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Passive Heat Removal System Analysis for the Westinghouse Lead Fast Reactor

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Westinghouse continues to develop its Next Generation high-capacity nuclear power plant (NPP) based on Lead-cooled Fast Reactor (LFR) technology. By leveraging its long experience in NPP commercialization as well as strategic domestic and international partnerships established to most effectively complement capabilities, Westinghouse is progressing the plant's design and its business and delivery model. With a power output of approximately 950 MWt, the Westinghouse LFR is a competitive, medium-size, simple, scalable and passively safe plant harnessing a liquid lead-cooled, fast neutron spectrum core operating at high temperatures in a pool configuration reactor encompassed by a passive heat removal system (PHRS). The paper focuses on the overall design of the Westinghouse LFR PHRS, and the analytical modeling and heat removal capabilities of the PHRS analyzed using the GOTHIC code. The PHRS design encompasses the LFR vessel and relies on a pool of water to effectively remove heat away from the reactor vessel during accident scenarios. During beyond design basis accidents, the PHRS pool water will eventually boil and steam off into the atmosphere, transitioning the pool to air-only cooling. To demonstrate the effectiveness of this system, an evaluation model of the PHRS was created with the GOTHIC computer program. GOTHIC is an integrated, general purpose thermal-hydraulics software package for design, licensing, safety and operating analysis of nuclear power plant containments, confinement buildings and system components. The code can model multiple forms of heat transfer including two-phase and boiling correlations. To simulate a real time response of the entire LFR PHRS, the GOTHIC code is coupled, using internal subroutines, to the LFR system code SAS4A/SASSYS 1. This paper will provide the details associated with the PHRS analysis for the Westinghouse LFR.

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