Testimony of NuScale Power before the
Committee on Energy and Natural Resources of the
U.S. Senate

Hearing to Examine the Status of Innovative Technologies Within the Nuclear Industry

Testimony provided by John L. Hopkins, Chairman and Chief Executive Officer, NuScale Power

May 17, 2016

Hearing to Examine the Status of Innovative Technologies Within the Nuclear Industry
Summary of Testimony provided by John L. Hopkins, NuScale Power
May 17, 2016

NuScale Power is the leading developer of American Small Modular Reactor (SMR) technology. This technology has been in development for more than 15 years. Our company is based in Corvallis, Oregon and majority-owned by the Fluor Corporation. We are advancing a unique and innovative SMR design, which offers the safest light water reactor nuclear technology that is near-term deployable.

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 patents issued or pending since 2011.

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.

We are preparing for our first deployment project known as the Utah Associated Municipal Power Systems (UAMPS) Carbon Free Power Project, which will be sited in Idaho, and possibly at a location on the Department of Energy's Idaho National Laboratory site. We expect to deliver our first project of twelve power modules in a 600MWe (gross) plant to UAMPS for an overnight price of approximately $3 Billion, with commercial operation commencing in 2024. Energy Northwest, which operates the Columbia Generating Station in Washington State, has joined this project, and holds a first right of offer to operate the UAMPS project.

In December 2013, the Department of Energy (DOE) selected NuScale as the sole awardee for funding in round two of the DOE's Small Modular Reactor Licensing Technical Support program, focusing on providing cost-share grants in support of licensing expenses. NuScale may receive up to $217MM of matching funds over 5 years. We are the only near-term deployable SMR developer receiving DOE funding support and we are proceeding full speed towards near-term commercialization. With the support from this funding, NuScale has expanded its workforce to include more than 600 people and has made substantial progress on the engineering, analysis, and testing needed to complete the design certification application for submittal to the NRC by the end of 2016. Successful completion of the DOE-funded SMR cost-share program depends on sustained Congressional support through continued appropriations. We appreciate your past support, and we ask that you continue to prioritize SMR programs in a tight budgetary environment.

A risk to the delivery of our technology as currently planned, is the uncertainty of the time and process for the NRC design certification and combined operating licensing efforts. In order to meet our customers' needs to deliver carbon-free electricity to their grids, we must be in position for commercial operations in 2024. NuScale has been engaged with the NRC on pre-application review efforts since April of 2008. We are on schedule to submit our Design Certification Application (DCA) by the end of 2016, and the NRC plan currently reflects a 40-month review schedule. We are currently working closely

with senior staff at NRC to complete final issuance of the NuScale Design Specific Review Standard, expected by the end of June 2016, which provides the acceptance criteria for their review of our DCA. We appreciate the quality interactions we continue to have with the Office of New Reactors and their dedication to a thorough and timely review. It is important that sufficient NRC resources are assigned to reviewing the NuScale application to ensure completion within this 40-month schedule, so that we can be in position to meet the growing marketplace demands for our carbon-free energy source.

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Hearing to Examine the Status of Innovative Technologies Within the Nuclear Industry

Written Testimony provided by John L. Hopkins, Chief Executive Officer, NuScale Power

May 27, 2016

NuScale Power is the leading developer of American Small Modular Reactor (SMR) Technology. For more than 15 years, our innovative company, based in Corvallis, Oregon and majority-owned by the Fluor Corporation, has been advancing a unique SMR design which offers the safest nuclear technology which is deployable in the near term. This significant advance, coupled with the deployment characteristics of our SMR design, can play a significant role in the future needs for baseload carbon-free electricity generation.

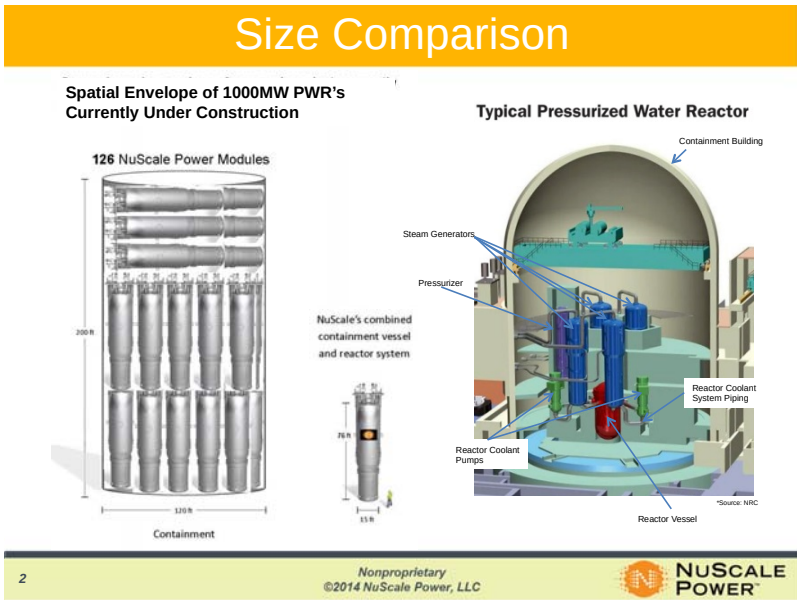
The genesis of our 50 MWe integral pressurized water reactor began over 15 years ago with a U.S. Department of Energy (DOE) grant through the Idaho National Laboratory and included the construction of a one-third scale electrically-heated prototype test facility to validate the safety features of the plant. This prototype has been in operation since 2003.

