U.S. DEPARTMENT OF ENERGY | Nuclear Energy

# Nuclear Energy University Programs
# FY 2016 Annual Planning Webinar

# Mission Supporting
# Fuel Cycle Technologies (MS-FC-1)

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# MS-FC-1 Workscope

The Fuel Cycle Research & Development program conducts generic (not site specific) research and development related to spent nuclear fuel, nuclear waste management and disposal issues. The program also conducts R&D on advanced fuel cycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, enhance safety, and limit proliferation risk. Applications are sought for advanced fuel treatment or material recovery processes, innovative fuel designs, and innovative fuel cycle analysis tools. Areas of interest include "blue sky" concepts for advanced methods of managing used nuclear fuel, such as innovative recycling, transport, storage, and disposal concepts. Areas of interest for fuel R&D include, but are not limited to, advanced concepts for existing LWR and other thermal spectrum reactors and advanced transmutation fuels for fast or mixed spectrum systems. Advanced fuel concepts may also include LWR fuel with improved performance benefits and fast reactor fuel with improved cladding performance (e.g., ability to withstand 400 dpa).

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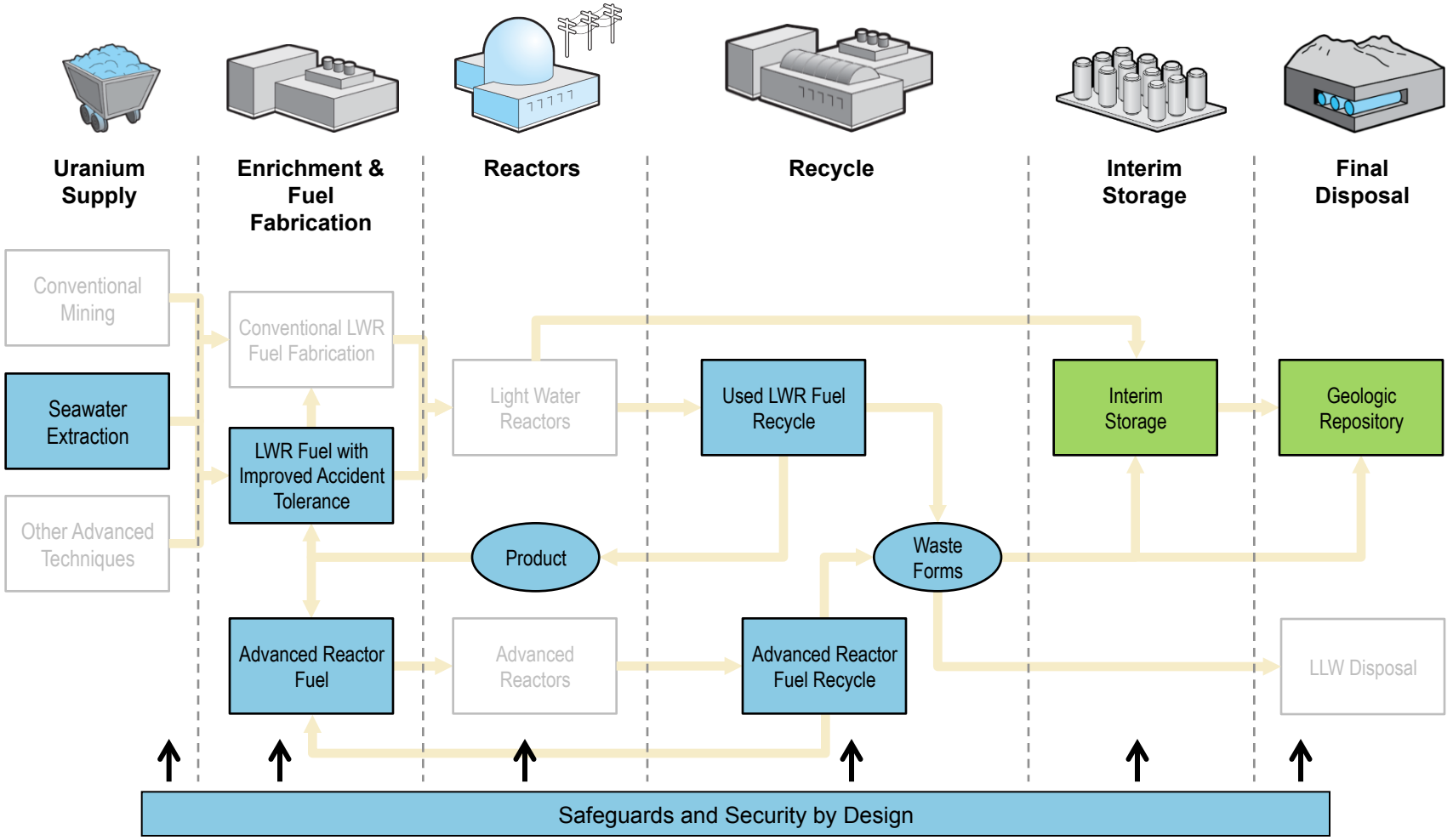
# Focus Areas



