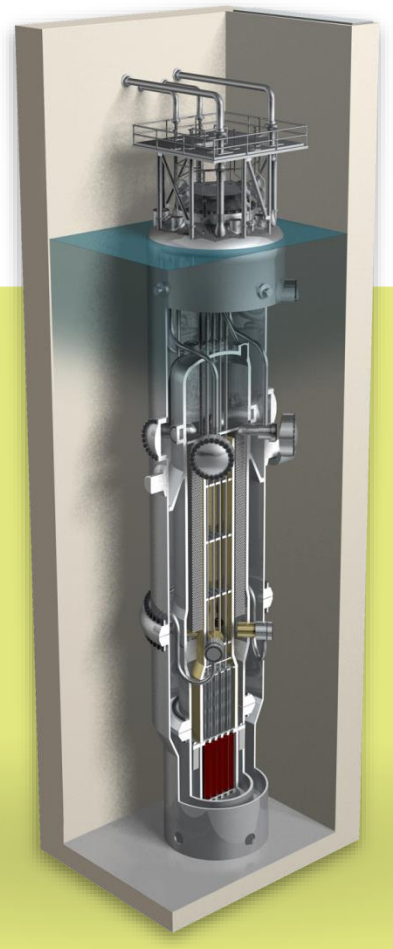


NuScale Power
Technology and Applications

Oregon State Legislature

Mike McGough

Chief Commercial Officer

September 22nd, 2016

NuScale Power™

Agenda

- NuScale Background
- What NuScale Means to Oregon
- Technology Overview
- Safety Attributes
- Testing Programs
- Licensing Plan and Status
- Commercialization Plan and Status

Brief NuScale History

- NuScale technology in development and design since 2000
- Electrically-heated 1/3-scale Integral test facility first operational in 2003
- Began NRC design certification (DC) pre-application project in April 2008, >20K Mhrs
- Acquired by Fluor in October 2011
- >560 people currently on project, ~$500MM spent project life-to-date ($12MM/mo)
- >320 patents pending/granted, 19 countries
- Portland, Corvallis, Rockville, Charlotte, Richland, London
- US DOE SMR Awardee, 12/12/13, $217MM

NuScale Engineering Offices Corvallis, Oregon

One-third scale Test Facility

NuScale Control Room Simulator

NuScale Power™

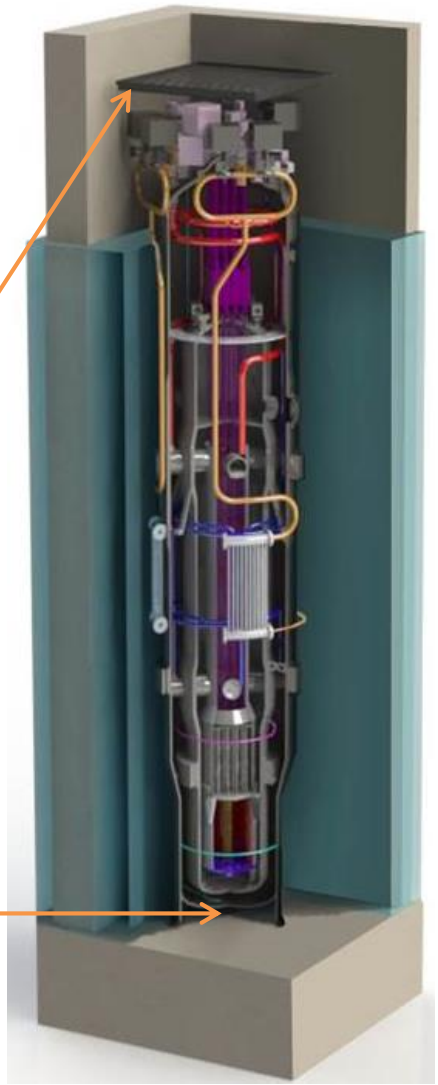
What NuScale Means to Oregon

- Oregon employee base over 400
- OSU off-spring
- OSU Nuclear Technology leadership
- Manufacturing supply chain (OIW, Greenberry)
- EcDev—New hotel being built in downtown Corvallis to support several thousand lodging nights annually
- Sold out every hotel in the region for August 2015 NuEx

What is a NuScale Power Module?

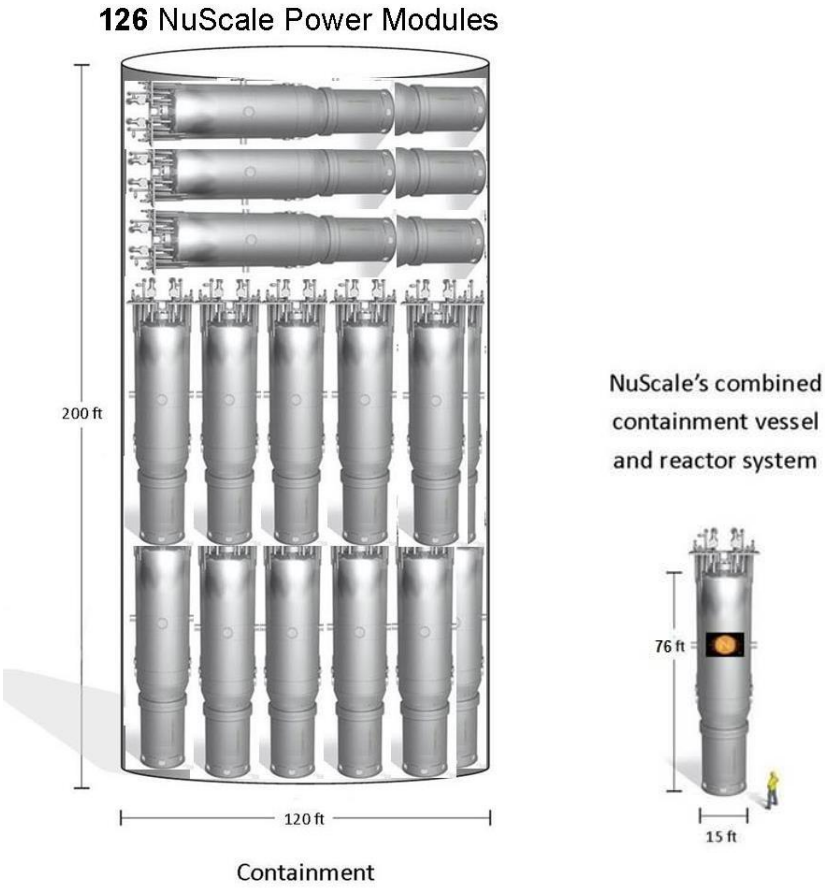
- A NuScale Power Module (NPM) includes the reactor vessel, steam generators, pressurizer and ***containment*** in an integral package that eliminates reactor coolant pumps and large bore piping (no LB-LOCA)
- Each NPM is 50 MWe and factory built for easy transport and installation
- Each NPM has its 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

