

**Quarterly Technical Progress Report – Phase I**  
**COOPERATIVE AGREEMENT**  
**DE-FC26-00NT40899**  
**Calla Energy Biomass Cofiring Project**

January 2001

**CONTRACTOR NAME**

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

**PERIOD OF PERFORMANCE**

From: September 25, 2000  
To: December 31, 2000

**CONTRACT PERIOD**

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

**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-NO<sub>x</sub> 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.

**TECHNICAL APPROACH CHANGES**

None

**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.

## **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<sub>x</sub> 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 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.

### **OPEN ITEMS**

Subcontracts shall be completed by the end of January 2001.

## **SUMMARY STATUS ASSESSMENT AND FORCAST**

### **Task 0.0. NEPA Review**

Calla and GTI have initiated the permit review and applications process based on updated preliminary design information.

### **Task 1.1 Feedstock Evaluation**

Calla has initiated review of available suppliers for biomass for this project and for collection of samples to be analyzed by GTI to initiate preparation of the process design basis.

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

Several approaches for LCV syngas combustion and integration with Calla's FBC power plant are being reviewed and evaluated.

### **Task 1.3. Conceptual Plant Design**

GTI has reviewed the process design and is finalizing the work scope for each subcontractor. Nexant and Carbona are ready to start the conceptual design of the biomass gasification plant.

### **Task 1.4. Technoeconomic Analysis**

No activity this period.

### **Task 1.5. Project Management – Phase I**

GTI has submitted the Detailed Milestone Plan and the Milestone Log for the project. The Hazardous Substance Plan was submitted as required. No hazardous substances shall be used during Phase I of the project.

The Project Kick-off Meeting was held between GTI and Calla Energy on October 27, 2000. GTI and Calla Energy presented the project plan at NETL's Biomass Cofiring Opportunities Kickoff Meeting at NETL's offices in Pittsburgh on October 24, 2000.

### **Task 1.6. Technology Conceptualization**

No activity this period.

### **Future Work Plan Next Quarter:**

- Complete the subcontracts with Nexant and Carbona.
- Complete feedstock selection to define design basis of facility.
- Initiate plant conceptual design.