

Nuclear Energy University Program (NEUP) Fiscal Year (FY) 21 Annual Planning Webinar

RC-2 Microreactor Cost Reduction and End-User Application Integration

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Department of Energy
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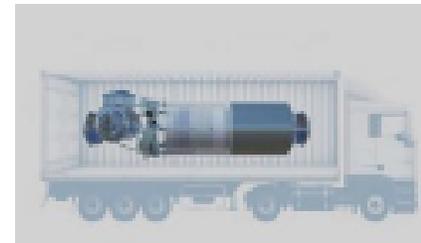
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Program Vision and Goals

Through cross-cutting research and development and technology demonstration support, by 2025 the Microreactor Program will:

- Achieve technological breakthroughs for key features of microreactors
- Empower initial demonstration of the next advanced reactor in the US
- Enable successful demonstrations of multiple domestic commercial microreactors.



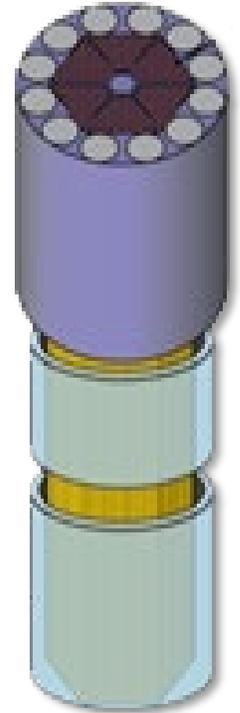
Objectives and Strategic Activities

Objectives

- Perform cross-cutting, national laboratory-led R&D activities to enable the demonstration and advancement of microreactor technologies
- Develop experimental infrastructure supporting microreactor system testing for early to mid-2020s demonstrations
- Provide cost-shared support for microreactor vendor concept development and licensing activities
- Remain closely engaged with the Nuclear Reactor Commission (NRC), industry, and Department of Defense (DoD) on related microreactor licensing and demonstration activities

Previous stakeholder feedback has motivated the following program activities:

- Validation testing of integrated microreactor systems and end-user applications in both non-nuclear and nuclear prototypical environments
- Maturing cross-cutting microreactor technologies such as heat pipes, advanced moderators, advanced materials, and heat exchangers
- Testing and validating remote monitoring and semi-autonomous control systems
- Addressing technical licensing challenges for both near-term microreactor demonstrations and future “nth of a kind” commercial applications



Program Structure

- **System Integration & Analyses**

- Using NEAMS-developed modeling and simulation tools to analyze and understand the performance and behavior of microreactors
- Performing techno-economic analyses of potential microreactor application and regional markets
- Identifying and resolving high-priority microreactor-specific regulatory technical challenges

- **Technology Maturation**

- Investigating innovative microreactor moderators, reflectors, and high-temperature materials properties, fabrication, and performance
- Maturing heat pipe and advanced heat exchanger technologies for integrating microreactor cores to power conversion units
- Leveraging ongoing NE advanced sensor R&D for microreactor remote health monitoring and semi-autonomous control regimes

- **Demonstration Capabilities**

- Operating and maintaining the MAGNET non-nuclear test bed platform for testing and gathering real-time data for key microreactor systems under electrically simulated prototypical nuclear response conditions
- Constructing the MARVEL nuclear test bed to complement MAGNET and provide a unique nuclear environment for validating autonomous operation regimes and demonstrating integration of end-user applications to an actual nuclear system



Integrated Simulation of heat-pipe microreactor



MAGNET Test Bed at INL Integrated Systems Laboratory

Many microreactor concepts under development in the United States anticipate commercial deployment within the next decade

- Broad deployment of microreactors will require they remain cost competitive with other available sources of energy
- This work scope seeks the development of technologies that advance the future deployment of microreactors by:
 - Improving their economic competitiveness
 - Enabling their integration into end-user applications for broad deployment and use

Improving Economic Competitiveness

Approaches for reducing microreactor construction, operation, and maintenance costs are of particular interest

Suggested areas of research include, but are not limited to:

- Readily deployable technologies and regimes that enable unattended and reliable operations
- Innovative use of existing advanced embedded sensors and instrumentation for remote online monitoring
- Reduction of fuel costs through more efficient use of fuel
- Alternatives for high cost microreactor components including core structures, heat exchangers, and power conversion
- Production approaches that enable standardization and efficient factory manufacturing and assembly

Proposals are highly encouraged to leverage experimental capabilities being developed by the Microreactor Program, particularly the use of the Microreactor Agile Non-Nuclear Experimental Testbed (MAGNET) at the Idaho National Laboratory (INL)

Note: Innovative proposals that could result in significant cost reductions are encouraged. Proposals should include a clear description of the potential for the proposed scope to reduce microreactor energy production costs.

Enabling End-User Application Integration

Seeking proposals for the development and experimental validation of technologies supporting the integration of end-user applications with microreactors

INL is developing the Microreactor Applications Research, Validation and Evaluation (MARVEL) test bed

- Includes the rapid development of a 100 kWth/20 kWe microreactor
- Planned for availability in FY22
- Provides platform to perform R&D for improved integration of microreactors to end-user applications

Examples of potential end-user applications for integration with microreactor technologies:

- High performance computing and communication
- HVAC
- Energy storage
- Water purification

Engagement with potential microreactor developers and end-users is highly encouraged.

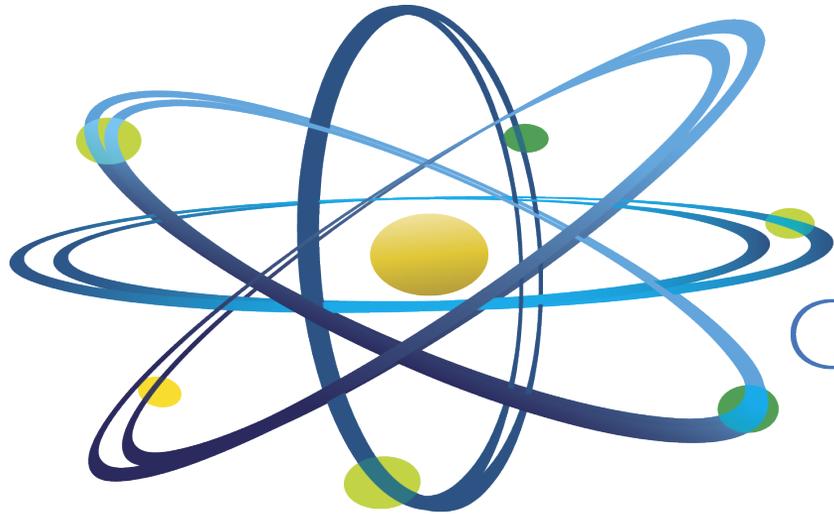
Proposals highly encouraged to leverage Microreactor Program experimental capabilities, including MARVEL

Note: Proposals should focus on resolving microreactor-specific end-user application integration technological challenges (general development of end-user capabilities and technologies is **not** being sought)

Additional Information

More information on the Microreactor Program as well as MAGNET and MARVEL is available on the Microreactor Program Website:

<https://gain.inl.gov/SitePages/MicroreactorProgram.aspx>



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