

GAIN-EPRI-NEI Microreactor Program Workshop - Non-Nuclear Testing (MAGNET)

Terry James Morton

August 2020



The INL is a U.S. Department of Energy National Laboratory
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Non-Nuclear Testing (MAGNET)

**GAIN-EPRI-NEI Microreactor Program
Workshop**

August 18, 2020

T.J. Morton (INL)

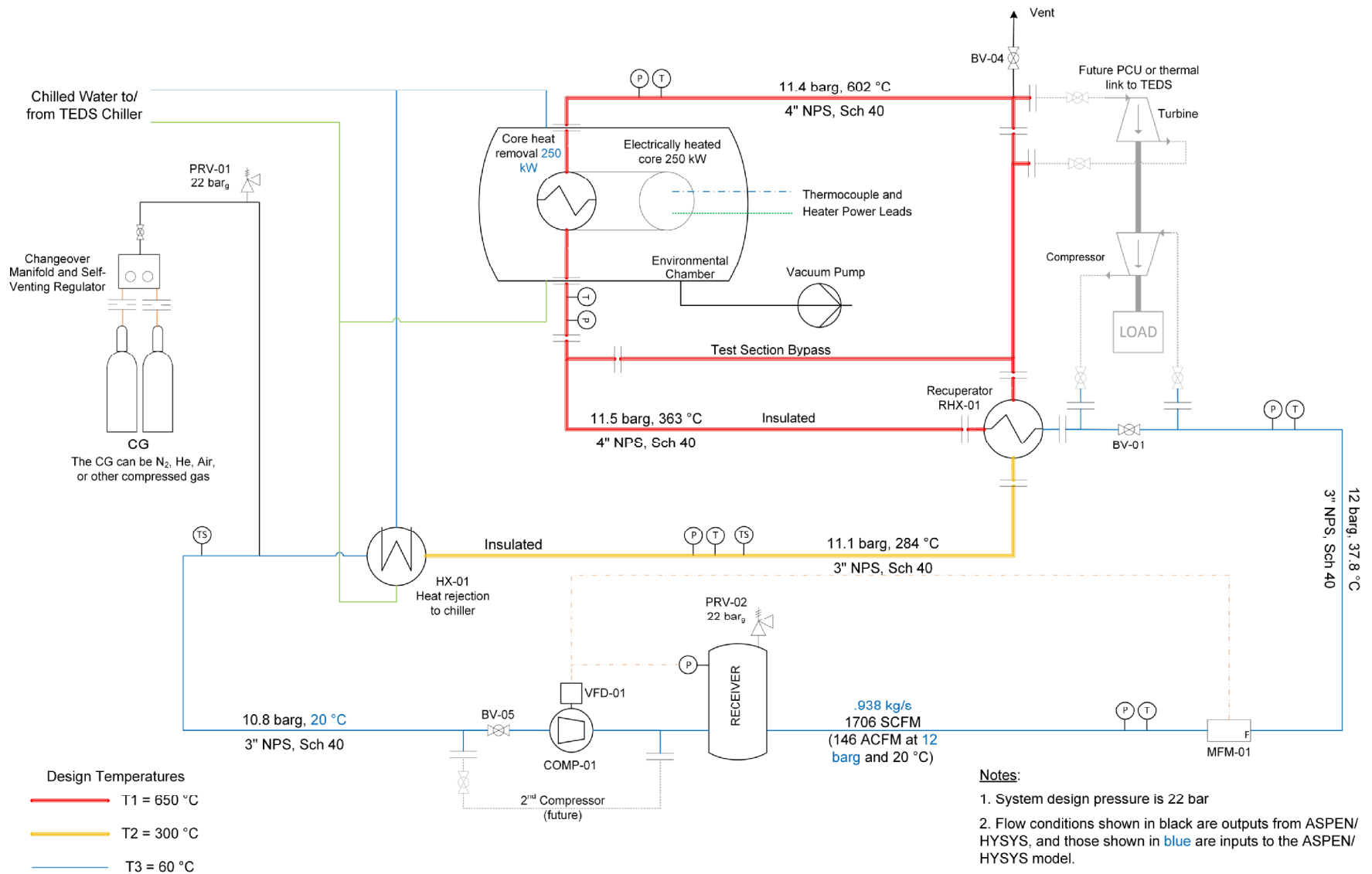
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Micoreactor Agile Non-Nuclear Experimental Test Bed (MAGNET)

