

SMALL MODULAR REACTORS SMALLER AND SMARTER?

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by

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Outline of Presentation

- **What are SMRs?**
- **Why are they being promoted?**
- **General regulatory concerns**
- **Design features of Integral Pressurized Water Reactors (iPWRs)**
- **Smarter?**

Small Modular Reactors

- **Less than 300 MWe**
 - 25-300 MWe designs proposed

- **Integrated Pressurized Water Reactors (iPWRs)**
 - NuScale and mPOWER (B&W)

- **Fast-Spectrum Liquid-Metal Cooled Reactors**
 - 4S (Toshiba), PRISM (GEH), and Hyperion

- **Gas- Cooled Reactors**
 - Next Generation Nuclear Plant (NGNP, GA/DOE)

Advantages of SMRs

- **Small size = small capital cost**
 - U.S. utilities have trouble financing large projects
 - Build up capacity one small unit at a time
 - Need to also be competitive on cost/kW
- **Small size attractive in certain markets**
 - Remote locations
 - Small grids (e.g., developing countries)

Regulatory Policy/Technical Issues

- **Source term**
 - Potential for radioactive release determines public risk
 - A function of design

- **Emergency planning**

- **Control room staffing**
 - How to operate multiple units in one control room

- **Operational programs**
 - Changes to inservice inspection/testing

Industry-Identified Issues

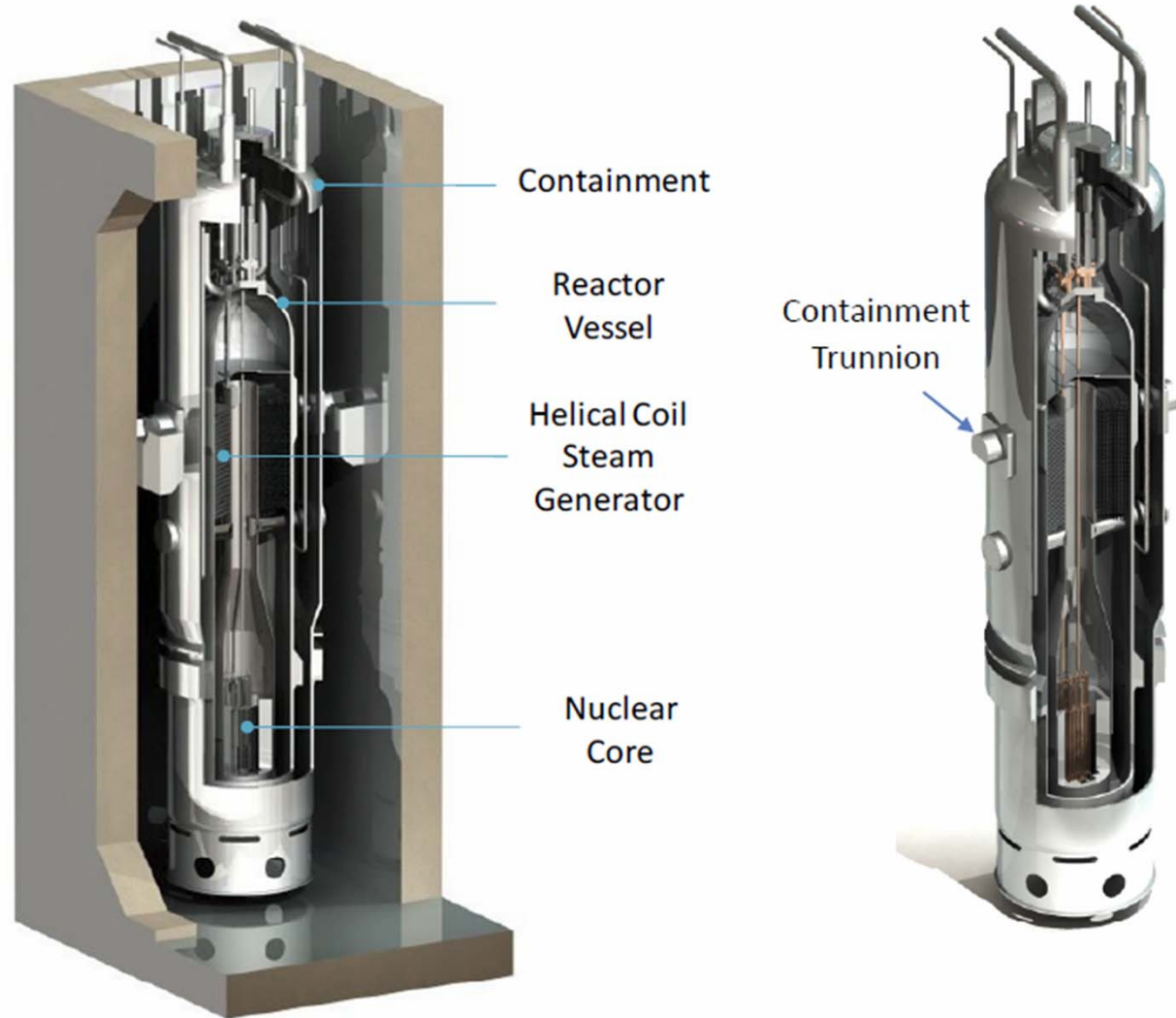
- Offsite emergency preparedness
- Physical security and staffing
- Annual fees
- Price-Anderson (liability)
- Decommissioning funding
- Format and scope of application
- Licensing and modularity

