COLLABORATIVE PROJECT ON FLUORIDE SALT COOLED HIGH TEMPERATURE REACTOR TECHNOLOGY DEVELOPMENT

David E. Holcomb and Jan Uhlíř

Oak Ridge National Laboratory, USA
Nuclear Research Institute Řež plc, Czech Republic

Abstract:

Molten fluoride salts are technically advantageous for use as a coolant in high temperature reactors. Fluoride salts can be used either as a low-pressure coolant for Fluoride salt-cooled High temperature Reactors (FHRs) or as both the coolant and fuel carrier for Molten Salt Reactors (MSRs). FHRs employ the same solid, coated-particle type fuel as is being developed for high temperature gas-cooled reactors. ORNL's current FHR class reactor design concept is the 1500 MW(e) Advanced High Temperature Reactor (AHTR). MSRs dissolve their fuel within the fluoride salt and can make use of the thorium–uranium fuel cycle. In both cases the use of molten fluoride salts provides excellent cooling capability at low-pressure helping to ensure full reactor passive safety in large-power output, high-temperature, economically competitive power plants. The high-temperature afforded by the fluoride salt coolant enables the reactors to also provide industrial process heat—notably including producing the hydrogen necessary to convert other carbon feedstocks into gasoline. Moreover, MSRs can sustainably use plentifully available thorium as a fuel, with much smaller production of transplutonium waste as compared to uranium-fueled reactors.

Under guidance from both the U.S. and Czech governments, in 2009 the scientific teams of Oak Ridge National Laboratory (ORNL) and the Nuclear Research Institute (NRI) began to prepare a bilateral collaborative benchmark project related to FHRs and MSRs. The project arose from the historical experience with fluoride molten salt technology at ORNL (from the 1940s–1970s during the MSR program era) and on-going ORNL FHR development activities as well as the on-going theoretical and experimental activity NRI in nuclear fluoride salt technologies.

Developing the cooperative molten salt R&D program required overcoming several, somewhat unanticipated, administrative, legal, and technical hurdles. Now, that the "Joint Declaration" between the U.S. Department of Energy and the Czech Ministry of Industry and Trade has been signed, the formal process for program approval has been completed and the technical project can proceed. The technical focus of the benchmark project is on FHR reactor core neutronic studies. The experimental component of the study covers transferring a portion of molten salt reactor experiment coolant salt, currently stored at ORNL, to NRI and performing molten salt reactivity worth neutronic measurements in NRI's LR-0 reactor as well as subsequent joint theoretical assessment.

This paper describes the scientific rationale for the project, the current status and immediate plans of the project, and potential follow-up projects within the bilateral collaborative R&D advanced nuclear technology area.