Objectives

- Provide a general-purpose, non-nuclear test bed to evaluate microreactor designs
- Provide detailed thermal-hydraulic, performance data for prototypical geometries and operating conditions
 - Test article/flow loop temperature-time histories during start up, shut down, steady state, and off-normal operations
 - Displacement and temperature field data for potential design performance verification and accompanying analytical model validation
- Demonstrate integration of a power conversion unit
- Demonstrate applicability of advanced manufacturing techniques, such as additive manufacturing and diffusion bonding for core and heat removal section designs
- Identify and develop advanced sensors and power conversion equipment including instrumentation and controls for autonomous operation
- Enhance readiness of public stakeholders, particularly DOE laboratories and US NRC, to design, operate, and test high-temperature reactor components

MAGNET P&ID



MAGNET Specifications

- Heat Removal Capacity: 250 kW (initial configuration supports 125 kW)
- Design Pressure: 22 bar
- Design Temperature: See P&ID
- Coolant: Compressed N₂ or He (or dry air if desired)
- Final Heat Sink: Chilled water (50% ethylene glycol) at 44 ° F
- Closed circuit cooling
- Expandable with potential to add power conversion unit (PCU) or HX interface with other system
- Recuperative HX (printed-circuit style HX)

Integrated Energy Systems Laboratory



IES Lab Rendering

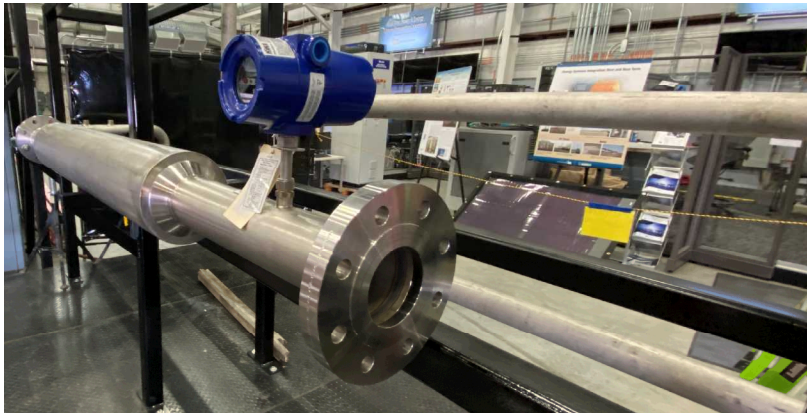
Program Activities and Accomplishments

MAGNET construction in progress

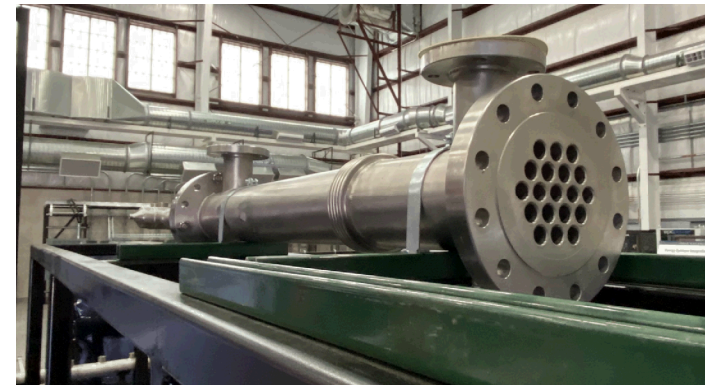
Vacuum chamber expected
in house early September
All major components
installed by 09/30 (expected)



