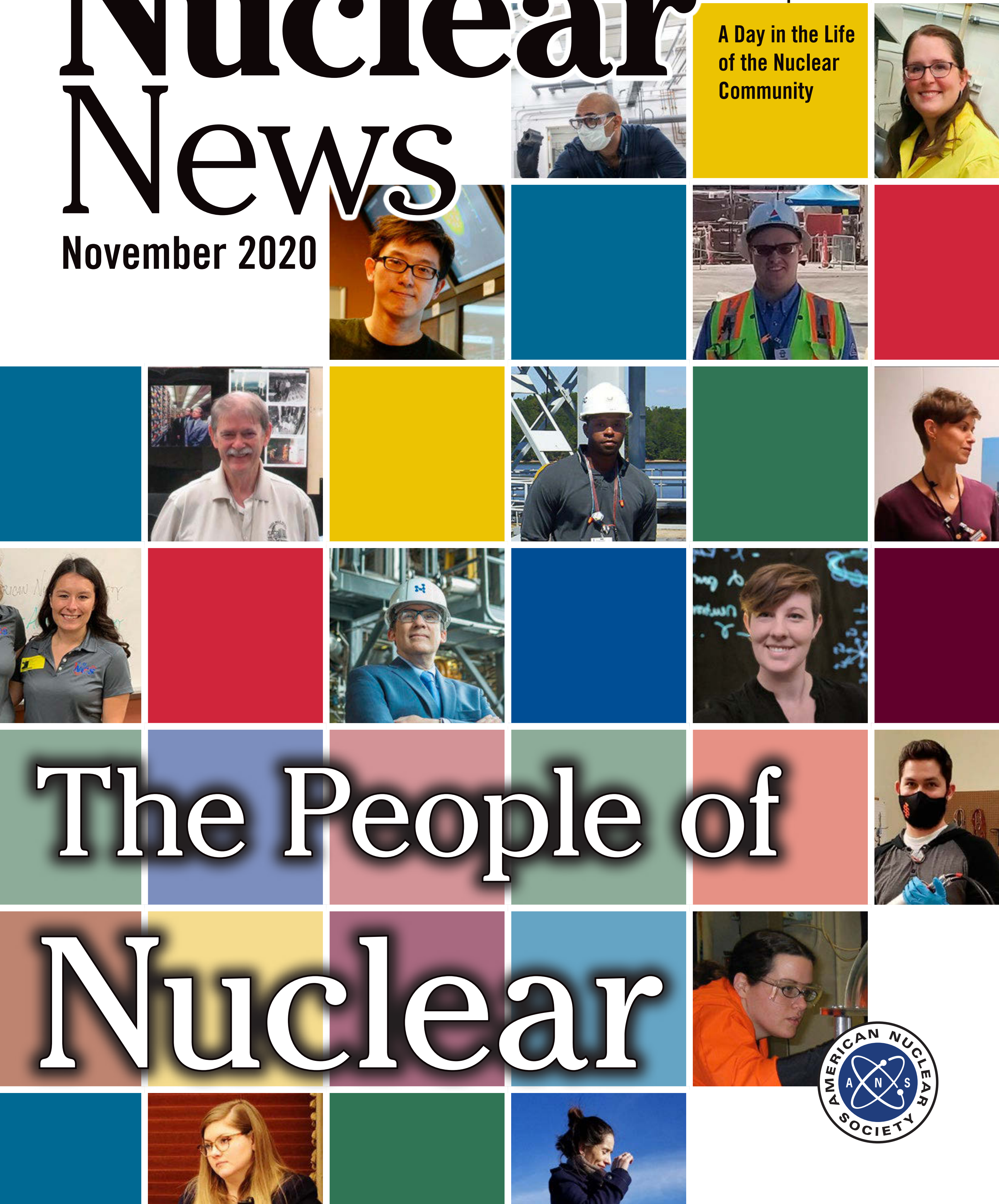
Nuclear News

November 2020

In This Issue:

Who Inspired You?

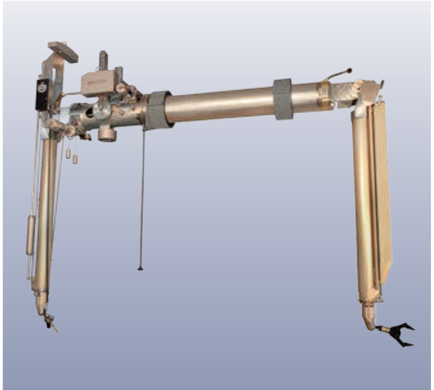
A Day in the Life of the Nuclear Community



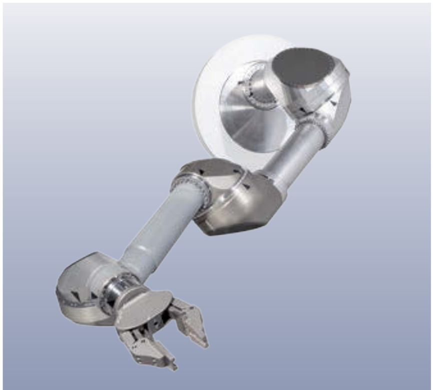
The People of Nuclear

American Nuclear Society

Barrel Gripper

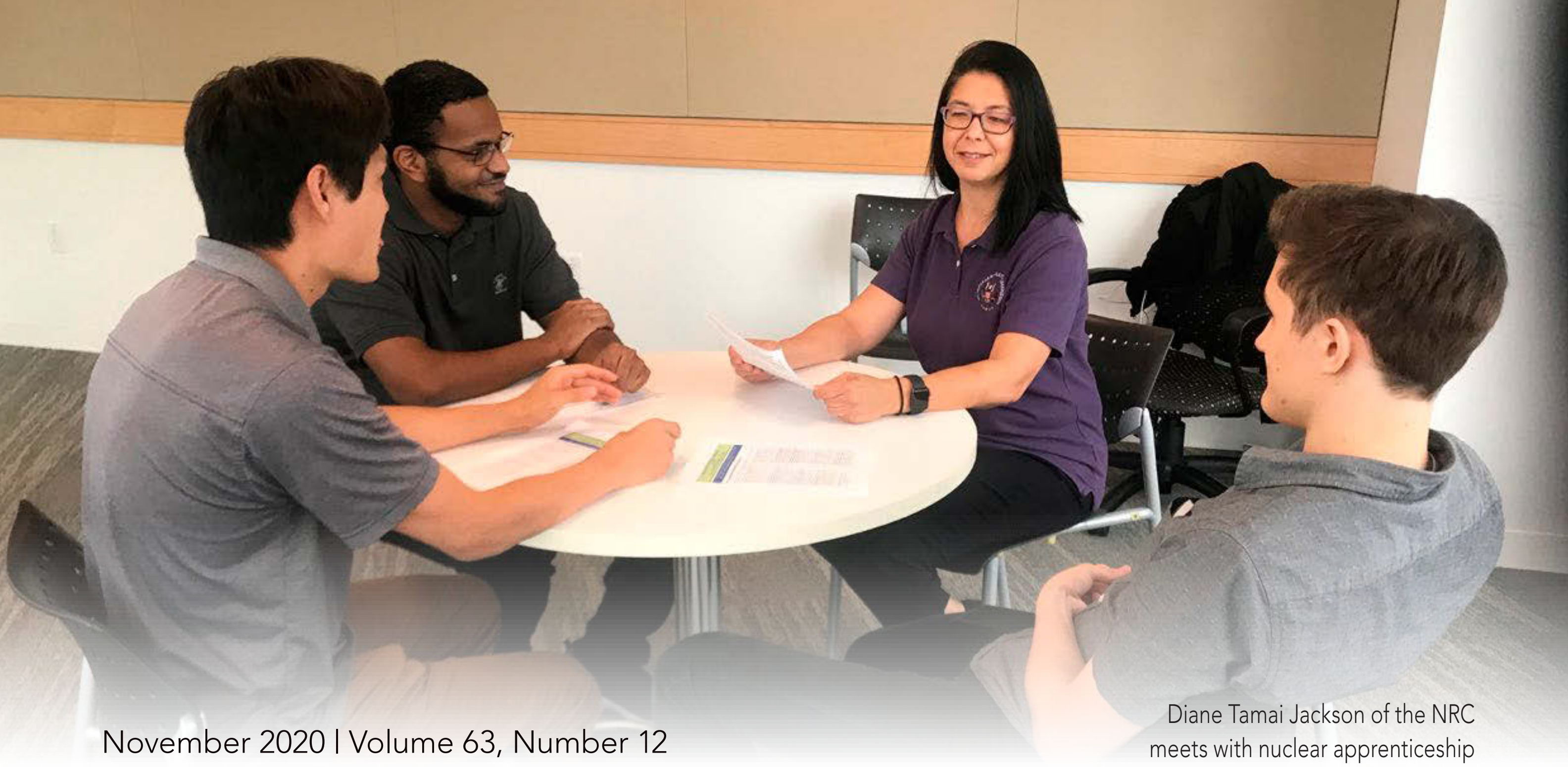


Telescopic Telemanipulator A100



Robotic System TELBOT®

Power Manipulator A1000



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Diane Tamai Jackson of the NRC meets with nuclear apprenticeship program participants. Read about her and other people of nuclear's "day in the life" on page 22.

The People of Nuclear

Every Issue


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The nuclear community

What makes nuclear unique? It is the technology, of course, but it is more than that. It is the people who have made it their career, whether in industry, academia, or government. It is the community.

Something new to *Nuclear News* is our first-ever "People of Nuclear" issue, devoted to those who work in the many disciplines that nuclear offers. A common theme as you read the personal tales in the "Who Inspired You?" and "A Day in the Life" sections of this issue is that "nuclear sticks like glue," as Leah Parks, systems performance analyst for the Nuclear Regulatory Commission, notes in her story on page 41.

What that means, Parks continues, is that there is a certain type of personality that nuclear attracts: "Those with a deep love of science and a devotion to realizing all the benefits that technology can bring when safely managed." No better words can capture what the nuclear community is all about.

And so the stories you will read in the following pages will illuminate the diversity of nuclear. Among others, we have contributions from college professors, a utility vice president, a congressional staffer, a senior regulatory engineer, a consultant, university students, a radiochemical engineer, a decommissioning specialist, a staff scientist, a program manager, a nuclear engineer, a radiation protection scientist, a nuclear machinist mate, and the founder and CNO of a reactor design company.

We also present an abridged memoir of longtime ANS member and Fellow Weston M. Stacey. During his lengthy involvement with nuclear technology, Stacey has worked at Knolls Atomic Power Laboratory and Argonne National Laboratory, led U.S. participation in the International Tokamak Reactor (INTOR) project, was involved with the Joint European Torus (JET) project, and taught classes at Georgia Tech, among other career highlights. The abridged memoir starts on page 60, but you can read the whole memoir on ANS's Newswire, at ans.org/news.

Now it is your turn. Write in and let *Nuclear News* know about your experience as a member of the nuclear community. We look forward to sharing your story with our many readers.

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Texts of most *Nuclear News* articles are available on the LexisNexis database, from Mead Data Corporation.

NN is good, but bring back Backscatter

I like the new look and feel of *Nuclear News*, but I am also in the camp that very much enjoyed reading Backscatter. It was my "reward" after reading the rest of the publication. The new feature on the back page is fine, but, in my opinion, it does not replace Backscatter.

Stanley Levinson
Lynchburg, Va.

I like the new *Nuclear News* format. It was probably past due for a change.

Jim Byrne
Dillsburg, Pa.

Editor's reply: It is rewarding to see that the "new" *Nuclear News* has inspired readers to write in with their comments. We do consider each suggestion carefully, and, in fact, we have been discussing a resurrection of some sort for Backscatter.

In addition, as you will read in this issue (and from the current and past "*Nuclear News* Asks" articles), there are plenty of personal stories from people in the community about who inspired them to pursue careers in nuclear and what their day is like while on the job.

Now it is your turn. Write in and let us know your story on any of the following topics, and we will publish them in future issues of *NN*:

- Who inspired you?
- A day in the life.
- Your ANS resume.

Send your submissions to rmichal@ans.org.

My ANS resume

Your "*Nuclear News* Asks" piece on Don Lorentz's resume in the August issue (page 148) prompted me to send you my "ANS resume."

I graduated at age 20 with a bachelor's degree in physics in 1954, followed much more slowly with a master's degree in nuclear engineering in 1957, and I joined ANS in 1958. Most of my ANS involvement was in the presentation of papers at national and topical meetings, giving some 15 papers and coauthoring about eight of them.

I did serve one term on the Publications Committee and coauthored a book—*Fermi-1: New Age for Nuclear Power*—published by ANS.

Although I retired from Detroit Edison in 2000, I maintained my ANS membership and involvement with the Michigan Section of ANS, serving as an executive committee member for a two-year term and giving a talk on the Fermi-1 fuel melting incident.

My ANS involvement now is relegated to receiving and reviewing *Nuclear News*, which of course, sadly, always includes the obituaries.

I'll conclude, as did Don Lorentz (*NN*, Aug. 2020, p. 148), by simply saying that I've always enjoyed my involvement in ANS and hope that others have and will do the same.

Earl Page
Orange, Conn.

Powered by people

Atomic energy is a natural resource, but it takes many people to make that resource accessible and to derive benefits for humanity—nuclear power and medical radioisotopes among them. The people of the nuclear community who have made that happen are not anonymous, and in this issue of *Nuclear News*, we're putting their hard work and accomplishments up front. Here are a few stats on the nuclear community at work.

A typical U.S. power reactor employs roughly

500-1,000

workers in a wide variety of fields:

nuclear engineers • reactor operators • accountants • electricians • welders • health physicists • chemists • and more

And creates about

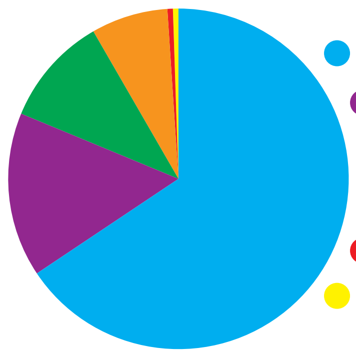
$40 million

in labor income per year

Source: NEI

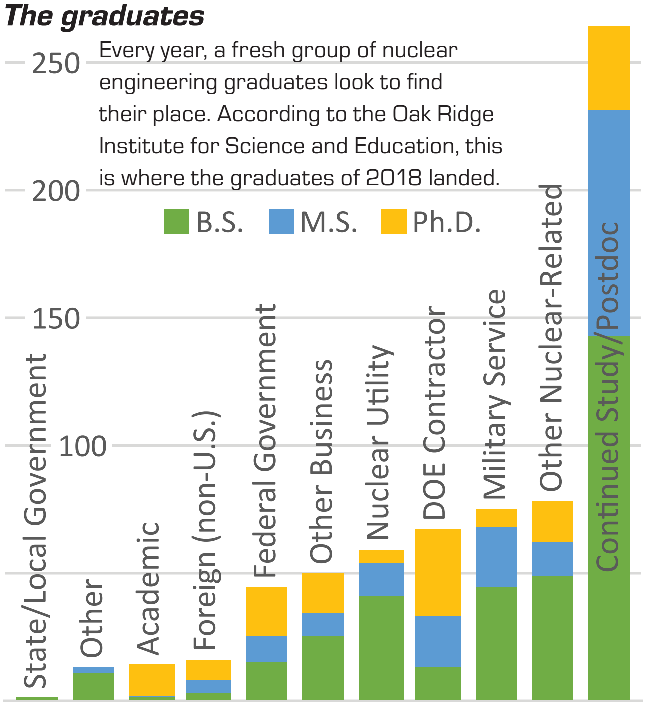
NRC workforce

The Nuclear Regulatory Commission's workforce of about 2,880 is 40 percent female and 60 percent male, with about 22 percent of employees under age 40 and 57 percent over age 50. Ethnic and racial demographics are shown here.



The graduates

Every year, a fresh group of nuclear engineering graduates look to find their place. According to the Oak Ridge Institute for Science and Education, this is where the graduates of 2018 landed.



Source: Oak Ridge Institute for Science and Education. Those for whom no data was reported and those still seeking employment at the time of the survey are not represented.

Nuclear power demographics

According to the *2020 U.S. Energy and Employment Report*, in 2019 the nuclear energy industry employed more than 70,000 people—about 61,000 in electric power generation and about 10,000 in nuclear fuels. Women represented 36 percent of the nuclear generation workforce, tied with natural gas generation as the highest of all generation technologies.

Demographic	Employees	Percent of Sector	National Workforce Averages
Male	39,079	64%	53%
Female	21,838	36%	47%
Hispanic or Latino	8,878	15%	18%
Not Hispanic or Latino	52,038	85%	82%
American Indian or Alaska Native	728	1%	>1%
Asian	6,328	10%	6%
Black or African American	7,398	12%	12%
Native Hawaiian or other Pacific Islander	510	1%	>1%
White	39,933	66%	78%
Two or more races	6,020	10%	2%
Veterans	3,646	6%	6%
55 and over	8,803	14%	23%
Union	7,443	12%	6%

Ensuring a bright future through discovery and public-private partnerships

Paul Kearns is laboratory director of Argonne National Laboratory.

By Paul Kearns

As I look forward to 2021, I am excited by the nuclear industry's bright future. Innovations abound—many new reactor designs and advances in fuels and the fuel cycle, as well as artificial intelligence that will accelerate research and development and, ultimately, reduce costs.

Here at Argonne National Laboratory, we are enthusiastically preparing for two new facilities that will support solving critical challenges for the nuclear industry: the exascale computer Aurora and the Activated Materials Laboratory (AML), which will support scientists as they apply the most advanced X-ray techniques to the characterization of nuclear structural materials and fuels. Both developments will help usher in a new era of scientific advances and strong partnerships with the private sector.

The promise of nuclear innovation hinges on the discovery of novel materials—structural, fuel, and other materials of use within the overall reactor system. Key to the development of new materials for nuclear energy applications is the need to measure and understand how those materials will respond to irradiation. Conducting experiments on irradiated materials is time-consuming and expensive. Today, our reliance on a handful of specialized facilities adds to regulatory and licensing delays and costs. To unlock our industry's full potential, we need to ease this bottleneck.

That's where Aurora and the AML come in. Both will allow us to examine nuclear materials in a way that was previously impossible.

As one of the world's fastest supercomputers, Aurora will address scientific problems at a level of detail that was previously impossible because the calculations alone would take several years to perform. Aurora will be 10 to 20 times quicker than the fastest supercomputers today. That's a billion billion (exascale = 10^{18} floating point operations per second) calculations per second, or about a million times faster than a desktop computer. That speed will spawn new discoveries and deeper understanding in many scientific fields—including medicine and its search for COVID-19 vaccines, as well as environmental science, national security, and others.

In addition to providing raw computing speed, Aurora will also enable the use of AI-based tools to develop better predictive models. For example, by developing quantitative comparisons between material impacts from neutron radiation and ion radiation, it may be possible for researchers to accelerate new materials qualification, a process that today takes over a decade.

Like Aurora, the AML will also quicken the pace of discovery. The AML will be located adjacent to the high-energy X-ray microscope beamline, a flagship long beamline that is part of the Advanced Photon Source (APS) upgrade project and that will enable deeper understanding of microstructures and radiation impacts. Thanks to the upgrade, the APS will offer the most powerful, focused high-energy X-rays in the world, with beams 500 times brighter than today, or 500 billion times brighter than a dentist's X-ray machine. At the AML, we will use these high-energy and focused X-rays to conduct detailed investigations of complex microstructures and their evolution within bulk materials exposed to radiation. Materials that can be investigated include structural and cladding materials, as well as nuclear fuels. Ultimately, our new capabilities will accelerate nuclear materials development and qualification—of critical importance to U.S. leadership in civil nuclear energy development and deployment.

Last year, nearly 100 industry scientists tapped into Argonne's Theta supercomputer, and we currently maintain more than 230 research agreements with companies at the APS. Our industry partnerships will grow when Aurora and the AML arrive. Leveraging this powerful mix of collaboration and world-class technology will help ensure that carbon-free nuclear power remains in the U.S. energy mix for decades to come.

The Diversity and Inclusion in ANS Committee

The Diversity and Inclusion in ANS Committee was established in 2018 to promote and support the participation of underrepresented or marginalized groups within the American Nuclear Society. Such groups include, but are not limited to, women, persons of color, members of the LGBTQA+ community, persons with disabilities, and other underrepresented groups.

The goals of the program are to promote diversity and inclusion in nuclear science, technology, and engineering, and to attract diverse and underrepresented groups to nuclear and other STEM-related fields. To help achieve these goals, under the guidance of the DIA Committee, the Society hosts networking events, organizes diversity-related sessions at meetings, provides travel grants for meetings, bestows awards, and offers leadership opportunities.

The DIA Committee, which was approved by the Board of Directors during the 2018 ANS Annual Meeting, was formed by expanding the Professional Women in ANS Committee with the inclusion of Nuclear Pride, an unofficial ANS LGBTQA+ group. Then in 2019, the Nuclear Engineering Education for the Disadvantaged Committee was included. The committee is the result of the combined efforts of several people over several years to ensure that these groups, named and unnamed, have a voice.

The committee has collaborated with many organizations both inside and outside of ANS. Within ANS, it has worked with the Education, Training and Workforce Development Division, the Young Members Group, and the Student Sections Committee. When this issue of *Nuclear News* went to print, DIA was collaborating with ETWDD, the SSC, and the Nuclear Engineering Department Heads Organization to hold a graduate job fair in November. Planning for the fair included working with the U.S. Department of Energy and minority-serving institutions.

Some members of the DIA Committee are working with external nuclear organizations, such as Women in Nuclear, Gender Champions in Nuclear Policy, and the National Organization of Gay and Lesbian Scientists and Technical Professionals.

As with most groups these days, the coronavirus has thrown a wrench into some of the DIA's plans for 2020. Much of its activities revolved around the in-person ANS Annual and Winter Meetings, which were converted to virtual events this year due to the pandemic. Facing those roadblocks, the

ANS Statement on Diversity

The American Nuclear Society is committed, in principle and in practice, to creating a diverse and welcoming environment for everyone interested in nuclear science and technology. Diversity means creating an environment—both in ANS and in the profession—in which all members are valued equitably for their skills and abilities and respected equally for their unique perspectives and experiences. Diverse backgrounds foster unique contributions and capabilities, and so creation of an inclusive Society ultimately leads to a more creative, effective, and technically respected Society.

ANS believes that everyone deserves opportunities for learning, networking, leadership, training, recognition, volunteering in Society activities, and all the other benefits that involvement in the Society brings, regardless of age, color, creed, disability, ethnicity, gender identity and expression, marital status, military service status, national origin, parental status, physical appearance, race, religion, sex, or sexual orientation. The selection of a member to serve in ANS's volunteer leadership structure shall be based solely on the member's ability, interest, and commitment to serve. In particular, ANS encourages members at each level of the Society and in each Professional Division and Technical Group to make special efforts to recruit underrepresented minorities and women to ensure that they are adequately represented in the Society.

committee adapted to an online platform to keep the mission moving forward and expand its reach to more members and friends of ANS. For example, DIA has started a roundtable webinar series. The first roundtable, "Black Racial Justice in the Nuclear Community," was held on September 2 and featured some ways to advocate and expand the voices heard in the nuclear community. The webinar resulted in a large number of members reaching out to the committee about the importance of hosting the roundtable and about how much the members got out of it.

Despite being a relatively new initiative, the committee has already seen progress being made through its engagement with the ANS membership.

Other initiatives include a multimedia resources tool kit, working with divisions and committees on organizing meetings (suggestions for speaker representation, reaching out to a larger audience), and stakeholder collaboration (working with diversity officers in industry, collaborating with peer organizations).

DIA leaders note that despite being a relatively new initiative, the committee has already seen progress being made through its engagement with the ANS membership. At the last in-person workshop/social, held during the ANS 2019 Winter Meeting, the committee received a lot of positive feedback from participating members (and ran out of food in the first 10 minutes because of the high attendance!).

Still, more progress is needed. The goal is to raise awareness, assessment, and action on several levels, from interpersonal to institutional to the nuclear community. That means the work will be ongoing as ANS continues to focus on diversity and inclusion ideals. One area facing the challenge of diversifying involves the fact that women have traditionally not entered into STEM careers. The first webinar also pointed out that few historically black colleges and universities offer a nuclear program.

"We have to fix the leaky pipeline," said DIA chair Lane Carasik. "We have to break bread with the

Spotlight On continues

communities we want to involve. We have to address issues that cause us to lose underrepresented and minority persons from ANS. You can't bring someone in and then not provide the environment for success."

The committee always has its eye on the future and finding ways to further engage the ANS membership, Carasik said. Its plans include enhanced collaboration with the ANS Board of Directors, staff, and volunteer leadership. It also plans to continue research and relationship development with other constituents in the nuclear community and other professional organizations. Other items in store include further roundtable sessions and conference panels, and possibly an ANS plenary session or a President's Special Session to broaden its impact on members. In addition, continued work on the resource tool kit, expansion of the travel grant program (for students to attend ANS national meetings), a future DIA scholarship, and many other activities are in the planning stages.

Members interested in getting involved with DIA can attend committee meetings and participate in the committee's activities. The DIA's webpage (ans.org/communities/diversity) includes more information, resources, and a link to ANS Position Statement No. 66, which addresses diversity and inclusion in the nuclear profession.

A fellowship like no other

By Bradley Williams,
2020 ANS Congressional Fellow

Upon entering the Dirksen Senate Office Building on January 6 to begin my tenure as the 2020 ANS Glenn T. Seaborg Congressional Science and Engineering Fellow, I knew I was embarking on an exciting new adventure. Little did I know how unique it would be.

From a presidential impeachment to a coronavirus pandemic, 2020 ANS Congressional Fellow Bradley Williams has had a unique experience during his fellowship on Capitol Hill.

Having worked in Washington, D.C., for my entire career, I knew this would be an exciting and fast-paced experience. Specific responsibilities for congressional fellows vary, depending on whether you're in a personal or committee office, or in the House or Senate. But no matter which office you call home, you'll have the opportunity to contribute to timely, meaningful, and varied work.

As with most jobs inside the Capital Beltway, networks are everything. Networking on Capitol Hill is best evidenced by the numerous coffee shops located throughout the complex. At any time of day, you'll find them packed with folks having short meetups. It didn't take me long to learn to appreciate decaf.

The first two and a half months of my fellowship were pretty much what I expected. On my first day on the job, I dove into hearing prep with the Senate Committee on Environment and Public Works. After that initial hearing to review the Nuclear Regulatory Commission's progress in implementing the Nuclear Energy Innovation and Modernization Act (NEIMA), I had a small window to settle in, get up to speed, and find my favorite coffee shop. But things quickly picked up. In March, we held a hearing on the NRC's fiscal year 2021 budget request, followed by a hearing the next week to consider the nomination of two NRC commissioners.

Somewhere in the middle of these hearings, I had the chance to sit in the Senate gallery and observe history. Some might say that witnessing only the third impeachment trial in U.S. history makes my time as a fellow unique. I had no idea it was about to become an unprecedented experience.

Friday, March 13, marked my first day of coronavirus-induced new normal. While not the experience I envisioned, it has been productive.

Nuclear Trending continues

Restrictions due to the coronavirus pandemic has given Williams more time at home with his wife Emily and daughter Whitney Hope.

I may be missing out on in-person interactions, but I am extremely thankful for the extra time with my wife and daughter.

In addition to changing how we work (now with Disney movies or Sesame Street in the background), the pandemic changed what we've worked on. Highlighting the important role of congressional oversight, we spent significant time this spring working with the NRC and utilities to ensure that plant operators were able to keep the lights on and crews were able to safely execute refueling and maintenance outages.

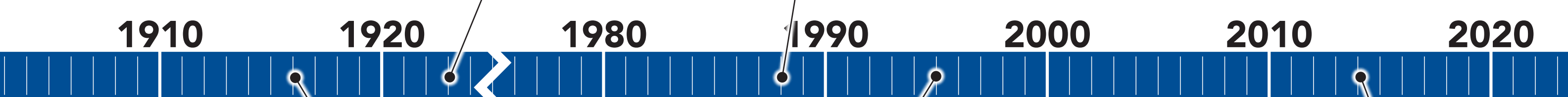
Not all has been unexpected. Heading into the fellowship, I knew that developing a follow-up to NEIMA was a priority. Having the opportunity to develop legislation has been a rewarding experience and brought me back into the office a few times for socially distanced and masked meetings and a hearing on our discussion draft bill. With only a few months left, I'm hopeful that the bill continues progressing.

Add in a Supreme Court justice confirmation and a presidential election, this experience continues in uncharted territory. Even with all the challenges, it has been a unique, amazing, and worthwhile experience.

Nuclear Notables—November

1923: J. Ernest Wilkins Jr., 20th (and first African American) ANS president (1974–1975) and ANS Fellow; worked at University of Chicago Metallurgical Laboratory during the Manhattan Project; born November 27.

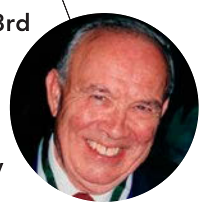
1988: E. Gail de Planque, 34th (and first female) ANS president (1988–1989) and ANS Fellow; presided over the ANS Winter Meeting in Washington, D.C., in November as attendees celebrated 50 years of fission.



1916: Nunzio J. Palladino, 16th ANS president (1967–1968) and ANS Fellow; NRC chairman (July 1981–June 1986); born November 10.

1995: Shirley Ann Jackson, NRC chairman (July 1995–June 1999); interviewed for cover story of the November 1995 issue of *Nuclear News*.

2014: Stanley R. Hatcher, 43rd ANS president (1997–1998) and one of only two non-Americans to hold that office; ANS Fellow; recognized nuclear industry leader; died November 30.



Is nuclear scalable and sustainable?

In the August issue of *Nuclear News*, I asked if you've ever wondered why nuclear isn't commonly considered *the* choice for clean power production. In that and subsequent columns, I provided some information about the cleanliness, safety, and reliability of nuclear for your use in everyday conversation as you make the case for this clean energy source. This month, let's tackle the scalable and sustainable aspects of nuclear.

If we define "scalable" as the ability to scale up the amount of nuclear in a reasonable time frame, the bottom line is that we must make nuclear power plants more affordable to build and operate. The high costs stem from both technical and policy issues. The Massachusetts Institute of Technology recently published a report that looked at these issues (energy.mit.edu/research/future-nuclear-energy-carbon-constrained-world/). The study recommends use of proven project and construction management practices, a shift from field construction to serial manufacturing, and internationally aligned regulatory policy. While the United States still has the highest amount of nuclear power capacity of any country, only two reactors are under construction here, with another five in the western hemisphere and 46 plants in the eastern hemisphere, per the World Nuclear Association (world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx). The technical challenges are similar across the globe, which suggests that construction practices and policy have a significant impact on the relative scalability. On average, nuclear currently is not as scalable as fossil fuels; however, that can change. Such change may be motivated if nuclear is expected to accommodate increasing demand for reliable, non-emitting sources of power. So-called renewables are scalable, but as discussed in last month's issue they are not reliable and cannot operate without backup from nuclear, fossil, and hydro plants.

