

Bringing Small Modular Reactors (SMRs) to Commercial Markets

DOE SMR Workshop

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U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Overview

- **Small (≤ 300 MWe) Modular Reactors (SMRs) offer an alternative to larger LWR designs.**
 - LWR and Fast and Gas Reactor designs are under development.
 - Modules can be combined and sequenced in a single licensed plant.
- **Benefits.**
 - Reduced financial risk.
 - » Smaller total investments may reduce financial risk.
 - Flexibility.
 - » Provide energy to meet localized demand or remote locations.
 - Portability.
 - » Built offsite and transported to location via barge, rail, or train.
 - Modular construction.
 - » Replicate in factory setting may lead to economies.

Conditions Affecting Nuclear Deployment

- **Vitality of domestic and global economies.**
- **Unpredictability of U.S. and international financial markets.**
 - Risk aversion and availability of funds.
- **Unhealthy balance sheets of electric utilities.**
 - Economic contraction and rate recovery affect balance sheets.
- **Legislation.**
 - Price on carbon emissions could favor nuclear option and SMRs.
- **Limited resources within Nuclear Regulatory Commission.**
 - Staff expertise and prioritization may hinder non-LWR designs.

Potential SMR Markets

- **Large base-load new generation not required.**
- **Near-term demand projections require SMR flexibility.**
- **New capacity needed to replace aging or costly generation.**
- **Mission and business critical energy needs.**
- **Disaster and emergency response.**
- **Electrical and process heat applications for industry.**
- **Remote location or distance from main electricity grid.**

Integrated LWR SMR Vendors

- **Babcock & Wilcox**

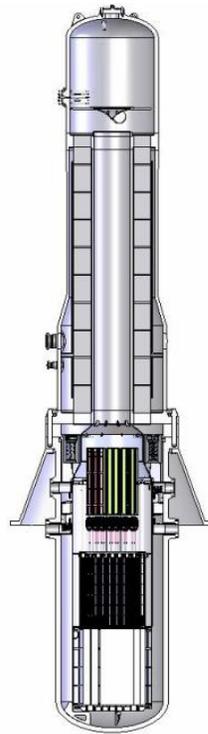
- mPower
- 125 MWe
- DCD: Mid 2012

- **NuScale Power, Inc.**

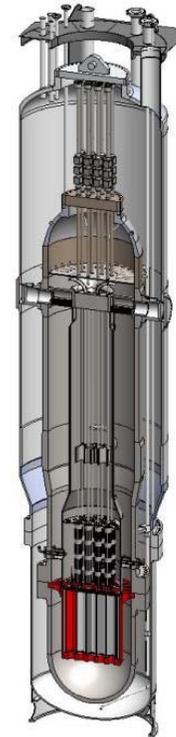
- NuScale
- 45 MWe
- DCD: Early 2012

- **Westinghouse International**

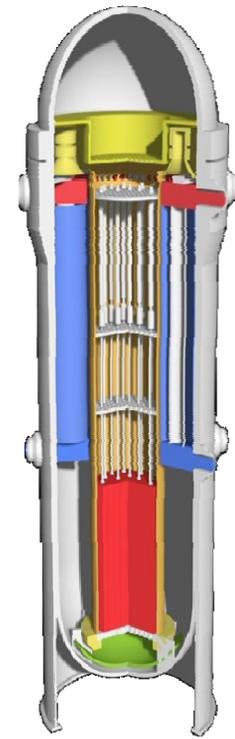
- International Reactor Innovative and Secure (IRIS)
- ≈300 MWe
- DCD: 2014



