As seen in the January 2020 issue of **Nuclear News**


THE *NUCLEAR NEWS* INTERVIEW

# Finan and Smith: The National Reactor Innovation Center

*The NRIC director and deputy director discuss the global nuclear energy race, what reactor innovation looks like, and when the next generation of nuclear systems will arrive.*

Authorized by the Nuclear Energy Innovation Capabilities Act, the National Reactor Innovation Center (NRIC) was established in August 2019 to provide resources to test, demonstrate, and assess the performance of new nuclear technologies—critical steps that must be completed before new reactor systems are available commercially. Through NRIC, which is led by Idaho National Laboratory, developers will gain access to the strategic infrastructure and assets of the national laboratories. These capabilities should enable the testing and demonstration of new nuclear systems that will generate carbon-free electricity, contribute to the decarbonization of major economic sectors, and support special applications using process heat.

John Wagner, associate laboratory director of INL's Nuclear Science and Technology Directorate, announced in October 2019 the selection of Ashley Finan to serve as the director of NRIC and Nicholas Smith to serve as the deputy director. Finan and Smith will lead efforts to accelerate the testing, demonstration, and commercialization of innovative reactor technologies in the United States.

Finan served most recently as executive director of the Nuclear Innovation Alliance, a nonprofit think tank working to enable nuclear power as a global solution to mitigate climate change. Prior to her work with the NIA, Finan led nuclear innovation programs at Clean Air Task Force. She holds bachelor's, master's, and doctorate degrees in nuclear science and engineering from the Massachusetts Institute of Technology.

Smith has worked with the research and development organization of Atlanta-based Southern Company since 2010, most recently as principal engineer. In this role, he oversaw a Generation IV nuclear reactor R&D program and was responsible for collaboration with reactor designers, national labs, and policymakers and early engagement with regulators. Smith holds a bachelor's degree in economics from San Diego State University, a bachelor's in electrical engineering from the University of Alabama at Birmingham, and a master's in nuclear engineering from North Carolina State University.

NRIC is based at Idaho National Laboratory. The NRIC team can be reached via email at <NRIC@inl.gov>. This interview was coordinated for *Nuclear News* by Laura Scheele, nuclear engagement strategist at INL.

*What was the inspiration for you to take on a leadership role with NRIC?*

**Finan:** I have always had a deep appreciation for clean air and the environment and have come to understand the importance of abundant clean energy in addressing global energy poverty. I also view U.S. leadership in nuclear technology as important for global security and U.S. geopolitical interests. I see advanced nuclear energy as a key tool in addressing those priorities and have studied intensely the challenges associated with commercialization. I have worked in energy policy over the past decade or so to develop recommendations to address those challenges. One of those recommendations made by me and others was NRIC. It addresses one of the major challenges, and I think the most immediate and pressing one, which is the need to build nuclear demonstration projects.

When I saw the position posted for NRIC director, it took my breath away. It is the ultimate act of follow-through to be able to implement a program I've recommended. I am deeply grateful for the opportunity and responsibility I've been given, as well as for our exceptionally talented team, and I am committed to making NRIC successful by making innovators successful. NRIC has the opportunity to restore U.S. leadership in advanced nuclear energy for the good of our nation and the world.

**Smith:** While working in R&D at Southern Company, I became acutely aware of the need to demonstrate the advanced reactor concepts that are being developed by industry. Modeling and simulation have progressed tremendously over the years; however, there is still no substitute for the "real thing." NRIC is set up to be that catalyst that makes demonstration reactors a reality. I could not be more excited about the future and what we are going to accomplish here.

*What was the catalyst for creating NRIC? Why NRIC, why now?*

**Finan & Smith:** The Nuclear Energy Innovation Capabilities Act authorized NRIC to enable the testing and demonstration of advanced reactors that will define the future of nuclear energy. Policymakers became aware of the need for a program like NRIC in large part due to the communication efforts of advanced nuclear energy companies, utilities, environmental groups, academics, and nongovernmental organizations that recognized the important role of nuclear energy innovation and identified key barriers to commercialization. Policymakers heard that the United States has significant technological infrastructure that is vital to commercialization but is not readily accessible to private companies. We thank the bill's sponsors for recognizing that we are poised on the brink of an energy revolution and for acting to eliminate the barriers that had been impeding progress. Many advanced reactor designs have progressed to the point where the natural next step is to build and demonstrate them. We have reached the point where it is time to stop predicting how these advanced reactors will perform and to begin testing and operating them.