General Features of NuScale

- 45 MWe per module
- Natural circulation cooling (no pumps, pipes, valves)
 - Eliminates some accident scenarios
 - Improves economics
- Two steam generators and pressurizer inside reactor pressure vessel
 - No primary piping breaks can cause loss-of-coolant accident
- Secondary cooling circuit utilizes simple off-the-shelf turbine-generator

Reactor Vessel and Containment

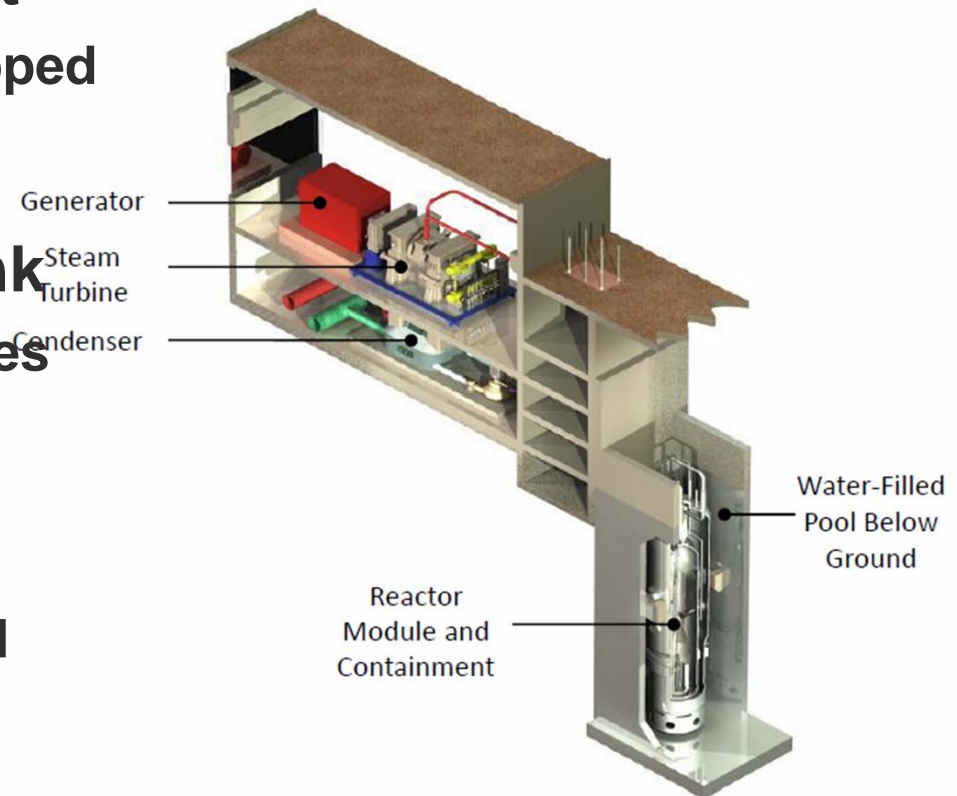
- Containment is in reactor pool
- Modules separated by a wall in the reactor pool (which also provides the containment support)
- Containment is maintained in a partial vacuum



