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"American Nuclear Energy Expansion: Powering a Clean and Secure Future"

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Chairman Duncan, Vice-Chairman Curtis, Ranking Member DeGette and members of the committee, it is an honor and privilege to be here today. My name is Jess Gehin, and I am the associate laboratory director for Nuclear Science and Technology at Idaho National Laboratory. INL is a United States Department of Energy national laboratory with approximately 5,800 scientists, engineers and support staff, multiple nuclear and non-nuclear experimental facilities, and an annual budget of more than $1.6 billion with a mission focused on nuclear energy, national and homeland security, and energy and environmental science and technology.

INL is the nation's nuclear energy research and development center. Work on 52 test reactors on our 890-square-mile Site starting in the 1950s helped establish a commercial nuclear energy industry that today generates nearly 20% of America's electricity and more than half of our zero-carbon electricity. That's more than all other electricity generation sources combined.

A brief snapshot of INL's rich history in nuclear energy includes:

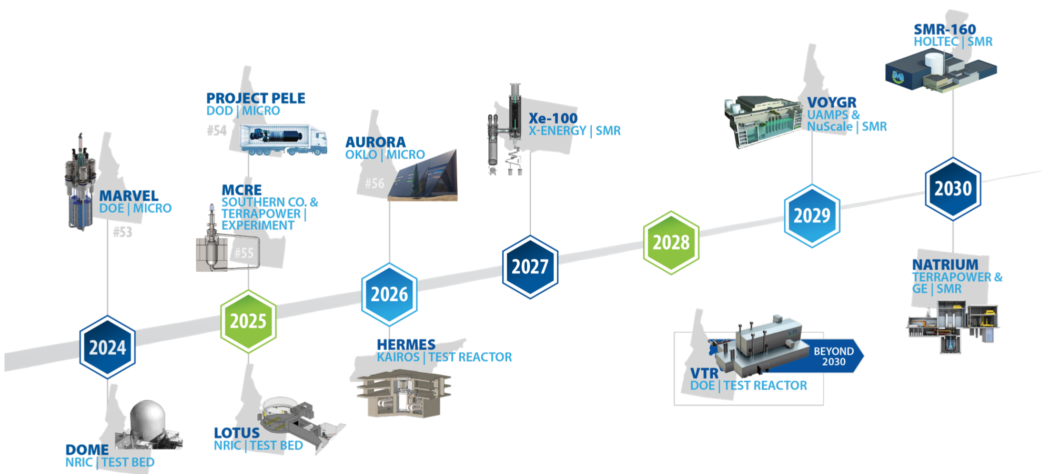
- Creating the first nuclear power plant.
- Becoming the first place to power a city using nuclear energy.
- Testing the first submarine reactor.
- Developing the first mobile nuclear power plant for the U.S. Army.
- Demonstrating the self-sustaining fuel cycle.
- Developing the basis for light water reactor safety.

Today, INL plays an important role in areas vital to the U.S. economy, national security and the environment. We help maintain and extend the lives of America's high-performing nuclear reactor fleet; work with industry to demonstrate and deploy the next generation of nuclear reactors; and partner with the U.S. Navy on testing vital to its nuclear powered fleet, which for decades has been a force for good in the world.

INL works directly with reactor developers on the research and development needed to bring their reactor concepts to the commercial market where they can serve our citizens and communities. There are many examples of this, including the TerraPower Natrium reactor in Wyoming; and the NuScale Power small modular reactor, which will be built and operated on the INL Site and generate zero-carbon power for the Utah Associated Municipal Power Systems (UAMPS) and its customers in six western states. The Tennessee Valley Authority has also announced planning for a General Electric BWRX-300 reactor to be sited at their Clinch River Site in Tennessee, with the potential for several additional deployments in their system.

Importantly, INL does not compete with the private sector. Our role, as it has been for roughly seven decades, is to conduct the science industry needs to fill gaps, eliminate barriers and move their reactor concepts closer to commercialization.

