U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2016 Annual Planning Webinar

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

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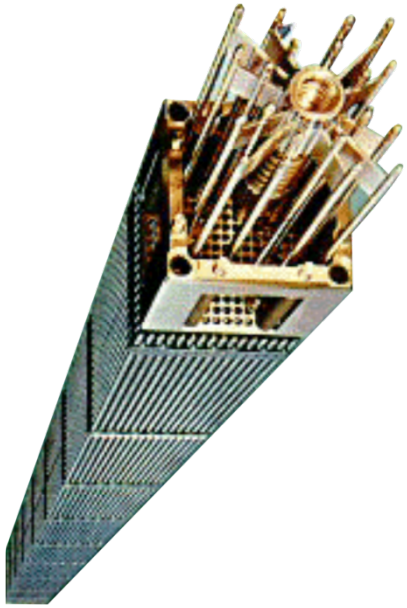
Mission of the Fuel Cycle Research & Development Program

- Conduct R&D on advanced sustainable fuel cycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, enhance safety, and limit proliferation risk;
- Conduct generic research and development and generic non-R&D activities related to used nuclear fuel, nuclear waste management and disposal issues;
- Lay the ground work and planning for the implementation of the Administration's strategy on the management of used nuclear fuel and high-level waste.

The program employs a long-term, science-based approach to foster innovative, transformational technology solutions to achieve this mission. Advancements in fuel cycle technologies and solutions support the enhanced availability, affordability, safety, and security of nuclear-generated electricity in the U.S.



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Nuclear Energy Research and Development: an Integrated Approach

Front End

Uranium Resources

- Conventional production
- Innovative approaches
  - U Seawater

Fuel Fabrication

- Safety enhanced LWR fuel
  - Accident tolerance
- Higher performance
  - Improved burnup