Sustainability is somewhat more subjective than scalability. In the context of energy use, let's define it as meeting the electricity needs of the current generation without compromising the ability of future generations to meet their needs. Estimates of fuel reserves for both fossil fuels and thermal nuclear indicate 50 years or more of relatively assured capacity. However, history indicates that the more and better we seek, the more we find. (For example, reference *Hubbert's Peak: The Impending World Oil Shortage*, by Kenneth Deffeyes.) And adding fast reactor technology to the nuclear portfolio gives us essentially limitless resources.

Meanwhile, the wind and sun will last effectively forever. But again, the lack of reliability makes these renewable options ineffective without backup. Further, power density calculations suggest that implementation of wind and solar is far less sustainable than nuclear. According to the Nuclear Energy Institute, the footprint of a nuclear power plant is about 1.3 square miles per 1,000 MWe capacity. To generate the same amount of electricity annually, a wind farm would require between 260 and 360 square miles. Compare that to the 305 square miles covered by all five boroughs of New York City! A solar power facility would require between 45 and 75 square miles—comparable to the 68-square-mile area of Washington, D.C. Is such land usage, accounting for population growth and increased electricity demand, sustainable?

I encourage you to do your own fact checking and calculations. Convince yourself, and then you can better convince others of the true value of nuclear.—*Mary Lou Dunzik-Gougar (president@ans.org)*

Nuclear Trending continues

LETTER FROM THE CEO

Do we have enough "People of Nuclear"?

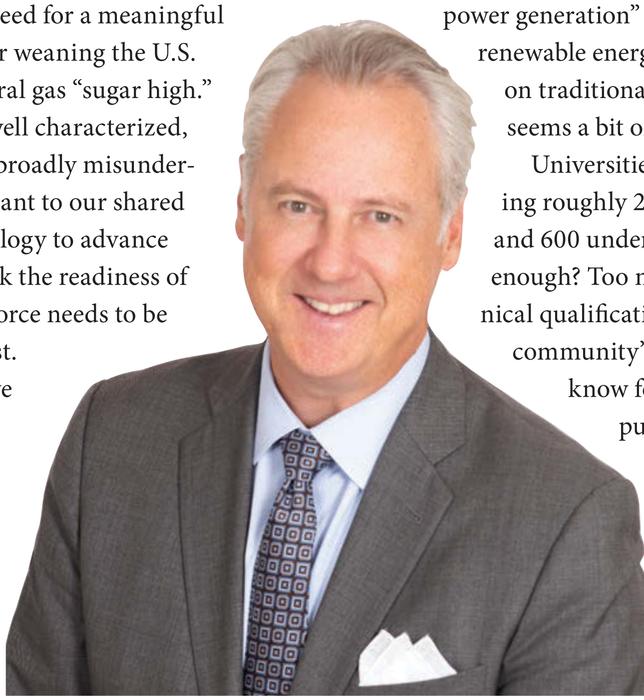
This month's issue of *Nuclear News* focuses on the People of Nuclear and what it means to be a member of the "Fellowship of the Atom."

The nuclear science and technology (S&T) community in the United States and around the world has had a tumultuous existence since the early days of Curie, Fermi, and Rickover. As one friend puts it, "I've seen the demise of nuclear four different times, but we're still here."

These days, I see a tender but growing optimism emanating from the men and women of the nuclear professional community. Advanced reactor designs are making their way through the Nuclear Regulatory Commission licensing process, major U.S. utilities are making deep decarbonization commitments, Congress is funding a significant increase in nuclear research and development investment, fusion is inching closer to commercial reality, and improvements in accelerator technology are enabling better diagnosis and treatment of disease.

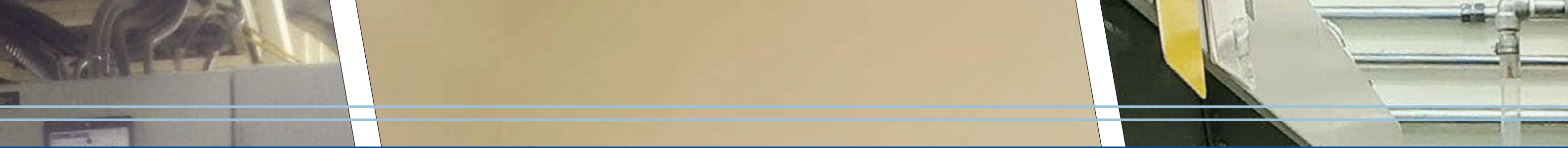
Of course, a few pieces still need to fall into place before we can truly proclaim the dawn of a new nuclear day. Some are obvious, like the need for a meaningful price on carbon emissions or weaning the U.S. electricity sector off its natural gas "sugar high." But other pieces are not as well characterized, or could be said to be more broadly misunderstood, yet are no less important to our shared goal of using nuclear technology to advance humanity. Personally, I think the readiness of our technical nuclear workforce needs to be near the top of everyone's list.

It's surprising how little we know about ourselves. A recent study by the National Association of State Energy Officials and the Energy Futures Initiative counted 60,916 workers employed in U.S. nuclear power generation in 2019, with another 9,406 employed in the nuclear fuels sector. The U.S. Bureau of Labor Statistics (BLS) estimated 16,900 jobs for nuclear engineers in the United States in 2019. Good information on the non-energy nuclear S&T workforce is harder to come by. The potential numbers are tantalizingly large, especially in the medical and life sciences industry, where the cross-disciplinary nature of the work defies easy categorization. We also lack a clear, unclassified picture of the needs of U.S. national laboratories, other than the looming impact of bimodal distribution—more people at the beginning or end of their career and fewer in the middle. U.S. House Energy and Water Appropriations Chair Marcy Kaptur (D., Ohio) recently cited conversations with U.S. Department of Energy lab directors that "30 to 40 percent of their highest level scientists pivoted toward retirement very soon" and that the "issue of recruitment is a very serious one."



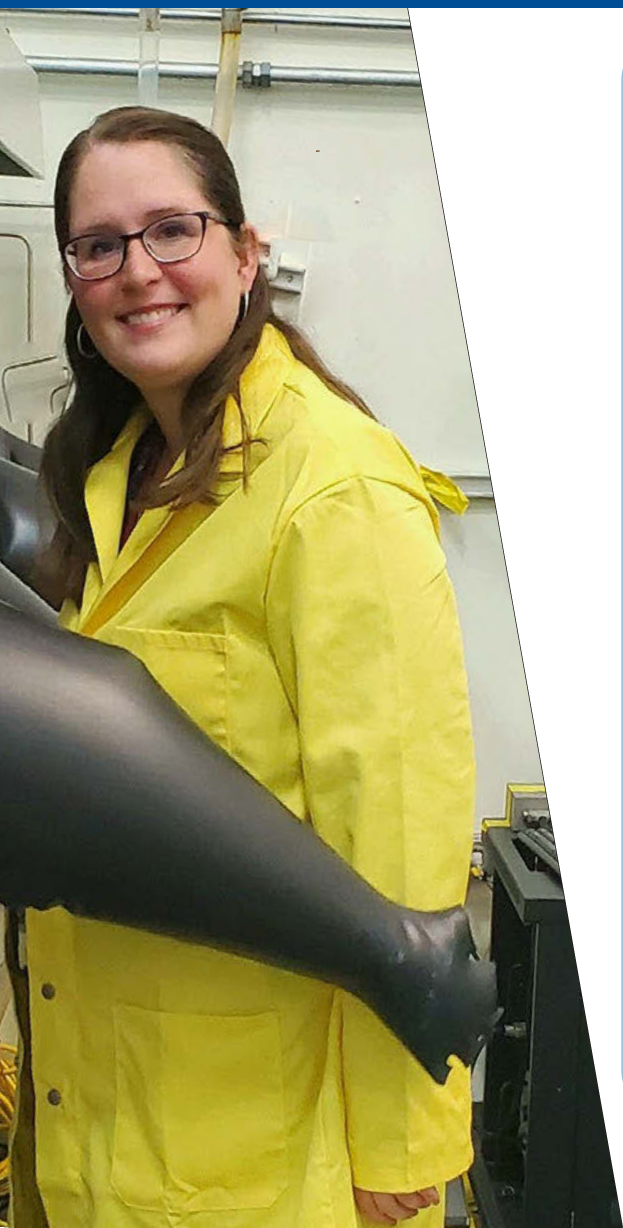
Back to BLS for a moment. They project a 13 percent *decline* in the job outlook for nuclear engineers in the 2020s, attributing it to utilities "opting for cheaper natural gas in power generation" and "the increasing viability of renewable energy … putting economic pressure on traditional nuclear power generation." That seems a bit one-dimensional, doesn't it?

Universities in the United States are awarding roughly 200 nuclear engineering PhDs and 600 undergraduate degrees a year. Is that enough? Too much? Are these graduates' technical qualifications aligned with the nuclear community's future needs? We simply don't know for sure, and that lack of knowledge puts us at greater risk of being unable to fully harness nuclear S&T to solve humanity's challenges in the critical years ahead.—*Craig Piercy, Executive Director/CEO (cpiercy@ans.org)*



A Day in the Life:

The Nuclear Community at Work



This issue of *Nuclear News* is focused on the individuals who make up our nuclear community.

We invited a small group of those individuals to tell us about their day-to-day work in some of the many occupations and applications of nuclear science and technology, and they responded generously. They were ready to tell us about the part they play, together with colleagues and team members, in supplying clean energy, advancing technology, protecting safety and health, and exploring fundamental science.

In these pages, we see a community that can celebrate both those workdays that record progress moving at a steady pace and the exceptional days when a goal is reached, a briefing is delivered, a contract goes through, a discovery is made, or an unforeseen challenge is overcome.

The *Nuclear News* staff hopes that you enjoy meeting these members of our community—or maybe get reacquainted with friends—through their words and photos.

Kurt Terrani

Director, Transformational Challenge Reactor Program, Oak Ridge National Laboratory

Terrani observing a chemical vapor infiltration furnace during densification of additively manufactured nuclear-grade silicon carbide.

I am the director of the Transformational Challenge Reactor program at Oak Ridge National Laboratory. We are targeting the application of additive manufacturing and augmented intelligence to deliver a better, cost-effective way of building reactors. A typical day involves numerous technical meetings, including one-on-ones with my staff. In a large, multidisciplinary effort, and especially one using an agile approach to move quickly, constant communication is key. The rest of my day goes toward responding to various program and management needs. The fun starts in the late afternoon when I work on publications. Writing journal articles, specifically making plots, is a true passion. It is especially fun when working with data from tests in ORNL's High Flux Isotope Reactor since few people have the privilege to access that beast of a machine and ORNL's other nuclear facilities.

I enjoy a fast-pace work environment, and ORNL does not disappoint. The key is to focus and ensure your work is technically sound. Another favorite activity is asking my team to take on something extraordinarily hard. I remind them that if what we are doing is not really difficult, then we do not belong at a national laboratory. Setting moonshot goals and inspiring a capable and diverse team to deliver is what I live for every day.

José N. Reyes Jr.

Cofounder and Chief Technology Officer, NuScale Power

Reyes at the NuScale Integral System Test (NIST-2) facility in Corvallis, Ore.

I lead a diverse team of talented engineers and other experts to bring NuScale's safe, affordable, and reliable small modular reactor—the NuScale Power Module—to the world.

On a typical day, I hold team meetings on one of our exciting research collaborations such as our advanced manufacturing project with the Electric Power Research Institute and the U.S. Department of Energy. Each meeting begins with an industrial and Institute of Nuclear Power Operations safety message, because safety comes second to none at NuScale. From there I might head into a media interview or conduct a presentation for a potential investor or utility customer to discuss the unique features of our SMR technology and its diverse applications.

August 28 was an exceptional day made possible by the dedication and commitment of the entire company: NuScale's SMR became the first-ever to receive U.S. Nuclear Regulatory Commission design approval. Since our founding in 2007, our culture of innovation has helped us grow to over 400 employees, with 550 patents granted or pending in 20 countries. NuScale is advancing its work to provide carbon-free power for the production of electricity, heat, and clean water to improve the quality of life for people around the world.

Amber McCarthy
Nuclear Criticality Safety Engineer, Consolidated Nuclear Security

As a nuclear criticality safety (NCS) engineer at the Y-12 National Security Complex in Oak Ridge, Tenn., I am responsible for helping ensure that fissile materials are safely transported, handled, and stored during normal and credible abnormal production operations. NCS engineers evaluate operations using calculations and Monte Carlo computer codes to demonstrate that processes can be performed safely.

A typical day is balanced between my desk and the plant. It is important that I spend time in production facilities and speak with operations and production representatives to fully understand the process conditions and continuously verify that the NCS analysis reflects the current state. NCS requirements and controls must be compatible with operations. The work done by NCS engineers helps the site deliver its mission, but more important, it protects the safety of workers. This cannot be achieved without input from multiple disciplines. One of my favorite aspects of the job is getting to work with people with diverse technical backgrounds to solve unique problems. Uranium is handled in very few places in the world, and it is amazing to get to work with one of the world's most valuable resources.

McCarthy (at right), with co-workers Dallas Moser and Marsha Knowles, at an Oak Ridge High School outreach event during Nuclear Science Week in October 2019.

Alyse Huffman
Professional Staff, U.S. House of Representatives Committee on Science, Space, and Technology

As professional staff, I spend most of my days studying clean energy research and development policy, keeping up with current events in clean energy and talking to stakeholders and other experts in the field. I also staff Chairwoman Eddie Bernice Johnson and other Democratic members of the committee and work on potential legislative solutions to help advance clean energy in an equitable and environmentally just way. September has been uniquely challenging and memorable because the bulk of the Energy subcommittee's legislative work for the entire Congress was being prepared to head to the floor as part of a clean energy innovation package. If passed into law, this package would be instrumental in making the investments we as a nation need to make to transition to a low-carbon future. It includes a nuclear energy section that would authorize much of the important work done in the Department of Energy's Office of Nuclear Energy, including an advanced reactor demonstration program, used nuclear fuel research, and research that would prolong the life of the current fleet of reactors in a safe way. Through my work on the Science, Space, and Technology Committee, I feel that I'm doing my part to help combat climate change.

Huffman staffs prior Energy Subcommittee Chairman Conor Lamb (D., Pa) for a House Science, Space, and Technology Committee hearing.

Continued

Natalie A. Yonker
Manager, Organizational Effectiveness, Dominion Energy's Millstone Station

My role oversees the Corrective Action Program, site Safety and Medical, Procedures and Records groups. Lately, much of my time involves the pandemic response. Like all things at Dominion Energy, my day starts with safety. I stop at the Safety Office to get alignment on safety conditions and compensatory measures that may be in place, plus any lessons learned to share from the fleet to report on at the daily station alignment meeting.

Yonker films a pre-outage safety blitz video.

I work with evaluators of causal investigation. I review all Operating Experience that Millstone communicates to the industry to ensure that the level of detail is sufficient for all to understand. I create initiatives choosing topics based on station trending to bolster station performance emphasizing human performance, elements of leadership, and teamwork attributes, with a focus on self-criticality and continuous learning. I lead the Valued and Engaged Employee team creating engagement activities and celebrations like our cornhole tournament or celebrating 1,000 days of safety success while keeping people safe during a pandemic. I recently met with a shift manager candidate who complimented the value of station engagement activities that were nonexistent before. To hear that what I do makes a difference is extremely motivating.

Spencer Ercanbrack
Undergraduate, Research Reactor Senior Reactor Operator and Research Assistant, Idaho State University

A typical morning begins early as I get out of bed to either work out or work on my research project before morning classes begin at 9:30 a.m. Classes ranging from circuit analysis to engineering modeling dominate the rest of the morning. Lunch provides a brief respite, and the rest of the afternoon is spent in my capacity as a research assistant writing code, working on writing a job report and getting a journal article published, and running simulations. When a senior reactor operator is needed at the Nuclear Engineering Laboratory's research reactor, I assist with activities ranging from new reactor operator training to reactor operations and maintenance. The remaining time in the day is spent on additional classes, homework, and, time permitting, Netflix. An exceptional day happened recently when my fellow research assistant and I submitted our 2020 fiscal year job report and presented our work to our employer and sponsors. We received much positive feedback, including interest in applying our work to additional areas in our field of research.

Ercanbrack, holding a boron trifluoride (BF_3) ionization chamber used to provide reactor neutronics information to safety channel number 2 on the reactor control console. The ionization chamber was removed from the reactor to undergo tests.

Matthew Denman
Principal Engineer, Reliability Engineering, Kairos Power

My typical day begins with a cup of coffee, toast, and passing my son, Sam, to his grandmother before walking to my home office. The probabilistic risk assessment (PRA) team is responsible for the risk triplet: what can go wrong, how likely is it, and what are the consequences. Remote work for our team of four has increased the need for clear communication, documentation, version control, peer review, automation, and testing to ensure that we are all progressing in the same direction. This automation includes developing R Markdown templates to facilitate the generation of reports, memos, and internal Web interfaces of our work product, which embraces Kairos Power's iterative approach to reduce development risk. Between these tasks, there is always time to share topical gifs and memes to liven up our days.

One of my PRA tasks was leading a multidisciplinary team over eight months to develop our mechanistic source term methodology. In May, I (virtually) briefed this methodology to the Nuclear Regulatory Commission staff, who have accepted it for review. Extraordinary opportunities to blaze new trails in reactor safety with a talented, committed, and funny team today brings me hope for a bright nuclear-powered tomorrow.

Temi O. Adeyeye
Fluid Systems Engineering, Westinghouse

I currently support fluid systems engineering for AP1000 plants, as well as other major project teams at Westinghouse. My background at Westinghouse is in fluid systems, valves, equipment, and outage services. This background has provided me with opportunities to support and lead efforts from operating plants and engineering services to AP1000 new plant design, construction, commissioning, startup, and licensing. A typical day at Westinghouse for me consists of working with engineering and project teams to implement design and project activities.

In 2018, AP1000 units in China completed initial plant startup testing. I had a lead role in supporting an integrated I&C and mechanical systems team. Startup testing consists of fuel loading, pre-critical testing, initial criticality, and power ascension testing. The effort was extraordinary because it was the first AP1000 plant startup test program.

The integrated I&C, mechanical, and control systems team demonstrated technical excellence and effective communication between Westinghouse, the customer, and other on-site technical roles to support a new generation of nuclear power plants around the world.

Don Williamson
Site Vice President Coordinator, Arkansas Nuclear One, Entergy Nuclear

My day-to-day activities support the site vice president. Whether this means coordinating visits by corporate partners, the Institute of Nuclear Power Operations, the World Association of Nuclear Operators, Entergy Nuclear board members, or Congresspeople, I work to make each visit successful. Work on a daily basis is a challenge, yet each day brings new opportunities and connections across the fleet and industry.

Annually, Entergy Nuclear selects board members to visit the site, meet with employees, and observe the state of the facilities. Part of my responsibilities working for the site vice president at Arkansas Nuclear One requires me to coordinate the tour, badging, and technical briefs. The success of visits depends upon essential skills such as communication and flexibility.

Coordinating each visit requires working across departments to schedule events and tours. During a visit, board members tour our site, meet with employees across multiple departments, visit the control room, and meet with our employee resource groups. We have to be flexible regarding the tour route as interactions can be more detailed than anticipated, requiring on-the-fly fixes to ensure we meet hard timelines.

Continued

Diane Tamai Jackson,
Chief, Nuclear Regulator Apprenticeship Network Branch, Nuclear Regulatory Commission

In June, as the U.S. Nuclear Regulatory Commission adapted to the COVID-19 pandemic, we welcomed 23 recently graduated scientists and engineers as the first cohort of our two-year development program, the Nuclear Regulator Apprenticeship Network (NRAN). This diverse group was strategically selected to support the NRC's forecasted skill needs.

My typical day includes leading seminars on regulatory, technical, and organizational knowledge, overseeing training progress, and stretching and assessing the participants' abilities. In the first 15 weeks, I ensured that they gained a broad understanding of the NRC before participating in three or four technical apprenticeships throughout the agency. These opportunities focus on applying their knowledge and gaining experience through on-the-job contributions.

An exceptional day for me was the day that the cohort members led team-building sessions. They split into teams and planned and led activities that related to NRC knowledge and organizational skills. Each team's end-of-day lessons-learned discussion made it clear to me that the cohort was ready to start apprenticeships with a strong foundation and a positive attitude. I am proud to be part of the agency's work to ensure that the NRC will fulfill our safety and security mission today and in the future.

Jackson meets with a small group of NRAN participants.

Nicolas Stauff
Principal Nuclear Engineer, Argonne National Laboratory

Work starts early to get in a few hours of uninterrupted technical work, such as advancing the design of a new microreactor core concept developed in support of our industrial partners or writing publications (and technical reports if toward the end of the fiscal year). Then, I try to get some fresh air and run in the Argonne

Stauff confers with colleagues.

Katy Huff
Assistant Professor, Department of Nuclear, Plasma, and Radiological Engineering, University of Illinois at Urbana-Champaign

In this pandemic, I undertake my research, teaching, and service mostly virtually. While no day is typical, mine usually begins around 6:30 a.m., when I start handling email, getting organized, and even taking meetings with researchers in distant time zones. Around 8:30 a.m., I (virtually) share coffee and discuss the day's tasks with the handful of undergraduate students, 10 graduate students, and one postdoctoral fellow in my research group. I then develop curriculum and teach my reactor physics course. In countless scattered meetings throughout the day, I serve on various committees, advise student groups, and attend administrative meetings. With the time remaining, I guide and direct research, which mostly consists of reading, writing, and reviewing grant proposals, theses, research articles, and software in collaboration with my students and colleagues.

forest before beginning a series of meetings with my teams to discuss various projects that I am leading.

This morning, I focused on economics analyses of nuclear reactors in U.S. grid markets completed to help the Department of Energy, Office of Nuclear Energy understand the challenges encountered by U.S. nuclear power plants, and I investigated policy and technical solutions to help address those challenges. This afternoon, my focus shifted to demonstrating the capability of advanced, high-fidelity multiphysics computation tools developed under the Nuclear Energy Advanced Modeling and Simulation program to design and analyze microreactor concepts developed by industry.

The best part of the job is when I feel I am contributing to advancing nuclear technologies through developing innovative solutions, such as represented by our recently filed patent on advanced moderator modules, to making microreactors cheaper and lighter for easier deployment, even to the moon.

Huff demonstrates her use of a lightboard for virtual lectures.

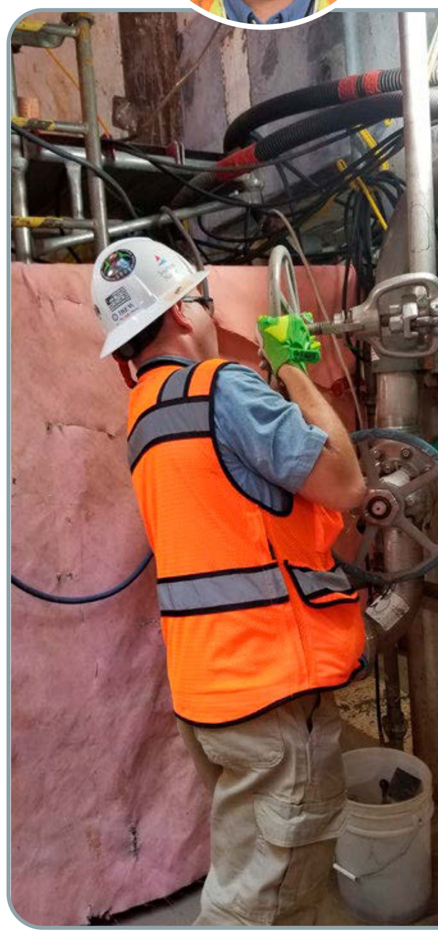
Recently, my weekends have been quite exceptional, as I've been spending them recording lectures for my course with a very slick-looking device called a lightboard. The transparent, illuminated glass panel allows me to write lecture notes and draw concepts while simultaneously speaking to the camera. With some clever automation arranged by our department's students, I can even start and stop recording without help, which is ideal for the COVID-19 era.

John Denisiuk
System Operator, Southern Nuclear's Plant Vogtle

As a system operator at Vogtle-3 and -4, I start my day with a shift brief to discuss the plant status, scheduled tests, and evolutions planned for the shift. Following the brief, I conduct rounds by monitoring all running equipment for my designated watch station, ensuring that the equipment is operating as expected. While conducting rounds, I take time to refresh my system knowledge and preview the upcoming testing activities.

As with any new plant, testing equipment presents its own unique challenges. However, our top priority is personnel safety. As a system operator, some of my most rewarding days are spent developing solutions to challenges that adhere to the highest standards of safety and quality. I enjoy doing my part to help Southern Company build and operate Vogtle-3 and -4 safely.

I'm confident that we can identify and clear any obstacles that would present a challenge for safe and proper testing on any equipment, with an overall goal of safe and reliable operations at Vogtle-3 and -4 in the future.


Denisiuk opens a valve to support testing.

Continued

Catherine Percher

Principal Investigator for Critical Experiments, Lawrence Livermore National Laboratory

After earning a nuclear engineering degree in the early 2000s, I started my career in nuclear criticality safety (NCS), a safety discipline whose goal is to avoid an unwanted self-sustaining nuclear chain reaction during fissionable material operations. My current position designing critical experiments isn't that big of a stretch from NCS. I'm using the same neutronics codes that I used for NCS, except now instead of limiting the system parameters (mass, moderation, etc.) to keep the calculations subcritical, I'm trying to optimize parameters and ensure criticality. As a principal investigator for critical experiments, my job focuses on determining experimental needs (soliciting input from the nuclear data, NCS, and other application communities), writing proposals to get experiments funded, completing neutronics calculations, leading a design team (drafters, other engineers, and safety disciplines), and lots of writing and presenting results (reports, papers, and benchmarks).

Percher adjusts the LLNL uranium training assembly.

One of the best things I get to do as part of my job is to teach part of a hands-on criticality course, combining my NCS and experimental experience. My part of the class uses eight nesting shells of high-enriched uranium metal that can be assembled in multiple configurations to experimentally demonstrate the neutron multiplication effects of mass, moderation, reflection, spacing, and poisons. I really enjoy helping the students make sense of the sometimes confusing neutron data and giving them hands-on experience with real nuclear material. I've found that teaching the class has also been a great way to maintain a link to the next generation of NCS engineers.

Marilyn C. Kray

Vice President, Nuclear Strategy and Development, Exelon Generation

As the vice president of nuclear strategy and development for Exelon, my role is to grow our business by leveraging our expertise gained through operating our fleet of 21 reactors. This means offering operational support services to companies considering owning a nuclear power reactor. In most cases, these potential new owners are evaluating a small modular reactor or some other advanced design. In many cases, these new owners are outside the United States, which is why it's not rare that my day starts before 7 a.m. eastern to accommodate another time zone. These odd hours are in exchange for the pre-COVID schedule, when I was traveling each week instead.

My next meeting today is in my capacity as chair of the Nuclear Energy Institute Advanced Reactor Working Group, which is the industry forum working with the Nuclear Regulatory Commission to revise the regulatory framework to accommodate the next generation of new reactors. That's followed by a meeting with Exelon's internal government affairs. Even though our immediate focus is state-level policy to keep our current fleet operating, we are also looking at the policy needed for the next generation. Speaking of our current fleet, my late-afternoon meeting is on a project, funded by the Department of Energy, where we will be constructing a hydrogen generation facility at one of our sites to improve its economic performance.

I interface with many different people from different entities. An exceptional day is when the events aren't discrete activities, but they converge and complement each other. One example is having a new owner's needs reflected in a DOE program funded through policy informed by the industry.

Tara Jones
Health Physicist Principal, Energy Northwest's Columbia Generating Station

With the special, unique, and complex characteristics of nuclear energy, one might think that a day in the life of a health physicist at a nuclear power plant is challenging. However, a typical day is actually mostly calm. My position at the Columbia Generating Station involves managing the internal/external dosimetry programs and being the subject matter expert for the asset management program that tracks instrumentation and dosimetry. My team often interacts with other departments and regulators who come for assessments and inspections. My job is to ensure that our radiation protection programs are healthy and follow all of the regulations set forth by the Nuclear Regulatory Commission and other agency standards. I help ensure that we remain trustworthy while continuously producing electricity safely and reliably.

Jones refers to a Columbia Generating Station site map.

Even quiet days can be extraordinary, though. An opportunity I had recently was to educate firefighters, emergency medical technicians, and hazmat response members on responding to transportation accidents involving radioactive materials. It was rewarding to be able to teach our heroes that radioactivity doesn't have to be scary, but it still needs to be respected. That is my primary goal in my career—to continuously educate and learn. It is an honor to be in this community.

Heath performs a containment walkdown at a nuclear power plant.

Jermaine Heath
Technical Assistant and Risk and Reliability Analyst, Nuclear Regulatory Commission

I have more than 17 years of experience in nuclear power, including over 13 years in power plant operations, inspections, and oversight. As a technical assistant and risk and reliability analyst at the U.S. Nuclear Regulatory Commission, I advise and provide program support to senior management on complex technical and regulatory issues concerning commercial nuclear reactor safety. Specifically, I provide technical and programmatic support for the evaluation of probabilistic risk assessment (PRA) related issues involving nuclear power plant reactor licensing, operation oversight, accident radiation dose assessment, health physics, and fire protection. Day to day, I support projects involving PRA development relating to internal and external plant events, reactor shutdown, and risk-informed engineering programs. In my role, I perform and support risk evaluations of issues identified during the follow-up of significant operational events that occur at nuclear power plants, using both quantitative and qualitative risk insights to help the NRC inspectors and staff determine the safety significance of degraded conditions at U.S. commercial power plants.

An exceptional day on the job is when I am able to combine my experience in reactor operations with PRA risk information to advise my management during a critical regulatory decision-making that provides reasonable assurance of the adequate protection of public health and safety.

Continued

Brian Dassatti

General Manager, Scientech Outage and Fuel Management Solutions, Curtiss-Wright Nuclear Division

As a professional engineer and general manager at Curtiss-Wright Nuclear Division, safety is paramount every day on the job. Beyond the daily management of operations, I work with our team and customers to deliver products and services that enhance worker safety and ensure component reliability. I am accountable for ensuring that our employees foster a positive nuclear safety culture and carry that culture into the field, along with adherence to all safety protocols. Whether it be our written safety commitment or robust COVID-19 continuity plan, we all own safety and watch out for ourselves and our colleagues.

Since the onset of COVID-19 in March, my days have been far from typical. I am proud to say that we have risen to the occasion as an essential business to meet our customers' needs during a very challenging time. We proactively prepared a COVID-19 continuity plan to comply with all state and federal guidelines, educated our employees on the virus and ways to mitigate its spread, and ensured that all workers were provided the necessary supplies and personal protection equipment. It is my daily goal that we continue to satisfy our customer commitments while ensuring the ongoing safety of our customers and employees.

