

Technical Development for S-CO₂ Advanced Energy Conversion

PI: Mark Anderson, University of Wisconsin

Collaborators: Gregory Nellis, University of Wisconsin
Sanford Klein, University of Wisconsin
Michael Corradini, University of Wisconsin
Devesh Ranjan, Texas A&M University
Yassin Hassan, Texas A&M University

Program: Reactor Concepts RD&D (ARC-1)

ABSTRACT

It is proposed to capture experimental data relating to S-CO₂ flows relevant to the Brayton cycle technology and use this data along with data from Sandia National Laboratory (SNL) and Barber Nichols (BNI) to develop new CFD models and cycle analysis tools to further the deployment of S-CO₂ power generation cycles.

The importance of improved efficiency and reduced capital cost has led to renewed interest in studying advanced Brayton cycles for high temperature energy conversion. Previous work conducted by Dostal et al. 2006 has shown that the supercritical CO₂ may be superior to other advanced high temperature cycles both from the standpoint of increased thermal efficiency as well as reduced size and cost of the required turbo-machinery components. These potential advantages make the cycle especially well-suited for any high temperature heat source including the Very High Temperature Reactor, the Sodium Fast Reactor and the Fluoride High temperature Reactor (VHTR, SFR and FHR). The cycle is also of interest for use in concentrating Solar Electrical Generation Systems (SEGS), biomass and thermal energy storage. Wright et al. 2008 has begun testing supercritical CO₂ compressors and turbines fabricated by Barber Nichols and found promising initial results. The Naval Reactors program has also expressed interest in S-CO₂ systems, due to their high power density and is in the process of building a split turbine compressor system. While this cycle is very attractive due to its high efficiency, high power density and limited reaction with sodium (i.e., making it of interest in the SFR program), there are still several areas where progress is needed to make this cycle commercially viable. The proposed research utilizes the existing facilities at the participating universities in order to address a number of key scientific and operational issues pertaining to the turbomachinery, CFD modeling of supercritical fluids and off design cycle analysis.