Providing Solutions to Energy and Environmental Problems


by Western Research Institute Laramie, Wyoming

July 1997

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# Table of Contents

<table>
<thead>
<tr>
<th>Program Overview</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of Appropriations, Obligations &amp; Expenditures</td>
<td>2</td>
</tr>
<tr>
<td>Executive Summary</td>
<td>3</td>
</tr>
<tr>
<td>Current Obligations</td>
<td>4</td>
</tr>
<tr>
<td>Current Expenditures</td>
<td>7</td>
</tr>
<tr>
<td>Technical Highlights</td>
<td>8</td>
</tr>
<tr>
<td>Summary of Objectives &amp; Accomplishments</td>
<td>9</td>
</tr>
<tr>
<td>Task 001 Development and Demonstration of a Practical Electric Downhole Steam Generator for Thermal Recovery of Heavy Oil and Tar</td>
<td>10</td>
</tr>
<tr>
<td>Task 002 Wetting Behavior of Selected Crude Oil/Brine/Rock Systems</td>
<td>11</td>
</tr>
<tr>
<td>Task 003 Coal Gasification, Power Generation and Product Market Study</td>
<td>12</td>
</tr>
<tr>
<td>Task 004 The Impact of Leachate from Clean Coal Technology Waste on the Stability of Clay Liners</td>
<td>13</td>
</tr>
<tr>
<td>Task 005 Investigation of Coprocessing Heavy Oil, Automobile Shredder Residue, and Coal</td>
<td>14</td>
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<tr>
<td>Task 006 Injection into Coal Seams for Simultaneous CO₂ Mitigation and Enhanced Recovery of Coalbed Methane</td>
<td>15</td>
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<tr>
<td>Task 007 Optimization of Carbonizer Operations in the FMC Coke Process</td>
<td>18</td>
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<tr>
<td>Task 008 Chemical Sensor and Field Screening Technology Development</td>
<td>19</td>
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<td>Task 009 Demonstration of the Koppelman &quot;Series C&quot; Process Using a Batch Test Unit with Powder River Basin Coal as Feed</td>
<td>22</td>
</tr>
<tr>
<td>Task 010 (Old Task 5.25) Remote Chemical Sensor Development</td>
<td>24</td>
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<td>Task 011 Market Assessment and Technical Feasibility Study of PFBC Ash Use</td>
<td>25</td>
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<td>Task Number</td>
<td>Task Description</td>
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<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>012</td>
<td>Solid State NMR Analysis of Naturally and Artificially Matured Kerogens</td>
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<td>013 (Old Task 5.6)</td>
<td>Contained Recovery of Oily Wastes Field Demonstration with Bell Lumber and Pole</td>
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<td>&quot;B Series&quot; Pilot Plant Tests</td>
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<td>015 (Old Task 5.26)</td>
<td>InSitu Treatment of Manufactured Gas Plant Contaminated Soils</td>
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<td>016</td>
<td>Development and Demonstration of a Wood-Fired Gas Turbine System</td>
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<td>017</td>
<td>Solid State NMR Analysis of Mowry Formation Shale from Different Sedimentary Basins</td>
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<td>018</td>
<td>Acid-Mine Drainage Prevention, Control, and Treatment Development for the Stocket/Sand Coulee Area</td>
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<td>019</td>
<td>PERF Dispersion Modeling Project. Phase 2 Major Field Demonstration</td>
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<td>020</td>
<td>Field Testing of the TaBoRR® Process Using the Asphalt and Dry Bottoms Configurations</td>
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<td>021</td>
<td>Validation of a New Soil VOC Sampler</td>
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<td>022</td>
<td>Market Assessment and Demonstration of Lignite FBC Ash Flowable Fill Applications</td>
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</table>
Cumulative JSRP Funding
Summarized by Technology Area

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

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

Environmental Programs
$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
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

