



Office of Nuclear Energy FY 2010 University Program Workshop

Dan Ingersoll

Generation IV

Small and Medium Reactors

Oak Ridge National Laboratory

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Interest in Smaller Sized Reactor Designs Are Beginning To (Re)Emerge

◆ **Benefits**

- Enhanced safety (robustness)
- Improved fabrication and construction logistics
- Greater operational flexibilities
- Favorable economics

◆ **Applications**

- Countries with small or limited electrical grid infrastructure
- Smaller private utilities in large-grid countries
- Special power applications such as defense
- Non-electrical (process heat) customers



Sampling of SMR Concepts Under Development World-Wide

- ◆ **Integral PWR:** CAREM (Ar), IMR (Jp), **IRIS (US)**, **NuScale (US)**, **mPower (US)**, SCOR (Fr), SMART (RoK)
- ◆ **Marine derivative PWR:** ABV (RF), KLT-40S (RF), NP-300 (Fr), VBER-300 (RF)
- ◆ **BWR/PHWR:** AHWR (In), CCR (Jp), MARS (It)
- ◆ **Gas-cooled:** GT-HTR-300 (Jp), **GT-MHR (US)**, HTR-PM (Ch), PBMR (SA)
- ◆ **Sodium-cooled:** 4S (Jp), BN-GT-300 (RF), KALIMER (RoK), **PRISM (US)**, RAPID (Jp)
- ◆ **Lead/Pb-Bi-cooled:** BREST (RF), **ENHS (US)**, LSPR (Jp), **STAR/SSTAR (US)**, SVBR-75/100 (RF)
- ◆ **Non-conventional:** **AHTR (US)**, CHTR (In), **Hyperion (US)**, MARS (RF), MSR-FUJI (Jp), **TWR (US)**



SMR Challenges – Technical

- ◆ **All designs have some degree of innovation in components, systems, and engineering, such as:**
 - Integral primary system configuration
 - Internal control rod drive mechanisms and pumps
 - Multiplexed control systems/interface
- ◆ **Longer-term systems strive for increased utility/security**
 - Long-lived fuels and materials for extended operation
 - Load-following and co-generation
- ◆ **Sensors, instrumentation and controls development are likely needed for all designs, for example:**
 - Power and flow monitoring in integral systems
 - Advance prognostics and diagnostics
 - Control systems for co-generation plants



SMR Challenges – Institutional

- ◆ **Mindset for large, centralized plants**
 - Fixation on economy-of-scale
 - Economy-of-hassle drivers
 - Perceived risk factors for nuclear plants
- ◆ **Traditional focus of regulators on large, LWR plants**
 - Standard 10-mile radius EPZ (in the U.S.)
 - Staffing and security force size
 - Plant vs module licensing
- ◆ **Fear of first-of-a-kind**
 - New business model as well as new design must be compelling



SMR Program: Overall Work Scope

- ◆ **New start for FY2010**
- ◆ **Objective: Facilitate the development and deployment of innovative SMR designs in order to meet the growing need for affordable, safe, secure, carbon-free energy, especially for non-traditional markets.**
- ◆ **Initial focus is on technology R&D that supports near-term and/or longer-term designs**
- ◆ **Will expand to include licensing and deployment needs**



New SMR Program Will Support Development and Deployment of Innovative Small and Medium-Sized Reactors

Need to address technical and institutional challenges

1. Technology R&D

- Cross-cutting technologies supporting new designs and applications
- Long-lived fuels and materials, instrumentations and controls, advanced manufacturing,

2. Innovative concepts and deployment issues

- Ultra-long-lived cores, load-following, co-generation
- Cost reduction and cost evaluation models
- Unique regulatory issues



NEEDS FOR FY10-11

- ◆ ***Technology R&D that supports near-term and/or longer-term designs***
 - *I&C that enables more in-vessel measurements of plant status and health monitoring*
 - *In-service inspection and maintenance techniques*
 - *Unique components such as compact heat exchangers*
 - *Long-lived fuels and materials*
- ◆ ***Modeling in support of SMR deployment***
 - *Models and assessments of SMR economic competitiveness*
 - *New approaches to support unique regulatory issues (such as EPZ, passive safety features, shared/multiplexed equipment, staffing requirements)*