNDING TO DATE	80,064	80,000
TOTAL PROJECT VALUE \$180,064

COSPONSOR FUNDING IN FY 97 CONSISTED OF \$20,000 CASH
 COSPONSOR FUNDING IN FY 95 CONSISTED OF \$30,000 CASH
 COSPONSOR FUNDING IN FY 94 CONSISTED OF \$30,000 CASH

Signature of Recipient and Date LEE & BRECK 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 18	Acid-Mine Drainage Prevention, Control, and Treatment Development for the Stockett/Sand Coulee Area	Status Ongoing
<p align="center">Sponsor Montana Bureau of Mines and Geology</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Extremely acidic water is continually discharging from abandoned coal mines in the Stockett/Sand Coulee area in Montana. The water is unusable and contaminates other waters in the area. Considerable money has been spent trying to remediate the acid-mine drainage that is occurring and in replacing other water supplies that have been contaminated by the drainage water. Techniques applied to the problem so far have focused on managing and containing the mine waters, with little success. This study is identifying the geologic, hydrologic, and chemical factors that control the production of the acid-mine drainage. Once the mechanisms are identified, potential treatment techniques will be evaluated. The most promising techniques will be modeled using a series of laboratory studies. Results of the study will be used to design a field demonstration project for the amelioration of drainage water at a specific site in the problem area.</i></p>		

Task Objective

The task objective is to evaluate the methods available and to develop methods to control or eliminate the production of acid in the Stockett/Sand Coulee mine area.

Quarter Objectives

Investigations concerning the establishment of coatings on the acid forming materials will continue. A selected number of the core samples will be analyzed to determine the extent of the acid-forming reaction zone in the Number 6 mine. The monitoring program will continue at the mine site.

Accomplishments

On-site water monitoring is on-going. A column study showing the impact of underground placement of acid-neutralizing materials on acid mine drainage is ongoing. A number of core samples have been analyzed showing that the acid generated in the mine appears to be directly associated with the coal seam and adjacent materials.

Activities for Next Quarter

Core samples will continue to be analyzed to determine the extent of the acid-forming reaction zone in the Number 6 mine. Column studies evaluating the impact of acid neutralizing materials on acid mine drainage are ongoing. Selected treatments dealing with acid neutralization in underground mine situations using alkaline and phosphate materials are being simulated in the laboratory. The monitoring program will continue at the mine site.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 018 ACID-MINE DRAINAGE PREVENTION, CONTROL, AND TREATMENT DEVELOPMENT FOR THE STOCKETT/SAND COULEE AREA	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

	USDOE	SPONSOR(S)
FY 1993 FUNDING		
FY 1994 FUNDING	119,665	120,000
FY 1995 FUNDING	91,403	90,845
FY 1996 FUNDING		
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	211,068	210,845
TOTAL PROJECT VALUE \$421,913

COSPONSOR FUNDING IN FY 95 CONSISTED OF \$90,845 IN-KIND
COSPONSOR FUNDING IN FY 94 CONSISTED OF \$120,000 IN-KIND

Signature of Recipient and Date LEE E BREDY 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 19	PERF Dispersion Modeling Project Phase 2 Major Field Demonstration	Status On-hold
<p align="center">Sponsor Petroleum Environmental Research Forum <i>(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 and Development Company)</i></p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>WRI and Petroleum Environmental Research Forum (93-16) are assessing the application of newly developed mathematical models for predicting dense gas dispersion by testing the models against the experimental results of large scale field simulations of chemical spills. The PERF and WRI are conducting field scale tests of dense gas dispersion in order to validate the models and to provide the hydrocarbon and chemical industries with information needed to conduct risk management assessments. Major components of the tests are; source emissions release system, meteorology data analyses and meteorology instrumentation, and the array configuration. The WRI 1993 HAZMAT spill test results, wind tunnel tests, and model results were used to aid in the design of the dispersion grid dimensions, sensor location, and test operation.</i></p>		

Task Objective

Implement and conduct the PERF 93-16 tests to the design specification and collect data for gas releases in the simulated petroleum refinery/tank farm under neutral and stable atmospheric conditions

Quarter Objectives

This quarter's primary objective has been to arrange funding from EPA and the PERF to support the data processing and analysis of the acquired data sets.

Accomplishments

No funding has been provided with which to complete the technical work.