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

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

<table>
<thead>
<tr>
<th>Task</th>
<th>Project</th>
<th>Previous Commitments</th>
<th>FY 97 Commitment</th>
<th>Total Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>USDOE</td>
<td>Sponsor</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>Electric Downhole Steam Generator</td>
<td>1,282,785</td>
<td>1,315,200</td>
<td>2,745,985</td>
</tr>
<tr>
<td>2</td>
<td>Wetting Behavior of Crude Oil/Brine/Rock Systems</td>
<td>1,132,356</td>
<td>1,220,793</td>
<td>2,353,149</td>
</tr>
<tr>
<td>3</td>
<td>Kerr Coal Product Market Study</td>
<td>57,039</td>
<td>60,000</td>
<td>117,039</td>
</tr>
<tr>
<td>7</td>
<td>Optimization of FMC Carbonizer</td>
<td>48,418</td>
<td>45,000</td>
<td>93,418</td>
</tr>
<tr>
<td>9</td>
<td>Demonstration of the &quot;Series C&quot; Process</td>
<td>2,456,205</td>
<td>2,588,800</td>
<td>5,045,005</td>
</tr>
<tr>
<td>14</td>
<td>&quot;Series B&quot; Pilot Plant Tests</td>
<td>8,668</td>
<td>10,092</td>
<td>18,760</td>
</tr>
<tr>
<td>6</td>
<td>Enhanced Recovery of Coalbed Methane</td>
<td>1,135,900</td>
<td>1,716,270</td>
<td>2,852,170</td>
</tr>
<tr>
<td>16</td>
<td>Demonstration of a Wood-Fired Gas Turbine System</td>
<td>1,416,234</td>
<td>2,303,984</td>
<td>3,720,218</td>
</tr>
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</table>

**Subtotal Energy Programs**

<table>
<thead>
<tr>
<th></th>
<th>USDOE</th>
<th>Sponsor</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>7,537,605</td>
<td>9,260,139</td>
<td>16,797,744</td>
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<tr>
<td></td>
<td>548,527</td>
<td>932,500</td>
<td>1,481,027</td>
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<tr>
<td></td>
<td>8,086,132</td>
<td>10,192,639</td>
<td>18,278,771</td>
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</table>

*Page 4*
<table>
<thead>
<tr>
<th>Task</th>
<th>Project</th>
<th>Previous Commitments</th>
<th>FY 97 Commitment</th>
<th>Total Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>USDOE</td>
<td>Sponsor</td>
<td>Total</td>
</tr>
<tr>
<td>8</td>
<td>Chemical Sensor and Field Screening Technology</td>
<td>749,900</td>
<td>749,900</td>
<td>1,499,800</td>
</tr>
<tr>
<td>10</td>
<td>Remote Chemical Sensor Development</td>
<td>355,000</td>
<td>232,081</td>
<td>587,081</td>
</tr>
<tr>
<td>12</td>
<td>NMR Analysis of Matured Kerogens</td>
<td>30,192</td>
<td>15,000</td>
<td>45,192</td>
</tr>
<tr>
<td>17</td>
<td>NMR Analysis of Mowry Formation Shales</td>
<td>60,064</td>
<td>60,000</td>
<td>120,064</td>
</tr>
<tr>
<td>19</td>
<td>PERF Phase II Demonstration</td>
<td>502,124</td>
<td>945,330</td>
<td>1,447,454</td>
</tr>
<tr>
<td>21</td>
<td>Validation of a New VOC Sampler</td>
<td>50,541</td>
<td>62,500</td>
<td>113,041</td>
</tr>
</tbody>
</table>

| 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 |

Page 5
Table 2 (Continued)
Tasks Approved for Funding Through Fiscal Year 1997

<table>
<thead>
<tr>
<th>Task</th>
<th>Project</th>
<th>Previous Commitments</th>
<th>FY 97 Commitment</th>
<th>Total Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>USDOE</td>
<td>Sponsor</td>
<td>Total</td>
</tr>
<tr>
<td>11</td>
<td>Market Assessment Study of PFBC Ash Use</td>
<td>447,638</td>
<td>603,500</td>
<td>1,051,138</td>
</tr>
<tr>
<td>13</td>
<td>CROW Field Demonstration of Biomass Lignite and Pole Soils</td>
<td>120,800</td>
<td>541,396</td>
<td>662,196</td>
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<tr>
<td>15</td>
<td>In Situ Treatment of MPG Contaminated Soils</td>
<td>405,289</td>
<td>1,360,523</td>
<td>1,765,812</td>
</tr>
<tr>
<td>18</td>
<td>Acid-Mine Drainage Prevention and Control</td>
<td>211,068</td>
<td>210,845</td>
<td>421,913</td>
</tr>
<tr>
<td>20</td>
<td>Field Testing of the TaBoRR Process</td>
<td>285,000</td>
<td>285,415</td>
<td>570,415</td>
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<tr>
<td>22</td>
<td>Market Assessment Study of PFBC Ash Use from Lignite</td>
<td>72,637</td>
<td>79,996</td>
<td>152,633</td>
</tr>
</tbody>
</table>

