

NE-22-27436 Modeling of Two-Phase Boiling Flow and Critical Heat Flux with the Star-CCM+® and NEK-2P CFD Codes

Framatome, an international company, designs, manufactures, and installs components, fuel, and instrumentation and control systems for nuclear plants. Their mission is to be the leading designer and supplier of nuclear steam supply systems, equipment, services, and fuel, continuously striving to reach the highest levels of performance and safety.

Maintaining a safe margin to critical heat flux (CHF) is a central requirement for the Nuclear Regulatory Commission (NRC) for plant safety in determining the maximum operating power. Currently, there is no computational fluid dynamics (CFD) commercialized technology available for robust two-phase boiling flow and CHF analyses that can predict, with acceptable accuracy and robustness, the critical parameters for the onset of flow instability.

This project focuses on the development, implementation, and initial validation of the STAR-CCM+® user-defined functionality for the two-fluid two-phase model (2F-2P). The focus will be on modeling two-phase boiling flow in realistic fuel-bundle geometries, including specific spacer geometries. Argonne National Laboratory's (ANL) previous development and implementation of the Extended Boiling Framework (EBF) in the CFD code STAR-CD, creates the necessary collaborative environment to further the capability that will allow for the accelerated delivery of advanced fuel designs for both the light water reactor and potential advanced reactor fuel markets.