



July 27-28, 2010

# **FY2011 NEUP Workshop SMR-Related Breakout Sessions**

Rockville, Maryland



# SMR Program Overview

- **Objective:** Facilitate the development and deployment of innovative SMR designs that can meet the growing need for affordable, safe, secure, carbon-free energy, especially for non-traditional markets.
- New start for FY2011 (pending appropriations)
- Considerable overlap with Advanced Reactor Concepts
- Modest overlap with Light Water Reactor Sustainability and Nuclear Energy Enabling Technologies

# SMR Program: Major Program Elements

- Design certification partnerships
  - Establish cost-shared projects with industry partners to accelerate design certification
- SMR technology R&D
  - Develop technologies that further reduce costs or enable advanced features and functionality of SMRs
- Advanced SMR concepts
  - Develop innovative concepts that utilize advanced technologies to achieve expanded functionality for SMRs
- SMR assessment tools
  - Develop new analysis tools, codes and standards, and cost models needed to assess SMR safety, security, performance, and economics.

# Translating SMR goals to technology needs

## Functional Goals

- Affordable and economically competitive
- Enhanced safety/robustness
- High availability
- Load-following
- Effective to safeguard
- Enhanced security
- Reduced proliferation risk
- Adaptable to broad range of sites and customers
- Effective resource utilization and waste management

## Technology

- Fuels
- Materials
- Instrumentation
- Controls
- Safeguards
- Security
- Modeling and Simulation
- Fabrication and Manufacturing

- *Emphasis on transformational technologies that enable next-generation SMRs*
- *Also support cross-cutting issues for near-commercial designs*

# SMR Workshop (June 29-30, 2010)

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- SMR Safety and Assessment Tools
- Instrumentation, Controls, and Human-Machine Interfaces
- Materials, Fuels, and Fabrication Technologies
- High-Performance Modeling and Simulation
- SMR Regulatory Issues

[www.nuclear.energy.gov/smrworkshop/agenda.html](http://www.nuclear.energy.gov/smrworkshop/agenda.html)

# SMR Safety and Assessment Tools

- Methods to analyze functional reliability of passive safety systems
- Validated plant analysis methods for SMR design characteristics (e.g. reactor/containment vessel coupling)
- Experimental data for validation of SMR-specific physics (e.g. internal SG flow phenomena)
- Methods for inspectability of transported NSSS
- PRA methodologies adapted to operational aspects of SMRs (e.g. operations or security staffing)
- Validation approaches for long-lived (30-year) cores

# Instrumentation, Controls, and Human-Machine Interfaces (1)

- Measurement technologies
  - In-vessel coolant level sensor
  - In-vessel flowmeter
  - High-temperature fission chamber and thermometry
- Diagnostics and prognostics
  - In-vessel electric signature analysis for condition monitoring
  - Stochastic process monitoring for surveillance of reactor internals
- Control and plant operations
  - Concepts of operation for multimodule plants
  - Multimodule supervisory control models

# Instrumentation, Controls, and Human-Machine Interfaces (2)

- I&C architecture and infrastructure
  - Dynamic plant models for multimodule and cogeneration plants
  - Reliable, expandable wireless network architectures
  - Innovative transmission technologies for in-vessel sensors

# Materials, Fuels, and Fabrication Technologies (1)

- Fuels
  - Evaluate and identify departures from existing LWR fuel operating conditions
  - Develop and qualify advanced fuels for thermal, fast, and high-temperature reactor concepts
- Materials
  - Evaluate material issues impacting in-service inspection
  - IGSCC models and data for thin-walled SG tubes in compression
  - Core materials for longer fuel cycle durations

# Materials, Fuels, and Fabrication Technologies (2)

- Fabrication technologies
  - Qualified processes for in-factory joining of advanced nuclear materials
  - Qualified cable splicing technologies for NSSS
  - Integrated design and manufacturing processes for SMR NSSS components

# Advanced Modeling and Simulation (1)

- High-fidelity physics data and models
  - Neutronics for high-leakage cores and non-conventional control strategies
  - Thermal-hydraulics for natural circulation during normal operations and transients
  - Fuel/material damage for extended fuel cycles and power cycling
  - Structural dynamics for high-burnup and extended fuel cycles

# Advanced Modeling and Simulation (2)

- Advanced and integrated simulation codes
  - Reactor and fuel design codes
  - Plant safety and dynamic behavior
  - Source term and hazard assessment for postulated accidents
  - Operation support and diagnostic systems
  - Reactor fabrication and assembly

# SMR Regulatory Issues

- Technical basis for modifications to the Emergency Planning Zone
- Fission product release data and transport models
- Automation technologies to reduce staffing requirements
- Probabilistic methods for functional differences and passive safety features of SMRs
- Advanced design tools and approaches for security integration
- Technical basis for underground siting
- Separate effects testing for iPWR systems