SCALE-UP OF MILD GASIFICATION TO A PROCESS DEVELOPMENT UNIT

**Progress Report for the Period:
February 21, 1992 - May 20, 1992**

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SUMMARY

The work performed during the second quarterly reporting period (February 21 through May 20, 1992) on the research program, "Scale-Up of Mild Gasification to a Process Development Unit" is presented in this report. The overall objective of this project is to develop the IGT Mild-Gasification (MILDGAS) process for near-term commercialization. The specific objectives of the program are to:

- design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup
- obtain large batches of coal-derived co-products for industrial evaluation
- prepare a detailed design of a demonstration unit
- develop technical and economic plans for commercialization of the MILDGAS process.

The project team that is performing the initial phases of the PDU development are: Kerr-McGee Coal Corporation (KMCC), the Institute of Gas Technology (IGT), Bechtel Corporation (Bechtel), and Southern Illinois University at Carbondale (SIUC).

The MILDGAS process is a continuous closed system for producing liquid and solid (char) co-products at mild operating conditions up to 50 psig and 1300°F. It is capable of processing a wide range of both eastern caking and western noncaking coals.

The PDU to be constructed is comprised of a 2.5-ft ID adiabatic gasifier for the production of char, coal liquids, and gases; a thermal cracker for upgrading of the coal liquids; and a hot briquetting unit for the production of form coke and smokeless fuel briquettes. The facility will also incorporate support equipment for environmentally acceptable disposal of process waste.

During the second quarter of the program, the revision of the Environmental Plan and NEPA Documentation was completed and submitted to the DOE for preparation of the NEPA application. Also, the revised Work Plan incorporating the suggestions made by the DOE Technical Monitor was completed and submitted.

In addition, bid packages for the major sections of the PDU (Task 2.1) were prepared and sent to the list of prospective bidders. We are currently awaiting receipt of the various bids.

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INTRODUCTION

Commercialization of the Institute of Gas Technology's Mild Gasification (MILDGAS) technology introduces a new industry into an economically depressed area. It utilizes a marginally marketable coal to produce char, in an environmentally acceptable manner, that can be used to make form coke, which is vitally needed in our metallurgical industry. It produces coal liquids which address import problems, and it also addresses the use of char for our electric utility industry. The specific objectives of the program are to: design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup; obtain large batches of coal-derived co-products for industrial evaluation; prepare a detailed design of a demonstration unit; and develop technical and economic plans for commercialization of the MILDGAS process.

The MILDGAS process is capable of processing both eastern caking and western non-caking coals. The MILDGAS process is designed to offer options in the product slate by varying the process conditions and by blending different feed coals. The liquids, which can be processed as feedstocks for chemicals (e.g., BTX, phenol, cresols, xylenols, naphthalene, and indene), pitch for use as a binder for electrodes in the aluminum industry, and fuels. Depending on the feed coal characteristics and the operating conditions, the char can be used as an improved fuel for power generation or briquetted hot to make form coke for steel-making blast furnaces or for foundry cupola operations. The hot briquetting process offers options for blending various chars, coals and other additives (like alloying agents) to tailor the properties of the form coke. The mild gasification and briquetting processes are done entirely within closed vessels which offer significant advantages over conventional coking practices for control of fugitive emissions.

The 1 ton/hr PDU facility that is to be constructed is comprised of a 2.5-ft ID adiabatic gasifier for the production of gases, coal liquids, and char; a thermal cracker for upgrading of the coal liquids; a hot briquetting unit for the production of binderless briquettes; and a calciner for producing form coke for blast furnaces and cupolas. These facilities are supported by an incinerator and a scrubber for environmentally acceptable disposal of all process-generated gases and surplus coal liquids.

Coal liquids from the PDU will be evaluated as feedstock for high-value chemicals and fuels by Reilly Industries, Inc. Reilly will also conduct separate modification operations such as thermal treatment with or without a Lewis Acid Catalyst, fractional distillation, and hydrotreating to produce specification-grade products. Reilly will take all the coal liquids produced at the PDU facility.

A major portion of the char produced will be used to make the form coke for blast furnaces and cupolas. The form coke for blast furnaces will be evaluated by several steel companies, including LTV and Armco. The form coke for use in a foundry cupola will be evaluated by General Motors Research Laboratories. In addition, the form coke will also be tested for foundry use at Pellet Technology Corporation's 60-inch cupola. The char from the PDU will also be evaluated at Southern Illinois University at Carbondale (SIUC) for relative reactivity and for suitability as a boiler fuel in a fluidized-bed combustor.

The product testing to be conducted in the program will yield a realistic assessment of the quality and economic value of both the coal liquids and solids produced. This input is required to update the market potential of the co-products and determine the slate of products and the economics of the demonstration and commercial plants for the MILDGAS process. The project team for the PDU development are: KMCC, Institute of Gas Technology (IGT),

Bechtel Corporation, SIUC, General Motors Corporation, Pellet Technology Corporation (PTC), LTV, Armco, Reilly and Auto Research.