Lawrence E. Boing

Manager, D&D Special Projects, Argonne National Laboratory

A typical day for a decommissioning specialist may involve many different activities, such as evaluating technical options for decontaminating or dismantling some equipment or material. Another activity might be sharing past decommissioning work experiences in the training of young engineers or project managers from operating contractors/licensees, service contractors, and regulators starting work in the nuclear decommissioning field. I also get involved with writing topical reports for the domestic and international communities on some aspects of industry topics that convey project experiences, key lessons learned, and best practices. With my 41 years of decommissioning experience, I have seen or participated in many different examples of various aspects of decommissioning projects. Many of the work experiences are domestic, but some are from the international area, with work in the decommissioning field expanding there every year.

An exceptional day might be a day, or most likely several weeks, when we are teaching a visiting group of either U.S. or international nuclear staff on how the decommissioning process is conducted from start to finish. In this case, the knowledge exchange is actually a two-way process, even though it may appear to only be one way. Always be able to learn more new information.

Jennifer K. Wheeler

Director, Regulatory Affairs and Fuel Production, X-energy

X-energy is developing a TRISO-based uranium fuel facility, TRISO-X, to fabricate 15.5 percent high-assay low-enriched uranium (HALEU) pebble fuel for the Xe-100 pebble bed high-temperature gas reactor, fuels up to 19.75 percent HALEU for other advanced reactor designs, and accident tolerant fuel for the current fleet of light-water reactors. X-energy is currently operating a commercial-scale fabrication line at Oak Ridge National Laboratory that is forming the basis for licensing the TRISO-X facility.

Working on a first-of-a-kind project is exciting and challenging. My best days so far have involved hosting Nuclear Regulatory Commission staff from headquarters and the Region II office for visits to our facilities at ORNL to see fuel development and facility design in action. I lead the development of a license application for submittal to the NRC for a 10 CFR 70 Category II (uranium enriched to 10 percent or more but less than 20 percent) special nuclear material license. A typical day for me involves any of the NRC-required plans and reports, including integrated safety analysis, security, material control and accounting, emergency preparedness, environmental, and decommissioning. I also get to leverage my civil engineering background by participating in planning the layout of the facility.

Yu-Chih Ko

Principal Engineer, Thermal Hydraulics Computations and Plant Simulations, TerraPower

As principal engineer for simulator development at TerraPower, my daily routine consists of checking and ensuring that all the glasstop simulators are working smoothly. I collect and analyze the data from previous simulations on a regular basis. The results from the simulator are then presented at our design integration meetings. Through this type of iteration, our reactor design can be improved and optimized at a much faster speed than traditional approaches. I am responsible for programming the simulator so that it can execute the specific features and functionality to support the design work. Hardware and software maintenance is part of my checklist as well. Presenting the simulator to visitors is always pleasant and interactive. I enjoy sharing our technology and am always inspired by the questions the visitors ask.

Ko collects and analyzes data from TerraPower's glasstop simulators.

In addition to the technical work, I am also managing the company-wide Knowledge Sharing Program (KSP), which provides a platform for all employees to share their knowledge, perspectives, and experience with colleagues. Topics of the KSP range from I&C to disability awareness to treehouse construction. This program has helped us as a company to stay connected on both a professional and personal level, especially during the pandemic this year.

Garrett Holter

Machinist's Mate Nuclear Second Class, U.S. Navy, Nuclear Power Training Unit, Charleston MTS-635

A typical day on the job for me starts with a muster of my crew, where the plan for the day is disseminated. During this time, we are assigned to various watch stations for the day. Because I am a machinist's mate, the watches I stand include Engine Room Supervisor, Engine Room Upper Level, Engine Room Lower Level, Feed Station, and Reactor Mechanic. Unlike most plants, we start up and shut down the reactor several times on most days. Typically, we break up an eight-hour shift into two halves. The first half is a shutdown and the second half is a startup. While standing watch, we have students as our under-instructs. We teach them how to stand each watch station and allow them to operate under our supervision.

I have a collateral duty as a shipyard competent person for confined space entry and atmospheric testing. This role requires me to test various spaces to ensure that the atmospheric requirements for habitability are met. An exceptional day for me occurs when these conditions are not deemed habitable, and I must get creative and quickly problem solve to ensure everyone's safety.

Holter stands outside the U.S. Navy's Nuclear Power Training Unit near Charleston, S.C.

Continued

Alicia Swift

Program Manager and Team Lead for Nonproliferation and Arms Control Programs, Pantex and Y-12

A typical day for me is anything but typical! I am the team lead for our many exciting international nuclear safeguards, nuclear export controls, and arms control/treaty verification research projects at the Pantex Plant and the Y-12 National Security Complex. I often lead project meetings, author research papers, or oversee the research program. I also frequently brief policymakers, or host tours of our unique capabilities, in order to inform decision-making on key nonproliferation topics. I enjoy being able to use my technical subject matter expertise in radiation detection, nuclear engineering, and verification technologies to recommend potential solutions to policy and scientific challenges.

One of the best parts of my job is being able to lead or participate in international collaborations. For example, I recently led a six-year bilateral U.S.-U.K. effort that successfully developed and demonstrated a novel portal monitor for arms control applications, called the Portal Monitor for Authentication and Certification. I also have been privileged to serve as a controller for the 2017 Quad Nuclear Verification Partnership's LETTERPRESS exercise in the United Kingdom, as well as an evaluator for the 2019 International Partnership for Nuclear Disarmament Verification's Nuclear Disarmament Verification (NuDiVe) exercise. I thoroughly enjoy working with international partners to solve verification challenges associated with arms control and disarmament.

Consuelo Guzmán-Leong

Principal Engineer and Director, LPI Inc.

I am a principal engineer and director of LPI's Richland, Wash., office. A typical workday as a principal engineer involves performing fracture mechanics calculations, fatigue evaluations, literature reviews, and report writing, as well as creating project status reports for clients, addressing comments on client reports, and conducting technical reviews (including but not limited to fracture mechanics calculations, structural evaluations, and inspection and maintenance plans). As the office director, my duties include writing proposals, conducting and reporting monthly financial forecasts for the office, giving weekly business development updates to LPI management, meeting current and potential clients, and performing staff evaluations. Job assignments also may require on-site visits to perform integrity and corrosion assessments, system walkdowns, and instrument installation for data collection and monitoring purposes.

Guzmán-Leong performs a condition assessment of concrete cooling towers.

An awesome day on the job is when project tasks get completed ahead of schedule and below budget, the technical reviewers do not find discrepancies with one's calculations (a huge relief!), the client agrees to one's proposition for resolving report or calculation comments and/or to add scope to the contract, instruments for data collection do not fall off (the extra epoxy/tape pays off!), and when informed that LPI's proposal was selected for contract award.

Mike McCracken
Communications Coordinator,
Southern Nuclear's Plant Vogtle

My primary role is planning and implementing communications strategies that promote and educate the public about nuclear energy and Plant Vogtle. Prior to COVID-19, that meant near daily programs involving a variety of people—from students to business leaders to elected officials—touring the plant and the Vogtle Energy Education Center.

I'm also directly involved in the community with off-site Vogtle presentations, charitable contributions, and community involvement. Added to that are emergency preparedness responsibilities (including participating in drills at our nearby Joint Information Center) and various types of support for company and site employee communications (i.e., writing articles).

Due to COVID-19 restrictions, I am now conducting much of my work remotely. This includes interactive virtual tours of Plant Vogtle, where we tailor our messages based on the audience. I, along with my communications colleagues at Plant Vogtle, Plant Farley, and Plant Hatch, am also supporting additional fleet and site employee communications efforts as of late.

Prior to COVID-19, McCracken conducted near daily programs for visitors to the Vogtle Energy Education Center.

What makes my job—and a typical day—special to me is a sense of accomplishment in strengthening public support and understanding of how nuclear energy at Plant Vogtle is used to safely and reliably generate a tremendous amount of electrical power. And, of course, this 24/7 energy is produced affordably and in an environmentally responsible and carbon-free manner. That's important to me.

Stephanie Holbrook Bruffey
Radiochemical Engineer,
Oak Ridge National Laboratory

Working at Oak Ridge National Laboratory as a radiochemical engineer keeps me busy! My specific field of expertise is in the recycle and reuse of nuclear fuel resources, and on any given day you might find me in one of our world-class laboratories performing experiments or in my office working on analyses of current and alternative nuclear fuel cycles. Experimentally, I'm often working on gas-solid adsorption testing, and I love getting involved in all aspects of the project—from hands-on system assembly to data collection, analysis, and reporting. One of the most rewarding aspects of my job is the opportunity to interact with my colleagues. Collaboration with senior researchers teaches me something new every day, and it excites me to be able to share those insights with researchers who are just getting started in their careers.

Bruffey working in a uranium glovebox at ORNL.

Continued

Eric Jebsen

Senior Regulatory Engineer,
Exelon Generation

In my career in commercial nuclear power, I've moved from nuclear core analysis outward to the switchyard and now focus on compliance with the North American Electric Reliability Corporation (NERC) standards. These standards are focused on assurance of supply to the grid, quite different from the focus of the Nuclear Regulatory Commission. During a typical day I may review analysis of geomagnetically induced current impact on our transformers, assess if a plant configuration change impacts the bulk electric system, respond to a "NERC alert" issued to apprise the industry of potential threats to our supply chain, or ensure that the demarcation between NRC and NERC cybersecurity requirements remains clear.

One very satisfying aspect of the job is developing the operating agreements that govern the typical work interactions between Exelon Nuclear as a generator and the connected transmission entities. Understanding the perspective of transmission companies—the dual nature of their retail operations and requirements to maintain voltage to our stations under various dynamic contingencies—and understanding how our generation impacts their operations and how we fit into the wider grid is both challenging and educational. Ultimately coming to agreement on how each party will conduct business while maintaining safety and grid reliability is very rewarding.

Jim Byrne

Consulting Engineer

I started in the nuclear Navy in 1974 following an interview with "the kindly old gentleman," Admiral Rickover, who selected me for his nuclear propulsion program. Five years later in March 1979, the Three Mile Island accident occurred, and as nuclear power plant construction projects started to be canceled, I thought it was time to look around.

Byrne in the control room at TMI-2.

I followed my Navy days with a brief stint at Sargent & Lundy before I started at TMI-2 in August 1980 in Licensing and Regulatory Affairs for the General Public Utilities Corporation (GPU). I worked my way through various roles until the end of the cleanup project in 1993. GPU next turned its attention to decommissioning of the Saxton nuclear reactor in Saxton, Pa., for which I was the engineering, licensing, and quality assurance manager. With the completion of that project in 2005 and turnover of my responsibilities, I retired in 2006.

Retirement did not take, and I continued to consult on various decommissioning projects for a number of years. In 2018 GPU asked me to come back to TMI-2 to help with planning for the closure of TMI-1 and later the sale of TMI-2 to EnergySolutions.

The work of a consulting engineer is not the most physically challenging endeavor; my days are spent writing and reviewing technical reports and studies with the occasional walkdown to make sure I know what I am talking about. It is nice to be back at TMI-2 and helping to plan for its decommissioning, which should start in just a few short years.

Lori Braase
Program Manager, Gateway for Accelerated Innovation in Nuclear (GAIN), Idaho National Laboratory

A typical day working for GAIN involves frequent and dynamic interactions with the GAIN team. As program manager, I organize and implement GAIN's strategic plans, industry-focused workshops, national lab engagement, and internal management activities. I've been in the nuclear field for 29 years and started working with GAIN on opening day in January 2016.

GAIN's mission is to provide the nuclear energy industry with access to cutting-edge R&D, along with the technical, regulatory, and financial support necessary to move innovative nuclear energy technologies toward commercialization in an accelerated and cost-effective fashion.

Braase (center) and the rest of the team sport new GAIN hats during an online meeting.

The GAIN-EPRI-NEI Microreactor Program Virtual Workshop, held June 18–19, 2019, was a major GAIN highlight. I worked with the planning team to organize and facilitate the two-day event. It was exciting to host over 130 participants at INL to engage on topics covering nuclear energy user/developer needs, supply chain considerations, and national laboratory supporting capabilities. Many connections were developed between national lab personnel and the microreactor industry.

Alireza Haghighat
Professor and Director of Nuclear Engineering Program, Department of Mechanical Engineering, Virginia Tech

My days are occupied by different activities, including meeting with research collaborators here at Virginia Tech and nationally and internationally as well. My current projects include the CHANDLER antineutrino detection system with the VT Physics Department and the RAPID code development and its experimental benchmarking in collaboration with the Jozef Stefan Institute in Slovenia. My work includes weekly group meetings and frequent individual meetings with graduate students via Zoom; preparing proposals, reports, and papers; serving as a reviewer for conferences and journals; serving on VT and national committees; and, naturally, preparing for my courses, responding to student questions, and grading homework and reports. As director of Virginia Tech's nuclear engineering program, and with help from staff and faculty, I am engaged in student recruitment; our online program and graduate certificate in Nuclear Science, Technology, and Policy; curriculum development; monitoring of our NRC fellowship programs; the organization of a webinar series; new program initiatives; and national and international activities. Much of this work is performed in Zoom meetings and through email communication.

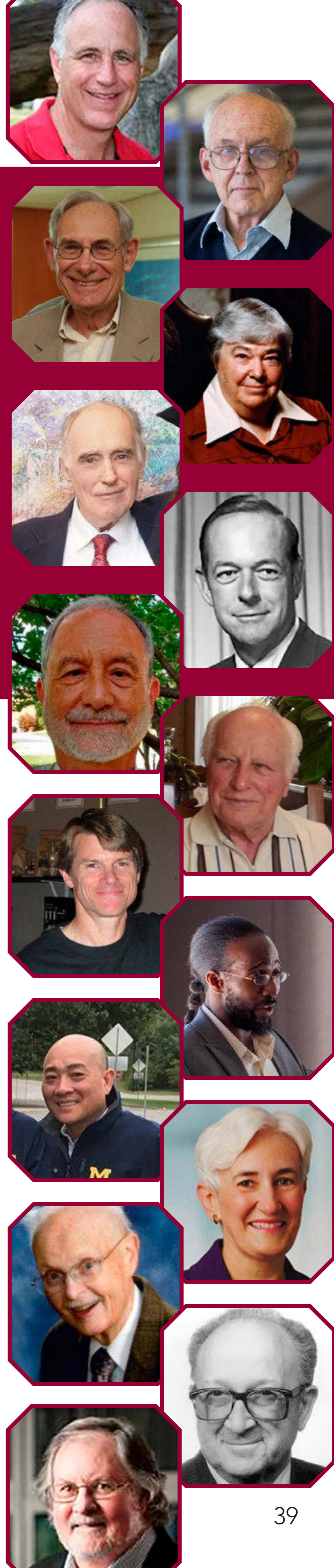
Who Inspired You?

Continuing on with our theme "**The People of Nuclear**," this article presents responses from various community members about those who inspired them—or the events or things that inspired them—to go on to have careers in nuclear.

There is an interesting mix of figures here, the most prominent being teachers who had lasting effects on their students. There are others who offered inspiration, too, including parents and other family members.

What all the respondents have in common is their inherent drive and their love of science and technology to keep nuclear moving forward.

We would like to hear your story. Write in to let us know about it and we will share it within the pages of *Nuclear News*.



Continued

Akio Yamamoto

Professor, Nagoya University

When I was in high school, I read an article in *Scientific American* (Japanese edition) on nuclear fusion technology, in which the future of fusion power was envisioned, which fascinated me and intrigued me to learn and conduct research on fusion technology. I joined the Nuclear Engineering Department of the School of Engineering at Kyoto University because the department is known for its excellence in this field. In the fourth year of the undergraduate course on nuclear engineering, I was faced with the choice of a laboratory for performing my bachelor's thesis research.

Fusion technology was appealing to many students at that time in Japan. However, there was an upper limit on the number of students that could join each laboratory. Because the university allowed only 20 enrollments each year for the undergraduate course on nuclear engineering, the number of students that could join each laboratory was also small (probably two, if I recall correctly). In the event of a conflict in selecting one's desired laboratory, the standard procedure to resolve the conflict was, interestingly, to throw a die.

Based on the random number from the die throw, unfortunately (or fortunately), I could not join the fusion research laboratory and instead chose the reactor physics laboratory. I immediately recognized the attractiveness of reactor physics and have been pursuing this academic field ever since.

Charlyne A. Smith

National Science Foundation Fellow and Nuclear Engineering PhD Candidate, University of Florida

Electricity is something that many people take for granted, especially when it is readily available. For others, electricity is so valuable that access is reason enough for celebration. I grew up in St. Catherine, Jamaica, and the latter rang true for me—even more so during natural disasters.

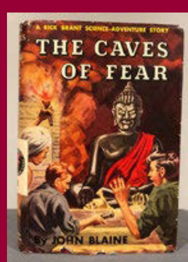
Growing up on a tropical island where the sun is in abundance for most of the year, I first turned to solar energy research for my undergraduate studies at Coppin State University (CSU). I was introduced to nuclear by Dr. Nickie J. Peters, a nuclear reactor specialist in the nuclear engineering program associated with the University of Missouri Research Reactor. Dr. Peters was invited to CSU as part of an Alumni in Excellence event hosted by the STEM club. He showed me that nuclear energy was an option that could provide reliable access to electricity on a large scale without generating greenhouse gases. After that encounter, I started to imagine the possibilities of nuclear energy being a part of the energy grid in Jamaica, and how if introduced it could almost immediately prove impactful by improving the lives of people in developing countries. That potential was enough for me to choose nuclear.

Dr. Nickie J. Peters

Steven Nesbit

President, LMNT Consulting, ANS Vice President/President-Elect

Like many in the generations before rampant electronic stimulation, I read a lot as a child and teenager. There were many books written for young readers, and I devoured series like the Hardy Boys, Tom Swift Jr., Chip Hilton, the Power Boys, and the Three Investigators. My favorite, though, was Rick Brant. Teenager Rick and his pal Scotty lived on Spindrift Island with Rick's father Hartson Brant, who headed the Spindrift Foundation of scientists. The group had great adventures all over the world, and always with a scientific twist. In *The Caves of Fear*, Rick, Scotty, their friend Chahda, and physicist Hobart Zircon traveled to the Himalayas and unraveled an international plot involving nuclear materials—specifically, heavy water. I wore the book out reading and rereading it.



I grew up thinking the potential of nuclear technology is immense, and I haven't changed my mind on that point. I can't point to a particular person for my decision to work in the nuclear energy field, but I think that Rick Brant deserves a fair share of the credit (or blame). I should probably acknowledge Hal Goodwin, the primary author of the series (under the pseudonym John Blaine).

Leah Parks

Systems Performance Analyst, U.S.Nuclear Regulatory Commission

My interest in nuclear was first inspired about 15 years ago by my PhD advisors at Vanderbilt University, Dr. Mark Abkowitz and Dr. Jim Clarke. Dr. Abkowitz, who specializes in risk management and hazardous material transportation, had served several years on the Nuclear Waste Technical Review Board, and Dr. Clarke, whose areas of expertise include chemical and nuclear waste, was serving on the NRC Advisory Committee on Nuclear Waste when I was at Vanderbilt. My curiosity was sparked by Dr. Clarke's colorful stories of the legacy of nuclear waste created during the Manhattan Project and by Dr. Abkowitz's thoughtful articulation of the way the nuclear industry approaches risk management. Dr. Abkowitz once told me when I was considering job opportunities, "You know, Leah, once you go nuclear, you rarely go back."

Dr. Mark Abkowitz

Dr. Jim Clarke

At the time I wasn't sure whether to interpret these as words of caution or as a prophecy of a lifelong fulfilling career. Fifteen years later, I'm still not sure I could explain exactly why nuclear sticks like glue. I guess there is a certain type of personality it attracts—those with a deep love of science and a devotion to realizing all the benefits technology can bring when safely managed. Whatever it is, I'm grateful to have been inspired.

Miriam Kreher

PhD Candidate, Massachusetts Institute of Technology

Although I am American, I mostly grew up in France. When given the opportunity to take an extra credit class in high school called Physics in English, I thought it could be an "easy A" and not much more. As it turns out, that class shaped my career. In just two hours a week, this class covered and compared energy sources, including their environmental impact, economic viability, and safety concerns. By the end of the year, it was obvious to me: nuclear energy has the power to save the world, and I wanted to help it do so.

How could I help? My options spanned from politics to art and everything in between. Having a scientific mind and a love for math, I chose engineering. I am now a nuclear engineer contributing to nuclear's computational modeling capability, and I have my high school bilingual physics teacher to thank for it. Thank you, Madame Nativel!

Gail H. Marcus

Consultant in Nuclear Power Technology and Policy, ANS Past President (2001–2002)

Sometimes, the smallest thing can have an outsized importance. It was November 1972, and I was about to present my first professional paper at the ANS Winter Meeting in Washington, D.C. I had invited my husband to attend, and when I picked up the registration material and gave him his badge, he was incensed. "It's pink," he said. "Doesn't ANS know that there are male spouses in the Society? You should do something about this!"

Octave du Temple

What could I do? I didn't know much about the Society, but I contacted staff headquarters. Octave du Temple, who was the executive director then, was very supportive and suggested that I do a survey of the female members of ANS. After I sent out my questionnaire, one of the recipients called me. It was Gail de Planque, who would later become the first female president of ANS. "This is great," she said. "Now, we need to organize a technical session on this subject." Which we did, in November 1975.

Gail de Planque

At that point, Octave and Gail suggested my name for one of the ANS committees. One thing led to another, and I subsequently served in many capacities, including as ANS president (2001–2002). I believe that my ANS involvement had a strong influence on my career path as well. And it all started with a pink badge.

Continued

Kevin O'Kula

Consulting Engineer, Amentum Technical Services

Growing up on eastern Long Island (New York) in the 1960s and early 1970s, I had much firsthand knowledge and experience with potatoes and farming but no awareness of the potential for a career in nuclear science and engineering. However, Brookhaven National Laboratory was just 15 miles upwind (most days), and we would experiment on the farm with BNL-irradiated seeds, and the Shoreham plant was to be built nearby, and so I was taking note. For me, it took two groups of dedicated teachers to provide the guideposts for my nuclear science and technology–based career.

Attending a parochial high school, I learned to appreciate the elegance of chemistry and laboratory thrills from a 20-something teacher, Mr. Michael Mannix. In senior year, I experienced the aura of classical and modern physics from a gifted, modest nun, Sister Mary Liguori, all of about 5 feet tall and 70 years young. These two were instrumental in pointing me toward pursuit of a career laden with heavy doses of math with a foundation in both physics and chemistry.

Later, as an undergraduate at Cornell, my advisor, K. Bingham Cady, lit the nuclear engineering flame. He suggested an Engineering Physics track and steered me to a summer job with Long Island Lighting Company and then entry into the Engineering Co-op program. Finally, in senior year, I took Prof. Paul Hartman's hands-on Advanced Physics Lab, and this experience sold me on the value of a solid laboratory work ethic (which was exactly how farming got done). It was a tough course because you "built it yourself," but it gave me confidence when an experimental thesis opportunity came up later at the University of Wisconsin. These four people, in their individual ways, really paved the way for me.

Zeyun Wu

Assistant Professor, Virginia Commonwealth University

My inclination toward nuclear engineering began in my early childhood with the realization that I was very good at math. That inclination grew to fascination during my high school days as I became more and more interested in nuclear physics. In college, I decided that a mixture of engineering and physics would allow me to study things more applicable than theoretical. This inspiration carried me to Texas A&M University, where I enrolled in the Nuclear Engineering PhD program—I found my calling in computational nuclear reactor physics. This niche area fits me to a tee because it seamlessly connected computational mathematics and nuclear physics applications.

Prof. Adams and Wu at Adams's 50th birthday party

During my time at Texas A&M, I worked closely with Prof. Marvin Adams, my PhD advisor. Dr. Adams was not only incredibly profound in the area of computational transport methods but also strictly professional in his working philosophy. His enthusiasm in nuclear engineering, his optimism surrounding our specialties, and his charming personality solidified my thinking that this field was the right one for me.

As I now enter my early/middle academia career with Virginia Commonwealth University, I direct my own computational reactor physics research group. Continuing through life, I look back to my original inspiration and realize that I am accomplishing exactly what I want to be doing. Nuclear engineering, in terms of clean energy and decarbonization, sees a bright future, and I am thrilled to be a part of it.

Emily H. Vu

Nuclear Energy University Program (NEUP) Fellowship Recipient, PhD candidate, University of Michigan

Growing up, I always enjoyed helping my dad with various projects. He showed me what was underneath the hood of a car, taught me how to safely use power tools, and never hesitated to teach me about the physical phenomena that happened around me every day. He consistently encouraged me to pursue a career in engineering.

We would talk frequently about what it meant to be an engineer, what a nuclear engineer does, and what nuclear energy is. He explained to me the process of nuclear fission and how it can be used to produce enormous amounts of energy. I was amazed by how clean and efficient nuclear energy was and the positive impacts it can have on the community and environment, and I was eager to learn more. My dad brought me to an open house at Ameren's Callaway Nuclear Generating Station, where he worked as a reactor engineer. I got to see a cooling tower in the flesh, step foot in the control room, and learn more about the make-up of a nuclear reactor.

Emily and her nuclear family

I am grateful for the knowledge my dad so eagerly passed down to me. He has always been confident in my abilities to be an engineer, but because of him, I chose nuclear.

Rachel Slaybaugh

Assistant Professor, University of California, Berkeley

Each step along my path involved inspiration from different people in major ways, and so many more in minor ways. My parents instilled a strong awareness about negative impacts of human activity on the environment. As a college freshman, I ended up at an ANS Student Conference in Berkeley (organized by my now good friend Darby Kimball) due to a series of random events. While there, I heard from the likes of Alan Waltar about how nuclear energy was the size and shape of a coal plant but didn't emit air pollution—I knew I wanted to work in nuclear for fighting climate change.

At my first ANS national meeting as a sophomore, I was a student assistant in a session for Ted Quinn, and Ted got me involved in ANS leadership as an undergrad. In junior year I took a class from Yousry Azmy and got interested in neutronics. Yousry sent me to Oak Ridge National Laboratory as an intern, where I worked with Dick Lillie, Bernadette Kirk, and Mark Williams. It was there where computational neutronics became my chosen area of study. I had previously met Paul Wilson at ANS meetings and worked for him at the University of Wisconsin, where he and Tom Evans mentored me through my PhD.

Catherine Prat

Senior Engineer, Westinghouse Electric Company

I have always been a planner—that factor of the Type A personality so common with nuclear engineers held true for me. By age 10, I knew I wanted to be an engineer. The intersection of helping people and using technology to solve problems spoke to me. I didn't know much about nuclear engineering then, but I did know about this big company in Pittsburgh that was a leader in nuclear technology: Westinghouse.

At one point in their careers, all four of my grandparents had worked for Westinghouse. Grandpa Tony was a tech working on submarines, Grandma Pat was a secretary, Grandma Martha was a librarian at one of their research facilities, and Grandpa Chuck had Westinghouse as a client in his insurance business. From their stories, I learned a lot about Westinghouse and how it had been a giant in all facets of technology but had focused in recent years on commercial nuclear power. By the time I came across an introduction to nuclear physics in my senior year of high school, and loved it, that cemented it for me. Nuclear power was awesome, and I wanted to be a part of deploying this technology around the world.

Continued

James W. "Jim" Behrens

U.S. Navy, retired,
ANS member since 1978

I am honored to share a photo of my high school science teacher and first mentor in science, Helen Myers, who taught at Bunker Hill High School, Bunker Hill, Ill. From 1961 through 1965, Ms. Myers followed and nurtured my scientific pursuits, which included participation in annual science fairs together with classroom instruction in general science, biology, and advanced biology.

My interest in nuclear began during freshman year of high school as I learned, in Ms. Myers's general science class, about the discovery of natural radioactivity by French engineer and physicist Henri Becquerel. For my freshman science fair project, entitled "Autoradiographs," I duplicated Becquerel's 1896 experiments by irradiating unexposed dental X-ray film packets with radiation from the radium-filled luminous dials of my bedroom Timex alarm clock. This very simple science project was the beginning that ultimately led to my long career as an experimental nuclear physicist.

Helen Myers

If you wish to learn further details of my professional career in nuclear (1961–2018), I encourage you to read my 200-page autobiography, titled *The Path Traveled: A Special Collection of the Lifetime Works and Achievements of James William Behrens*, which I self-published in 2018.

Bill Rosko

North America I&C Customer Business Manager, Rolls-Royce

Between my junior and senior years in college, I had the opportunity to intern in steam turbine generator marketing. A year later I received a call from my internship manager informing me she had moved to a new organization and wanted to know if I was interested in joining their Nuclear Commercial Operations Division. I didn't know much about commercial nuclear power, but it sounded like an interesting opportunity, and I've been in the industry ever since.

My first position was in strategic marketing focusing on new markets, and then I moved to a customer-facing role supporting service centers. From there I moved to instrumentation and control (I&C), where I continued to work with global customers. That challenge led to my product management role, where I had responsibility for leading development and supply of select systems for both existing and new build. All the while I have had the good fortune to work with truly wonderful, professional, and dedicated customers and co-workers.

Currently, I'm the North America I&C customer business manager for Rolls-Royce, working with a great team out of Grenoble, France. Our industry has provided me wonderful opportunities and is an industry that's even more relevant today than when I first began.

Florent Heidet

Group Manager, Advanced Nuclear Energy Systems, Argonne National Laboratory

The person with the biggest influence on my path worked in the mining industry as an engineer since World War II and so was familiar with coal power. He also was living only a few strides away from the oldest commercial French nuclear power plant, the Fessenheim nuclear power plant. Having lived in this energy-rich region and through that era where nuclear played a key role in the regrowth of France and its energy independence, he knew the importance of nuclear energy. This was my grandfather, Guy Heidet, who first introduced me to nuclear power.

Guy Heidet

It became customary that when I would visit my grandparents over the summer for a couple of weeks, my grandfather would take me to various places to satisfy my curiosity for science and machinery. He took me as a 13-year-old kid on a tour of Fessenheim, which was my first time visiting any power plant besides a hydroelectric dam. While I did not immediately fully appreciate all the intricate details or importance of this plant, the trip sparked an interest in learning more about it and eventually joining and contributing to this, our nuclear community.

Piyush Sabharwall

Advanced Heat Transport Lead, Systems Integration Department, Idaho National Laboratory

The inspiration to be an engineer was present in the very early stages of my childhood. I was first introduced to atoms and atomic structure by my eighth-grade science teacher, which piqued my interest. Back then in India, nuclear engineering was not offered as a discipline in college; hence, I decided to pursue mechanical engineering.

I was planning to pursue my master's in mechanical engineering until I had the opportunity to interact with Prof. Qiao Wu, Prof. Jose Reyes, and Yeon Jong Yoo from Oregon State University's Nuclear Engineering Department. There, I became intrigued once again with nuclear energy. My conversations with them revived my interest, and I decided to pursue my master's in nuclear. Yeon Jong Yoo, apart from being a friend and colleague, guided me as a mentor. As my graduate work progressed, it fueled my passion for sustainability and clean energy, and I went on to earn a doctorate in the field.