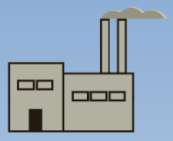
Reactors

- Light Water Reactor Sustainability
- SMR support and R&D
- Advanced Reactors

Back End

Interim Storage

- Evaluating extended time frames
- Transport after storage



Recycle

- Separations
- Recycled fuel
- Secondary waste treatment

Disposal

- Alternative geologies
- Alternative waste forms

←----------Safeguards and Security By Design----------→

Optimize through Systems Analysis, Engineering, and Integration

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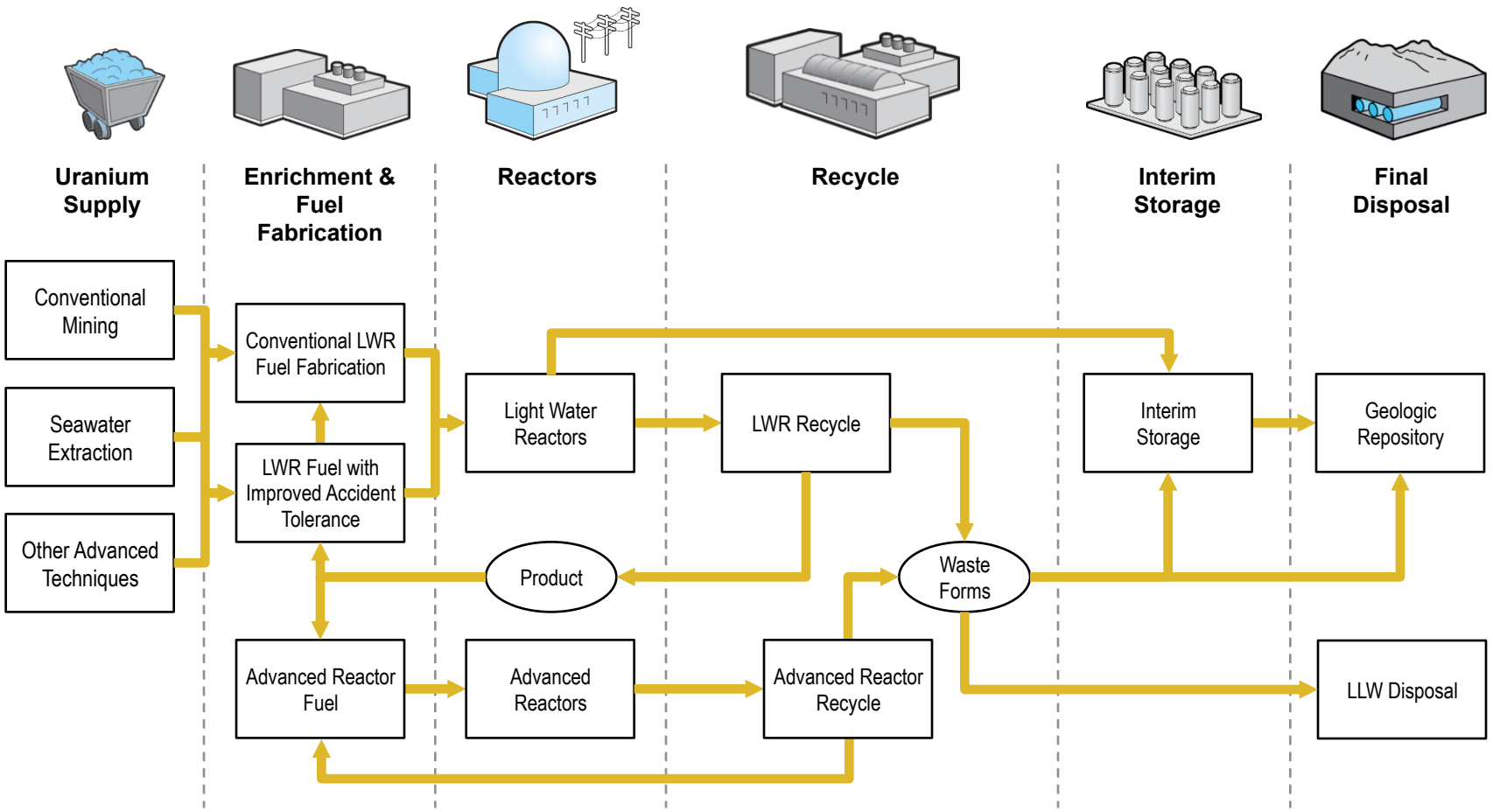
The Nuclear Fuel Cycle as a System Could Incorporate Many Components



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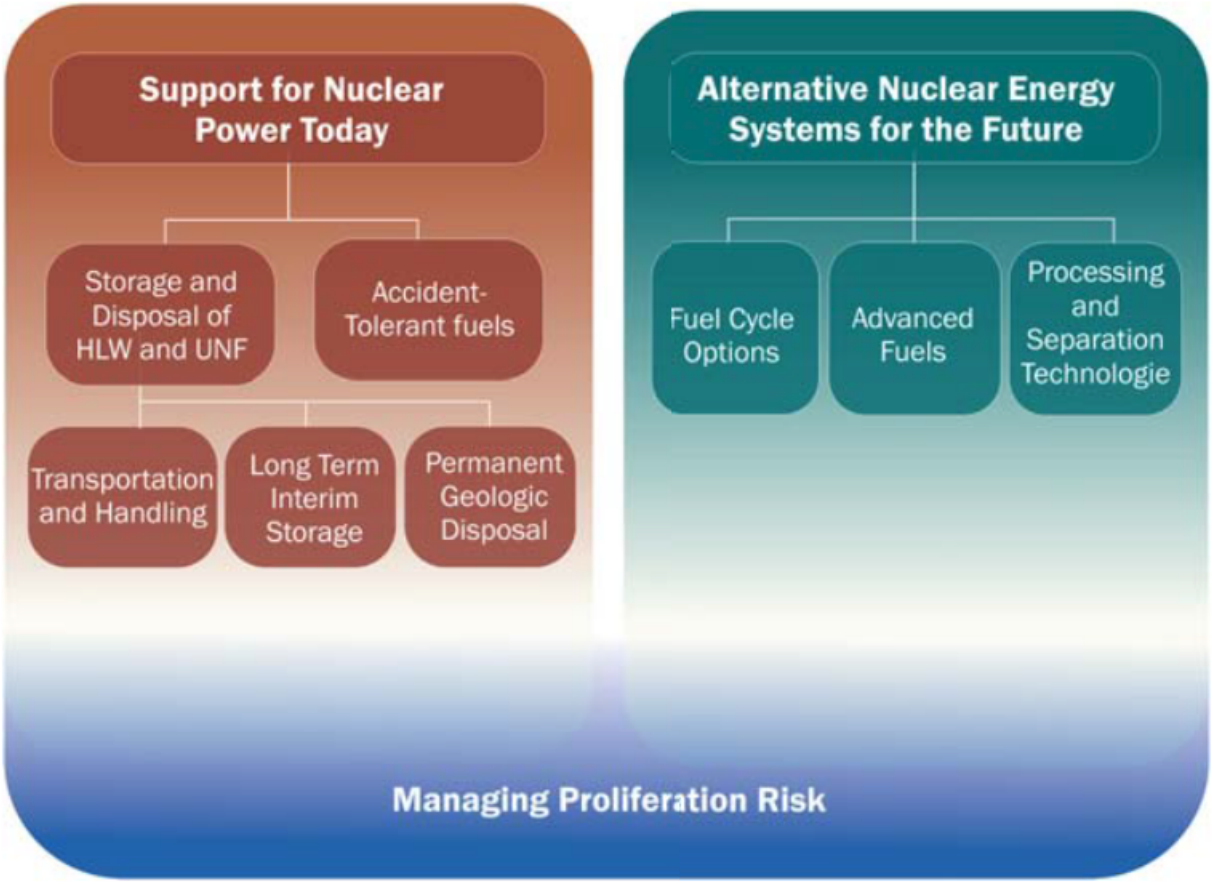
Balancing Near-Term and Long-Term Objectives