Photos: INL

**Finan:** "NRIC has the opportunity to restore U.S. leadership in advanced nuclear energy for the good of our nation and the world."

**Smith:** "We have reached the point where it is time to stop predicting how these advanced reactors will perform and to begin testing and operating them."

*Where do you see U.S. global leadership on nuclear power at this point?*

**Finan:** The United States historically led the world on nuclear power, but we have lost a lot of ground. In fact, the National Reactor Testing Station, now part of INL, is the site where the United States built 52 reactors and produced the first usable nuclear electricity. This nation has an inspiring legacy of innovation and demonstration that we are drawing upon to establish NRIC. We still have the best operations, the strongest safety, security, and nonproliferation standards, and the most robust innovation capacity. However, if the United States does not have a competitive export model and competitive products, we cannot be global leaders. Today's innovation in nuclear energy in this country presents us with a compelling but also perishable opportunity to regain lost leadership. We are at a decision point: Either the United States accelerates ahead of our competitors, or we cede our position to others. For economic, environmental, and geopolitical reasons, I believe the former path is superior, and the establishment of NRIC alongside other complementary policies seems to reflect a similar judgment by our policymakers.

**Smith:** Nuclear power was originally developed here in the United States. We paved the way and are going to do it again. Nuclear is simply too important to the energy-environment nexus for us not to.

*What are the biggest consequences to the United States if it doesn't move forward purposefully?*

**Finan:** In my view, if the United States does not move forward purposefully, we are likely to see a continued decline in our current nuclear industry, decline in our international nuclear energy influence, and inadequate progress on advanced reactors. Nuclear plants that retire early for economic reasons will be largely replaced with emitting generation, and we will lose a key tool in our efforts to decarbonize our economy. We will decarbonize only at significantly elevated cost, if the models are directionally on target. Other countries will purchase nuclear energy from our adversaries, establishing enduring technological dependencies that will drive alliances and future geopolitics, particularly in fast-growing economies in Africa, Asia, South America, and Eastern Europe.

Dominant exporters will hold the greatest influence over global nuclear safety and security norms, and the United States will assert its influence over global nonproliferation policy only at significant cost through other foreign policy levers. The cost of maintaining the supply chain for our defense nuclear activities will fall more heavily on the taxpayer, and we will lose an economic and leadership opportunity in a strategic energy technology. That's a dim picture, but I believe it's a probable outcome if we don't commit to moving ahead.

But let's not let that happen. We at NRIC are committed to moving ahead.

**Smith:** If the United States doesn't lead in advanced reactor development and demonstration, we are going to be

Photo: INL

NRIC's Nicholas Smith and Ashley Finan talk near the entrance to INL's Materials and Fuels Complex (seen in background).

buying our reactors from foreign countries. That means lost economic growth, and it puts us in an unfortunate position with respect to the nuclear sciences. There are externalities to having domestic reactor development activities going on. The most talented scientists and engineers want to work on the most difficult and rewarding problems. If the United States bows out of the advanced nuclear development space, we are going to lose out on a lot of brilliant minds.

*What is your view of the next generation of nuclear reactors and the technologies that are out there?*

**Finan:** We are seeing tremendous innovation in technologies, end uses, and business and deployment models for nuclear energy. Reactor developers and investors are embracing market requirements and end-user needs and exploring a variety of nuclear system uses, including industrial heat supply, hydrogen production, systems that integrate nuclear with renewables and storage, propulsion systems, floating platform models, etc. We are seeing interest from new customers both domestically and globally and from investors new to the nuclear energy field. We also see growing interest in space applications and national security missions, which could be early movers.

There's a growing recognition that plant design cannot occur in a vacuum, and advanced designs must address market requirements. In combination with a program like NRIC and other complementary efforts, I think that approach will produce world-changing technology.

