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NuScale Power: A Nuclear Manufacturing Paradigm Shift

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The Global Reality

An additional 197 quadrillion BTUs of energy are needed to lift 5.9 billion people out of energy poverty.

More than 1 billion metric tons of food is lost or wasted each year for lack of cooling.

783 million people do not have access to clean water.

Air pollution in developing economies routinely exceed U.S. standards.
NuScale Power provides scalable advanced nuclear technology for the production of electricity, heat, and clean water to improve the quality of life for people around the world.
Who is NuScale Power?

- Initial concept started with Department of Energy MASLWR program at Oregon State University.
- **NuScale Power** was formed in 2007 for the sole purpose of completing the design of and commercializing a small modular reactor – the NuScale Power Module™ (NPM).
- **Fluor**, global engineering and construction company, became lead investor in 2011.
- In 2013, NuScale won $226M in matching funds in a competitive U.S. DOE funding opportunity.
- >350 patents granted or pending in nearly 20 countries.
- ~350 full-time employees in 6 offices in the U.S. and 1 office in London.
- NuScale design currently undergoing rigorous review by the **U.S. Nuclear Regulatory Commission (NRC)**.
Core Technology: NuScale Power Module

- A NuScale Power Module™ (NPM) includes the **reactor vessel, steam generators, pressurizer, and containment** in an integral package – simple design that eliminates reactor coolant pumps, large bore piping and other systems and components found in large conventional reactors.

- Each 50 MWe module:
  - is small enough to be factory built for easy transport and installation
  - has a dedicated power conversion system for flexible, independent operation
  - can be incrementally added to match load growth – up to 12 modules for 600 MWe gross (~570 net) total output
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.
Each NuScale power module feeds one turbine generator train eliminating single-shaft risk

- 100% turbine bypass capability
- Generator is totally enclosed water to air cooled (no hydrogen cooling required)
- Small, simple components support short, simple refueling outages
Advantages of Small Modular Approach

- Factory Fabrication
- Transportable
- Small Footprint
- Flexible Operation
Where do we go from here?
Blazing the Trail to Commercialization

- First NPM Delivery (2025)
- Construction (2022)
- COL Received (2022)
- Design Certification (2020)
- COLA Submittal (2019)
- Award First NUFAB Contract (2018)
- DCA Completed (2016), Docketed (2017)
- Site Selection (2016)
- U.S. DOE SMR Grant Awardee (2013)
- Topicals
  - Secured First Customer (2013)
  - Simulator (2012)
  - Formation of Advisory Board (2011)
  - Fluor Acquisition (2011)
  - Begin NRC Pre-Application (2008)
  - Formation of NuScale Power, LLC. (2007)
  - DOE MASLWR Program (2000)

- Engineering + Testing
- IP Portfolio - >390 Patents (Granted or Pending)
- Building Supply Chain
- Securing Additional Customers
- Raising Additional Capital
- Continuing Efforts
- COMMERCIAL OPERATION of First NuScale Plant (2026)
- About 1 Billion
NuScale Baseline DC Review

Completed
DCA
12/31/16

P1 – PSER and RAIs
4/16/18

P2 – SER w/OIs
5/16/19

P3 - ACRS review of
SER w/OIs
8/27/19

P4 - Adv SER w/no OIs
12/12/19

P5 - ACRS review
Adv SER w/no OIs
6/23/20

P6 – FSER
9/08/20

Rulemaking
Jan 2021

Design Certified
Jan 2021

NRC Accepted
3/15/17

Total projected duration for NRC review and approval - 46 months
Looking Ahead – Selected Milestones

- Select Manufacturing Partner
- ASME N-Stamp
- COLA Work Begins

- COLA
  - Complete Simulator Training and Testing

- Design Cert
  - NPM Long-lead Procure
  - Submit COLA

- NPM manufacture

2018 2019 2020 2021

Moving Beyond Licensing of the Design
So what’s different?

- Nuclear Steam Supply System is all contained in the NuScale Power Module (NPM)
- The NPM is factory built
- The turbine buildings do not have nuclear safety related equipment
- The NPM is an ASME Section III reactor pressure vessel inside of an ASME Section III containment vessel
- Each NPM feeds steam to its own steam plant – that means 12 steam turbines and associated equipment
- It is truly small modular nuclear generation
The Paradigm Shift

- Unique—not like a traditional power plant
- Steady-state manufacturing on a factory assembly line versus a site construction job
- Select and develop a set of supplier partners for all NuScale plants, not a bid list for one plant
  - close partnerships are critical
  - pricing models and terms negotiated in advance
  - suppliers are vested in the long term viability of NuScale
  - standard specifications
Impacts on the Industry

- Factory Focus
- Fixed pricing opportunities
- Quantities versus size
- Standardization
- Load shaping and load following
- Non-utility uses
  - Desalinization
  - Hydrogen production
  - Mission critical power
Beyond Baseload: NuScale Diverse Energy Platform (NuDEP)

- **OIL REFINERIES**
  - Oil Refineries Study - Reduction of Carbon Emissions (Fluor and NuScale)

- **HYDROGEN PRODUCTION**
  - Hydrogen Production Study - High Temperature Steam Electrolysis (INL and NuScale)

- **DESLINATION**
  - Desalination Study - Sized for the Carlsbad Site (Aquatech and NuScale)

- **MISSION CRITICAL FACILITIES**
  - Reliable Power for Mission Critical Facilities (NuScale)

- **WIND**
  - Integration with wind study - Horse Butte Site (UAMPS, ENW and NuScale)

- **NUSCALE PLANT**
The Future of Energy is Getting Closer

NuFuel HTP2 Testing

One-third scale NIST-1 Test Facility

NuScale Control Room Simulator
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