- Satisfy increasing demand for near-term action on used nuclear fuel storage and transportation and for accident-tolerant fuels.
- Maintain the momentum for long-term R&D activities with the potential for game-changing improvements.

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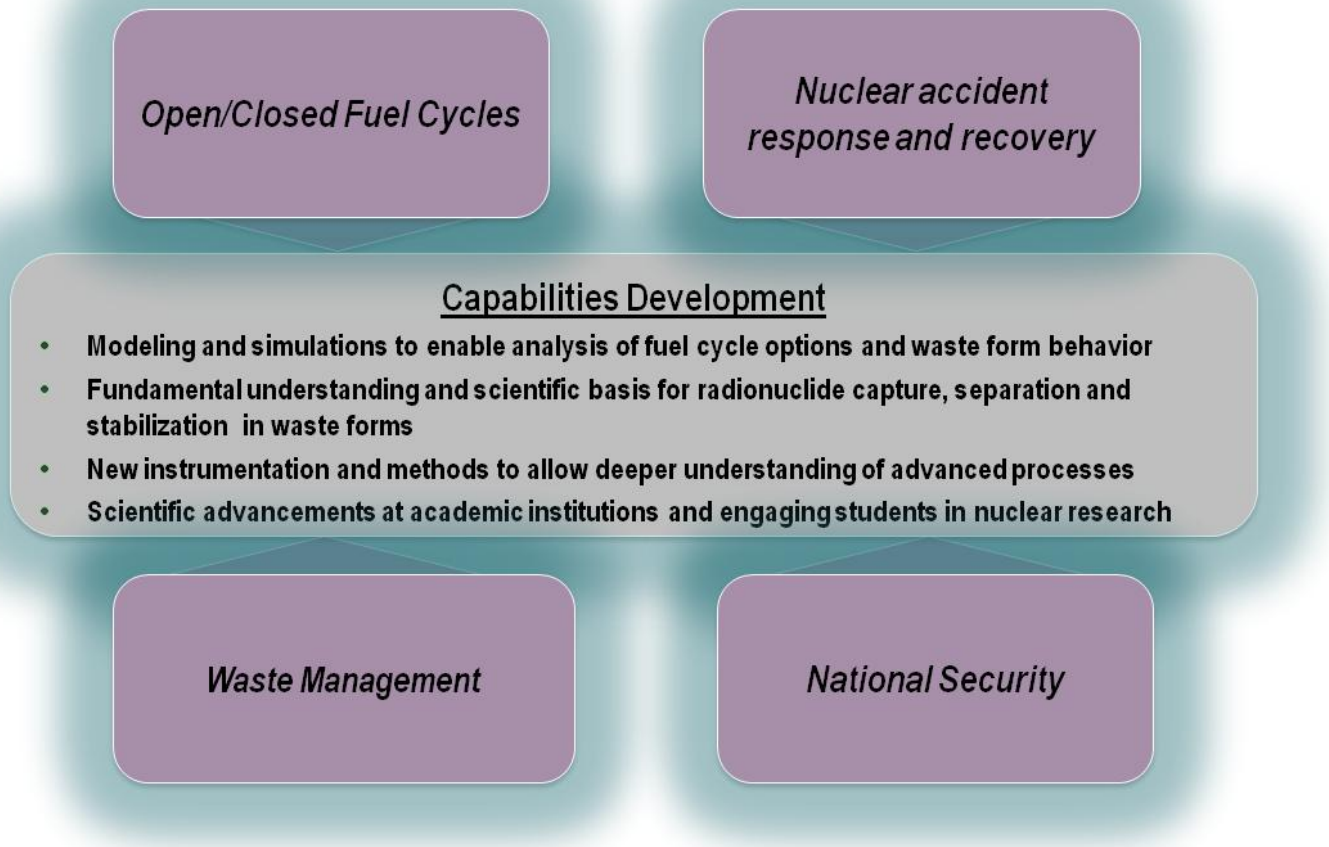
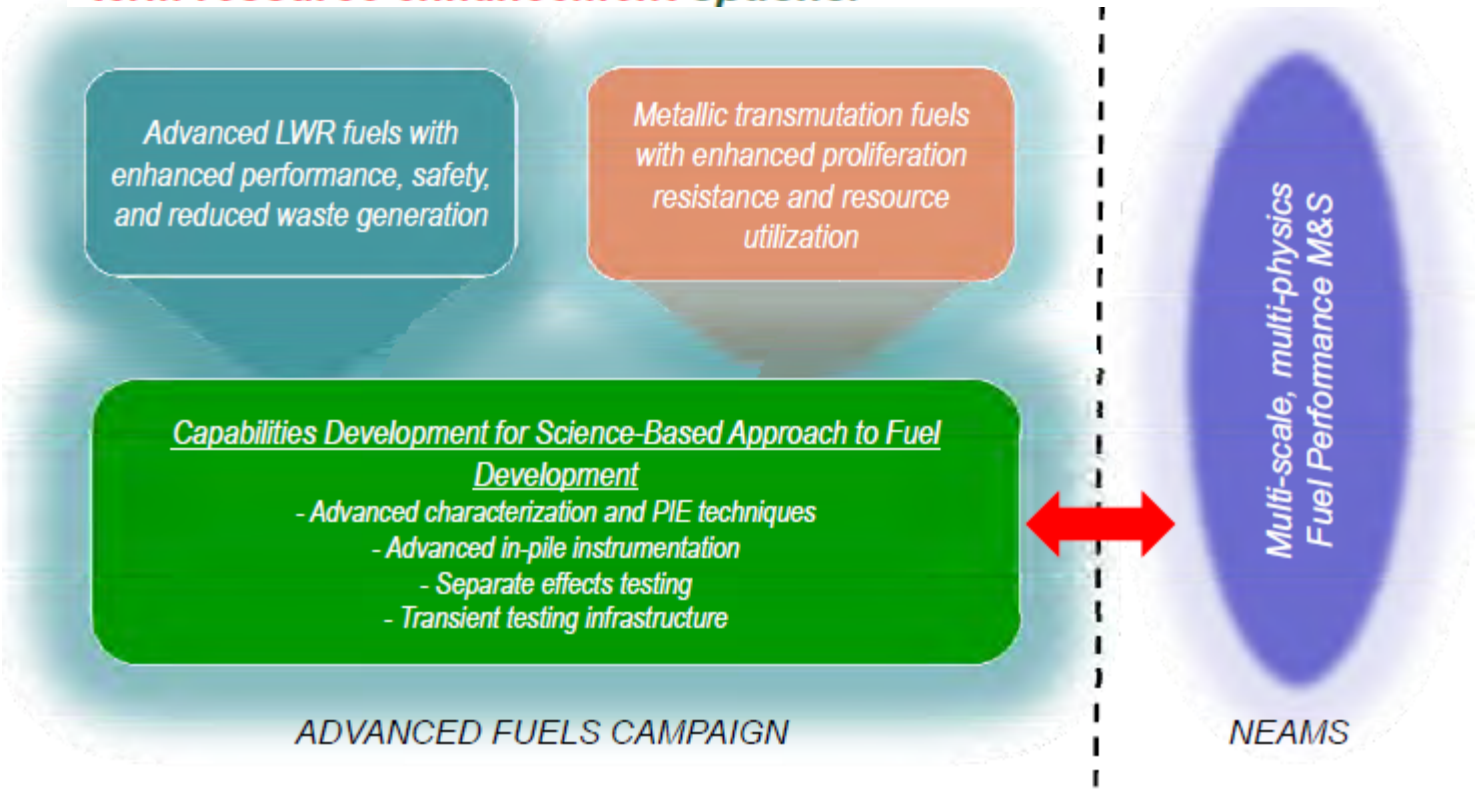
Material Recovery and Waste Form Development

