Written Testimony of
Dr. Jacob DeWitte
CEO and Co-Founder, Oklo Inc.

Before the Committee on Energy and Natural Resources
United States Senate

Status of Advanced Nuclear Reactor Technologies

May 17, 2016

Written Testimony

Chairman Murkowski, Ranking Member Cantwell, and distinguished members of this Committee, I want to thank you for holding this hearing and for giving me the opportunity to testify. I am honored to be here today.

I am Jacob DeWitte, co-founder and CEO of Oklo Inc. We are a Silicon Valley based company developing and building a very small reactor. We are working on a 2 MW compact fast reactor designed to bring distributed, clean, affordable, and reliable nuclear power to the market. These reactors fit into a containerized system that can bring power to a wide variety of markets both domestically and internationally that do not have access to affordable and reliable power, and in some cases do not have access to power at all. Our reactor operates purely on natural forces, with very few moving parts in the entire system, and is designed to operate for 12 years before refueling with no emissions. It is sized appropriately to open up new opportunities for clean and safe nuclear power in remote, rural, and native communities, as well as industrial and military sites in areas that have previously been too small to support larger reactors. This system has the potential to reduce these customer's energy bills by up to 90%. Furthermore, our reactor is up to 300 times more fuel efficient than current reactors, and can consume the used fuel from today's reactors, as well as the depleted uranium stockpiles around the nation. In fact, our reactors, and others like it, could power the world for 500 years with the global inventory of used fuel and depleted uranium, all while reducing the radioactive lifetime of those materials. Our reactors can also assist with plutonium disposition by consuming excess cold war era materials and turning them into clean, peaceful energy.

I am excited that you are holding this hearing on advanced nuclear reactors because it something I have been passionate about since my childhood. I was born and raised in Albuquerque, New Mexico, where my Saturdays as a young boy were often filled by my father taking me to get donuts in the morning, and then going to the National Atomic Museum, now known as the National Nuclear Science Museum. During those trips, I recall being captivated by the science and physics of nuclear power. I was amazed at how we could take something so small and get so much out of it, and I knew I wanted to work on nuclear technology. I was particularly drawn towards advanced nuclear reactors during my undergraduate and graduate studies, and during internships with national laboratories and industry. I viewed advanced reactor technologies as the next step in the technological progression of nuclear technology, and the field to which I wanted to contribute.

Advanced Reactors

Advanced reactors can provide affordable, carbon-free electricity and industrial process heat at a global scale, while also providing a new option for the looming replacement of America's nuclear energy fleet as existing reactors reach the end of their licensed lifetimes. Advanced reactors offer the promise to realize the energy future envisioned by the intellectual giants upon whose shoulders we all stand. Fermi, Weinberg, Wigner, Seaborg, and others all saw the potential that next generation reactors have. These reactors can provide clean, affordable, reliable, and extremely safe carbon-free power at a global scale. Some of the attributes of advanced reactors include:

- Competitive economics due to reduced capital costs and shortened construction times
- Multiple energy output streams ranging from electricity to process heat
- Improved fuel efficiency and the ability to consume used nuclear fuel, unlocking the vast reserves of energy contained in today's waste inventories
- Flexible operations such as load following and grid stabilization to couple with renewables
- Passive and inherent safety leading to "walk away safe" characteristics
- Flexible siting independent of access to cooling water

Additionally, advanced reactors enable a broad diversity of reactor sizes. Micro reactors, like ours, can bring clean, affordable, and reliable nuclear power to areas which cannot support larger plants. Alaska and Hawai'i are good examples, but there are quite a few places in the continental United States, as well as the US protectorates that are excellent candidates for our reactors. The size and characteristics of our reactors also enable entirely different market applications currently underserved by existing energy technologies. Looking further afield, advanced reactor technologies can be used to fuel mankind's ambitions of navigating the stars. We need energy to explore the heavens, and nuclear energy will power future trips to our neighboring planets and beyond. This is not science fiction. This work is happening today, and our reactors build on the rich legacy of space reactor development in this country.

The Advanced Reactor Industry

Dozens of startups and large companies are now working to commercialize advanced reactor technologies in the United States. Advanced reactor commercialization efforts have grown significantly in the past decade, particularly in the last five years, and these efforts are better equipped than ever to bring these technologies to market. Innovation is alive and well, and advances in computational modeling and simulation, and an injection of talented, creative, and hungry young engineers into the nuclear industry have fueled much of this growth. Federal efforts to attract students into nuclear engineering programs over the last decade are paying dividends, and there is more to come.

Furthermore, advanced reactor research and development activities sponsored by the Department of Energy and the national laboratories over the past few decades have demonstrated much of the core technologies that these startups and larger companies are working to commercialize. In particular, the Integral Fast Reactor program, the Experimental Breeder Reactor-II and Fast Flux Test Facility reactors, the High Temperature Gas Reactor fuel development and qualification program, and work on the Molten Salt Reactor Experiment, among many others have proven the key concepts for many these advanced reactor technologies.

