TESTIMONY OF

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"ADVANCING NUCLEAR ENERGY: POWERING THE FUTURE"

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Chairman Weber, Ranking Member Veasey and members of the subcommittee, it is a pleasure to be with you today. I'm grateful for the opportunity to testify on implementation of S.97, the Nuclear Energy Innovation Capabilities Act (NEICA). I want to thank this subcommittee, and your colleagues in the Senate, for the vision, hard work and persistence it took to get this important legislation signed into law.

The NEICA bill takes significant steps to reestablish U.S. leadership in nuclear energy and support private sector development and deployment of advanced reactors.

NEICA makes the unique capabilities of the Department of Energy's national laboratories available to the private sector and academia to accelerate innovation for advanced reactor development and deployment.

This far-reaching legislation:

- directs DOE to construct a Versatile Reactor-Based Fast Neutron Source;
- directs DOE to establish a National Reactor Innovation Center (NRIC);
- authorizes enhanced modelling and simulation capabilities to support advanced reactor development;
- and authorizes a cost-share grant program that will cover Nuclear Regulatory Commission fees to speed bringing advanced reactors to market.

My testimony will touch on how INL and other national labs will use these expanded authorities to support the private sector effort to deploy advanced reactors.

Let's talk about the Versatile Reactor-Based Fast Neutron Source, or what we refer to as the Versatile Test Reactor (VTR):

A fast neutron test reactor is needed to support testing of advanced fuels, materials, instrumentation and sensors. Importantly, this is a capability the U.S. does not possess.

Development and construction of this test reactor will eliminate reliance on Russia for these irradiation tests and reposition the U.S. at the forefront of developing and improving new nuclear energy systems.

In a parallel track with the NEICA bill, the need for this capability was recognized in February 2017 when a DOE Nuclear Energy Advisory Committee (NEAC) report recommended that the Office of Nuclear Energy "proceed immediately with pre-conceptual planning activities to support a new test reactor."

Since publication of this report, and as the NEICA bill moved through Congress, a multi-disciplinary team of national labs, private companies and universities have been assembled to develop the pre-conceptual design.

Following extensive engagement with relevant stakeholders, we have developed the functional requirements for the VTR. The mission need document, “Critical Decision (CD)-0 in DOE Order 413,” is being prepared by DOE for submittal in January 2019.

Last week, $3.5 million in university awards were announced, to address various technical aspects related to the VTR.

Earlier this month, we selected several initial university proposals to participate in the VTR progam, with an emphasis on experimental designs, and we are negotiating the terms of the contracts.

In the near future, INL will award a contract to an industry partner to complete the conceptual design and cost estimate for the VTR. The current schedule calls for a completed conceptual design and cost and schedule estimate, as input to CD-1 in DOE Order 413, to be completed in 2021.

At that time, assuming approval of the CD-1 package, DOE can proceed with a procurement to hire an engineering and design company to complete the final design and construction of the VTR.

Throughout this process, under the direction of the Office of Nuclear Energy, the national laboratory, industry and university team is defining the long-term experimental program to meet U.S. industry and government needs.

The current schedule calls for the VTR to be operational by October 2026.

Next, I’d like to discuss establishment of a National Reactor Innovation Center (NRIC) to support advanced reactor development and demonstration.

In many ways, this approach harkens back to the decision in 1949 to establish the National Reactor Testing Station at what is now Idaho National Laboratory.

On this 890 square-mile site in the Idaho desert, the U.S. government - including the nuclear Navy - and the private sector built, tested and demonstrated first-of-a-kind reactors that were later deployed around the world. The efforts in those days established U.S. nuclear technology leadership around the world for decades.

We see the NRIC as a place where government and private companies can come to INL to test and demonstrate new reactor designs, as well as materials, fuels and other nuclear energy technologies. The NRIC at INL includes:

- Sites for testing and demonstration of new and novel reactors;
- Facilities that support research and development of advanced materials and fuels through unique R&D facilities for fuel fabrication, irradiation, and characterization;

- Integration of high-performance computing capabilities with experimental capabilities to create a new digital engineering approach to nuclear reactor development; and
- Laboratory, industry, and university partnerships to support the future workforce through training and education.

As was done in the past for light water reactors, such testing will enable advanced reactor deployment by demonstrating nuclear system operating performance, safety security and resilience, and providing data and experience for licensing and benchmarking of new computer modeling and simulation tools. It will improve safety performance, operating codes and security resilience of fuels and reactors.

In a manner that continues our leadership role for the DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative, INL will serve as the interface to bring all of the national lab and university capabilities together to address the challenges brought to us by the private sector.

Finally, NEICA calls for expanded high performance computing (HPC) modelling and simulation capabilities to develop new reactor technologies.

DOE currently has two programs - the Nuclear Energy Advanced Modeling and Simulation (NEAMS) program and the Consortium for the Advanced Simulation (CASL) Energy Innovation Hub - that are focused on bringing advancements in HPC to nuclear energy.

These programs have made outstanding progress over the past decade for both current operating reactors and future advanced designs. In order to achieve the vision outlined in NEICA, experts in modeling and simulation at the national laboratories, along with federal staff in the DOE Office of Nuclear Energy, are formulating an ambitious plan for the future of nuclear energy modeling and simulation as a single program to start in 2020 that I'm calling "ModSim2020."