mPower



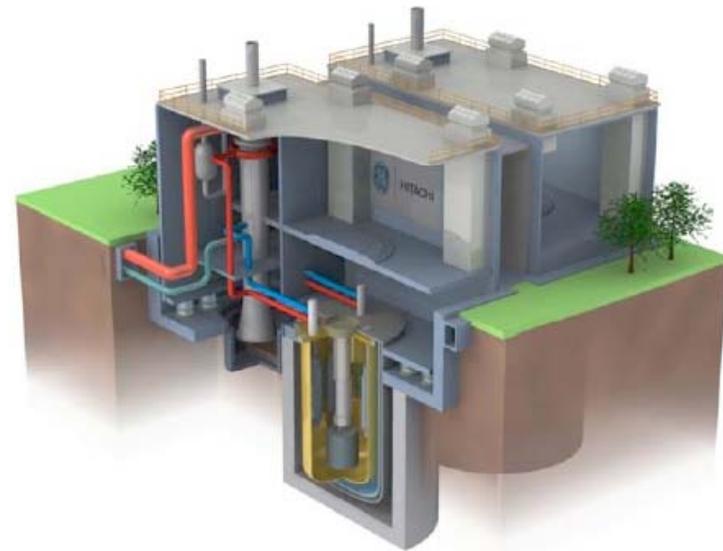
NuScale



IRIS

Advanced SMR Vendor Designs

- **Brookhaven Technology Group**
 - Global Energy Module (GEM50)
 - 10 MWe
- **General Electric**
 - Power Reactor Inherently Safe Module (PRISM)
 - 311 MWe
- **Hyperion Power Generation**
 - Hyperion Reactor
 - 30 MWe
- **TerraPower**
 - Traveling Wave Reactor (TWR)
 - 500-1200 MWe
- **Westinghouse - Toshiba**
 - Toshiba 4S (Super Safe, Small and Simple)
 - 10 MWe



HTGR SMR Vendor Designs

- **Areva**
 - Advanced Reactors for Energy Supply (ANTARES)
 - 275 MWe
- **General Atomics (NGNP)**
 - Modular High-Temperature Reactors (MHR)
 - 280 MWe
- **PBMR/Westinghouse**
 - Pebble Bed Modular Reactor (PBMR)
 - 250 MWe



SMR Economic Benefits

- **Reduced financial risk.**
 - Total smaller upfront investment may reduce financial risk.
- **Flexibility.**
 - Modularity allows additional units to be added to meet increased demand.
- **Performing asset.**
 - Operating units can provide financing for future additional units.
- **Domestic forgings and manufacturing.**
 - Revitalize nuclear industry in the U.S.
- **Job creation.**
 - Jobs created by domestic manufacturing, construction, and operation.

Safety Benefits

- **Smaller source term inventory.**
 - Postulated accidents result in less public dose.
- **Below grade reactor siting.**
 - Reduced design basis threat.
- **Reduced Emergency Planning Zone.**
 - Colocation with industrial applications may be viable.
- **Simplified design eliminates/mitigates several postulated accidents.**
 - Loss of Coolant and Core Damage Accidents.
- **Improved decay heat removal.**
 - Lower decay heat generated.
 - Passive decay heat removal in many designs.

Operational Benefits

- **Continuous 24/7 operational capability for mission critical applications.**
 - Petrochemical applications.
 - Department of Defense domestic bases.
- **Safety considerations may permit siting closer to load or energy need.**
 - SMR and industry colocation.
- **Simple maintenance and refueling.**
 - Simplified design enables less maintenance to system and components.
 - Fuel enhancements support longer fuel life and simplified refueling.
- **Lower water usage.**
 - Some designs are non-water cooled.
 - Others have lower water usage.

SMR Summary

- **There is a domestic market and need for SMRs in the U.S.**
- **Nuclear industry is responding with innovative designs to meet demand.**
- **DOE is working with industry, DoD and NRC to address issues and obstacles.**
- **New market will stimulate and revamp US manufacturing industry.**
- **Congress and other federal agencies are recognizing benefits of SMRs as part of the clean energy portfolio.**
- **DOE responding by establishing an SMR program in NE.**

Why SMR Workshop?

- **Inform stakeholders and public about SMRs and potential DOE program and activities**
- **Obtain input from technical/regulatory experts individuals in industry, National Labs, academia and federal agencies**
 - June 30th session is working meeting to discuss important design and licensing issues
 - 38 Organizations represented (e.g., 12 federal agencies, 37 National Labs, 9 Universities, 40 industry, 5 Congressional)
- **DOE expectations to inform SMR program:**
 - Information on high priority R&D items
 - Information on high priority design issues
 - Information on regulatory or licensing issues