Testimony
Dr. José N. Reyes
To the Oregon Senate Energy and Environment Committee
Advanced Small Modular Nuclear Reactors
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My name is José Reyes, and I am the Co-founder and Chief Technology Officer of NuScale Power, based in Corvallis. It is a pleasure to be here with you and thank you to Senator Boquist and to the Senate Committee on Energy and Environment for inviting me to speak today.

I would like to report on the state of advanced small modular reactor or "SMR" technology, NuScale Power's progress as an SMR developer, and how this advanced nuclear technology can support an accelerated transition to a clean energy economy in Oregon.

NuScale Update

I am pleased to provide you with a brief update of our company's progress. NuScale's work continues to serve as a catalyst for the SMR industry, and we are on the frontier of innovation in energy. While there a many promising technologies under development, many are years from commercialization. NuScale's technology development program is very mature, with the program focus now on readying its SMR technology for equipment manufacture and construction.

In August of last year, we made history as the first ever SMR design to be approved by the U.S. Nuclear Regulatory Commission, which is among the most rigorous and thorough review processes. This confirmed the proven safety case of our SMR technology and the benefits of our simpler design.

To date, NuScale has spent over $1B private/public investment to develop intellectual property and license our innovative SMR technology. We currently have over 400 employees in five U.S. offices and one office in London, with 323 located in our Corvallis and Portland offices.

Innovation within the company continues; growing from my three original patents to 560 patents pending or granted in 20 countries.

We have completed more than $100M in testing programs, and our first commercial project is the Utah Associated Municipal Power Systems (UAMPS) Carbon Free Power Project in Idaho. The first NuScale module as part of that project will be operational by mid-2029.

Introduction to NuScale's SMR Technology

NuScale Power has developed a new modular light water reactor nuclear power plant to supply energy for electrical generation, district heating, desalination, and other process heat applications. At the heart of its power plant is the NuScale Power Module™, our small modular reactor (SMR) that can generate 77 megawatts of electricity (MWe) using a safer, smaller, and scalable version of pressurized water reactor technology.

The NuScale Power Module™ uses the principles of buoyancy-driven natural circulation; no pumps are needed to circulate water through the reactor. Its smaller, simpler design eliminates the need for reactor coolant pumps, large-bore piping, and other complex systems and components found in currently operating nuclear power plants.

The NuScale Power Module™, including containment, is fully factory-built and shipped to the plant site by truck, rail, or barge without the need for field fabrication, erection, or construction—taking safety-related work out of the field.

NuScale's flagship plant design can accommodate up to 12 modules, resulting in a total gross output of 924 megawatts electric (MWe). We also offer smaller power plant solutions in four-module (308 MWe) and six-module (462 MWe) sizes that are underpinned by the rigorous safety case of our flagship design.

Each module produces 250 MWt of process heat that can be directed to a steam turbine generator power conversion system for the production of electricity, or to a variety of process heat systems.

Safety and Resilience

As Oregon and other states consider advanced SMRs, it is important to distinguish SMRs from their older, larger nuclear power plant predecessors. With a fully passive safety system design, the NuScale SMR is "walk-away" safe, which means that on a loss of power, our safety features provide stable, long-term nuclear core cooling under all conditions.

Unlike the reactors of the past, NuScale SMRs do not require power, operator or computer action, or the addition of water to keep safety features functioning and the reactor cool. This second-to-none safety case is what NuScale has trademarked as its Triple Crown for Nuclear Plant Safety™, and it is **an industry first for commercial nuclear power and is one of the significant features validated by the U.S Nuclear Regulatory Commission (NRC) approval last summer.**

NuScale SMR's level of resiliency is unmatched by any operating nuclear plant in the world and has significant resilience features that will not only enable the plant to adapt to natural disasters and extreme weather events—but also to provide highly reliable, long-term power to support grid power stability.

The NuScale power plant is seismically robust and resilient to earthquakes and other natural events as well as to human-caused phenomena like electromagnetic pulse events and cyber-attacks. This makes SMRs an ideal source of emergency power to supply critical infrastructure and support recovery efforts after devastating natural disasters.

