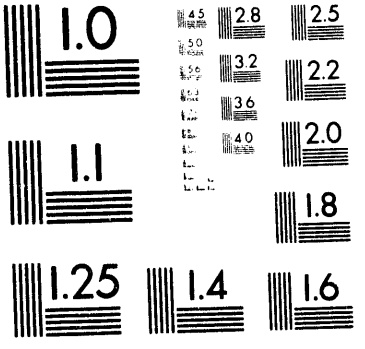
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24167-010

Rawlins UCG Demonstration Project

FINAL

TECHNICAL PROGRESS REPORT

FOR THE PERIOD

MAY 10, 1988 - AUGUST 9, 1988

November 30, 1988

Prepared in Support of

U.S. Department of Energy
Cooperative Agreement No. DE-FC21-88MC24167

Energy International, Inc.
135 William Pitt Way
Pittsburgh, PA 15238
EI Report No. 1088-023

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I. INTRODUCTION

The U.S. Department of Energy and Energy International, Inc. have entered into a Cooperative Agreement to conduct a cost-shared field test demonstrating the operation of commercial-scale steeply dipping bed underground coal gasification (UCG) modules to provide the synthesis gas for a small-scale commercial ammonia plant. The field test and the commercial ammonia plant will be located near Rawlins, Wyoming. During this demonstration test, two or more modules will be operated simultaneously until one module is completely consumed and an additional module is brought on line. During this period, the average coal gasification rate will be between 500 and 1,200 tons per day. A portion of the raw UCG product gas will be cleaned and converted into a synthesis gas, which will be used as feedstock to a 400-500 ton per day ammonia plant. The UCG facility will continue to operate subsequent to the demonstration to provide feedstock for the commercial plant. Energy International is responsible for accomplishing specific objectives in accordance with the Statement of Work by designing, installing, operating and monitoring the performance of the UCG modules as the feedstock source for the small-scale commercial ammonia plant.

This Technical Progress Report covers the period from May 10, 1988 through August 9, 1988. The "Proof-of-Concept (POC) Field Test" reference will be changed to "Rawlins UCG Demonstration Project" in this report and in all future reporting.

During this period, the project activities focused on project structuring, financing, and project management activities. Because the negotiations with investors were not completed on the schedule anticipated, adjustment of the schedule and activities was necessary. All major activities requiring the expenditure of funds were halted and work was suspended pending the availability of funds and new schedules. These changes have dictated the level of progress or delays for all of the tasks of the project throughout the period of this report.

II. ACTIVE PROJECT TASKS

1.0 Phase I - Design and Permitting

1.1 Project Integration

Management Summary

The major project management activities during this reporting period concentrated on three areas: (1) preparation and submittal of letters and reports to the DOE to satisfy the requirements for both coordination and deliverables, (2) coordination, review and suspension of engineering, design, and technical support areas, and (3) preparation and submittal of documents, agreements, and supporting data needed to support the development of financing agreements. A listing of key reports, meetings, and letter communications follows.

List of Key Communications
(Letters, Reports and Meetings)

Date	From	To	Title or Subject
5/16	EI	DOE	Revised material balance on Project Management Plan
5/19	EI	DOE	Sent Area 20 PDS's and cogen information
5/23	EI	DOE	Draft - Project Management Plan - Volume IV
5/23	DOE	EI	Guidelines for Project Evaluation Plan
5/26			40% Design Review Meeting
6/01	EI	DOE	Rawlins Project Status - clarification of status
6/10	EI	DOE	Draft 1 - Project Evaluation Plan
6/14	EI	DOE	Request for change in scope of project
6/24	DOE	EI	Comments on Draft Project Evaluation Plan
6/28	EI	DOE	Final - Environmental Monitoring Plan Outline
6/30	EI	DOE	Request extension of Phase I to November 1, 1988
7/06	DOE	EI	Amendment 002 to Cooperative Agreement extending Phase I to August 31, 1988
7/07	EI	DOE	Draft 2 - Project Evaluation Plan

7/08	DOE	EI	DOE offered to pay 50% of costs to hold CNC compressors, but turned down extension
7/15			Scope change review meeting at EI
7/25	EI	DOE	Draft 2 - Technical Progress Report (for January 1, 1987 to February 9, 1988)
7/29	EI	DOE	Revised Project Management Plan - Volume IV to reflect project status discussed July 15, 1988
8/01	EI	DOE	Notification of inability to secure Phase II funding and request for additional Phase I funding to restructure and reorganize the project. Asked for $374,434 (DOE share - $187,217)
8/04	EI	DOE	Restructured the August 1 request to modify Phase I, increase Phase I by additional $400,000 ($200,000 DOE share)
8/04	EI	DOE	Revised Baseline Reports for: - Federal Assistance Milestone Plan - (EIA-459B) - Federal Assistance Management Summary Report (EIA-459E)

Procurement

In the area of procurement during the period May 10 through August 9, 1988:

1. Energy International, Inc.'s corporate procurement procedures were revised.

2. DOE's Contracting Officer reviewed and discussed with EI personnel those procedures prior to their revision.

3. Five procurements were made this period: (a) reclaiming mud pits which remained after the winter drilling operation; (b) installation of permanent telephone lines up to the site; (c) filing fees for the Wyoming Industrial Siting Permit and Permit to Mine; (d) fees for the formation of Rawlins UCG Company and Rawlins Products Incorporated; and (e) for consultation regarding project management and administration.

