U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

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DOE Microreactor Program

Non-Nuclear Testing (MAGNET Facility)

GAIN-EPRI-NEI Microreactor Program Workshop

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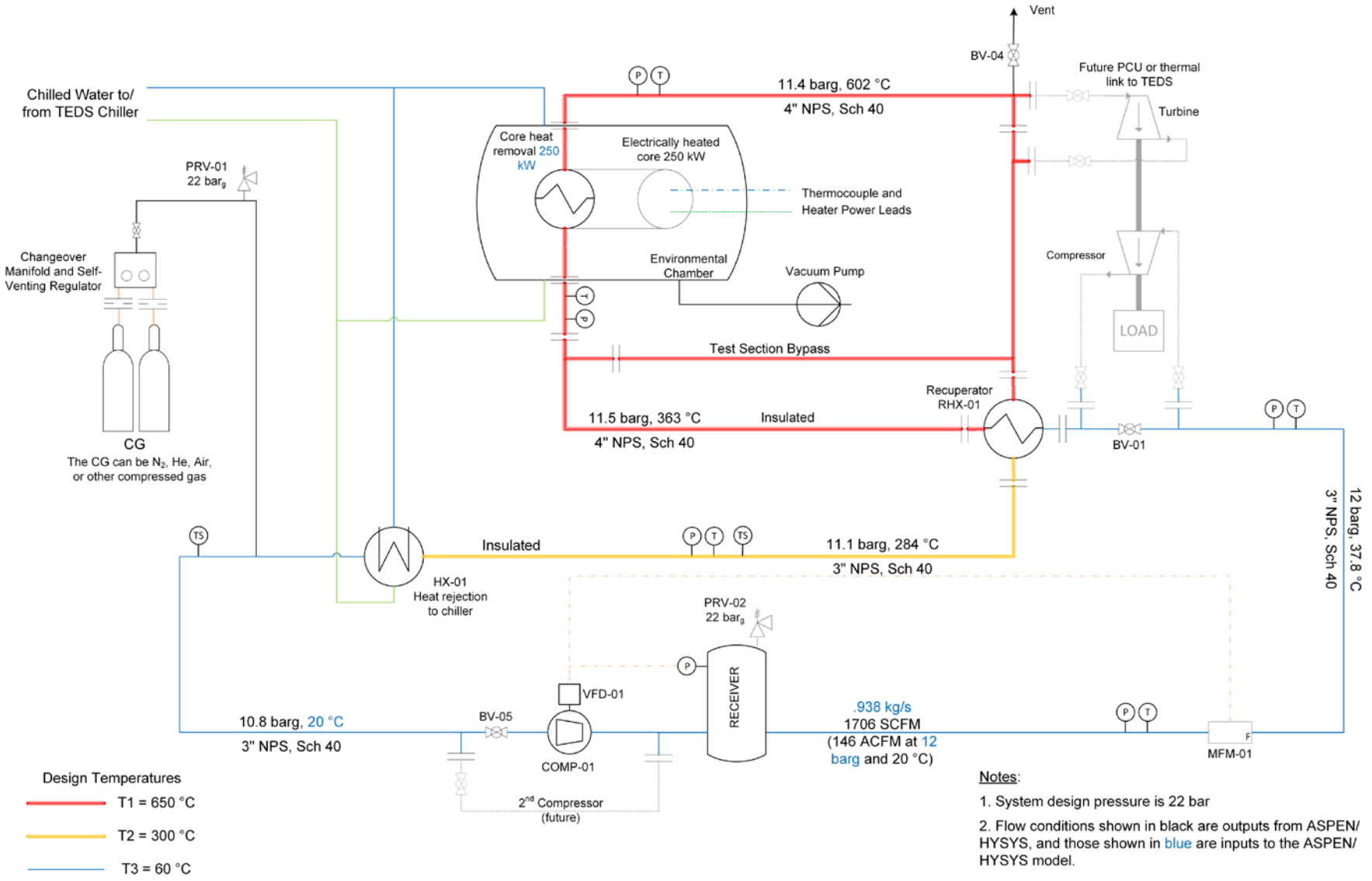
Microreactor Agile Non-Nuclear Experimental Test Bed (MAGNET)