KMCC, which has large reserves of both eastern and western coals, is very much interested in near-term commercialization of the MILDGAS process. KMCC is responsible for the overall management and technical direction of the program. IGT, as the originator of the MILDGAS technology, is responsible for technology development, product evaluation management, and overall technical supervision. Bechtel Corporation is the A&E firm responsible for the process and plant design and construction, development of a demonstration plant design, and input to the commercialization plan revision. SIUC operates the Illinois Coal Development Park at Carterville, Illinois, which will be the location of the PDU. SIUC is responsible for operation of the PDU facility and for evaluation of the char product as a boiler fuel.

The State of Illinois is the major contributor of the cost sharing portion of this program. Their contribution is being supplemented by KMCC, SIUC, and GM. Contributions of Reilly and the steel companies are gratefully acknowledged but are not considered part of the cost sharing. All acceptable grades of form coke produced at the PDU facility will be sold by Hickman Williams Co., the largest brokers for coke in the midwest.

TECHNICAL DISCUSSION

Task 1. Work and Environmental Plans

Objective: The objective of this task is to develop work and environmental plans for the project.

Summary: This quarter, drafts of the Work Plan and the Environmental Plan and NEPA Documentation were revised to incorporate the suggestions of the DOE Technical Monitor and final versions were submitted to DOE. The Work Plan includes details of the design and construction work to be performed, the rationale for and the experiments to be conducted in the PDU, the test sample analyses to be performed, and interpretations of the experimental results. The Environmental Plan and NEPA Documentation consists of the data that are required by DOE for compliance with the National Environmental Policy Act (NEPA).

Subtask 2.1 PDU Design Engineering

Objective The objective of this subtask is to complete the design and engineering for the PDU. The initial phase of this subtask consists of reviewing the conceptual process design and the process performance data with the data obtained from the mild gasification tests in the IGT 100-lb/h Process Research Unit. Other parts of this subtask consist of process design, civil/structural design, electrical and control design, mechanical design, procurement, and a definitive cost estimate.

Summary Prior to NEPA approval, the project work will be limited to preliminary project engineering, which will include the following:

- Development of the process design

- Preparation of environmental data to support the NEPA compliance process
- Preparation of engineering specifications for obtaining bids
- Solicitation of equipment and material pricing and bid evaluation
- Preparation of engineering drawings including P&ID's
- Preparation of the project definitive cost estimate

The project work plan and schedule are based on awarding equipment packages by July 1, 1992. In the event that NEPA approval is delayed beyond that date, it is recommended that DOE approve the cost of vendor engineering by the successful bidders for the equipment packages. This would allow the selected vendors to accomplish the front end engineering of their packages and would expedite vendor prints that are required for the execution of the detailed design. This should minimize adverse cost and schedule impact to the project due to delays in obtaining the NEPA approval.

The layout studies and the site plan were completed this quarter. Also, the shop fabricated package suppliers prequalifications were reviewed and the list of bidders was finalized.

Two meetings were held at Bechtel to refine the Process Flow Diagrams (PFD) and calculate the magnitude of the flow streams. Sufficient process design to enable an accurate estimate of the product streams and the liquid and gaseous effluent streams had to be prepared to supply data for the NEPA documentation.

The MILDGAS reactor section of the PDU was a major consideration in the development of the PFDs this quarter. Gas for the fluidization of the gasifier bed will be provided by recycled product gas and will be heated by combustion of approximately 2% of

the product gas. This hot gas stream will provide approximately half of the heat load for the gasifier. The remainder of the heat will be provided by partial combustion of the recycled char in a long residence-time standpipe. The design of this standpipe is critical to the gasifier heat supply and its operation requires balancing the pressure drops in the char recycle loop.

As the design of each section has been completed in sufficient detail, bid packages were sent to the prospective bidders. This is necessary to prepare a definitive cost estimate as early as possible. Bid packages have been prepared and sent to the bidders for the following sections: (100) coal handling and preparation section; (200) the gasification section; (300) the liquids condensation section; (400) the incinerator and scrubber section; (500) liquids storage train; and (700) the char handling and storage section.

Plans for Next Quarter During the next quarter, the bids for the individual sections will be received and reviewed and an estimated total plant cost will be prepared. This plant cost will be analyzed for possible cost savings.

Tasks 2.2 through Task 6.

No work was scheduled on these tasks for this quarter.

Task 7. Project Management

Objective The objectives of this task include the normal project management functions of planning, control, and reporting of project progress.

Summary This quarter, the renewal proposal was prepared and submitted for DOE approval for the second project time period (May 1992 - January 1993). This proposal contained a summary of the work that has been completed to date, a detailed projection of the work that is expected to be completed during the second project time period, and an estimate of the costs for this time period.

In early April, IGT, Bechtel, and DOE personnel visited SIUC to obtain site specific design data and NEPA data. In addition to the SIUC personnel, representatives of the Crab Orchard Wildlife Refuge, the Herrin and Carbondale Fire Departments, and the Central Illinois Public Services Co. (CIPS) attended this two-day meeting. Discussion items included the site plan for the PDU, fire protection, water and sewage facilities, electrical and gas supply, and extensive investigation of the Crab Orchard Wildlife Refuge facilities and the industrial sites within the Refuge. Action items were assigned to various team members to clarify points that are pertinent to the process design and the NEPA documentation.

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