

Quarterly Technical Progress Report – Phase I

COOPERATIVE AGREEMENT DE-FC26-00NT40899

Calla Energy Biomass Cofiring Project

July 2001

CONTRACTOR NAME

Gas Technology Institute
1700 South Mount Prospect Road
Des Plaines, IL 60018-1804

PERIOD OF PERFORMANCE

From: April 1, 2001
To: June 30, 2001

CONTRACT PERIOD

From: September 25, 2000
To: September 30, 2001

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ABSTRACT

The Calla Energy Biomass Project, to be located in Estill County, Kentucky is to be conducted in two phases. The objective of Phase I is to evaluate the technical and economic feasibility of cofiring biomass-based gasification fuel-gas in a power generation boiler. Waste coal fines are to be evaluated as the cofired fuel. The project is based on the use of commercially available technology for feeding and gas cleanup that would be suitable for deployment in municipal, large industrial and utility applications. Define a combustion system for the biomass gasification-based fuel-gas capable of stable, low-NO_x combustion over the full range of gaseous fuel mixtures, with low carbon monoxide emissions and turndown capabilities suitable for large-scale power generation applications.

The objective for Phase II is to design, install and demonstrate the combined gasification and combustion system in a large-scale, long-term cofiring operation to promote acceptance and utilization of indirect biomass cofiring technology for large-scale power generation applications.

During this Performance Period work efforts proceeded, and Carbona completed the gasifier island design package. Nexant has completed the balance of plant support systems design and the design for the biomass feed system. Work on the Technoeconomic Study is proceeding. Approximately 75% of the specified hardware quotations have been received at the end of the reporting period. A meeting is scheduled for July 23rd and 24th to review the preliminary cost estimates. GTI presented a status review update of the project at the DOE/NETL contractor's review meeting in Pittsburgh on June 21st.

TABLE OF CONTENTS

Abstract	2
Table of Contents	3
Introduction	4
Executive Summary	4
Experimental	5
Results and Discussion.....	7
Conclusion.....	9
Appendix A, List of Specifications Developed.....	11
Appendix B, Draft Process Design Data.....	12

List of Graphical Materials

Process Flow Sheet.....	12
Gasifier Island Layout.....	13
Biomass Feed System Flow Diagram	14

INTRODUCTION

The Gas Technology Institute, GTI, has assembled a team to perform this project. The team includes Calla Energy Partners, who is providing cost sharing resources. Calla is a developer of energy projects, and plans to generate steam and electricity from the completed facility in an industrial park to be located in Estill County Kentucky. Biomass in the form of saw dust and wood chips shall be acquired from lumber mills located in the region. Coal waste from the impoundment ponds at the site is planned as the cofiring fuel.

GTI shall work with CARBONA and NEXANT to develop a design for a complete gasification facility capable of delivering low-Btu fuel gas, LCV, to a boiler to be provided by Calla. GTI shall also design a dual-fuel natural gas/LCV gas burner to provide clean, high-efficiency combustion to be installed in Calla's boiler.

EXECUTIVE SUMMARY

Contract Objectives

This project is to be conducted in two phases. The objective of Phase I is to evaluate the technical and economic feasibility of cofiring biomass-based gasification fuel-gas in a power generation boiler. Waste coal fines are to be evaluated as the cofired fuel. The project is based on the use of commercially available technology for feeding and gas cleanup that would be suitable for deployment in municipal, large industrial and utility applications. Define a combustion system for the biomass gasification-based fuel-gas capable of stable, low-NOx combustion over the full range of gaseous fuel mixtures, with low carbon monoxide emissions and turndown capabilities suitable for large-scale power generation applications.

The objective for Phase II is to design, install and demonstrate the combined gasification and combustion system in a large-scale, long-term cofiring operation to promote acceptance and utilization of indirect biomass cofiring technology for large-scale power generation applications.

Current Activities

During this Performance Period work efforts proceeded, and Carbona completed the gasifier island design package. Nexant has completed the balance of plant support systems design and the design for the biomass feed system. Work on the Technoeconomic Study is proceeding. Approximately 75% of the specified hardware quotations have been received at the end of the reporting period. A meeting is scheduled for July 23rd and 24th to review the preliminary cost estimates. GTI presented a status review update of the project at the DOE/NETL contractor's review meeting in Pittsburgh on June 21st.

Technical Approach Changes

None

EXPERIMENTAL

Project Tasks

Task 1.0 Phase I - Feasibility Study

The objective of Phase I is to evaluate the major technical and economic factors determining project viability and to define the specific fuel sources, fuel handling requirements, gasification system and combustion system configurations necessary to insure a successful biomass cofiring demonstration. This objective will be accomplished through the following tasks:

Task 0.0. NEPA Information

Calla Energy Partners will provide reports and documentation deemed necessary for DOE to prepare a NEPA review of the project. This information shall describe all anticipated environmental impacts of the proposed project. The NEPA review and approval process shall be completed by DOE before Phase II is initiated.

