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Mechanical Engineering

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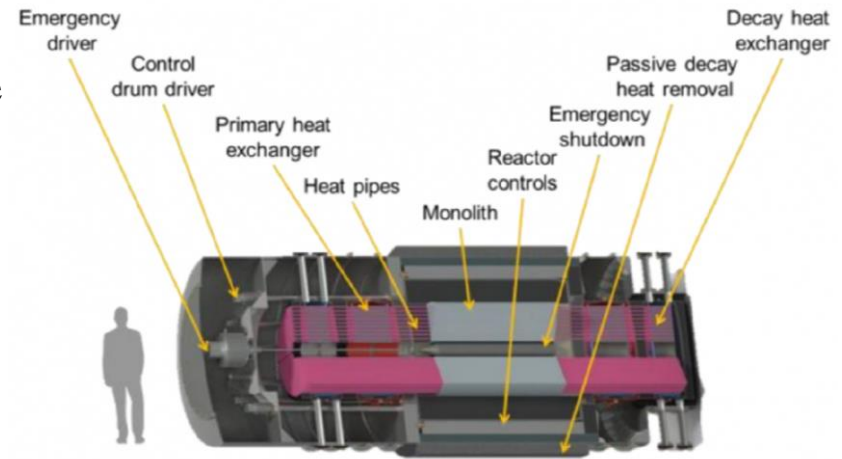
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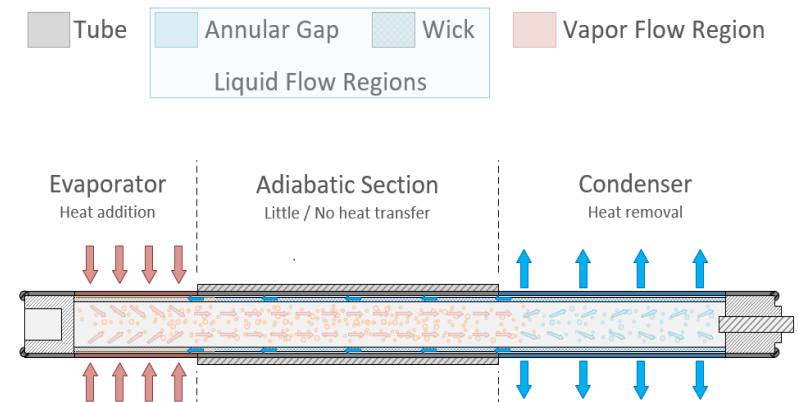
Hometown: Maple Grove, MN

Background

- Microreactors are being developed to provide a portable power supply in remote locations
- Liquid metal heat pipes are employed to allow for compact and efficient heat transfer
- Liquid sodium is vaporized in the evaporator section, travels through the pipe, and condenses in the condenser section
- Liquid condensate travels back to evaporator via capillary action in the wick with no pumping required
- LANL & INL are developing Sockeye, a program to model microreactors, including the liquid metal heat pipes



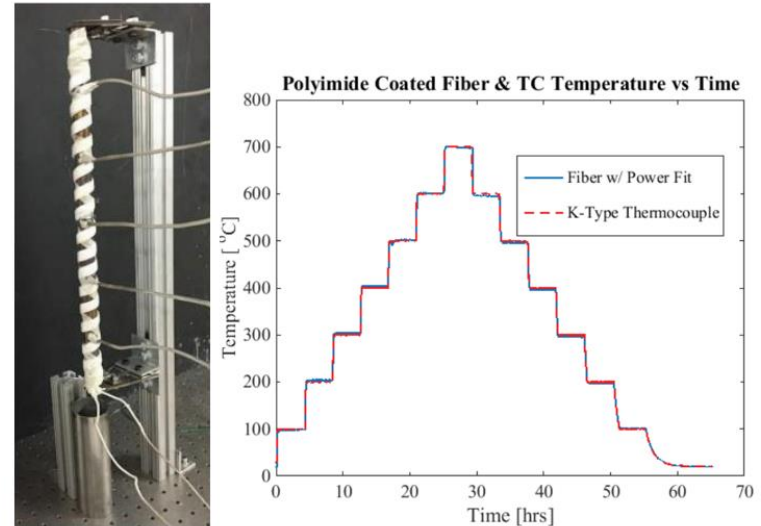
Cross-section of Westinghouse eVinci microreactor.



