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The Current Development Status of Fluoride Salt Cooled High Temperature Reactor (FHR) Technology And its Overlap with HIF Target Chamber Concepts

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The fluoride salt cooled high temperature reactor (FHR) is a class of fission reactor designs that use liquid fluoride salt coolant, TRISO coated particle fuel, and graphite moderator. Heavy ion fusion (HIF) can likewise make use of liquid fluoride salts, to create thick or thin liquid layers to protect structures in the target chamber from ablation by target x-rays and damage from fusion neutron irradiation. This presentation summarizes ongoing work in support of design development and safety analysis of FHR systems. Development work for fluoride salt systems with application to both FHR and HIF includes thermal-hydraulic modeling and experimentation, salt chemistry control, tritium management, salt corrosion of metallic alloys, and development of major components (e.g., pumps, heat exchangers) and gas-Brayton cycle power conversion systems.

In support of FHR development, a thermal-hydraulic experimental test bay for separate effects (SETs) and integral effect tests (IETs) was built at UC Berkeley, and a second IET facility is under design. The experiments investigate heat transfer and fluid dynamics and they make use of oils as simulant fluids at reduced scale, temperature, and power of the prototypical salt-cooled system. With direct application to HIF, vortex tube flow was investigated in scaled experiments with mineral oil. Liquid jets response to impulse loading was likewise studied using water as a simulant fluid.

A set of four workshops engaging industry and national laboratory experts are planned for the current year, with the goal of developing a technology pathway to the design and licensing of a commercial FHR. The pathway will include experimental and modeling efforts at universities and national laboratories, requirements for a component test facility for reliability testing of fluoride salt equipment at prototypical conditions, requirements for an FHR test reactor, and development of a pre-conceptual design for a commercial reactor.

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