These attributes have also attracted over $1 billion in private investment. These investors are supporting advanced reactor companies due to the massive market potential, as well as the environmental benefits. Many see advanced nuclear as the only way to tackle climate change. Some have not invested in energy before, but the business case for advanced nuclear has changed the equation for these investors. And while the capital invested so far is large, there is still much more that can and will be invested in advanced nuclear reactor projects, especially if a few opportunities are pursued.

<u>Opportunities and Challenges</u>

Advanced reactor developers face a variety of hurdles and challenges to deploying their reactors. One such challenge is the regulatory process, which is a significant and necessary challenge that advanced reactor developers must navigate. Unfortunately, the regulatory process as it exists today is not well suited for these new technologies and the venture finance models that fund them. On the other hand, the idea that advanced reactors cannot be licensed today is also misguided. We have found clear licensing pathways for our technology, but there is room for improvement and modernization.

We support Senate Bill S.2795 which addresses and improves many of the issues with the regulatory process today, such as implementing staged licensing processes, risk-informed and performance-based frameworks, reformed hearing schedules, and revised fee structures. It is also important to mention the progress made by the NRC towards supporting advanced reactor licensing. Recent work with the DOE on advanced reactor design criteria, and new guidance on digital instrumentation and control and mechanistic source term quantification will have a substantial effect on advanced reactor licensing. We also encourage reform on security and staffing requirements so they are "right-sized" to reactor size. Furthermore, future regulatory reforms should yield requirements and cost burdens that reflect reactor size and safety performance. I would also like to acknowledge the work NuScale has done to address many of these challenges. The work they are doing is paving the way on many of these issues, from which we will all benefit.

The legacy of R&D by the DOE and its predecessors in the last 70 years has been tremendously helpful to advanced reactor developers today. We are all building on that work. More recently, DOE has supported multiple programs which are helping accelerate advanced reactor development more quickly, but there is still more we can do. The GAIN program and their small business vouchers are a good example of recent efforts, and I would like to see this program continue and expand.

DOE's work on advanced reactor fuel characterization and qualification has been and will continue to be quite valuable to advanced reactor commercialization efforts. The facilities and resources used for this work are good examples of just some of the capabilities within the national laboratory complex from which we and other advanced reactor developers can benefit. GAIN provides an avenue for streamlined access to DOE facilities and expertise, and continued initiatives within the GAIN program will help propel advanced reactor efforts. Additionally, DOE sites could be ideal proving grounds for first-of-a-kind reactors. NuScale and INL are paving the way here, and these relationships and processes should continue to be improved and modernized. And as we approach deployment of our earliest reactors, loan guarantee programs will continue to be crucial to accelerate building advanced reactors.

Another DOE resource that is often underappreciated is their inventory of nuclear fuels. Demonstration, prototype, and first-of-a-kind versions of advanced reactors will require a variety of fuels, and we would all benefit from being able to use some of the fuel that DOE manages. DOE should anticipate these opportunities, and manage their fuel resources accordingly so they are in usable forms and compositions. This may also reduce DOE's fuel management burdens.

The advanced reactor industry has significant global potential. Unfortunately, recent changes to nuclear technology export rules will hinder global growth for U.S. companies. These rules are outdated and need to be modernized so that this growing industry can flourish.

Finally, I must warn against DOE or any federal agency from playing kingmaker or trying to pick winners or losers in the advanced reactor industry. That could severely damage the rising advanced reactor movement. We all have a vector on getting to market and achieving cost parity or superiority to coal and gas, while being carbon free at a global scale. Getting there will be hard, but it is an exciting time to be in the industry, and participate in the flurry of ongoing activity.

<u>Closing Thoughts</u>

The advanced reactor industry in the United States is growing rapidly. Innovation in nuclear is proceeding at a pace reminiscent of the early days of nuclear power, with dozens of startups and over $1 billion in private capital at work developing the future of energy technologies. The United States is still the global leader in nuclear technology, and we have taken steps to cultivate this growing movement, but there is still more to be done to remove outdated obstacles, and clear hurdles that slow the growth of this industry. We have a unique opportunity in front of us. If we seize it, we can lead the world in a clean energy transition powered by advanced reactors that can mitigate the effects of climate change, bring affordable and reliable power to the billions without it, and support an entirely new technology and manufacturing workforce. I thank you for this opportunity to testify, and would be pleased to respond to any questions you might have, today or in the future.

Bio

Jacob DeWitte is the co-founder and CEO of Oklo, formerly UPower, a Sunnyvale, CA based company developing an advanced 2 MW reactor. Jacob has been working with nuclear technology since his childhood, and has deep experience with nuclear reactor design and analysis. He has worked with many advanced reactor designs including sodium fast reactors, molten salt reactors, and next generation PWRs. Jacob has also been involved with front-end and back-end nuclear fuel cycle technology development and analysis. Jacob led the reactor design efforts on a waste consuming molten salt reactor at the University of Florida, and led core design at GE for their PRISM sodium cooled fast reactor. Jacob has also worked at Sandia National Labs, Urenco US, and the naval reactor research laboratories. Jacob is originally from Albuquerque, NM. He completed his undergraduate studies in nuclear engineering at the University of Florida and his SM and PhD in nuclear engineering at MIT.