To accomplish this, INL works closely with the Gateway for Accelerated Innovation in Nuclear and Nuclear Reactor Innovation Center to partner with the private sector and resolve technical issues impeding deployment. INL is establishing test beds to advance this work. The DOME and LOTUS test beds are scheduled for completion in the next few years. In the next couple years, INL will begin operating the 53rd, 54th and 55th reactors on the Site: the Microreactor Applications Research Validation and EvaLuation, or MARVEL, microreactor; Project Pele, a microreactor being developed with the Department of Defense; and the Molten Chloride Reactor Experiment, or MCRE, a molten salt reactor experiment being developed in partnership with Southern Company and TerraPower. Numerous other advanced reactor projects are also planned to be demonstrated before the end of this decade, including the projects listed on INL's advanced reactor timeline below.



Before moving on, I'd like to provide a little about myself. I have a long background in nuclear energy, with nuclear engineering degrees from Kansas State University and masters and doctorate degrees from the Massachusetts Institute of Technology. Prior to becoming associate laboratory director, I was the chief scientist for Nuclear Science and Technology at INL, with established experience in nuclear core physics, reactor core and system technologies, rector modeling and simulation, and fuel cycle applications of reactors. I formerly led key programs for the department's Office of Nuclear Energy. I am a Fellow of the American Nuclear Society.

I want to thank members of this committee for their long-standing and unwavering support for the U.S. commercial nuclear industry and for maintaining and expanding our global leadership in nuclear technology.

And I appreciate this opportunity to discuss issues of great importance to our nation.

Background

As background, I would like to provide a brief summary of the current U.S. nuclear energy landscape. The United States once built and deployed nuclear reactors regularly. And we maintained a robust domestic fuel cycle capability, from mining to conversion to enrichment to fuel fabrication.

Currently, 92 high-performing reactors make up the U.S. domestic fleet. This is soon to increase to 93 and 94 with the completion and startup of units 3 and 4 at the Vogtle site in Georgia. Our current reactors run on low enriched uranium, or LEU, uranium fuel that is enriched up to 5% with uranium-235. The United States is highly reliant on other nations for uranium needed to operate our reactor fleet.

Currently, our nation imports over 90% of the uranium needed for our reactor fleet. In the United States, uranium mining has decreased 92% since 1980. In 2021, the United States domestically produced only 5% of the uranium purchased, according to the U.S. government's Energy Information Administration.

This uranium must be enriched to fuel our reactors, and currently we have limited ability to perform this enrichment in the U.S. Only one enrichment facility operates domestically, the Urenco USA plant in New Mexico, with the capacity to support about one third of the current reactor fleet, according to information compiled by the Urenco Group. The remainder is obtained by importing enriched uranium.

The advanced reactor development that I will discuss later requires high assay low enriched uranium, called HALEU, with enrichments up to 20% U-235. We have had no ability to produce HALEU in the U.S. There are developments to establish a capability with Centrus receiving Nuclear Regulatory Commission approval in 2021 to make HALEU at its enrichment facility in Ohio. It is the only licensed HALEU production facility in the United States.

But our lack of domestic fuel cycle capabilities is already hurting efforts to deploy the next generation of technologies needed to allow our commercial fleet to produce 24/7, carbon free power more than 92% of the time – more reliably than any other source of generation. TerraPower recently extended the timetable on its Wyoming-based Natrium reactor because of concerns about fuel availability.

A positive outcome has been the bipartisan passage of key nuclear energy-related legislation in recent years, demonstrating that there is a broad understanding and consensus on nuclear energy's importance to our nation's economy, environment, national security, and power grid stability, security and resiliency. This legislation and funding support provides a start to reestablish the domestic nuclear enterprise for advanced reactors and the fuel supply they require.

As we look to the future of nuclear energy in the United States, I would encourage members of this committee to consider the following questions related to sustaining the current nuclear reactor fleet, expanding deployment of advanced reactor technologies, and waste storage and disposition.

1. **How do we leverage our existing nuclear industry to ensure our domestic energy security**?

As stated above, we have 92 operating reactors providing a tremendous resource for the U.S. A key imperative is to ensure these reactors continue to provide clean and reliable power. Economic conditions have resulted in some reactors being shut down. We cannot allow more reactors to be shut down and we need to extend the life of remaining reactors.

Here are important things that the industry needs:

First, we must ensure that our plants are not subject to economic variations that can result in them being shut down prematurely. Thanks to recent state actions and legislation that provided the Civil Nuclear Credit program, there are resources to keep the plants running. Additional legislation leveled the playing field for energy by enabling tax credits for expanded operations.

