NuScale Power History

- NuScale first of current US SMRs to begin design of commercial NPP.
- NuScale technology in development and design since 2000 (DOE) MASLWR program, with INL, lessons from AP600/1000 ¼-scale testing facility built and operational
- Electrically-heated 1/3-scale Integral test facility first operational in 2003
- Began NRC design certification (DC) pre-application project in April 2008
- Acquired by Fluor in October 2011
- ~300 FTE’s currently on project, ~$200MM spent project life-to-date
- 67 positions currently open, adding 100+
- 115 patents pending/granted, 17 countries
NuScale and DOE Complete Agreement

- Competition Winner announced December 12th, 2013
- Contract Completed MAY 28, 2014

- Initiates Up To $217M Funding Of NuScale SMR Development

- PORTLAND, Ore. - NuScale Power announced today that it has finalized the cooperative agreement with the US Department of Energy (DOE) as an awardee under the program for “Cost-Shared Development of Innovative Small Modular Reactor Designs.”

- The company will use the funds to perform the engineering and testing needed to proceed through the Nuclear Regulatory Commission Design Certification Process.
NuScale and DOE Complete FOA
“It is important that we continue to develop new technologies, including small modular nuclear reactors, as part of the long-term solution to carbon reduction.”

- Gina McCarthy, U.S. EPA Administrator addressing the Western Governor’s Association annual meeting in Colorado Springs, CO. on June 10, 2014.
“This technology, I think, is maturing at exactly the right time to be a factor in that low-carbon strategy,” the governor said. “We’re not going to get to that low-carbon future with the same kind of thinking we were using 20, 30, 40 years ago.”

- John Kitzhaber, Governor of Oregon, during a visit to NuScale Power on July 25, 2014.
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 45 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 540 MWe total output.
**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.
Size Comparison

Comparison size envelope of new nuclear plants currently under construction in the United States

126 NuScale Power Modules

Typical Pressurized Water Reactor

NuScale’s combined containment vessel and reactor system

*Source: NRC
The Safety Case
NuScale Announces Major Breakthrough in Safety

Wall Street Journal April 16, 2013

- NuScale design has achieved the “Triple Crown” for nuclear plant safety. The plant can safely shut-down and self-cool, indefinitely, with:
  - **No Operator Action**
  - **No AC or DC Power**
  - **No Additional Water**

- Safety valves align in their safest configuration on loss of all plant power.
- Details of the Alternate System Fail-safe concept were presented to the NRC in December 2012.
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

NuScale CDF: 1 event per 300 Million operating reactor years.
Added Barriers Between Fuel and 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 Due to Design Attributes

- Passive Safety
- Additional Fission Product Barriers
- Significant Delay in Release of Radiation
NuScale Safety Systems

- **Systems and Components Needed to Protect the Core:**
  - Reactor Pressure Vessel
  - Containment Vessel
  - Reactor Coolant System
  - Decay Heat Removal System
  - Emergency Core Cooling System
  - Control Rod Drive System
  - Containment Isolation System
  - Ultimate Heat Sink
  - Residual Heat Removal System
  - Safety Injection System
  - Refueling Water Storage Tank
  - Condensate Storage Tank
  - Auxiliary Feedwater System
  - Emergency Service Water System
  - Hydrogen Recombiner or Ignition System
  - Containment Spray System
  - Reactor Coolant Pumps
  - Safety Related Electrical Distribution Systems
  - Alternative Off-site Power
  - Emergency Diesel Generators
  - Safety Related 1E Battery System
  - Anticipated Transient without Scram (ATWS) System
Fewer Systems, 73% Fewer SCRAMS

- 58% of events cause by power conversion systems
- 86% of power conversion related scrams prevented by NuScale design
- 27% of events caused by electrical distribution system
- 82% of electrical related scrams prevented by NuScale design
**SMR Comparison**

**NuScale Power Module:**
- If power is lost:
  - Indefinite cooling w/o operator action
- Containment Vessel: factory-built
- Reactor Coolant Pumps: 0
  - coolant circulates by convection, conduction, and gravity

**180 MWe design:**
- If power is lost:
  - 14 day coping time
  - Containment Vessel: field-built
  - Reactor Coolant Pumps: 8
  - any RCP failure will result in immediate shutdown
How do we know it works?
Comprehensive Testing Program

Our testing supports reactor safety code development and validation, reactor design, and technology maturation to reduce FOAK risk.
NuScale Integral System Test (NIST) Facility

Containment Vessel and Pool

- 1/3 Scale Test Facility in operation since 2003
  - Models RPV, Containment and Pool
  - Prototypic Fluid Conditions
  - NQA-1 Program review and Site Visit by NRC 8/12

- Test Facility Scaling Methodology sent to NRC 12/10

- IAEA international standard problem test 5/11

- NRC Certification Testing Program in progress.
  - Data Being used for Safety Analysis Code Validation
Full-Scale Main Control Room Simulator for HFE/HMI Studies

NRC Review of HFE Program and Site Visit 1/13
What About Customers?