Task 1.1. Feedstock Evaluation

In this task, GTI and Calla shall identify and fully characterize the available economically viable biomass fuel resources for the plant. Approximately 1000 tons per day of sawdust is known to be available from 3 sawmills within eleven miles of the plant site. Fuel supply and transportation contracts will be negotiated during Phase I to insure adequate primary and backup feedstock supplies for the plant. In negotiating any contracts, realization will be made that the project may end at the completion of the feasibility study and not proceed further. Based on the fuels identified, gasifier sizing, feed handling, feed preparation and gasifier feed system requirements will be defined for the process simulation modeling and the conceptual plant design.

Task 1.2. Process Simulation and Combustion System CFD Modeling

Based on the range of feedstocks identified in Task 1.1, the GTI Team shall perform process modeling to evaluate and optimize plant configuration, reliability and efficiency. GTI will use its proprietary gasification model to develop gasifier heat and material balances, perform gasifier sizing calculations, predict product fuel gas compositions, and define process input and output flow ranges for each feedstock identified and mixtures thereof. NEXANT shall use APEN simulation to model the remaining plant systems and components under consideration using information developed under previous and on-going studies for the US Department of Energy (DOE) to the extent possible, providing a consistent basis of information and methodologies with previous DOE efforts. GTI will use the Fluent Computational Fluid Dynamics software to perform modeling calculations for the FIR low-NO_x LCV gas burner design. Fluent modeling has been developed specifically for, and used extensively in, the FIR burner development work by GTI to date.

Task 1.3. Conceptual Plant Design

Based on the feedstock and design configuration modeling results from Tasks 1.1 and 1.2, the GTI team shall develop detailed flow sheets with heat and material balances, performance estimates, and total plant capital cost estimates for the design cases agreed upon. This information will form the basis for the technoeconomic study conducted in Task 1.4.

At the beginning of the conceptual design task, Calla Energy Partners shall prepare a project permitting study identifying all federal, state and local permits required for the entire project through demonstration operations. This study will include a listing of all likely actions necessary to satisfy each permitting requirement, an approximate average time required to obtain the permit based on local experience with similar projects, the likely cost to the project, and the suggested project team member to be responsible for obtaining the permit.

Task 1.4. Technoeconomic Analysis

The capital costs at the total plant cost (IPC) level shall be determined including equipment, materials, labor, indirect construction costs, engineering, and contingencies. Operation and maintenance cost values will be determined on a first-year basis and subsequently leveled on the basis of a 20-year plant book life to form a part of the economic analysis. Quantities for major consumables such as fuels and sorbent will be taken from the technology-specific heat and material balance diagrams developed for each plant application. Other consumables will be evaluated on the basis of the quantity required using reference data. Operation costs are determined on the basis of the number of operators. Maintenance costs are evaluated on the basis of requirements for each major plant section. The capital and operating cost results for each plant case are combined with plant performance in the comprehensive evaluation of the COE. Details of the plant design definition, capital cost estimate, operations and maintenance cost estimate and economic analysis will be reported as follows:

- Plant Design
- Process Flow Sheets (heat and material balances)
- Performance Summary Table
- Overall efficiency and net plant heat rate (HHV basis)
- Summary Capital Estimate including detailed Code of Accounts
- Summary of production costs with details of the following sub-accounts: Fixed O&M, Variable O&M, Consumables, By-product Credit, and Fuel
- COE based on 15-year private sector financing based on 90% capacity factor

Task 1.5. Project Management – Phase I

Project review meetings shall be conducted as required. A topical report shall be prepared at the completion of Phase I that describes the findings of the study. A GO/NO-GO decision on Phase II must be received from DOE before initiation of detailed design and construction.

Task 1.6. Technology Conceptualization

GTI shall prepare a feasibility analysis of the advanced technology, based on their gasification experience. This report shall focus on the potential future opportunities of the proposed technology and other related gasification opportunities for biomass.

Phase II Plant Design, Construction and Demonstration

Contingent on a decision to proceed based on the results of the Phase I feasibility study, detailed design, construction and demonstration of the biomass gasification-based fossil fuel cofiring facility will be completed in Phase II. This will be covered under a follow-on contract to this agreement.

RESULTS AND DISCUSSION

Task 0.0. NEPA Review

Calla Energy has met extensively with B&W to negotiate equipment costs for the ACFB. Calla Energy has not yet completed a purchase agreement for the boiler. Calla Energy has received questions on the Air Permits submitted to the Kentucky Department of Air Quality. They have responded to those questions, and are awaiting permit approval. Calla Energy continues to negotiate for better terms to the proposed power purchase agreement.