Subtotal, Environ. Programs | 1,700,838 | 3,261,259 | 4,962,097 | 3,078,762 | 5,877,255 | 8,956,017 |

Total, All Programs | 10,986,264 | 14,586,209 | 25,572,473 | 20,966,213 | 3,755,996 | 5,652,209 | 13,062,477 | 18,342,205 | 31,424,682 |
## Current Expenditures

Table 3
Expenditures on Contract DE-FC21-93MC30127

<table>
<thead>
<tr>
<th>Task</th>
<th>Budget</th>
<th>Expended Prior Periods</th>
<th>April 1997</th>
<th>May 1997</th>
<th>June 1997</th>
<th>Total</th>
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<td>1</td>
<td>$1,282,785</td>
<td>$1,270,742</td>
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<td>1,132,356</td>
<td>1,161,421</td>
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<td>57,039</td>
<td>56,969</td>
<td>Completed</td>
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<td>Withdrawn</td>
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<td>6</td>
<td>1,135,900</td>
<td>948,847</td>
<td>12,273</td>
<td>10,590</td>
<td>14,056</td>
<td>985,766</td>
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<td>48,418</td>
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<td>749,900</td>
<td>711,139</td>
<td>11,250</td>
<td>7,917</td>
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<td>3,004,732</td>
<td>2,100,585</td>
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<td>11</td>
<td>447,638</td>
<td>402,201</td>
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<td>30,192</td>
<td>30,760</td>
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<td>143,800</td>
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<td>2,574</td>
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<td>8,668</td>
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<td>405,289</td>
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<td>Completed</td>
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<td>306,235</td>
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<td>16</td>
<td>1,416,234</td>
<td>1,282,013</td>
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<td>1,282,013</td>
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<td>80,064</td>
<td>54,003</td>
<td>551</td>
<td>4,441</td>
<td>165</td>
<td>59,160</td>
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<tr>
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<td>211,068</td>
<td>172,677</td>
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<td>5,233</td>
<td>4,910</td>
<td>186,122</td>
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<td>19</td>
<td>502,124</td>
<td>513,995</td>
<td>(185,241)</td>
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<td>328,755</td>
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<td>20</td>
<td>1,567,287</td>
<td>971,051</td>
<td>70,127</td>
<td>65,814</td>
<td>163,871</td>
<td>1,270,863</td>
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<td>21</td>
<td>200,303</td>
<td>37,683</td>
<td>8,626</td>
<td>7,336</td>
<td>4,248</td>
<td>57,903</td>
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<td></td>
<td>72,637</td>
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</table>

Total $13,082,477 $10,846,722 ($23,523) $213,352 $248,169 $11,264,719
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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Wetting Behavior of Selected Crude Oil/Brine/Rock Systems

Sponsors
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

Reporting Period: April 1 through June 30, 1997

Background
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.

Status
The project has been completed.
<table>
<thead>
<tr>
<th>Task 3</th>
<th>Coal Gasification, Power Generation, and Product Market Study</th>
<th>Status Completed</th>
</tr>
</thead>
</table>

**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.
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.

Status

The project has been completed.
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.

Status

This project was withdrawn due to the sponsor's inability to provide matching funds.
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-CO$_2$/N$_2$ 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 CO$_2$ 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 CO$_2$/N$_2$ 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 CO₂ MITIGATION AND ENHANCED RECOVERY OF COALBED METHANE

Date of Title Completion DE-FC21-93MC30127

Name and Address WESTERN RESEARCH INSTITUTE 365 NORTH NINTH STREET LARAMIE, WYOMING 82070

Reporting Period 4/1/97 through 6/30/97

Project Funding History

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Total Project Value $2,852,170

Project Expenditures

FRANK CARLSON, PROJECT MANAGER

Major Milestone Status

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<td>CO₂/N₂ Lab Tests (Wyoming)</td>
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Quarterly Reports

Fiscal Year 1997 March June September December

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

Signature of Recipient and Date Lee E. Breck 7/2/97

Signature of USDOE Reviewing Representative and Date
Sponsor
University of Wyoming Western Coal Consortium

Reporting Period: April 1 through June 30, 1997

Background
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.