Administrative and Business Development

In June Energy International experienced reluctance by investors to conclude negotiations because the estimated construction completion date was too close to the expiration of the tax credits under Section 29 of the U.S. Internal Revenue Service codes. This credit is critical to the financing of the project.

Efforts were initiated with the Wyoming Congressional delegation to include a 12-month extension of the tax credit in the Technical Correction Bill being proposed by the Ways and Means Committee of the U.S. House of Representatives. The bill was voted on by the House on August 8, 1988. It is likely that the extension will also be part of the Senate version of the bill. Passage of the bill is of major importance to Energy International's ability to finalize project financing.

Agreement in principle was reached with Development Finance Corporation of New Zealand and with a U.S. broker for the purchase of the total production of the ammonia plant. The terms include the guaranteed purchases of the volume produced at a market price for a three-year period. This agreement is important to the financing of the project.

1.2 Technical Support

All outside technical support operations were suspended until firm financing arrangements can be made for the project.

The financial investment consultants requested that an independent study focusing on the underground coal gasification aspects of the project be conducted by Williams Energy Services Company (WESCO). That independent "due-diligence" review was begun on April 1, 1988 and was concluded May 17, 1988. The "Conclusions and Observations" section of the WESCO report is attached to this report as Exhibit A. The results of this review are consistent with all previous reviews and understanding of the technology.

A design review meeting was held at the Energy International offices between Energy International and DOE representatives on May 26, 1988 to review engineering progress at the 40% design level.

1.3 Environmental, Health, Safety and Socioeconomic

Efforts continued on acquiring the necessary construction and operating permits. The Wyoming Industrial Development Siting Council issued to Energy International a permit to construct and operate the Rawlins UCG project. This permit provides an extremely positive impact to the project. The Council examined environmental, health, safety and socioeconomic issues in great detail. All levels of state and local government reviewed the project and provided input. As a result, future interaction with the State of Wyoming for permits, licenses, etc. should proceed smoothly.

In addition to the Industrial Siting Permit, the Air Quality and County Building Permits were obtained the first week of June. The final permits required prior to construction (wastewater disposal and domestic sewage) have been drafted.

The ferruginous hawk monitoring program concluded in June. Four out of seven artificial nesting territories were utilized which is an excellent acceptance response for the first season. Construction of additional nesting structures are planned before next winter.

Archeological and cultural surveys were performed on the plant site, offsite storage/loading area and the majority of the proposed pipeline corridors. A couple of proposed disturbance areas were identified as possibly being culturally and historically significant. Recommendations have been made by the surveying archeologist to mitigate impact on these areas through avoidance, historical documentation and/or excavation. A decision will be made on the form of mitigation when final locations and routes are determined.

1.4 Site Characterization

The geological and hydrological reports have been compiled. The coal resource and water hydrology information is being reviewed and edited for submission as a DOE deliverable "Site Characterization Report".

The geologic data reveals a steeply dipping, (60^{o}) tight and predictable coal resource. Low vertical and horizontal permeabilities reduce the chance of process gas migration.

Additional baseline water samples were acquired in June. Samples will be obtained from the monitoring wells in September and November to complete the one-year baseline required for the Mining Permit Application. The hydrology information confirms results from the 1979 and 1981 test burns. Nominal ground water exists in extremely tight sand formations resulting in low recharge capabilities. The water quality is poor and classified primarily for industrial use (Class IV).

Overall, the resources available at the North Knobs site meet or exceed the prerequisite criteria required for UCG operations.

1.5 Process Well Design

No further design efforts during this report period.

1.6 Surface Facility Design

The following sections summarize the design and engineering activities of Fluor Daniel for this period.

Summary of Design and Engineering

The project was put on "hold" on May 9, 1988 and was demobilized by May 13, 1988. All flow sheet reviews were completed with all but a few issued as "Approved for Design" (AFD). All narrative specifications prepared were reviewed and issued "Approved for Construction" (AFC). Eight "Requests for Quotation" (RFQ) were issued and then put on "hold". One purchase order was committed and then cancelled without charge. The bid evaluation for the Site Preparation Contract was completed. Copies of all Process Flow Diagrams, Mechanical Flow Diagrams, and prepared Narrative Specifications were submitted to DOE for review.