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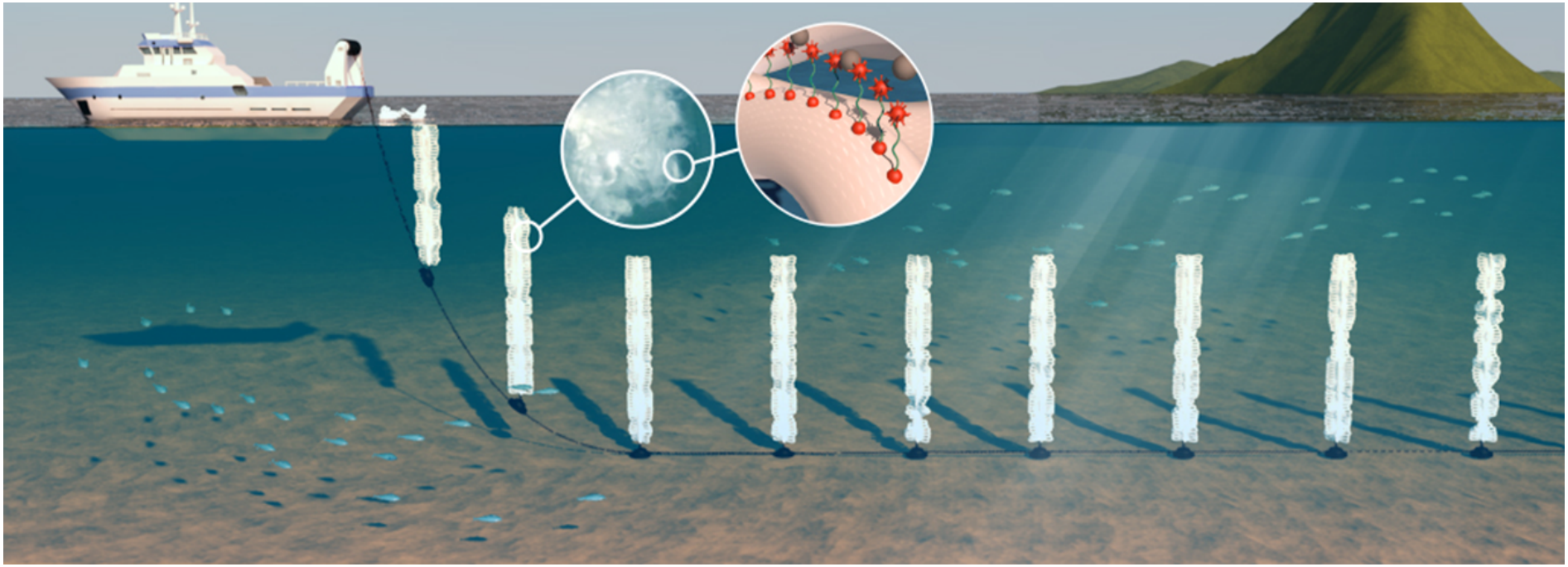
# Fuel Resources: Seawater Uranium Recovery

**Program Goal –** To develop advanced adsorbent materials to extract uranium from seawater to reduce technology cost and uncertainties.

