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Before the Senate Energy and Natural Resources Committee

Hearing on Ohio House Bill 434 Enact Advanced Nuclear Technology Helping Energize Mankind (ANTHEM) Act

November 29, 2022

Chairman McColley, Vice Chairman Schuring, Representative Martin, and Members of the House Energy and Natural Resources Committee, thank you for inviting me to testify before you today.

My name is Edward (Ed) Pheil and I am the Co-Founder and Chief Technology Officer of Exodys Energy. Exodys is an advanced reactor design company seeking to develop and commercialize the Exodys Fast Chloride Molten Salt Reactor (FC-MSR), representing a cross-section of nuclear energy and high-level waste management. Our mission is to provide sustainable, inexpensive baseload & load following electricity, and process heat energy while consuming nuclear waste and providing options for nuclear services for irradiation testing, diagnostics, medical isotopes and treatments. My motivation to found Exodys stemmed from my hometown - I was born and raised near Three Mile Island, which inspired me to dedicate my life to nuclear reactors because I saw that no one was harmed after the casualty.

Prior to Exodys, I spent over three decades working at the Naval Nuclear Laboratory (NNL, formerly United States Department of Energy's Knolls Atomic Power Laboratory). At the NNL, we were involved in the design and construction of the US Navy's reactors for submarine aircraft carriers, and Jupiter Icy Moons (JIMO) spacecraft for propulsion and power. I began in operations training Navy students, then shifted to design, to which I've devoted the majority of my career. To this day, I have been involved in reactor design and support for 9 different reactors, including new reactors (Virginia & Columbia Class Subs, and Ford Carriers, new core startup testing for 15 reactors, as well as design studies for MANY types of Advanced Reactors technologies.

I want to thank the members of the Committee for holding this hearing on a pressing topic for Exodys and the United States position in the global nuclear technology market. I welcome the opportunity to share with you the potential of the advanced nuclear industry, and its importance on both our pollution and carbon reduction as well as nuclear waste reduction strategies. A primary goal is to mitigate the public concerns with nuclear by design, for example: Reduce Cost, Eliminate long term waste (1,000,000yr) by consuming all the Uranium, Plutonium, & higher actinides, minimize proliferation risk, & ensure passive safety

The Importance of Advanced Nuclear Technology to the United States

Nuclear power is crucial to US energy independence and the 78,000 tonnes of Stored Nuclear Fuel, and depleted uranium from Portsmouth, OH, can help secure this energy independence for Ohio for the coming centuries. Nuclear energy represents 15% of

Ohio's electricity mix and almost 90% of its emission-free electricity. Recently, it has been widely recognized by institutions such as The United Nations' Intergovernmental Panel on Climate Change (IPCC), as an important source of power for the future energy mix. Isotope production has also bettered our society with the advent of nuclear medical imaging and treatments. The cost of nuclear energy has been growing in the United States for a myriad of reasons, however the main driver is the lack of R&D incentives and funding to improve a currently half-century-old technology to rebuild the nuclear skills in innovation, design, build, and trade skills, like welding and advanced manufacturing. Building these skills is a requisite for the success of advanced nuclear, and skills Ohio has & can expand.

The negative perception of existing nuclear technology, which has abated investment and innovation, is mostly built on the fear of accidents such as Chernobyl and Fukushima. In addition, concerns around the storage of long-lived spent nuclear fuel waste and the threat of arms proliferation have served as excuses to stymie innovation. Exod elected its molten salt reactor concept to integrate solutions to these problems by design.

Fortunately, the United States developed a portfolio of "advanced" reactor solutions back in the 1960s and 70s. Exodys is one of the many vendors commercializing such designs. Exodys specifically designed to minimize cost (liquid chloride salt fuel, low pressure, high temperature process heat temperatures), close the fuel cycle by using a fast reactor to consume SNF without reprocessing, as the main fuel source and consume excess world plutonium to reduce proliferation concerns, by using fuel which is never weapons grade in the reactor. Mixing SNF & plutonium making the fuel, denatures the plutonium. Liquid fuel allows for access to extract medical isotopes or placing irradiation & test cells anywhere in or around the core. The design is specifically designed to maximize flexibility for many uses, including load following.

