Y-12

OAK RIDGE Y-12 PLANT

LOCKHEED MARTIN

Project Accomplishment Summery Report for Project Number 92-MULT-025-B2-04

TURBINE-GENERATOR SET DEVELOPMENT FOR POWER GENERATION

Donald J. Adams
Lockheed Martin Energy Systems, Inc.
S. G. Berenyi
Allison Engine Company

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Title: Turbine-Generator Set Development for Power Generation
DOE TTI Number: 92-MULT-025-B2-04
CRADA Number: Y1292-0111
Partner: Allison Engine Company

BACKGROUND

The intended result of this project was to expand the current knowledge base and gain more extensive design capability in state of the art generator design for future hybrid electric vehicle power systems. To achieve the goals of the project it would also have to explore the development of very smooth, ultra-high-speed variable speed motors and their controls that could also meet severe operating environment and design geometry constraints. This type of system was not and still is not commercially available.

Electric vehicle power generation is a globally competitive design issue and General Motors found the axial gap motor technology developed at the Oak Ridge National Laboratory (ORNL) attractive for this application. ORNL has been active in axial gap motor/generator development and it's associated electronics for over 25 years. General Motors' lack of experience in this area, coupled with a high level of interest in the technology due to its high efficiency and unique packaging advantages, led to a desire to team with ORNL in this endeavor. General Motors was to supply the gas turbine hardware, facilities, and manpower to adequately evaluate these advanced generators. ORNL would develop a 35 kW generator and the associated power controlled regulator.

DESCRIPTION

The goal of this effort was to design, develop, and demonstrate an integrated turbine genset suitable for the power generation requirements of a hybrid automotive propulsion system. The result of this effort would have been prototype generator hardware including controllers for testing and evaluation by Allison Engine Company. The generator would have been coupled to a suitably sized and configured gas turbine engine, which would operate on a laboratory load bank. This effort could lead to extensive knowledge and design capability in the most efficient generator design for hybrid electric vehicle power generation and potentially to commercialization of these advanced technologies. Though the use of the high-speed turbines as a power source for the hybrid-electric vehicles, a significant reduction in nitrous oxides emissions would be achieved when compared to those of conventional gas powered vehicles.

Development of the ultra high-speed 35 kW generator, power regulator, and its controller was to be performed at ORNL. Towards this effort, progress was made on developing innovative control algorithms for the high-speed machine as well as evaluation of optimum methods of coupling the machine controller to the power regulator. Packaging issues presented by the harsh operating environment presented by the turbine were examined and the power electronics controller design was initiated. The power regulator design was begun and some fabrication of hardware was completed. Preliminary electrical design of the generator was started as well as the stringent mechanical design requirements for the machines rotating parts.

BENEFITS TO DOE

This cooperative agreement was consistent with DOE's mission to improve U.S. industrial competitiveness through development of improved electric motor efficiencies. Defense Programs most direct benefit is in the development work in the area of very smooth, ultra-high-speed variable speed motors and their controls for use in machining applications. The agreement provided additional benefit to DOE's Y-12 Plant by enabling the facility and technical staff to increase their state-of-the-art technological knowledge and maintain a current state of weapons manufacturing readiness. DOE-DP further benefited from knowledge developed from attempts to define the characteristics of optimum electric generators and motor drives. This technology is useful for a variety of production applications, such as machining systems, and has the potential for dramatically improving manufacturing processes throughout DP production facilities. Considerable resources, both in dollars and personnel, within the Nuclear Weapons Complex are devoted to assessment of technology applications in pursuit of more efficient and even unattended machining. The participation of a leading industrial company's engineers and the use of their facilities afforded the potential for an extensive examination of this technology and a reduction of cost had the DP Complex attempted to perform this development outside of the partnership arrangement.

ECONOMIC IMPACT

Due to the lack of involvement of an Industrial Partner the project was not completed, therefore no assessment of the economic impact of the results can be made.

PROJECT STATUS

The CRADA was executed on October 8, 1992 and was terminated on June 30, 1993 by Energy Systems because Allison Gas Turbine Division was unable to participate in the CRADA. Energy Systems held discussions with other potential partners for conducting the project. Eventually, DP decided not to pursue this effort and all related work and project partner development activities ceased.

DOE FACILITY POINT OF CONTACT FOR PROJECT INFORMATION

Donald J. Adams
Oak Ridge National Laboratory
PO Box 2009
Bldg. 9104-2, MS 8058
Oak Ridge, Tennessee 37831-8058
phone: (423) 576-0260
fax: (423) 241-6124

COMPANY POINTS OF CONTACT

Allison Engine Company
S. G. Berenyi
P.O. Box 420-M/C T 11
Indianapolis, Indiana 46206

PROJECT EXAMPLES

The project was terminated prior to its culmination. As such, no deliverable hardware is available for demonstration purposes.

TECHNOLOGY COMMERCIALIZATION

Since the Industrial Partner never actively participated in this project, there are no reasonable plans for commercialization as a result of this effort.

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Don Adams, MS-8058, 9104-2

Ray Ford, MS-8084, 9203

Joyce Shepherd, MS-6416, 5002

Andy Stevens, DOE/ORO, MS-8009, 9704-2

Diane Bird, DOE/HQ, DP-17

Bill Wilburn, MS-8015, 9704-2

Lab Records, MS-6285, 4500-N

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S. G. Berenyi, Allison Engine Company, P.O. Box 420-M/C T 11, Indianapolis, Indiana
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