NUCLEAR ENERGY RESEARCH INITIATIVE

Heat Exchanger Studies for Supercritical CO_2 Power Conversion System

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Project Number: 05-146

Collaborators: Argonne National Laboratory

Related Program: Gen IV

Project Description

Advanced power conversion technology, consisting of a gas turbine Brayton Cycle utilizing supercritical carbon dioxide as the working fluid, is being considered for application in some of the Generation IV nuclear energy systems. This design is expected to significantly reduce plant cost, size, and complexity, and increase efficiency. An added benefit is that this design can operate at high temperatures suitable for cogeneration of hydrogen. While such benefits derive from the unique thermo-physical properties of supercritical CO_2, these same properties also present technical challenges to the regenerative heat exchanger design. To maximize the usefulness of this design, a compact heat exchanger would be required. Basic heat exchanger performance data are needed in order to develop an improved design for application to the supercritical CO_2 power conversion system.

The objectives of this project are to establish heat exchanger performance under design conditions, estimate performance for beyond design-basis accidents, and compare different heat exchanger design options.

Work Scope

The project will conduct the following activities:

- Design, construct, and operate an experimental facility for performance testing of compact heat exchangers for the supercritical CO_2 Brayton cycle recuperator/cooler application.
- Obtain heat transfer and pressure drop data to evaluate performance of selected compact heat exchanger designs (e.g., Printed Circuit Heat Exchanger or PCHE).
- Develop fluid flow and heat transfer simulation models and tools to support the evaluation of heat exchanger designs.