Status
The project has been completed.
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.


- 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.
**Task 008**  
**Chemical Sensor and Field Screening Technology Development**

**Program/Project Identification No.**  
DE-FC21-93MC30127

**Program/Project Title**  

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

**Project Fundings History**

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**Project Expenditures**

- **John Schabron, Project Manager**

- **Fiscal Year 1997:**  
  - March  
  - June  
  - September  
  - December

- 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 Bledsoe 7/22/97  

**Signature of USDoe Reviewing Representative and Date**
<table>
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<tr>
<th>Task</th>
<th>Demonstration of the Koppelman “Series C” Process Using a Batch Test Unit with Powder River Basin Coal as Feed</th>
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**Sponsor**

K-Fuel Incorporated

**Reporting Period: April 1 through June 30, 1997**

**Background**

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.

**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 NOx 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 NOx 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 NOx emissions study and prepare an annual technical report describing activities during the first year of Phase III.
DEMOBSTRATION OF THE KOPPELMAN "SERIES C" PROCESS USING A BATCH TEST UNIT WITH POWDER RIVER BASIN COAL AS FEED

WESTERN RESEARCH INSTITUTE
365 NORTH NINTH STREET
LARAMIE, WYOMING 82070

FISCAL YEAR 1997
MARCH JUNE SEPTEMBER DECEMBER

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 E. Bledsoe 7/21/97
Remote Chemical Sensor Development

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.
Market Assessment and Technical Feasibility
Study of PFBC Ash Use

Sponsor
Electric Power Research Institute

Reporting Period: April 1 through June 30, 1997

Background
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.

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 Maclntosh 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-FC21-93MC30127

**Program/Project Title**
MARKET ASSESSMENT AND TECHNICAL FEASIBILITY STUDY OF PFBC ASH USE

**Task 011**

**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**

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**Total Project Value:** $1,051,138

**Project Expenditures**

**Major Milestone Status**

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**Fiscal Year 1997**
- March
- June
- September
- December

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 Priede 7/21/97

**Signature of USDOE Reviewing Representative and Date**
### Background

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.

### Status

The project has been completed.
Task Contained Recovery of Oily Wastes (CROW™) Status
Field Demonstration with Bell Lumber and Pole Ongoing

Sponsor
Bell Lumber and Pole

Reporting Period: April 1 through June 30, 1997

Background
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.

Footnote
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.

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.

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.
**Project ID:** DE-FC21-93MC30127

**Project Title:** TASK 013

**Reporting Period:** 4/1/97 through 6/30/97

**Name and Address:**

WESTERN RESEARCH INSTITUTE
365 NORTH NINTH STREET
LARAMIE, WYOMING 82070

**Start Date:** MARCH 26, 1993

**Completion Date:** MARCH 25, 1997

**Project Funding History**

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**Total Project Value:** $721,196

**Project Expenditures**

LYLE JOHNSON, PROJECT MANAGER

**Major Milestone Status**

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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 7/2/97

Signature of USDOE Reviewing Representative and Date:
Background

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.

Status

The project has been completed.
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<th>In Situ Treatment of Manufactured Gas Plant Contaminated Soils Demonstration Program</th>
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**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 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.
- 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

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Total Project Value $3,720,218

PROJECT EXPENDITURES

Vijay Sethi, Project Manager

PROJECT E~PENDITURES

FISCAL YEAR 1997

MAJOR MILESTONE STATUS

Maintain Cold Stand-by
Operations
Quarterly Reports

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. BIEDER 7/21/97
Signature of USDOE Reviewing Representative and Date
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.

