Quarterly Technical Progress Report – Phase I

COOPERATIVE AGREEMENT
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Calla Energy Biomass Cofiring Project

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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-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.

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 was completed. GTI conducted a project review meeting with Carbona and Nexant on July 23rd and 24th to review the preliminary cost estimates of the facility. A project review meeting between GTI, Calla Energy and their Support Team and the DOE Project Manager was conducted on September 7th. GTI requested a no-cost, 2 month extension to the contract which was granted by DOE. On September 26, 2001, GTI received supplemental authorization A002 from DOE contracts for additional work to be performed under Phase I. GTI worked with Calla Energy to develop request for funding to proceed with Phase II.
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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 was completed. GTI conducted a project review meeting with Carbona and Nexant on July 23rd and 24th to review the preliminary cost estimates of the facility. A project review meeting between GTI, Calla Energy and their Support Team and the DOE Project Manager was conducted on September 7. GTI requested a no-cost, 2 month extension to the contract which was granted by DOE. On September 26, 2001, GTI received supplemental authorization A002 from DOE contracts for additional work to be performed under Phase I. GTI worked with Calla Energy to develop request for funding to proceed with Phase II.
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-NOx LCV gas burner design. Fluent modeling has been developed
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 levelized 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. Calla anticipates receipt of permits from KDAQ by the end of the year.

**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 most environmental issues.

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

Combustion System

At the project review meeting conducted in Cincinnati September 7, 2001, Calla Energy and their Team Members – LeggMason (financial services) indicated that they would prefer that the LCV gas be used in a gas fired burner rather than in the new fluid-bed boiler. This is because the boiler vendor has indicated reluctance to guarantee their boiler performance if the modified burners are installed. GTI will resume engineering of the FIR burners for a natural gas fired boiler retrofit, once Calla identifies the specific boiler
to be used for the project. An allowance for the burner costs is included in the techno-economic analysis, Task 1.4.

**Gasification System**
No activities in this area during the past period.

**Task 1.3. Conceptual Plant Design**
No major activities were conducted in this area during this period.

**Task 1.4. Technoeconomic Analysis**
The economic analysis of the project was conducted based on the capital and operating cost estimates developed. Nexant is soliciting budget quotations from vendors for itemized equipment for the facility. Once all quotations have been received, Nexant performed a factored estimate of the costs based on their experience to determine the total plant installed costs. Nexant also developed an estimate of the operating costs for the plant.

GTI conducted a project review meeting with Carbona and Nexant on July 23rd and 24th to review the preliminary cost estimates of the facility.

From the cost estimates, GTI developed a financial analysis of the facility that was reviewed at the project review meeting on September 7th, 2001. Client participation included: Chuck Yates, President of Calla Energy, Frank Starr and Marcus Smith of LeggMason (financial consultant), Bernie Laseke, ENSR (environmental consultant), James Kasey, ERORA (power services consultant), Bob Notheis, GE/PS (contract operator for the facility), and Lisa Underwood, (legal consultant). Sean Plasynski, USDOE/NETL also participated in the meeting.

A summary of the financial analysis is included in Figure 1, contained in Appendix A. This indicates the relationship between fuel cost for biomass to the value of the fuel gas from a biomass facility of this size (no DOE cost sharing). The specific costs for Calla Energy are not indicated on the diagram presented in this report.

**Task 1.5. Project Management – Phase I**
GTI has continued to manage the work flow among the subcontractors to keep the project on schedule. Work is continuing on completion of the topical report due at the conclusion of the design portion of Phase I.

The following meetings were held for this project:
- July 23rd and 24th with GTI, Carbona, and Nexant.
- September 7th, with DOE/NETL and the Calla Energy Project Team.

GTI’s was prepared to present a paper at the Fifth Biomass Conference of the Americas. The conference is being held in Orlando, Florida the week of September 17th. Due to the
events of September 11th, the presentation of the paper has been pushed back to the week of December 17th.

GTI has requested and been granted a no-cost 2-month extension of the contract. This was requested to allow more time to complete the paperwork necessary for the Application for Funds for Project Continuation for Phase II. This should be submitted within the next month. GTI was also granted a supplement to Phase I to conduct additional work, beyond the original scope of the project on September 26, 2001.

**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**
GTI completed the technical efforts required under the agreement during this period. The technoeconomic analysis was developed and reviewed for the project. Calla Energy indicated their commitment to proceed with this project, subject to receipt of all permits and DOE cofunding.

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 working with Calla Energy to complete documentation required for the Application of Funds for Phase II. This should be completed within the next month.

GTI is developing a detailed Scope of work to cover scope of work outlined in Supplement A002 issued September 26, 2001.

The Topical Report for the project will be submitted early December.

**Future Work Plan Next Quarter:**
• Issue Topical Report
Appendix A

Fuel Cost Impact on Product Gas Value (years 3 - 10)

Note: 20 year financing
10 year tax credit

Figure 1. Relationship Between Fuel Cost and Product Gas Value