



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2013 Annual Planning Webinar

**Advanced Technologies, Development and Demonstration
(RC-2)**

Brian K. Robinson

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Advanced Reactor Technologies Program Overview, Mission & Structure

■ The newly formed Office of Advanced Reactor Technologies includes the following programs:

- Next Generation Nuclear Plant (NGNP)
- Advanced SMR R&D
- Advanced Reactor Concepts

■ Program Mission:

- To research and develop advanced technologies to significantly improve the efficiency, safety, and performance of advanced reactor systems.

■ Program Structure (RC-2):

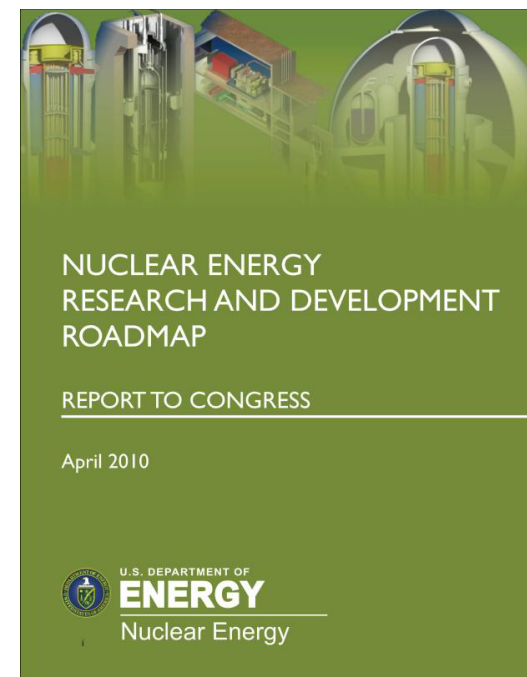
Program Director – Tom O’Connor (DOE-HQ)

Federal POC – Brian K. Robinson (DOE-HQ)

Technical POC – Dr. Robert Hill (ANL)

■ R&D efforts support Nuclear Energy R&D Roadmap Objectives 2 & 3

- (2) Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals
- (3) Develop sustainable nuclear fuel cycles
 - “The overall goal is to have demonstrated the technologies necessary to allow commercial deployment of solution(s) for the sustainable management of used nuclear fuel that is safe, economic, and secure and widely acceptable to American society by 2050.”



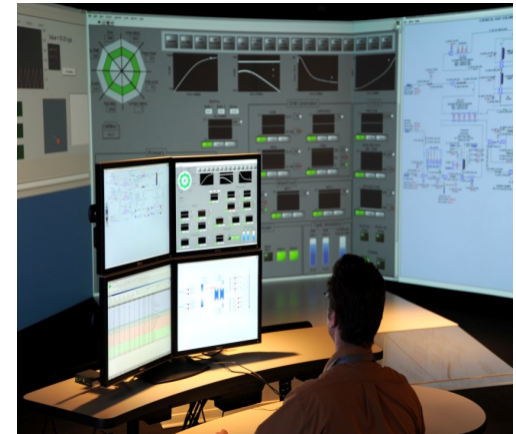
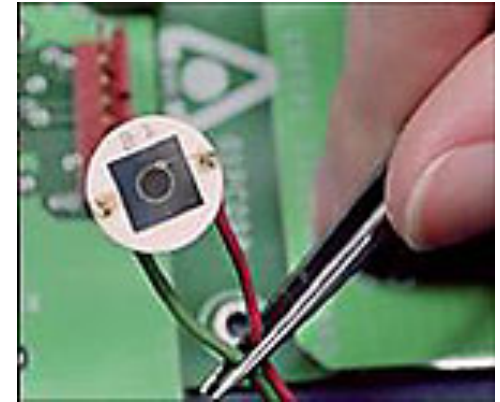
Advanced Reactor Technologies Research Questions

R&D programs are working to address several high level questions related to advanced reactor development and eventual deployment including:

- How can we improve the affordability of nuclear power?
- How can we improve the inherent safety of advanced nuclear reactors?
- How can we improve on the proliferation resistance of advanced reactors?
- How can we address the issue of nuclear waste through advanced fuel cycle options?
- How can we expand nuclear technologies into non-traditional nuclear energy markets?
- How can we increase the performance and efficiency of advanced nuclear plants through new materials, advanced systems or components?