MAGNET Skid and Pipe Racks



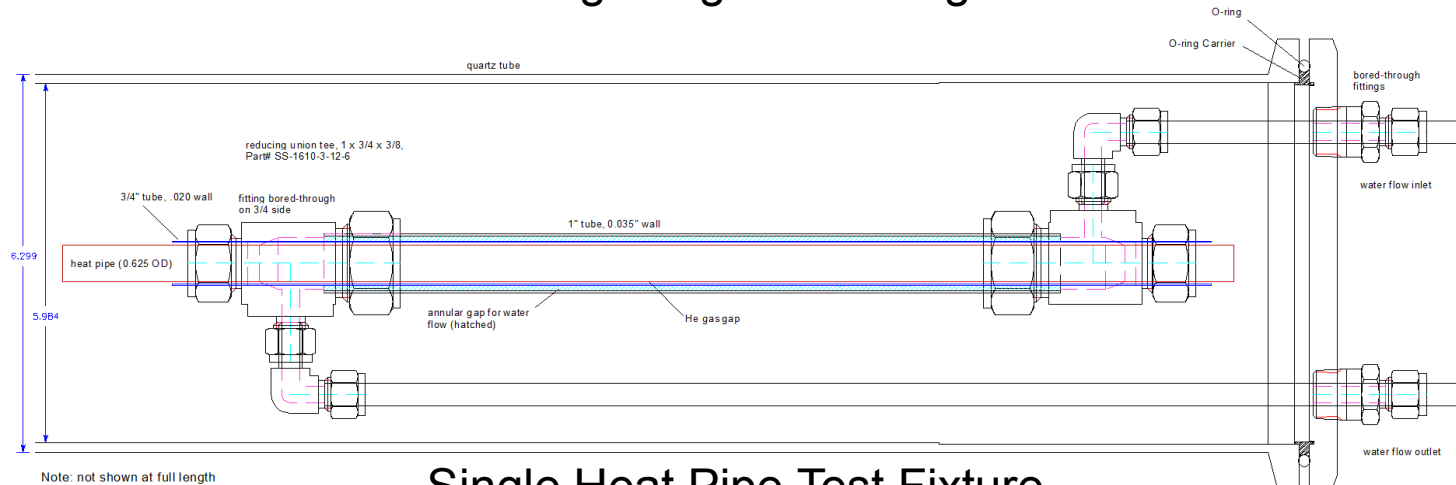
MFM-01



HX-01

Single Heat Pipe Testing

A single heat pipe test article will undergo preliminary testing in a temporary test fixture while MAGNET construction is under way. Results and feedback from this testing will guide testing in MAGNET.



Single Heat Pipe Test Fixture

- Water cooled shroud across a gas gap - a wire wrap will be used to center the heat pipe inside calorimeter tube
- Water cooling can support high heat removal rates - greater than the heat pipe rating
- Heat transfer across gap is a combination of radiation plus conduction - conduction is dominant
- Steady-state heat pipe temperature and heat flux can be varied by using He or Ar gas or by varying the length of the condenser section

Single Heat Pipe Testing

Single heat pipe test stand assembly in progress

Instrumentation installation in progress

Final plumbing by end August

Testing to begin in early September



Quartz tube allows tests in vacuum or inert gas environments



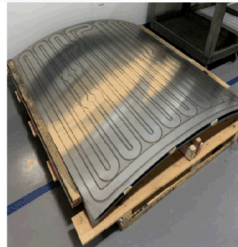
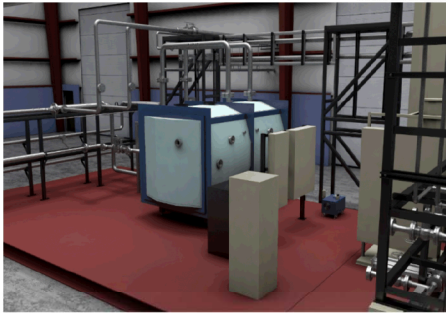
Test stand and power and instrumentation cabinet