**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-FC21-93MC30127  
Program/Project Title  TASK 017  
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  

PROJECT FUNDING HISTORY  

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PROJECT EXPENDITURES  
FRAN MIKHIS, PROJECT MANAGER  

DOLLAR CEILING  
PLANNED  
ACTUAL  

REPORTING PERIOD  

MAJOR MILESTONE STATUS  

CONDUCT ANALYSIS AS REQUIRED  

QUARTERLY REPORTS  

FISCAL YEAR 1997  
MARCH  
JUNE  
SEPTEMBER  
DECEMBER  

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 & Brady 7/21/97  

Signature of USDOE Reviewing Representative and Date
Background

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.

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

PROJECT FUNDING HISTORY

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Total Project Value $421,913

PROJECT EXPENDITURES
TERRY BROWN, PROJECT MANAGER

FISCAL YEAR 1997

MAJOR MILESTONE STATUS

- Subtask 1 - Baseline
  - Groundwater
  - Surface Water
  - Subtask 2
  - Recharge Interception
- Control Reactions
- Subtask 3
- Enhanced Oxidation
- Quarterly Reports

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

Signature of Recipient and Date: Lee E. Young 7/21/97
Signature of USDOE Reviewing Representative and Date: Lee E. Young 7/21/97
**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 PERF Dispersion Modeling Project
Phase 2

Major Field Demonstration

Task 019

Reporting Period 4/1/97 through 6/30/97

Program/Project Start Date March 26, 1993

Completion Date March 25, 1997

Project Funding History

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Total Project Value: $1,447,454

Project Expenditures

Signature of Reviewing Representative and Date

Validating & Report

Cospensor Funding in FY 95 consisted of $315,000 cash and $630,330 in-kind

Quarterly Reports

Fiscal Year 1997

March

June

September

December

Signature of Recipient and Date

Lee B. Breck 7/21/97
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.
FIELD TESTING OF THE TaBoRR PROCESS USING THE ASPHALT AND DRY BOTTOMS CONFIGURATIONS

Western Research Institute
365 North Ninth Street
Laramie, Wyoming 82070

Project Funding History

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PROJECT EXPENDITURES

Report & Expenditures:

- March 93: 200
- March 94: 400
- March 95: 600
- March 96: 800
- March 97: 1000
- March 98: 1200
- March 99: 1400
- March 00: 1600

Cost: $4,352,702

Major Milestone Status

- Verify Operability
- Conduct Tests
- Shakedown Carbonizer
- Dry Bottom Testing
- Quarterly Reports

Fiscal Year 1997

March: Complete
June: Complete
September: Complete
December: Complete

Cosperson Funding in FY 97 consisted of $750,000 cash and $1,750,000 in-kind.
Cosperson Funding in FY 96 consisted of $285,415 in-kind.

Signature of Recipient and Date
Lee [Signature] 7/21/97

Signature of USDOE Reviewing Representative and Date

Validation of a New Soil VOC Sampler

**Sponsor**
En Chem Incorporated

**Reporting Period:** April 1 through June 30, 1997

**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.
VALIDATION OF A NEW SOIL VOC SAMPLER

WESTERN RESEARCH INSTITUTE
365 NORTH NINTH STREET
LARAMIE, WYOMING 82070

PROJECT FUNDING HISTORY

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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 BIRD 7/21/97

Signature of USDOE Reviewing Representative and Date
Market Assessment and Demonstration of Lignite FBC Ash Flowable Fill Applications

Sponsor
North Dakota Industrial Commission and Montana-Dakota Utilities

Reporting Period: April 1 through June 30, 1997

Background
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.

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 Heath. 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 Heath 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 Title**

**DE-FC21-93MC30127**

**TASK 022**

**MARKET ASSESSMENT AND DEMONSTRATION OF LIGNITE FBC ASH FLOWABLE FILL APPLICATIONS**

**Name and Address**

**WESTERN RESEARCH INSTITUTE**

**365 NORTH NINTH STREET**

**LARAMIE, WYOMING 82070**

**PROJECT FUNDING HISTORY**

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**REPORTING PERIOD**

**PROJECT EXPENDITURES**

**ALAN BLAND, PROJECT MANAGER**

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

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**Signature of Recipient and Date**

**Signature of USDOE Reviewing Representative and Date**

**Lee E. Breda 7/2/97**