**Smith:** Some really cool stuff is being designed right now. For the longest time, "nuclear energy" meant "gigantic light-water reactor," because that was all anyone was working on. Now you have companies branching out into all kinds of configurations, like tristructural isotropic (TRISO) particle fuel with gas coolant, molten salt, where the fuel is actually a liquid, and even solid TRISO fuel with molten salt coolant. Some companies are using heat pipes instead of heat exchangers or using thorium instead of uranium. We are even seeing people challenge the ideas around how to moderate the reactor by using metal hydrides or simply designing a reactor without the use of a moderator at all. There are all of these interesting options that open up when people stop thinking "that's just the way we have always done it" and start innovating.

*How do you define "reactor innovation"?*

**Finan:** Innovation is the development and application of new ideas or the new combination of existing ideas or technologies. The innovation I'm interested in brings increased value to society by offering more effective solutions or meeting new requirements. Innovation is a process, but also a product. We have been engaged in the process of reactor innovation for decades and are on the cusp of seeing those products. NRIC is an essential bridge to help developers move to demonstrating the viability of their product.

**Smith:** In my mind, reactor innovation means understanding all of the possible ways to configure the machine and making design choices because they are the best option, not simply because it's what people have experience with or what is "closest to commercialization." These innovators are looking at the use case for a modern nuclear energy system unencumbered by design decisions that don't make sense for the customers they are trying to reach.

*Do you see innovation possibilities in the application of reactor technologies—in other words, innovation in end uses as well as in the design?*

**Finan:** Absolutely. Innovation has historically featured finding new and additional uses for existing technologies. Cameras and phones existed separately, but the marriage of the two was an innovation. Reactor innovators are listening to what their potential customers need and exploring how to meet those needs. That may include combining nuclear energy with hydrogen production, with propulsion, with renewable energy sources and storage, etc.

**Smith:** We are already seeing companies that are designing reactors where electricity production isn't their main purpose. Process heat for industrial applications, the production of cancer-fighting medical isotopes, and nuclear thermal propulsion for space travel. Nuclear is capable of so much more than simply boiling water.

*How do you define success for NRIC?*

**Finan & Smith:** If we are successful, we'll host at least one reactor demonstration by the end of 2025. We intend to demonstrate at least two by then, and we are preparing for more.

*What are the biggest opportunities for NRIC, both near term and long term?*

**Finan & Smith:** The presence of a dedicated and talented industry combined with the clear organizational mandate granted to NRIC by policymakers presents a tremendous opportunity. But it is not just an opportunity for NRIC—it is an opportunity for the United States to regain nuclear energy leadership, for nuclear innovators to become world-class companies, and for the global community to meet its energy and environmental goals. NRIC is capable of providing truly significant and profound results, and the people on our team authentically believe that. This team believes in the importance of demonstrating nuclear reactors. We are committed to serving the nation and removing obstacles to demonstration. That might mean regulatory support for one company, or providing access to fuel for another, but whatever it

takes, we are going to marshal all of our resources to empower reactor developers to be successful.

*What are the biggest challenges?*

**Finan:** Our biggest challenge is doubt. Many are doubtful that we can demonstrate new nuclear energy technology in the United States. But history counsels us to be more hopeful. This nation built dozens of reactors on the National Reactor Testing Station [now the INL site] in the 1950s, and private industry and the Atomic Energy Commission partnered to demonstrate about a dozen more across the country. We have ambitious goals, but the United States has done bigger and bolder things, so we know we are well within the bounds of the possible.

Success will require the support and confidence of industry, policymakers, energy customers, and the public. We currently have strong support from many; we need to broaden that, and we need to earn their confidence. We intend to do so by making immediate and sustained tangible progress toward demonstration. We also need to demonstrate technologies that meet the needs of markets and of society. Several approaches will help us achieve that, including governance measures and the incorporation of innovative complementary technologies and integration, like hybrid energy systems and advanced construction techniques.

**Smith:** I think the biggest challenge is fear of failure. When people are afraid to fail, they don't innovate. They go back to what they know works. Fear of failure makes people underestimate their abilities. It destroys the motivation to try, because if you don't try you can't fail. We can't be afraid to fail. We have to find a way to be successful in nuclear energy.

