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Industry/University Consortium for ATS Research

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Contractor:

S.C. Energy Research & Development Center
386-2 College Avenue
Clemson, SC 29634

Contract Number:

DE-FC21-92MC29061

Conference Title:

Joint Contractors Meeting: FE/EE Advanced Turbine Systems
Conference, FE Fuel Cells and Coal-Fired Heat Engines Conference

Conference Location:

Morgantown, West Virginia

Conference Dates:

August 3-5, 1993

Conference Sponsor:

U.S. Department of Energy, Morgantown Energy
Technology Center

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CONTRACT INFORMATION

Cooperative Agreement	DE-FC21-92MC29061
Contractor	S.C. Energy Research & Development Center 386-2 College Avenue Clemson, SC 29634 (803) 656-2267
Contractor Project Manager	R.P. Allen
Principal Investigator	L.P. Golan
METC Project Manager	Dr. Paul L. Micheli
Period of Performance	9/30/92 - 3/30/97

OBJECTIVES

The objective of the overall ATS Program is to develop ultra-high efficiency, environmentally superior, and cost competitive gas turbine systems for base-load application in utility, independent power producer and industrial markets. The overall ATS program has four elements one of Technology Base Development which is designed to support the overall program. The Industry/University research consortium is part of the ATS Technology Base Development element and is designed to provide the technology research support required by the program. The research is to be industrial driven, non-proprietary, useful to all, and conducted by the University performing members.

power producing.

Workshop I was attended by key decision-makers in the gas turbine industry, relevant academic, and involved government technology sponsors. The Workshop was initiated with general overview presentations covering important background areas such as the users desires, manufacturers perspective, Federal government R&D policy and interested industry/technical groups. The attendees then broke into three technical "focus" groups for discussion sessions. The results from the discussions were summarized into two general categories: programmatic and technical. Several significant programmatic conclusions were reached. The attendees unanimously believed the philosophy/goals of the Workshop were nationally very relevant and timely. The attendees agreed that better coordination of industry, university, and government activities would be very helpful in accelerating the development of advanced gas turbines. One approach suggested to meet this end would be an industry driven university-led Gas Turbine Research Program. Such a program could execute research activities of joint industry/university/ government interest, result in more relevant academic programs, and increase the future supply of graduates with skills needed by the gas turbine industry.

BACKGROUND INFORMATION

The Industry/University ATS research program is the result of two planning workshops. Workshop I was held April 8-10, 1991 and had the goal of identifying research needs for advanced gas turbine cycles that would permit rapid commercialization of cycles with significant improvements over the machines currently under development, in terms of the cost of electricity produced and the environmental burdens resulting from their use in

Workshop II was held in January 1992 and continued the identification of the research needs to develop advanced gas turbine systems. The goals established for the ATS systems were

- efficiency exceeding 60% for large utility turbine system and 15% improvement in heat rate for industrial systems
- busbar energy costs 10% less than current state of the art and
- fuel flexible designs.

In addition Workshop II participants agreed that an industry driven research consortium was an acceptable mechanism to achieve base technology development needs.

In September 1992 a cooperative agreement was signed between DOE/METC and the South Carolina Energy Research and Development Center for an industry/university consortium to conduct the R&D needed to support the overall ATS program. Fifty-six universities from 30 states have joined the ATS research activity as performing members (see Table I). Five turbine manufacturers (Allison Gas Turbine Division of General Motors, General Electric Power Generation Department, Solar Turbines United Technologies Turbo Power and Marine Inc., and Westinghouse Electric Power Generation Unit) along with Fluor Daniel, an engineering/construction firm, have agreed to be co-sponsors.