Reference: NuScale Power Overview of NuScale Design Slides, April 2, 2009

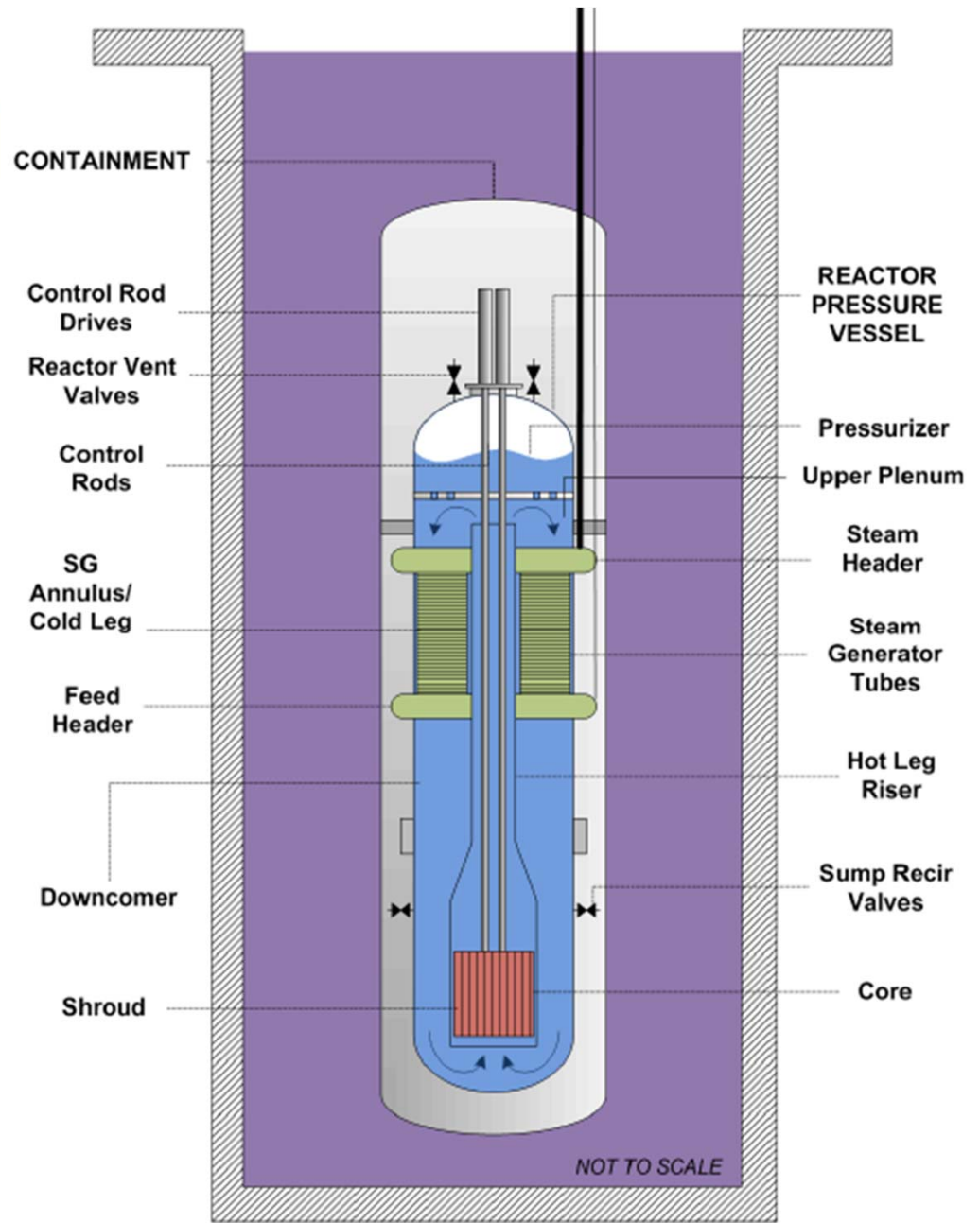
Other Features

- **Nuclear steam supply system is factory built**
 - Prefabricated and shipped by rail, truck, or barge
- **Large natural heat sink**
 - Simplifies and enhances safety case
- **Below grade reactor**
 - Enhances security and safety
- **Up to 12 modules at one site**