Unique Safety Features

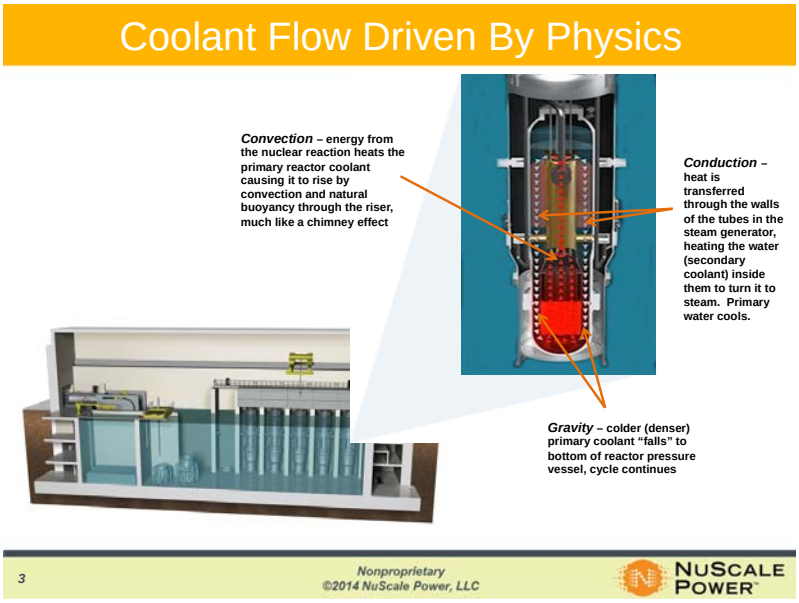
First, I will speak about the safety features of the NuScale SMR plant design. We eliminated many of the complex systems found in existing operating nuclear power plants and replaced them with a design which emphasizes the use of the natural forces of physics. The result of this unique design is a nuclear plant immune to the effects of a complete loss of all electricity sources to the generating facility, such as the situation that was experienced at Fukushima.

As shown in this illustration, 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 an event where all sources of electricity are absent, the NuScale Power Module (NPM) shuts itself down and self-cools for an indefinite period of time, with no operator action required, no need for additional water other than the 7.4-million gallon pool the NPMs are already immersed in, and no electricity. This capability has been demonstrated and witnessed by the U.S. Nuclear Regulatory Commission (NRC) and is protected by patents issued or pending since 2011.

How exactly does this work?



This picture illustrates the size of a 50MWe NPM compared to a typical 1000MWe-class plant operating today (on the right) and the spatial envelope of the containment buildings being constructed today in Georgia and South Carolina (on the left). The image on the right shows reactor coolant pump motors, steam generators, a reactor containment building, pressurizer and hundreds of feet of large-diameter thick-wall reactor coolant system piping through which approximately 20 million gallons per hour of high temperature reactor coolant water flow. The center image is the NPM which is a complete integrated nuclear steam supply system. It is a factory-built unit, including the containment, reactor vessel, steam generators and pressurizer, all contained in one cylindrical, road-transportable vessel (Note: By design the NPM does not contain reactor coolant pumps nor large diameter reactor coolant system piping).



The NPM uses simple forces of physics to drive the coolant flow, as shown in this illustration. The image on the right shows the NPM which includes an outer steel vessel (containment vessel) containing an inner vessel (reactor vessel), installed underground and in a 7.4-million-gallon pool of water. NPMs are installed in a reactor building pool designed to accommodate up to 12 NPMs. The NPM operates when the heat from nuclear fission in the reactor core, represented by the red area at the bottom of the diagram, heats pressurized water causing the water to rise by buoyancy and convection through the bronze-colored tube, much like a chimney-effect. The bronze-colored tube is surrounded by coiled tubes containing cooler water. As the hot water passes over these tubes it gives up energy by transferring heat from the hotter water to the cooler water by conduction through the walls of the tubes, causing the internal water to turn to steam. The steam is then directed to rotate a turbine and generate electricity. As the hot water gives up energy, it becomes cooler, and thus denser, which causes it to fall by gravity to the bottom of the reactor vessel where the natural circulation flow cycle continues. The NPM eliminates many of the electrically-driven components required to protect the core found in today's conventional nuclear plants. That is, in the NuScale design, electricity is simply not required to protect the core.

The Role of the U.S. DOE in SMR Technology Development

In the early 2000's, Congress authorized a program known as NP-2010, to stimulate the revival of the U.S. nuclear industry with a cost-share of the private sector investments in design and licensing. This program resulted in the certification of two new nuclear plant designs, one of which is being built today in Georgia and South Carolina. Of note, the design certification testing for that design was performed under contract to the designer by NuScale founder and Chief Technology Officer, Dr. Jose Reyes, on facilities he designed and which were constructed adjacent to where the NuScale test facility is located in Corvallis, Oregon.