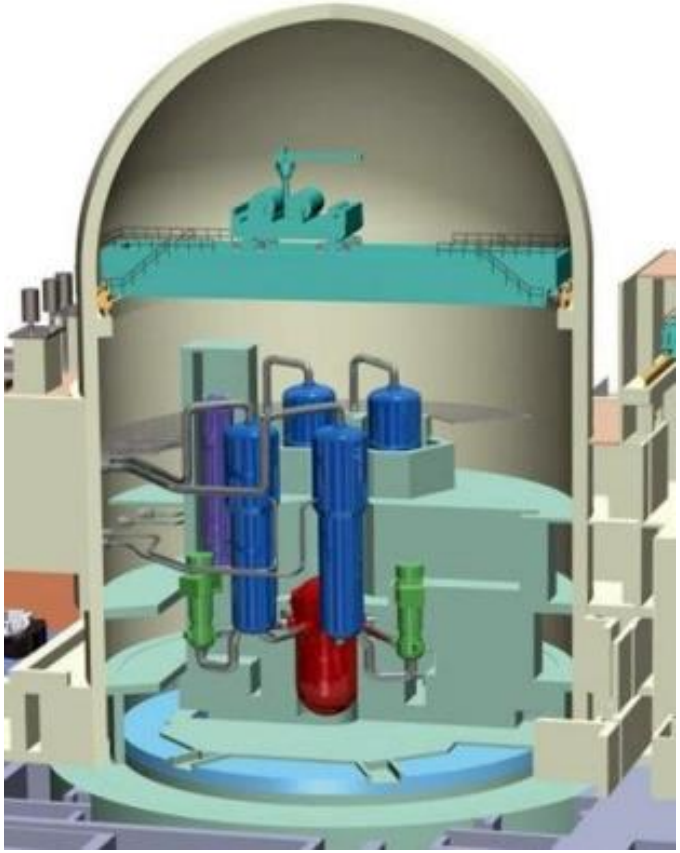


Size Comparison

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



Typical Pressurized Water Reactor

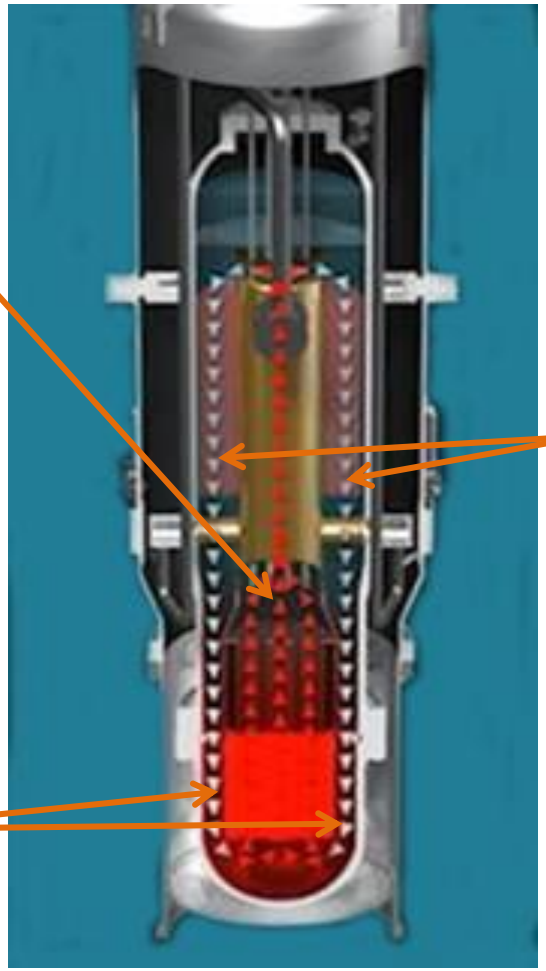


*Source: NRC

NuScale Power™

Coolant Flow Driven By Physics

***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**



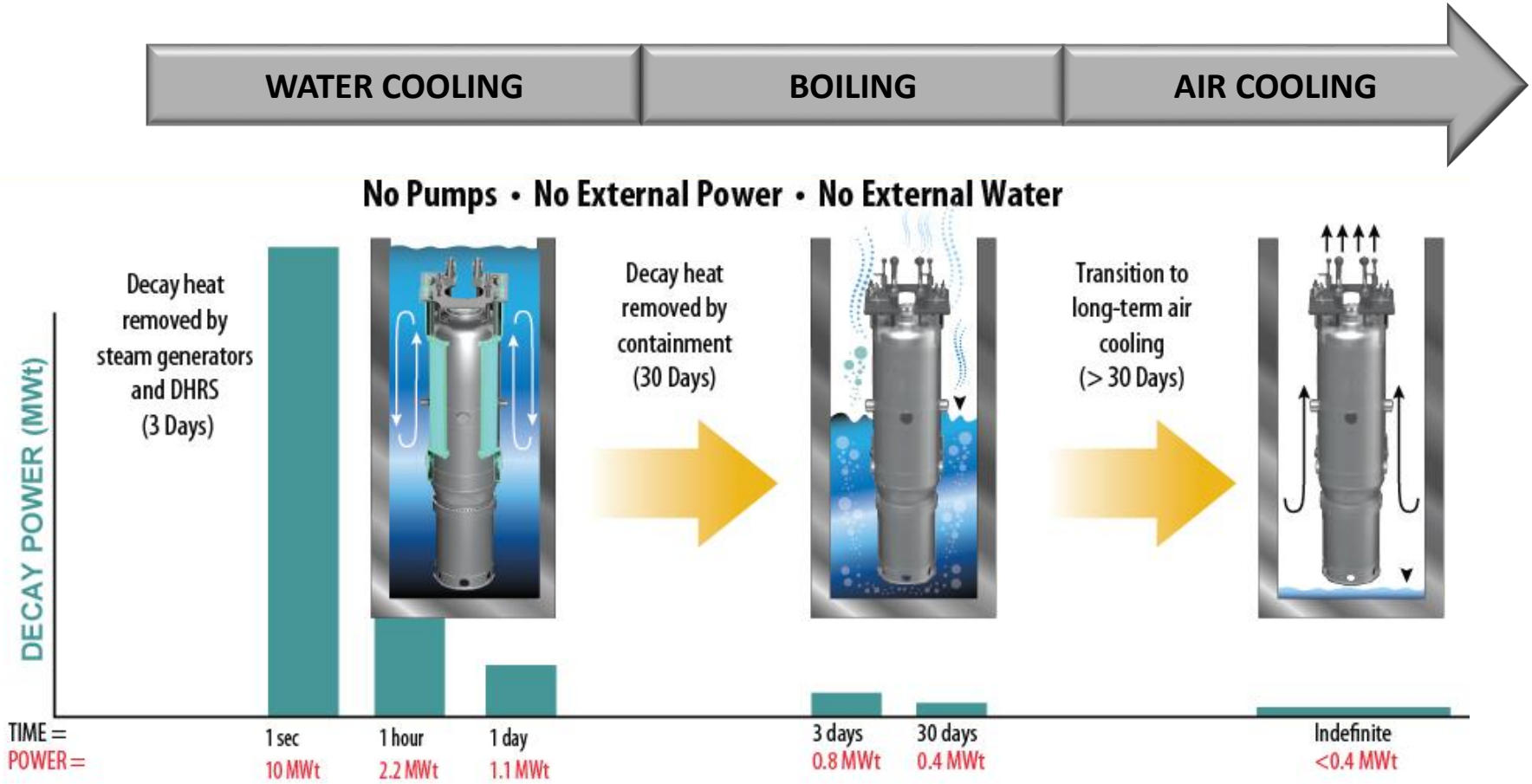
***Conduction* – heat is transferred through the walls of the tubes in the steam generator, heating the water (secondary coolant) inside them to turn it to steam. Primary water cools.**