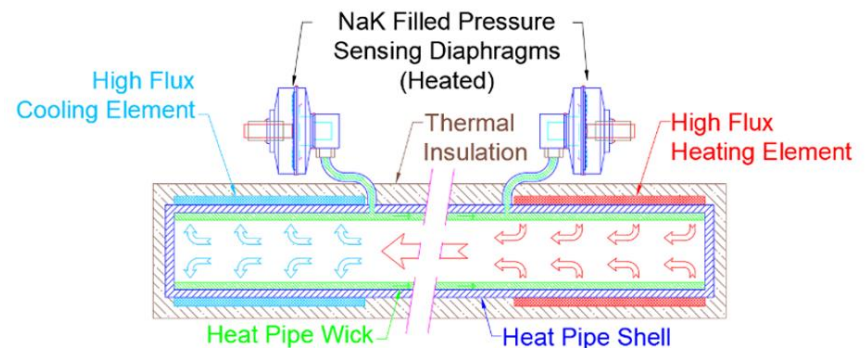
Heat pipe with a screen-mesh wick.

Goals and Objectives

- To support the development of Sockeye, experimental data is needed to validate model results, including temperature and pressure distributions and transient start-up data
- The internal temperature distribution will be explored using thermocouples and Fiber-optic Distributed Temperature Sensor (FO-DTS) technology
- Measuring the small pressure drops (<1 kPa) within the heat pipe will be challenging and will require NaK-filled diaphragms connected to a pressure transducer



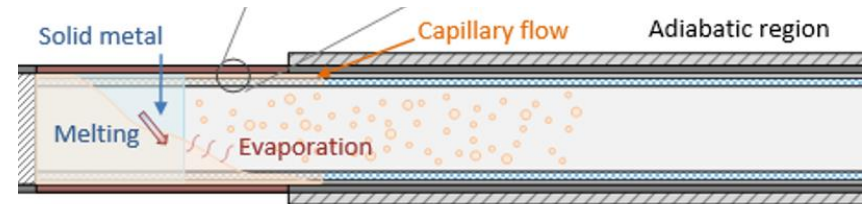
FO-DTS test setup & results.



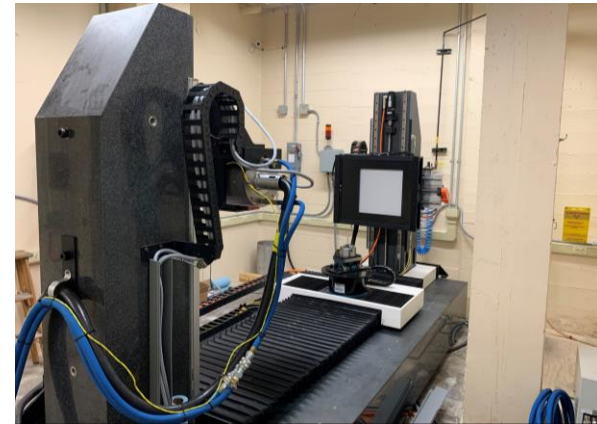
Schematic of pressure measurement.

Transient Start-up

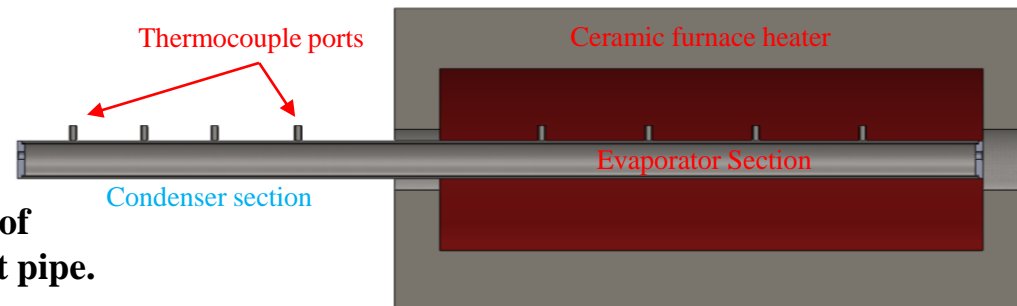
- Transient start-up of a sodium heat pipe involves solid-liquid-vapor phase change and transition from molecular to continuum flow
- To help investigate these complex phenomena, a 450kV X-ray scanner will be employed to image the heat pipe during start-up and steady-state operation
- A prototype heat pipe is currently under development to explore and optimize X-ray imaging techniques.
- Prototype will use a cylindrical furnace heater to apply heat to the evaporator



Heat pipe transient start-up.



450kV X-ray CT scanner.



Cross-section of prototype heat pipe.