Gas Technology Institute (GTI), 05NT42649

"Partial Oxidation Gas Turbine (PGOT)
for
Power and Hydrogen Co-Production from Coal Derived Fuel in Industrial Applications"

FACT SHEET (DRAFT)

I. PROJECT PARTICIPANTS

A. Prime Participant: GTI (Dr. Joseph Rabovitser, PI), 1700 S. Mount Prospect Road, Des Plainesm, IL 60018, www.gastechnology.org

B. Sub-Award Participants: Solar Turbines (Dr. Kenneth Smith), Siemens (Dennis Horazak), ORNL (Dr. James Keiser), Georgia Institute of Technology (Dr. Tim Lieuwin)

II. PROJECT DESCRIPTION

A. Objectives

This effort will produce (1) a feasibility design for retrofitting a conventional gas turbine for partial oxidation IGGC plant duty, (2) a conceptual Integrated Gas Combined Cycle (IGCC) plant design (systems study) that integrates the retrofitted turbine design; and (3) a preliminary industry needs assessment.

The systems study goal is an optimal (efficiency and cost) conceptual IGCC power that produces electricity and hydrogen products. An appropriate financial analysis methodology will be used to determine required selling price of these products. The conceptual systems design will feature a MW-scale Partial Oxidation Gas Turbine (POGT) whose basis is a conventional and available gas turbine retrofitted for operation in the conceptual IGCC plant.

B. Background/Relevancy

Background. GTI has been working on the Partial Oxidation Gas Turbine (POGT) concept since 1995. A computer code for systems analysis of POGT unit operation has been developed. Siemens has performed technical feasibility and cost analysis studies of the partial oxidation power cycle. The California Energy Commission (CEC) and GRI enlisted the team of GTI, Solar Turbines and Belcan Corporation to design and build a 10 MWt pressurized Partial Oxidation Reactor with the concept of testing this unit for it's eventual replacement of traditional gas turbine combustors. The unit was commissioned Summer of 2005 and is located at GTI.

Relevancy. The cooperative agreement work will result in the "feasibility" design for retrofit of a conventional turbine to POGT duty. Additionally, a "conceptual" design of one more Integrated Gasification Combined Cycle (IGCC) or Combined Fuel and Power (CFP) plants will be performed. These designs will form the basis for decision making that hopefully will commit to

the construction of novel new power plants offering a mix of multiple products (hydrogen, syngas and electricity) for industrial size operations.

C. Period of Performance: October 1, 2005 thru July 31, 2007.

D. Project Summary

Plant Schemes. A procedure is being documented that explain the rationale or approach for choosing plant size, for arranging and interconnecting major equipment items and plant units, for executing materials and energy balances, for labeling streams, for indicting stream compositions and conditions, for setting equipment specifications, and for defining unique plant units to more accurately estimate their costs. The procedure will explain how plant capital and operating costs are determined. The procedure will show how these costs are translated into cost of products ($/ KW-HR or $/1000Btus of fuel). The procedure and documentation of work done by it will lend itself to easiest possible validation by third parties.

A baseline plant "scheme" will be developed and used to execute POGT-IGCC plant design (systems studies) in order to show the implication of POGT unit in terms of thermodynamic performance and cost. In parallel, a "first guess" best size of the conceptual IGGC system will be made based on a cursory market study of industry need for plant products indicated the plant scheme.

Conceptual IGCC-POGT Plant Designs The Project Team is developing a systems study model easy to exercise via sensitivity analysis. The purpose is to understand the implications of larger or smaller plant sizes (cost of products required and market penetration implications) and any important engineering variables. Best process and economic engineering analysis practices are being used to quantify the thermodynamic and economic implications for integrating a POGT in an IGCC plant concept.

Identify/Select Candidate Turbines for Retrofit

An engineering team has been formed to assess the feasibility for converting existing/available turbine designs and hardware for duty as a partial oxidation gas turbine in the Conceptual IGCC Plant Design produced in tasks above. The engineering team is identifying and ranking best candidates for POGT duty. GTI will summarize these findings and report the results of this identification effort to the COR.

The team is identifying all technical issues associated with conversion of best candidate existing turbine designs/hardware for POGT duty, adjusting the ranking of best candidates accordingly; and is selecting the most suitable conventional turbine for retrofit design activities.

Industry Needs Assessment A preliminary assessment is being done to aid setting the plant size basis for the systems study(s) and to develop consumption profiles by industry type as well as show co-product/byproduct value (hydrogen and syngas). A weighted relevance of the POGT for selected industries is being determined considering plant performance and minimum product cost needed to operate the plant and retire debt.

III. PROJECT COSTS

A. DOE $929,992
B. GTI: $326,858
C. Total: $1,256,850

IV. MAJOR ACCOMPLISHMENTS SINCE BEGINNING OF PROJECT

- Identified Five Turbines That Qualify for Partial Oxidation Retrofit
- Selected Two Types of Gasifier, a high temperature entrained flow gasifier and moderate temperature fluidized bed gasifier, for preliminary IGCC scheme
- Selected H2 Purification Scheme for required Quality of Produced H2
- Conceptual IGCC Plant Design Has Been Started
- POGT Feasibility Design Has been Initiated

V. MAJOR ACTIVITIES PLANNED

- Select Three Turbine for Retrofit Feasibility Design
- Select One Type of Gasifier for Conceptual IGCC Plant Design
- Continue Conceptual IGCC Plant Design
- Continue POGT Feasibility Design for the Three Selected Turbines

VI. ISSUES: None