

NUCLEAR ENERGY RESEARCH INITIATIVE

Materials and Design Methodology for Very High-Temperature Nuclear Systems

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Project Number: 07-024

Collaborators: Stress Engineering Services

Program Area: Generation IV

Project Description

The objective of this research project is to address major materials performance and methodology issues for the design and construction of high temperature and very high temperature nuclear systems. This work will provide a synergy between the development of simplified, but robust, design rules for high-temperature systems and materials testing, along with performance and improvement of these systems. Such systems will have to deal with time-dependent materials properties (creep, creep-fatigue, high-temperature corrosion) in components with complex stress states, long intended service lives, and aggressive operating environments. Routine mechanical properties data and current high-temperature design methodology do not provide adequate information for long-term, robust system design. This project will address these issues. In addition, high-temperature materials testing in relevant corrosive environments (low oxygen, partial pressure with substantial carbon activities) will be performed to support further code qualification of existing alloys and the development of emerging alloys.

Workscope

This project will consist of the following tasks:

- 1) High-Temperature Design Methodologies
 - ASME and European code assessment
 - Simplified high-temperature rules and design approaches
 - Creep-fatigue-crack-corrosion design
 - Constitutive behavior
- 2) Materials Mechanical Testing
 - Inert testing
 - Creep-fatigue, thermal fatigue testing
 - Microstructural analysis
- 3) Materials Mechanical/Corrosion Testing
 - HT gas corrosion facilities reconstruction
 - Corrosion exposure/testing
 - Creep-fatigue, thermal fatigue testing
 - Microstructural analysis