Technology Maturation

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For Tech. Mat.

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Outline

- Overview
- High Temperature Moderator Material
- Instrumentation and Sensors
- Heat Transfer/37 Heat Pipe Test Article
- NEUP – Structural Integrity
- NEUP – Heat Pipe Failures
- NEUP – Heat Exchanger Technology
- Future Work/Wrap-Up

MRP Microreactor Program

How Technology Maturation Meets Program Objectives

- Through cross-cutting research and development and technology demonstration support, achieve technological breakthroughs for key features of microreactors, examine:
  - Moderation to reduce required fuel mass
  - Instrumentation and sensors
  - Advanced heat transfer
- Meet critical R&D needs of existing developers that require national lab or university expertise or capabilities.
  - Develop and irradiate samples of moderating material
  - Build and test non-nuclear test articles
- Develop advanced technologies and concepts for next-generation microreactor applications and systems.
  - Design and fabricate state-of-the-art technology.
  - Understand performance of systems with instruments.
- Enable future microreactor applications
  - Coupling of the above components.

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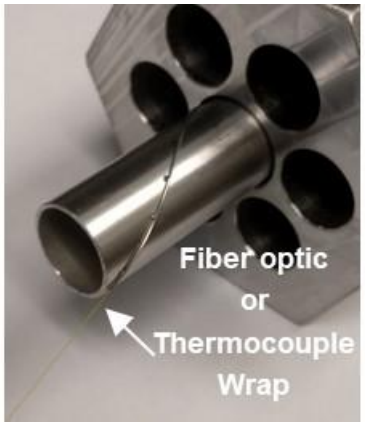
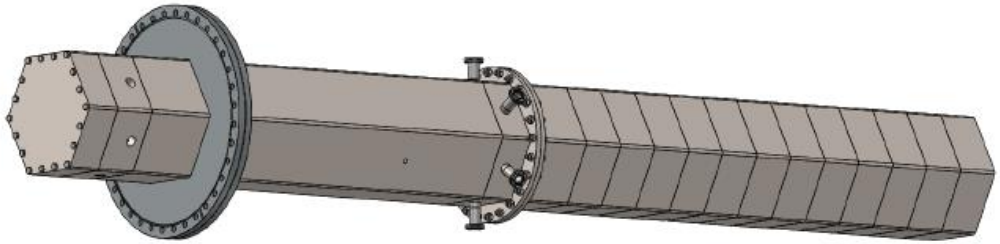
Three control areas are currently supported

- High Temperature Moderator Material
  - INL (Chase Taylor)
  - LANL (Erik Luther)
- Instrumentation and Sensors
  - ORNL (Chris Petrie)
  - INL (Troy Unruh)
  - LANL (TJ Ulrich)
- Heat Transfer
  - LANL (Bob Reid)
- 4-5 journal articles in special issue of Nuclear Technology





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High Temperature Moderator Material

- FY20: Fabricated samples of yttrium hydride.
- FY21: Samples were irradiated in ATR.
- FY22: Initiated PIE on irradiated samples.
- FY22: Performed neutron imaging to understand hydrogen migration with temperature
- FY21: Initiated cladding and containment analysis for hydrides.
- FY21: Performed critical experiment on YH.

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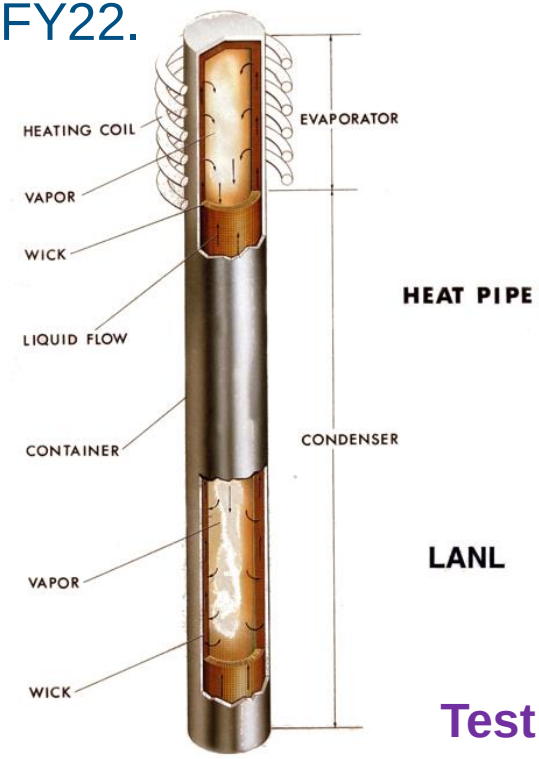
Heat Transfer – focus on heat pipes

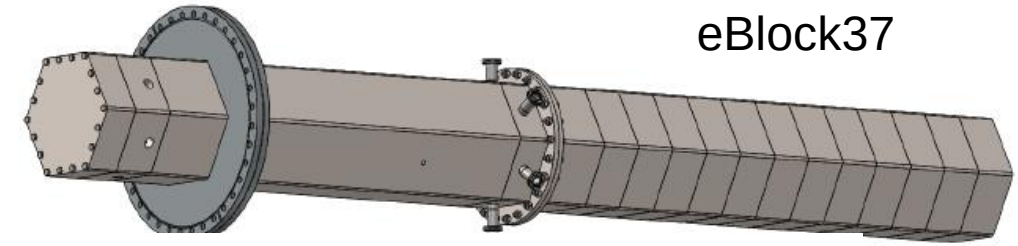
- 37 heat pipe article is being fabricated.
  - Core block components are being joined then combined with heat exchanger part.
  - High fidelity wicks fabricated; need to be added to the 2 m long article, then filled with sodium.
  - Final step is laser weld system at LANL then ship to INL.
- Fuel rods will be simulated with cartridge heaters and combined heat pipe/heat exchanger article will be tested at MAGNET in FY22.