Task 1.1 Feedstock Evaluation

At the project meeting GTI conducted on April 2 and 3, 2001, the design basis was defined to be 50% of each material (saw dust and slabs/bark). The analysis determined that these materials require drying prior to feeding to the gasifier. Alternative dryer designs were investigated. A steam driven dryer posed several technical and economic issues. A gas driven dryer posed environmental questions based on possible VOC emissions.

It was decided to pursue a design that would use hot flue gas at 800 °F from the ACFB to dry the feed material. The exhaust from the dryer would be returned to the boiler, eliminating all environmental issues.

GTI has not received samples from Calla Energy of railroad ties to determine their effect on the plant design. However, preliminary review suggests that the base design can readily accept this material with little difficulty.

Task 1.2. Process Simulation and Combustion System CFD Modeling Combustion System

GTI discussed with B&W their project status with Calla Energy. B&W indicated that they are continuing to negotiate with Calla Energy on the supply of the boiler facilities. B&W is very busy inhouse responding to numerous inquiries on new equipment supply. They will not perform any engineering for this project until they have a firm equipment supply contract and the power purchase agreement is signed. This insures the viability of the project and allows them to concentrate their efforts on revenue guaranteed projects.

For this reason, design of the burners for the LCV to be delivered to the boiler continues on hold.

For design of the syngas burners for the ACFB to proceed, three activities must be completed:

- Power purchase agreement must be executed by Calla Energy and a transmission company
- Purchase order for the boiler must be completed – to allow engineering work to proceed by the boiler vendor.
- A Secrecy Agreement must be completed between GTI and the Boiler Vendor.

Gasification System

A team meeting was conducted by GTI to review the draft flow sheet and material balance on April 2nd. During the past reporting period, Carbona has completed the process design and initiated their efforts under Task 1.3 for the Conceptual Plant design effort. This work was submitted to GTI for approval, and was approved for specification development.

Task 1.3. Conceptual Plant Design

Carbona has completed the specifications for the gasifier island and submitted them for to GTI for approval. They have been approved for cost analysis purposes. GTI released the specifications to Nexant to develop preliminary cost estimates. Nexant has designed the fuel preparation system and specified the other auxiliary systems required for the plant.

Flow diagrams of the facility provided by Carbona and Nexant are included in Appendix A. A list of specifications developed for process equipment designed for this project is listed in Appendix B.

Task 1.4. Technoeconomic Analysis

GTI authorized Nexant to begin the Technoeconomic analysis. Nexant is soliciting budget quotations from vendors for itemized equipment for the facility. Approximately 75% of the quotations have been received back from vendors by the end of the reporting period. Once all quotations have been received, Nexant shall do a factored estimate of the costs based on their experience to determine the total plant installed costs.

GTI has scheduled a meeting for July 23rd and 24th to review the preliminary cost estimates of the facility.

Task 1.5. Project Management – Phase I

GTI has continued to manage the work flow among the subcontractors to keep the project on schedule.

The following meetings were held for this project:

- April 1st and 2nd with GTI, Carbona, and Nexant.

- June 21st and 22nd, with DOE/NETL at the Biomass Projects Contractor's Conference

GTI's proposed paper has been accepted for presentation at the Fifth Biomass Conference of the Americas. The conference is being held in Orlando, Florida the week of September 17th.

Task 1.6. Technology Conceptualization

Dr. Suresh Babu, representing GTI, has participated in several meetings and made several contributions towards the development of U.S. DOE's draft Strategic Plan for Biomass Gasification. The initial draft was being coordinated by Antares is now under further review by U.S. DOE.

CONCLUSION

Summary Status Assessment And Forecast

A meeting was conducted by GTI in NEXANT's offices on April 2nd and 3rd to review the Process Design Concept effort completed by Carbona, Task 1.2, and to initiate the balance of plant design effort by NEXANT. A Calla Energy representative participated in the meeting via Telecon to address site design issues. Also during the meeting, environmental questions were addressed by Calla Energy's consultant at J.A. Jones.

Work efforts proceeded, and Carbona completed the gasifier island design package. Nexant has completed the balance of plant support systems design and the design for the biomass feed system.

Work on the Technoeconomic Study is proceeding. Approximately 75% of the specified hardware quotations have been received at the end of the reporting period. A meeting is scheduled for July 23rd and 24th to review the preliminary cost estimates.

GTI presented a status review update of the project at the DOE/NETL contractor's review meeting in Pittsburgh on June 21st.

Open Items

GTI is waiting for B&W to complete a Confidentiality Agreement to allow detailed design and modeling of the burners to proceed.

GTI is waiting to receive a sample of railroad ties to determine their impact on the design of the facility.

