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Concepts NREC Supercritical CO2 Energy Recovery System Wins Honorable Mention in *Pumps & Systems'* Product Innovation of the Year Contest

The Phase I Small Business Innovative Research (SBIR) program project promises significantly improved power efficiencies in gas turbine prime movers for ship propulsion.

White River Junction, Vt. – December 5, 2011 – Concepts NREC (*CN*), a world leader in turbomachinery design, research, engineering and manufacturing, announces that its Supercritical CO2 Energy Recovery System has won an honorable mention in *Pumps & Systems'* 2011 Product Innovation of the Year contest. Each year, *Pumps & Systems* magazine recognizes the best new products of the year with the Product Innovation of the Year Award. This year's winners will be featured in the *Pumps & Systems* December 2011 issue.

"The Concepts NREC team is honored to receive this award and the recognition of *Pumps & Systems* magazine as part of its Project Innovation of the Year contest," says Frank Di Bella, PE and Program Manager, Large Product Development, for Concepts NREC. "We are very proud of our accomplishments on the Supercritical CO2 Energy Recovery System as part of the Phase I Small Business Innovative Research (SBIR) program, and we are excited about its possibilities for improving power efficiencies in gas turbine prime movers used for ship propulsion."

In January 2011, *CN* was awarded a Phase I Small Business Innovative Research (SBIR) grant from the U.S. Navy to improve the power efficiency of its gas turbine prime movers used for ship propulsion. The eight-month analytical study is in collaboration with the Maine Maritime Academy and its principal consultant, Travis Wallace, President, Thermoelectric Power Systems, LLC. The Navy's RFP required that the power recovery system improve the power output of the prime mover by at least 20%. Considerations include the effects that transient power demand from the prime mover have on the waste heat flow rate and temperature, which may consequently affect the fatigue integrity of the heat exchangers and stability of the turbomachinery subsystems.

The power improvement system must comply with space constraints inherent in onboard marine vessel power plants, as well as the interest in being economical. The complexity of using steam heat recovery systems precluded their consideration as a solution for this project.

CN's winning proposal suggested the use of a Brayton cycle-based, supercritical carbon dioxide (S-CO2) system to recover waste heat from a Rolls-Royce MT-30 gas turbine, a prime mover used in marine applications.

CN also suggested the viability of integrating one or more thermoelectric generator (TEG) system(s) within the S-CO2 cycle to further increase the power recovery, using an auxiliary combustion system,

perhaps powered by onboard, combustible bio-refuse and waste oils. This could provide thermal stability within the power recovery system during periods of transient power demands. The S- CO2 cycle has been promoted in several U.S. Department of Energy (DOE) project studies as an efficient prime mover system using nuclear energy as the heat source. A *CN* study, commissioned by Knolls Atomic Power Laboratories (KAPL), demonstrated the viability of an S-CO2 compressor and turbine design.

CN's efforts in Phase I will focus on the thermodynamic modeling of the S-CO2 cycle and conducting a feasibility analysis of an advanced design for a TEG-heat exchanger that integrates TEG modules with sufficient surface area for the necessary heat transfer required to benefit the S-CO2 cycle. An assessment of the benefits of using TEG systems with the S-CO2 cycle and an auxiliary-fueled combustion system to maintain thermal stability and provide auxiliary (boost) power will be included. Also detailed will be the conceptualized design of an S-CO2 compressor, turbine, and generator using a single drive shaft in a compact, modular package that reduces bearings, seals, and gearbox drives, reduces operation and maintenance costs and facilitates installation in the confined spaces of the engine room. An auxiliary combustion system adds heat energy input to the cycle if the prime mover is either unavailable or at a part-load demand and enables the supercritical heat exchanger to maintain relatively constant pressure and material temperatures, thus minimizing thermal or mechanical fatigue. Bioderived fuels for the auxiliary combustion system will also be considered to further increase economic viability.

After reviewing *CN*'s May 2011 Supercritical CO2 Power Cycle Symposium paper entitled, "Gas Turbine Engine Exhaust Waste Heat Recovery Navy Shipboard Module Development," the editors of *Pumps & Systems* magazine awarded *CN* with its Product Innovation of the Year Honorable Mention. For more information about the award and *CN*'s Supercritical CO2 Energy Recovery System, refer to the December 2011 issue of *Pumps & Systems*.

About Concepts NREC
Concepts NREC is a leading worldwide organization providing turbomachinery design, engineering, manufacturing and CAE/CAM software, with a staff of 100+ professionals at its facilities in Wilder, Vt., and Woburn, Mass. For over half a century, Concepts NREC has provided manufacturers, users, government agencies and the engineering community with technology tools, services and products that have met their needs, helped achieve their goals, and aided in development and production of some of the world's most advanced products. Concepts NREC is headquartered at 217 Billings Farm Road, White River Junction, VT, 05001-9486. Telephone: 802-296-2321. Facsimile: 802-296-2325. For more information, go to: www.ConceptsNREC.com.

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