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

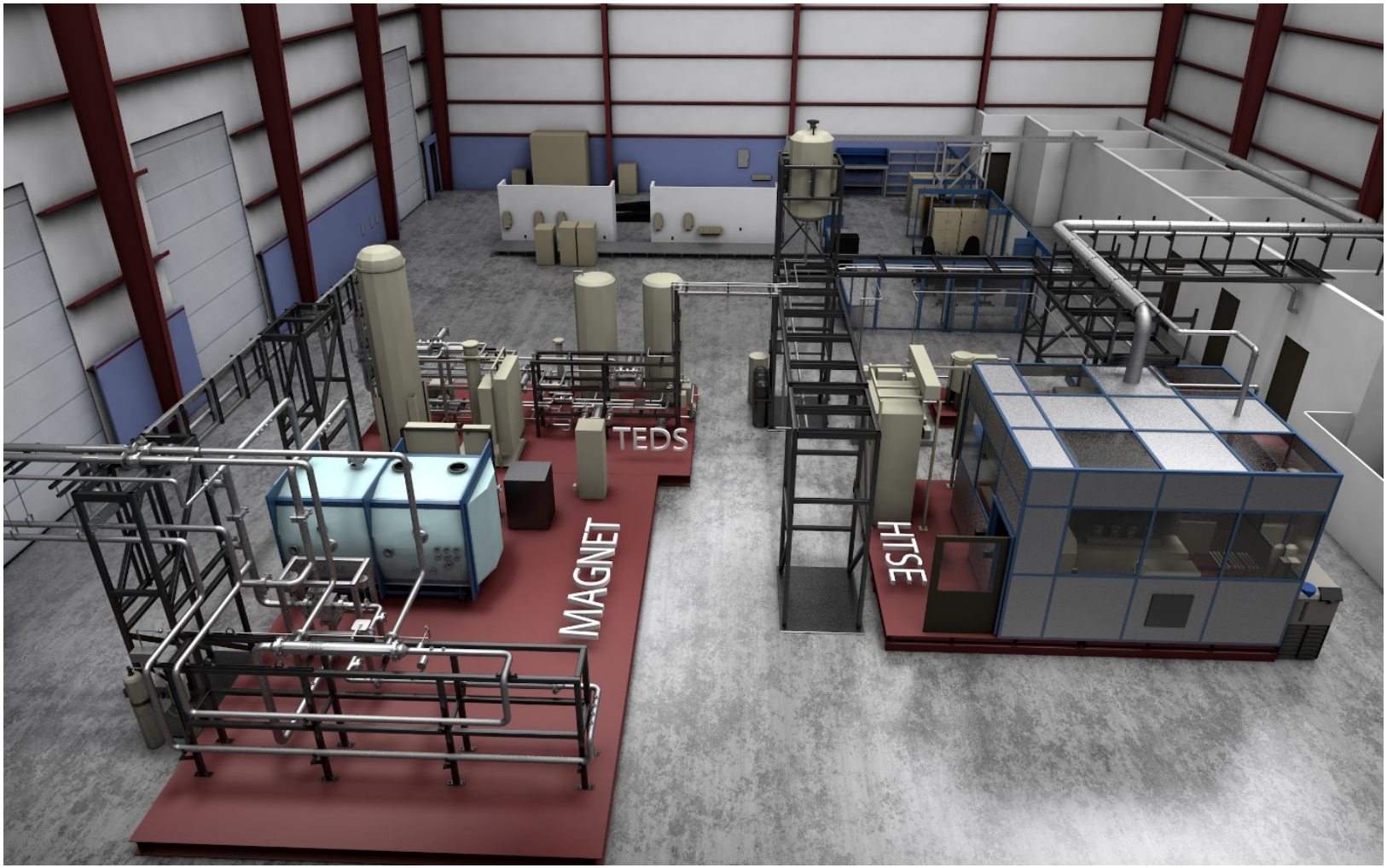
MAGNET P&ID


Vent
BV-04
Future PCU or thermal link to TEDS
Turbine
Compressor
LOAD
Chilled Water to/ from TEDS Chiller
11.4 barg, 602 °C
4" NPS, Sch 40
Core heat removal 250 kW
Electrically heated core 250 kW
Thermocouple and Heater Power Leads
Environmental Chamber
Vacuum Pump
PRV-01 22 barg
Changeover Manifold and Self-Venting Regulator
Test Section Bypass
Recuperator RHX-01
11.5 barg, 363 °C
Insulated
4" NPS, Sch 40
BV-01
CG
The CG can be N2, He, Air, or other compressed gas
Insulated
11.1 barg, 284 °C
3" NPS, Sch 40
12 barg, 37.8 °C
3" NPS, Sch 40
HX-01
Heat rejection to chiller
PRV-02 22 barg
VFD-01
RECEIVER
BV-05
10.8 barg, 20 °C
3" NPS, Sch 40
COMP-01
2nd Compressor (future)
.938 kg/s
1706 SCFM
(146 ACFM at 12 barg and 20 °C)
MFM-01
Design Temperatures
T1 = 650 °C
T2 = 300 °C
T3 = 60 °C
Notes:
1. System design pressure is 22 bar
2. Flow conditions shown in black are outputs from ASPEN/ HYSYS, and those shown in blue are inputs to the ASPEN/ HYSYS model.

MAGNET Specifications

- Heat Removal Capacity: 250 kW (initial configuration supports 125 kW)
- Design Pressure: 22 bar
- Design Temperature: See P&ID
- Coolant: Compressed N_2 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