Activities for Next Quarter

Quality assurance for the test operations is completed. The final report will be prepared upon receipt of the remaining funding from EPA and the PERF.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 019 PERF DISPERSION MODELING PROJECT PHASE 2 MAJOR FIELD DEMONSTRATION	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(s)
FY 1993 FUNDING		
FY 1994 FUNDING		
FY 1995 FUNDING	502,124	945,330
FY 1996 FUNDING		
FY 1997 FUNDING		
PROJECT FUNDING TO DATE	502,124	945,330
TOTAL PROJECT VALUE \$1,447,454

COSPONSOR FUNDING IN FY 95 CONSISTED OF \$315,000 CASH AND \$630,330 IN-KIND

Signature of Recipient and Date LEE E BREDY 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 20	Field Testing of the TaBoRR Process Using the Asphalt and Dry Bottoms Configurations	Status Ongoing
<p align="center">Sponsors Naval Petroleum Reserve -3, Pease Oil Field Equipment, Wallace Energy, Inc., the Rocky Mountain Oilfield Testing Center and Canadian Earth and Environmental Engineering, Inc.</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Tank bottom wastes are emulsions composed of crude oil, water and solids that are produced from various depths. The crude oil composition is dependent on the source rock and reservoir maturation and consists of a wide range of hydrocarbons that include alkanes, naphthenes and aromatic compounds. These compounds have a wide range of emulsion characteristics that prevent the effective use of any current technology. Although the TaBoRR process was conceptually designed to handle this wide range of emulsified material, further testing is required to verify this experimentally. This project addresses the issues of processing a variety of different feed materials from many sources as well as modifying the process to handle a wider range of oil, water and solid concentrations.</i></p>		

Task Objectives

The task objectives are to:

- Perform modifications to the process to allow for handling larger water concentrations and larger solid sizes present in the feed material;
- Test and operate the unit using a variety of feed materials;
- Determine the feasibility of using the bottoms material as a road material;
- Perform modifications to the process to convert the bottoms into solid material and use the gaseous hydrocarbons as a fuel source for the process; and
- Test and operate the unit to ensure environmental compliance and verify process economics

Quarter Objectives

Complete mass and energy balances for the stripper and pyrolyzer. Modify and test the flash system. Finish modifications and test stripper operation. Modify and test the product recovery system. Shakedown and operate the pyrolyzer. Characterize materials created by the pyrolyzer. Procure and test material from different sources.

Accomplishments

The pyrolyzer fabrication was completed by the subcontractor and plant components assembled onto three skids. Electrical and instrumentation wiring were completed and Control strategies were defined. Shakedown of the pyrolyzer was initiated with early tests showing that there were several leaks in the shell. All of the leaks were in areas where access around the process twin screws restricted repairs. Nevertheless, the leaks have been repaired. Early indications are that the fluidized bed side of the plant functions as

envisioned. Tests are underway to checkout the process side of the pyrolyzer.

As reported in the previous quarterly report, material received from Wallace Energy caused severe erosive wear of the flash valve. In consultations with the valve manufacturer, valve internals were upgraded to cobalt-cemented tungsten carbide. Further testing showed that valve wear was still an issue. Based on coal slurry atomization tests conducted at GE in support of USDOE's coal-fired diesel engine development work, it appears that flash valve internals may require diamond compact inserts in wear prone areas. Working closely with the valve manufacturer, internals have been redesigned and parts procured.

Approximately 123 bbls of feed material was received from NPR-3. The material contained approximately 55 % water and about 8 % solids. The material was subjected to multiple flashes and

flash/decant and the water content was reduced to about 10 %. Despite a high solids content, during this operation cobalt-cemented tungsten carbide components did not suffer wear, indicating that the Wallace Energy material is exceptionally high in hard and/or angular solid particles. During the stripping phase of testing with NPR-3 material it was discovered that the stripper bottoms outlet and internals were plugged with coke. This problem presumably arose during operations at higher temperatures while Pease material was being processed.

Various options for cleaning out the stripper are being explored and evaluated.

Activities for Next Quarter

Clean out the stripper and complete NPR-3 testing. Shakedown the pyrolyzer with stripper bottoms.