- Separations and Waste Forms is renamed in FY 2015 to reflect the expanded portfolio to a wider array of applications than just separations.

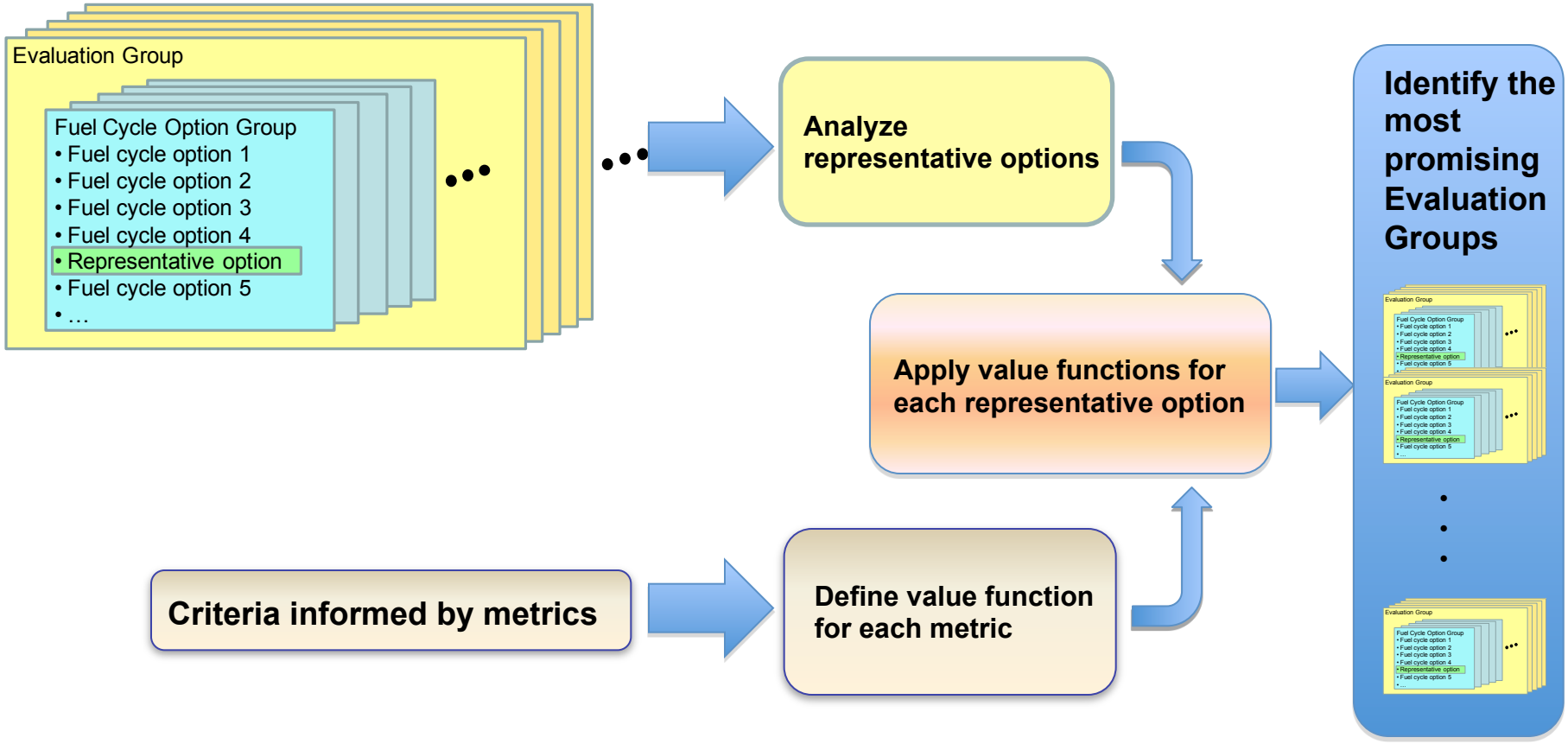


Advanced Fuels

The FCRD Advanced Fuel Campaign is tasked with development of near term Accident Tolerant LWR fuel technology and performing research and development of long term resource enhancement options.