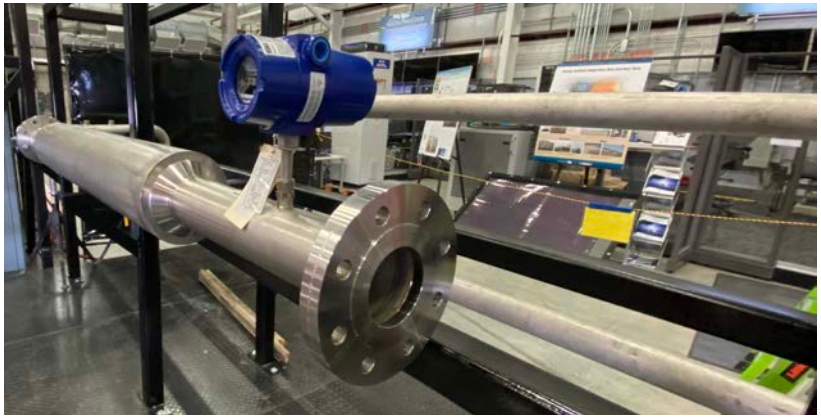
IES Lab Rendering

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

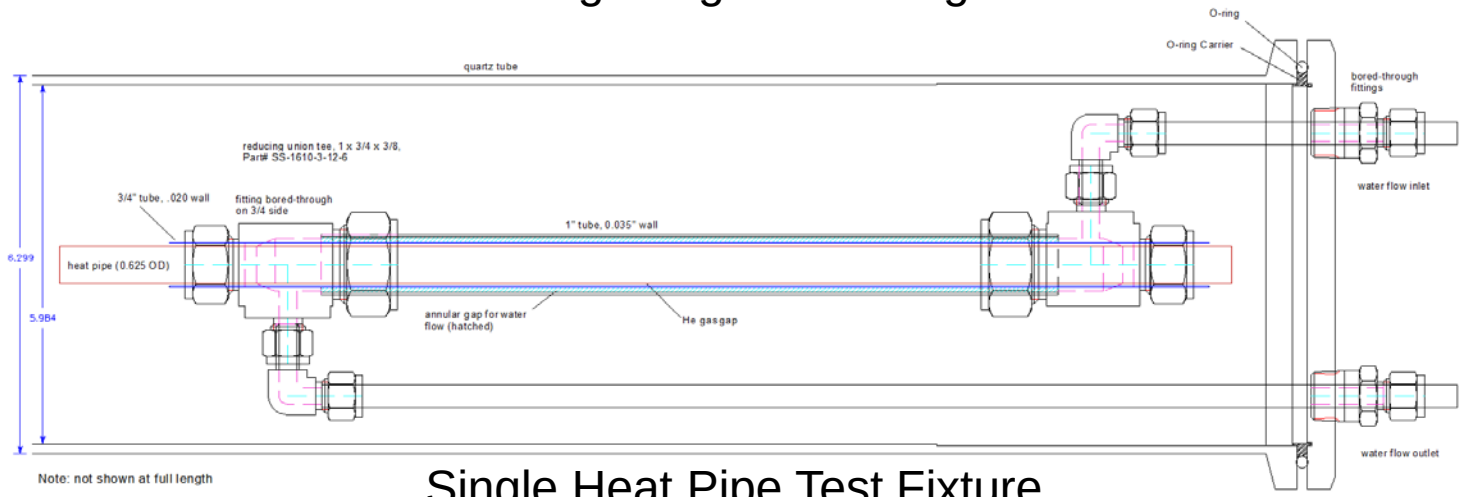


MFM-01

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

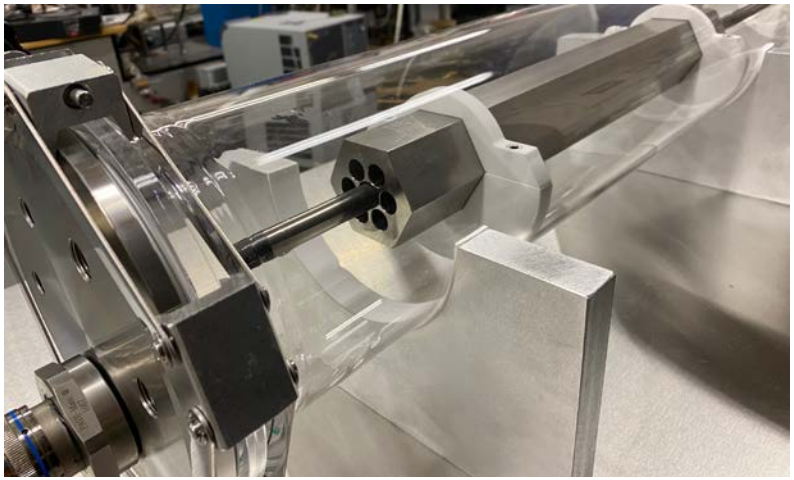
- Water cooled shroud across a gas gap - a wire wrap will be used to center the heat pipe inside calorimeter tube
- Water cooling can support high heat removal rates - greater than the heat pipe rating
- Heat transfer across gap is a combination of radiation plus conduction - conduction is dominant
- 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

Test stand and power and instrumentation cabinet