***Gravity* – colder (denser) primary coolant "falls" to bottom of reactor pressure vessel, cycle continues**

SAFETY

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

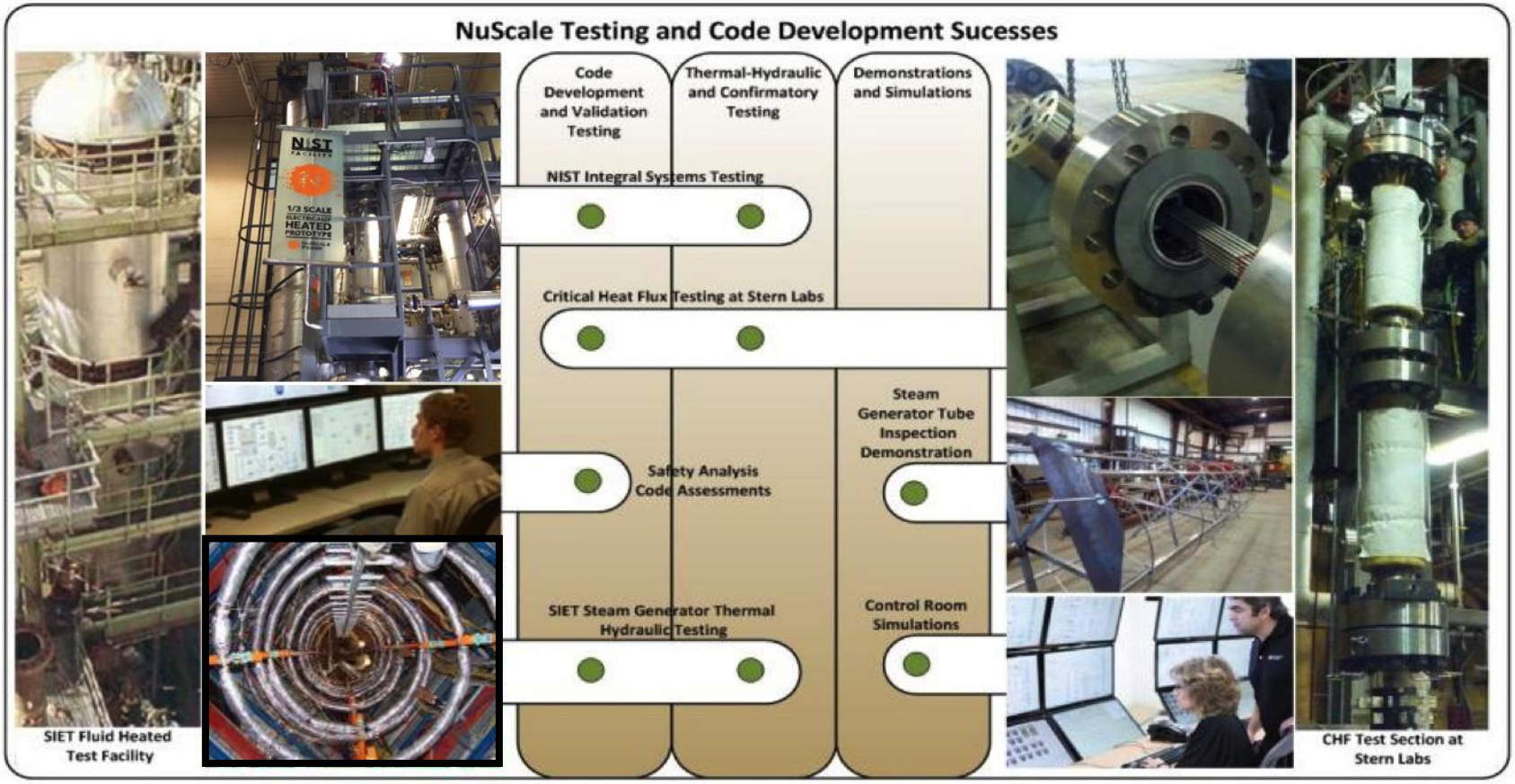
NuScale Power™

How Do We Know It Works?

- TESTING TESTING TESTING

NuScale Reactor Qualification Test Plan

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

NIST-1 Test Facility

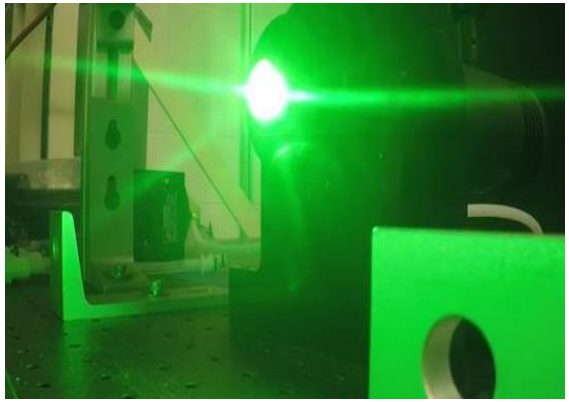
LOCA testing for NRELAP5 validation complete

- HP-01 (volume and elevation)
- HP-02 (high pressure condensation)
- HP-03 (DHRX characterization)
- HP-04 (cooling pool characterization)
- HP-05 (powered natural circulation flow)
- HP-06 (CVCS discharge line break)
- HP-07 (pressurizer spray line break)
- HP-09 (ECCS RVV spurious opening)

Stability testing for PIM code validation complete

NRC inspection of NIST-1 is complete

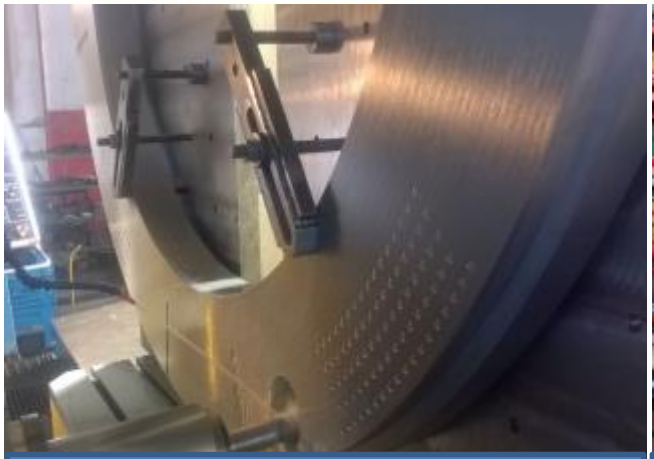
Long Term Cooling Testing is underway



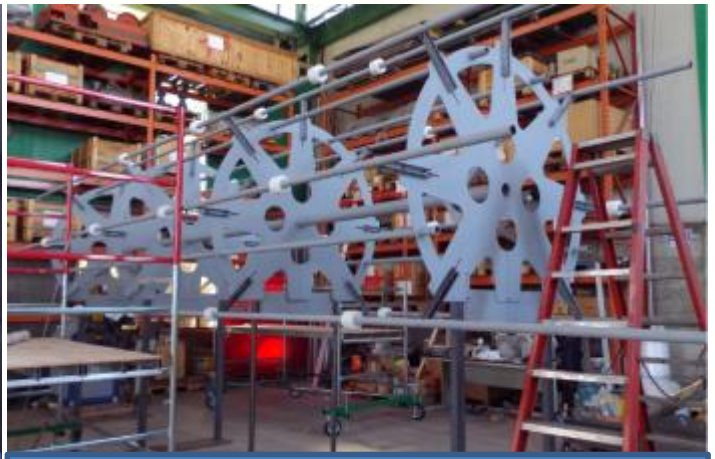
New laser PIV system to measure local cooling pool liquid velocities at containment heat transfer plate.