Program/Project Identification No. DE-FC2 I-93MC30 I 27	Program/Project Title TASK O20 FIELD TESTING OF THE TABORR PROCESS USING THE ASPHALT AND DRY BOTTOMS CONFIGURATIONS	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(s)
FY 1993 FUNDING		
FY 1994 FUNDING		
FY 1995 FUNDING		
FY 1996 FUNDING	285,000	285,415
FY 1997 FUNDING	1,282,287	2,500,000
PROJECT FUNDING TO DATE	1,567,287	2,785,287
TOTAL PROJECT VALUE \$4,352,702

COSPONSOR FUNDING IN FY 97 CONSISTED OF \$750,000 CASH AND \$1,750,000 IN-KIND
COSPONSOR FUNDING IN FY 96 CONSISTED OF \$285,415 IN-KIND

Signature of Recipient and Date Lee E. Brady 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 21	Validation of a New Soil VOC Sampler	Status Ongoing
Sponsor En Chem Incorporated		
Reporting Period: April 1 through June 30, 1997		
<p align="center">Background</p> <p><i>WRI is providing technical support directed at achieving national acceptance for the EnCore sampling device to enhance its market acceptance by both the regulatory community and environmental contract firms that are responsible for the evaluation of VOC contamination at sites throughout the country. One version of the EnCore sampler is accepted for use by the state of Wisconsin. It is a stainless steel device that requires cleaning after use. En Chem is developing a disposable version of the sampler which will lower the cost of use and enhance its acceptance. WRI is evaluating the operation of the stainless steel device. Following successful evaluation, WRI will approach the American Society for Testing and Materials (ASTM) to initiate a process for method preparation and approval in ASTM format. The ASTM approval process will be initiated with the goal of providing national acceptance of the EnCore samplers. WRI will also provide technical support to En Chem in the development of a disposable plastic version of the EnCore sampler.</i></p>		

Task Objective

Western Research Institute is facilitating national acceptance of the EnCore™ soil volatile organic compound (VOC) sampling device by conducting product tests, method development, and method validation activities.

Quarter Objectives

- Attend the meeting of ASTM committee D-34 on Waste management in St Louis in April and discuss the new draft practice and revision of ASTM D-4547.
- Work with the corporate co-sponsor to perform experiments to verify the performance of the disposable plastic prototype EnCore sampling devices. Incorporate the results into the new draft practice.

Accomplishments

- Susan Sorini attended the meeting of ASTM Committee D-34 on Waste

Management in St Louis in April. She was appointed chairman of ASTM Task Group D-34.01.01 on Environmental Monitoring and Sampling, under which the new draft practice titled "Standard Practice for Using a Coring Tube for Sampling and Storing Soil for Volatile Organic Analysis" will be developed.

- An ASTM publicity announcement describing the development and validation of the new draft practice appeared in the June issue of ASTM's Standardization News. Several companies contacted WRI in response to the announcement expressing interest in participating in the validation process.
- The timing of tests required for the development of the new ASTM practice were discussed with En Chem, Inc. personnel. The molding problems with the initial batch of prototype RTP polymer samplers has been corrected, and the first batch of about 200 devices will be produced in the near future. After initial

testing of these devices, the experimental work to document their performance will begin. To expedite acceptance of the new practice, reference to freezing the samples as a way of storage was deleted. We will adhere to the currently accepted technique of refrigeration for up to 48 hours. Later we can experiment with freezing to generate sufficient data to demonstrate its utility.

- WRI continued to participate in the review of drafts of the revision of ASTM D-4547, "Standard Practice for Sampling Waste and Soils for Volatile Organics". Revision of this method in conjunction with development of the new practice will be ideal because the new practice can be referenced in D-4547. The revision of D-

4547 is part of the EPA/ASTM Accelerated Standards Program.

- Several drafts of a paper by Al Hewitt of the U.S. Army Cold Regions Lab titled "A Tool for the Collection and Storage of Soil Samples for Volatile Organic Compound Analysis" were reviewed at the request of Dr. Hewitt.

Activities for Next Quarter

- Work with the corporate co-sponsor to perform experiments to verify the performance of the disposable plastic prototype EnCore sampling devices. Incorporate the results into the new draft practice.

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 021 VALIDATION OF A NEW SOIL VOC SAMPLER	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING		
FY 1994 FUNDING		
FY 1995 FUNDING		
FY 1996 FUNDING	50,541	62,500
FY 1997 FUNDING	149,762	187,500
PROJECT FUNDING TO DATE	200,303	250,000
TOTAL PROJECT VALUE \$450,303

COSPONSOR FUNDING IN FY 97 CONSISTED OF \$37,500 CASH AND \$150,000 IN-KIND
COSPONSOR FUNDING IN FY 96 CONSISTED OF \$12,500 CASH AND \$50,000 IN-KIND

