Natural Convection Cooling of the GTL-1 Experiment in the Advanced Test Reactor

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This presentation describes a thermal hydraulic model used to simulate natural convection cooling for the GTL-1 experiment in the Advanced Test Reactor (ATR) after normal reactor shutdown. The GTL-1 experiment assembly contains U_3Si_2/Al dispersion fuel in 16 aluminum clad miniplates in a capsule experiment assembly designed for irradiation in the South Flux Trap. The fuel plates are assembled in a configuration that maintains cooling similar to the ATR fuel elements. The elapsed time after reactor shutdown when the emergency pumps can be turned off and the experiment can be adequately cooled by natural convection cooling was determined using a system thermal hydraulic model. The model simulates one-dimensional heat conduction in the miniplates, capsules, basket, adapter and in-pile tube and one-dimensional convective heat transfer to the coolant. Sufficient time for cooling is necessary to remove decay heat without reaching saturation temperature in the primary coolant. Decay heat values are conservatively based upon infinite operation at a South lobe power of 35.6 MW. A thermal hydraulic analysis to assess the effectiveness of natural convection cooling 13 hours after reactor shutdown was performed using verified and validated RELAP5/MOD3 version 3.2.1.2 on a Compaq AlphaStation XP1000 running the UNIX operating system. The RELAP5 analysis for natural convection flow with the experiment in the reactor 13 hours after reactor shutdown show a maximum coolant temperature of 174.9 °F (79.4 °C), which indicates that bulk boiling will not occur.