NEUP Nuclear Energy University Programs
U.S. Department of Energy

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FY2011
NEUP Workshop

Nuclear Energy Enabling Technologies (NEET)

Rockville, Maryland

Mission

- Develop crosscutting technologies that directly support and complement the Office of Nuclear Energy's development of new and advanced reactor concepts and fuel cycle technologies

- Encourage the development of transformative, "out-of-the-box" solutions across the full range of nuclear energy technology issues

- Focus on innovative research relevant to multiple reactor and fuel cycle concepts that offer the promise of dramatically improved performance.

Goal: address critical technology gaps relevant to multiple reactor and fuel concepts.

Program Elements

NEET consists of three program elements

- Energy Innovation HUB for Modeling & Simulation ($24.3M requested)
- Transformative Nuclear Energy Concepts ($28.9M requested)
- Crosscutting Technologies ($43.3M requested)
  - Reactor Materials
  - Proliferation Risk Assessment
  - Advanced Sensors and Instrumentation
  - Advanced Methods for Manufacturing
  - Modeling and Simulation

NEUP proposals are being sought in Crosscutting Technologies

Reactor Materials

- R&D will focus on new classes of alloys and materials not yet considered for reactor performance but may enable transformative performance.
- Looking to improve parameters by a factor of five to ten through custom design using materials science techniques, industrial knowledge and previous experience
- Concepts that may be evaluated include optimized alloy composition, engineered microstructures, age-tempered microstructures, or combinations thereof
- More radical concepts that may be explored include bi-metallic layers, metal/ceramic composites, ion-beam or surface modified alloys.

Proliferation Risk Assessment

- Developing new tools and approaches for understanding, limiting, and managing the risks of proliferation and physical security for fuel cycle options.
- Will focus on assessments required to inform domestic fuel cycle technology and system option development.
- Assessments will:
  - Exploit science-based approaches for analyzing difficult-to-quantify proliferation risk factors or indicators (e.g., capabilities, motivations, and intentions)
  - Evaluate the diverse decision factors (including economics, public health and safety, public perceptions, environmental benefits and proliferation and terrorism risk reduction) for different fuel cycle options to understand the tradeoffs and potential synergies between these decision criteria.
  - Apply these tools to study nuclear energy system options and display the results in a useful format for decision makers.

Advanced Sensors and Instrumentation

- R&D on unique sensor and instrumentation infrastructure technology to monitor and control new advanced reactors and small modular reactor systems.
- Advancement in sensor, infrastructure, and control technology is needed due to the unique operating conditions and fluids, upset and accident conditions, and degradation and aging phenomena (e.g., multiple units, very high temperatures, and liquid metal) inherent to advanced reactors.
- Expected that some development work will provide useful information for measurement, sensing, and materials accountability in waste management and fuel cycle arenas as well.

Advanced Methods for Manufacturing

- R&D on advanced manufacturing technologies
- Expected to draw upon successful practices in oil, aircraft, and shipbuilding industries
- Will employ modeling and simulation to validate and optimize new technologies
- Technologies to be evaluated may include:
  - Hybrid gas metal arc and laser welding
  - Automated Non-Destructive Examination Techniques
  - Prefabricated modular rebar assemblies

Modeling and Simulation

- R&D to create and deploy ***science-based verified*** and ***validated*** modeling and simulation capabilities essential for the design, implementation, and operation of **FUTURE** advanced nuclear energy systems:
  - **Predict** the performance and safety of future advanced reactors
  - **Predict** the performance of nuclear fuel pins and assemblies, applicable to both existing and future advanced nuclear reactor fuel design and fabrication
  - **Predict** the coupled performance of safeguards and separation systems
  - **Predict** the performance of different types of waste forms under different repository conditions for their expected lifetimes (potentially up to a million years)