NUCLEAR ENERGY RESEARCH INITIATIVE

Molten Salt Heat Transport Loop: Materials Corrosion and Heat Transfer Phenomena

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Project Number: 05-154

Collaborators: None

Related Program: NHI

Project Description

The next generation nuclear power plant (NGNP) is likely to be a high-temperature reactor utilizing graphite moderation with TRISO (isotropic coatings of three materials) fuel particles in either a matrix or pebble bed configuration. The NGNP will be designed to produce two energy products: electricity and process heat for hydrogen production. Producing process heat requires a heat transport fluid such as high-pressure inert gas (helium or carbon dioxide) or molten fluoride salt.

Because the interface between the reactor and the hydrogen production system will likely involve long heat transfer paths at elevated temperatures, a heat transport working fluid that has superior heat transfer characteristics would be required. The heat transport fluid should (1) be chemically compatible with the surrounding structural materials, (2) have superior fluid-mechanical and heat transfer proprieties, and (3) have acceptable safety characteristics under normal and abnormal conditions. This project investigates the potential of molten salt as a possible transport fluid and also investigates the corrosion resistance of structural materials that would come into contact with the molten salt.

The objective of this project is to demonstrate that molten fluoride salt can be successfully implemented in a low-pressure intermediate heat exchange loop. This project will focus on researching molten fluoride salts as the process-heat transport medium and the corrosion compatibility of surrounding materials with this medium.

Work Scope

The work will be performed as follows:

- Design, fabricate, and operate molten fluoride salt capsules in a flow loop under prototypic NGNP conditions using appropriate geometric scaling;
- Plan, design, and execute a series of corrosion compatibility experiments in the heat exchange loop in order to develop a database on the structural materials' behavior for a range of candidate materials that are being considered for the NGNP design;
- Document the observed corrosion effects and heat transport performance as integral and separate-effects database.