Congress also authorized a similar program for Small Modular Reactor design and licensing cost sharing. In December 2013 DOE selected NuScale as the sole awardee for funding in round two of DOE's SMR program, focusing on providing cost-share grants in support of licensing expenses. As such, we may

receive up to $217 million of matching funds to aid in funding the approximately $1 billion necessary to complete the design and license it for construction. We have spent approximately $420 million on the project to-date, including about 60% of our DOE award. Successful completion of the SMR cost-share program depends on sustained Congressional support through continued appropriations. We appreciate your past support, and ask that you continue to prioritize SMR programs in a tight budgetary environment.

A substantial portion of DOE's cost-shared funding will help pay for NRC fees required of all NRC applicants. To date, NuScale has incurred over $6 million in NRC fees to pay for the approximately 20,000 hours of NRC staff time utilized to date. We estimate we will incur a total of approximately $60 million in NRC fees by the time we complete the 40-month review of our design application.

The Importance of Timely NRC Design Certification and Combined Operating License Actions

In order to ensure that the NuScale design is ready to meet the needs of our prospective customer base as they begin to reduce their reliance on carbon-generating assets, we will need the NRC to complete preparations for the receipt of our design certification application and to conduct the design certification review in a timeframe that meets these needs. We hear two consistent concerns from prospective customers and investors: 1) regulatory uncertainty—will regulations change in mid-process?, and 2) skepticism the NRC can complete their review in the 40 months the NRC has planned.

NuScale is aggressively working with the NRC to address both of these concerns. With respect to regulatory uncertainty, we have engaged the NRC in pre-application submittal preparation since early 2008, in order to prepare the NRC for how we will develop the design certification application in the context of the unique features of our design. Together with the NRC we have collaboratively identified additional remaining technical, licensing and policy issues to be addressed by the end of 2016.
With respect to the NRC's ability to conduct the Design Certification Application review within 40 months, we see two critical issues to address: 1) extending the NRC's review time on critical areas by submitting portions of the design in advance; and 2) obtaining dedicated NRC staff resources to review our design. To address the first issue NuScale is submitting portions of our application early, in the form of what are known as topical reports, on 13 specific aspects of the design. Seven of these are under NRC review and six will be submitted in the next 4 months. By submitting these reports, we effectively extend the staff's review time and reduce the scope of work that needs to be done when the remainder of the application is submitted. Regarding the second issue, the NRC reviewed the initial wave of applications submitted for design certifications using a matrix organization, where the same staff person reviewed multiple designs. While that approach is efficient and makes sense when all the designs are similar, such an approach may create more schedule risk for a unique design such as NuScale's. Therefore, we believe a dedicated NRC staff review team, whose members' sole function is to review the NuScale design, is more likely to meet the NRC's commitment to 40 months. Such a focused approach would help to ensure that sufficient resources are identified for the review in advance of the submittal and that staff can be trained on the unique safety features of our design prior to submittal of the application. We have been working collaboratively with the NRC to help develop this approach.

Customers and Markets

The most important element for the success of our program is whether there will be market demand for non-carbon-generating baseload electricity. Our prospective customers are faced with increasing

carbon regulation, accelerated coal plant retirements, and increased integration of intermittent renewable generation assets from wind and solar. The NPM is uniquely positioned to provide a baseload resource that meets these needs and is complementary to renewables by being designed for load-following. And, since a NuScale plant consists of twelve individual power modules, it has the ability to load follow incrementally by varying the output of individual modules to match variations in intermittent generation.

The first deployment of a NuScale plant is currently designated for the Utah Associated Municipal Power Systems (UAMPS) for the project known as the "UAMPS Carbon Free Power Project (UAMPS CFPP)." UAMPS's project contemplates commercial operation of the first NPM in 2024. The plant will be located in Idaho, possibly at the DOE's Idaho National Laboratory site. The exact location is currently being identified through a rigorous site selection process. Energy Northwest has joined this project by holding the first right of offer to operate the UAMPS project.

The NuScale plant is expected to be delivered to UAMPS for a price of approximately $3 billion. We plan to construct it on a schedule of approximately 36 months from the start of safety-related construction through commissioning of the first module.

Conclusion

NuScale is proud to be developing a new innovative Small Modular Reactor technology for the deployment of a nuclear power generating asset that sets a new safety standard for nuclear energy facilities, is carbon-free, factory-built, incrementally deployable, and significantly less costly than large generating units. The NuScale Power Module is a disruptive technology that will change the way the world views nuclear energy, and it will play an important role in next generation deployment of baseload electricity. We are grateful for the support of the U.S. DOE and the Congress. We take the responsibilities associated with the use of taxpayer dollars, very seriously and are singularly focused on our role in the re-establishment of U.S. leadership in small modular reactor nuclear technology.