INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Supercritical Carbon Dioxide Brayton Cycle Energy Conversion

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Project Abstract

The objective of this project is to develop Supercritical Carbon Dioxide (S-CO_2) Brayton cycle energy conversion systems and evaluate their performance when coupled to Generation IV reactors. The S-CO_2 Brayton cycle is expected to provide improved conversion efficiencies at high temperatures. The plant has a smaller footprint, is less complex, and uses fewer components than a conventional design. Moreover, the high fluid density of S-CO_2 greatly reduces component sizes. For example, an S-CO_2 turbine for a 400 MW_t heat source may be no more than 1 meter in length and 1 to 1.5 meters in diameter. This substantially reduces the technical risks associated with developing reactors and energy conversion schemes that require much higher temperatures.

During this project, the Korea Atomic Energy Research Institute (KAERI) will develop S-CO_2 Brayton cycle energy conversion systems coupled with Very High Temperature Reactors (VHTR) and Sodium Fast Reactors (SFR). At the same time, Argonne National Laboratory (ANL) will advance development of an S-CO_2 Brayton cycle energy conversion system for coupling with Lead-Cooled Fast Reactors (LFRs).

The project team will develop a plant dynamics analysis computer code for the coupled S-CO_2 Brayton cycle/reactor systems. The code will be applied to investigate and develop control strategies during operational transients and postulated accidents. In addition, dynamic analyses of integrated plant transient behavior will be performed for specific control strategies. The team will also work with a commercial turbomachinery vendor to develop improved methodologies for turbomachinery modeling during normal and off-design performance.