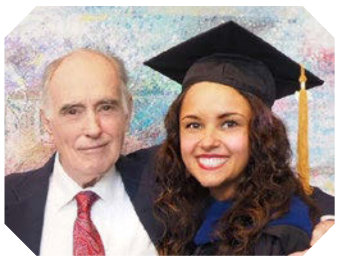
Growing up in India and experiencing pollution on a daily basis made me realize that fossil fuels cannot be a long-term solution. Having this in the background and searching for a long-term sustainability solution made my decision to pursue nuclear even easier. I am proud and honored to be part of such an environmentally conscious and enthusiastic group that understands the needs of the planet and cares about the environment and the future generations that we will leave this world to.

Kallie Metzger

Advanced Fuels Development Lead, ATF Technology, Westinghouse Electric Company

Throughout my professional career, I have been lucky to find myself surrounded by influential mentors and advocates. Dr. Elwyn Roberts stands out as the one who most inspired my career path. I met Elwyn as a graduate student at the University of South Carolina. He was my technical advisor, and he had an innate ability to ask challenging questions that rocked my research to its core. This "tough tutelage" forced me to develop strong problem-solving skills and technical chops in the area of nuclear fuel and materials.

I loved the stories Elwyn would inject from his prior career as manager of nuclear materials at Westinghouse Electric Company. He experienced the early years of civilian nuclear power and was privileged to personally discover and solve many of the very fuel behaviors I studied in textbooks. I yearned for the opportunity to contribute to something so groundbreaking. Luckily, I found my opportunity at the same place Elwyn began his career. Today, I lead advanced fuels development at Westinghouse, designing the next generation of nuclear fuels and materials. I call on an old friend whenever our program needs a challenge review. That's right—I hired Elwyn, the person most capable of asking hard questions!



Dr. Roberts and Metzger

Julie G. Ezold

Californium-252 Program Manager, Oak Ridge National Laboratory

It was the summer before my senior year of high school, and I had the opportunity to attend the Hopwood Scholarship Summer Program at Lynchburg College. I could choose one of 13 different topics for a one-week intensive study. Yours truly chose nuclear chemistry since I was going to be taking AP Chemistry in the fall. My instructor was Dr. Neal Sumerlin, associate professor of chemistry. Dr. Sumerlin was a great instructor and made the week fun and challenging at the same time. Our "textbook" was one he had written, since there wasn't one applicable for the undergraduate level he was teaching. He did an amazing job of explaining the material in terms that we could understand and providing problems that applied the information. The lab topics were detectors, half-life, and decay; they proved to be exciting and piqued my interest. We even took a memorable field trip to see the University of Virginia's nuclear reactor. Unfortunately, our van broke down, and the reactor wasn't running when we got there. When my parents picked me up, I announced that I was going to be a nuclear engineer!

Dr. Neal Sumerlin

Continued

Andrew Klein

Professor Emeritus, Oregon State University, ANS Past President (2016–2017)

Dr. Dixy Lee Ray

Prof. Ed Klevans

Prof. Bill Vogelsang

My real inspiration for becoming a nuclear engineer can be more broadly defined than by an individual person or opportunity. As a young student growing up in eastern Pennsylvania on the edge of coal country, one fundamental question consistently bothered me: Since electricity will be critical to the future, how can we best make electricity without polluting the air and water? The answer to this question has always been nuclear, because without it we will never approach the clean-air world that we, and our children and grandchildren, will require.

To accomplish my goal, I have crossed paths with a number of inspirational people and teachers who helped me along the way. These include Dr. Dixy Lee Ray, then-chair of the U.S. Atomic Energy Commission, who I heard speak during my freshman year at Penn State; Prof. Ed Klevans, my *de facto* advisor and mentor as an undergraduate at Penn State and a lifelong friend and colleague; and Prof. Bill Vogelsang, my thesis advisor at the University of Wisconsin and predecessor as editor of ANS's *Nuclear Technology* journal. All of these provided me with the many small and large inspirations to become a nuclear engineer.

Alan E. Waltar

ANS Past President (1994–1995)

I grew up on a small dairy farm in western Washington, totally oblivious to the field of nuclear technology. All I wanted was to inherit the farm and build it into a first-class showpiece. But my father had a stroke while I was in the eighth grade and had to sell the farm. Fortunately, my high school science teacher, Ralph Nelson, was a master mentor and drew me into the sciences. In my small high school, with 21 in my class, I couldn't have been more fortunate than to have Mr. Nelson as my teacher of algebra, calculus, trigonometry, physics, chemistry, health—plus serving as my local Scoutmaster and driver of my school bus. He inspired me to pursue a career in science.

Later, as a senior studying electrical engineering at the University of Washington, I enrolled in Introduction to Nuclear Engineering, taught by Prof. Les Babb (head of the Nuclear Engineering Department). He was a staunch believer in and motivator for the future of nuclear engineering and was, without doubt, the major figure in my life in directing my future into this field.

These two men changed my life, for which I am forever grateful!

Warren "Pete" Miller

Former Assistant Secretary of Energy for Nuclear Energy

I entered the United States Military Academy at West Point in the summer of 1960 when the entire four-year curriculum was fixed (with no electives), leading to a B.S. in engineering sciences. In the last semester of my senior year, in 1964, a change was made—we had a choice between a course in civil engineering and one in nuclear engineering. I don't remember the nuclear textbook in detail, but comparing it to the one for civil engineering made the decision easy for me. Nuclei with orbiting electrons were much more interesting than beams and trusses.

After five years in the U.S. Army, I decided to leave active duty, pursue a master's degree in nuclear engineering, and enter the private sector. After one year at Northwestern University, my mentor and advisor, Prof. Elmer E. Lewis, saw promise in me and encouraged me to continue for a PhD. I graduated from Northwestern in 1973 with a PhD, served for almost 30 years at Los Alamos National Laboratory, and later was sworn in as Department of Energy assistant secretary for nuclear energy in 2009. Early support from the USMA and Elmer Lewis were key to launching my career.

Temitope A. Taiwo

Interim Division Director, Nuclear Science and Engineering Division, Argonne National Laboratory

I have been inspired in nuclear science and engineering by many noble acquaintances during my undergraduate, postgraduate, and employment experiences. I focus here on my thesis advisor, the late Dr. Allan Henry, during my PhD studies at the Massachusetts Institute of Technology. I interacted with him for about three years, taking two advanced reactor physics courses and working on my thesis. He was already well-established, first as manager of reactor theory and methods at the Bettis Atomic Power Laboratory and later as a professor at MIT. He had also written the famous book *Nuclear Reactor Analysis*. He was very accommodating, allowing me to practically walk into his office to discuss the progress being made in my work, including any challenges. Interactions with him enabled quality time with the famous Drs. Norman Rasmussen and Neil Todreas as well as others at MIT. I remember with gratitude Dr. Henry's encouragement to join the American Nuclear Society and the American Physical Society and his strong promotion of me to enable employment at Northeast Utilities, Connecticut. I also sought his letter of recommendation while seeking employment at Argonne National Laboratory. My interactions with him gave me confidence that I could be successful in the field.

Dr. Allan Henry

Jinan Yang

Sr. Nuclear Engineer–Reactor Analyst, Kairos Power LLC

My career started when I graduated with a bachelor's degree in applied mathematics in China and then joined the Monte Carlo Method Group at the China Institute of Atomic Energy. While there I learned about the SCALE code package and dreamed someday that I would be able to work at Oak Ridge National Laboratory—with an ultimate goal of reaching the moon!

In 1998, I had the opportunity to work on nuclear-related applications in Japan. To expand my knowledge, I started reading nuclear engineering papers. I realized that the last author on several papers I read was the same person, Prof. Edward Larsen from the University of Michigan. Unfortunately, I didn't understand the content, but I was so fascinated by the methods and ideas in these papers that I went on to read more papers having the same last author. Of course, the first authors on these papers were all Prof. Larsen's students. Fast forward to 2011, I completed my PhD studies in nuclear engineering and radiological sciences at the University of Michigan. My thesis advisor was . . . Prof. Edward Larsen!

Prof. Edward Larsen

I am very pleased with my transition from mathematician to nuclear engineer. I believe that nuclear energy can improve people's quality of life while protecting the environment.

Kathryn A. McCarthy

US ITER Project Director

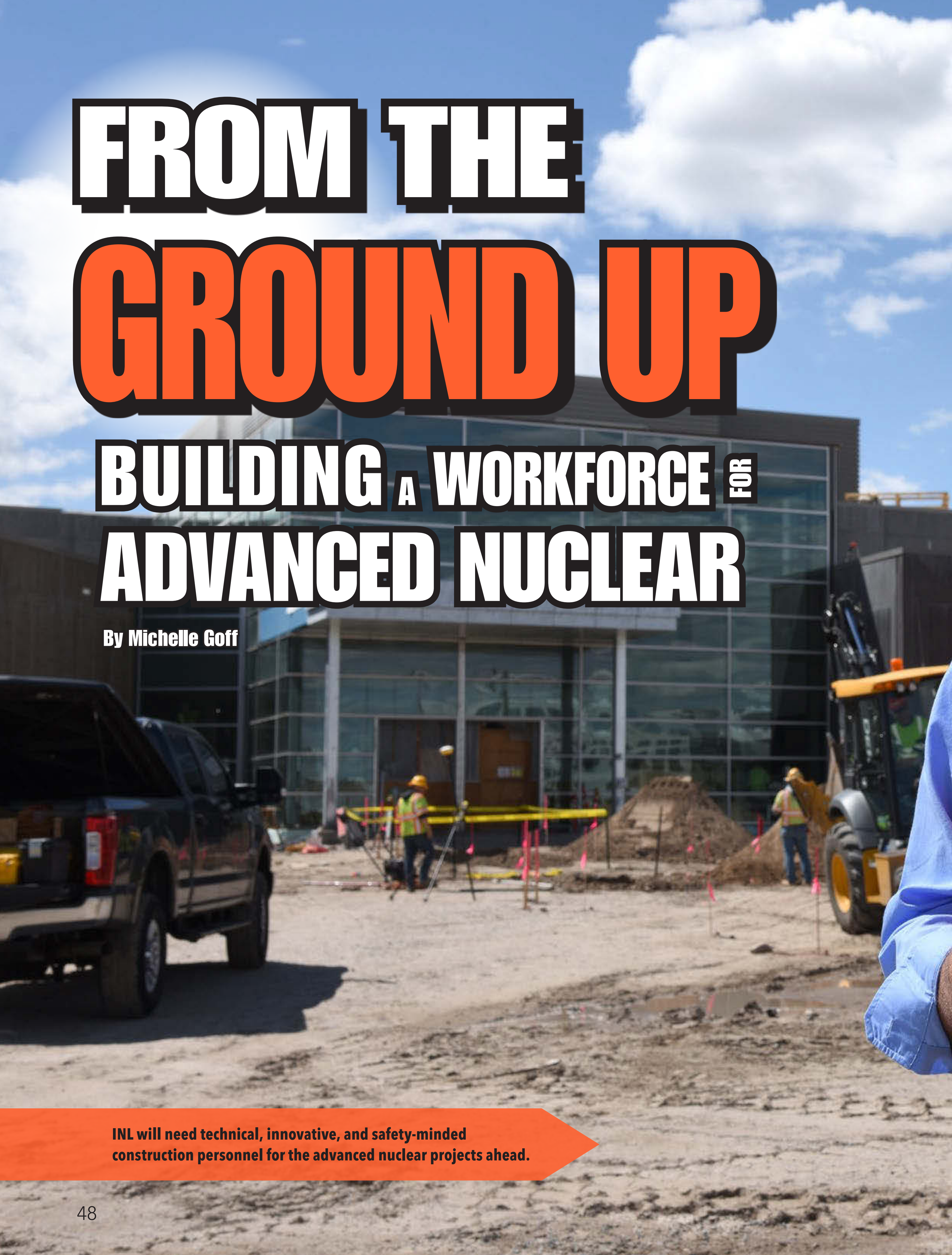
By the time I started my senior year in high school, I had decided I wanted to be a music major. However, I enjoyed my math and science classes and started rethinking that plan when funding for the arts in public schools fell victim to budget reductions. My parents raised my sisters and me to make our own choices and didn't push us into any particular career path—but definitely emphasized the importance of a college degree. My father was an engineer, and that career path sounded interesting. I pivoted from music, but what kind of engineering should I pursue?

That year, the events at Three Mile Island happened, and my high school physics teacher, Malcolm Wells, talked about them in class. He talked about the clean energy produced by nuclear power and how important that was. It was intriguing to me, and I decided to become a nuclear engineer. I enrolled in the nuclear engineering program at the University of Arizona and stuck with it (even though it could be a bit of a conversation-stopper at college parties).

FROM THE GROUND UP

BUILDING A WORKFORCE FOR ADVANCED NUCLEAR

By Michelle Goff



INL will need technical, innovative, and safety-minded construction personnel for the advanced nuclear projects ahead.

Photo: INL

Advanced reactor demonstration projects on the horizon will challenge the nuclear supply chain in new ways. A vital component that can be easy to overlook is the need for skilled construction, trades, and crafts workers. That’s why Idaho National Laboratory is forging valuable networks to address these needs.

Around the world, researchers in the energy industry are engaging in the work of studying, testing, and developing carbon-free energy solutions. Throughout these circles, many scientists and engineers are embracing the possibilities of advanced nuclear technologies, including small modular reactors and microreactors. While these innovative technologies are poised to address some of the nation’s biggest concerns, they also present their own unique challenges, including the need for a large and talented workforce within the construction industry.

Fortunately, the state of Idaho and its key nuclear players are well-equipped for this challenge. In southeastern Idaho, home of Idaho National Laboratory, strong partnerships throughout the region have forged networks between the lab and the educational institutions, employers, trades, and unions that are working to establish this highly specialized nuclear talent pipeline.

Continued

Idaho team members toured Plant Vogtle to learn from the experiences and challenges the plant faced with the supply chain. Photo: Southern Nuclear

The responsibility of overseeing and supporting reactor innovators as they test, demonstrate, and assess advanced nuclear concepts falls to Ashley Finan, director of the National Reactor Innovation Center (NRIC). Before coming to INL, Finan worked as the executive director for the Nuclear Innovation Alliance. In that role, as well as in her previous career as director for nuclear innovation with the Clean Air Task Force, she managed organizational strategy, operations, policy development, technical development, stakeholder outreach, and fundraising, providing expertise and guidance to policy makers, academic teams, industry stakeholders, and nongovernmental organizations. Finan's doctoral work in nuclear science and engineering focused on energy innovation investment and policy organization for nuclear and renewable energy technologies. She has played important roles in studies focused on using advanced nuclear energy to reduce greenhouse gas emissions in several applications, including hydrogen production, coal-to-liquids processing, and oil production methods.

Amy Lientz, director of INL's Energy Industry Supply Chain program, is leading the charge to develop a strong nuclear supply chain to support these efforts. Lientz and the program are responsible for coordinating vital efforts to fill these anticipated energy workforce needs and connect possible industry partners to future business opportunities with INL. She brings experience in energy industry engagement to the lab, where she worked as the director of its partnerships team before transitioning to the supply chain program. Lientz serves as the incoming chair for the Idaho Technology Council. She also has advisory roles with the McClure Policy Center and the U.S. Council for Competitiveness. She works to inspire young women and students from rural communities to pursue engineering careers in her role as an advisor to the College of Engineering, her alma mater at the University of Idaho.

"We have no shortage of construction needs here at INL, and we also have an excellent open dialogue with the trades and unions about what those needs are currently and what we are anticipating for the future," Lientz said. "All of that is vital for us to get the assistance we need here at INL and within the subcontracting community to support these major advanced nuclear projects."

Lientz's supply chain program was established to fulfill these needs by bringing together the right stakeholders to prepare and effect change, build the new energy workforce, and introduce new businesses to growing energy opportunities at INL.

A network of advanced nuclear experts, supply chain experts, and representatives from local government and educational institutions represented Idaho at Plant Vogtle. Photo: Southern Nuclear

New nuclear on the horizon

On the list of key future projects at INL are SMRs and microreactors, which can provide reliable carbon-free power to both urban and rural communities while taking up a small physical footprint and offering greater resilience to security threats. The lab is on the list of potential sites for a Versatile Test Reactor (VTR), which, through state-of-the-art irradiation testing functionality, will provide the technological capabilities necessary to continue the process of advanced reactor research and innovation.

If these projects are approved to move forward, the INL Desert Site would require 5,000 new construction workers within the next seven years, with the bump reaching its highest point between 2024 and 2027. This is following two already record-breaking construction years at INL; 2019 saw almost twice the amount of construction taking place on the Desert Site and the Research and Education Campus in Idaho Falls as in the few years prior, and in 2020, INL achieved a 35 percent increase in construction workers on-site compared to 2019.

In the coming years, developing NRIC and SMRs and microreactors will challenge the nuclear supply chain in new ways. Many new designs will use advanced fuel forms that do not already have an established domestic supply chain. The new coolants required for these designs come with a need for new valves, sensors, instrumentation, compressors, and shielding, and filling that need will demand an innovative approach. Ultimately, NRIC will accelerate the preparedness for advanced reactors within the nuclear supply chain by providing component testing capabilities and mock-ups of reactor systems before critical demonstrations.

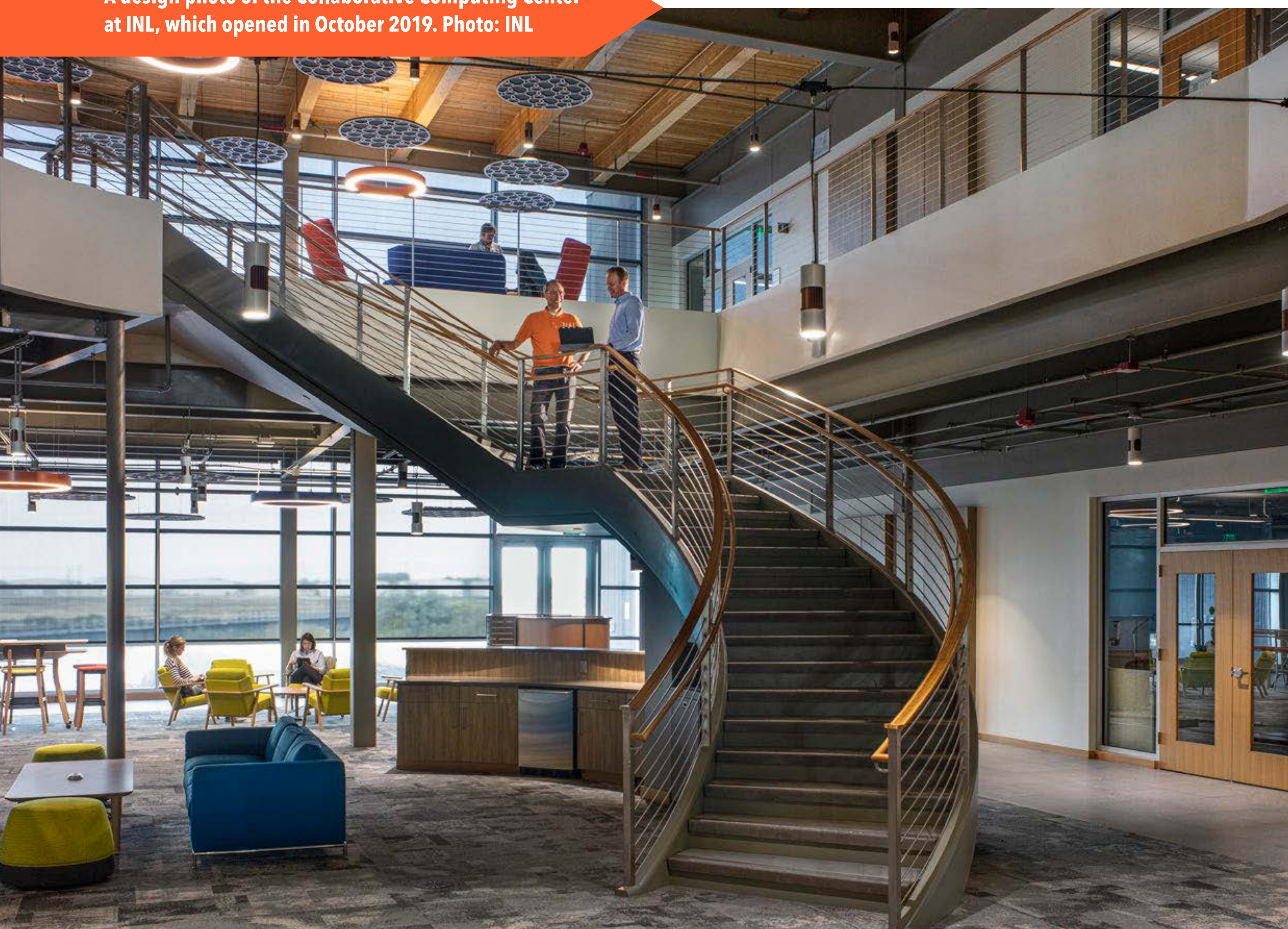
Continued

The NRIC test beds, which will host microreactor demonstrations, are expected to be operational by 2024. Facility construction needs will include mechanical/structural construction; lifting and crane support; electrical, gas supply, and operations support; and heat rejection systems design and construction. The NRIC team is applying digital engineering tools throughout test bed design and construction, which will allow them to quickly manipulate the system designs and processes and interface seamlessly with innovators using the test beds. This will lead to easier analyses of design trade-offs, better performance, and new insights, ultimately enhancing the reactor's innovation capabilities. NRIC is pursuing developments in advanced construction technology, which could lead to transformative cost cutting. The NRIC team will also need a greater diversity of suppliers to ensure continuing improvement and competitive pricing.

"The types of reactors we'll be demonstrating here at NRIC will use novel components that demand a highly skilled workforce and innovation-focused talent pipeline," said Finan. "We will be exercising advanced technologies and will look for construction teams that embrace state-of-the-art approaches."

VTR will also create significant and particular supply chain needs; the target timeline for this reactor's completion is late 2026 or early 2027. Lee Nelson from the VTR team has already begun considering the supply chain needs and reaching out to potential suppliers. "Contacting people directly has been made a lot more difficult because of COVID-19, and we have already run into some challenges with long lead times on equipment needed for the reactor," Nelson said. Some pieces of equipment that the team still needs for VTR's initial design phase include control rod driving mechanisms, the reactor module, an in-vessel transfer machine, and an electromagnetic pump.

A design photo of the Collaborative Computing Center at INL, which opened in October 2019. Photo: INL



Addressing labor shortages

As construction needs grow across the lab's projects, INL and its partners are equipped to deal with the upcoming challenges. Ed Anderson, deputy director for INL's Facilities and Site Services directorate, is in the process of developing communication networks with the Idaho Building Contractors Association in eastern Idaho and with building trades and unions. He anticipates that the lab is looking at many more busy construction years, and he noted that the contractor community in the region is growing and providing a wealth of capabilities to meet these needs.

"Because of the robust safety culture here at the lab, we need to be recruiting the best of the best for these advanced nuclear construction projects," Anderson said.

For their part, the labor unions in the area are aware of and actively working to fulfill the lab's needs. Dave Inskeep, the coordinator for the region's building trades, noted that local labor unions have recently taken in as many as 100 new apprentices in their construction apprenticeship programs. However, many key shortages still need to be addressed.

Specifically, Inskeep said, "We are facing a local shortage in carpenters. My team is working closely with national and international representatives for these trades, in hopes of pulling in the most qualified and available craftsmen. We have also noticed that the local carpenters are rebuilding their apprenticeship program, which is a hopeful sign."

Stacey Francis, INL's Small Business Program manager, anticipates that this influx of construction needs will provide opportunities for local and regional small businesses as well. Francis encouraged any small businesses interested in partnering with INL to research the safety and construction needs of advanced nuclear technology so that they are equipped to meet these singular challenges. Francis said that in order to qualify to do business with INL, companies need to have an active profile in the System for Award Management (sam.gov) and be registered in the INL Vendor Portal (vendor.inl.gov).

Ongoing construction at INL. Photos: INL

Hope Morrow, a labor economist at INL, projects that the lab will be creating 135 new union trade openings, with the highest needs in the electrician and waste technician operations arena. "Between 2020 and 2025, we anticipate that, on top of the already high average of over 500 annual craft employment and subcontract positions, we will hire 1,184 individuals," Morrow said. These positions will be mostly short-term in nature or temporary project hires, around 860 of which will be created in 2024 to support the VTR project. Among these new hires, the greatest needs will be for pipefitters, HVAC mechanics, and carpenters.

Continued

University and community college pipeline

Recruiting the talent necessary to fill this construction pipeline starts with partnerships between the lab and local educational institutions. The College of Eastern Idaho (CEI), based in Idaho Falls, is actively working on developing new programs and courses designed to educate the incoming workforce on nuclear and radiation safety and construction needs. Idaho State University (ISU) is looking into adding instructors to its Energy Systems Technology and Education Center (ESTEC), which is also supported by CEI.

ESTEC was established in close partnership with INL about 12 years ago, with the intent of developing a continuous talent pipeline to address concerns about training knowledgeable new workers to populate technical positions as individuals with years of experience retire. Initially the program, which has been largely supported through INL grant money, was designed to nurture potential among instrumentation, electrical, and mechanical engineering technicians, but according to Vince Bowen, executive director for ESTEC, they have recently added several new opportunities that are more relevant to INL's key research and operations areas, including training programs for nuclear operator technicians and industrial cybersecurity technicians.

ESTEC also supports workforce development programs and helping graduates enter trades, although its primary focus is on the technical and engineering aspects of INL's mission. CEI, by contrast, is focused more strongly on engaging its students and the surrounding community in construction and trade work. CEI already has well-established electrical, HVAC, and plumbing apprenticeship programs and is looking to augment those programs with a multitrade pre-apprenticeship that will feed existing programs while serving as a pipeline into the union trade apprenticeships.

"One of the biggest challenges we're facing as we grow these programs is not only the wealth of skilled individuals needed to support INL projects, but also the reality that the lab's large need is going to take skilled laborers away from other industries. Because of that, we have to have a way to continue filling the need outside of INL as these advanced nuclear projects grow," said Michelle Holt, CEI's executive director for workforce training and continuing education. "To address this critical issue, we are reaching out across our Idaho community to connect with high school juniors and seniors, adults not currently on a specified career path, underemployed and unemployed individuals, veterans, and those who face higher barriers to employment, including people in vocational rehab programs or those leaving correctional institutions."

CEI collaborates closely with building and trade unions, and several of its outreach activities within the community operate in conjunction with these entities. The college is also involved with the Construction Combine program, which was started by ISU; both educational institutions work with the Association of General Contractors, Home Depot, and other state and regional partners to put together an annual two-day building event where their audience of predominantly high school students can learn basic construction and safety skills from building professionals. At the end of this program, many of the participants walk away with promising job offers.

"One major barrier to meeting needs for large projects like the ones INL is undertaking is the stigma surrounding construction and trade work," Holt added. "That has changed significantly in the past few years, but our partnership with INL will always need to include an emphasis on the high value and growth potential for our young people in construction careers."

From a nuclear perspective, Holt noted that CEI is evaluating best practices from other community colleges regarding associate degree options that would equip their students to best support nuclear career paths.

Essential STEM outreach

As a basis, INL and its partners recognize that developing this major talent pipeline has to begin at an early stage in each student's educational journey. The lab's K-12 STEM Outreach Program ensures that young students learn about the many career opportunities in the region and particularly those in support of INL's mission. Jennifer Jackson manages this program, which focuses on increasing career awareness, recruiting students and faculty, high school early-start programs, and retooling the existing, available workforce to better support lab-wide needs.

"It's more important than ever that industry works closely with teachers, college and career advisors, and policy makers to create viable education and career pathways in career technical education," Jackson said. "After high school, students need to continue their learning and advance in a skill progression as part of certificated training and work-based learning programs. These pathways lead to exciting career opportunities and a high quality of living."

As INL prepares for this new age of nuclear technology, continued partnerships with educational institutions, construction subcontractors, and building and trade groups will be essential to supporting the growing needs of the innovation occurring at the nation's nuclear energy R&D laboratory. Fortunately, INL and its networks within Idaho are up to the challenge.

Michelle Goff is an INL communications specialist.

Businesses interested in partnering with INL must have a profile in the System for Award Management (sam.gov) and be registered in the INL Vendor Portal (vendor.inl.gov).

(Previous page and below) Aerial shots of two new buildings on INL's Idaho Falls campus. Photos: INL

Join Our Nuclear Family

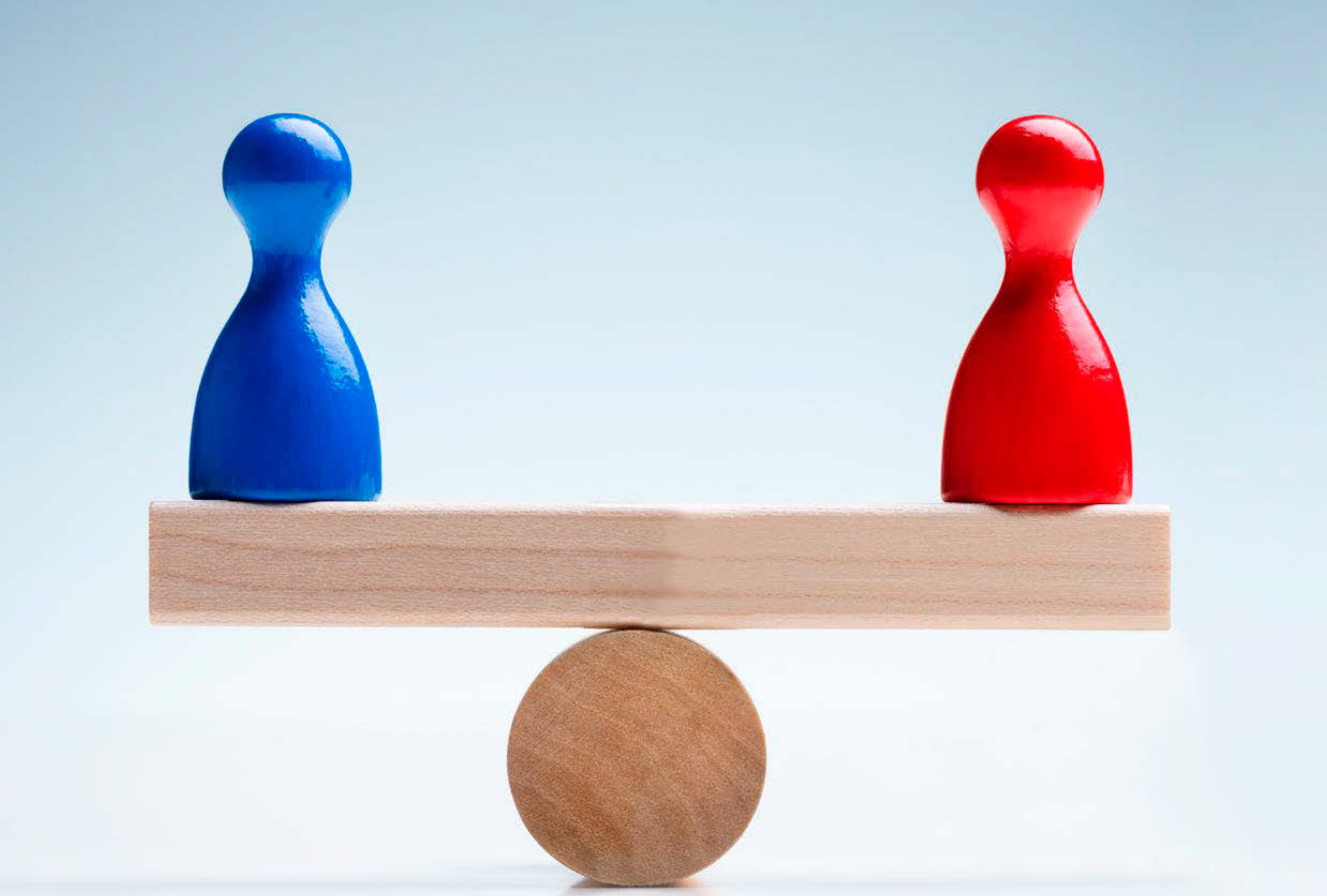
FIND YOUR PLACE @ IDAHO NATIONAL LABORATORY

As the birthplace of clean nuclear energy, INL has hosted 52 reactor demonstrations. Our scientists and engineers are supporting reactor innovators to bring their projects to life through DOE's Advanced Reactor Demonstrations Program (ARDP).