SG Flow Induced Vibration (FIV) Test Hardware

Tube Supports



Machining of Tube Sheet

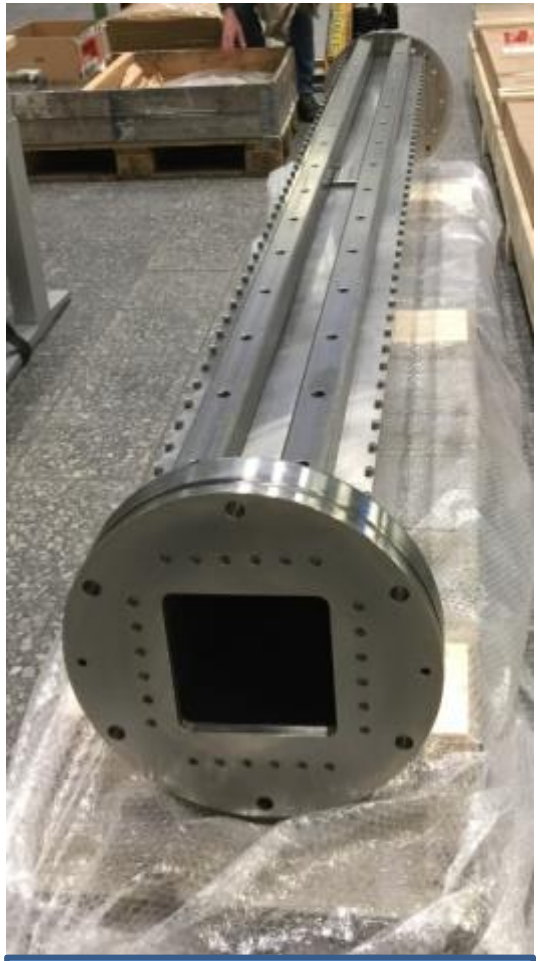


Tube Bending Rig

Vessel Head

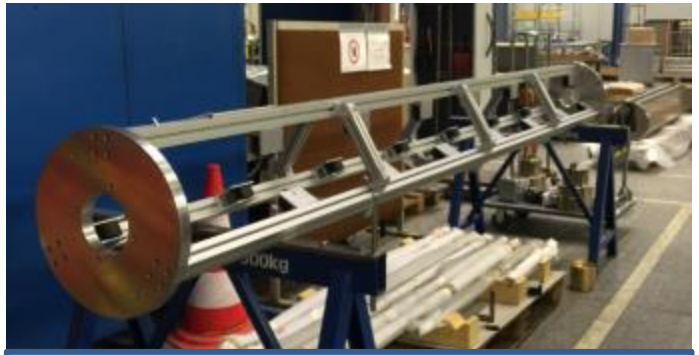
Tube Bending

CRA and Drive Shaft Drop Alignment Test Hardware



Fuel Assembly Housing

Support Beam



Counterweight Guide Assembly

Guide Tube/Card Housing

NuScale RPV Head Ingot Being Forged

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

Images Provided courtesy of Sheffield Forgemasters International Ltd

Machining of the NuScale RPV Head

Images provided courtesy of Sheffield Forgemasters International Ltd

NuScale Upper Module Mockup

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)

NuScale Power Control Room Simulator

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

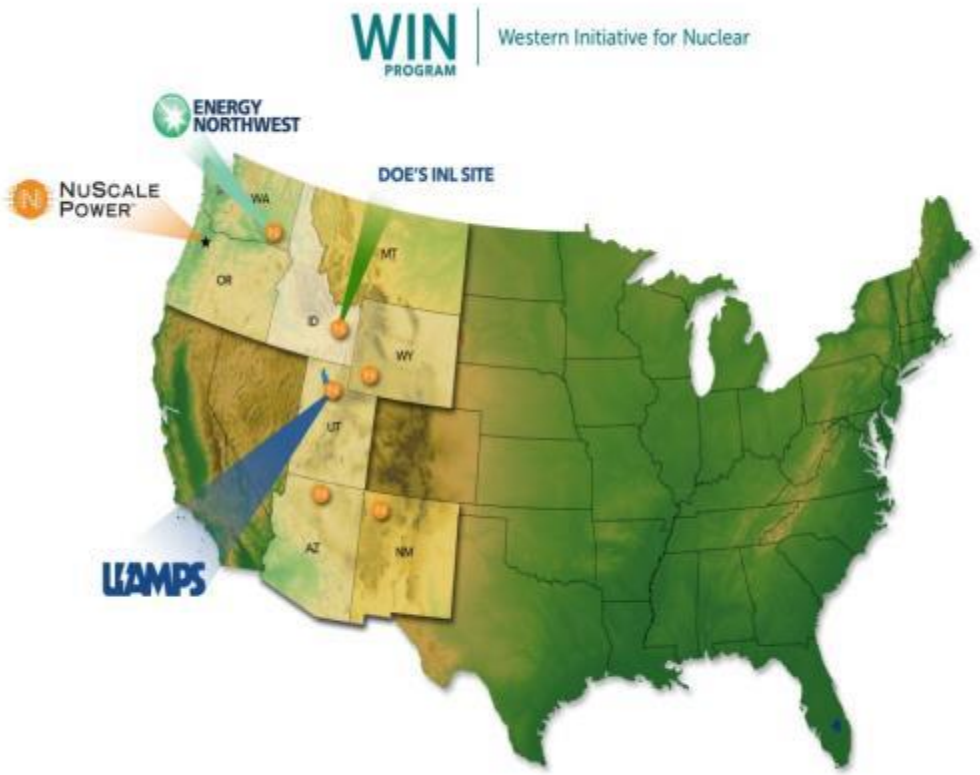
NuScale Power Design Certification Application

Commercialization Plan and Status

Program WIN (Western Initiative for Nuclear)