NuScale's strong safety case also justifies an emergency planning zone (EPZ) in the U.S. that only extends as far as the site boundary as opposed to 10 miles for current U.S. nuclear plants. That allows the NuScale plant to be sited in close proximity to process heat off-takers, for district heating near population centers, and to repower retiring coal-fired power plants.

Nuclear Supports a Balanced Clean Energy Portfolio and Complements Renewables

NuScale SMRs have a range of potential applications to help Oregon advance its clean energy economy. Our SMR power plant is designed to provide reliable, always-on baseload power for grids that incorporate intermittent wind and solar generation due to changing weather conditions and time of day. **Our SMRs can be used to shape, firm or integrate electricity from a renewable energy facility as contemplated under ORS 261.253(4)(c).**

For example, on slide 7, you can see this graph related to a study that was performed with the Horse Butte Wind Farm in Idaho to show the capability of a NuScale module to load-follow with the wind farm over the course of a day.

The combination of the small unit capacity of a NuScale module and a multi-module approach to the plant design contribute to the plant's suitability for load-following operations. The key power management options of the NuScale plant, include the following:

- Taking one or more modules offline for extended periods of low grid demand or sustained wind output,
- Maneuvering reactor power for one or more modules during intermediate periods to compensate for hourly changes in demand or wind generation, or
- Bypassing the module's steam turbine directly to the condenser for rapid responses to load or wind generation variations.

Recent studies show that integrating NuScale SMRs with renewables provides the least cost path to reaching clean energy mandates. These include studies by MIT[1], the International Energy Agency[2] and E3[3] demonstrate that moving to a low carbon economy with nuclear is far more affordable. MIT reported that without nuclear energy, the cost of deep decarbonization of the electricity sector would be two to three times higher. E3 reported that without nuclear energy, achieving Washington State's 100% clean electricity standard by 2045 would cost $8 billion more per year.[4]

Cost Competitive, Carbon-Free Hydrogen Production

With NuScale's multi-module plant design, SMRs can be designated to supply energy for electrical generation, as well as for diverse functions, including hydrogen production, desalination, district heating, process heat applications, or power storage. SMR use in these applications provides an additional pathway to reduce carbon dioxide emissions from transportation and industrial processes that account for approximately two-thirds of all emissions.

NuScale's innovative multi-module power plant design means that a NuScale plant could produce reliable clean electricity for the grid while allocating one or more modules to economically produce hydrogen when electricity demand is low.

In 2020, NuScale updated a study that it conducted in 2014 with the Idaho National Laboratory (INL) to examine the technical and economic aspects of producing hydrogen from NuScale modules. The updated analysis found that with the recent (November 2020) 25 percent increase in power output of a NuScale Power Module to 77 MWe/250 MWt, one module is capable of producing 2,053 kg/hour of hydrogen, or nearly 50 metric tons per day.

Over 95% of the world's hydrogen is currently produced using fossil fuels, with the most common method being steam methane reforming from natural gas. Renewables cannot produce all of this hydrogen alone, and advanced modular reactors will be required to produce enough clean hydrogen to displace the 100 million barrels of oil that are currently consumed around the world each day.

Conclusion

As power generating facilities across the U.S. come under increasing strain in the face of extreme weather events and aging infrastructure, we have a mandate to implement solutions that will ensure a more resilient and reliable energy system for current and future generations.

Small modular reactors are an advanced nuclear technology solution that can support this effort, with features, capability, and performance not found in current nuclear power plants and other generating facilities.

NuScale is a truly innovative, home-grown Oregon company seeking to deliver safe and affordable carbon-free power to all while ensuring a clean-energy future in the U.S. and beyond. NuScale is proud to be the developer of an innovative advanced SMR technology that will reduce

carbon emissions as part of a balanced clean energy system, provide opportunities for job growth and economic prosperity, and ensure a secure, reliable, and resilient energy future for our state and for the country in the years and decades to come.

I want to thank the Senate Committee for the opportunity to testify before you today, and I look forward to your questions.

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1 *The Future of Nuclear Energy in a Carbon-Constrained World: An Interdisciplinary MIT Study*, 2018.

2 "Nuclear Power in a Clean Energy System,", IEA, Paris, 2019.

3 *Pacific Northwest Zero-Emitting Resources Study*, 2020.

4 *Ibid., Executive Summary*