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OAK RIDGE Y-12 PLANT

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Project Accomplishment Summary
for
Project Number 91-Y12P-073-A1

COST EFFECTIVE MACHINING OF CERAMICS (CEMOC)

W. E. Barkman
Lockheed Martin Energy Systems, Inc.

Machine Tool, Ceramics, and Diesel Engine Companies

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PROJECT ACCOMPLISHMENT SUMMARY

Title: Cost Effective Machining Of Ceramics (CEMOC)
Project Number: 91-Y12P-073-A1
Partner: Machine Tool, Ceramics, and Diesel Engine companies

BACKGROUND

Finish machining operations contribute the majority of the costs associated with fabricating high quality ceramic products. These components are typically used in harsh environments such as diesel engines, defense machinery, and automotive components. The required finishing operations involve a variety of technologies including process controls, machine coolants, product certification, etc. and are not limited only to component grinding methods. The broad range of manufacturing problem solving expertise available in Oak Ridge provided resources that were far beyond what are typically available to the CRADA partners. These partners contributed equipment, such as state-of-the-art machine tools, and operation-specific experience that allowed Oak Ridge personnel to significantly expand their knowledge and experience base. In addition, addressing these challenging tasks enabled Oak Ridge personnel to maintain familiarity with rapidly advancing technologies, such as those associated with computer control systems.

DESCRIPTION

The purpose of the CEMOC program was to support U.S. industry needs in fabricating precision components, from difficult to machine materials, while maintaining and enhancing the precision manufacturing skills of the Oak Ridge Complex. Oak Ridge and partner company personnel worked in a team relationship wherein each contributed equally to the success of the program. In general, Oak Ridge contributed a wider range of expertise to a given task while the companies provided operations-specific equipment and shop-floor services. Process control technologies, machining procedures and parameters, and coolant-related environmental tasks were the primary focus areas. The companies were very pleased with the results of the CRADAs and are planning on continuing the relationships.

BENEFITS TO DOE

Process control technologies such as machine monitoring and machine vision were applied to specific industrial problems. These problems ranged in areas from process modeling and machining operations development, to cutting tools, to machining and inspection technology, and to machining environments. In accomplishing the CRADA tasks, Oak Ridge personnel enhanced their capabilities for continuously monitoring the condition of manufacturing processes and equipment without performing extensive, off-line certification operations on completed workpieces. Much of this capability was obtained through the application of state-of-the-art computer systems. Previous levels of expertise in these areas were becoming obsolete due to the rapidly evolving capabilities associated with newer generations of desktop computers.

In addition, Y-12's Advanced Development and Technology Program (ADaPT) pilot projects will take advantage of a variety of technology developments begun as CEMOC projects. CEMOC participated in the funding of the High Throughput and Reliability project, which applies in-process sensor systems to machine tools to develop monitoring systems and process

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models that accurately predict equipment performance problems before they show up as degraded product quality or a major equipment malfunction. The data collection, analysis, and modeling hardware and software developed for the Cincinnati Milacron Magnum machine will be applied to Y-12 turning machines in the ADaPT Agile Production Operations (APO) Pilot Project and will eventually find use in Y-12 production operations.

APO will also benefit from the machine vision process-monitoring activities conducted under the Machining and Inspection of Structural Ceramic Components project, which was funded through CEMOC. Previously, an optical tool inspection and compensation system, developed under the 1980's Precision Flexible Manufacturing System (PFMS) Program, applied state-of-the-art machine vision technologies for the correction of tool path errors caused by unpredictable tool wear. This system was installed on the Y-12 Enhanced T-base Lathe plus a new machine tool recently acquired by Los Alamos National Laboratory (LANL) for machining plutonium. The original optical tool inspection and compensation techniques are still applicable for use in today's manufacturing environment but the vision system hardware used in the PFMS Program is now obsolete. This project has allowed Y-12 to maintain an up-to-date working knowledge of modern vision system hardware (e.g. higher resolution array and line scan cameras and vision interface boards). This will facilitate the application of advanced process monitoring and compensation techniques to current manufacturing applications (including a potential partnership pilot with LANL).

CEMOC has joined with the Technologies Enabling Agile Manufacturing (TEAM) Program to sponsor work on the Hexapod steward platform machine assessment. This Hexapod machine offers the potential performing milling, drilling, and turning operations on a single enclosed machine tool. This machine may have intermittent production applications; however, for the near term it's continued evaluation is being picked up by APO and the Oak Ridge Centers for Manufacturing Technology's Center for Machining Processes and Systems.

ECONOMIC IMPACT

One industrial partner has already begun to apply the results of the CEMOC project in terms of machine tool design modifications and machining coolant formulations/treatment options. This will result in increased product sales and the resolution of product liability issues. Coolant formulations and treatment options are now available to enhance worker and environmental health. This results in a stronger U.S. machine tool industry and high-skill level employment opportunities. In addition, another partner has gained a significant increase in knowledge about their own manufacturing operations and will continue to use this information to improve the capabilities of future manufacturing systems. More detailed information on these two CRADAs is available in CRADA specific Project Accomplishment Summary reports.

PROJECT STATUS

The CEMOC program is complete.

DOE FACILITY POINT(S) OF CONTACT FOR PROJECT INFORMATION:

W. E. Barkman
Lockheed Martin Energy Systems, Inc.
P.O. Box 2009

Building 9201-3, Mail Stop 8068
Oak Ridge, TN 37831
Phone 423 574-1843
FAX 423 576-4663

PROJECT EXAMPLES

At this time, there are no project examples that the partners are ready to release.

TECHNOLOGY COMMERCIALIZATION

Results of this project have already been incorporated into commercial projects but are not considered ready for public disclosure by the industrial partners.

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