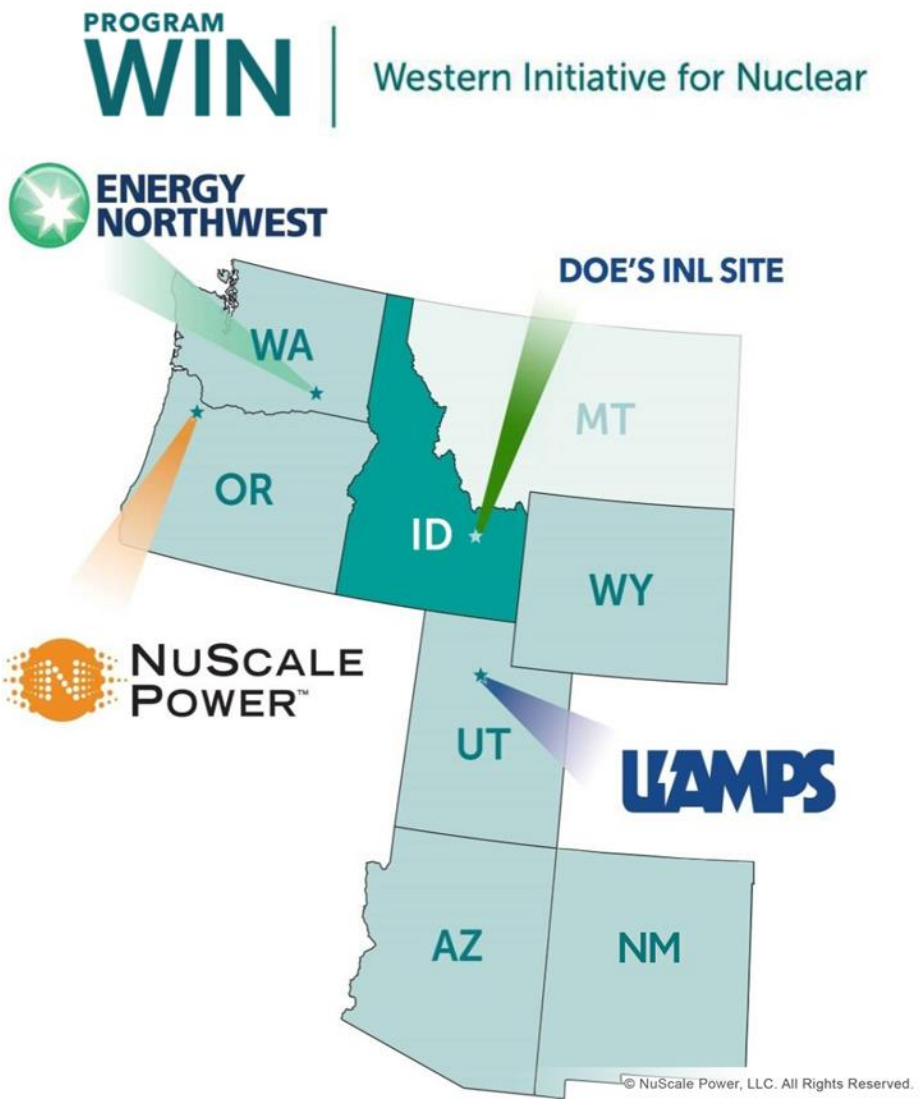
- Western Initiative for Nuclear (WIN) is a multi-western state collaboration to deploy a series of NuScale Power Projects

- Involved Program WIN participants: NuScale, UAMPS, Energy Northwest, ID, UT, OR, WA, WY, AZ, NM, MT?



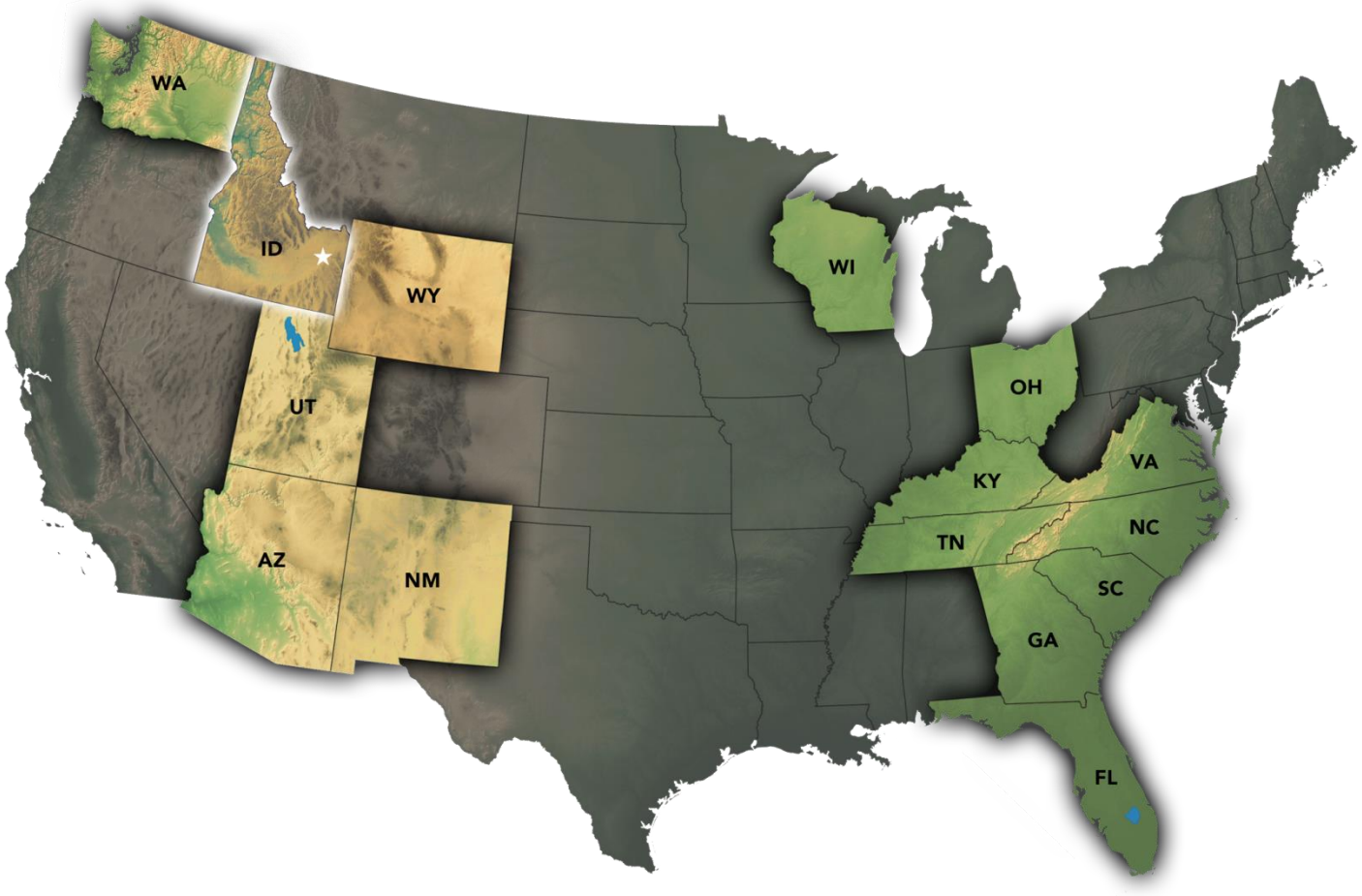
First Deployment: UAMPS CFPP

- Utah Associated Municipal Power Systems (UAMPS) Carbon Free Power Project (CFPP) will be first deployment, sited somewhere in Idaho.
- Site selection underway
- 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

