Nuclear Energy University Programs

MS-RC1 - Reactor Concepts RD&D

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Reactor Concepts RD&D (MS-RC1)

- Identification, investigation and development of revolutionary transformational advanced reactor system concepts and features having the potential to significantly improve performance in sustainability, safety, economics, performance, security or proliferation resistance.

- Such transformational advanced reactor concepts could include designs employing advanced coolants, fuel configurations and operational characteristics.

- Concepts could also include small modular reactors with unique capabilities to address operational missions other than the delivery of baseload electric power, such as industrial process heat or mobile reactors that can provide temporary power during emergency situations.

- The scope of the proposed project should include
  - a thorough viability assessment of the concept,
  - a detailed technology gap analysis, and
  - a comprehensive technology development roadmap that identifies research needed on key feasibility issues.

Transformative Nuclear Concepts R&D (FY 2012)

- This Area supports via an open, competitive solicitation process, investigator-initiated transformative projects
  - *High-risk, high-reward concepts*
  - Potential for significant leaps in advanced nuclear technology development
- Primary goals:
  - Encourage identification and development of "outside-the-box" options in all aspects of civilian nuclear energy program
  - Ensure that good ideas have sufficient outlet for exploration
- Covers full range of nuclear energy technology and not specific to any on-going mission activities
- Key mechanism in NE's R&D portfolio to further encourage transformative thinking and promote creative solutions to the universe of nuclear energy challenges and questions.

Nuclear Energy Enabling Technologies

- **Transformative Nuclear Concepts R&D — will support, via an open, competitive** solicitation process, investigator-initiated projects that relate to any aspect of nuclear energy generation—reactor and power conversion technologies, fuels and fuel management, waste disposal, nonproliferation, and so forth— ensuring that good ideas have sufficient outlet for exploration.

- The research on transformative nuclear concepts will pursue non-traditional nuclear energy ideas that offer the potential for improved system performance and may radically alter nuclear system configuration and development needs.

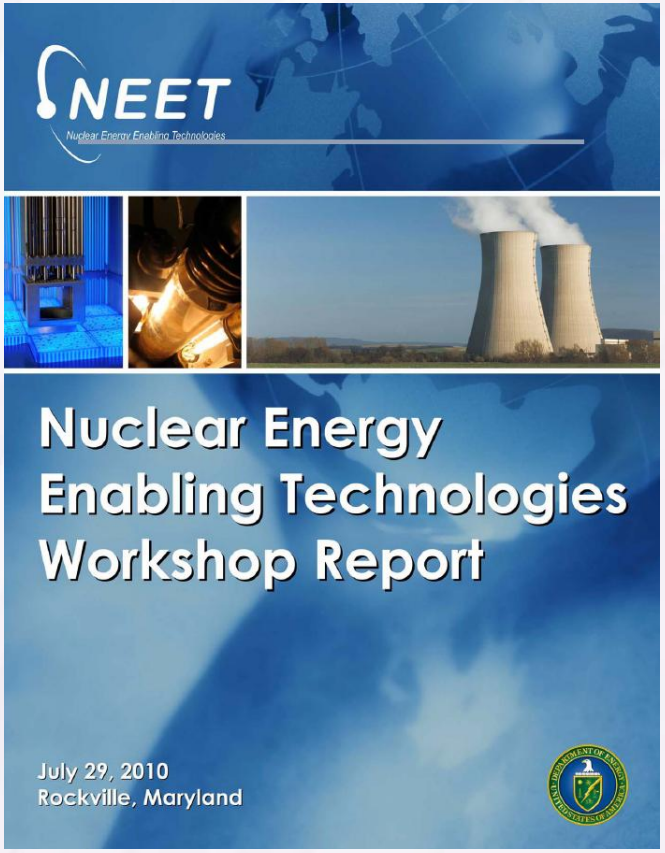
- This could include the development of specialized nuclear fuels, revolutionary materials, tailored coolants, new techniques for energy conversion, or other innovations.

Reactor and Power Conversion Grand Challenges

The mission is to research and develop advanced technologies to significantly improve the efficiency and safety performance of transmutation systems

Three over-arching grand challenges have been identified in the area of reactor and power conversion:

- *Develop transmutation options that meet <u>a broad range of fuel cycle strategies</u> ranging from deep burn actinide consumption to extended uranium utilization*
- *Develop high performance transmutation options with usable energy products – comparable to LWR generation costs*
- *Demonstrate prevention of radiation release to public for all events – normal operation, accidents, or malevolent acts*



Transformative Fast Reactor Area

- *NEET Program Objective - "Transformative nuclear concepts will pursue non-traditional nuclear energy ideas that offer the potential for improved system performance and may radically alter nuclear system configuration and development needs."*

- Reactor System Level R&D
  - Under the Gen-IV funding in FY2010, Dr. Robert Hill (ANL) sent out a request to the DOE labs for transformative reactor concepts for the nuclear energy mission
  - He received 19 ideas for transformative nuclear systems/concepts
  - These concepts were reviewed and evaluated by an expert panel

- Proposed R&D Area – "Transformative System (Cycle) Level non-traditional nuclear energy concepts that can radically alter nuclear system configuration and development needs"

Concept of Pebble-Bed Flouride Salt-Cooled HTR
Development of Performance-Based Regulatory Method
Fast-Flux Modular Reactor
Fast-Spectrum Molten Salt Reactor
Heat Pipe Fast Reactor for Burning and Power
High Flux, Dedicated Transmuter for Am and Cm
Integrated Metallic Fuel Reactor
Laser Inertial Fusion-Fission Transmutation
Lead-Cooled Transformational Reactor
Lead-Cooled Transmutation Reactor
Liquid-Salt Cooled Fast Reactor
Nano-Fluid Nuclear Reactor
Reduced Moderated Boiling Water Reactor
Spent Fuel Disposal using Small D-T Fusion Driver
Subcritical Minor Actinide Transmutation
Supercritical CO_2 Fast Reactor
Thorium Based Sodium-Cooled Fast Reactor
Thorium Fuel Cycle: Proliferation Benefits
Ultra-Fast Spectrum Transmutation Reactor

Distinction between ARC-1 and MS-RC1

- ARC-1
  - Related to current on-going Advanced Reactor Concept (ARC) programmatic work
  - Can be full system or subsystems and components

- MS-RC1
  - Blue sky – radical, not related to on-going ARC work
  - Needs to be a full system/concept