MICR

DOE MICROREACTOR PROGRAM

The U.S. DOE Microreactor Program

Performing Research and Development to Enable Microreactor Development, Deployment and Commercialization

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 (INL), 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 of the program 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. National laboratories participating in the Microreactor Program are INL, Argonne National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory and Sandia National Laboratory.

What are the benefits of the Microreactor Program?

This program performs unique microreactor-related activities that can directly reduce the technology risks and uncertainties of near-term designs and next-generation microreactor applications and concepts.

Because microreactor designs under development are novel and possess unique technology features—such as autonomous operation, inherent safety, and full transportability—there is a significant need for R&D support. The DOE national laboratory complex is uniquely positioned to fulfill those needs to support industry and other stakeholders. This program performs R&D in areas pertaining specifically to civilian commercial microreactors, though recognizingsynergies with ongoing defense microreactor R&D efforts.

What are microreactors?

Microreactors are a class of very small modular reactors targeted for non-conventional nuclear markets. These include remote communities, mining sites and remote defense bases, as well as applications such as back-up generation for power plants, humanitarian assistance, and disaster relief missions. Such applications may be uniquely addressed by this new class of innovative nuclear reactors.

What are the key objectives of the Microreactor Program?

The key objectives of this program are:

Meet critical cross-cutting R&D needs of existing developers that require national laboratory, university and industry expertise and capabilities.

Develop R&D infrastructure to support design, demonstration, regulatory and safety-related tests and to collect data to validate modeling and simulation tools.

Develop advanced technology and technology concepts that enable improved performance, economics, or integration of microreactors.

U.S. DOE Microreactor Program Vision

Through cross-cutting R&D and technology demonstration support, by 2025 the Microreactor Program will:

- ***Achieve*** technological breakthroughs for key features of microreactors
- ***Enable*** successful maturations of multiple domestic commercial microreactor technologies
- ***Empower*** initial demonstrations of the next advanced reactors in the United States

What is the scope of the Microreactor Program?

The microreactor program performs R&D to support the development, demonstration, and deployment in the following areas:

System Integration & Analyses

Seek understanding of the microreactor design space by investigating innovative microreactor concepts, performing regulatory research to support the regulatory basis for microreactordeployments, and performing R&D to increase the technical readiness for microreactor deployments. Activities include:

Integrated modeling and simulation of microreactors

Establish the areas of applicability and gaps in experimental data needed to improve the performance prediction capabilitiesof existing modeling and simulation tools, specifically those developed by the program Nuclear Energy Advanced Modeling and Simulation (NEAMS).

Techno-economic analysis

Perform economic analysis and market studies to guide the development of the reactor designs to guide microreactor developers to meet economic targets for competitiveness.

Licensing and regulatory

Perform research to support licensing pathways for microreactor development and work with industry, academia, and the U.S. Nuclear Regulatory Commission to provide data and information on issues related to those pathways.

Technology Maturation

Mature key technologies used for the design and development of microreactors, including:

High-Temperature Moderator Materials

Focus near-term on the development of yttrium-hydride. Other moderator materials may be considered in the future.

Heat Transfer, and Power Conversion

Investigate unique challenges associated with transporting heat from the core due to the compact footprint, radiation field, transportability and high temperatures presented by the inherent features of microreactors. Also, research and test the non-nuclear components required for a microreactor to advance technology and increase our understanding of system performance.

Advanced Structural Material Manufacturing and Testing

Establish better understanding of the performance of microreactor core and reactor structures under extreme conditions and detailed manufacturing processes.

Instrumentation and Sensors

Perform research for instrumentation for the non-nuclear test bed, sensors for structural health, and autonomous sensing and control.

Legacy Fuel Data

DOE-NE has supported efforts to recover and preserve metallic fuel data generated throughout the U.S. Sodium-Cooled Fast Reactor program. The data are essential for future licensing activities of metallic-fuel-based advanced fast reactors, as well as analysis and modeling and simulation activities.

Demonstration Capabilities

Perform nuclear and non-nuclear testing and support of activities needed to support microreactor demonstrations.

Microreactor AGile Non-nuclear Experimental Testbed (MAGNET)

An integrated thermal test capability to simulate core thermal behavior, heat pipe and primary integrated electrically heated thermal heat exchanger performance and passive decay heat removal to support verification of modeling and simulation tools.

Microreactor Applications Research, Validation and Evaluation (MARVEL)

A platform to support development and demonstration of the integration of end use technologies with a small-scale nuclear microreactor.

Single Primary Heat Extraction and Removal Emulator (SPHERE)

A platform to support non-nuclear thermal and integrated systems testing capabilities. This capability shall provide a better understanding of thermal performance of the heat pipe under a wide range of heating values and operating temperatures, further enhancing the understanding of heat pipe startup and transient operation.

This conceptual rendering shows MAGNET with other components at INL's Integrated Energy Systems (IES) Laboratory.

MRP Microreactor Program

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