Systems Analysis and Integration



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Material Protection, Accounting and Control Technologies (MPACT) Campaign

- **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
  - Develop tools, technologies, and approaches in support of used fuel safeguards and security for extended storage, electrochemical processing, and other advanced nuclear energy systems

  Technology Development

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

  Applications

  - Develop guidelines for safeguards and security by design and publish guidance documents

  Leadership

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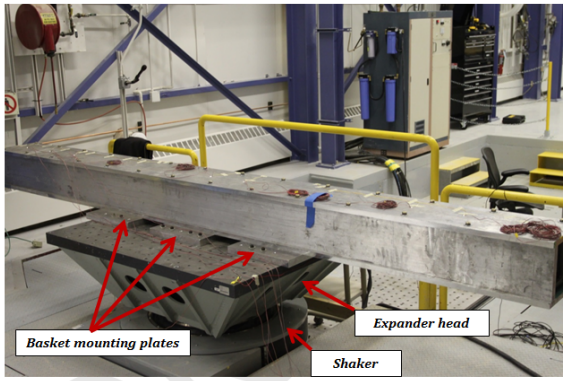
Used Nuclear Fuel Disposition: Transportation Planning

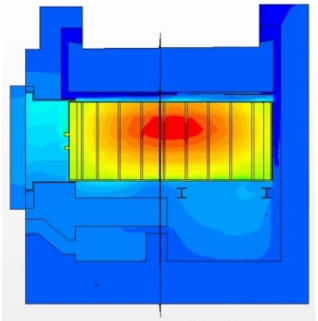
- **Prepare for the eventual large-scale transport of used nuclear fuel and high-level waste:**
  - Collaborate with stakeholders on revised NWPA Section 180(c) Policy and National Transportation Plan
  - Evaluate the inventory, transportation interface, and shipping status of used nuclear fuel, initial focus on shut-down reactor sites
  - Assess and address transportation needs, (e.g., rail cars, casks, support and security).

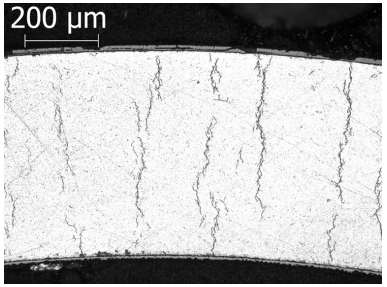
Facilities and railcars at Valognes Railway Terminal

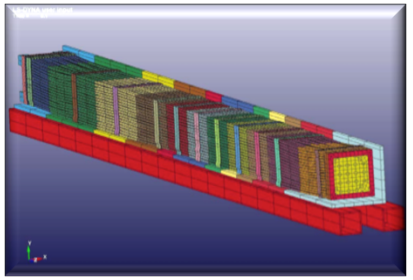
Used Nuclear Fuel Disposition
Extended Storage & Transportation R&D

- **Better understand degradation mechanisms relevant to long-term storage and subsequent transportation:**
  - Potential for corrosion of stainless steel canisters
  - Thermal history of used fuel in storage
  - Effects of hydride formation and reorientation on the material properties of high-burnup cladding
  - Mechanical loads on fuel assemblies during normal conditions of transport









MS-FC-1 Workscope Description

- **Sustainable fuel cycle options are those that improve uranium resource availability and utilization, minimize waste generation, and provide adequate capability and capacity to manage all wastes produced by the fuel cycle. The objective is to develop a suite of options that will enable future decision-makers to make informed choices about how best to manage the used fuel from reactors. Applications should address the technologies and options that would allow for the sustainable management of used nuclear fuel that is safe, economic, and secure and widely acceptable to American society. Examples of topics may include 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 transmutation fuel include, but are not limited to, existing LWRs, other thermal, and fast or mixed spectrum reactors. 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). Extended use of nuclear power may drive improvements in defining resource availability and on fuel resource exploration and mining.**