The vision for ModSim2020 is transformation, through advanced modeling and simulation, of the nuclear system design and regulation paradigm from reliance primarily on empirical data to reliance on predictive simulations supported with limited experimental data. This program will focus on accelerating the development and deployment of advanced nuclear technologies through integration of modeling and simulation with experimental capabilities and programs.

ModSim2020 will take advantage of developments in the Office of Science Advanced Scientific Computing Research (ASCR) program through leadership computing facilities, the exascale program and related software development.

INL also is developing engineering-scale computing resources, through a new Collaborative Computing Center (C3), that will bring expertise and computing resources to support national laboratory, university and industry research, development and education.

NEICA truly arrived at just the right moment:

I say that because NuScale and the Utah Associated Municipal Power Systems (UAMPS), a consortium that serves more than 40 communities in seven western states, are looking to deploy the first small modular nuclear reactors at INL by 2026.

This project has been strongly and consistently supported by Congress.

Through the Joint Use Modular Plant (JUMP) program, and a potential power purchase agreement, DOE and INL are partners in the effort to deploy small reactors and develop a potentially large export market for U.S. industry.

DOE and INL are engaging with the Department of Defense (DoD), as recently encouraged by the National Defense Authorization Act, to develop microreactors and allow critical national security infrastructure, such as military bases, to be self-sufficient for their power needs.

These microreactors could also be used by forward-deployed U.S. military forces and remote communities in places like Alaska.

DOE and INL are working with NASA to look at advanced reactors that could support the power needs for manned space missions.

To summarize, both the private and public sectors have a great need for advanced reactor technologies. NEICA will help us meet those needs and ensure a future that is prosperous, clean, secure and resilient.

I also was asked to address issues where legislative direction and support could help us speed the deployment of advanced reactor technologies.

I'd like to highlight one of the most important areas where additional support is needed: helping DOE make high-assay, low-enriched uranium (HALEU) fuel available for advanced reactor companies – fuel with uranium-235 enrichment greater than the 5 percent enrichment commercially available today and less than the 20 percent-enrichment safeguards limit.

The U.S. does not have commercial capability to produce this fuel, and DOE is embarking on a couple paths to respond to this need.

At INL, we have identified two potential sources of HALEU that DOE might be able to make available, but funding will be needed to prepare the material for subsequent fuel fabrication.

I'll conclude by saying that implementing the NEICA vision – and establishing a National Reactor Innovation Center - will challenge the DOE to develop new agreements and contracting mechanisms that enable more effective private-public partnerships, in which DOE assets and laboratory personnel are contracted to support private demonstration efforts.

I appreciate the opportunity to testify and I want to thank you again for your support and passage of the NEICA legislation. I look forward to your questions.

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Dr. John C. Wagner is the associate laboratory director of INL's Nuclear Science & Technology (NS&T) directorate. His previous roles included director of Domestic Programs in NS&T as well as director of the Technical Integration Office for the DOE-NE Light Water Reactor Sustainability Program at INL. Wagner initially joined INL as the chief scientist at the Materials and Fuels Complex in 2016. He has more than 20 years of experience performing research, and managing and leading research and development projects, programs and organizations.

Wagner received a B.S. in nuclear engineering from the Missouri University of Science and Technology in 1992, and M.S. and Ph.D. degrees from the Pennsylvania State University in 1994 and 1997, respectively. Following graduate school, Wagner joined Holtec International as a principal engineer, performing criticality safety analyses and licensing activities for spent fuel storage pools and storage and transportation casks. Wagner joined the Oak Ridge National Laboratory (ORNL) as an R&D staff member in 1999, performing research in the areas of hybrid (Monte Carlo/deterministic) radiation transport methods, burnup credit criticality safety, and spent nuclear fuel characterization and safety.

While at ORNL, Wagner held various technical leadership positions, including technical lead for postclosure criticality in support of DOE OCRWM's Lead Laboratory for Repository Systems, Radiation Transport Methods Deputy Focus Area lead for the Consortium for Advanced Simulation of Light Water Reactors (CASL), and national technical director of the DOE Office of Nuclear Energy's Nuclear Fuels Storage and Transportation Planning Project. Wagner also held various management positions, including group leader for the Criticality and Shielding Methods and Applications, Radiation Transport, and Used Fuel Systems groups.

In 2014, Wagner became director of the Reactor and Nuclear Systems Division (RNSD), with responsibility for management direction and leadership to focus and integrate the seven RNSD R&D groups (Advanced Reactor Systems and Safety, Nuclear Data and Criticality Safety, Nuclear Security Modeling, Radiation Transport, Reactor Physics, Thermal Hydraulics and Irradiation Engineering, and Used Fuel Systems) and the Radiation Safety Information Computational Center. Wagner is a Fellow of the American Nuclear Society and recipient of the 2013 E.O. Lawrence Award. He has authored or co-authored more than 170 refereed journal and conference articles, technical reports, and conference summaries. He was the original developer of the A3MCNP and ADVANTG codes and led the development of the CADIS and Forward-Weighted CADIS hybrid transport methods.

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