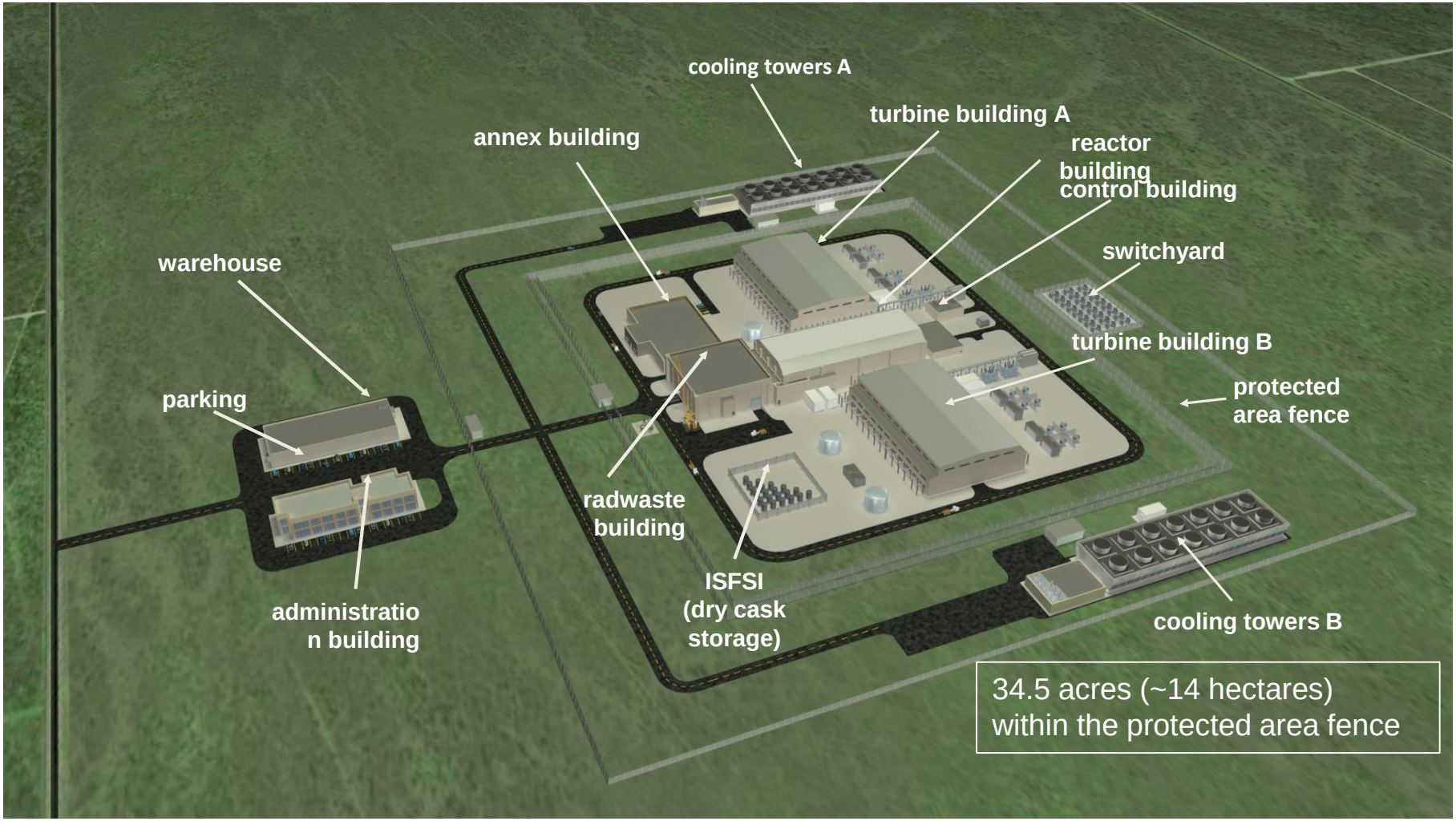


Other States on the SMR Scene

- Utah
- Washington
- Arizona
- Tennessee
- Wyoming
- North Carolina
- South Carolina
- Wisconsin
- Kentucky
- New Mexico
- Ohio
- Virginia
- Florida
- Georgia



Site Overview



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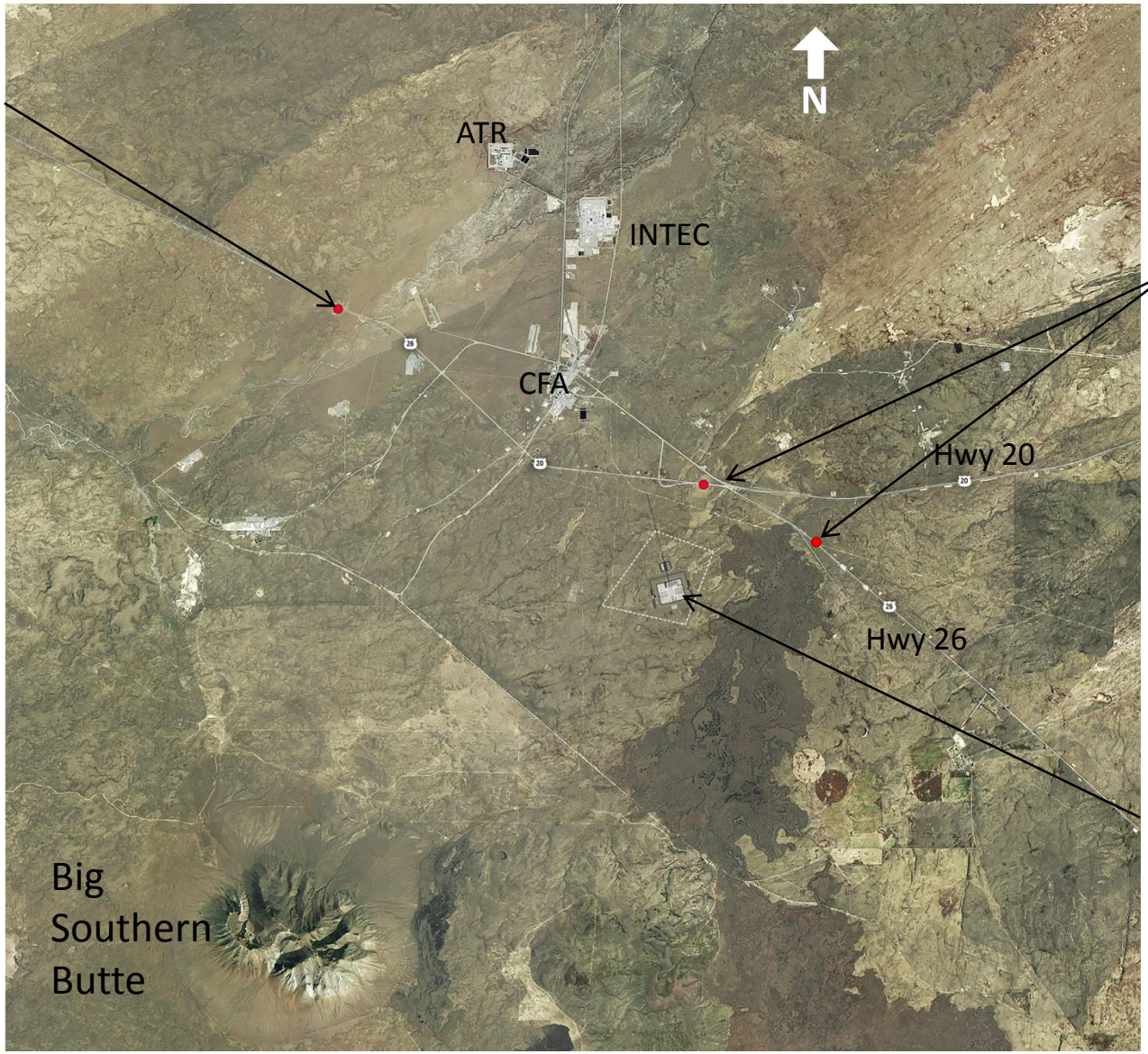
Satellite View of Site