Process Design

The Energy International-Fluor Daniel reviews of all mechanical and utility flow diagrams were completed prior to the project being placed on hold. Flow diagrams for the utility water systems and the gas cleanup quench and oil/water separation were placed on "hold". All other flow diagrams were issued AFD.

The development of instrument data sheets continued. The fuel balance was updated to incorporate accumulated changes and modifications. Process Plant Consultants provided support to Energy International in their water permit application efforts.

Civil/Structural - Specifications for the pre-engineered building shells were completed and issued AFC. Bulk material RFQ packages were developed for concrete, rebar, anchor bolts and structural steel at Augusta. A design study for HDPE liners in the ponds was also completed and incorporated into the site prep drawings.

Piping - Plot plans for the Water Treatment Plant, Ammonia Plant and Gas Cleanup Plant were issued AFC. Pipe stress analyses of the Ammonia Plant reactor/reformer layout and offsite flare system began. Analysis of the UCG well module and sleeperway from the West Site was completed. A check of preliminary insulation thicknesses based on a three-year payback was started. Color coding of existing Ammonia Plant P&ID's for demolition and existing piping drawings for demolition, removal and relocation was initiated. A valve count for the valve reconditioning inquiry was prepared.

Mechanical - RFQ packages were developed for the incinerator, high-speed pumps, dissolved air flotation unit, coalescers, agitator and flare, as well as a revision to the cooling water pumps.

The recommendation for purchase of the Raw Water Treatment System was completed.

A meeting was held with Cooper Energy Services to begin planning the removal, reconditioning and reinstallation of the air/syngas engine compressors.

Control Systems - Flow sheet reviews were completed.

Electrical - Temporary power layouts and details were being squad checked with material takeoffs completed. RFQ packages were completed for the Power Distribution Centers and temporary construction bulk materials.

Cost and Scheduling - Project Area Schedules were reevaluated based on completed engineering discipline schedules and further construction planning. Construction planning continued for the Ammonia Plant dismantling at Augusta and field mobilization for site prep work at Rawlins.

Procurements and Contracts - Eight RFQ's were issued. All were subsequently placed on "hold". One Purchase Order was committed and subsequently cancelled at no charge.

An RFQ was issued for the Control Building Shell contract.

Construction - Detailed planning continued for the Ammonia Plant dismantling at Augusta and field mobilization at Rawlins. The RFQ for the Control Building Shell was reviewed.

1.7 Resource Acquisition

Discussions had previously led to agreement-in-principal with Union Pacific Resources Company to provide road access and pipeline rights-of-way. During this period, Union Pacific Resources Company agreed to provide such rights-of-way by means of a perpetual easement which required additional survey work. Union Pacific is currently processing the formal documents. The Bureau of Land Management has requested a detailed Plan & Development covering our pipeline rights-of-way rather than approving sections in piece-meal. This document will be submitted when all routes have been determined, surveyed, and final pipeline designs completed.

Process water has been secured for the project under contract terms signed May 18, 1988 with the City of Rawlins. The water will be provided from the Miller Hill Well Field south of the city. This contract agreement provides for final approval of our Water Supply/Water Yield analysis submitted with the Wyoming State Engineers Office. It also enables us to finalize the last leg of the pipeline supply route.

Negotiations with Pacific Power and Light have provided an economically viable way to install permanent electric power. This power will work in conjunction with cogeneration and provide a backup reserve.

1.8 Preliminary Site Civil Preparation

Bid evaluation of the site preparation contract was completed and the successful bidder selected. He has subsequently been advised that the project has been put on "hold". No further site civil work has been performed.

III. SUMMARY

Most of the activities during this period focused on placing of the project on hold until private funding for the balance of the project is identified. Key accomplishments during this time were:

- Completion of 40% Design Review activities
- Completion of site preparation procurements
- Granting of the Industrial Siting Characterization Permit to Construct
- Ferruginous hawk nesting program proceeding
- Completion of first round groundwater sampling (results to be reported next quarter)
- Preparation of five papers for presentation at the UCG Symposium in Chicago

Progress is being made in the private funding search with positive results anticipated during the next quarter.

EXHIBIT A

WILLIAMS ENERGY SERVICES COMPANY UCG REPORT

SECTION 2

CONCLUSIONS AND OBSERVATIONS

SECTION 2

CONCLUSIONS AND OBSERVATIONS

The following is an abbreviated consolidation of certain observations and conclusions developed during technical assessment by WESCO of the El UCG-to-Ammonia Project. A total perception of the considerations and evaluations involved in this work can, however, be attained only by detailed review of all the subsequent sections of this document.

General

- The site, both surface and underground, selected for this Project, has been well confirmed by El as having characteristics which are suitable for applying UCG technology.

