Microreactor Agile Non-nuclear Experimental Testbed (MAGNET)

Thermohydraulic Testing Capability to Enable Microreactors

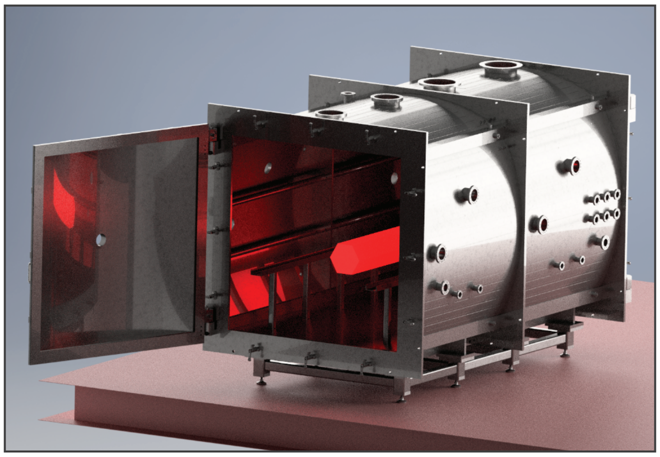
The U.S. Department of Energy (DOE) Microreactor Program was established to support research and development (R&D) of technologies related to the development, demonstration and deployment of very small, transportable reactors to provide power and heat for decentralized generation in civilian, industrial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

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 licensed and deployed by commercial entities to meet specific use case requirements.

The DOE Microreactor Program is led by Idaho National Laboratory (INL). 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?

Under the auspices of the DOE Microreactor Program, INL 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 will be done in advance of nuclear system demonstration. 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.

What are specific technical objectives of MAGNET?

Work done at MAGNET has the following objectives:

- **Provide displacement and temperature data** that could be used for verifying potential design performance and to validate accompanying analytical models.
- **Show structural integrity of core structures:** thermal stress, strain, aging/fatigue, creep, deformation.
- **Evaluate interface between heat pipes and heat exchanger** for both geometric compatibility, heat pipe functionality, and heat transfer capabilities.
- **Develop potential high-performance, integral heat exchangers based on advanced manufacturing techniques,** incorporating high-efficiency heat transfer from the core to the power cycle working fluid.
- **Test the interface of the heat exchanger** to integrated systems for power generation or for process heat applications.
- **Demonstrate the performance of advanced fabrication techniques** such as additive manufacturing or diffusion bonding to nuclear reactor applications.

Develop and test advanced sensors and power-conversion equipment, including instrumentation for autonomous operation.

Study cyclic loading experiments that support testing for load following operations.

Enhance readiness of the public to design, operate, and test new types of high-temperature reactor components.

What are the design specifications for MAGNET?

Electrically Heated Core

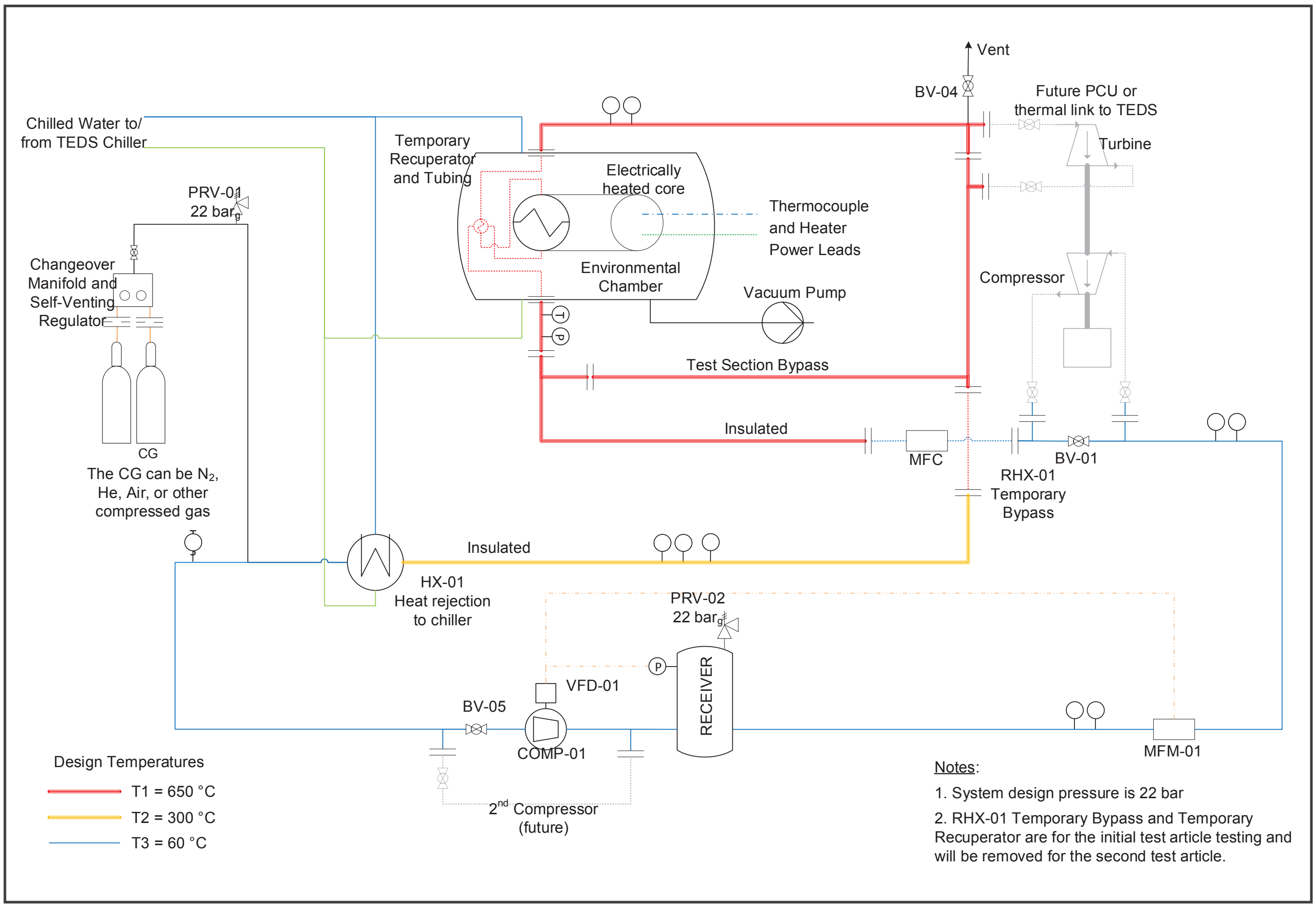
- Test bed designed for up to 250 kW electrical power to core heaters
- Maximum test article temperature of 750°C

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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