*What advanced reactor technologies do you see as being closest to commercialization?*

**Finan:** All U.S. advanced reactor technologies have yet to be proved in an operational setting, but any one of them could be demonstrated rapidly with a well-organized effort and sufficient resources. While the need for abundant clean energy is urgent, I am cautious about focusing on which technology is most developed. A product that is ready quickly but does not meet society's needs is not a bargain, and if we are committed to moving forward on any given project, I am confident that we can execute it in a timely way. I think that proposals that include demonstrations in the near term and the medium term are made in order to answer this concern, providing both rapid demonstrations that may work for some markets and longer-term demonstrations that require more time but fill an important global energy need.

More important than the details of the technology is the level of commitment to the effort. NRIC is fully committed to empowering innovators and eager to help them succeed.

**Smith:** I don't like that question. Light-water reactor technology is the closest to commercialization. Everything else faces enough technology development, licensing work, and fundraising risk that saying one technology is ahead of another is like guessing who will win the Super Bowl before the first game of the season has been played. The word "innovation" is in our name. NRIC is here to make sure that the best concepts are not overlooked because they decided to try a different path.

*What specific services, resources, and capabilities are you providing to advanced reactor technology innovators?*

**Finan & Smith:** NRIC is already working with developers to provide access to demonstration-related nuclear energy capabilities, resources, sites, and expertise across the national laboratory system. Resources will include various fuel materials, existing sites like the Experimental Breeder Reactor-II dome, undeveloped sites, and experimental facilities. Beyond that, NRIC is going to work to identify viable options

to help reactor developers get everything they need. Working alongside the talented people here at INL is amazing. When questions come up, you don't have to walk very far down the hall before you run into one of the world's experts on the topic. We know complementary talent exists at other labs as well, and we're going to make sure that NRIC makes those valuable connections.

*When will we see NRIC deliver something tangible?*

**Finan & Smith:** NRIC is already engaged in several demonstration reactor projects and experiments. Stay tuned. Our goal is to support the demonstration of at least one advanced reactor by the end of 2025.

*How can reactor innovators work with you?*

**Finan & Smith:** The first step for reactor innovators—and anyone else who wants to work with us—is to contact us. It's really that simple. In terms of partnering, we have a variety of mechanisms, including Cooperative Research and Development Agreements and Funding Opportunity Announcements. We intend to be flexible and structure the partnership mechanism to meet the needs of interested partners. We recently collaborated with the staff of the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative to develop a survey that went out to the reactor design community. Responding to that survey is a great way to help us start identifying how we can work together.

*How does NRIC relate to GAIN?*

**Finan & Smith:** GAIN and NRIC are complementary and coordinated efforts to support the nuclear energy industry. GAIN is an initiative that provides the nuclear energy industry with access to the DOE's national laboratory complex for technical, regulatory, and financial support. GAIN is applicable at all stages of development. NRIC, by contrast, is a capability intensely focused on the demonstration and testing of reactor concepts and is designed to enable innovators nearing the demonstration phase. We are working together with the GAIN team to provide a continuum of support that is complementary and efficient.

*What is the public mood concerning advanced nuclear technologies? Do you see differences between the public outlook and the policymaker outlook?*

**Finan:** There's tremendous interest in what advanced nuclear can do to decarbonize our economy, to provide energy to people in need, and to meet energy-intensive demands in market segments like desalination, advanced agriculture, and clean transit hubs. It seems as though there is greater awareness of advanced nuclear technologies among policymakers than among the general public, so there is a need to communicate more openly about the opportunities that advanced nuclear technology can offer.

**Smith:** I think people are excited about the future of nuclear energy. Whenever it comes up, people are always very interested in discussing the new designs and how much untapped potential there is in nuclear technology.

*How can the American Nuclear Society support the commercialization of advanced reactor technologies?*

**Finan & Smith:** NRIC needs the support of nuclear professionals across the diversity of the discipline to work with us to identify paths to success. We certainly see a continuum between today's light-water reactors and the reactor systems of tomorrow. We need both to succeed. Help us inspire the stakeholders, empower the innovators, and deliver on everything that nuclear can be.

*Is there anything you'd like to say that we haven't covered?*

**Finan & Smith:** The NRIC team looks forward to working with innovators to demonstrate technology that will change the world's energy future. NN