NUCLEAR ENERGY UNIVERSITY PROGRAMS

Modeling the Stress Strain Relationships and Predicting Failure Probabilities For Graphite Core Components

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Collaborators:
None

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Abstract

This project will implement inelastic constitutive models that will yield the requisite stress-strain information necessary for graphite component design. Accurate knowledge of stress states (both elastic and inelastic) is required to assess how close a nuclear core component is to failure. Strain states are needed to assess deformations in order to ascertain serviceability issues relating to failure, e.g., whether too much shrinkage has taken place for the core to function properly. Failure probabilities, as opposed to safety factors, are required in order to capture the variability in failure strength in tensile regimes. The current stress state is used to predict the probability of failure. Stochastic failure models will be developed that can accommodate possible material anisotropy. This work will also model material damage (i.e., degradation of mechanical properties) due to radiation exposure.

The team will design tools for components fabricated from nuclear graphite. These tools must readily interact with finite element software—in particular, COMSOL, the software algorithm currently being utilized by the Idaho National Laboratory. For the elastic response of graphite, the team will adopt anisotropic stress-strain relationships available in COMSOL. Data from the literature will be utilized to characterize the appropriate elastic material constants.