Testimony of Chris Colbert, Chief Strategy Officer, NuScale Power, LLC

Chair Helm, committee members, my name is Chris Colbert and I am a resident of Lake Oswego and the Chief Strategy Officer for NuScale Power. I understand that today's hearing is an informational hearing and that there will be no further consideration of SB 990 during the current session. However, given the progress NuScale has made since the last time we testified before this committee, I believe it is appropriate for the Oregon legislature to reconsider the potential that advanced nuclear technologies, including NuScale's Small Modular Reactor, have in Oregon's future energy infrastructure. Given the strong interest in today's hearing, I will defer to Dr Reyes testimony and our written submissions and limit my comments to what has changed since Measure 7 passed in 1980 and what is the same, but could use some clarification.

So what has changed since Measure 7 passed in 1980:

The NuScale design provides improved safety – Emergency Planning Zone, 10 miles being the current standard for large reactors, is likely to be at site boundary of a NuScale Plant – this will be subject to rigorous review by the US Nuclear Regulatory Commission.

Climate Change – Intergovernmental Panel on Climate Changes states that Nuclear Power Plants (including SMRs) have carbon dioxide emissions per kilowatt hour generated that are the same order of magnitude as wind, solar and hydro, making them an option to replace existing fossil-fueled generation and so at the scale necessary to rapidly decarbonize.

Affordability – Large reactors like those being built in the southeast cost $15-$18 bn and take 8 years – a NuScale plant is $3bn and 3-4 yrs making it far more accessible to smaller utilities, states and countries.

Resiliency – all nuclear plants are designed to withstand extreme events, natural or manmade – NuScale is no exception. In light of concerns with respect to a Cascadia Subduction Zone Earthquake and recent cyber attacks, we have initiated studies with the Columbia Lifelines Program to investigate how these attributes can contribute to a highly reliable and resilient network for the Pacific Northwest.

Economics – NuScale plant is competitive with coal and gas when taking account of social cost of carbon

Flexibility – NuScale plants can adjust power to balance changes in wind and solar generation to efficiently meet load. Potential for integration with other technologies, desalination and hydrogen production further improves the benefits of NuScale's flexibility

Spent Fuel Disposal – technical solutions exist and are operational, e.g., Finland recently opened its permanent, deep geologic repository. The US has spent $10 bn developing Yucca Mountain and others have proposed interim consolidated storage facilities for commercial nuclear spent fuel in New Mexico and Texas. We don't underestimate the political issues associated with permanent repositories but it is no longer a technical or a funding issue.

Finally, based on some of the comments I've seen submitted, I did want to clarify the following:

First, low-enriched uranium light-water reactors like NuScale have not been the pathway to nuclear weapons proliferation

Second, the Hanford waste cleanup is due to nuclear weapons production, not commercial nuclear spent fuel – all US commercial spent fuel is currently safely stored in spent fuel pools, or as is the case for Trojan, in dry casks. This storage has been in operation for decades and all indications are that it will be sufficient for a hundred years or more.

In closing, we believe that NuScale SMRs could play an important role in Oregon's energy future as it seeks to decarbonize its electricity supply, improve its resiliency while keeping it affordable and competitive. The world is looking to the US to lead in these efforts and increasingly to Oregon-based NuScale as a leader in US SMRs.

This concludes my remarks and I look forward to any questions you may have.

Testimony provided by Christopher J. Colbert, NuScale Power
May 24, 2017

Chair Ken Helm, members of the committee, my name is Chris Colbert. I am the Chief Strategy Officer of NuScale Power LLC, headquartered in suburban Portland, Oregon.

I am here today to testify in favor of Senate Bill 990 that would establish requirements for the siting of Small Modular Reactors in Oregon.

Today, NuScale Power is the leading developer of American Small Modular Reactor (SMR) technology. NuScale has over three hundred staff working in Oregon and well over three hundred patents granted or pending worldwide. We are advancing a unique and innovative SMR design, which offers the safest light water reactor nuclear technology that is near-term deployable. We believe that our technology can meet the U.S. and global needs for clean, affordable, reliable and economic electricity generation.

