

## Center for Thermal-Fluids Applications in Nuclear Energy: Toward Industry Adoption

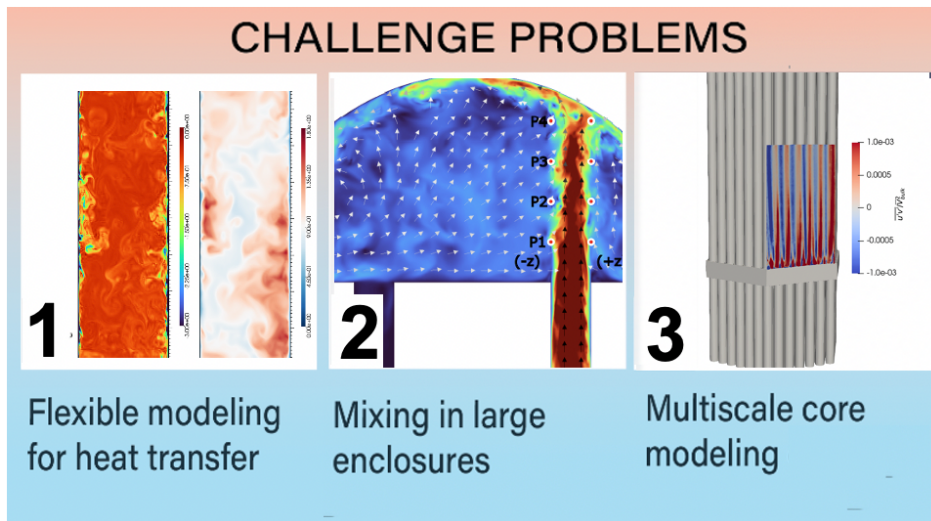
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**Program:** Phase II IRP

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### ABSTRACT:

In the ambitious Phase II project of the Center for Thermal-Fluids Applications in Nuclear Energy, we aim to build upon the foundation laid in Phase I, leveraging the same prolific team and framework that has seen remarkable scientific achievements. Our goal is to address the complex challenge of scale bridging in transient phenomena—a task not fully captured by the steady-state methods developed in Phase I. We continue to focus on three of the challenge problems identified in Phase I in collaboration with our industry partners (See Figure 1).



**Figure 1.** Challenge problems for Phase II.

Our proposed work extends the successful multiscale knowledgebase to encompass full transient modeling. This necessitates the development of innovative, computationally efficient system thermal hydraulics methods that can integrate physics, constitutive closures, and multimodal datasets across different scales. We intend to enhance the predictive capabilities of data-driven system thermal-hydraulics models, which are critical for the safety analysis and licensing of advanced nuclear reactors. A key aspect of our strategy involves streamlining the multiscale framework to facilitate its adoption in the industry. This streamlining will be achieved through the integration of Large Language Models like



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GPT, which will be demonstrated in complex industry use cases. By doing so, we aim to simplify the current multiscale framework, which is often cumbersome and error-prone due to its manual-intensive processes.

Phase II is poised to revolutionize the thermal-hydraulics community by offering a more dynamic, data-integrated, and user-friendly approach. This will not only advance the state of the art but also ensure that our methodologies are robust, accurate, and applicable to the evolving needs of the industry.