**R&D Investments Strategies**: To develop advanced adsorbent materials that can simultaneously enhance U sorption **capacity, selectivity, kinetics, and materials durability**



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# Advanced Fuels

Advanced LWR fuels with enhanced performance, safety, and reduced waste generation

Advanced reactor fuels with enhanced proliferation resistance and resource utilization

Capability Development for Science-Based Approach to Fuel Development
- Advanced characterization and PIE techniques
- Advanced in-pile instrumentation
- Separate effects testing
- Transient testing infrastructure

Multi-scale, multi-physics fuel performance modeling & simulation

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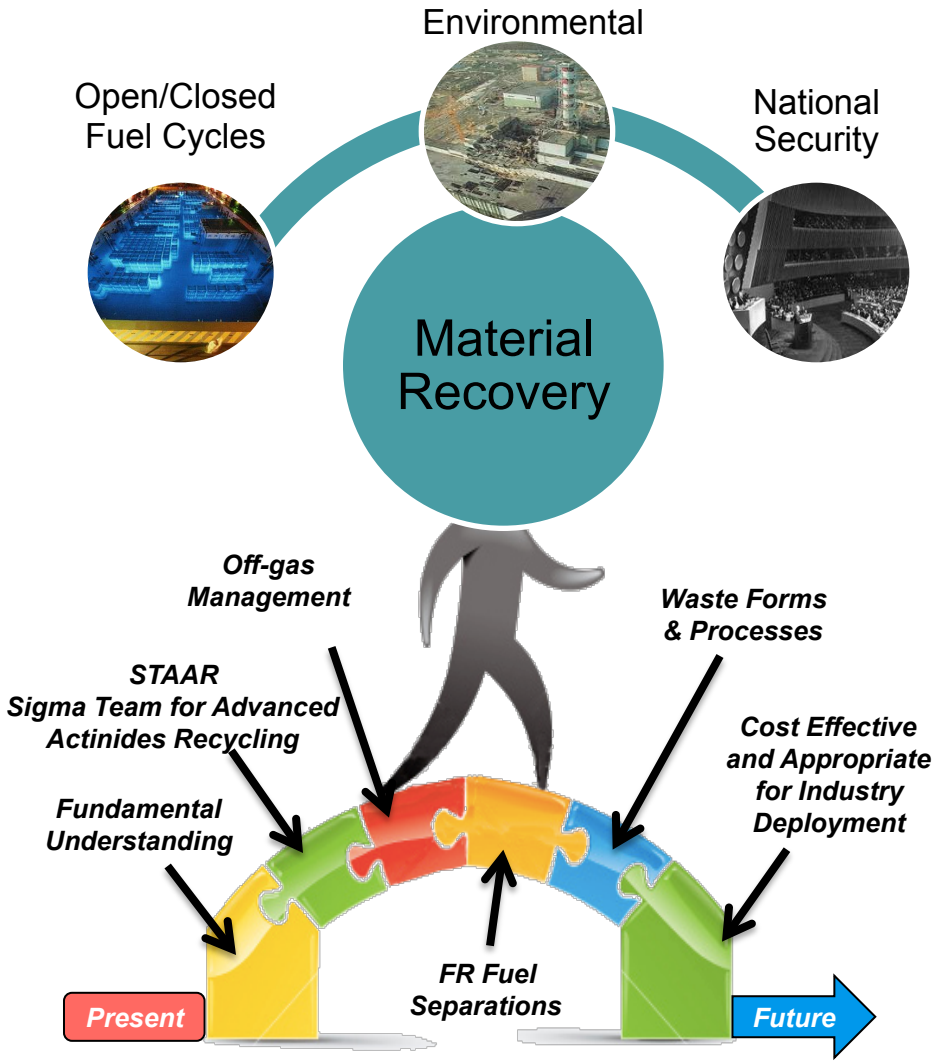
# Material Recovery & Waste Form Development (MRWFD)