Advanced Reactor Technologies Program Research Needs

- **Instrumentation and Controls, Human Machine Interface (ICHMI)**
 - Advanced high temperature instrumentation for liquid metal reactors
 - In-service inspection technology/techniques
- **Component and Technology Development**
 - Advanced reactor technologies with emphasis on operations, compact configurations, and energy conversion systems
 - Advanced Materials (covered in RC-3)
- **Safety and Licensing**
 - Advanced Modeling and Simulation
 - Seismic Isolation Technology
 - Seismic modeling





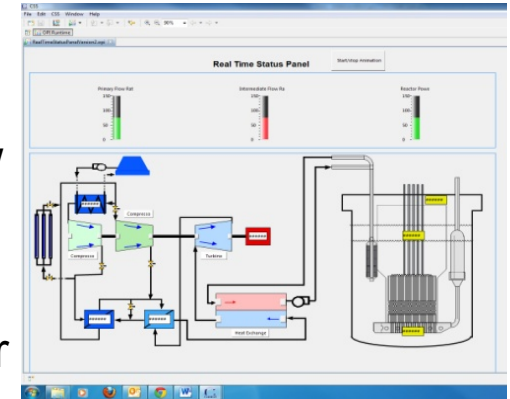
Workscope Description: Instrumentation Control Human Machine Interface (ICHMI) Pathway

■ Design and operational aspects

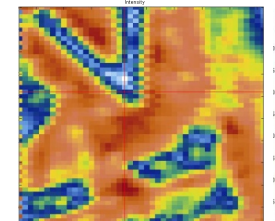
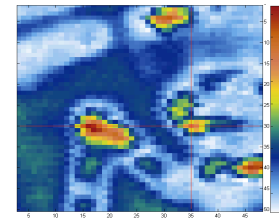
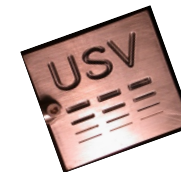
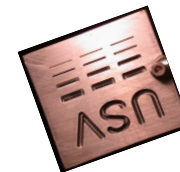
- New sensors and measurement systems for integral/pool designs for high temperature and corrosive environments (including in-service inspection)
- Advanced control rooms and control architectures for multi-module operation
- The integration of passive and active systems in achieving both safety and normal operation goals
- Development of a model for defining the principles of human/machine functions associated with concepts of operation

■ Address needs for expanded functionality

- Advanced controls for co-generation and grid-stabilizing operation



Real-time Reactor Plant Simulations



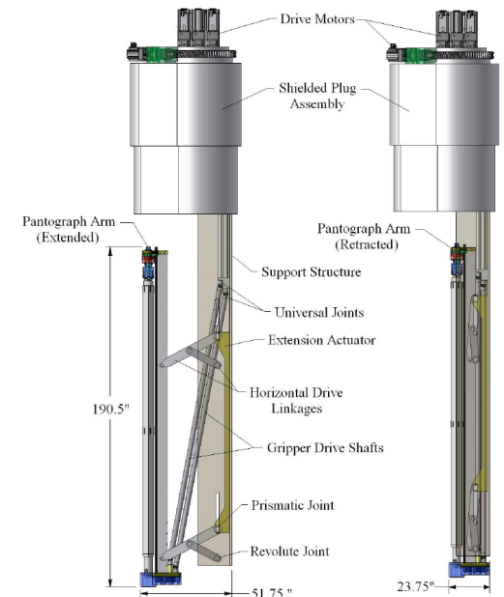


Workscope Description: Component and Technology Development

■ For advanced reactors to achieve their potential, various components and technologies need to be developed including:

- Improved design approaches (e.g., compact configuration) to reduce cost and improve performance
- Compact heat exchanger or innovative steam generator designs
- Advanced simulation for optimized design
- Corrosion and oxygen control systems for a lead-bismuth cooled fast reactor

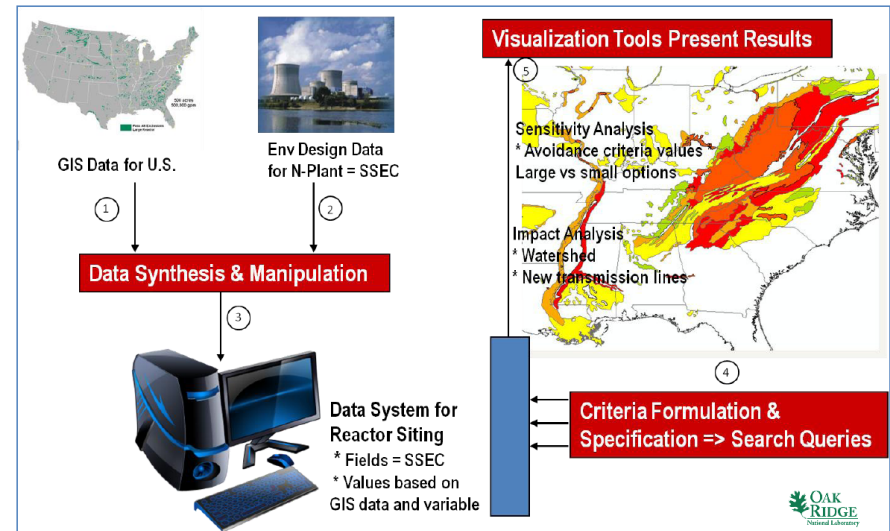
Reactor concept submittals should be submitted to MS-RC1.





Workscope Description: Safety and Licensing

- **Development of PRA methodologies and tools to predict the safety, security, safeguards, and performance reactor systems.**
 - Address issues identified in NRC SECY11-0156
- **Evaluate potential reactor sites by applying geographical information system (GIS) and spatial modeling techniques**
 - To develop specific site screening evaluation criteria
- **Perform a regulatory gap analysis and development of licensing support plan**
 - Address issues identified in NRC SECY10-0034
 - Collaborate with the Nuclear Energy Institute (NEI), American Nuclear Society (ANS)
 - Coordinate with other organizations on advanced reactor related codes and standards (NESCC)



University Interest in Advanced Reactor Technologies R&D

- A variety of reactor technologies have been proposed for advanced small modular reactors
 - Targeted improvements in safety, and affordability
 - Potential to expand nuclear energy into new markets and application
- Innovative R&D proposals are solicited in the areas of:
 - Instrumentation, Control, Human, Machine Interface
 - Component and Technology Development
 - Safety and Licensing
- The outputs from these projects will fold back into our R&D programs to support the advancement of advanced reactors.

Recent NEUP Awards

Examples of awarded NEUP Advanced Reactor Technology R&D:

FY12

- Nonlinear Ultrasonic Techniques to Monitor Radiation damage in RPV and Internal Components
- Advanced Supercritical Carbon Dioxide Brayton Cycle Development
- Thermoelectric-Driven Sustainable Sensing and Actuation Systems for Fault-Tolerant Nuclear Incidents
- Integral Reactor Containment Condensation Model and Experimental Validation
- Investigation of Natural Circulation Instability and Transients in Passively Safe Small Modular Reactors

FY11

- In-situ Monitoring of Components in Small Modular Reactors Using Process and Electrical Signature Analysis
- Critical Heat Flux Phenomena at High Pressure and Low Mass Fluxes, Tests and Models
- Technical Development for S-CO₂ Advanced Energy Conversion
- A complete list of the FY12 winning proposals can be found at:

https://inlportal.inl.gov/portal/server.pt/community/neup_home/600/FY-12_R&D_awards

Questions?