The Inflation Reduction Act created a nuclear power production tax credit to support existing nuclear generators and delay potential retirements that would increase greenhouse gas emissions. This support for existing nuclear generation expands on the Civil Nuclear Credit Program established in the Bipartisan Infrastructure Law.

As mentioned previously, our reactors require a reliable supply of uranium and enrichment services. According to the Energy Information Administration, owners and operators of U.S. nuclear power reactors purchased the equivalent of roughly 47 million pounds of uranium in 2021. Of that, 35% came from Kazakhstan, 15% from Canada, and 14% from both Australia and Russia.

The Russian invasion of Ukraine puts the United States, and many other nations, in a precarious situation. The deteriorating relationship between our nations has resulted in increasing pressure, including from members of Congress, to end uranium imports from Russia. This would require us to identify a path to operate our existing and future reactors without Russian-imported uranium and supporting enrichment services.

In the short term, a reduction in supply, naturally, drives up costs. Given the already tenuous financial status of many U.S. nuclear power plants, this could result in even more premature closures, leading to more carbon emissions from other generation sources and a less reliable and resilient power grid.

We know that being dependent on foreign nations, including those who do not have our best interests at heart, is both a national security and economic risk. We also know the national security benefits that come with a strong civil nuclear energy industry.

Addressing these issues and continuing to operate our current fleet of reactors benefits our nation, beyond the energy that these plants provide.

2) **How do we ensure successful deployment of new nuclear energy that is critical to our energy security, global leadership and climate objectives**?

While we must sustain operations of our existing commercial reactors, we also need to look to the future and support the advanced technologies that will help power American prosperity for decades to come.

The recent DOE report on the Pathways to Commercial Liftoff: Advanced Nuclear (https://liftoff.energy.gov/) states that the domestic nuclear capacity has the potential to triple by 2050. That is an increase to 300 GWe from the current 100 GWe. This ambitious goal requires us to aggressively develop, demonstrate and deploy new reactors.

Demonstrating reactors is one of the first steps to achieve this goal. To that end, we are making significant progress in demonstrating and deploying first-of-a-kind advanced reactors in the next decade. That includes DOE-authorized reactors on the INL Site, such as MARVEL and MCRE. These reactors will greatly expand our knowledge and, importantly, prove that the U.S. once again can develop new reactor technologies. MARVEL is scheduled to become operational late next year. This will be the first new reactor deployed on the INL Site in a half-century.

Additional reactors will be demonstrated at INL through test beds established by the National Reactor Innovation Center. In 2024, INL will open the DOME Test Bed that will support microreactor demonstrations, and the LOTUS Test Bed to enable other advanced reactor experiments and demonstrations, the first being MCRE.

Commercial demonstrations are planned later this decade on our site in Idaho, in Wyoming, and on the Gulf Coast. That includes developing and deploying NuScale Power's small modular reactor for UAMPS. The centerpiece of UAMPS' Carbon Free Power Project, the NuScale reactor will begin producing electricity for customers in six western states in 2029. The TerraPower Natrium reactor will be deployed in Wyoming, and the X-energy Xe-100 reactors will be deployed at sites on the Texas coast.

Deploying these reactors will require a supply chain for high assay low enriched uranium. While announcing a $150 million cost-shared award with American Centrifuge Operating in November 2022 to demonstrate the nation's ability to produce HALEU, DOE said it projects that more than 40 metric tons of HALEU will be needed before the end of this decade to deploy a new fleet of advanced reactors and support the Administration's goal of 100% clean electricity by 2035.

The IRA recognized – and funded – the need to develop a supply chain for advanced reactors. This funding provides a unique opportunity to help the U.S. nuclear energy industry become more competitive globally by ensuring a domestic supply of HALEU.

We also need to support the current needs of advanced reactor developers and near-term demonstrations while new capabilities are deployed. At INL, we are working to supply HALEU from DOE-owned materials, including processing Experimental Breeder Reactor-II spent fuel, to recover the uranium and down-blend it to HALEU to create limited supply. This material is not the only existing spent fuel in the DOE system that could be applied for HALEU production, and we should invest in recovering these materials to provide a bridge until a commercial HALEU supply is available.

Other provisions within the IRA are vital for the nuclear energy industry because they place nuclear on a level playing field with other forms of power production to support increased deployments.