Signature of Recipient and Date Lee E. Brady 7/21/97	Signature of USDOE Reviewing Representative and Date
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Task 22	Market Assessment and Demonstration of Lignite FBC Ash Flowable Fill Applications	Status Ongoing
<p align="center">Sponsor North Dakota Industrial Commission and Montana-Dakota Utilities</p>		
<p align="center">Reporting Period: April 1 through June 30, 1997</p>		
<p align="center">Background</p> <p><i>Controlled low strength flowable fill materials have found acceptance in the construction industry as a viable low cost option for excavatable and structural fill applications. Use of the FBC ash derived from the burning of North Dakota lignite at the Montana-Dakota Utilities (MDU) Heskett plant in flowable fill construction materials represents a potential new market for the ash providing revenue and avoiding the costs and environmental consequences associated with its disposal. This study is to (1) establish the engineering and environmental properties of MDU ash based flowable fill materials; (2) make an assessment of the market for MDU flowable fill; and (3) demonstrate the viability of MDU flowable fill materials through full scale demonstrations.</i></p>		

Task Objective

Determine through laboratory testing and field demonstration the technical and environmental potential of using FBC ash from the Montana-Dakota Utilities (MDU) Heskett fluidized bed combustion (FBC) plant in the production of 'excavatable' and structural' grade flowable fill materials for construction applications.

Quarter Objectives

- Begin the laboratory scale MDU CLSFFM testing
- Initiate market assessments and potential field demonstration sites

Accomplishments

Task II testing of the MDU flowable fill began during the quarter. Task II scope of testing addressed the following areas.

- **Expansion-Shrinkage Pressures and Settlement** - Testing has not been initiated.

- **Freeze/Thaw Cycle Performance** - The test specimens have been prepared and cycle testing has been completed. The testing follows the ASTM D-560 procedure using the MDU 'structural' grade flowable fill with and without air entrainment. The issue of freeze/thaw durability is not an issue for the 'excavatable' grade of MDU CLSFFM. The results of the testing indicate that AEA are not needed for freeze/thaw durability. However, AEA can be used to reduce the strength for excavatable fill materials.
- **Permeate Characteristics** - The permeate characteristics are being tested according to the experimental plan and methodology developed in conjunction with the North Dakota Department of Health. Preliminary tests have been conducted to shake down the environmental 'field simulator'. Based on the results of the ASTM D-3987 leachate and bulk analysis tests, WRI has developed a list of chemical parameters to be analyzed for on the permeates from the 'field simulator'. Testing was initiated using the MDU flowable fill and a local ND

soil. Permeates have been collected and are being prepared for analysis. The mixture of crushed MDU flowable fill and ND soil designed to simulate the impact of excavated fill on the soil was also conducted and the permeates are being prepared for analysis.

- **Embed Compatibility** - The embed testing continues. Test coupons of copper, rebar, galvanized conduit, portland cement and portland cement with fly ash have been implanted in MDU flowable fill mix and are being cycled under wet/dry conditions for up to 1 year. Multiple sets of mixes and coupons have been fabricated to allow the coupons to be examined after varying ages. The first set of coupons will be evaluated at the end of July.
- **Additional Environmental Testing** - In addition, the North Dakota Department of Health had suggested an expansion of the environmental testing to include more detailed characterization of the raw ash and leaching according to the ASTM D-

3987. Samples of both the MDU raw fly ash and MDU flowable fill mix have been subjected to ASTM leachate D-3987 testing and bulk chemical analysis. The characterization of these materials is extensive, including trace metals and radionuclides. The list covers the relevant chemical species included in the Primary and Secondary Drinking Water Standards. The results have been tabulated and are being sent to the ND Department of Health for their review. In summary, with the exception of the pH the D-3987 extract meets the specifications of both the domestic and agriculture water standards

Activities for Next Quarter

- Complete the laboratory scale MDU CLSFFM testing
- Initiate market assessments and determination of potential field demonstration sites

Program/Project Identification No. DE-FC21-93MC30127	Program/Project Title TASK 022 MARKET ASSESSMENT AND DEMONSTRATION OF LIGNITE FBC ASH FLOWABLE FILL APPLICATIONS	Reporting Period 4/1/97 through 6/30/97
Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070		Program/Project Start Date MARCH 26, 1993
		Completion Date MARCH 25, 1997

PROJECT FUNDING HISTORY		
	USDOE	SPONSOR(S)
FY 1993 FUNDING		
FY 1994 FUNDING		
FY 1995 FUNDING		
FY 1996 FUNDING		
FY 1997 FUNDING	72,637	79,996
PROJECT FUNDING TO DATE	72,637	79,996
TOTAL PROJECT VALUE \$152,633

COSPONSOR FUNDING IN FY 97 CONSISTED OF \$50,996 CASH AND \$29,000 IN-KIND

Signature of Recipient and Date Lee E Bredy 7/21/97	Signature of USDOE Reviewing Representative and Date
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