Test stand gas/vacuum/cooling end and control computer

Future Work Plans and Priorities

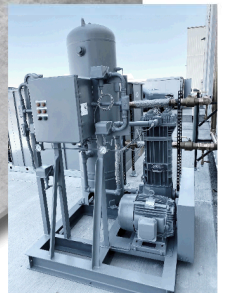
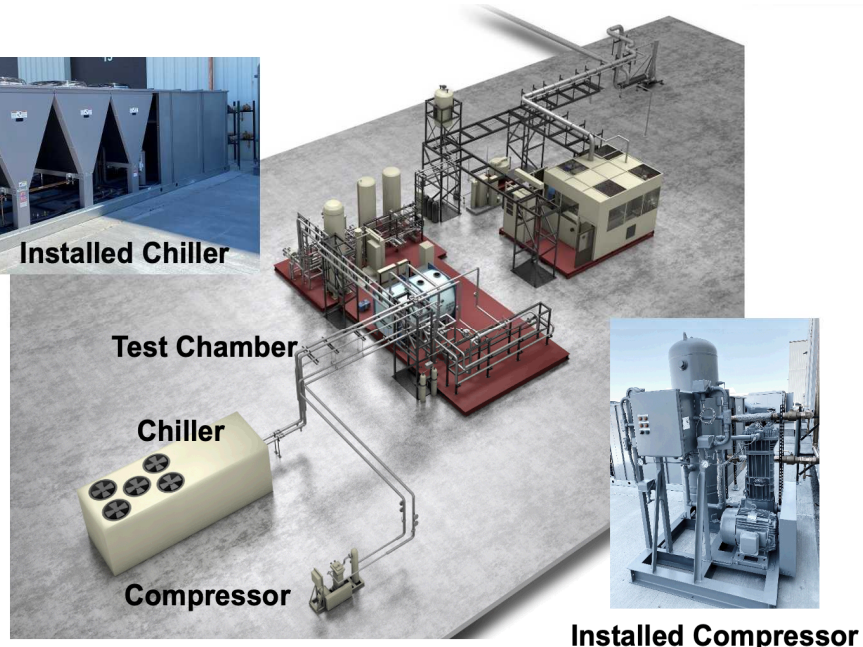
- Complete single heat pipe testing at BCTC
- Test single heat pipe test article in MAGNET starting mid-December
- Prepare MAGNET for 37 heat pipe test article
- Integrate MAGNET with thermal energy distribution system (TEDS) in FY21 – collaboration with Integrated Energy Systems
- Integrate PCU – collaboration with Sandia
- Prepare MAGNET modifications based on feedback from testing on 37 heat pipe test article



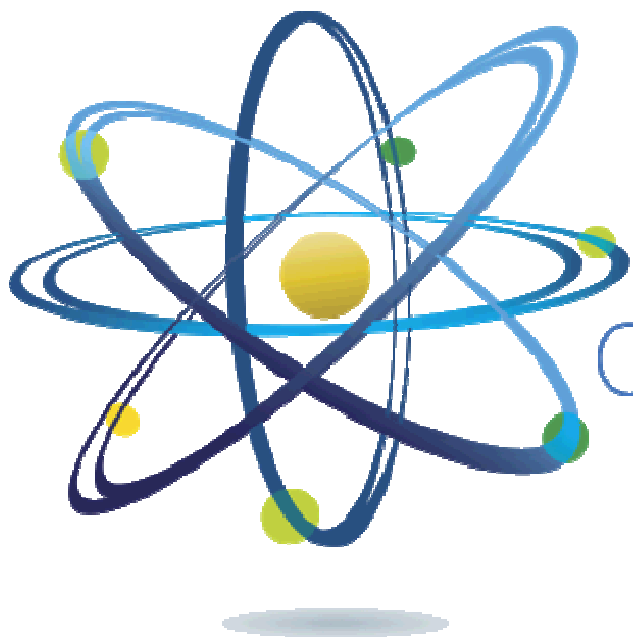
Chamber endwall in fabrication at Kurt Lesker showing hydra-cooling channels



Chamber bottom with supports and hydra-cooling channels



Installed Compressor



Clean. **Reliable. Nuclear.**