Join our family of advanced nuclear professionals at INL! We need experts at all career stages to support our ongoing innovation in fuel, materials, design, safety/regulatory research, and integrated energy systems.

Send your resume to **nucjobs@inl.gov**

INL Idaho National Laboratory



Balancing the Equation

How Gender Champions are leading the way toward equity in the nuclear community

Laura S. H. Holgate and Jack Brosnan

For too long, women in the nuclear field have had the common experience of being the only woman in a meeting or at a work site. Countless times, women have sat in audiences before all-male panels of nuclear experts. Many senior people continue to hold outdated assumptions about how women can contribute to nuclear topics. Nuclear institutions, from the academy to the C suite, still reflect old models of what it means to succeed and lead. At the same time, women—and men—have benefited from the wealth of talented and inspiring women mentors, peers, and students in the nuclear realm.

Continued

Recent efforts have proven successful in developing professional pipelines to attract new talent to the field, but without top-down change, new talent will be trapped in an old system.

In 2017, the disconnect between these realities drove the vision of Gender Champions in Nuclear Policy (GCNP), a network designed to increase the presence, visibility, and impact of women in the nuclear policy field. Drawing on the format of International Gender Champions—a similar organization that Laura helped expand from the diplomatic community in Geneva to Vienna during her service there—GCNP set out to change the institutional culture of nuclear policy by engaging the leaders of the institutions and organizations whose mission and members make up the nuclear policy world.

GCNP promotes gender equity by advocating for greater representation of women in the field—working to elevate women's voices on nuclear issues and to create more opportunities for entry into the field, as well as to promote retention and advancement. The need for these goals reflects a legacy of gender imbalance that has resulted in male-dominated leadership across the nuclear community. Recent efforts have proven successful in developing professional pipelines to attract new talent to the field, but without top-down change, new talent will be trapped in an old system. Our Gender Champions generate momentum at the highest levels to catalyze cultural change—our best hope for reaching gender equality.

GCNP's focus on leadership recognizes that despite decades of efforts to raise women up in nuclear policy, they remain significantly underrepresented as government leaders, media sources, executives, authors, speakers, faculty, and in a host of other measures of nuclear expertise and excellence. The talent pipeline has been full for years, but it loses women over the course of their careers, indicating institutional deficiencies rather than lack of women's interest or ability. The Gender Champions model tackles that issue head on, by enlisting the heads of think tanks, foundations, nongovernmental organizations, professional societies, advocacy groups, commercial firms, research institutions, and media outlets working in nuclear policy to design and publicize SMARTIE (Specific, Measurable, Ambitious, Realistic, Time-bound, Inclusive, and Equitable) pledges to advance gender equity in their organizations' personnel and programming.

Among the 60 current Gender Champions, almost one-third lead organizations that draw from the nuclear engineering and technical community. From the American Nuclear Society to Idaho and Los Alamos national laboratories to the Nuclear Energy Institute to Women in Nuclear, these leaders have committed to gender pay equity, telework and flextime, respectful behavior policies, parental leave, more women experts and board members, paid internships, diversity training, more women on panels and in journals, leadership development for women, and many other concrete actions that have proven to enhance gender balance. All Gender Champions also pledge that they will personally, in general, not appear on all-male panels.

The first GCNP progress report, published in May 2020 and covering the 43 Gender Champions who joined during 2019, contains plenty of good news about the Champions' pledges and what they and their institutions have learned in the process of implementing those promises. The majority of Champions were able to avoid speaking on "manels," and 65 percent of their individual pledges were fully met, with 29 percent of pledges partially met. People serving as Focal Points—who are individuals designated by each Champion to have day-to-day responsibility to implement, track, and report on their pledges—reported that the more the individual pledges were designed through engagement and buy-in from the entire staff, the more successfully the pledges were achieved.

The report also points to obstacles that nuclear policy organizations continue to face in seeking to achieve gender equity and the substantive benefits that it brings. Unsurprisingly, commitments that were costly or that required the involvement of actors or forces outside of an individual organization were among the more difficult ones to complete. In some cases, larger organizations seemed to have more difficulty completing their pledges, perhaps because of multiple layers of decision-making, but larger organizations also tended to have dedicated staff with expertise in key components of creating an equitable organization, such as human resources. In addition, the vibrant network of Focal Points has created opportunities for sharing experiences and practices across organizations.

The vibrant network of Focal Points has created opportunities for sharing experiences and practices across organizations.

Data and measurement are critical to achieving gender equity. Leaders must understand the baseline of their organization's gender status and key defining components both to designing the pledges needed for improvement and to measuring that improvement. Making these data visible both inside and outside the organization contributes to accountability and to the image of an organization. We have heard of young applicants in the nuclear field who chose to apply exclusively to organizations headed by Gender Champions.

In the longer term, the success of GCNP hinges on several factors. Perhaps most important among them is the network's continued expansion, in pursuit of reaching critical mass within the nuclear community. GCNP's network is a broad cross-sector sampling of organizations, but significant work remains to be done in accessing harder-to-reach corners of the community.

Gender Champions and Focal Points have expressed a desire to be more ambitious in their goal setting and the design of their SMARTIE pledge commitments. Supporting their ambitions, amplifying their successes, and shoring up their ability to address challenges are all crucial to GCNP's success and growth. As Champions and their respective organizations successfully implement voluntary commitments, it will become increasingly clear that concerted, directed effort does produce results. As the network grows and develops, its ability to become a self-supporting instrument for sharing of knowledge and resources will strengthen exponentially. Champions who successfully advance gender equity within their organizations advance the goals of the network at large and strengthen the resolve of their peers and allies to do the same.

GCNP is looking for additional ways to support Champions and Focal Points. We are adding resources to our website (gcnuclearpolicy.org), and we are facilitating focused discussions on building high-quality mentoring programs and creating meeting formats that are more conducive to women participants and speakers. We are promoting the benefits of high-quality training as a tool to enhance diversity, equity, and inclusion. Our Twitter account (@gcnuclearpolicy) highlights new Champions and their pledges and amplifies resources and related organizations and opportunities.

The numerous nuclear challenges we face—deterrence, nonproliferation, security, energy, disarmament, and so on—are truly matters of life and death for our species and our planet, and as such, they require our best minds and our most committed participants. Our community will only succeed if we are inclusive of diversity of knowledge, perspective, experience, and ways of working. Our Champions know that, and we honor and appreciate their personal engagement and the contributions of their representatives, the Focal Points, in achieving such visible progress in the first year.

Laura S. H. Holgate is a retired ambassador, vice president for materials risk management at the Nuclear Threat Initiative, and a cofounder of GCNP. Jack Brosnan is program officer for materials risk management at NTI.

A Life in Fission and Fusion Reactor Physics and Design

By Weston M. Stacey

I have enjoyed a long and stimulating career in applied nuclear physics—specifically nuclear reactor physics, nuclear fusion plasma physics, and nuclear fission and fusion reactor design—which has enabled me to know and interact with many of the scientists and engineers who have brought the field of nuclear energy forward over the past half-century. In this time, I have had the good fortune to interact with and contribute (directly and indirectly) to the education of many of the people who will carry the field forward over the next half-century.

I was an unlikely prospect for a career in applied nuclear physics. My boyhood was one of hunting quail and doves in the cornfields and woodlands of south Georgia, fishing for bass in the nearby Flint River, of playing high school football and driving around a small town with similarly aimless friends to see what was going on (not much). I didn't think about anything remotely scientific. However, I was an avid reader who had discovered Steinbeck, Hemingway, Fitzgerald, Wolfe, some of Faulkner and Dostoevsky, and a few "Improve Your Vocabulary" books by the time I graduated from high school.

If anything, I came to physics through mathematics. In junior high, I was the one sent to the blackboard to straighten out a classmate's disastrous development of axioms into proofs in geometry and trigonometry classes, but it was later, when I encountered algebra, that I realized that I loved applied math. When

Closing session INTOR Workshop, International Atomic Energy Agency, Vienna, Austria (November 1987). Weston M. Stacey is seated fourth from left among his colleagues.

I found out that you could actually calculate where you would come ashore on the other side of a river that was *W* feet wide and flowing with speed *V* feet per second if you could swim across with speed *S* feet per second (I swam frequently in such a river, the nearby Flint), I was hooked. High school physics was pretty much a few new and intriguing laws and a lot of algebra, so I liked it, also. When I learned that some people actually made their living doing this sort of fascinating stuff, that fact registered. My high school physics and chemistry teacher, Chappell Collins, gave me Glasstone's *Sourcebook of Atomic Energy* (probably in an effort to redirect my creative uses of the Bunsen burner in chemistry lab). I could understand just enough of it to read through a few times, and that surely started me on the path I have followed, although it was far from a straight one.

College was not an automatic next step after high school in southern Georgia in those days, and the thought entered my head mainly through discussions about football scholarships. But this all changed one afternoon in 1954 when all 25 of the senior boys in our high school were assembled in the auditorium to hear a Navy recruiter. In the process of listing the opportunities of a career in the U.S. Navy, he passed quickly over "this other program that pays your way to college and you come out an officer," adding that it was very competitive and that none of us would probably be interested. Looking back, I realize that my interest was challenged by the "very competitive" part, and when the recruiting session was over I asked the recruiter about it. He rummaged around in the bottom of his briefcase and found a crumpled brochure, which he handed me with a "Here, read this," and no further ado.

Continued

This brochure described a Naval Reserve Officer Training Corps (NROTC) program, which provided full college tuition, plus a living stipend, for four years, at any one of a hundred or so of the better colleges in the country. It also informed me that the local exam would be held 100 miles north in Macon the next weekend. I was there when the doors opened and, thanks in no small part to those Latin and Greek root words in the "Improve Your Vocabulary" books, did well enough to win a fellowship.

I didn't know a thing about any of those hundred or so leading universities, except I had three "uncles" who had been pretty good football players at Georgia Tech, and so I went there. I fit in socially quite well and did well enough academically, graduating with a 3.2/4.0 grade point average and a bachelor's degree in physics in 1959.

I married my high school sweetheart, Helen, and went into the Marine Corps for two years to repay my NROTC obligations. Only toward the end of that time did I finally give some thought to what I would do with the rest of my life. Nuclear energy was becoming more important in the world, and Georgia Tech had just started a master's program in nuclear science with courses in reactor physics, reactor engineering, and radiation biology. At times, the challenging program was a bit like being in the Marine Corps again—uphill into a blizzard of adversity—but I went through it and graduated in June 1962.

My first job was at the Knolls Atomic Power Laboratory (1962–1969), where I worked on the design of destroyer, submarine, and aircraft carrier nuclear reactors and methods development for nodal codes, xenon spatial oscillations, space-time dynamics, and variational methods. I had the good fortune during this time to learn reactor physics from Jack Shannon, Joe Bulmer, Don Anthony, Norman Francis, David Selengut, Floyd Merriman, Frank Judge, and others, and to participate in the KAPL Advanced Reactor Engineering Program. At the encouragement of my Knolls colleagues, I took a few years (1964–1966) to earn a PhD in Nuclear Engineering at the Massachusetts Institute of Technology, with thesis advisors Irving Kaplan and Kent Hansen. Then it was back to KAPL, where I became head of the Reactor Dynamics group (Dave Wade, Dick Hooper, Roger Rydin, Cy Adams, and Jim Wyman) for the A1G Project, under Frank Judge.

I really liked KAPL, but nevertheless, I moved to Argonne National Laboratory in 1969 to become head of the Fast Reactor Theory group under Bob Avery in the Reactor Physics Division, becoming associate director for theory and computations a few years later. At ANL, I worked with Harry Hummel, Dan Meneley, Bert Toppel, Dick Hwang, Herb Henryson, Chuck Till, Ely Gelbard—even a couple of familiar faces from KAPL in Dave Wade and Cy Adams—among many other outstanding reactor physicists. I was the founding director of the Fusion Power Program and organized and led the pioneering ANL Tokamak Experimental Power Reactor Design Study.

By 1977, I found myself doing more research *management* and less research at ANL, and so I accepted an offer to become Callaway Professor of Nuclear

Engineering at Georgia Tech. I took the position perhaps also in some small measure because of the feeling that I would be repaying Georgia Tech for those important early steps the school had provided me, and I taught and performed/guided research there until my retirement in 2020.

From 1978 to 1988, I organized and led the U.S. participation in the International Atomic Energy Agency International Tokamak Reactor (INTOR) Workshop, with participation from the United States, the Soviet Union, Japan, and Europe. The INTOR Workshop evaluated the readiness of magnetic fusion to move forward into the power reactor phase, the successful outcome of which led directly to the creation of the international ITER Project in 1985. In addition, I organized and led the Fusion Research Center at Georgia Tech, through which students and faculty have participated as members of the DIII-D National Team for the leading U.S. tokamak experiment and in the Department of Energy's fusion research program.

Colleagues have been important in my professional life because I learn from them and make use of their unique skills to extend my own. In my career I was fortunate to have a great many valued colleagues at every step, including many at Georgia Tech alongside dozens of talented graduate students and postdocs.

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Weston Monroe (Bill) Stacey is a member and Fellow of the American Nuclear Society and the American Physical Society, a member of the American Association for the Advancement of Science, and a lifetime member of Who's Who in America. He received the ANS Outstanding Publication in Reactor Physics Award (1972), the Outstanding Achievement in Fusion Award (1981), the Outstanding Accomplishment in Fusion Award (1996), the Seaborg Medal (2001), and the Wigner Reactor Physicist Award (2003). He received U.S. Department of Energy Certificates of Appreciation (1982, 1988) and the DOE Distinguished Associate Award (1990) for his leadership of INTOR, leading to establishment of the ITER Project. He received the Sigma Xi Sustained Research Award (1998), the Georgia Tech Faculty Author Award (2003), and the Fusion Power Associates Distinguished Career Award (2009). He has served as technical program chair of the ANS Mathematics and Computation Topical Meeting (Charleston, 1975) and the ANS National Meeting (Atlanta, 1979), as chair of the ANS M&C Division (1973–1974), as vice chair of the Fusion Energy Division (1977–1978), and as a member of the ANS Board of Directors (1974–1977). He has published 13 textbooks or research monographs and about 350 research papers on nuclear reactor physics, fusion plasma physics, and reactor engineering.

There is much more to Weston M. Stacey's memoir. Find the complete story of his working life online at the ANS Nuclear Cafe.

Entergy takes net-zero pledge, teams with Mitsubishi to decarbonize with hydrogen

Above: Paul Browning, Mitsubishi Power, and Paul Hinnenkamp, Entergy, sign the joint agreement on September 23. Photo: Entergy

New Orleans–based Entergy Corporation on September 24 announced a commitment to achieve net-zero carbon emissions by 2050, joining a growing list of major energy companies to make that promise—including Ameren Corporation (see story below), Dominion Energy, Duke Energy, Southern Company, Xcel Energy, and Public Service Enterprise Group. And, like those companies, Entergy says it sees nuclear playing an important role in the realization of that goal.

According to the announcement, key actions will include the following:

- Continuing investment in existing zero-carbon nuclear power and in modern, efficient natural gas generating units, while retiring coal and older, less efficient gas-powered units. (Although Entergy is in the midst of a full exit from the merchant power market and has scheduled the Indian Point-3 and Palisades reactors for early retirement [in 2021 and 2022, respectively], the company remains bullish on nuclear facilities in its regulated Dixie territory, including Arkansas Nuclear One, in Russellville, Ark.; Grand Gulf, in Port Gibson, Miss.; River Bend, in St. Francisville, La.; and Waterford, in Killona, La.)
- Evaluating and enhancing the company's portfolio transformation with emerging technologies, such as advanced nuclear, distributed resources, alternative fuels like renewable natural gas and green hydrogen, and carbon capture and sequestration.
- Ongoing integration of renewable energy resources, storage, and innovative applications of conventional generation into the company's long-term generation portfolio transformation.
- Continuing to engage with partners and gain experience enhancing natural systems such as

wetlands and forests that absorb carbon.

- Working across and between sectors, such as transportation and industry, on beneficial electrification and net emission-reduction initiatives.
- Collaborating with customers, key suppliers, and industry partners to advance the technologies and strategies necessary to reduce carbon emissions.

A new partner

Entergy's net-zero news came just one day after the company announced the signing of a joint development agreement with Mitsubishi Power, a subsidiary of Mitsubishi Heavy Industries, to bring decarbonization projects to Entergy's utility businesses in Arkansas, Louisiana, Mississippi, and Texas.

The partnership, according to Entergy, will focus on the following:

- Developing hydrogen-capable gas turbine combined-cycle facilities.
- Developing green hydrogen production, storage, and transportation facilities.
- Creating nuclear-supplied electrolysis facilities with energy storage.
- Developing utility-scale battery storage systems.
- Enabling economic growth through partnerships with Entergy utility customers.

"Mitsubishi Power is a first mover in hydrogen-enabled gas turbine and long- and short-term storage solutions," Entergy said in its announcement of the agreement. "It also provides the world's first and only standard integrated green hydrogen packages. The Hydaptive and Hystore packages optimize integration across renewables, energy storage, and hydrogen-enabled gas-turbine power plants, which all work together to create and incorporate green hydrogen—a key to reaching carbonless emissions."

AMEREN

Utility signs up for net zero, plans to extend Callaway operation

Ameren Corporation has established a goal of net-zero carbon emissions by 2050 across all of its operations in Missouri and Illinois, according to a September 28 news release from the company. The goal is included in subsidiary Ameren Missouri's latest integrated resource plan (IRP), filed with the Missouri Public Service Commission. (In Ameren Missouri's 2017 IRP, carbon emissions were to be reduced 80 percent from 2005 levels by 2050.)

To help achieve net zero, Ameren said that it expects to seek an extension of the operating license for its Callaway nuclear plant, a 1,190-MWe pressurized water reactor located near Fulton, Mo. In 2015, the Nuclear Regulatory Commission renewed the operating license for Callaway—which entered commercial operation in 1985—to 2044.

The company also said that it is planning its largest-ever expansion of solar and wind generation, with some $4.5 billion allocated over the next 10 years to add 3,100 MW of renewable energy. By 2040, that number is expected to increase to 5,400 MW.

In addition, Ameren intends to move up the closure dates of two of its coal-fired plants in Missouri: The Sioux plant is now slated for

As part of its net-zero emissions pledge, Ameren plans to keep its Callaway nuclear plant operating beyond 2044. Photo: Ameren

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retirement in 2028, and the Rush Island plant in 2039. More than 75 percent of the company's current coal-fired energy generating capacity is expected to be retired by 2040, and all coal-fired plants are scheduled to be retired by 2042, Ameren said.

"This is a step change in renewable energy investments and carbon emission reductions from the plan we presented three years ago," said Marty Lyons, chairman and president of Ameren Missouri. "Under our plan, customers will receive significant benefits from advances in technology and falling renewable energy costs, as well as from robust energy efficiency programs to help keep their energy costs affordable."

Ameren's plan for reaching net zero is also expecting contributions from advanced energy technologies, including nuclear. The IRP's executive summary states, "New technologies will be critical to achieving our goal of net-zero CO_2 emission by 2050, so we will be actively participating in efforts to help advance the development of technologies such as carbon capture and sequestration, the use of hydrogen fuel for electric production and energy storage, next-generation nuclear, and large-scale long-cycle battery energy storage."

LEGISLATION

Measures to bolster cybersecurity in energy sector approved by House


McNerney


Latta

The House of Representatives on September 29 unanimously passed three bills aimed at strengthening the cybersecurity of the U.S. electric grid and other energy infrastructure. The legislation now moves to the Senate for consideration.

The Enhancing Grid Security through Public-Private Partnerships Act (H.R. 359), introduced by Rep. Jerry McNerney (D., Calif.) and cosponsored by Rep. Bob Latta (R., Ohio), would direct the Department of Energy to facilitate and encourage public-private partnerships to address security risks of electric utilities.

The Cyber Sense Act of 2020 (H.R. 360), introduced by Latta and cosponsored by McNerney, would require the DOE to test the cybersecurity of products and technologies intended for use in the bulk power system.

Finally, the Energy Emergency Leadership Act (H.R. 362), introduced by Rep. Bobby Rush (D., Ill.) and cosponsored by Rep. Tim Walberg (R., Mich.), would create a new DOE assistant secretary position with jurisdiction over all energy emergency and energy security functions related to energy supply, infrastructure, and cybersecurity.

Frank Pallone Jr. (D., N.J.), chairman of the House Energy and Commerce Committee, and Rush released a joint statement on the bills' passage, saying, "Right now, our aging electric grid is uniquely vulnerable to cyberattack, putting our communities at risk of being disconnected by bad actors or foreign governments seeking to sow chaos. Together, this legislation works to dramatically improve our cybersecurity and our readiness to combat potential attacks. These important bills will foster a much more reliable, safe, and cybersecure energy sector, and we're proud that they passed today with such bipartisan support."

In a separate statement, the Energy and Commerce Committee's ranking member, Rep. Greg Walden (R., Ore.), and Rep. Fred Upton (R., Mich.), said, "The COVID-19 pandemic has underscored the importance of stopping supply chain threats, including ensuring the security of our electric grid. From electricity to Wi-Fi, a secure, reliable grid is vital to all Americans. We thank our House colleagues for supporting three bipartisan bills that will bolster our energy security and keep our grid safe from cyberattacks, and we urge our Senate colleagues to take swift action to keep our electric grid safe and running."

PLANT SAFETY

ASLB adds conditions to Seabrook license amendment

An ASLB calls for closer scrutiny of concrete degradation at Seabrook. Photo: NextEra

An Atomic Safety and Licensing Board has rendered its decision on a challenge to a license amendment concerning concrete degradation—known as alkali-silica reaction, or ASR—at the Seabrook nuclear power plant, upholding the amendment but imposing four additional conditions. The board found the new conditions to be necessary to provide adequate protection of public health and safety, according to a September 11 Nuclear Regulatory Commission press release. (The ASLB is the NRC's independent body charged with conducting adjudicatory hearings and deciding legal challenges to the agency's licensing and enforcement actions.)

The challenge to NextEra Energy's license amendment for Seabrook was brought in 2017 by the C-10 Research and Education Foundation, an opponent of license renewal for the New Hampshire facility, which houses one 1,248-MWe four-loop pressurized water reactor.

The ASLB concluded that the amended license will meet the NRC's requirements when the

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agency's Office of Nuclear Reactor Regulation imposes the following conditions:

- NextEra will monitor certain devices measuring concrete expansion every six months, rather than starting in 2025 and every 10 years after that.
- If stress analyses show degradation-related expansion and other forces will exceed the strength of rebar in the concrete, NextEra must monitor the affected rebar to ensure it has not yielded or failed, or detect such failure if it has already occurred.
- If the degradation-related expansion rate in any area of a "seismic Category I" structure significantly exceeds a certain limit, NextEra will evaluate whether to implement more frequent monitoring.
- Each concrete core extracted from Seabrook must undergo a detailed microscopic evaluation to detect degradation-related features.

Declaring a partial victory, C-10's executive director, Natalie Hildt Treat, said, "NextEra Energy Seabrook has been sent back to the drawing board with this extremely detailed ruling. While the [ASLB] ultimately accepted the company's concrete testing program, it did so with several important conditions that will do more to ensure the health and safety of the public."

In a statement, Peter Robbins, NextEra's director of nuclear communications, expressed satisfaction that the license amendment had been upheld, adding, "Seabrook's program to monitor and manage ASR is comprehensive and effective. Nothing is more important than the safety of employees and the public, and our robust ASR program is part of that commitment to safety. Public dialogue is an ongoing component of the NRC's regulatory process, and we appreciate having had the opportunity to share the scientific basis of our testing and monitoring programs with the ASLB."

NextEra discovered concrete degradation at Seabrook a decade ago, during actions related to its license renewal application for the plant. The cause of the problem was later identified as ASR, a chemical reaction between water and concrete that results in the formation of a gel that can expand and cause "micro-cracks." The phenomenon is also known as "concrete cancer."

In 2016, NextEra submitted the license amendment request (LAR) to alter Seabrook's license to include appropriate management and analysis of ASR-affected components. More specifically, the request called for revising the plant's updated final safety analysis report to include methods for analyzing seismic Category I structures with concrete affected by ASR. According to the LAR, approval by the NRC would allow NextEra "to proceed in an optimum, safe, and effective manner toward a long-term solution for ASR degradation at Seabrook Station. The proposed methodology changes are necessary to reconcile the design basis of the containment building and other seismic Category I structures that are affected by ASR."

In April 2017, however, C-10 filed a request for a hearing on the LAR, and later that year, the ASLB issued a 100-page ruling that admitted five of the group's contentions, combining them into one reformulated contention: "The large-scale test program, undertaken for NextEra at the Ferguson Structural Engineering Laboratory, has yielded data that are not representative of the progression of ASR at Seabrook. As a result, the proposed monitoring, acceptance criteria, and inspection intervals are not adequate."

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ADVANCED REACTORS

HALEU investment a key part of TerraPower's demo proposal

TerraPower announced on September 15 that it plans to work with Centrus Energy to establish commercial-scale production facilities for the high-assay, low-enriched uranium (HALEU) needed to fuel many advanced reactor designs. The proposed investment in HALEU fuel fabrication is tied to a TerraPower-led submittal to the Department of Energy's Advanced Reactor Demonstration Program (ARDP), which was created to support the deployment of two first-of-a-kind advanced reactor designs within five to seven years. TerraPower would like one of those designs to be Natrium, the 345-MWe sodium fast reactor it has developed with GE Hitachi Nuclear Energy.

HALEU, enriched to between 5 and 19.75 percent fissile uranium-235, occupies a middle ground between low-enriched uranium (enriched up to 5 percent U-235 and used in the U.S. power reactor fleet today) and highly enriched uranium (enriched above 20 percent U-235). While HALEU is not yet commercially available, several advanced reactor developers have created designs that would use the fuel, which, thanks to its increased U-235 content, holds potential for improved reactor economics and fuel efficiency. HALEU can be fabricated into different fuel forms, including TRISO fuel particles and solid metallic fuel, such as that proposed for TerraPower's Natrium.

The ARDP requires applicants to "establish a plan by which they would obtain the fuel/special nuclear material needed for their projects." TerraPower's application proposes that, if selected for the ARDP, the company would work with Centrus to build commercial-scale capacity to produce HALEU and fabricate it into metal fuel assemblies. During the first year of the proposed collaboration, TerraPower and Centrus would initiate facility design and licensing and produce detailed plans and cost estimates. Specific terms of the agreement have not been disclosed.

In addition to creating HALEU production capacity, TerraPower and its partners plan to establish a new Category II metal fuel fabrication facility scaled to meet the needs of the Natrium demonstration program and equipped to produce lead test assemblies for the demonstration. Category II fuel fabrication facilities are authorized by the Nuclear Regulatory Commission to handle uranium at enrichments of 19.75 percent or less, and there are currently no Category II

In Case You Missed It—Power & Operations

Dominion Energy has filed with the NRC to renew the North Anna nuclear power plant's reactor operating licenses for additional 20-year terms, the Richmond, Va.-based utility announced September 4. The North Anna plant, located in Mineral, Va., is home to twin 973-MWe three-loop Westinghouse pressurized water reactors. The filing makes the plant the second nuclear facility in the state to seek subsequent license renewal, after Dominion's filing of a similar application in 2018 to renew the licenses of its two Surry units—twin 874-MWe reactors. The NRC is currently reviewing that application.

China is on track to overtake the United States in nuclear power capacity by 2026, according to GlobalData, a U.K.-based research and analytics company. More than 160 GW of nuclear capacity will likely be added globally between 2020 and 2030, some 66 percent of which is anticipated to take place in China, India, and Russia, the company reported on September 9. China alone is set to account for more than 50 percent (83 GW) of the new capacity, followed by India with 8.9 percent (14.5 GW) and Russia with 6.4 percent (10.5 GW). GlobalData also projects that during the same period, more than 76 GW of nuclear capacity will be retired.

Darlington-3's refurbishment began in late August with the start of defueling, Ontario Power Generation (OPG) announced on September 3. Originally scheduled to begin in May of this year, Unit 3's refurbishment was postponed due to the COVID-19 pandemic.

Ontario's Darlington nuclear power plant. Photo: OPG

Located in Clarington, Ontario, Canada, the Darlington plant houses four 878-MWe CANDU pressurized heavy-water reactors, all of which entered commercial operation in the early 1990s. The 10-year refurbishment project commenced in earnest in October 2016, when Unit 2 was taken off line (*NN*, Dec. 2016, pg. 45). The refurbished Unit 2 was returned to service in early June, and in late July, Unit 3 was shut down and disconnected from the grid in preparation for its refurbishment.

The Darlington-1 refurbishment is scheduled to start in the first quarter of 2022 and be completed in the second quarter of 2025, while work on Darlington-4 is scheduled to begin in the third quarter of 2023, with completion in the fourth quarter of 2026.

Unit 5 at the Tianwan nuclear plant completed its full-power continuous operation assessment on September 8, meeting the conditions for commercial operation, according to China National Nuclear Corporation. The domestically designed ACPR-1000 pressurized water reactor is the company's 22nd reactor to start commercial operation, raising the CNNC fleet's installed capacity from 19.112 million kilowatts to 20.230 million.

Unit 5 at the Tianwan nuclear plant. Photo: CNNC

For in-depth coverage of these stories and more, see the ANS Newswire at ans.org/news.

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fabrication facilities in the United States.

"We are investing in American capability because it offers advantages related to assured domestic supply for the Natrium technology's long-term commercialization prospects," said Chris Levesque, TerraPower president and chief executive officer. "We are pleased that this effort supports broader Department of Energy goals with regard to HALEU production and market deployment of domestic advanced reactor technology."

