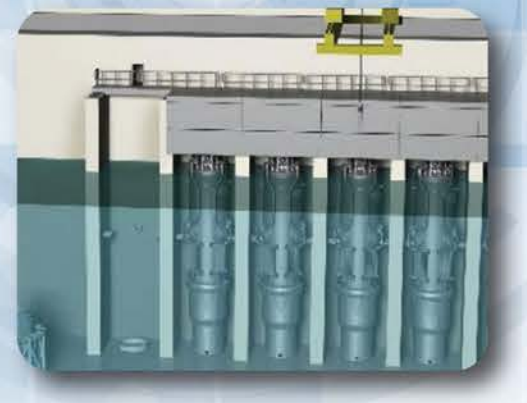
DOE-NE Microreactor R&D Program Technical Scope



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June 18, 2019

GAIN-EPRI-NEI-USNIC Micro-reactor Workshop

Idaho National Laboratory

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Programmatic Objectives/Goals

- The DOE-funded program will conduct fundamental R&D to reduce uncertainty and risk in the design and development of microreactors to facilitate rapid technology commercialization
- R&D is selected to support technology maturation that is broadly applicable to multiple reactor cooling/technology options to ensure that concepts can be licensed and deployed to meet specific use-case requirements
- Primary Objectives for FY19:
  - Engage with industry and DOD
  - Enable demonstration of microreactors
  - Mature key technologies specifically needed by microreactor developers
  - Assess microreactor specific regulatory and licensing issues

Summary of FY19 Work Scope

- Program Management and Integration
  - Managing technical work, engagement with Industry and DOD, workshops
- System Integration and Analysis
  - Demonstrate virtual test bed capabilities (integrated systems modeling)
  - Market analysis for civilian deployment of microreactors
- Demonstration Support Capabilities
  - Stand up capability for non-nuclear testing and demonstration of integrated microreactor systems within a microgrid architecture
  - Evaluation and readiness for HALEU fuel fabrication and demonstration siting
- Technology Maturation
  - High temperature moderators, advanced heat pipes, power conversion, fuel qualification data, materials, and microreactor instrumentation and operations
- Licensing/Regulatory
  - Transportation of fueled microreactors, evaluation of regulatory approaches

Scope Informed by Industry Feedback on R&D Needs for the Microreactor Community
This workshop provides an opportunity for Developers to Inform Program Planning

System Integration and Analysis

- Demonstrate, through simulations, key aspects of microreactors including load-following, ease of grid integration, safety, control systems, etc.
- Develop models and exercise integrated simulation capabilities, leveraging NEAMS microreactor modeling capabilities
  - Those capabilities are being developed this year with NEAMS MW-class reactor funding
  - Microreactor program will drive development by applying tools and providing feedback/direction
- Benchmark with existing mature codes
- Provide capabilities for industry, and potentially NRC, that are consistent with approaches for non-LWR modeling and simulation

Non-Nuclear Test and Demonstration Capability to Provide for Testing of Microreactors

- Developing non-nuclear test bed to support testing of microreactor components in prototypical environment: monolith, heat pipes, heat exchange/power conversion, instrumentation, moderators
  - Test normal operations: startup, steady-state, load-following, shutdown
  - Test off-normal: system transients, non-functioning components (failed heat pipes, hydrogen migration from moderators, integrity of joints and bonds)
  - Test of control systems: autonomous, semi-autonomous, remote
- Use engineering test and demonstration capability to generate component performance data to support design, licensing and computer code validation
- Can be used by developers to provide a test bed for future engineering tests, support training of industry and NRC

Nuclear Fuel Fabrication and Demonstration Siting

- Fuel fab and demonstration siting needed for accelerated time frame for microreactor demonstrations, within 5 years for some proposed concepts.
- Needs include:
  - Access to High Assay Low-Enriched Uranium (HALEU)
  - Engineering-scale fuel-fabrication capability
  - Locations to site the microreactor demonstrations
  - Flexible regulatory approaches
- Program evaluating existing infrastructure to support this scope and timeframe.

Nuclear Fuel Fabrication and Demonstration Siting

- Fabrication Facilities to Support Nuclear Demonstrations
  - Investigation of existing facilities available for engineering-scale fuel fabrication
  - Initial preparations for fuel fabrication facility that will support production of fuel the microreactor nuclear demonstrations
- Site Assessment, Evaluation, Selection
  - Begin assessment of possible sites at INL for microreactor nuclear demonstration
  - Work will include initial site evaluation, prioritization/selection, and initial preparation
- HALEU Decontamination
  - Work initiated in FY18 to determine the EBR-II HALEU decontamination level achievable, considering revision to the INL Fuel Conditioning Facility ingot preparation process.

Technology Maturation of Key Microreactor Technologies

A range of technologies are being investigated under this work scope, including:

- Advanced moderators – Development and testing of high temperature moderators
- Development of advanced heat-pipes, heat removal systems, power conversion systems
- Fuel and Material Qualification – Historical U-Zr qualification data, G91 steel qualification
- Core structures – Fabrication, joining, testing of microreactor core structures such as core blocks
- Sensors, Instrumentation, and Controls – Embedded sensors, autonomous/semi-autonomous/remote monitoring

Transportation and Licensing

Areas in which work has been initiated:

- Transportation
  - Develop basis for factory-to-site transportation of fully-assembles and fueled reactors
  - Post-operation storage and return
- Licensing/regulatory
  - Evaluation of licensing paths (NRC, DOE, DOD)
  - Site independent design and licensing
  - Addressing regulatory barriers (EPZ, aircraft impact rule, etc.)

Your input will ensure that the program is performing work of value to Microreactor Developers

- This workshop provides a venue for engagement between microreactor developers and the program.
- The agenda is designed to:
  - Provide time for microreactor developers to discuss their needs
  - Laboratory researchers to provide overview of current technical work
  - Discussion time through open lunches
  - A summary discussion on needs, capabilities, and gaps
- This information will be used to inform the microreactor scope for FY20 and beyond.

Thank you for your input!

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