Advanced High-Temperature Reactor (AHTR) Loss-of-Forced-Circulation Accidents

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ABSTRACT

The Advanced High-Temperature Reactor (AHTR), a new concept that borrows the prismatic core design from the Gas-Turbine Modular Helium Reactor (GT-MHR) and substitutes a clean molten salt for the helium coolant, is being evaluated as part of the U.S. Department of Energy Generation-IV Program. Initial studies have shown the potential for a considerably greater thermal power output within the confines of a 600-MW(t) GT-MHR-size vessel while still retaining "passive safety" characteristics. A 3-D thermal-hydraulic (T/H) core simulation model developed at Oak Ridge National Laboratory (ORNL) for studying gas-cooled reactor accidents was modified to accommodate AHTR core T/H characteristics. The limitations of the model approximations used for a molten salt vs a gas coolant were evaluated, and preliminary results indicate that there is a negligible effect for long-term transients. Initial studies of AHTR loss-of-forced-circulation (LOFC) accident scenarios show that passive cooling mechanisms are sufficient for preventing core heatups that exceed prescribed temperature limitations for fuel failure, coolant boiling, and vessel damage for a 2400-MW(t) reactor. Included are brief descriptions of the current version of the AHTR concept, the T/H models, the resulting predicted behavior during LOFCs, and sensitivity studies indicating the importance of various design features and other assumptions.