FACT SHEET
Rampressor Shock Wave Compressor , DE-FC26-06NT42651
(Ramgen Power Systems, RPS)

I. PROJECT PARTICIPANTS

A. Prime Participant: Ramgen Power Systems, Inc (RPS) under cooperative Agreement DE-FC26-06NT42651

B. Sub-Award Participants: ASE Technologies (ASE), Manufacturing Resources Inc. (MRI), Geminus Technologies Development (GTD), Steve Kushnick, P.E., Alouette Technology.

II. PROJECT DESCRIPTION

A. Objective(s): Based on aerospace ramjet technology, Ramgen Power Systems is developing a novel more cost effective compressor concepts (air and carbon dioxide) for support of coal fueled gasification stationary power applications and for potential replacement of the compressor component in gas turbines.

B. Background: Ramgen has successfully demonstrated proof-of-concept of its Rampressor supersonic compressor in a 12-month testing program conducted at Boeing's Nozzle Test Facility (NTF) in Seattle, WA. The test's principal goal was to demonstrate the successful adaptation of supersonic flight inlet designs and performance to the rotating environment found on a compressor disc. A Rampressor with a 2.5:1 pressure ratio was built and extensively instrumented to measure performance and operational characteristics of the test rotor. A parallel effort constructed analytical performance prediction tools and the experimental results were then used to refine those prediction tools. The test results combined with the performance prediction tools confirmed expectations and validated the preliminary performance and operational claims of the Rampressor technology. The experiment successfully demonstrated that supersonic flight inlet designs and performance can be adapted to a rotating disc.

The rotating disk in the Rampressor unit performs the compression function on which, the compression is accomplished with super-sonic inlet technology by employing air velocities beyond the speed of sound that use shock waves to efficiently compress the air.

In comparison to existing compressors, the Rampressor design should result in lower fabrication cost, and operate more economically. In addition, the simplicity of the Rampressor engine is projected to result in higher reliability and availability.

C. Project Summary: In Phase I the project will continue R&D necessary to show the feasibility of commercial compressor products based upon Ramgen's unique shock wave compression concepts that claim higher efficiency, smaller foot print; and, more competitive costs than traditional axial compressors.

After final testing and satisfactory validation of the Rampressor air compressor design, Ramgen will commence design of a carbon dioxide (CO2) Conceptual Design. The starting Conceptual Design of a CO2 prototype will be sufficiently flexible so that the size can be scaled, as needed, to optimize an IGCC plant. A ¼ scale design is envisioned that would be based on a product rated at 150,000 lbm/hr, or 21,400 icfm, 15 psia suction pressure and the specified nominal discharge pressure of 1500 psia. Feasibility, preliminary and detailed designs will occur in subsequent phases.

The ¼ capacity size allows for comparisons versus conventional centrifugal compression design approaches. The ¼ capacity prototype size is a more affordable and prudent approach for developing this first of a kind machine. The ¼ capacity prototype design will assume a conventional turbo gearbox similar to those manufactured by BHS-Cincinnati. Larger compressors designed for IGCC plant duty would most likely be designed to take advantage of direct drive high speed motor technology.

As all tasks are being performed, Ramgen will identify technical barriers and issues as well as R&D needed to overcome these. Ramgen will document such insights as they occur, discuss them in Quarterly Progress Reports and Project Review Meetings, and summarize these in a Final Report.

D. Period of Performance: 5/10/2006 through 1/9/2011.

III. PROJECT COSTS

A. DOE Costs	$9,494,546
B. Prime Cost Sharing	$6,614,685
C. Partner Cost Sharing	$ TBD
D. TOTAL COST	$16,109,211

IV. MAJOR ACCOMPLISHMENTS SINCE THE BEGINNING OF DOE SUPPORT

- A 2.8 MW ramjet engine conceptual design was completed (April 2002)
- The 2.8 MW design was based on extensive testing of a first ever 10 MW Ramgen ramjet engine (2001 through 2002).
- Preliminary results showed that emission levels dropped below 10 ppmv NOx, CO and unburned hydrocarbon.
- Means to dramatically downsize to a 400 kW engine size evolved from a successful external design review.

- A strategic decision was made in February 2004 to focus Ramgen on development of the Rampressor product.

- Ramgen calculations indicate that a 10:1 pressure ratio Rampressor compressor, conventional burner and standard non-air cooled turbine could achieve near 40% cycle efficiency if the system were recuperated.

- Successfully demonstrated supersonic flight inlet designs and performance can be adapted to a rotating disc with a 2.5:1 pressure ratio test called Rampressor 1

- Completed the Rampressor II Turbine Design FY 2005

- Constructed the Rampressor II rig and readied it for testing to start Jan 2006.

V. MAJOR ACTIVITIES PLANNED DURING THE NEXT 18 MONTHS

- Complete Rampressor II (air compression) testing.
- Initiate a Conceptual Design of a CO2 compressor.

VI. ISSUES

- Initiating testing of Rampressor II has been challenging.