Table 1. Performing University Members

University of Alabama - Huntsville
 University of Arkansas
 Auburn University
 Brigham Young University
 University of California - Berkeley
 University of California - Davis
 University of California - Irvine
 California Institute of Technology
 Carnegie Mellon University
 Clarkson University
 Clemson University
 Cleveland State University
 Cornell University
 University of Dayton

University of Delaware
 University of Denver
 Drexel University
 Florida Atlantic University
 Florida Institute of Technology
 Georgia Institute of Technology
 University of Hawaii - Manoa
 University of Houston
 Iowa State University
 University of Iowa
 University of Kansas
 Lehigh University
 Louisiana State University
 University of Maryland - College Park
 Mercer University
 Michigan State University
 Michigan Technological University
 University of Michigan
 University of Minnesota
 University of Missouri - Rolla
 University of Notre Dame
 University of Oklahoma
 Penn State University
 University of Pittsburgh
 Princeton University
 Purdue University
 University of South Alabama
 University of South Carolina
 Southern University
 Syracuse University
 University of Tennessee
 Tennessee Technological University
 Texas A&M
 University of Texas - Arlington
 University of Utah
 Vanderbilt University
 Virginia Polytechnic Institute
 Washington University
 West Virginia University
 University of Wisconsin-Milwaukee
 Worcester Polytechnic Institute
 University of Wyoming

The research program is managed by the South Carolina Energy Research and Development Center, however, the Industrial co-sponsors along with representatives from EPRI and GRI form an Industrial Review Board which identified ATS issues needed by industry and suitable for university research.

The SCERDC issues competitive solicitations reflecting the guidance from the IRB. The proposals are evaluated by the IRB which recommends which programs are to be funded based on the available financial resources. The research performed by the universities is to be performed in existing facilities so that research dollars are spent on people power rather than development of new facilities. University membership remains open.

PROJECT DESCRIPTION/RESULTS

The SCERDC released the first RFP solicitation in the spring of 93. Fifty-one proposals from 43 schools distributed in 26 states were received. The total funding requested by the schools was 29M\$. The technology splits of the research are shown on Table II.

Table 2. Technology Splits, %

Heat Transfer	23
Combustion	21
Materials	18
Aero	13
Dynamics	11
Cycles	5
Controls	3
Other	6
	100

The Industrial Review Board met at the SCERDC over a three day period in early June and recommended the following:

The proposals were selected by the program's Industrial Review Board from 51 submitted by 43 universities. Award recipients and research subjects include:

- Brigham Young University, combustion modeling for advanced gas turbines;
- University of California - Berkeley, porous combustion material investigation;

- Clarkson University, ice formation design method for loss reduction;
- Lehigh University, functionally gradient materials for thermal barrier coatings;
- Louisiana State University, vortex generator induced heat transfer;
- Pennsylvania State University, life prediction of advanced materials;
- Purdue University, NOx reduction for advanced gas turbines;
- Texas A&M University, turbine cooling and heat transfer studies;
- Vanderbilt University, NOx and CO models for lean premixed combustors; and
- Virginia Polytechnic Institute and State University, ceramic actuators for combustion control.

FUTURE

Assuming that the 1994 budget request before Congress is approved, the SCERDC expects to issue another RFP in late 1993. At that time, additional research awards could be made dependent on the proposals and university capabilities.

As part of the plan to broaden the gas turbine technology base among American engineering schools a seminar series is being planned and requests have been released to the Industrial Review Board members to provide problems suitable for senior project design are to be used by the university. Via the involvement of the undergraduate engineers in this program, we will benefit the industry by providing an experienced crop of potential employees. The senior-design project activity will be of no cost to the research program. These areas will be developed slowly and evaluated to assure the success.

REFERENCES

1. *Proceedings of Workshop to Define Gas Turbine System Research Needs*, April 8-10, 1991, Greenville, South Carolina.
2. *Proceedings of Workshop to Define Gas Turbine System Research Needs - II*, January 7-8, 1992, Greenville, South Carolina.
3. Bajura, R.A., H.A. Webb, and E.L. Parsons, "A Proposed Plan for an Advanced Turbine Systems Program," In *Proceedings of Workshop to Define Gas Turbine System Research Needs - II*.
4. Webb, H.A., and R.A. Bajura, "Development of Advanced Turbine Systems -- Meeting Tomorrow's Needs," presented at the *Energy Daily Conference: Advanced Combustion Turbines: Looking Past the 90's*, June 25-26, 1992, Washington, DC.
5. Golan, L.P., Center for Advanced Gas Turbine Systems Research, In *Proceedings of the Ninth Annual Coal Fueled Heat Engines, Advanced Pressurized Fluidized Bed Combustion and Gas Stream Cleanup Systems Contractor's Meetings*, 259-265, DOE/METC - 93/6/29. NTIS/DE9300233.

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