Our design is uniquely safe. We have solved one of the most vexing problems of the nuclear industry with what we call the "Triple Crown of Nuclear Safety." In the case of a loss of all sources of electricity at the plant, the NuScale Power Module shuts itself down and self-cools for an unlimited period of time, with no operator action required, no need for additional water, and no electricity. The NuScale Power Module uses simple properties of physics: convection, conduction and gravity, to drive the flow of coolant in the reactor. The thermal-hydraulic properties and capabilities of our technology have been demonstrated through an extensive test program inspected by the U.S. Nuclear Regulatory Commission (NRC), and which are protected by numerous patents. Because our SMR is safe, small and has numerous barriers between the nuclear fuel and the environment, the Emergency Planning Zone for a NuScale plant is expected to be greatly reduced from the 10 mile emergency planning zone for current reactors in the U.S. In fact, we believe it may be limited to the site boundary of the plant, approximately 74 acres.

In December 2016, after nearly $560 million invested and the dedication of over 600 employees and temporary staff, NuScale submitted a 12,000 page Design Certification Application to the U.S. Nuclear Regulatory Commission. In March 2017, the U.S. NRC notified NuScale that our application had been accepted for review. We expect the US NRC will complete its review and issue our Design Certification approximately 40 months from now. Our first project is expected to be the Utah Association of Municipal Power Systems Carbon Free Power Project, located on the Idaho National Laboratory. Commercial operation of the first NuScale Power Module would begin in 2026.

The NuScale Power Module is an ideal option for carbon free electricity generation. The NuScale design is dramatically smaller than today's pressurized water reactors and eliminates the need for safety-related electrically-driven pumps, motors and valves necessary to protect the nuclear core. It can be factory-manufactured and transported to a site via rail, truck or barge. The NuScale Power Module can produce 50 MWe and one to twelve modules can be installed in a plant over time to produce up to 600MWe.

The NuScale Power Module is particularly well-suited to providing reliable, resilient power for mission critical applications, balancing variable renewable energy resources and providing heat and electricity for non-electric applications such as desalination. Importantly, a NuScale SMR is designed to withstand major disasters, natural or man-made, including aircraft impacts, large earthquakes, and cyber and physical attacks. This is an important capability as the availability of electricity in the aftermath of such events is critical to providing emergency services and accelerating a return to normalcy.

With respect to SB 990, we welcome the local voice in siting an SMR as the voice of the local community is critical in confirming buy-in by those most affected by siting an SMR. Unlike today's operating nuclear fleet, the NuScale SMR is designed to have an emergency planning zone that is as small as the plant site boundary.

In summary, we think it is prudent for Oregon to consider the siting of SMRs in Oregon and we support Senate Bill 990. It is important to see continued support for our technology from the State of Oregon to help justify our continued growth and development in Corvallis and Portland. We believe that we can provide clean, affordable and reliable energy to Oregon, home to NuScale and the founding of our technology. NuScale appreciates the opportunity to present to the Committee and we are ready to answer any questions the Committee may have.

May 23, 2017

TO: House Committee in Energy & Environment

FR: Chris Colbert, Chief Strategy Officer, NuScale Power, LLC

RE: Supplemental Information in Support of SB 990 Testimony

We are supplementing our testimony of May 24, 2017, in support of SB 990, with the following additional information. We have summarized this additional information in the attached power point presentation.

Background: NuScale is an Oregon Company. NuScale Power, LLC (NuScale) small modular reactor (SMR) technology was created and is being developed in Oregon. Our company's major base of operations is Corvallis, Oregon and NuScale is headquartered in Portland. NuScale's SMR test facility is located on the campus of Oregon State University. NuScale has served as an economic engine benefitting Oregon and other Oregon-based businesses. In 2016, NuScale paid more than $27 million in Oregon salaries and provided $2 million in Oregon tax deposits. We have worked with Oregon-based suppliers including Oregon Iron Works, Harris Thermal, Greenberry, and many more. To date, NuScale has invested more than $560 million in the development and licensing of its SMR design. Siting and building a NuScale SMR in Oregon would create thousands of high paying jobs and offer new economic opportunities for Oregon suppliers.

Resiliency: The NuScale Plant is designed to withstand an array of natural and human-caused events. The requirements and expectations in this regard are set out in various U.S. Nuclear Regulatory Commission regulations, policy statements, and guidance documents. As these documents are lengthy, we provide below a synopsis of the requirements for a number of such events, and design considerations addressing those events.

- Natural hazards: NRC regulations at 10 CFR Part 50, Appendix A, and implementing documents require that the plant is capable of safely withstanding credible natural hazards. The plant is protected against natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches, based on the most severe of the natural phenomena that have been historically reported for a particular site, with margin appropriate to the available data The NuScale design is based on generic site parameters developed to encompass a wide range of sites, and the plant owner is required to ensure the design is suitable for the actual site. The NuScale design provides the capability to withstand these natural events without depending on electrical power or external sources of cooling water.