The IRA transitions from the current technology-specific tax credits for renewable energy into technology-neutral credits that place advanced nuclear energy on a level playing field with other zero-carbon generation. The credits are available beginning in 2025 as either production tax credits or investment tax credits. These tax credits will likely improve access to financing for advanced nuclear projects, in the same way that such credits have for renewable projects.

Additional tax incentives are available for projects located in "energy communities," including those with high employment in fossil fuel extraction, brownfield sites, or where coal mines or coal-fired power plants have closed. Retired coal generation sites, such as the Wyoming site for TerraPower's Natrium demonstration project, may be particularly suitable for advanced nuclear projects, which are compact enough to locate on the site; in addition, the projects can benefit from existing transmission and water supply infrastructure.

But much more remains to be done. As we move toward deployment of advanced reactors, to power our economy and combat climate change, we need to accelerate deployment of a self-sufficient, domestic HALEU fuel cycle.

3) **How does nuclear energy support our national security interests**?

American ingenuity created the nuclear energy industry. The majority of reactors around the world are based on U.S. technology. As a result, our safety and nonproliferation standards are the world's standards. But as the U.S. nuclear energy industry has been stuck in neutral for decades, other nations have moved forward. That includes Russia and China, which has plans to develop approximately 30 reactors around the world, in nations such as Pakistan, Nigeria, Egypt, Indonesia and Malaysia.

The world needs us. It needs American experience, expertise and values. It needs the U.S. government – working with industry and academia – to set safety and nonproliferation standards as we enter a new era of nuclear energy production.

We cannot abdicate our world leadership in nuclear energy development and deployment. When we build new systems – and export our technologies, materials and services – we also export our values, and so much more.

A nuclear power plant is designed to operate for six to eight decades. When a country sells a nuclear reactor to another nation, it begins what can be a century-long relationship that encompasses many areas.

There are fuel purchases, maintenance, technical support, and other supply and service contracts. There also is cooperation between buyer and seller nations in the areas of:

- Education.
- Research and development.
- Training.
- Cyber and physical security.
- Environmental protection.
- Safety and nonproliferation.

We know that more nations in Asia, Africa, South America and the Middle East are interested in nuclear energy, to generate clean, reliable and secure electricity; to desalinate water; to produce hydrogen; to power remote communities; and more. These nations will look for developers who can quickly, safely, affordably and effectively develop a reactor and get it deployed.

And because U.S. developers are not competing on equal terms, too many of these nations will turn to China, Russia or our friends in South Korea. This presents not just a missed opportunity, but in the case of Russian and Chinese expansion, a danger to U.S. national security.

Nobody should feel good about the Russians setting world standards for safety and nonproliferation. Nor should the U.S. cede world leadership to China in this crucial area.

But given the momentum we have built and the innovations taking place in developing advanced reactors, we have an opportunity to reestablish our world leadership in nuclear energy. There is much we can do as a nation to catch up to, and pass, our competitors and regain our status as the leader in nuclear energy technology and development.

That includes working with our close allies on the uranium supply and developing new domestic mining, conversion and enrichment capabilities, with urgency, to ensure the availability of a domestic supply of fuel, provide certainty to our existing fleet of nuclear power plants, and help ensure our domestic energy security.

4. **How can the regulatory process be improved to accelerate deployment of nuclear plants**?

The United States benefits from the Nuclear Regulatory Commission, which is viewed as the world leader in nuclear safety licensing and regulation. While acknowledging the important nuclear safety role satisfied by the NRC, it is apparent that one of the most significant time and resource intensive activities for new reactor developers is the NRC licensing process.

To enable timely demonstrations and support large-scale deployment we need an effective and efficient licensing process. The challenge is particularly acute for advanced reactors, which may raise unique regulatory questions and be smaller in size, resulting in a much higher proportional impact from regulatory and cost challenges. This situation presents a risk given the urgency utilities are working to transition to clean, noncarbon-emitting energy sources like nuclear energy.

The NRC is undertaking rulemaking to provide a risk-informed, technology-inclusive framework for commercial nuclear plants, 10 CFR 53, that when finalized will be used for future advanced reactor licensing. The NRC also is taking steps to enable a variant of reactors in the areas of emergency planning and environmental reviews and is looking at licensing fees.

