NuScale Power
Small Modular Reactors

Mike McGough
Chief Commercial Officer

The Energy Summit 2016
US Space and Rocket Center
Huntsville, Alabama
November 15th, 2016
What is a NuScale Power Module?

- A NuScale Power Module (NPM) includes the reactor vessel, steam generators, pressurizer and containment in an integral package that eliminates reactor coolant pumps and large bore piping (no LB-LOCA).
- Each NPM is 50 MWe and factory built for easy transport and installation.
- Each NPM has its own skid-mounted steam turbine-generator and condenser.
- Each NPM is installed below-grade in a seismically robust, steel-lined, concrete pool.
- NPMs can be incrementally added to match load growth - up to 12 NPMs for 600 MWe gross (~570 net) total output.
Comparison size envelope of new nuclear plants currently under construction in the United States

126 NuScale Power Modules

NuScale’s combined containment vessel and reactor system

Typical Pressurized Water Reactor

*Source: NRC
**Convection** – energy from the nuclear reaction heats the primary reactor coolant causing it to rise by convection and natural buoyancy through the riser, much like a chimney effect.

**Conduction** – heat is transferred through the walls of the tubes in the steam generator, heating the water (secondary coolant) inside them to turn it to steam. Primary water cools.

**Gravity** – colder (denser) primary coolant “falls” to bottom of reactor pressure vessel, cycle continues.
Core Damage Frequency Significantly Reduced

Source: NRC White Paper, D. Dube; basis for discussion at 2/18/09 public meeting on implementation of risk matrices for new nuclear reactors
More Barriers Between Fuel & Environment

**Conventional Designs**
1. Fuel Pellet and Cladding
2. Reactor Vessel
3. Containment

**NuScale’s Additional Barriers**
4. Water in Reactor Pool
5. Stainless Steel Lined Concrete Reactor Pool
6. Biological Shield Covers Each Reactor
7. Reactor Building
Smaller Emergency Planning Zone (EPZ) due to safer design.

Traditional PWR:
- Containment
- Reactor Vessel
- Fuel Cladding

10 mi EPZ

NuScale Plant:
- Reactor Building
- Reactor Pool
- Containment
- Reactor Vessel
- Fuel Cladding

Site Boundary EPZ:
- Passive Safety
- Additional Fission Product Barriers
- Significant Delay in Release of Radiation

(depending on site characteristics)
Innovative Advancements to Reactor Safety
Nuclear fuel cooled indefinitely without AC or DC power*

• 30 days is a minimum based on very conservative estimates.

*Alternate 1E power system design eliminates the need for 1E qualified batteries to perform ESFAS protective functions – Patent Pending
NuScale Reactor Qualification Test Plan outlines Design Certification and First Of A Kind Engineering (FOAKE) projects for reactor safety code development, validation, reactor design and technology maturation to reduce First Of A Kind (FOAK) design risk.
Full Length SG Test (TF-2) Construction/Hardware
NuScale RPV Head Ingot Being Forged

- 150 inches diameter
- 30 inches high
- 142,000 pounds

Images Provided courtesy of Sheffield Forgemasters International Ltd
Control Rooms

President Jimmy Carter briefed by James R. Floyd, supervisor of TMI-2 operations, with Harold R. Denton, director of the Office of Nuclear Reactor Regulation in the Nuclear Regulatory Commission. This control room design was complete in the late 1960s, before construction began in 1970.

In this April 29, 2015 photo, Chris Dujado, left, and Billy Horton, right, control room operators for Unit 2, review information from monitoring panels at the Watts Bar Nuclear Plant near Spring City, Tenn. The control room design is strikingly similar to those of the 1960s, despite innovations behind the panels. (AP Photo/Mark Zaleski)
The NuScale Power simulator control room design brings together decades of Digital I&C, Human Factors Engineering and Human Systems Interface research and field experience.

At a recent NuScale Family day, 10-year-old Sam Shore felt completely at home in the NuScale Control Room Simulator.
NuScale Control Room Simulator
First Deployment: UAMPS CFPP

- Utah Associated Municipal Power Systems (UAMPS) Carbon Free Power Project (CFPP) will be first deployment, in Idaho.
- Site selection finalization
- DOE INL site use agreement
- NRC COLA commitment
- UAMPS consists of 44 members serving load in 7 western states.
- 33 UAMPS members are subscribers in CFPP
- Energy NorthWest as Operator
Overall UAMPS CFPP Project Schedule

**Project Development (see detail)**

- **2014**: Define Team Members and structure
- **2015**: Develop Business Model
- **2016**: Onboard Partners
- **2017**: Site Use Agreements
- **2018**: Site Selection
- **2019**: Reference Plant Design
- **2020**: Start Finalized Plant Design
- **2021**: Complete Final Plant Design
- **2022**: Draft DSRS
- **2023**: Submit DCA
- **2024**: NRC Issue DC
- **2025**: Final DSRS

**Design & Engineering**

- **2014**: Site Characterization
- **2015**: Start COLA
- **2016**: Submit COLA
- **2017**: NRC Issue COL
- **2018**: Site Prep & Mobilization
- **2019**: 1st Safety Concrete Pour
- **2020**: Install Module 1
- **2021**: Install Module 12
- **2022**: Order Modules
- **2023**: Start Module Fabrication
- **2024**: Complete Operational Readiness Program
- **2025**: Module 1 COD

**Construction and Fabrication**

- **2014**: Start Operational Readiness Program
- **2015**: Operator Training Program Accreditation
- **2016**: Complete Operational Readiness Program
- **2017**: Module 1 COD
- **2018**: Module 12 COD
- **2019**: 1st Fuel Load

**Operations**

- **2014**: Site Selection
- **2015**: Start COLA
- **2016**: Submit COLA
- **2017**: NRC Issue COL
Site Overview

- annex building
- cooling towers A
- turbine building A
- reactor building control building
- switchyard
- turbine building B
- protected area fence
- warehouse
- parking
- radwaste building
- ISFSI (dry cask storage)
- cooling towers B

34.5 acres (~14 hectares) within the protected area fence
Satellite View of Site

Big Lost River Rest Stop

Closest points of public approach to plant

Proposed location of NuScale Site (approximate)

Note: the actual location has not yet been determined within the boundary

Big Southern Butte
View of Site From Lost River Rest Stop

NuScale Site
(partially occluded, ~ 6 miles from viewer)

Big Southern Butte
(~ 10 miles from viewer)

Southeast  Viewing direction  South
NuEx Tours – NIST, Control Room Simulator and UMM
Mike McGough
Chief Commercial Officer
MMcGough@nuscalepower.com

www.nuscalepower.com

The Element of Nu