NUCLEAR ENERGY UNIVERSITY PROGRAMS

Study of Air ingress across the duct during the accident conditions

PI: Hassan, Yassin - Texas A&M University

Collaborators:
Ugaz, Victor - Texas A&M University

Project Number: 09-841

Initiative: Gen IV

Abstract

The goal of this project is to study the fundamental physical phenomena associated with air ingress in very high temperature reactors (VHTRs). Air ingress may occur due to a rupture of primary piping and a subsequent breach in the primary pressure boundary in helium-cooled and graphite-moderated VHTRs. Significant air ingress is a concern because it introduces potential to expose the fuel, graphite support rods, and core to a risk of severe graphite oxidation. Two of the most probable air ingress scenarios involve rupture of a control rod or fuel access standpipe, and rupture in the main coolant pipe on the lower part of the reactor pressure vessel. Therefore, establishing a fundamental understanding of air ingress phenomena is critical in order to rationally evaluate safety of existing VHTRs and develop new designs that minimize these risks. But despite this importance, progress toward developing these predictive capabilities has been slowed by the complex nature of the underlying phenomena. The combination of interdiffusion among multiple species, molecular diffusion, natural convection, and complex geometries, as well as the multiple chemical reactions involved, impose significant roadblocks to both modeling and experiment design.

The project team will employ a coordinated experimental and computational effort that will help gain a deeper understanding of multiphased air ingress phenomena. This project will enhance advanced modeling and simulation methods, enabling calculation of nuclear power plant transients and accident scenarios with a high degree of confidence. The following are the project tasks:

- Perform particle image velocimetry measurement of multiphase air ingresses.
- Perform computational fluid dynamics analysis of air ingress phenomena.