NUCLEAR ENERGY RESEARCH INITIATIVE

Neutronic and Thermal-Hydraulic Coupling Techniques for Sodium Cooled Fast Reactor Simulations

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Program Area: AFC R&D

Collaborators: University of Chicago; Commissariat a l'Energie Atomique (CEA); Argonne National Laboratory

Project Description

The objective of this project is to develop and implement efficient coupling algorithms related to neutronic-thermalhydraulic coupled simulations applied to sodium cooled fast reactors.

This project will involve prototyping the following two methodologies: 1) coupling paradigm using an operator-split technique that can preserve the accuracy order of each physics component and 2) coupling paradigm using a Jacobian or Jacobian-free formulation, with physics-based preconditioner. The researchers will address the different spatial and time scales found in sodium cooled fast reactor applications and will apply their methodology to demonstrate inherent safety features of sodium fast reactors with metallic fuel. Typical anticipated transients without scram will be modeled.

Workscope

This project consists of the following primary workscope:

- Assess the inconsistencies in commonly used coupling strategies
- Analyze potential improvements to operator-split techniques
- Develop consistent nonlinear time integrators
- Apply the methodologies to the demonstration of metallic fuel sodium fast reactors inherent safety
- Perform anticipated transients without scram analysis
- Assess the performance of the new technology