- Terrorism: NRC regulations at 10 CFR Part 73 and implementing documents require a variety of measures to protect nuclear reactors and stored fuel against sabotage, theft, diversion, and other malicious acts. NRC implements physical protection requirements consistent with the significance of the facilities or material to be protected, and licensees are responsible for providing the protection. Physical protection includes both design features incorporated in the NuScale design (e.g., protected areas and intrusion detection), and operational programs to be provided by the plant operator (e.g., an armed response force).

- Aircraft impact: NRC regulations at 10 CFR 50.150 and implementing documents require applicants for new nuclear power reactors to perform a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft. The NuScale design incorporates design features and functional capabilities to assure the reactor core remains cooled, the containment remains intact, spent fuel cooling is maintained, and spent fuel pool integrity is maintained in the event of the worst-case assumed aircraft strike, exceeding NRC's minimum criteria.

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- Cyber security: NRC regulations at 10 CFR 73.54 and implementing documents require measures to protect digital computers, communication systems, and networks associated with safety-related, important-to-safety, security, and emergency preparedness functions from cyber-attacks. NRC requires the facility to protect against cyber-attacks that would compromise the integrity, deny access, or impact the operation of those systems, networks, and equipment.

Flexibility: The NuScale Power Module can rapidly adjust power output by adjusting reactor power or bypassing steam from the steam turbine generator to the condenser. This is a valuable capability given the intermittency of renewable generation and its increasing penetration into the electric supply system. Currently, this renewable energy intermittency is balanced using fast-start, natural gas turbines. NuScale performed an analysis of the NuScale ramping capability using historical data from the Horse Butte wind farm outside of Idaho Falls and demonstrated that a single NuScale Power Module could vary power using steam bypass only, and more efficiently with a combination of steam bypass and reactor power changes. We have included this study which was peer-reviewed and published at the 2015 International Congress on Advances in Nuclear Power Plants (ICAPP).

Reliability: The NuScale Plant may have one to twelve NuScale Power Modules. As each NuScale Power Module can produce 50 MWe, the output of a NuScale Plant can be 50 MWe to 600 MWe. For a 600 MWe NuScale Plant, we have performed an analysis that the NuScale Plant can supply 100 MWe to a mission critical load with a 99.99% reliability over 60 years. We have included this analysis which was submitted for peer review and published as part of ICAPP 2016.

Economic Development: The economic benefits of a NuScale Plant commence with construction and extend through the 60 year life of the NuScale Plant. The peak construction labor force is ~1200, and the construction period is approximately three years. The permanent operations staff is ~365, approximately one quarter of which will have bachelor's degrees and the remainder with high school and associates degrees. The average salary for a nuclear plant worker is ~$90,000 per year, which is significantly higher than other base load generating plants, e.g., natural gas combined cycle, clean coal, biomass or geothermal. We have included a white paper summarizing the job potential of various baseload generating technologies.

Carbon-free: Nuclear power currently provides 20% of U.S. electricity and nearly 60% of its carbon-free energy. All other renewables, excluding hydro, provide 8%. This underscores that nuclear energy is an important carbon-free technology that can be deployed on the scale necessary to deeply decarbonize the U.S. and global electricity sector. NuScale's technology adds the flexibility needed for nuclear energy to work on a more decentralized grid with renewables, decreasing the need for fossil fuel back-up.

Affordable: With a long-run levelized cost of electricity (LCOE) of $86/MWh, the NuScale Plant compares favorably to the next lowest cost option, natural gas combined cycle with carbon capture and sequestration (CCS), $85/MWh. At a ~$3bn overnight capital cost for a twelve NPM, 600 MWe NuScale Plant, the plant is within the financial capability of utilities that would consider similar sized coal or natural gas plants. We have included in the NuScale Power Summary Presentation a chart that compares the LCOE of a NuScale Plant, first plant and nth plant, to other technologies based on analyses and methodologies by the U.S. Energy Information Administration.

Attachments:

NuScale Power Summary Presentation
ICAPP 2015 published paper: "Can Nuclear Energy and Renewables be Friends?"
ICAPP 2016 published paper: "Highly Reliable Nuclear Power for Mission-Critical Applications"
White Paper: Upgrading America's Energy System