Future Work Plan Next Quarter:

- Complete plant techno-economic analysis
- Complete Secrecy Agreement with B&W
- Complete the burner design

- Complete all aspects of project
- Issue Final Report

Appendix A

The following is a list of specifications developed for the Estill County Kentucky Biomass Cofiring Project.

- Gasifier
- Fuel Feed
- Limestone Feed
- Gasifier Ash Removal
- Process Air
- Product Gas Ducting
- Product Gas Cooling
- Product Gas Filtering
- Filter Ash Removal
- Flare
- High Pressure Cooling Water
- Nitrogen Distribution
- Biomass Dryer Specification
- Biomass Feed Prep
- Inert Gas Generation System
- Waste Heat Boiler
- Startup Gas Supply

Figure B2. Gasifier Island Layout

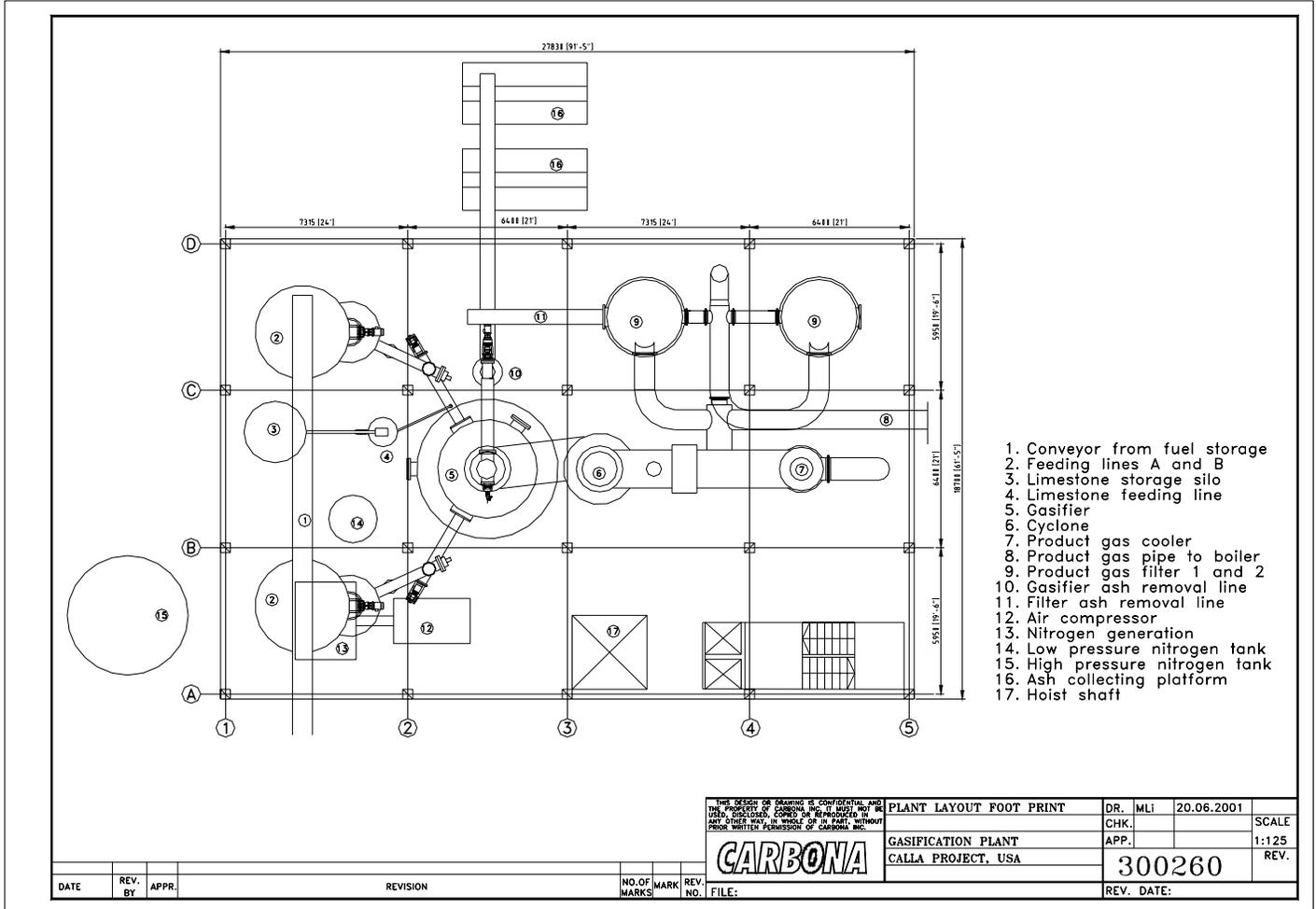


Figure B3. Biomass Feed System Flow Diagram

