NUCLEAR ENERGY UNIVERSITY PROGRAMS

Experimental Study and Computational Simulations of Key Pebble Bed Thermomechanics Issues for Design and Safety

PI: Tokuhiro, Akira - University of Idaho

Project Number: 09-810

Initiative/Campaign: Gen IV/Methods

Collaborators:
Cogliati, Joshua - Idaho National Laboratory
Ougouag, Abderrafi M. - Idaho National Laboratory
Potirniche, Gabriel - University of Idaho
Rink, Karl - University of Idaho

Abstract

This project will conduct experimental and computational simulation of key thermal-mechanical issues affecting the design and safety of pebble-bed (PB) reactors. The team will design and construct a separate effects test to study and benchmark the potential dust-generation rate, as well as study the conditions under which a dust explosion may occur in a standardized, instrumented explosion chamber. The project consists of the following tasks:

- Broaden the scope of thermal-mechanic modeling and simulation of the anticipated pebble-bed reactor configuration, with a focus on estimating the generation rate of graphite dust particulates. Researchers will develop a methodology that encompasses discrete element, finite element, and coupled approaches that overcome current challenges.
- Design and construct a smaller-scale separate effects test facility, connected to an existing energetic materials explosion/combustion chamber, to benchmark the thermal-mechanics of dust generation and study the potential for dust explosion. The team will conduct tests to simulate dust generation, entrainment, and transport and will analyze how much dust is generated by a PB reactor.
- Conduct experiments simulating air ingress into the explosion/combustion cell upon depressurization transport of generated dust from the separate effects experiment or from defined injection of a prepared mass of dust. Researchers will compare experimental data to map the minimum explosive limit and will estimate dust characteristics for explosion/combustion.