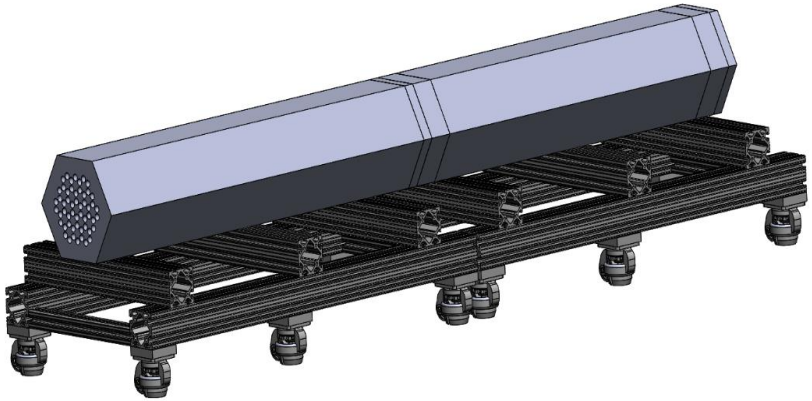


HEAT PIPE

LANL

eBlock37





Test Article on Handling Cart

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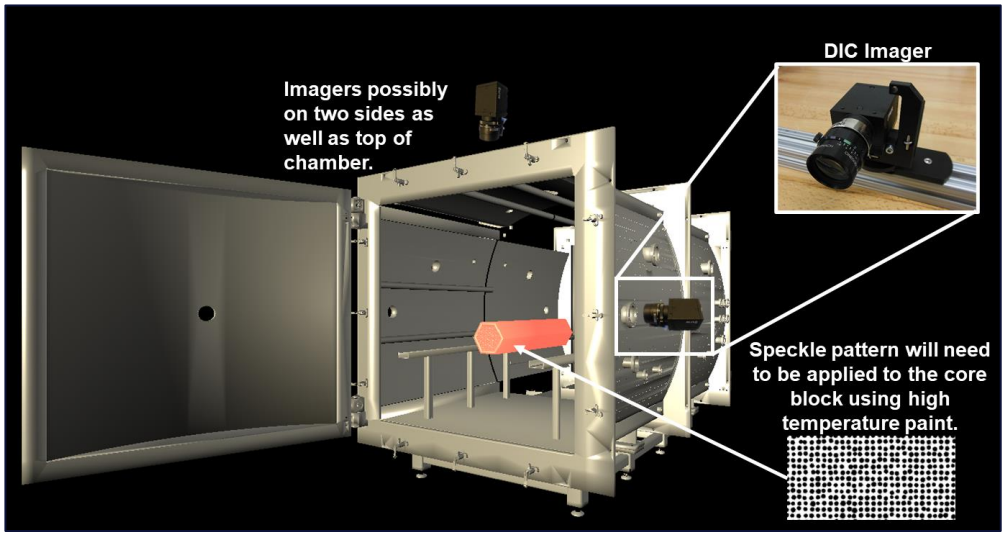
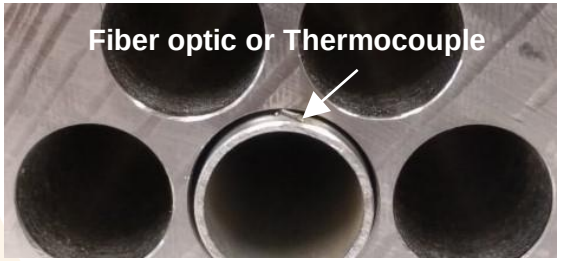
Instrumentation and Sensors

Fiber optics, Digital Image Correlation, Thermocouples, and More





Distributed temperature sensor measurement mockup

Thermocouple weld mockup

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Work packages	$	Milestones	Due Date
AT-22OR080401 – ORNL Instrumentation and Sensors	$113k	Perform test on article with embedded sensors	7/29/22 On track
AT-22IN080402 – Instrumentation and Sensors – INL	$100k	Test sensors - SPHERE Test sensors - MAGNET Final Annual Report	(4/26/22) 7/28/22 8/31/22 On track
AT-22LA080403 – Instrumentation and Sensors – LANL	$89k	Report on proposed structural health measurements	9/30/22
AT-22LA080404 – Heat Transfer – LANL	$948k ($200k)	Document progress Complete assembly of 37 heat pipe article Ship article to INL	1/31/22 6/30/22 (delayed) 7/31/22
AT-22LA080405 – High Temperature Moderator – LANL	$415k	Report on neutron imaging Advanced Handbook v2	8/31/22 9/30/22
AT-22IN080406 – High Temperature Moderator - INL	$958k	Ship capsules for PIE Disassemble capsules Complete ½ PIE	11/30/21 2/28/22 8/30/22

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Conclusions

- Upcoming presentations will give technical details
- Followed by discussion of future work needs

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