Daniel B. Poneman, Centrus president and CEO, said, "By catalyzing commercial-scale HALEU production, the proposed investment would put America in the leadership position when it comes to fueling the advanced reactors of tomorrow. This partnership with TerraPower would enable us to expand beyond demonstration scale, and we have more than enough room at the Ohio plant to continue expanding uranium enrichment and fuel fabrication capability as demand grows and the market matures."

Centrus is currently working under a three-year, $115-million cost-shared contract with the DOE to deploy 16 of its AC-100M centrifuges at its Piketon, Ohio, facility to demonstrate HALEU production. Centrus has also applied to the NRC for a license to produce HALEU.

Once the demonstration is complete in mid-2022, TerraPower and Centrus would work to expand the facility. According to TerraPower, the Natrium proposal includes private investment beyond the 50 percent cost-share minimum required by the DOE for ARDP demonstration reactors. This additional investment is "to ensure that both the reactor can be commercialized within five to seven years and that new HALEU production capacity can be built," according to TerraPower, and "can benefit the large number of advanced reactor developers planning on using HALEU."

The U.S. Nuclear Fuel Working Group report issued by the DOE in April 2020 identified HALEU production capability as a key priority and anticipated that the technology "can be adopted by the private sector for commercialization and deployment after the three-year [cost-shared contract], should the demonstration be successful and demand materialize." TerraPower is signaling its readiness to step into that role. Bills including support for HALEU production have received bipartisan backing in Congress.

WORLD NUCLEAR ASSOCIATION

Bilbao y León picked to lead U.K.-based organization

Sama Bilbao y León, formerly head of the Division of Nuclear Technology Development and Economics at the OECD Nuclear Energy Agency, succeeded Agneta Rising as the World Nuclear Association's director general at the end of October.

Bilbao y León

Rising, who took the reins of the London-based WNA in January 2013, is the former vice president, environment, at Vattenfall AB; cofounder and former president of Women in Nuclear; and former president of both the European Nuclear Society and Swedish Nuclear Society. The WNA said that she has stepped down "to move to new endeavors."

Bilbao y León, a member of the American Nuclear Society since 1994, has been a nuclear safety analysis engineer with Dominion Energy, director of the nuclear engineering program and associate professor in the Department of Mechanical and Nuclear Engineering at Virginia Commonwealth University, and technical head of the Water Cooled Reactors Technology Development Unit at the International Atomic Energy Agency. Originally from Spain, she holds a bachelor's degree in mechanical engineering and a master's in energy technologies from the Polytechnic University of Madrid, a master's and doctorate in nuclear engineering and engineering physics from the University of Wisconsin–Madison, and an MBA from Averett University. Her areas of expertise include nuclear thermal hydraulics for both light-water reactors and sodium-cooled reactors, nuclear reactor design, nuclear safety, and energy and environmental policy. According to the WNA, Bilbao y León's extensive experience working in international environments makes her particularly suited to lead the organization.

"I am honored and delighted to have been given the opportunity to lead the World Nuclear Association," Bilbao y León said. "Agneta leaves some very big shoes to fill, and I will do my best to do so. I look forward to working together with the association's members, the board, and the secretariat to continue making the case for nuclear energy as a clean, reliable, cost-effective, and low-carbon energy source."

New report highlights nuclear supply chain opportunities

The World Nuclear Association on September 23 released *The World Nuclear Supply Chain: Outlook 2040*, a market-oriented look at the opportunities and challenges for nuclear power plants and their supply chain, including scenarios for the evolution of nuclear energy over the next two decades. The report provides information on nearly 300 major independent suppliers of nuclear-grade structures, systems, components, and services, as well as an up-to-date picture of ongoing and planned nuclear plant construction, decommissioning, and major refurbishment and waste management projects.

Key highlights from the report include:

- At the end of 2019, there were 442 operable commercial nuclear power reactors around the

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world and 50 under construction. There are specific plans for another 109 power reactors. Nuclear power worldwide generates sales revenues worth around $300 billion a year for electricity utilities.

■ Of the 321 new reactors expected to come on line between 2019 and 2040 in the report's reference scenario, 82 are projected to be built in the OECD countries, 134 in China, 25 in Eastern Europe and Central Asia, and 42 in India. In the upper scenario, some 467 new reactors are completed by 2040, with 114 in the OECD countries, 207 in China, 33 in Eastern Europe and Central Asia, and 50 in India.

■ Under the reference scenario, revenues from operating nuclear plants are expected to grow at 2.0 percent annually over the coming two decades to reach some $460 billion by 2040, with 68 percent of the growth occurring in the emerging industrial economies (the non-OECD area, including China).

■ The value of the capital expenditure in new nuclear build to 2040 is on the order of $972 billion in the reference scenario and $1.68 trillion in the upper scenario. Of these totals, international projects could amount to $475 billion and $870 billion in the reference and upper scenarios, respectively.

■ The value of ongoing new construction has been about $220 billion worldwide, of which about $6 billion to $10 billion a year consists of international procurement for goods and services—or between one-fifth and one-quarter of the total value of all projects.

■ The total value of work for long-term operation could amount to some $50 billion to $100 billion. This could amount to around $4 billion a year of international procurement.

■ The market for decommissioning is also substantial. The value of decommissioning work on projects involving immediate dismantling by 2040 could total almost $150 billion.

The report, which is free to WNA member organizations, is available for purchase at world-nuclear.org/shop/products/the-world-nuclear-supply-chain-outlook-2040.aspx for £475 (about $605).

UNITED KINGDOM

Deadline for proposed Welsh plant extended, third party interest expressed

Despite Tokyo-based Hitachi Ltd.'s decision in mid-September to withdraw from the Wylfa Newydd nuclear-build project in Wales, by month's end, a small degree of hope for the project had reappeared: On September 30, the United Kingdom's Planning Inspectorate announced that it would delay its decision regarding issuance of a development consent order (DCO) for Wylfa Newydd.

The original deadline for the decision had been September 30, but following the receipt of a pair of letters from Horizon Nuclear Power—the Hitachi subsidiary in charge of the project—the inspectorate consented to a December 31 extension.

Duncan Hawthorne, Horizon Nuclear's chief executive officer, first requested the end-of-the-year extension in a letter dated September 22, writing, "Due to the recent change in circumstance [a reference to Hitachi's exit from the project], a short extension to the decision deadline would be beneficial to enable Horizon to work constructively with its key stakeholders to ascertain the options for the Wylfa Newydd DCO project and secure its future, recognizing

Artist's rendering of the Wylfa Newydd project. Image: Horizon Nuclear Power

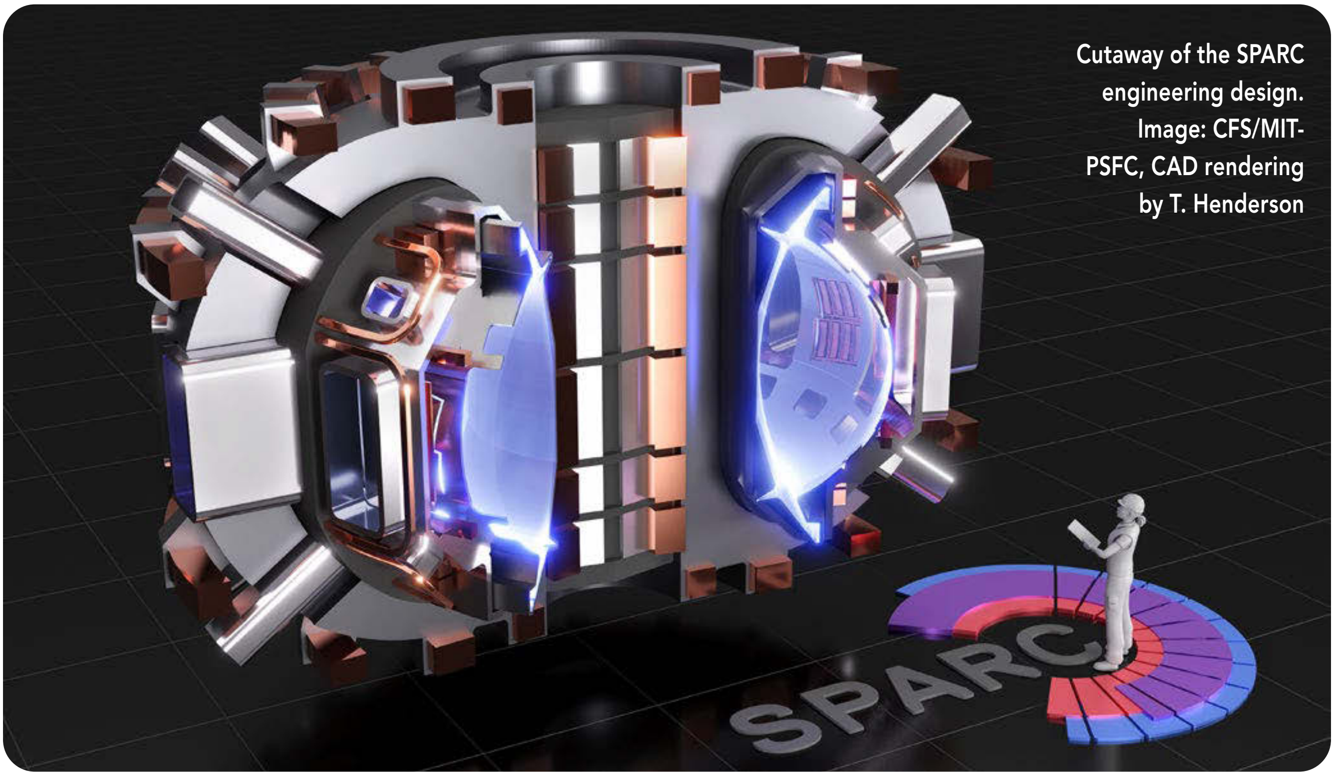
the critical role nuclear power has to play in helping tackle the U.K.'s energy needs, meet climate change targets, and level up the economy through green growth and job creation."

In the second letter, dated September 28, Hawthorne informed the inspectorate that his firm "has been engaged in discussions with third parties that have expressed an interest in progressing with the development of new nuclear generation at the Wylfa Newydd site in Anglesey, Wales. These discussions are still at an early stage, and it is felt that a short deferral would allow time for Horizon and those interested parties to determine whether, and if so how, the Wylfa Newydd DCO project could be taken forward in Hitachi, Ltd.'s absence. Part of that consideration would relate to the possibility and benefits of seeing the current development consent order application through to conclusion, and any issues that would need to be addressed."

Formed in 2009 to develop new nuclear power stations in the United Kingdom, Horizon Nuclear Power was acquired by Hitachi in November 2012. The following year, Horizon announced plans to construct two advanced boiling water reactors next to the now-shuttered Wylfa nuclear power station on the island of Anglesey, off the northwest coast of Wales. The new plant would be called Wylfa Newydd—Welsh for "New Wylfa."

In December 2017, U.K. regulators approved Hitachi-GE Nuclear Energy's ABWR design following the completion of the required generic design assessment. In 2018, Hitachi entered into negotiations with the British government regarding various options for governmental support of the Wylfa Newydd project, including the potential for equity and debt investments.

In January last year, however, Hitachi announced that it was suspending the project after failing to reach a financing agreement with the government.



Cutaway of the SPARC engineering design. Image: CFS/MIT-PSFC, CAD rendering by T. Henderson

A look at Commonwealth Fusion's burning plasma ambitions

Commonwealth Fusion Systems (CFS) proposes to build a compact fusion device that it expects will achieve a burning plasma—a self-sustaining fusion reaction—and become the world's first net energy (Q>1) fusion system. Seven open-access, peer-reviewed papers on the physics basis of the fusion tokamak design have been written in collaboration with the Massachusetts Institute of Technology's Plasma Science and Fusion Center and were published on September 29 in a special edition of the *Journal of Plasma Physics*.

The timeline for this planned device, called SPARC, sets it apart from other magnetic confinement fusion tokamaks: Construction is to begin in 2021, with the device coming on line in 2025.

The newly published papers reflect work of 47 researchers from 12 institutions and more than two years of work by CFS and the Plasma Science and Fusion Center to refine their design and outline the key research questions that SPARC is expected to help answer as CFS targets a future fusion power plant. According to CFS, the papers apply the same physics rules and simulations used to design ITER, now under construction in France, and predict, based on results from existing experiments, that SPARC will achieve its goal of Q>2. In fact, the papers describe how, under certain parameters, SPARC could achieve a Q ratio of 10 or more.

"These are concrete public predictions that when we build SPARC, the machine will produce net energy and even high gain fusion from the plasma," said CFS's chief executive officer, Bob Mumgaard. "The combination of established plasma physics, new innovative magnets, and reduced scale opens new possibilities for commercial fusion energy in time to make a difference for climate change."

CFS envisions SPARC coming on line in 2025 as the world's first net energy–producing fusion machine, fusing hydrogen isotopes deuterium and tritium. SPARC is being designed as a pulsed experiment and would not generate electricity, although CFS plans to follow SPARC with a net electricity–producing fusion pilot plant called ARC (for affordable, robust, and compact).

To achieve fusion, the deuterium-tritium fuel must be heated to about 100 million degrees centigrade. While both ITER and SPARC would use magnets to confine a charged plasma, SPARC would use high-temperature superconducting magnets made of rare earth barium copper oxide. The operational limits for plasma pressure, density, and current increase with magnetic field. According to CFS, the new high-temperature superconducting magnets can "enable a similar performance as ITER, but built more than 10 times smaller and on a significantly faster timeline." The team plans to demonstrate a 20-tesla, large-bore magnet next year, the same year that construction on SPARC would begin.

According to CFS, the SPARC design would be about twice the size of the now-retired MIT Alcator C-Mod experiment but would achieve fusion performance comparable to that expected in the much larger ITER reactor. CFS was spun out of MIT in spring 2018, and the company continues to collaborate with MIT's Plasma Science and Fusion Center.

Martin Greenwald, deputy director of that center and one of the project's lead scientists, wrote an editorial, titled "Status of the SPARC physics basics," that was published in the journal. "The design for the ITER experiment explicitly required the highest possible magnetic field achievable with the niobium-based technology available at the time," Greenwald said. "The use of a newer, higher field magnet technology enables similar levels of plasma performance in devices of considerably smaller size and thus lower capital cost."

In Case You Missed It—Research & Applications

The NRC is funding its first grants under the Integrated University Program in fiscal year 2020, and on September 21 the agency announced plans to award more than $7.25 million in research and development grants to 15 peer-reviewed proposals. The Nuclear Regulatory Commission plans to award the remainder of $16 million appropriated by Congress in fiscal year 2020 under the Integrated University Program by the end of April 2021; those funds are allotted for scholarships, fellowships, trade schools and community colleges, and faculty development. More information is available at sssnrc.gov/about-nrc/grants.html.

CNL is working with Kairos Power on research and engineering for technologies to separate, analyze, and store the tritium that would be created during the operation of Kairos Power's proposed TRISO-fueled, fluoride-salt–cooled small modular reactor. The reactor, called the Kairos Power FHR, would produce tritium as a by-product, requiring the company to incorporate and maintain engineering controls to ensure the protection of workers and the environment.

The agreement was made under the Canadian Nuclear Research Initiative (CNRI) and was announced by Canadian Nuclear Laboratories in early September. In addition to Kairos Power, reactor developers selected for cost-sharing arrangements through the CNRI program in November 2019 were Moltex Canada, Terrestrial Energy, and Ultra Safe Nuclear Corporation.

For in-depth coverage of these stories and more, see the ANS Newswire at ans.org/news.

Research & Applications continues

VERSATILE TEST REACTOR

"Critical decision" keeps accelerated testing facility plan on schedule

Now that the Department of Energy has approved Critical Decision 1 for the Versatile Test Reactor (VTR) project, the engineering design phase can begin once Congress appropriates funding, according to a September 23 announcement from the DOE's Office of Nuclear Energy. The DOE has requested $295 million for the project in fiscal year 2021.

The news came nearly one month after a team led by Bechtel National Inc., and including GE Hitachi Nuclear Energy (GEH) and TerraPower, entered into contract negotiations with Battelle Energy Alliance for the design-and-build phase of the VTR. GEH's sodium-cooled fast reactor PRISM technology was selected to support the VTR program in November 2018.

"The Versatile Test Reactor addresses a long-standing gap in research infrastructure in the United States," said Energy Secretary Dan Brouillette. "We have not had a fast neutron spectrum test facility for decades. Many of the new reactor designs under development in the United States require this sort of long-term testing capability."

Critical Decision 1, known as "Approve Alternative Selection and Cost Range," is the second step in the formal process the DOE uses to review and manage research infrastructure projects. In August 2019, the DOE issued a notice of intent to prepare an environmental impact statement (EIS) for the VTR as part of Critical Decision 1 activities. Earlier in 2019, Critical Decision 0 approved the need for the VTR, and Critical Decision 2/3, scheduled for July–September 2022, would set the project baseline and authorize the start of construction.

"The approval of Critical Decision 1 establishes a solid foundation upon which the design phase can begin," said Rita Baranwal, DOE assistant secretary for nuclear energy.

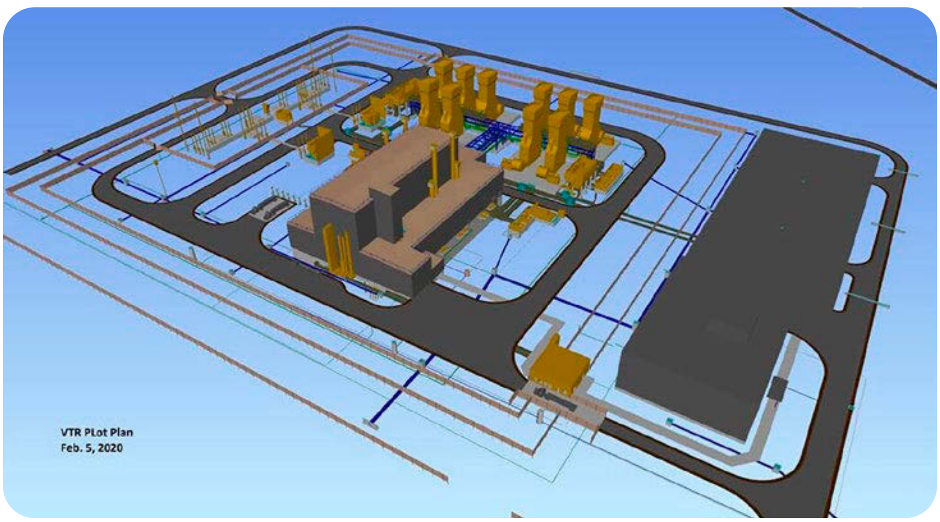
The VTR will generate neutrons at higher speeds and higher concentrations than existing test infrastructure to provide accelerated testing of advanced nuclear fuels, materials, instrumentation, and sensors.

Once built, the VTR will be able to conduct tests and experiments in eight key areas: molten salt reactors, gas-cooled fast reactors, lead-cooled fast reactors, sodium-cooled fast reactors, structural materials testing, systems for rapid specimen/test insertion and retrieval, digital engineering and virtual design and construction, and instrumentation and controls.

The current VTR schedule calls for a record of decision on the design, technology selection, and location for the VTR in late 2021, following the completion of the EIS.

The VTR project is being managed by Idaho National Laboratory on behalf of the DOE's Office of Nuclear Energy. INL and Oak Ridge National Laboratory are the two potential hosts for the VTR. According to the DOE, the VTR could be operating as early as 2026.

The proposed Versatile Test Reactor complex would cover about 20 acres. Image: INL



MEDICAL RADIOISOTOPES

Progress being made toward Mo-99 production at Darlington

Ontario Power Generation, its subsidiary Laurentis Energy Partners, and BWXT ITG Canada and its affiliates announced on September 24 that the companies are making "significant progress" toward the production of molybdenum-99 at OPG's Darlington nuclear power plant. Darlington will become the first commercial operating nuclear reactor to produce the medical radioisotope.

Over the past 24 months, a team of more than 100 BWXT and Laurentis personnel designed tooling at BWXT's facility in Peterborough, Ontario. The tooling, which will be used to deliver molybdenum targets into the Darlington reactor for irradiation, is currently being manufactured at the Peterborough facility.

Darlington Nuclear Generating Station. Photo: OPG

BWXT announced in June 2018 that it was working with OPG to produce Mo-99 at the four-unit Darlington plant in Ontario, Canada. According to BWXT, the design of Darlington's

Research & Applications continues

CANDU reactors allows for the insertion and removal of molybdenum targets into the reactor while in operation, ensuring OPG's ability to irradiate targets on a reliable basis. As CANDU reactors use natural uranium as fuel, Mo-99 can be produced without the proliferation concerns related to the use of high-enriched uranium. A precursor to technetium-99m, Mo-99 is used in more than 40 million procedures a year to detect cancers and diagnose various medical conditions.

At the time of the original announcement, BWXT said that it expected to begin the production of Mo-99 at Darlington, subject to Canadian regulatory reviews and approvals, by the end of 2019. The company did not indicate in its latest announcement when it expects production to begin.

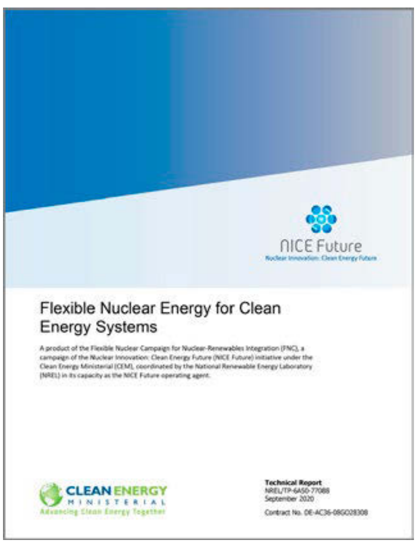
Before it ceased production in 2016, Canada's National Research Universal reactor produced about 40 percent of the world's supply of Mo-99. Canadian Nuclear Laboratories permanently shut down the reactor in 2018. Since then, the U.S. and Canadian governments have been seeking to build alternative supply sources of the radioisotope for the North American market.

Jean Nash, clinical manager of molecular imaging for Canada's University Health Network, said, "Over the last 10 years, there has been a reduction in the accessibility of radioisotopes, and this supply issue has only been exacerbated with the onset of COVID. A new, reliable supply will allow for more stable access to medical isotopes and support hospitals and clinicians in Ontario, Canada, and beyond to provide better patient care."

INTEGRATED ENERGY SYSTEMS

New report explores value of flexible nuclear energy in clean energy systems

A report from the Clean Energy Ministerial's (CEM) Nuclear Innovation: Clean Energy (NICE) Future initiative examines the potential roles that flexible nuclear energy generation can play in both current and future clean energy systems.



A product of the initiative's Flexible Nuclear Campaign for Nuclear-Renewables Integration, the 154-page report, *Flexible Nuclear Energy for Clean Energy Systems*, includes the views of experts from government agencies, ministries, and industry organizations across the globe.

The report uses the term "flexibility" to mean the ability of an energy source to economically provide services when and where they are needed by end users. Energy services can include both electric and nonelectric applications using both traditional and advanced nuclear power plants and integrated systems, according to the report.

"With the growing diversity of electricity sources, flexibility is a vital characteristic of reliable electricity systems and may also provide value in serving nonelectric energy needs," the authors state in the report's introduction.

Flexibility on the nuclear generation side may entail ramping power up or down to meet demand; energy may also be stored for later use and used to produce alternative products such as thermal, electrical, or chemical energy, depending on the required time and power demand.

On the use side, flexible demand response approaches may be employed to shift demand when possible, thereby reducing peaks, slowing ramp rates, and limiting stress on the grid.

Other key insights include:

- There is already an established body of knowledge surrounding flexible operation of existing nuclear plants.
- Many organizations are researching how nuclear reactors can increase the speed with which they change their electrical output and diversify their energy products.
- Advanced reactors will present even more opportunities for flexibility in nuclear systems.
- Nuclear energy has the potential to couple with many other energy sources in a synergistic fashion.

The CEM is a high-level global forum created to promote clean energy technology, share lessons learned and best practices, and encourage the transition to a global clean energy economy. Its co-lead countries are represented by the U.S. Department of Energy; Natural Resources Canada; Ministry of Economy, Trade, and Industry of Japan; and the Department of Business, Energy, and Industrial Strategy of the United Kingdom. The report can be found at nice-future.org/flexible-nuclear-energy-clean-energy-systems.

Presented by ANS's **Radwaste Solutions**
See the latest issue at ans.org/rs

Decommissioning of Florida's Crystal River-3 set to begin

Duke Energy and Accelerated Decommissioning Partners (ADP) on October 1 announced the completion of a transaction to begin decontaminating and dismantling the Crystal River-3 nuclear power plant this year instead of in 2067. ADP, a joint venture of NorthStar Group Services and Orano USA formed in 2017, was awarded a $540 million contract by Duke Energy in 2019 to complete the decommissioning of the pressurized water reactor by 2027—nearly 50 years sooner than originally planned.

The Nuclear Regulatory Commission approved the transfer of Crystal River's operating license from Duke Energy to ADP on April 1, and the Florida Public Service Commission unanimously approved the transaction on August 18 (*NN*, Oct. 2020, p. 90). Duke Energy permanently ceased operations at Crystal River-3, in Citrus County, Fla., in 2013, initially placing the reactor in safe storage (SAFSTOR), whereby the decommissioning work would begin in 2067 and end by 2074.

Under the previously announced contract, Duke Energy remains the NRC-licensed owner of the nuclear plant, property, and equipment, other than the independent spent fuel storage installation (ISFSI), and retains ownership and control of the trust fund that pays for the decommissioning. At the time the contract was announced in 2019, Crystal River's decommissioning trust fund totaled about $717 million, according to Duke Energy, which said that it will continue to have access to the site and will pay ADP only for work completed.

Above: Decommissioning of Crystal River-3 is to be completed by 2027. Photo: Duke Energy

ADP becomes the NRC-licensed operator responsible for decommissioning the plant in compliance with all state and federal regulations. The company also becomes responsible for operating and maintaining the ISFSI and owns the ISFSI assets, including the used nuclear fuel assemblies.

According to the companies, decommissioning planning and engineering work are under way. Between 2021 and 2026, ADP will remove, package, and ship shielded radioactive components, such as the reactor vessel, to an off-site licensed disposal facility and will then demolish the nuclear plant's buildings. Only the ISFSI will remain when D&D work is completed in 2027.

Although Duke Energy has not determined how it might repurpose the property, the company said that it has no plans to sell it. Crystal River-3 shares the site, known as the Crystal River Energy Complex, with four operational fossil fuel power plants.

"Our experienced team of decommissioning experts provides a turnkey solution to Duke Energy customers for a fixed price on a guaranteed schedule," said Scott State, chief executive officer of ADP. "We are committed to being good partners with Duke Energy, state and federal regulators, and the local community."

ADP parent company NorthStar purchased the Vermont Yankee nuclear power plant in 2019 and is currently decommissioning it with support from Orano USA.

HANFORD SITE

Hanford transitions to new cleanup contract

Central Plateau Cleanup Company, the Amentum-led joint venture with Fluor and Atkins, was cleared by the Department of Energy to begin a 60-day transition, starting on October 5, to the Central Plateau Cleanup Contract at the Hanford Site near Richland, Wash. As announced by Amentum on September 16, the company has received "notice to proceed" on the $10-billion, 10-year cleanup contract from the DOE.

The DOE awarded the indefinite-delivery/indefinite-quantity contract to Central Plateau Cleanup in December 2019, replacing the plateau remediation contract held by CH2M Hill Plateau Remediation Company, a subsidiary of Jacobs.

Under the cleanup contract, Central Plateau Cleanup will be responsible for the management and operation of the DOE's Richland Operations Office cleanup facilities; the deactivation, decommissioning, decontamination, and demolition of Hanford facilities and remediation of waste sites; management of waste retrieval, treatment, storage, and disposal; preparation of Resource Conversation and Recovery Act/Comprehensive Environmental Response Compensation, and Liability Act decision documents to support cleanup actions associated with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement); and core business functions to support these efforts.

An Amentum-led joint venture will take over cleanup of Hanford's Central Plateau. Photo: DOE

Hanford's Central Plateau contains former plutonium fuel processing facilities, waste disposal areas, and industrial-sized facilities that once refined plutonium fuel into its final product.

"We have assembled a tremendous team led by Scott Sax, and the entire leadership team is anxious to begin working with the talented Hanford workforce, regulators, and other

Waste Management continues

The launch of the Salt Waste Processing Facility at the Department of Energy's Savannah River Site in South Carolina was marked with a ribbon-cutting ceremony on September 24. Participants included, from left, Rep. Joe Wilson; Parsons chairman and chief executive officer Chuck Harrington; under secretary for science Paul Dabbar; DOE-Savannah River manager Mike Budney; DOE senior advisor William "Ike" White; Parsons president and chief operations officer Carey Smith; SWPF federal project director Pam Marks; and Parsons senior vice president and SWPF project manager Frank Sheppard. The DOE authorized hot operations of the SWPF in August (*NN*, Oct. 2020, p. 88). Photo: DOE

Hanford stakeholders," said Mark Whitney, executive vice president and general manager of Amentum's nuclear and environment strategic business unit. "We look forward to sharing our transition plans to continue work on this important DOE cleanup mission."

Scott Sax, president and project manager of the Central Plateau Cleanup Company, added, "Our goal is to be the safest, best-performing, most-respected cleanup contractor in the Department of Energy complex. Our team is ready to join hands with other site contractors in a One Hanford approach, and we are committed to getting the job done."

SAVANNAH RIVER SITE

DOE issues RFP for $21 billion site contract

The Department of Energy's Office of Environmental Management (EM) has begun accepting bids on a new 10-year, $21-billion contract for the Savannah River Site in South Carolina. EM issued a final request for proposal for the SRS integrated mission completion contract (IMCC) on October 1, posting it to EM's dedicated SRS IMCC website, at emcbc.doe.gov/SEB/srsimc/index.php. The deadline for proposals is December 1.

The IMCC would coalesce the work of two current contractors, including Savannah River Remediation, the site's liquid waste contractor led by Amentum with partners Bechtel National, Jacobs, and BWX Technologies, into a single contract, combining liquid waste work with nuclear materials management.

Work to be performed under the indefinite delivery/indefinite quantity contract will include support for the liquid waste stabilization/disposition and nuclear materials management and stabilization, among other requirements. This includes the operation of Savannah River's liquid waste tank farms, the Defense Waste Processing Facility, and the Salt Waste Processing Facility, which was recently authorized to begin operations. The contractor would also be tasked with constructing the Saltstone Disposal Units to permanently store processed waste.

For the procurement, EM said that it is pursuing a streamlined selection process under the DOE's new end-state contracting model, which focuses on the elements of key personnel, past performance, management approach, and cost to support a qualifications-based selection of the bidding team that represents the best value to the government. The streamlined contracting model also shifts focus on post-award partnering to determine the most appropriate requirements and technical approach to achieve the greatest amount of cleanup progress, according to EM.

CANADA

Recycled heavy water may benefit non-nuclear industries

BWXT Canada Ltd. (BWXT) will work with Ontario Power Generation (OPG) subsidiary Laurentis Energy Partners in developing technology that will assist in the recycling of heavy water from OPG's CANDU reactors, OPG's Centre for Canadian Nuclear Sustainability (CCNS) announced on September 17.