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

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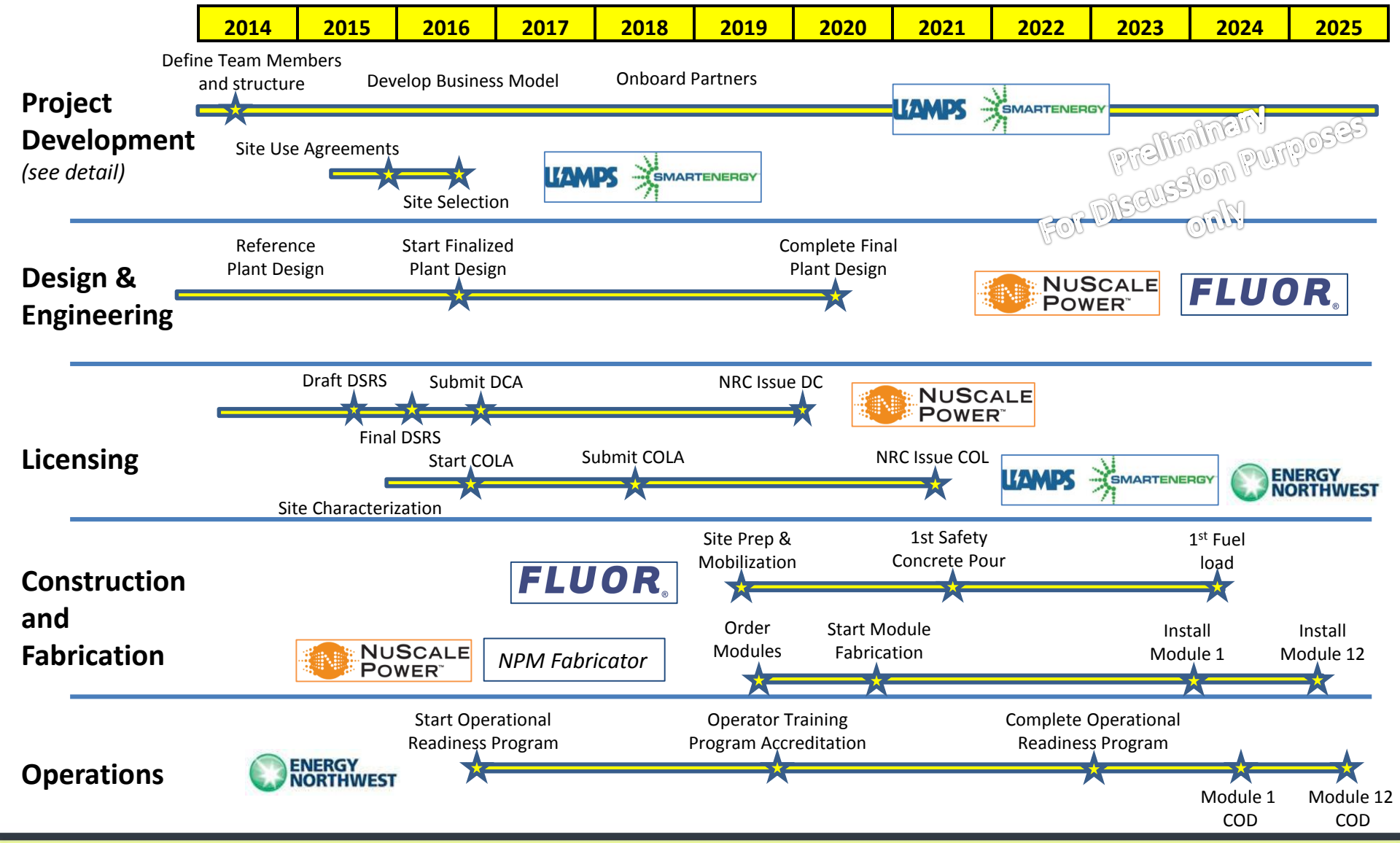
View of Site From Lost River Rest Stop

Southeast *Viewing direction* *South*

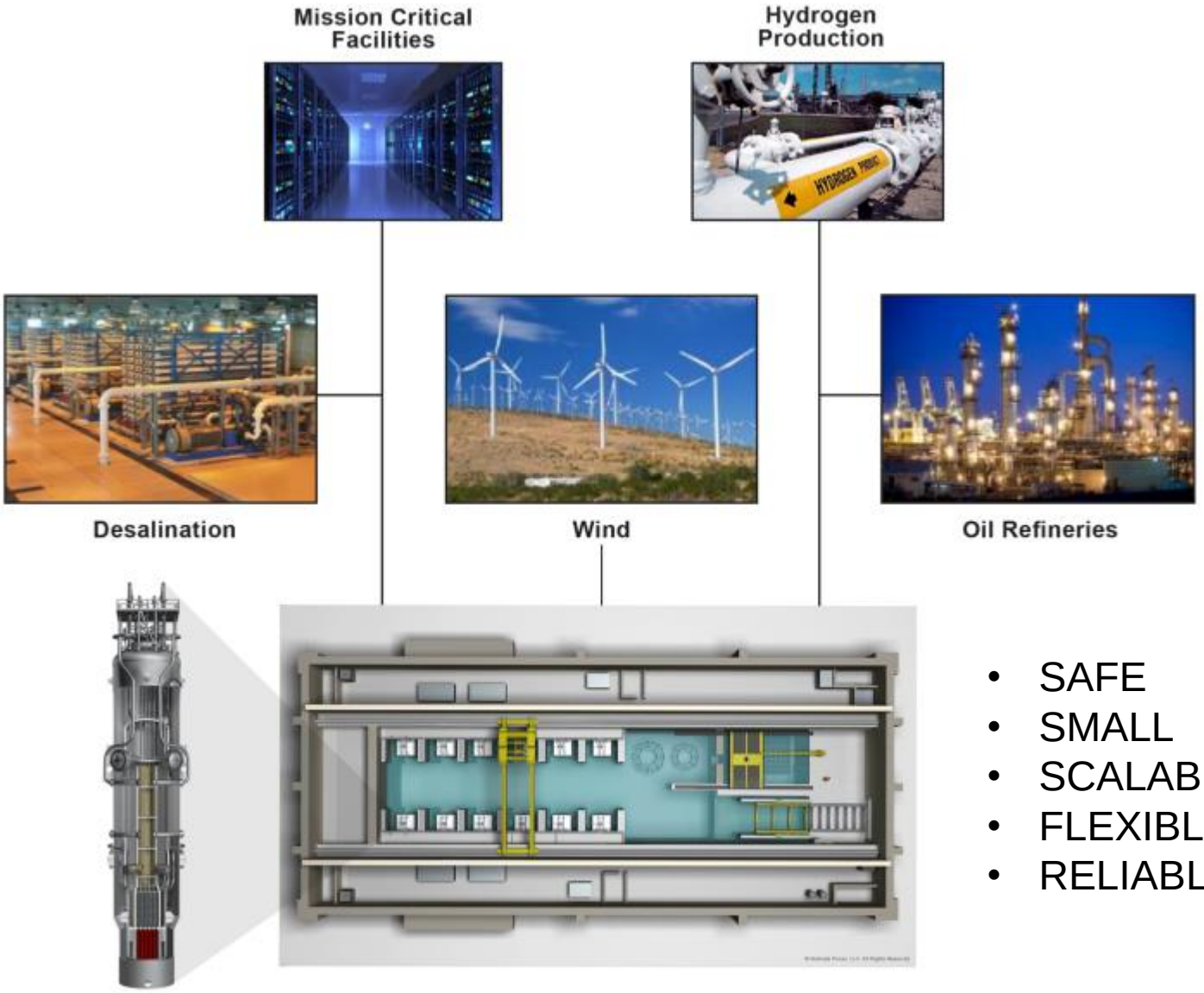
Overall UAMPS CFPP Project Schedule



NuScale Power

NuScale Advisory Board (NuAB)

