DOE-NE Microreactor R&D Program Technical Scope

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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!