NUCLEAR ENERGY RESEARCH INITIATIVE

Development of Efficient Flowsheet and Transient Modeling for Nuclear Heat Coupled Sulfur Iodine Cycle for Hydrogen Production

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Collaborators: None

Project Number: 06-060

Program Area: Nuclear Hydrogen Initiative

Project Description

The main goal of this project is to develop a flowsheet for the closed-loop sulfur iodine (SI) cycle for nuclear hydrogen production. This flowsheet will use current advances in acid decomposition and product gas separation to achieve high thermal efficiency. It will result in the development of transient analysis methods for the SI cycle. Although the closed-loop SI cycle has recently been demonstrated on a bench scale, several challenges remain, such as maintaining stable operation, enhancing efficiency, obtaining thermodynamic data for the reactions, coupling to a high-temperature nuclear reactor, and determining transient behavior of the coupled system. This project will develop models to study transient performance of the closed-loop SI cycle. In addition, this research will explore several alternatives to SI cycles that have been proposed.

A model for the General Atomics (GA) SI cycle flowsheet will be developed using ASPEN PLUS and benchmarked with flowsheet simulation results. Flowsheet modifications will be considered using new membrane techniques for efficient separation of the process gases in the SI cycle. A comparative study of a modified flow sheet with the GA flowsheet will then be performed to identify further technical challenges and research needs. A transient analysis model for the nuclear-hydrogen coupled plant will also be developed for use as a tool to derive process control strategies and logic for coupled plant transient scenarios.

Workscope

Specific objectives of the project are to:

- Perform benchmark flowsheet analysis of the baseline SI cycle
- Investigate membrane techniques for HI and H_2SO_4 decomposition and separation processes
- Perform comparative flowsheet analyses of the modified cycles
- Develop component-wise SI cycle models for application to the transient analysis
- Perform preliminary analysis of transient behavior of the closed-loop SI cycle