- **MRWFD's mission** is to develop advanced material recovery as well as advanced waste form development technologies that improve current fuel cycle performance and enable a sustainable fuel cycle, with minimal processing, waste generation, and potential for material diversion.
- **Off-Gas Capture and Immobilization**
  - Management of process off-gasses (I-129, H-3, Kr-85, and C-14) to meet U.S. regulatory constraints
- **Waste Management**
  - Waste forms and processes need to be developed as an integral part of material recovery technology development. As advanced recycling processes are developed, unique waste streams arise that must be managed in a safe, environmentally responsible and cost effective way.

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# Used Fuel Disposition R&D

## Storage & Transportation

**Support the development of the technical bases:**

- To demonstrate used fuel integrity for extended storage periods
- For fuel retrievability and transportation after long term storage
- For trasnsportation of high burnup fuel

## Disposal

- Provide a sound technical basis for multiple viable disposal options in the US.
- Increase confidence in the robustness of generic disposal concepts.
- Develop the science and engineering tools needed to support disposal concept implementation.

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# Material Protection, Accounting & Control Technologies (MPACT)

- **Mission** – Develop innovative technologies and analysis tools to enable *next generation nuclear materials management* for existing and future U.S. nuclear fuel cycles, to manage and minimize proliferation and terrorism risk.
- **Objectives**
  - Develop and demonstrate advanced material control and accounting technologies that would, if implemented, fill important gaps
  - Develop, demonstrate and apply MPACT analysis tools to assess effectiveness and efficiency and guide R&D and support advanced integration capabilities

  } Technology Development
  - Perform technical assessments in support of advanced fuel cycle concepts and approaches

  } Applications
  - Develop guidelines for safeguards and security by design and apply to new facility concepts

  } Leadership

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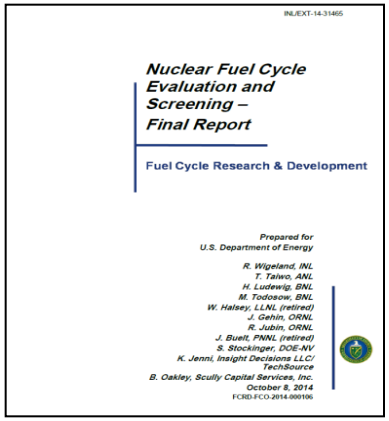
# Systems Analysis & Integration

- **Provides the critical capability needed to analyze complex nuclear energy system options, assess overall performance, and improve understanding of the interdependencies between various subsystems and associated technologies.**

- **A comprehensive Fuel Cycle Evaluation and Screening Report is available at http://fuelcycleevalution.inl.gov. Results are used to improve coordination and integration of R&D activities conducted by the DOE-NE Offices of Fuel Cycle Technologies and Nuclear Reactor Technologies.**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*Nuclear Fuel Cycle Evaluation and Screening – Final Report*

Fuel Cycle Research & Development

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- **Key ongoing activities include:**
  - Analyze transitions from the current fuel cycle to the much smaller set of "most promising" fuel cycles identified by the evaluation and screening study.
  - Conduct market-based analyses of potential nuclear energy generation, including consideration of carbon emissions and climate change policies.
  - Develop improved understanding of nuclear facility costs to support cost projections and to identify where cost reductions are possible through R&D.
  - Examine system impacts of using accident tolerant fuels.
  - Develop and implement a process for technology and system readiness assessments.
  - Maintain a publicly available fuel cycle catalog as a resource of fuel cycle knowledge, including technology development.