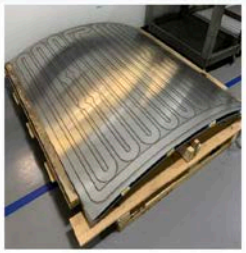


Quartz tube allows tests in vacuum or inert gas environments

Test stand gas/vacuum/cooling end and control computer

Future Work Plans and Priorities

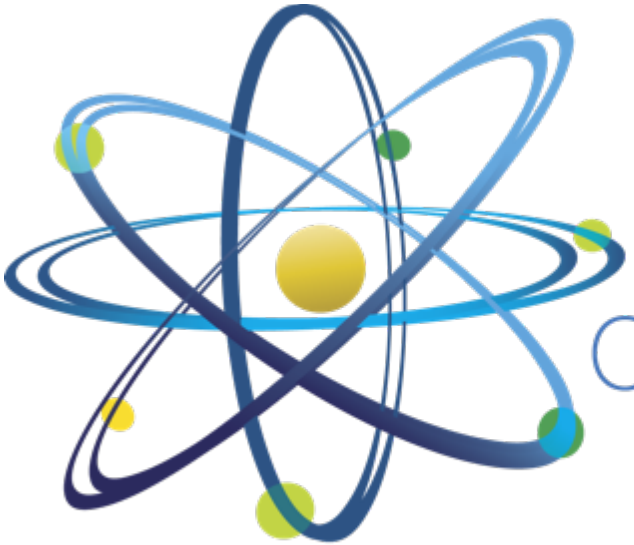
- Complete single heat pipe testing at BCTC
- Test single heat pipe test article in MAGNET starting mid-December
- Prepare MAGNET for 37 heat pipe test article
- Integrate MAGNET with thermal energy distribution system (TEDS) in FY21 – collaboration with Integrated Energy Systems
- Integrate Power Conversion Unit – 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



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