- NuAB—NuScale Advisory Board
- 24 member firms representing nearly two-thirds of US installed nuclear capacity
- Plus international membership
- We have a line of sight to our first dozen projects
- COD Timing between now and 2030
The Genesis of Project WIN

- **June 2010:** Idaho Governor Butch Otter became Chair of Western Governors Association (WGA) and sponsored Western nuclear energy policy
- **June 2011:** “The Future of Nuclear Energy: Shaping a Western Policy” published: discusses SMR’s explicitly
- **Feb 2012:** Otter creates Idaho Leadership in Nuclear Energy (LINE) Commission
- **June 2012:** Utah Governor Gary Herbert becomes WGA Chair and sponsors development of a 10-year energy plan-patterned after Utah 10-year plan
- **June 2013:** WGA 10-yr plan unveiled with stated goal to “Find ways to accelerate the introduction of SMRs into the marketplace.”
First Deployment: Project WIN

- Western Initiative for Nuclear (WIN) is a multi-western state collaboration to deploy a NuScale Power Project, sited in ID.
- Involved Project WIN participants: NuScale, UAMPS, Energy Northwest, ID, UT, OR, WA, WY, AZ, NM?, MT?
Project WIN Details

- First commercial project: Preferred location within the Idaho National Laboratory (INL) Site.

- Commercial operation in 2023.

- A 12-module plant (540 MWe)

- Will provide immediate advantages to the Western region:
  - Provide clean, affordable energy and professional jobs
  - Demonstrate the operations and benefits of this SMR technology
  - Act as a catalyst for subsequent SMR energy facilities throughout the Western states
NuScale Power Supplier’s Day

- **Thursday August 21st**: as part of the continuing efforts of the Western Initiative for Nuclear and in conjunction with the 2014 Intermountain Energy Summit being held August 19th & 20th in Idaho Falls

- Invitation to all potential Small Modular Reactor (SMR) industry suppliers to participate

- Location: Shilo Inn and Convention Center, Idaho Falls, ID

- **Schedule:**
  - August 20th – Open-bar cocktail reception: 7PM-9PM
  - August 21st – Presentations: 9AM-11AM; One-on-one meetings: 1PM-4PM
  - Over 100 appointments scheduled so far, suppliers from over 30 states

- Must register using our online registration. No walk-ins.

[www.nuscalepower.com/suppliersdayidaho.aspx](http://www.nuscalepower.com/suppliersdayidaho.aspx)
What Will Project WIN mean to Idaho?

- Establishes INL as key player in SMR deployment
- Creates slipstream for other NuScale projects, both within WIN family and elsewhere worldwide
- Project will create ~1000 construction jobs at peak, for duration of 2-3 years
- Indirect economic benefits and associated job multipliers
- Full-time plant employment ~360 at average salaries $85K
- Indirect economic benefits
- Establishes Idaho as potential desired location for NuScale supply chain members
Overall WIN Project Schedule

**Project Development** (see detail)
- Define Team Members and structure
- Start COLA
- Submit COLA NRC Issue COL
- Draft DSRS
- Final DSRS
- NRC Issue DC
- Site Use Agreements
- Site Selection
- Reference Plant Design
- Start Finalized Plant Design
- Complete Final Plant Design

**Design & Engineering**
- Module 1 COD
- Module 12 COD

**Licensing**
- Order Modules
- Start Module Fabrication
- Deliver Module 1
- Deliver Module 12
- Site Prep & Mobilization
- 1st Safety Concrete Pour
- 1st Fuel load
- Site Characterization

**Construction and Fabrication**
- Start Operational Readiness Program
- Operator Training Program Accreditation
- Complete Operational Readiness Program

**Operations**
- Reference Plant Design
- Start Finalized Plant Design
- Complete Final Plant Design

**Overall WIN Project Schedule**
- Licensing
- Construction and Fabrication
- Operations

**Reference**
- Plant Design
- Operations Development
- Operations (see detail)
- Project Development
- Licensing
- Construction and Fabrication
- Operations

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What is Needed to Ensure a Successful Project?

- Need a committed owner/buyer – will ultimately drive site selection decision for the project
- Project will need to demonstrate sufficient need for/use of generated power
- State should consider doing economic impact study which gains state legislative buy-in
- State public and political support
- Suitable plant economics/investment profile (e.g. long-term PPA’s, perhaps including labs and DOD facilities)
- Favorable/supportive local and state permitting and approval processes
- Economic development incentives
- Sufficient capable facility workforce and community interest
COMING SOON TO AN ELECTRIC GRID NEAR YOU!

Mike McGough
Chief Commercial Officer
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IT'S A Nu DAY FOR A 60-YEAR OLD INDUSTRY.

NuScale Power™

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