

Microreactor AGile Non-nuclear Experimental Testbed (MAGNET)

Integrated Thermal Testing Capability to Enable Microreactors

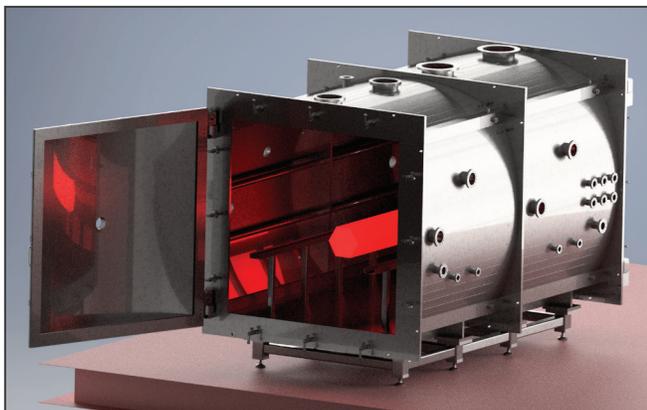
The U.S. Department of Energy (DOE) Microreactor Program supports research and development (R&D) of technologies related to the development, demonstration and deployment of very small, factory fabricated, transportable reactors to provide power and heat for decentralized generation in civilian, industrial and defense energy sectors.

Led by Idaho National Laboratory, the program conducts both fundamental and applied R&D to reduce the risks associated with new technology performance and manufacturing readiness of microreactors. The intent is to ensure that microreactor concepts can be developed, licensed and deployed by commercial entities to meet specific use case requirements.

The program coordinates work and activities across participating laboratories, universities and industry as well as other DOE programs. Participating national laboratories are Argonne National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Sandia National Laboratories.

What is the Microreactor AGile non-Nuclear Experimental Testbed?

The DOE Microreactor Program is developing a thermal-hydraulic test capability called the Microreactor AGile Non-nuclear Experimental Testbed (MAGNET). MAGNET will use electrical heating elements to simulate core thermal behavior, primary heat exchanger performance, and passive decay heat removal for heat pipe and gas-cooled microreactors.



MAGNET Environmental Enclosure

MAGNET will provide a facility for researchers and technology developers to test new microreactor concepts in a relevant environment to advance technical maturity.

MAGNET will support verification and validation of detailed microreactor thermal hydraulic models applicable under startup, shutdown, steady-state, and off normal transient behavior in steady-state operation, transient operation and load following conditions.

Testing using MAGNET can be done in advance of nuclear system demonstration. The DOE Microreactor program is planning experiments with the first experiment scheduled for December 2020. MAGNET is available for use by national laboratory, university and industry partners.

MAGNET will ultimately be integrated into the broader INL Systems Integration Laboratory, which includes thermal and electrical energy users such as steam electrolysis, real-time digital simulators for power systems emulation, a microgrid test bed, a thermal energy distribution system (TEDS), and renewable energy generation.

How will MAGNET be used to support microreactor development?

MAGNET can be broadly used to test microreactor structures and systems. Specific examples include:

Heat transfer within microreactor components, including core structures and heat exchange components and for alternative heat removal approaches

Structural performance of core structures, including evaluating thermal stress, strain, aging/fatigue, creep and deformation

Evaluation of heat pipe performance and integration for transfer of heat from core structures to heat exchangers for heat pipe functionality, heat transfer capabilities and geometric compatibility

Investigation of high-performance integral heat exchangers for high-efficiency heat transfer from core structures to power cycle working fluids

Testing of components produced by advanced manufacturing, including heat exchangers, core components and other structures

Testing advanced sensors, instrumentation and control through instrumented test articles and control systems

Cyclic load testing to understand material and component behaviors for transient and load following operations

Validation of modeling and simulation tools through experiments and direct engagement with computational model and tool developers

What are the design specifications for MAGNET?

