Catalytic Combustion for Ultra-Low NOx Hydrogen Turbines
DE-FC26-05NT42647

FACT SHEET
October 12, 2006

I. PROJECT PARTICIPANTS

Precision Combustion, Inc. (Lead)
410 Sackett Point Road
North Haven, CT 06473

Solar Turbines, Inc. (Subcontract)
2200 Pacific Highway
San Diego, CA 92101

II. PROJECT DESCRIPTION

A. Objective

A 39 month program to develop and demonstrate a combustion system for MW (megawatt) class H2 (hydrogen) turbines that has the capability to burn H2 as fuel, maintain and/or extend current levels of efficiency, reduce NOx to the <3 ppm level (@ 15% O_2), and eliminate emissions of carbon dioxide.

B. Background / Relevancy

1. Background

Precision Combustion, Inc. (PCI), with DOE and gas turbine manufacturer support, has developed a leapfrog advance in catalytic combustor technology that offers ultra-low emissions (NOx < 3 ppm, low single digit CO) clean and efficient catalytic combustion for gas turbines. Originally developed under DOE's SBIR program, Rich Catalytic Lean burn (RCL®) technology offers simultaneous improvements in emissions, efficiency, fuel flexibility and component life, and is now moving toward natural gas-fired gas turbine field trial with Solar Turbines, Inc. The technology has retrofit potential and has been demonstrated operable with multiple fuels.

The current program focusing on hydrogen was awarded following proposal submission by PCI, with Solar Turbines, Inc. as subcontractor, in response to DOE solicitation DE-PS26-05NT42380 **(**Topic 3A). The technology to be developed uses the fuel flexibility of PCI's RCL® catalytic reactor in a combustion system for hydrogen fuel.

2. Relevancy

This program is directed toward DOE's goals of achieving near zero emissions gas turbines burning hydrogen fuel and without CO2 emission. This advances DOE's objectives for achievement of low single digit NOx emissions, improvement in efficiency v/s post-combustion controls, fuel flexibility for similar low emissions of

syngas or natural gas, a significant net reduction in IGCC system net capital and operating costs, and a route to commercialization across the power generation field.

C. Period of Performance

Phase I - October 1, 2005 through August 31, 2006
Phase II - September 1, 2006 through August 31, 2008
*Phase III - September 1, 2008 through August 31, 2009
*Note: To be negotiated as part of the Continuation Process.

D. Project Summary

The project will develop and achieve combustor demonstration of an ultra low NOx rich catalytic combustion system for fuel-flexible hydrogen combustors in megawatt-scale turbines. This will develop PCI's rich catalytic combustion technology for fuel flexible hydrogen application, in collaboration with Solar Turbines, Inc. and provide a roadmap to commercialization of the technology across all size ranges of power generation turbines. This technology, in a current DOE program, has demonstrated subscale ultra-low NOx emissions with syngas and with hydrogen diluted with nitrogen (low single digit NOx corrected to 15% O2 with operation at IGCC base load combustor temperatures and 10 atm pressure). The benefits include combustors capable of delivering near-zero NOx without costly post-combustion controls and without requirement for added sulfur control. This advances DOE's objectives for achievement of low single digit NOx emissions, improvement in efficiency v/s post-combustion controls, fuel flexibility, a significant net reduction in IGCC system net capital and operating costs, and a route to commercialization across the power generation field.

The work plan is in three phases. Phase I involves development of conceptual designs for catalytic combustion technology for hydrogen fuel and R&D implementation plan. Phase II, Detailed Design and Validation Test Program, concentrates on development of multiple full-scale modules for validation testing, to include full pressure testing and resolution of key issues. In Phase III, the full-scale design will be frozen, and a full combustor system (sector) with multiple catalytic combustor modules will be fabricated for an initial rig testing.

III. PROJECT COSTS

	DOE	Cost Share	Total
Phase I	$1,001,391	$ 250,348	$1,251,739
Phase II	$2,501,974	$1,072,505	$3,574,479
Phase III	*$1,842,127	$1,842,126	$3,684,253

The prime contractor (Precision Combustion, Inc.) and participating OEM (Solar Turbines, Inc) will provide the cost share for the program.
*Note: To be negotiated as part of the Continuation Process.

IV. RECENT MAJOR ACCOMPLISHMENTS

- Solar Turbines, Inc. the world's largest manufacturer of mid-range industrial gas turbines (1-15 MW) is on-board. Taurus 70, (T70) has been down selected as the

engine development platform in terms of RCL integration, highest cost effectiveness for development purposes and engine efficiency among the Solar Turbines, Inc engine family.

- Reactor Durability Testing: Several reactor coating formulations have been tested up to 100 hours for screening. More samples are being prepared and tested to achieve enhanced durability and catalyst performance.
- Reactor Design: The reactor design (Generation II) and fabrication for H2 combustion completed. Testing with promising performance completed.
- Preparation of R&D Implementation plan by both at PCI and Solar Turbines, Inc. completed and submitted to DOE.
- Diluent selection study completed.
- Meetings and discussions:
    - Kick-off meeting was held at DOE- Morgantown facility. Discussed the R&D implementation plan with DOE technical staff.
    - Held a technical conference call with DOE technical personnel on material durability
    - Technical presentation at the International Colloquium on Environmentally Preferred Advanced Power Generation (ICEPAG - 2006)
    - Technical presentation at the 23rd Annual International Pittsburgh Coal Conference (2006)

V. MAJOR TASKS PLANNED IN OUTYEARS (6 MONTHS)

- Complete subscale GEN II reactor testing
- Complete the design of the full-scale test module for testing at Solar Turbines, Inc.
- Complete fabrication of full-scale test module
- Complete preliminary testing of full-scale module

VI. ISSUES

None

VII. ATTACHMENTS

None