The collaborative project will recycle heavy water used to cool Canadian pressurized heavy-water reactors such as those in OPG's Pickering and Darlington nuclear power plants. Once recycled, the heavy water will be used in a growing number of non-nuclear applications that include pharmaceuticals, medical diagnostics, and next-generation electronics, including fiber optics.

OPG launched the CCNS in July of this year in an effort to integrate collaboration and research in the nuclear sector while also supporting work to prepare for decommissioning the Pickering plant. OPG has indicated that Pickering, an eight-unit CANDU reactor, will end commercial production in 2024, with decommissioning beginning in 2028. In 2016, OPG began a 10-year refurbishment project for its four-unit Darlington plant that will allow the plant to operate an additional 30 years.

"The Centre for Canadian Nuclear Sustainability provides the opportunity for industry leaders to combine their research and expertise to support innovative and sustainable solutions in nuclear life cycle management," said Carla Carmichael, vice president of nuclear decommissioning strategies for OPG. "This agreement between Laurentis Energy Partners and BWXT is a great example of the CCNS in action."

Waste Management continues

UNITED KINGDOM

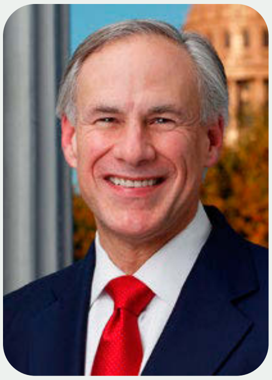
Magnox D&D cost rises 45 percent, NAO says

The National Audit Office (NAO) of the United Kingdom reported on September 11 that the total cost of the work needed to put the country's Magnox nuclear sites into "care and maintenance" has increased by up to an estimated £2.7 billion (about $3.5 billion) since the office's last estimate in 2017. The NAO, which scrutinizes U.K. public spending, released its findings in a report examining the Nuclear Decommissioning Authority's (NDA) management of a renegotiated decontamination and decommissioning contract with Cavendish Fluor Partnership.

When the NDA awarded Cavendish Fluor Partnership the contract to decommission two nuclear research sites and 10 Magnox nuclear power sites in 2014, the D&D cost was estimated

In Case You Missed It—Waste Management

Texas' governor is opposing two interim storage sites in Texas and New Mexico. In a letter sent to President Trump on September 30, Texas Gov. Greg Abbott expressed his opposition to the two proposed consolidated interim storage facilities for spent nuclear fuel that are currently under review by the Nuclear Regulatory Commission—Interim Storage Partners' (ISP) storage facility in West Texas and Holtec International's planned facility in New Mexico, near the Texas border. Abbott is claiming that the facilities will put U.S. energy security at risk by being sited within the oil-producing region of the Permian Basin. Abbott also said that he was opposed to increasing the amount of radioactive waste permitted to be disposed of in Texas without state approval. In April 2019, Abbott wrote to the Department of Energy and the NRC expressing his objections to federal actions that could allow Waste Control Specialists (WCS) to accept greater-than-Class-C waste at its disposal site in Andrews County, Texas. ISP is a joint venture of WCS and Orano USA.



Abbott

The comment period on Hanford's draft LLW document has been extended until November 27 by the Department of Energy. The *Draft Waste Incidental to Reprocessing Evaluation for Vitrified Low-Activity Waste Disposed Onsite at the Hanford Site, Washington*, which supports the DOE's decision to dispose of vitrified low-level radioactive waste at an on-site disposal facility at the Hanford Site near Richland, Wash., was initially made available on May 26, opening a 120-day comment period. Notice of the extension was published in the September 22 *Federal Register*. Comments on the draft LLW evaluation may be submitted by email to ILAWDraftWIR@rl.gov, or by mail to Jennifer Colburn, U.S. Department of Energy, P.O. Box 450, MSIN H6–60, Richland, WA 99354. The draft document can be found on the Hanford website, at hanford.gov/page.cfm/VitrifiedLowActivityWaste.

The waste vitrification plant under construction at Hanford. Photo: DOE

For in-depth coverage of these stories and more, see the ANS Newswire at ans.org/news.

The U.K.'s Bradwell Magnox site after being placed in "care and maintenance." Photo: Magnox Ltd.

at £3.8 billion (about $4.9 billion). In an October 2017 report, the NAO found that the expected costs of decommissioning the Magnox sites increased by £2.2 billion, to £6 billion (about $7.7 billion). The NDA's decommissioning contract with Cavendish Fluor Partnership, a joint venture of London-based Babcock International and the U.S. engineering firm Fluor, ended in August 2019.

According to the NAO, in July 2019, the NDA estimated that the Magnox program would cost even more: between £6.9 billion and £8.7 billion (about $8.9 billion and $11.2 billion), with a best estimate of £7.5 billion (about $9.6 billion) to get all the Magnox sites cleared and safely enclosed, ready for what is called the care and maintenance phase of decommissioning. During that phase, the reactors and waste facilities are sealed and the site kept in a secure state, potentially for some 80 years, to allow radiation levels to decay over time.

"Costs are likely to be subject to further change, largely because of the inherent uncertainties involved in cleaning up the U.K.'s nuclear sites," the NAO said, adding that the NDA is continuing to refine its estimates.

Following the award of the 14-year Magnox contract to Cavendish Fluor Partnership, a U.K. court ruled that the NDA had wrongly decided the outcome of the procurement process, leading the NDA to terminate the contract with the company in 2019, nine years early. In the interim, the contract was also renegotiated due to a "significant mismatch" between the work specified in the tendered contract and the work that needed to be done. The management of the Magnox sites and ownership of Magnox Ltd., the company responsible for carrying out the site decommissioning work, transferred from Cavendish Fluor Partnership to the NDA on September 1, 2019.

"Given the challenging circumstances created by the failure of the initial procurement and early phase of the Magnox contract, the NDA did well to negotiate a revised contract to enable it to move to its new delivery model," the NAO said in a release announcing its 2020 report, which can be found at nao.org.uk/report/terminating-the-magnox-contract.

Candidates nominated for 2021 national election


Arndt


McDaniel


Klann


Wharton

Candidates have been named to fill seven ANS leadership positions with terms beginning in June 2021.

The candidates for a one-year term as vice president/president-elect are Steven A. Arndt and Corey McDaniel. Arndt, ANS Fellow and member since 1981, is a senior technical advisor with the Nuclear Regulatory Commission, and McDaniel, ANS member since 2008, is chief commercial officer and director of industry engagement at Idaho National Laboratory.

The elected candidate will succeed current ANS Vice President/President-Elect Steven Nesbit in June 2021, when Nesbit becomes president.

The candidates for a two-year term as treasurer are Ray Klann and W. A. "Art" Wharton III. Klann, ANS member since 1991, is a senior scientist and group lead in the National Security Directorate at Pacific Northwest National Laboratory, and Wharton, ANS member since 2004, is a vice president at Studsvik Scandpower. Wharton, currently serving as treasurer, is running for a second term.

ANS members elected to the Board of Directors serve three-year terms that begin and end during an ANS Annual Meeting. In the 2021 election, with the recent change to ANS Bylaws to add a Young Member director, there are four U.S. director-at-large positions and one U.S. Young Member director-at-large position to be filled.

The 10 candidates who have been nominated to fill four U.S. director-at-large seats are Harsh Desai, Nuclear Energy Institute; Julie Ezold, Oak Ridge National Laboratory; Jess Gehin, Idaho National Laboratory; Kathryn Huff, University of Illinois at Urbana-Champaign; Jeff King, Colorado School of Mines; Stephen LaMont, Los Alamos National Laboratory; Jean-Francois Lucchini, Los Alamos National Laboratory; John Mahoney, High Expectations International; Jessika Rojas, Virginia Commonwealth University; and Tracy Stover, Savannah River Nuclear Solutions.

Nominated to run for the U.S. Young Member director position are Benjamin Holtzman, Nuclear Energy Institute, and Catherine Prat, Westinghouse Electric Company.

Directors with terms ending in June 2021 are Harsh Desai, Miriam Kreher (student director), Thomas Remick, Rebecca Steinman, Paul Wilson, and Akio Yamamoto.

The Nominating Committee for the 2021 election was chaired by Immediate Past President Marilyn Kray and included Local Sections Committee Chair Shikha Prasad, Professional Divisions Committee Chair Deborah Hill, Andrew Klein, Kathy McCarthy, David Pointer, Andrew Sowder, and Rebecca Steinman.

Members may also nominate candidates by petition for officer and director vacancies. Acceptable petitions must contain the original signature of 200 or more ANS voting members, have the nominee's written consent, and reach ANS headquarters no later than January 11, 2021.

Ballots for the 2021 election will be sent electronically on February 22, 2021, and must be submitted by 1:00 p.m. (EDT) on Tuesday, April 13, 2021.

Seven new ANS Fellows named

American Nuclear Society Fellows hold the highest grade of membership in the Society. The following new Fellows will be recognized on November 16 during the opening plenary session of the 2020 ANS Virtual Winter Meeting.

David L. Aumiller, ANS member since 1995 and senior advisor at Bechtel Marine Propulsion Corporation, for innovative and significant contributions to the development, verification, qualification, and application of advanced nuclear reactor safety analysis methods and codes; increased fundamental knowledge of thermal hydraulic processes; and the development of advanced code coupling methodologies.

J. Rory Kennedy, ANS member since 2003 and director of the Nuclear Science User Facilities at Idaho National Laboratory, for transforming the way research and development for nuclear fuels and materials is conducted. His influence, leadership, and tireless advocacy for researchers have had a significant impact on the global nuclear energy enterprise.

Karen Vierow Kirkland, ANS member since 1990 and a nuclear engineering professor at Texas A&M University, for significant research contributions in two-phase flow, condensation heat transfer, and severe accident phenomena in nuclear reactors to improve the understanding of nuclear reactor performance, reactor safety, and severe accident management strategies, and for contributions to the education and professional mentoring of university students.

David J. Kropaczek, ANS member since 1992 and director of the Consortium for Advanced Simulation of Light Water Reactors at Oak Ridge National Laboratory, for the innovative development and application of computational methods to solve nuclear fuel cycle optimization problems for pressurized and boiling water reactor systems, including the first-of-a-kind application of large-scale combinatorial optimization techniques related to the design of fuel assemblies, core loading patterns, operating strategies, and multicycle planning.

Evelyn M. Mullen, ANS member since 1988 and chief operating officer of global security at Los Alamos National Laboratory, for ensuring the nation's criticality experimental capability and for leadership in the field of nuclear national security.

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Lin Shao, ANS member since 2007 and professor of nuclear engineering at Texas A&M University, for his contributions to the understanding of fundamental radiation materials science and the development of accelerator ion beam techniques, and for his contributions as an educator and mentor to nuclear engineering students.

Michael L. Zerkle, ANS member since 1981 and senior advisor at the Naval Nuclear Laboratory, in recognition of distinguished and influential original research, advocacy, and scientific contributions in the development of specialized reactor physics methods incorporated into advanced reactor design, meticulous and expert validation of national nuclear data libraries, and the development of innovative thermal neutron scattering evaluation methods for advanced moderators using first-principles atomistic modeling.

ANS CHAMPIONS—2020 MEMBERSHIP YEAR

LEGACY CIRCLE
Kevin R. O'Kula
Michael J. Wallace

PATRON
Vincent J. Esposito
Guy P. Estes
Tsahi Gozani
David K. Hayes
Anthony Hechanova
R. Shane Johnson
W. Reed Johnson
John R. Longenecker
Peter B. Lyons
William L. Myers
Loren C. Schmid
Andrew O. Smetana
Weston M. Stacey Jr.
Luc G. G. Van Den Durpel
Brian N. Woolweber

BENEFACTORS
Robert W. Albrecht
Joseph S. Armijo
Carol L. Berrigan
Leonard J. Bond
Laural L. Briggs
Barry L. Butterfield
Kenneth T. Canavan
Heather J. M. Chichester
Nam Zin Cho
Frank D. Coon III
Kenneth A. Ewell
Thomas H. Fanning
Madeline A. Feltus
Luisa F. Hansen
Paul E. Hartnett
John E. Kelly
Richard H. Lagdon Jr.
Hangyu Li
Michael L. Marler
Greg Mason
Kaichiro Odajima
Edward L. Quinn
Joseph Y. R. Rashid
Philip Ray
Laura Scheele
Kenneth J. Schrader
Richard R. Schultz
David H. Smith
Russell E. Stachowski
Rebecca L. Steinman
Donald R. Todd
Richard F. Walker
Paul P. Wilson

ADVOCATES
Nusret S. Aksan
Allan Aldridge
Kelsey Amundson
John M. Anderson
David L. Aumiller
Paul E. Benneche
Frederick D. Benton
Roger N. Blomquist
Roger L. Boyer
Michael E. Button
Michael T. Coyle
Gwyneth Cravens
Bruce W. Crawford
Timothy M. Crook
Harsh S. Desai
Anthony Dimitriadis
Mitchell T. Farmer
Jeffrey A. Favorite
Jesus M. Garcia Figueroa
Nicholas A. Gentile
Micah J. Hackett
Phillip B. Haga
Donald E. Hall
Roger K. Harshbarger
John W. Houck
John J. Hummer
Rodney W. Johnson
Dale Klein
Dale E. Knutson
William R. Kohlroser
Jay S. Lan
K. P. Lau
David R. Lawson
Peter C. LeBlond
William A. Loeb
Frank H. McDougall
Arthur T. Motta
John A. Nakoski
Steven P. Nesbit
David S. Orr
Earl M. Page
Supathorn Phongikaroon
W. David Pointer
Brett D. Rampal
Robert C. Rogers
Sudipta Saha
Sagid Salah
Heidi H. Schuette
Howard C. Shaffer III
Olga Cortes Rabelo Leão Simbalista
Mike S. Singh
Roger C. Sit
Sandra M. Sloan
Richard B. Stout
Nicholas W. Thompson
Michael K. Webb
Yasunori Yamanaka
Larry D. Young

SUPPORTERS
Sultan M. Al Qahtani
Jessiah J. Ardor
Sven O. Bader
Jeanette Berry
Madison N. Bushloper
James J. Byrne
Dorothy R. Davidson
Jacob R. Dobler
Lynne E. Ecker
Scotty D. Ferguson
Steven M. Fontaine
Jeffery S. Gill
Alex Henke
Saoud Henzab
Eric Jebsen
Sidney A. Keener
Miriam A. Kreher
Pablo M. Mulás
Fuga Nishioka
Joan Parker
Walter E. Perry
Ross C. Robinson
Reginald M. Ronningen
Mohammad A. Sharaf
Roger D. Weber
Abdullah Weiss

Through their generous contributions, ANS Champions show their commitment to furthering the mission of the American Nuclear Society. To join in supporting the Society's goals, become a Legacy Circle member ($1,000 or more), Patron ($500–$999), Benefactor ($250–$499), Advocate ($100–$249) or Supporter (up to $99) when submitting your renewal application, or contact the ANS Membership Department at 800/323-3044 or members@ans.org.

ANS names Winter Meeting award winners

The American Nuclear Society has named the recipients of seven awards that will be presented during the 2020 ANS Virtual Winter Meeting, which begins on November 16.

Milton Levenson Distinguished Service Award

To **Kevin R. O'Kula**, ANS member since 1976 and consulting engineer for Amentum Technical Services, for demonstrated leadership, professionalism, and dedication for more than 38 years in the field of nuclear engineering, supporting all aspects of Department of Energy and Nuclear Regulatory Commission activities. He has authored more than 40 papers and provided technical leadership to numerous ANS programs and conferences. He is an industry expert in the areas of nuclear facility source term evaluations, probabilistic and quantitative risk assessment and severe accident analysis, accident and consequence analysis, source term evaluation, hydrogen safety, software quality assurance, and safety analyses.

Seaborg Medal

To **Michael Z. Podowski**, ANS member since 2006 and professor emeritus at Rensselaer Polytechnic Institute, for longtime leadership and outstanding scientific and engineering research achievements to advance the safety and efficiency of nuclear energy generation worldwide.

E. Gail de Planque Medal

To **Kliss McNeel**, director of environment, safety, security, and health at Fluor Idaho, for inspirational vision and outstanding leadership in creating environment, safety, health, and quality and assurance programs integral to the safe and environmentally protective cleanup of national and international nuclear legacy projects.

Mary Jane Oestmann Professional Women's Achievement Award

To **Maria Okuniewski**, ANS member since 1997 and an assistant professor in the School of Materials Engineering at Purdue University, for her dedication to nuclear materials research and the education and professional development of young researchers in the field of nuclear materials science and engineering.

Landis Public Communication and Education Award

To **William G. Wabbersen Jr.**, ANS member since 1989 and a nuclear engineer at the National Nuclear Security Administration, for his origination and development of cross-cutting, innovative educational tools to introduce nuclear science concepts to tens of

ANS News continues

thousands of students of every age through the Interactive Nucleus Display (2010), the ANS Isotope Discovery Kit (2013), and the Isotopes App (2020).

Young Members Advancement Award

To **Lisa M. Marshall**, ANS member since 2005 and director of outreach, retention, and engagement in the Nuclear Engineering Department at North Carolina State University, for her significant contributions in advancing student and young members through her dedication, service, and leadership.

Crook

Wargon

Young Member Excellence Award

To **Timothy M. Crook**, ANS member since 2011 and a nuclear engineer at MCR Performance Solutions, and **Matthew D. Wargon**, ANS member since 2012 and senior nuclear engineer/computational physicist at TerraPower, for their tireless efforts in enabling student and young members toward nuclear science, engineering, and technology.

Rahnema named editor of *Nuclear Science and Engineering*

Rahnema

Farzad Rahnema, a professor of nuclear engineering and director of the Computational Reactor and Medical Physics Laboratory at the Georgia Institute of Technology, has been appointed editor-designate of the American Nuclear Society's *Nuclear Science and Engineering* Journal.

Rahnema, an ANS Fellow and member since 1989, was named editor-designate by ANS President Mary Lou Dunzik-Gougar on September 8, and he began his duties on October 1. He succeeds current editor Michael Corradini, who has been serving on an interim basis since Dan Cacuci retired from the role in November 2019.

"I am honored to be named the editor of *Nuclear Science and Engineering*, the premier journal in its field," Rahnema said. "I consider this appointment a strategic service to the American Nuclear Society and am especially excited for the opportunity to take *NSE* to the next level."

Rahnema earned a bachelor's degree from the Illinois Institute of Technology and a master's degree from Louisiana State University. He received his Ph.D. in nuclear engineering from the University of California at Los Angeles. His principal research interest is in the areas of theoretical and computational radiation transport and reactor physics, with an emphasis on resolving the challenges and current major issues in high-fidelity modeling and simulation of nuclear systems.

Prior to joining Georgia Tech in 1992, Rahnema was a principal engineer at General Electric Nuclear Energy, where his responsibilities included GE's 3D core simulator, PANACEA, used for reactor core design and as the engine for the 3D MONICORE system that monitors operating boiling water reactors.

Rahnema was the recipient of the 2019 ANS Gerald C. Pomraning Memorial Award for outstanding contributions toward the advancement of the fields of mathematics and computation in support of advancing the understanding of these topics of interest to the ANS membership.

ANS members approve amendment adding YMG rep to board of directors

The American Nuclear Society will include a representative from the Young Members Group on its Board of Directors after ANS members voted overwhelmingly in favor of amending Article B6 of the ANS bylaws. The change was mandated by Objective Outcome 5 of the ANS Change Plan 2020.

To keep the number of directors at 16, the approved amendment decreased the number of non–U.S. resident directors from three to two.

The change goes into effect immediately as the Nominating Committee is already deliberating for June's new Board members. To be eligible for the YMG position, the member must be younger than 36 on June 1 of the election year. The change in the Board's composition gives the YMG, which has more than 3,500 members, a collective voting voice.

"The Young Members Group is thrilled that the vote passed," YMG Chair Catherine Prat told ANS News. "This reaffirms the message that the Society values diversity. Giving a seat at the table to a young member is an important step in making sure that the different groups within ANS each have representation."

Although ANS has reduced the number of non-U.S. directors, the intention is not to reduce the Society's international focus. Another element of the change plan is to incorporate international functions within the External Affairs Committee and to create a new ANS International Council that will advise the Board and the Executive Committee directly.

ANS Student Sections virtual 5K fundraising event nears completion

There is still time to participate in the "Nuclear Power: Let's Keep it Running" 5K virtual run fundraiser sponsored by the ANS Student Sections Committee. The virtual 5K is designed to raise awareness about safe, clean, and reliable nuclear energy and to enrich the experiences of students in nuclear science and technology.

The campaign has raised more than $2,500 and consists of an online donation platform where student sections can form teams, organize runs, and connect to donors within their communities and throughout the country.

Join the effort as an organizer, runner, or donor by visiting classy.org/event/nuclear-power-lets-keep-it-running/e247911. Proceeds will support ANS Student Section activities and the ANS Student Program.

NUCLEAR POWER
LET'S KEEP IT RUNNING
2020
5K RUN

ANS News continues

New Members

The ANS members and student members listed below joined the Society in September 2020.

Aduloju, Sunday C., Oak Ridge National Laboratory
Akstulewicz, Francis M., Atoz Reactor Consulting
Andrus, Christopher F., Nine Mile Point Nuclear Station Unit 2
Armour, William E.
Arno, Margaret, Lawrence Livermore National Laboratory

Baer, Ken, Metatomic Inc.
Bailey, Teresa S., Lawrence Livermore National Laboratory
Beran, Michael, Naval Nuclear Laboratory
Blackwell, Joseph Blaine, Premier Technology
Britt, Philip S., University of Wisconsin–Madison
Brown, David, Exelon
Buckner, Jamie, Evoqua Water Technologies

Campbell, Benedict, AWE Plc
Coppersmith, Kevin, Coppersmith Consulting
Cothen, William, Beaver Valley Power Station

Field, Ryan E.
Fontaine, Steven M., Lawrence Livermore National Laboratory
Fornof, James D., Dauntless Solutions

Gleason, Barbara, Superior Technical Ceramics
Golden, Jerry
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Roh, Heedoh

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Stehle, Nick, Arizona Public Service
Stump, Maximilian
Subhash, Ghatu , University of Florida

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Weber, Theodore-Itochu
Wender, Samuel A., IV, Energy Harbor
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Abdoelatef, Mohammed G.
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Philipps, Joseph C.

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McDonald, Richmond

University of Pittsburgh
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Kinzler, Gregory
Sweeney, Brenna

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Toro Almodovar, Laura Carolina

University of Sharjah (United Arab Emirates)
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University of Tennessee–Knoxville
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Drouet, Lance M.
Phung, Quang T.
Tom, Anthony F.
Toy, Jasmine M.

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Fuentes, Tyler J.
Ohrt, Dylan D.
Ybarra, Gilbert M.

University of Utah
Newhart, Garrett

University of Western Ontario (Canada)
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Schnell, Adam

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Morrison, Greg

Virginia Commonwealth University
Bryars, Davis
Carlson, Liam Nils
Smith, John T.

Washington State University
Cummings, Joseph A.

Industry

NOTE: *Nuclear News* publishes news about nuclear industry contracts—but only about contract awards. We generally do not publish announcements that the work is under way or announcements that the work has been completed. Send your new contract award announcements to: Industry Editor, *Nuclear News*, 555 N. Kensington Ave., La Grange Park, IL 60526; fax 708/579-8204; email nucnews@ans.org.

BUSINESS DEVELOPMENTS

Terrestrial, CNL to collaborate on IMSR Safeguards

Terrestrial Energy announced on September 15 an agreement with **Canadian Nuclear Laboratories** (CNL) to collaborate on a program of work evaluating "Safeguards," an international regulatory framework aimed to ensure the security of nuclear material. The program is related to the operation of Terrestrial Energy's integral molten salt reactor (IMSR), a Generation IV advanced nuclear power plant. The work will involve establishing material accounting methods to track the IMSR's nuclear fuel salt and is being supported by CNL's Canadian Nuclear Research Initiative.

■ **Framatome** announced an exclusive partnership agreement on September 3 with ADAGOS to bring advanced, parsimonious artificial intelligence technology to the nuclear energy industry. ADAGOS's NeurEco architecture introduces a third-generation neural network to solve large and complex problems using fewer computational and data resources compared to previous generations. Neural networks analyze data and information in a way that mimics the human brain. NeurEco addresses common challenges to artificial intelligence and deep-learning technology.

■ **SHINE Medical Technologies**, a nuclear technology company based in Janesville, Wis., announced on September 2 that it has closed on an $80 million Series C financing deal. **Fidelity Management and Research Company** was the largest investor in the round, which also included participation from other new investors alongside current investors in the company. SHINE is building a medical isotope production facility in Janesville that will initially produce molybdenum-99, or Mo-99, which is used in more than 40 million patient procedures annually.

■ **Cavendish Nuclear** will continue to provide complex engineering support for the U.K. fleet of nuclear power stations following renewal of the lifetime enterprise agreement with **EDF Energy**. Capabilities secured include the Whetstone advanced assembly and test facility in Leicester, which has an essential role in developing and supplying reactor protection, graphite monitoring, fuel route equipment, and other services to EDF. The agreement also secures a team to provide bespoke nuclear-grade components and mitigate obsolescence risks and to provide safety, quality, and technical leadership across all of EDF Energy's operational sites and facilities. These changes complement long-term arrangements already in place with EDF to further secure the necessary capability to safely operate the United Kingdom's advanced gas-cooled reactor fleet and the single pressurized water reactor at Sizewell.

CONTRACTS

Rolls-Royce signs pair of deals with China's nuclear corporation

Rolls-Royce was awarded two multi-million-euro contracts in September by **China National Nuclear Corporation** related to Zhangzhou Units 1 and 2. The first deal, announced on September 3, is for Rolls-Royce to provide the neutron flux monitoring system for the two reactors, which are currently under construction in Zhangzhou, China. As part of the contract, Rolls-Royce will provide a complete system using the Spinline digital technology, including ex-core neutron detectors, cables, and connections and associated electronic systems, to Zhangzhou-1 and Zhangzhou-2, both of which use the Hualong One reactor design.

On September 17, Rolls-Royce announced its deal to provide Bibloc pressure transmitters for the two Zhangzhou units. As part of the contract, Rolls-Royce will provide more than 200 Bibloc safety-classified pressure transmitters and the associated accessories such as cables, connections, and electronics. Including this latest installation, these transmitters will now be in place on 36 nuclear reactors in China.

■ **Jacobs** was selected by the United Kingdom Atomic Energy Authority (UKAEA) to support research into nuclear fusion and related technologies, the company announced on September 30. Under the engineering, design, and build framework for electrical assemblies, Jacobs will support UKAEA's research and development work in the Remote Applications in Challenging Environments facility at Culham Science Centre in Oxfordshire, England. Work will include engineering design and installation of control panels, safety interlock panels, and wiring looms for a control cubicle to support the testing of a new range of actuators being developed by UKAEA.

Jacobs was also awarded a contract under the UKAEA's Engineering Design Services Framework to provide technical and specialist nuclear services across a broad portfolio of fusion-related programs.

■ The Department of Energy on September 29 awarded a contract to Richland, Wash.–based **Hanford**

Industry continues

Laboratory Management and Integration (HLMI) that will provide analytical laboratory services at the Hanford Site in southeastern Washington. The HLMI members are **Navarro Research and Engineering** (Oak Ridge, Tenn.) and **Advanced Technologies and Laboratories International** (Gaithersburg, Md.). The cost-plus-award fee small business contract is valued at approximately $389 million with a five-year base period and two one-year option periods. HLMI will have the sole responsibility to operate, manage, and maintain the 222-S Hanford laboratory complex.

■ **Candu Energy** has been awarded a $6.9 million multiyear contract to support **Bruce Power**'s primary heat transport system's pump seal maintenance program through 2023, Candu's parent company, SNC-Lavalin, announced on September 9. The ongoing effort includes working with support from Canadian Nuclear Laboratories and with the supply chain to improve economies of scale associated with the long-term plan to lower costs. The CAN-series pump seals have been installed in a number of CANDU stations, including all eight units at Bruce Power.

■ **Savannah River National Laboratory** announced on September 15 that it had two proposals totaling $3.8 million selected by the Department of Energy's Advanced Research Projects Agency–Energy (ARPA-E) for the development of transformational technology that will enable a sustainable fuel cycle for commercial fusion reactors.

The first project, a collaborative effort with Clemson University and the University of South Carolina, takes on the challenge of moving tritium gas at high flows through the fusion plant using vacuum pumps. The three-year project, if successful, will meet ARPA-E's targets for a fusion power plant and will reduce pump operational costs at fusion facilities from an estimated $14.5 million a year to $103,000. It would also reduce pump electric power consumption by a factor of 10, from an estimated 2.8 megawatts to 0.25 megawatts annually.

The second three-year project focuses on the portion of the fuel cycle known as breeding, where the fusion power plant will generate its own tritium fuel through the interaction of neutrons with lithium. This process intensification has the potential to reduce tritium extraction costs from $1,500 a gram to $0.04 a gram and diminish the facility footprint required from 55,000 square feet to slightly more than 100 square feet. The three-year project will scale up the process from the demonstrated proof of concept to an intermediate scale, demonstrating viability for further fusion-relevant application.

■ **Exitech Corporation** of Maryville, Tenn., announced on September 1 that it has been awarded a long-term contract by the Nuclear Regulatory Commission to provide support services for the NRC Technical Training Center Configuration Control Program at its Technical Training Center in Chattanooga. The scope of work includes hardware and software maintenance and upgrades, as well as procurement assistance, associated with six full-scope nuclear plant simulators. Exitech will staff the training facility and provide on-call assistance from its offices in Maryville and St. Marys, Ga.

■ **Unison**, a provider of acquisition management software and insight to government agencies, program offices, and contractors, announced on September 1 that the Nuclear Regulatory Commission has awarded a General Services Administration Federal Supply Schedule task order to Unison for an acquisition management solution. The task order has a three-month base period plus four one-year option periods. Under this task order, Unison will provide the NRC with a full suite of Unison products. In addition, Unison is providing two "bots" from the stable of Unison's machine learning robotic apps: the Automated Closeout Bot, which will allow the NRC to reduce its backlog of contracts ready for closeout, and the data validation engine, which will automate configurable rules for improved data quality and accuracy.

ACTIONS

Standards published, approved

The following standards have been approved:

■ ANSI/ANS-6.6.1–2015 (R2020), *Calculation and Measurement of Direct and Scattered Radiation from LWR Nuclear Power Plants* (reaffirmation of ANSI/ANS-6.6.1–2015).

This standard defines calculational requirements and discusses measurement techniques for estimates of dose rates near light-water reactor nuclear power plants due to direct and scattered gamma-rays from contained sources on-site. On-site locations outside of plant buildings and locations in the off-site unrestricted area are considered. The standard includes normal operation and shutdown conditions but does not address accident or normal operational transient conditions.

■ ANSI/ANS-8.27–2015 (R2020), *Burnup Credit for LWR Fuel* (reaffirmation of ANSI/ANS-8.27–2015).