  Such confirmation is based largely upon data and related information developed during two indepth operating tests conducted at the same Rawlins site. (see Section 3.4. Also ref. 14, 15 and 16.)

- The two field operations tests at Rawlins have been very successful largely because of the quality of the site.

  The site boasts an almost ideal combination of factors which would meet or exceed a comprehensive list of accepted criteria for suitability.

- The proposed UCG module design and operation is a reasonable scale-up from the data bases and operations generated during two tests at the same site as that proposed for this commercial Project.

- More recent drilling at the site has provided further support of the design bases for the five UCG modules which will be constructed during the first year of commercial operation. Such drilling has also provided information used to more accurately assess the available quantity of coal under lease.

- Application of the proposed design and methods for gasification of coal underground should be technically successful.

Coal Nature

- For coal seams which dip at a sufficient angle, the coal will tend to fall to the bottom of the cavity created during the gasification, thus forming a fire pit for the efficient utilization of reactants.

The results of the Rawlins II field test indicate that the 63° dip angle is fully adequate to promote this phenomenon of coal falling into the fire pit.

- o A variation in dip, if excessive, could increase drilling costs and can potentially shorten the life of a module.

  The 63° coal seam dip at the proposed site has a variation of less than 2°.

- o The Rawlins II operations test results indicated no difficulties having been caused by excessive parting material or by molten slag effects. This is a result which was anticipated, given the steep dip of this coal source.

- o The coal seam thickness at the Rawlins site is 22.7 feet with a variation of ±6 feet. This variation in thickness is within tolerable limits.

Boundary Strata

- o The boundary strata of the underground reactors are made up of the mineral deposits surrounding the coal seam.

  The Rawlins resource appears to have near ideal boundary strata conditions meeting all requirements.

Coal Chemistry

- o The coal at the Rawlins site is non-swelling subbituminous, clearly excellent for UCG.

Coal Quantity

- o The coal resource that EI has under lease equates to 18.3 years of requirements. This is adequate for the 15 year projected life as planned plus a 22% contingency (see related detail in Section 3.3 and Section 4).

  Also, in this respect EI has advised that negotiations are currently underway for securing additional UCG coal.

Module Design

- o Module design for the Project provides for recovery, through a single production well, product gases generated from four injection wells, only two of which are operating at any given time.

  The consistently successful application of this design policy could produce significant savings in well drilling and completion costs.

- o EI should consider the possibility of dual product gas gathering lines. When the produced raw gas quality from a module declines until it is no longer suitable for synthesis gas it may still have value as fuel gas or for blending with natural gas for fuel. Such dual gathering would assure optimum economics with respect to that portion of the raw gas being conditioned only for fuel use.

- o EI should, and is, making minimal provisions for possible higher module operating pressure than is projected.

Hydrology

- o Consideration of excessive amounts of water influx into the modules has been addressed.

  The Project site has a low groundwater yield. There are no potable aquifers less than 100 feet above or 50 feet below the test seam nor any high yield aquifers less than 50 feet above or 30 feet below the seam. There is no significant communication between the test seam and the boundary strata. Hydrology related characteristics are good.

Logistics

- o The surface characteristics of the site can clearly influence the economics of UCG. The ideal topography would of course be flat, with sparse vegetation and minimum soil/alluvium cover.

  The Rawlins site is located on an almost perfect surface setting with very little recontouring of the land required.

- o A highly favorable operating characteristic of this project is the design capability to provide alternative generation of ammonia plant feedstock from natural gas, in the event that the production of UCG-derived feedstock should be less than fully successful.

  The successful commercial implementation of UCG technology at Rawlins indicates economic advantage sufficient to support dual feed system.

- o During the two field tests at the site of the project, there was no surface subsidence nor significant air emissions. Ground water contamination cleaned up without treatment being required.

- o The U.S. Department of Energy (DOE) has issued a "Finding of No Significant Impact" (FONSI) to the environment. Discussions with Wyoming Department of

Environmental Quality personnel give WESCO the impression that EI will receive environmental permits to construct and operate the UCG-to-Ammonia Project within a time frame that will meet EI plans.

It is believed that environmental matters will not be a significant problem for permitting or operating the UCG facility at Rawlins.

Additional Recognitions

- While UCG technology has not yet been practiced commercially, in the U.S.A., it is not new. Commercial UCG facilities have been successfully operated in the Soviet Union since 1941.

  Most requirements for successful UCG operations in the Soviet Union and in the United States are similar. Both need a good site that has the required coal geology and chemistry. Both need to drill and complete wells that will survive for the length of time they are needed. The other requirements for developing a successful commercial UCG project in the United States have been performed in the Soviet Union and they can be performed successfully at Rawlins.

- Facilities for processing of the raw UCG product gas to condition it for ammonia plant feedstock and facilities to convert such feedstock into ammonia have been evaluated by others.

DATE
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10/18/93
END