Fauske & Associates
partnered with
Argonne National Laboratory and Westinghouse Electric Co.

RFA-17-14611, Development of an Integrated Mechanistic Source Term Assessment Capability for Lead- and Sodium-cooled Fast Reactors.

YEAR AWARDED: 2017

TOTAL PROJECT VALUE: $500K (DOE funds: $400K, awardee cost share: $100K)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Tanju Sofu (tsofu@anl.gov)

DESCRIPTION: This Gateway for Accelerated Innovation in Nuclear voucher helped fund research by Fauske & Associates (FAI), Argonne National Laboratory (ANL), and Westinghouse Electric Co. aimed at developing a computational capability for predicting radionuclide release from a broad spectrum of accidents that can be postulated to occur at liquid-metal-cooled reactor (LMR) facilities. Specifically, the project coupled the SAS4A/SASSYS-1 transient and accident analysis code developed by ANL with the radionuclide transport analysis capability of the Facility Flow, Aerosol, Thermal, and Explosion (FATE) code developed by FAI. The testing of both individual codes and the coupled system was performed on a generic lead-cooled fast reactor (LFR) design to also capture the key differences between the LFR and the sodium fast reactor (SFR) for which the SAS4A/SASSYS-1 code had originally been developed and from which the coupled code inherits some features requiring modification before its application to LFR systems. Doing this, a computational capability applicable to both LFR and SFR systems was obtained to assist LMR developers in performing a realistic, scenario-dependent mechanistic source term assessments expected not only to strengthen their safety case but also to support easier siting and claims on reduced emergency planning zone requirements.

BENEFIT: LMRs show very low likelihood of core damage with minimally engineered safety features, greatly improving the economics of any project. To ease the path to licensing and justify a smaller emergency planning zone, however, regulators need to see detailed and accurate mechanistic source term assessments during the accident scenarios that could lead to fuel failures.

IMPACT: SAS4A/SASSYS-1 provides the capability to mechanistically model a wide spectrum of postulated accidents in LMRs, including multiple-failure unprotected (without scram) accidents. FATE provides the capability to track radionuclides released during an accident to the primary coolant, cover gas, and containment. The integrated SAS4A-FATE code system provides a unique capability to calculate mechanistically—for a specified accident scenario and plant design—the release of the radionuclides from the fuel pins to the coolant, reactor vessel gas space, containment, and ultimately to the environment.

NEXT STEPS: Progress has been made in modeling a representative LFR with SAS4A and FATE codes, showing a good agreement between the two and establishing the basis for subsequent code coupling activities. Ultimately, SAS4A-FATE provides a flexible framework for the future implementation of enhanced mechanistic models of radionuclide release, retention, and transport for mechanistic source term evaluation for LMRs.