Electrically Heated Core

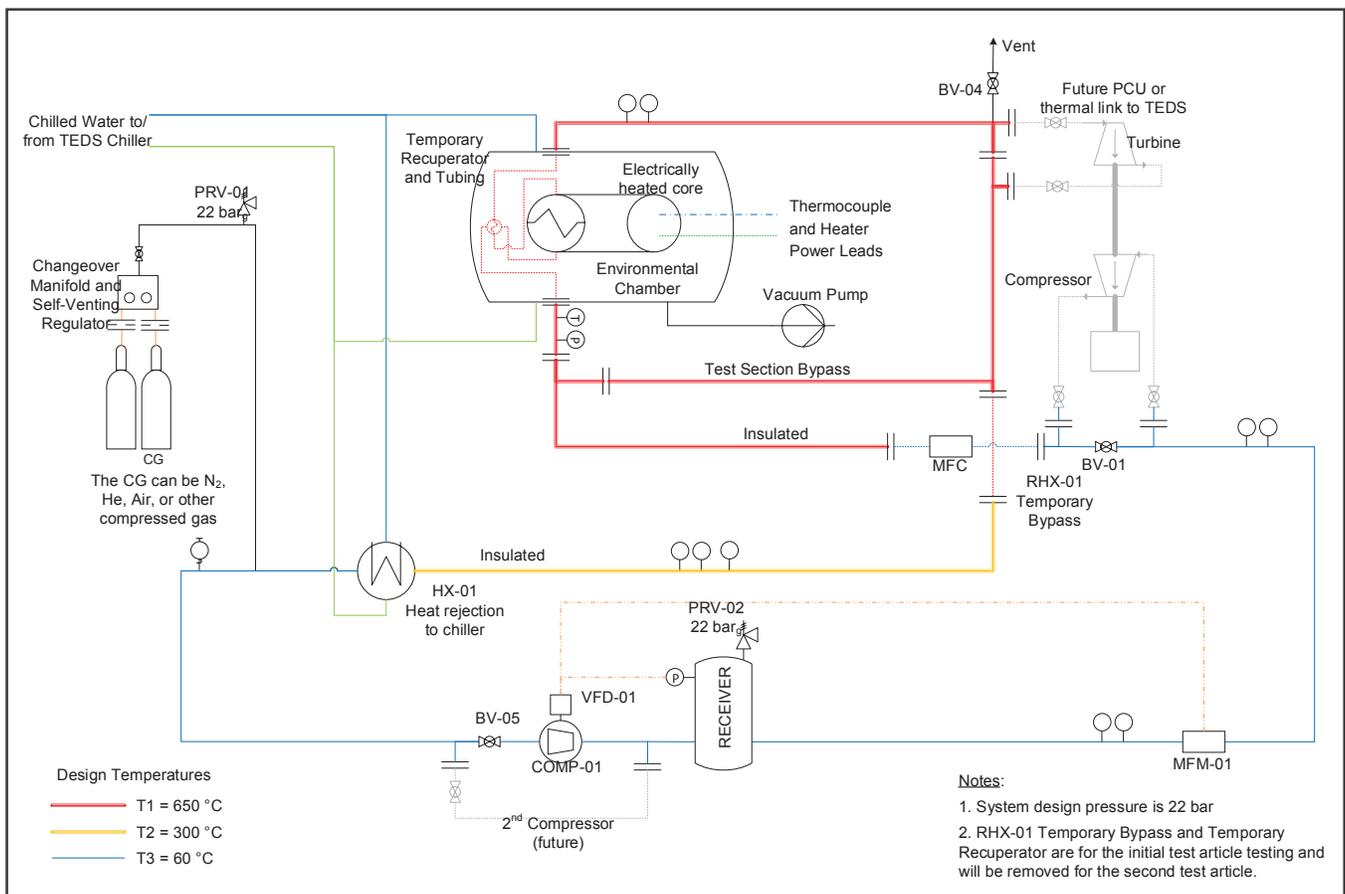
- Test bed designed for up to 250 kW electrical power to core heaters
- Maximum test article temperature of 750°C

Environmental Chamber

- Vacuum (10^{-4} torr) or inert gas
- 5 ft × 5 ft × 10 ft with test article support platform on rails
- Water-cooled chamber walls
- Flanges for gas flow connections, instrumentation feedthroughs ports and viewing windows

Gas Coolant Flow Loop

- Designed for operation with air, nitrogen, or inert gas, such as helium
- Up to 250 kW heat removal from test article core or heat removal section
- Design pressure 22 barg
- Design temperature 650 °C in hot section
- Gas flow rates up to 43.7 ACFM at 290 psig (initial single-compressor configuration)
 - Nitrogen mass-flow rates up to 0.5 kg/s
 - He gas mass-flow rates up to 0.07 kg/s
 - Feedback controlled for constant mass-flow rate
 - Compressor speed control via variable-frequency drive
- Designed for future incorporation of a PCU
- A 350 kW Recuperator



MAGNET Process Flow Diagram

For more information

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