NuScale Diverse Energy Platform (NuDEP) Initiative



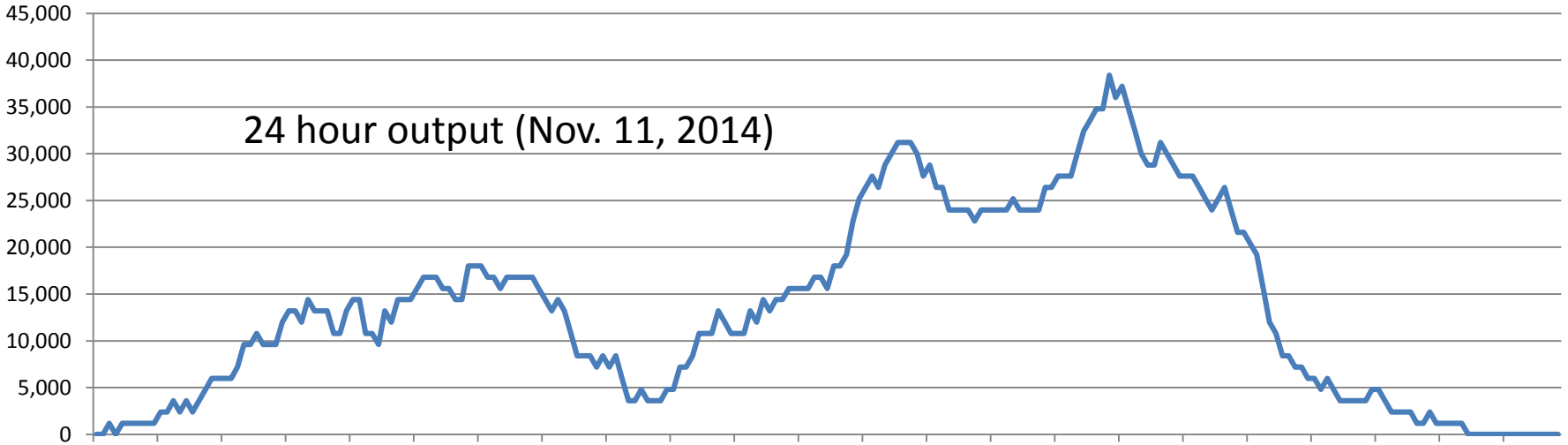
- SAFE
- SMALL
- SCALABLE
- FLEXIBLE
- RELIABLE

NuScale/UAMPS/ENW Study on Integration with Wind Farm

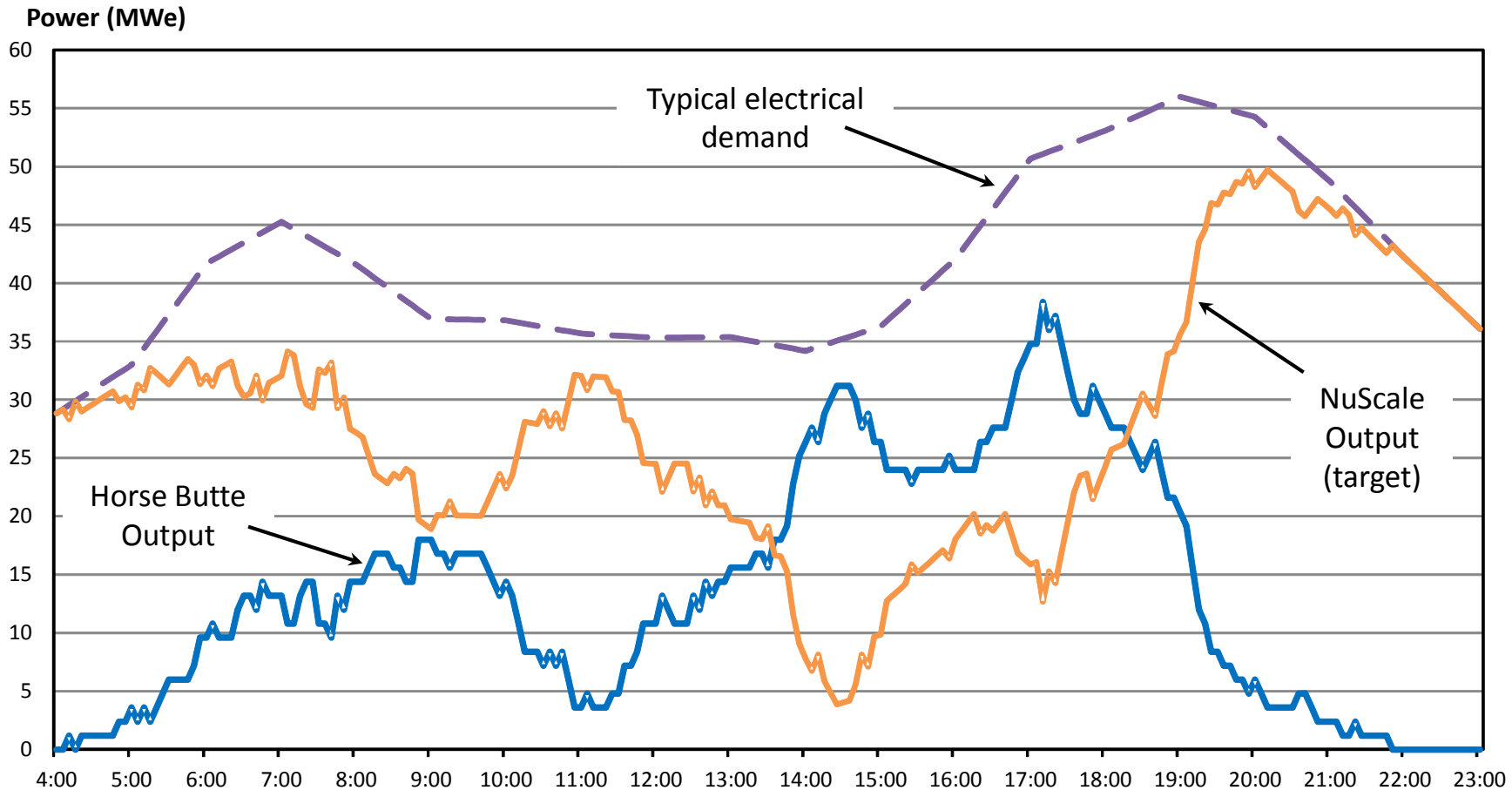
- NuScale includes unique capabilities for following electric load requirements as they vary with customer demand and rapid output variations from renewables: NuFollow™
- There are three means to change power output from a NuScale facility:
  - **Dispatchable modules** – taking one or more reactors offline for extended periods of low grid demand or sustained wind output
  - **Power Maneuverability** – adjusting reactor power for one or more modules (intermediate time frames)
  - **Turbine Bypass** – bypassing turbine steam to the condenser (short time frames
- Explored integration with Horse Butte wind farm in Idaho
- Partnered with Utah Associated Municipal Power Systems and Energy Northwest

Horse Butte Wind Farm

- Commissioned in 2012
- 32 Vestas V100 turbines
- 1.8 MWe capacity per turbine
- 57.6 MWe total capacity
- 17,600 acres



Target Output for NuScale Module



NuScale Paper Released 4/20/16

- Patterned after memory storage RAIR (Redundant Array of Independent Discs)
- NuScale Redundant Array of Integrated Reactors (RAID)
- Produces Reliable power at 99.99% for 100MW, based on 12-module NuScale plant

NuEx Tours – NIST, Control Room Simulator and UMM

NuSCALE POWER™

NuEx August 20-21, 2015 Corvallis, OR

NuScale Power™

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The Element of Nu

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