My experience working on all different types of reactors allowed Exodys to utilize the most beneficial features of water reactors, gas reactors (high temperature), liquid metal reactors (low pressure/no boiling), and heat pipe reactors, while optimizing out the challenges of each.

Source: ABB Velocity Suite / U.S. Energy Information Administration

The reactor uses low-cost molten table salt with the fuel dissolved in the salt that cannot boil and freezes if it leaks. The same reactor vessel is used from very small scale 10MWth prototype/test reactor to large scale 1200MWelectricity or 3000MWth process heat reactor. There is no new reactor to buy to scale up power. Easily adding heat exchangers and pumps scales the power level. The reactor has up to 6 loops. When the reactor heats up, power goes down. The reactor load follows by following the temperatures. If it gets hotter or the pumps fail, the salt cannot boil and the fuel drains. The decay heat is passively cooled to air, no water required.

Like other US advanced nuclear vendors, we are planning to construct and operate a non-commercial, non-power demonstration 10MWth molten salt reactor in the US. We are currently looking at several sites including the DOE's Portsmouth, OH site, which used to enrich uranium. It is now being remediated and we are among a group of advanced reactor vendors included in developing an Early Site Permit for the site.

Addressing the Nuclear Waste Problem

Exodys is also developing a solution to the accumulating nuclear waste issue. Our most recent accomplishment includes the demonstration of our nuclear waste to fuel conversion process with DOE national laboratory experts. This allows us to convert waste into fuel in a much simpler, low cost, and safer process than existing technologies, without reprocessing. The Exodys reactor can consume any actinide: Stored Nuclear Fuel, depleted uranium, excess plutonium, natural uranium, etc., while producing massive amounts of energy compared to today's reactors, 30 times the energy from current reactor waste, and almost 300 times the energy if you include the depleted uranium in Portsmouth, OH.

Nuclear Power Experience A Diminishing Talent Pool

Since the US stopped building nuclear power, the design and build experience is decaying, and needs to be rebuilt. The export of manufacturing jobs overseas, allowed the trade skills, like welding, electrical, pipefitting jobs and skills to decay away. These skills need to be rebuilt starting in STEM is basic schooling, including nuclear science, more science and engineering in college, especially chemical, materials, and nuclear engineering. We need to rebuild the basic manufacturing skill base jobs to be able to develop advanced nuclear.

Conclusion

H.B. 434 will be crucial to spur investment and innovation in Ohio's nuclear industry. The advanced nuclear community will welcome the creation of the Ohio nuclear development authority and consortium. This will provide us with opportunities for public-private cooperation for the development and demonstration for new reactor designs and components.

Exodys is turning Liabilities (Waste) into Assets Ffuel)

It will also provide opportunities to pursue innovative solutions to the waste problem by closing the fuel cycle cost effectively. In addition to improving resistance to state or terror-driven arms proliferation it would also facilitate non-proliferative US nuclear exports, which contribute to global peace and security. Advanced nuclear presents a lot of promise for our future generations' needs beyond electricity such as medical isotopes, industrial process heat, decarbonization of the transportation sector (synthetic fuels, hydrogen production), and space travel. This could create job opportunities and drive up the state's exports to the rest of the US and the world.

I hope my testimony will provide you with the same sense of urgency the industry faces in leveraging the remaining experienced nuclear reactor designers. The Ohio House Bill 434 would be a great step forward in creating a sustainable energy industry and reinvigorate the US' leadership in the nuclear industry and gain the support of the US public. I look forward to your questions and am happy to provide supplemental information at the Committee and its Members' request.

Thank you.