Fluid Stratification Separate Effects Analysis, Testing and Benchmarking

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ABSTRACT:

High temperature gas reactors (HTGR) are poised to spearhead the next generation of nuclear reactors, due to their passive safety characteristics and their applications flexibility. Able to provide base load power or process heat for industrial applications, HGTRs may be a critical component to reducing emissions in the United States and abroad. However, increased interest and development has also highlighted areas needing significant research, one of which being the double-ended guillotine break (DEGB). While itself a beyond design basis accident (BDBA), analysis of this and other accidents like the depressurized conduction cool-down have revealed phenomena that are of critical interest. Specifically, air-ingress accidents represent a substantial challenge to the sustained safe operation of high temperature gas reactors, and their compatriots the very high temperature reactors. The purpose of this study is to experimentally characterize, in a scaled separate effects test facility, the role of stratified flow as it contributes to the air-ingress accident. Planned efforts include scaling analysis to preserve the dominant phenomena of air ingress and transition to natural circulation, develop an experimental facility to investigate stratified flow between a binary gas mixture of helium and nitrogen under isothermal and heated conditions, establish an experimental database describing stratification flow and front behavior in simple geometries under isothermal and heated conditions, and develop predictive models of stratified flow and front behavior.