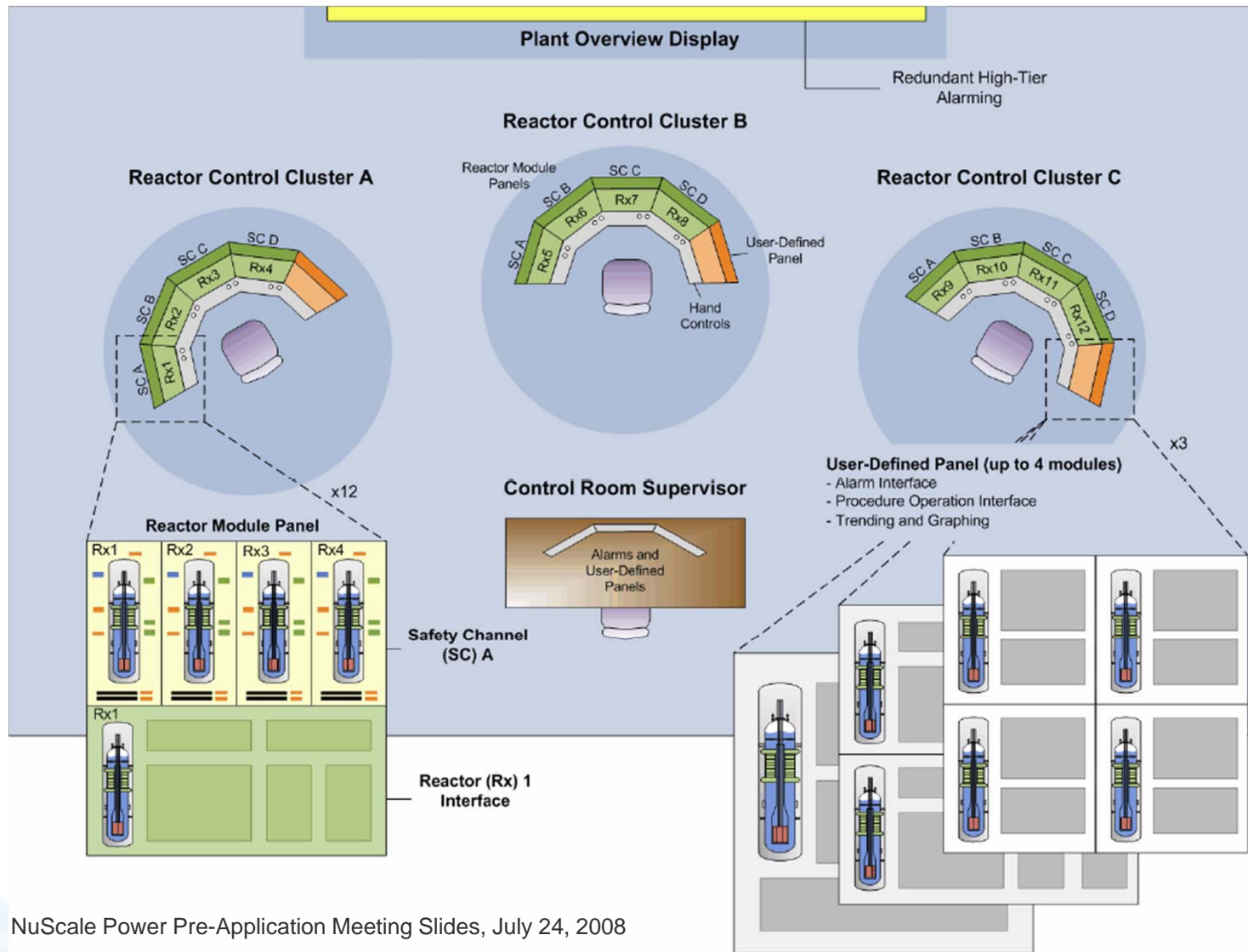


Normal Cooling

- Helical coil OTSG
- Two tube banks
 - 536 tubes / bank
 - ~1.6 cm OD
 - Avg length 30 m
- FW inlet header and steam outlet header



Multi-Module Control Room Layout



Reference: NuScale Power Pre-Application Meeting Slides, July 24, 2008

Smarter?

- Promising technologies
- Lots of competition
- Regulatory hurdles
- Technical hurdles