But what else can be done? Some of the areas for improvement include:

- Regulatory time frames could be sped up by looking at reforms to hearings that are currently mandatory. This should include reviewing the requirements for mandatory hearings, alignment of hearings, and simplifying legislative hearing processes. Public meeting requirements for information exchange also can add significant time to the regulatory process.

- An important part of licensing includes environmental reviews, which could be expedited by clarifying the NRC safety-focused mission state to specifically include objectives for timely and efficient reviews similar to other safety-focused regulatory agencies such as the Federal Aviation Administration and the Food and Drug Administration

- Roles of bodies within the NRC, including the Advisory Committee on Reactor Safeguards, should be clarified to ensure that they are focused and not onerous. And there could be specific provisions to accelerate NEPA reviews for noncommercial reactor projects on DOE sites.

- The NRC licensing process could provide more schedule certainty by strengthening the requirements for NRC milestones for new reactor licensing activities by including shorter timelines, more rigid reporting requirements, and accounting for the full duration of licensing activities. This could be enabled by having an independent review team shadow an entire NRC licensing review start to finish and provide recommendations to further accelerate the licensing process.

- The schedules and fee structures should also be reflective of the scale and complexity of the reactor designs being licensed. Advanced reactors come in a range of sizes and simplified designs and

- Finally, there are areas that could provide financial benefits to encourage reactor demonstrations, such as modifying the fee structure including eliminating fees for pre-licensing activities and early site permits, as well as changes that could encourage international investment. In addition, we should indefinitely extend the Price-Anderson Act coverage for nuclear hazards indemnification for covered DOE contractors and NRC licenses. The Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) act introduced in the Senate recently includes these points.

4. **How do we address the back end of the fuel cycle**?

There is a need to address our near- and long-term spent fuel management responsibilities. We have the technical capacity and knowledge to responsibly and safely manage spent nuclear fuel, but we need the support of an appropriate policy solution.

The Nuclear Waste Policy Act (NWPA of 1982), and as amended in 1987, understandably reflects the national priorities and concerns of the time. There have been various attempts to further amend the NWPA to better reflect the nuclear waste management realities, policies and needs of today, but none have succeeded.

Simply put, the present framework for interim storage and disposal of the U.S. spent fuel inventory is inadequate to meet the challenges of today or tomorrow. We need a new policy framework.

The near-term deployment of consolidated interim storage would be a useful component of an integrated waste management system, but the need for deep geologic disposal capacity remains.

Congress has directed DOE to use a consent-based siting approach in the pursuit of federal consolidated interim storage for the nation's spent nuclear fuel inventory. However, federal interim storage facilities of sufficient capacity cannot be constructed without revising the NWPA to remove the prerequisite for repository construction authorization and inadequate capacity limits.

Recycling remains a potential option for industry and policymakers to consider. Recycling material can allow for better utilization of fuel resources as well as provide benefits for waste disposition. INL, and other national laboratories, are conducting research and development in this area and more is needed to determine how to improve the economics of recycling while better understanding the proliferation risks to be able to deploy these technologies with confidence.

As stated earlier, INL is working to supply HALEU by recovering it from DOE-owned used fuel. We are doing this by processing the high-enriched uranium spent fuel to recover the uranium and down-blend it to HALEU. This work not only benefits private sector companies looking to develop and deploy advanced reactors, but also establishes capabilities that allow us to better understand the recycling process. However, increased research is needed to support recycling as a fuel cycle option and maintain our capabilities and expertise.

I will conclude with this:

Private-sector companies contemplating investments in nuclear energy find themselves in a difficult situation. A fuel supply dependent on imports, and now in doubt considering the Russian-Ukraine conflict, breeds uncertainty and stifles investments in the advanced technologies our nation needs.

More certainty in the fuel cycle, by developing a 100% domestic HALEU supply, would help alleviate uncertainty and inspire investments in microreactor technologies, small modular reactors, and other advanced nuclear technologies now in development.

More flexible regulations, which do not compromise safety but reflect the changing needs of advanced reactors, would help cut the time and expense of developing and deploying the advanced nuclear technologies our nation needs to power the economy and protect our environment.

Addressing our spent fuel and waste management obligations would boost public confidence in the nuclear energy industry, offer certainty to nuclear plant operators, utilities and communities where spent fuel is being safely stored.

I appreciate the opportunity to testify, and I want to thank the committee again for its attention to this important issue for our nation. I look forward to your questions.