This standard provides criteria for accounting for reactivity effects of fuel irradiation and radioactive decay in criticality safety control of storage, transportation, and disposal of commercial LWR UO_2 fuel assemblies. This standard assumes that the fuel and any fixed burnable absorbers are contained in an intact assembly. Additional considerations could be necessary for fuel assemblies that have been disassembled, consolidated, damaged, or reconfigured in any manner.

Published

The following standards have been published:

■ ANSI/ANS-2.27–2020, *Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments* (revision of ANSI/ANS-2.27–2008; R2016).

This standard provides requirements and recommended practices for conducting investigations and acquiring data sets needed to characterize seismic sources for probabilistic seismic hazard analysis of both vibratory ground motion and permanent tectonic surface deformation. The data sets provide information for site response and soil structure interaction effects needed for the design of nuclear facilities. The data sets are also used to evaluate other seismically induced ground failure hazards (e.g., liquefaction, ground settlement, slope failure).

■ ANSI/ANS-2.29–2020, *Probabilistic Seismic Hazard Analysis* (revision of ANSI/ANS-2.29–2008; R2016).

This standard provides criteria and guidance for performing a probabilistic seismic hazard analysis that is used in the design and construction of nuclear facilities, i.e, facilities that store, process, test, or fabricate radioactive materials in such form and quantity that a nuclear risk to the workers, to the off-site public, or to the environment may exist. These include, but are not limited to, nuclear fuel manufacturing facilities; nuclear material waste processing, storage, fabrication, and reprocessing facilities; uranium enrichment facilities; tritium production and handling facilities; radioactive materials laboratories; and nuclear reactors.

Volunteer support needed

The following standards projects are in need of volunteer support. Interested individuals should contact standards@ans.org for more information.

■ ANS-2.32, *Guidance on the Selection and Evaluation of Remediation Methods for Subsurface Contamination* (development of new standard).

■ ANS-2.35, *Guidelines for Estimating Present and Projecting Future Socioeconomic Impacts from the Construction, Operations, and Decommissioning of Nuclear Sites* (development of new standard).

■ ANS-56.1, *Containment Hydrogen Control* (development of new standard).

■ ANS-56.2, *Containment Isolation Provisions for Fluid Systems after a LOCA* (historical revision of ANS-56.2–1989 [W1999]).

Opinion

ANEEL: Thorium-based reactor fuel could support a new wave of nuclear power

For decades, nuclear engineers have dreamt up new formulas, shapes, and sizes for the radioactive fuel that powers the reactors of the world's nuclear power plants (our greatest source of zero-carbon electric power). Today, most of what's used for reactor fuel is enriched uranium. In the future, fuel compositions could shift toward the very promising element thorium.

A potential breakthrough: The Department of Energy, Idaho National Laboratory, and the Nuclear Engineering and Science Center at Texas A&M University have partnered with Clean Core Thorium Energy (CCTE) to fabricate a new type of nuclear fuel, called Advanced Nuclear Energy for Enriched Life, or ANEEL.

With a proprietary combination of thorium and uranium, particularly high-assay low-enriched uranium, or HALEU, ANEEL fuel can address several issues that have plagued nuclear power—cost, proliferation, and waste. Plus, this fuel, being made in the United States, positions it as a prime candidate for export to emerging nuclear markets.

So developing new technologies, especially advanced fuels, is critical for this deployment. The ANEEL fuel can be used in traditional boiling water and pressurized water reactors, but it really shines when used in heavy-water reactors, like the Canada deuterium uranium (CANDU) reactor and the pressurized heavy-water reactor (PHWR). More importantly, it can be developed and deployed rather quickly. CCTE plans to go to market with this technology by 2024.

"Today, emerging countries and their citizens, ever hungry for the power needed to drive the engines of progress and prosperity, need an abundant and uninterruptible source of clean baseload power. This solution must address multiple key barriers, including cost, efficiency, and sustainability," says Mehul Shah, chief executive officer and founder of CCTE. "The urgency of realizing such a vision becomes even more critical as time is lost in the face of an accelerating climate crisis."

The CANDU and PHWR reactors

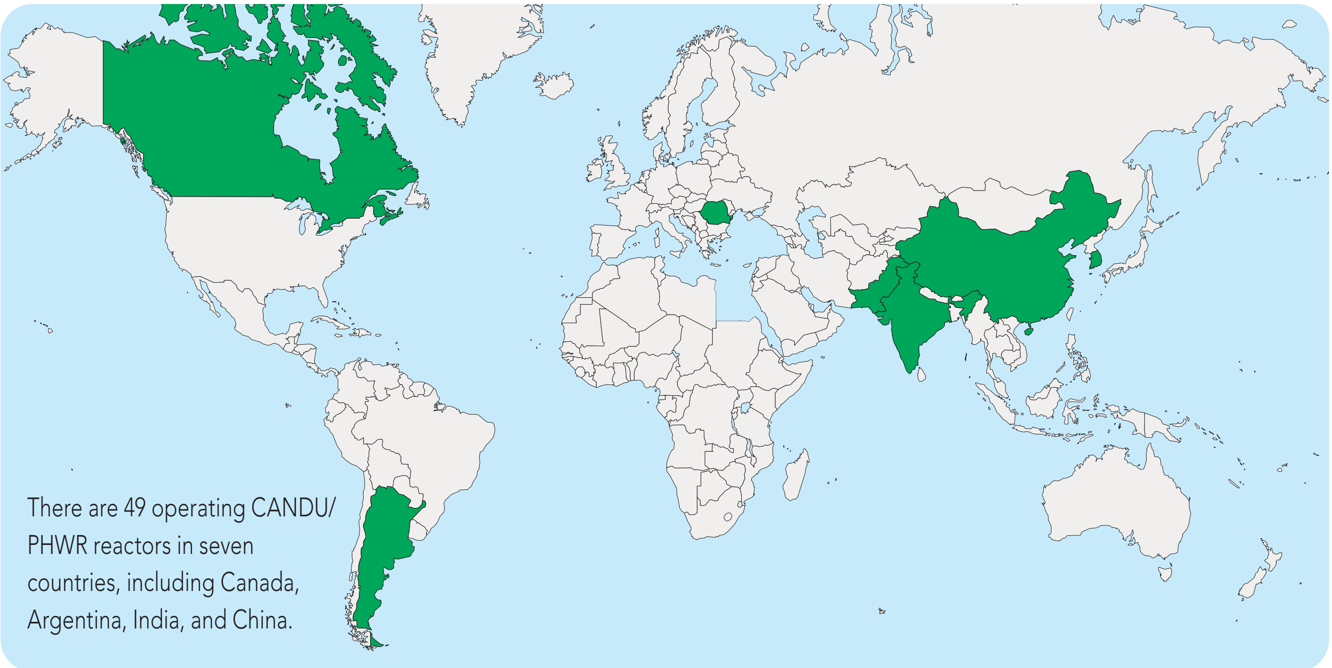
The CANDU reactor was developed in the 1950s in Canada and more recently has appeared in India as the PHWR. These reactors are heavy-water cooled and moderated pressurized water reactors.

This CANDU/PHWR nuclear fuel bundle is identical to the CCTE new ANEEL fuel bundle but with a different composition of U/Th. The bundle is 50 cm long and 10 cm in diameter. Photo: Coddie/Dreamstime.com

CANDU/PHWRs are well established small and medium reactors. All 19 of Canada's nuclear reactors are of the CANDU design. Other nations with CANDU reactors include Argentina, China, India, South Korea, Pakistan, and Romania. India has 18 PHWRs that are based on the CANDU design. The nearly 50 CANDU and PHWR reactors in service comprise roughly 10 percent of reactors worldwide.

Currently, 30 countries are considering, planning, or starting nuclear programs, and an additional 20 countries, most of which are developing countries, have expressed an interest in launching a nuclear program in the future. The CANDU/PHWR is an optimal reactor choice for developing nations, when equipped with the right fuel.

CANDU/PHWRs generally use natural uranium (0.7 percent



uranium-235) oxide as fuel, so they need a more efficient moderator. In this case, these reactors use heavy water (D_2O).

In addition, the thorium in the mix has a higher melting point and lower operating temperature, which makes it inherently safer than straight uranium and more resistant to core meltdowns.

The ANEEL fuel has a very high fuel burnup rate of about 55,000 MWd/T (megawatt-days per ton of fuel) as compared to natural uranium fuel used in currently operating CANDU/PHWRs with a burnup of around 7,000 MWd/T. This is important in a few ways.

Higher burnup means that the fuel stays in the reactor longer and we get more energy out of the same amount of fuel. Also, more neutron poisons breed in over the fuel's use, including plutonium-240, -241, and -242, making the spent fuel prohibitively difficult to make into a weapon.

Also, the higher fuel burnup of ANEEL fuel will reduce waste by over 80 percent, and that waste ends up with much less plutonium because more of the plutonium is burned to make energy, simultaneously making the spent fuel proliferation resistant. Less spent fuel means less refueling, less cost, less fuel handling, and less volume to dispose of.

In addition, CANDU/PHWR reactors don't have to be shut down to refuel but can be refueled at full power. Kaiga-1 PHWR in India and Darlington-1 in Canada hold the world records for continuous operation at 962 days and 963 days of uninterrupted operation, respectively.

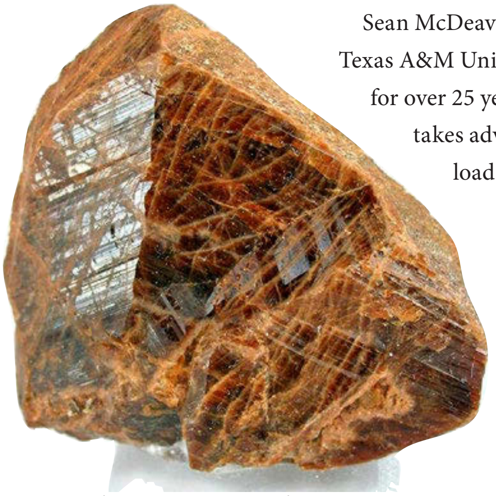
In an existing CANDU/PHWR using natural uranium, each fuel bundle weighs roughly 15 kg. After the first 150 days of operation, an average of eight such bundles would need to be replaced daily for the rest of the reactor's operating life of 60 years.

With ANEEL fuel, each fuel bundle weighs approximately 10.65 kg. After the first 1,400 days of operation, an average of only one such bundle would need be replaced daily for the remainder of the reactor's operating life, leading to significantly less waste.

The interesting thing about thorium

Like most even-numbered heavy isotopes, thorium-232 doesn't fission easily. But like nonfissile uranium-238 forming plutonium-239 through neutron absorption, which then fissions to produce energy, thorium-232 also absorbs a neutron and then quickly double beta decays to uranium-233, which then fissions to produce energy.

Opinion continues



Thorium is contained in, and produced from, the natural mineral monazite, occurring often as a sand deposit. Photo: Rob Lavinsky, irocks.com

Sean McDeavitt, nuclear engineering professor and director of the Nuclear Engineering and Science Center at Texas A&M University, notes, "I've been actively working on and around nuclear fuel behavior and applications for over 25 years. The ANEEL fuel concept integrated with the existing CANDU/PHWR reactor technology takes advantage of thorium's superior properties, performance, and abundance to generate clean baseload electricity with reduced environmental impact."

Texas A&M will fabricate the ANEEL fuel pellets at its Nuclear Engineering and Science Center and deliver them to INL. INL will conduct high-burnup irradiation testing of the ANEEL fuel pellets (up to 70,000 MWd/T) in its accelerated test rig at the Advanced Test Reactor. This will be followed by post-irradiation examination and fuel qualification, all under the stringent guidelines and quality assurance requirements of the DOE and the Nuclear Regulatory Commission.

"We look forward to supporting these efforts to develop advanced nuclear fuels," says Jess Gehin, INL chief scientist. "As the nation's center for nuclear energy research and development, INL supports industry needs with unique facilities, capabilities, and expertise."

There is well over twice as much thorium on earth as uranium. India itself has more thorium than uranium, particularly in the form of monazite sands, a reason that the country has been pursuing thorium in nuclear reactors for decades.

The geopolitical implications

The advantages of the ANEEL fuel fit several elements in the DOE's recently released report "Restoring America's Competitive Nuclear Energy Advantage," which says that nuclear power is intrinsically tied to national security.

Whenever the United States is involved in another country's nuclear program, that country signs various agreements related to security, weapons nonproliferation, and nuclear materials, including nuclear fuel. Agreements such as a 123 Agreement, and other agreements like those committing the country to forgo domestic uranium enrichment and reprocessing of spent fuel, are put in place, as well as signing the International Atomic Energy Agency's Additional Protocol, which institutes more stringent inspection regimes.

To date, the United States has entered into roughly 23 such 123 Agreements with 48 countries, including Ukraine, Morocco, Egypt, and Taiwan.

But the U.S. nuclear program has atrophied over the past few decades. At the same time, other countries have strengthened, particularly Russia and China—both of which have state-owned enterprises and are less than caring about security and environmental concerns—as well as others like South Korea, which has an industry that is government-supported in ways that just can't happen in the United States.

Having a new fuel made in America that can be used in reactors in other countries brings the United States back into play in the nuclear supply chain and allows us to reach more of the nations around the world.

With current bilateral recognition in the United States that nuclear is necessary for clean baseload energy, CCTE's ANEEL-fueled CANDU/PHWR reactors could be deployed to more emerging countries faster by easing concerns of proliferation and waste management.

And maybe we can actually decrease the amount of coal burned.

This article is republished, with minimal edits, from a blog post appearing on Forbes.com.

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The chairman of the United States Energy Association, **Sheila Hollis,** has been appointed acting executive director of USEA. Her appointment comes after the passing of longtime USEA Executive Director Barry Worthington on August 14. Hollis, who has served as USEA chairman since June 2019, was previously treasurer of the board of directors. In addition, former USEA chairman **Vicky Bailey**, who served from 2013 to 2019, was appointed to the position of executive chairperson.


Hollis


Bailey

Brian Greene has been named vice president of GSE Systems' Nuclear Industry Training and Consulting business. Greene spent more than a decade with System One in professional staffing, operating in a diverse portfolio of businesses, with a particular focus in the nuclear energy and engineering sectors.


Greene

Ken Wells has been named chief engineer of Savannah River Remediation (SRR), the liquid waste contractor at the Savannah River Site in South Carolina. Wells takes over the position previously held by Phil Breidenbach, who became SRR's president and project manager in March 2020. As chief engineer, Wells will manage, plan, and integrate all engineering services required to support SRR's liquid waste work scope.

The Nuclear Regulatory Commission has announced the selection of two senior resident inspectors and two resident inspectors. **Christopher Highley** is the new senior resident inspector at the Susquehanna nuclear power plant in Salem Township, Pa. Highley joined the NRC in late 2014 as a reactor engineer in the Division of Reactor Projects in the agency's Region I Office in King of Prussia, Pa. Since November 2015, he has served as the resident inspector at the Millstone nuclear power plant in Waterford, Conn. **Donald Krause** is the new senior resident inspector at the Diablo Canyon nuclear power plant in San Luis Obispo, Calif. Krause joined the NRC in 2014 as a reactor engineer in the NRC's Region III office in Lisle, Ill. He also served as the resident inspector at the Monticello nuclear power plant in Monticello, Minn. **Sarah Temple** was selected the resident inspector at Southern Nuclear Operating Company's Farley nuclear power plant, located near Columbia, Ala. Temple began her NRC career in 2010 as a civil engineer in the Division of Construction Inspection in the NRC Region II office in Atlanta, Ga. From 2014 until her new assignment at the Farley plant, she served as a resident inspector for construction at Vogtle-3 and -4, the two units under construction near Waynesboro, Ga. **Arthur Childs** was named resident inspector at the Waterford plant in Killona, La. Childs served six years in the U.S. Navy on the USS *Enterprise*. He worked at Sargent & Lundy as a senior associate in its nuclear technology and regulations group before joining the NRC in 2019 as a reactor engineer.


Highley

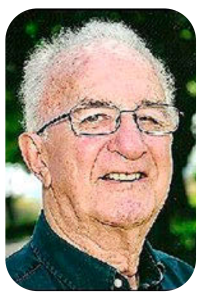

Krause


Temple


Childs

Obituaries

John H. Roecker, 85, ANS member since 1975; earned a bachelor's degree in physics from the University of Illinois at Urbana-Champaign in 1957; worked for the Atomics International Division of North American Aviation before joining Rockwell Hanford Operations at the Hanford Site near Richland,


Roecker

People continues

Wash., in 1977, serving as director of research and engineering and waste management; in 1987, took a position within Rockwell at Rocky Flats, Colo.; returned to Richland in 1990 to work for Westinghouse Hanford before retiring in 1992; worked as nuclear energy consultant to the federal government in retirement; died April 27.

Sidney M. Stoller, 95, ANS member since 1955; earned a bachelor's degree in chemical engineering from the City College of New York in 1943; established S.M. Stoller Corporation, an environmental, nuclear, and technical consulting and engineering firm in 1959, with offices in Manhattan and Boulder, Colo.; was internationally recognized in the field of nuclear power as a consultant; died October 2, 2019.

Stoller

Barbara Thomas Judge, 73, former chair of the U.K. Atomic Energy Authority (UKAEA); spent her early career in business and finance before being named to the UKAEA in 2002; was UKAEA chair from 2004 to 2010; following the Fukushima Daiichi accident in 2011, she led the safety task force of an international panel working for the Tokyo Electric Power Company; died August 31.

Judge

A. David Rossin (1931–2020)

A. David "Dave" Rossin, the 38th president of the American Nuclear Society, died on April 7 after testing positive for COVID-19. (His wife, Sandy, who also tested positive, died on April 10.) Rossin was an ANS Fellow and a charter member of ANS.

Rossin

Born on May 5, 1931, in Cleveland Heights, Ohio, Rossin graduated with a bachelor's degree in applied and engineering physics from Cornell University in 1954. That was followed by a master's degree in nuclear engineering from the Massachusetts Institute of Technology in 1955, a master's degree in business administration from Northwestern University in 1963, and a doctoral degree in metallurgy from the Case Institute of Technology (now Case Western Reserve University) in 1966.

Rossin spent the early years of his career (1955–1972) in research at Argonne National Laboratory, where he served on the laboratory's Safety Review Committee and was its chair for two years. His scientific research focused on predictions of embrittlement of nuclear reactor pressure vessel steel, and he published papers that continue to be referenced in lifetime assessments for commercial nuclear power plants.

Rossin served as director of the Nuclear Safety Analysis Center at the Electric Power Research Institute (EPRI) in California until he was appointed by President Reagan as assistant secretary for nuclear energy at the U.S. Department of Energy in 1986.

After his departure from the DOE in 1987, Rossin started a consulting firm, Rossin and Associates, in Los Alto Hills, Calif. He consulted with Lawrence Livermore, Sandia, and Los Alamos national laboratories and was a member and chair of the Diablo Canyon Independent Safety Review Committee from 1999 until 2002.

From 1996 until 2003, Rossin was a center-affiliated scholar at the Center for International Security and Cooperation at Stanford University. His research focused on the people and events that led up to the U.S. policy decision in 1977 to abandon reprocessing of spent nuclear reactor fuel. The thinking, writing, political judgments, tactical decisions, and internal negotiations that led up to the policy itself were critical in defining its form, how it was implemented, and the legislation that followed it.

Prior to joining EPRI, Rossin was with the Commonwealth Edison Company in Illinois, where he was director of research and chaired the company's Nuclear Waste Task Force.

From 1988 to 1991, he was a visiting scientist in nuclear engineering at the University of California at Berkeley, where he taught a graduate-level course on the nuclear fuel cycle.

Index to Advertisers

Since the magazine accepted its first advertisement in 1960, *Nuclear News* has proudly partnered with hundreds of vendors and organizations to help keep the worldwide nuclear field informed about the latest products and services, conferences and events, employment opportunities, and academic/training courses. If you are performing or seeking nuclear-related work, make sure advertising in our magazine is part of your business development strategy and annual budget.

View ads and request product/service information from this and past issues at: ans.org/advertising/nn/da.

Calendar

● First time listed, or significant change made.
● ■ ANS event.
● ■ Non-ANS event cosponsored by ANS.

November

■ Nov. 15–19—**2020 ANS Virtual Winter Meeting**, Virtual meeting. answinter.org

● Nov. 18–19—**International Conference on Generation IV and Small Reactors (G4SR-2)**, Virtual meeting. g4sr.org

Nov. 24–26—**9th International Conference on Nuclear Decommissioning (ICOND 2020)**, Aachen, Germany. icond.de/welcome.html

Nov. 30–Dec. 2—**12th Annual European Power Strategy & Systems Summit**, Prague, Czech Republic. europeanpowergeneration.eu

December

Dec. 7–10—**OECD/NEA Specialist Workshop on Advanced Measurement Method and Instrumentation for Enhancing Severe Accident Management in an NPP Addressing Emergency, Stabilization and Long-term Recovery Phases (SAMMI-2020)**, Virtual meeting. sammi-2020.org

Dec. 8–10—**World Nuclear Exhibition (WNE 2020)**, Villepinte, France. world-nuclear-exhibition.com

January

● Jan. 18–19—**15th International Congress of the International Radiation Protection Association (IRPA15)**, Seoul, South Korea. irpa2020.org. A virtual counterpart to this event will begin January 18 and continue through February 5.

● Jan. 28–29—**ICNETH 2021: 15. International Conference on Nuclear Engineering and Thermal Hydraulics**, Virtual meeting. waset.org/nuclear-engineering-and-thermal-hydraulics-conference-in-january-2021-in-new-york

Jan. 28–30—**11th International Conference on Future Environment and Energy (ICFEE 2021)**, Tokyo, Japan. icfee.org

Jan. 28–30—**SNMMI 2021 Mid-Winter Meeting**, Society of Nuclear Medicine and Molecular Imaging, San Francisco, Calif. snmmi.org/MeetingsEvents/Content.aspx?ItemNumber=33340

February

■ Feb. 8–11—**Conference on Nuclear Training and Education: A Biennial International Forum (CONTE 2021)**, Amelia Island, Fla., ans.org/meetings/view-331

Feb. 24–26—**International Power Summit 2021**, Virtual meeting. arena-international.com/ips

● Feb. 24–25—**8th Nuclear Decommissioning and Waste Management Summit**, London, U.K. wplgroup.com/aci/event/nuclear-decommissioning-waste-management-summit/

March

Mar. 3–4—**Maintenance in Power Plants 2021**, Karlsruhe, Germany. vgb.org/en/instandhaltung_kraftwerken2021.html

Mar. 7–11—**WM Symposia 2021**, Phoenix, Ariz. wmsym.org

Mar. 10–11—**Enlit Australia**, Melbourne, Australia. enlit-australia.com

Mar. 16–18—**The Society for Radiological Protection Annual Conference**, Bournemouth, UK. srp-uk.org/events/2020AnnualConference

Mar. 17–19—**15th International Symposium "Conditioning of Radioactive Operational & Decommissioning Wastes" (KONTEC 2021)**, Dresden, Germany. kontec-symposium.com

Mar. 21–26—**12th International Conference on Methods and Applications of Radioanalytical Chemistry (MARC XII)**, Kailua-Kona, Hawaii. marcconference.org

Mar. 25—**Nuclear Engineering for Safety, Control and Security**, Bristol, UK. events2.theiet.org/nuclear/about.cfm

Mar. 30–Apr. 1—**PowerGen International**, Orlando, Fla. powergen.com

April

■ Apr. 8–10—**ANS Student Conference**, Raleigh, N.C. ans.org/meetings/view-student2021

■ Apr. 11–15—**International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021)**, Raleigh, N.C. mc.ans.org

May

● May 3–7—**Atalante 2021**, Nimes, France. atalante2020.org/index.html

● May 10–15—**28th IAEA Fusion Energy Conference (FEC 2020)**, Nice, France. iaea.org/events/fec-2020

● May 23–26—**7th International Conference on Nuclear and Renewable Energy Resources (NURER2020)**, Ankara, Turkey. nurer2020.org/

2021 ANS Annual Meeting

June 13-17, 2021 | Omni / Convention Center | Providence, RI

CALL FOR PAPERS

EXECUTIVE CHAIRS

Technical Program Chair
Nicholas Brown (University of Tennessee, Knoxville)

SUMMARY DEADLINE: FRIDAY, FEBRUARY 5, 2021

- **FEBRUARY** → SUBMISSION OF SUMMARIES: **Friday, February 5, 2021**
- **FEBRUARY** → SUBMISSION OF DESCRIPTION AND PANELISTS/SPEAKERS FOR PREVIEW PROGRAM: **Friday, February 12, 2021**
- **FEBRUARY** → AUTHOR NOTIFICATION OF ACCEPTANCE: **Thursday, February 25, 2021**
- **MARCH** → REVISED SUMMARIES DUE: **Monday, March 15, 2021**
- **APRIL** → ANY ADDITIONAL DESCRIPTIONS AND PANELISTS/SPEAKERS FOR OFFICIAL PROGRAM: **Friday, April 2, 2021**

Although ANS is committed to providing the best in-person conferences, we all understand these are trying times. Our intention is to move forward as planned, but we may have to transition to a virtual meeting. We will keep the website updated with the most current information, and we look forward to the 2021 ANS Annual Meeting!

INTRODUCING OUR NEW EXECUTIVE TRACK

ANS is establishing a new high-level track at the national meetings in June and November. This track is designed to provide busy nuclear professionals a broader look at developments in nuclear science and technology, as well as their impact on policy and markets.

FORMAT

Authors are now REQUIRED to use the ANS Template and Guidelines for TRANSACTIONS Summary Preparation provided on the ANS Web site, ans.org/pubs/transactions. Summaries must be submitted electronically using original Microsoft Word documents and the ANS Electronic Paper Submission and Review System. Summaries not based on the ANS Template will be REJECTED.

GUIDELINES FOR SUMMARIES

Please submit summaries describing work that is NEW, SIGNIFICANT, and RELEVANT to the nuclear industry. ANS will publish all accepted summaries in the TRANSACTIONS. Papers are presented orally at the meeting and presenters are expected to register for the meeting. Non–U.S. attendees requesting a Visa or invitation letter: registrar@ans.org. Completed papers may be published elsewhere, but the summaries become the property of ANS. Under no circumstances should a summary or full paper be published in any other publication prior to presentation at the ANS meeting. It is the author's responsibility to protect classified or proprietary information.

CONTENT

1. Introduction: State the purpose of the work.
2. Description of the actual work: Must be NEW and SIGNIFICANT.
3. Results: Discuss their significance.
4. References: If any, must be closely related published works. Minimize the number of references.
5. Do not present a bibliographical listing.

LENGTH

1. The minimum length is one full page.
2. The maximum length is four pages, including references, tables, and figures.
3. Limit title to ten words; limit listing authors to three or fewer if possible.

SUBMIT A SUMMARY

epsr.ans.org/meeting

PROGRAM SPECIALIST

Janet Davis
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jdavis@ans.org

2021 ANNUAL MEETING: SESSION TITLES BY DIVISION (P) = Panel

1. AEROSPACE NUCLEAR SCIENCE AND TECHNOLOGY (ANSTD)
   - 1a. Aerospace Nuclear Science and Technology: General
   - 1b. Advances in Nuclear Propulsion Technologies
   - 1c. Advances in Space Nuclear Reactor Power
2. DECOMMISSIONING AND ENVIRONMENTAL SCIENCES (DESD)
   - 2a. Decommissioning Projects in the Northeast (P)
   - 2b. Environmental Remediation in the Northeast (P)
   - 2c. General Topics in Decommissioning and Environmental Science (P)
3. EDUCATION, TRAINING, AND WORKFORCE DEVELOPMENT (ETWDD)
   - 3a. Cutting Edge Techniques in Education, Training and Distance Education
   - 3b. Training, Human Performance and Workforce Development
   - 3c. Focus on Communications I (P)
   - 3d. Focus on Communications II (P)
   - 3e. Young Nuclear Engineering Programs: New, Embedded or Hybrid
   - 3f. ANS Nuclear Grand Challenges I
   - 3g. ANS Grand Challenges II
4. FUEL CYCLE AND WASTE MANAGEMENT (FCWMD)
   - 4a. Fuel Cycle and Waste Management: General
   - 4b. Advances in Actinide Separations
   - 4c. Research and Management of High-Level Radioactive Waste
   - 4d. Used Fuel Storage and Transportation
   - 4e. Fundamental Chemistry and Engineering Supporting Nuclear Waste Management
   - 4f. University Research in Fuel Cycle and Waste Management
   - 4g. Uranium Extraction, Purification, and Remediation
   - 4h. Experimental and Computational Molten Salt Chemistry
   - 4i. The Need for HALEU: Real or Pending (P)
   - 4j. Innovations for Ensuring Safe Extended Dry Storage (P)
   - 4k. Updates from the High Burnup Cask Demonstration Project (P)
   - 4l. Fuel Cycle Needs to Support Advanced and Small Reactors (P)
   - 4m. Closing the Fuel Cycle with Small Modular Reprocessing Facilities (P)
   - 4n. Creating Value from Waste: Recycling Valuable Isotopes for Non-Energy Applications (P)
5. ISOTOPES AND RADIATION (IRD)
   - 5a. Isotope and Radiation: General
   - 5b. The US Research and Test Reactor Fleet 2021-2040 - supporting advanced nuclear technology
6. MATERIALS SCIENCE AND TECHNOLOGY (MSTD)
   - 6a. Fuels and Materials for Molten Salt Reactors
   - 6b. In-Pile Testing of Nuclear Fuels and Materials
   - 6c. Accelerated Materials Discovery
   - 6d. Fuel Materials for Space Propulsion Reactors
   - 6e. Advanced Manufacturing/Additive Manufacturing
   - 6f. Post-Irradiation Examination
   - 6g. Sensors and In-Pile Instrumentation
   - 6h. Nuclear Science User Facilities
   - 6i. Accident Tolerant Fuels
   - 6j. Nuclear Fuels
   - 6k. Plutonium Handbook
   - 6l. Aging of Materials
   - 6m. Materials for Small Modular Reactors and Transformational Challenge Reactor
   - 6n. Fuels and Materials for Micro-reactor applications
7. MATHEMATICS AND COMPUTATION (MCD)
   - 7a. Current Issues in Computational Methods–Roundtable (P)
   - 7b. Transport Methods
   - 7c. Computational Methods and Mathematical Modeling
   - 7d. Uncertainty Quantification and Sensitivity Analysis
   - 7e. Advances in Machine Learning and Artificial Intelligence
8. NUCLEAR CRITICALITY SAFETY (NCSD)
   - 8a. Data, Analysis and Operations in Nuclear Criticality Safety
   - 8b. Sharing of Good Industry Practices and/or Lessons Learned in Nuclear Criticality Safety
   - 8c. An International Perspective on Nuclear Criticality Safety Standards (P)
   - 8d. OECD NEA Programs Related to Criticality Safety (P)
   - 8e. Advanced Session on Impact of Chemistry on Nuclear Criticality Safety Evaluations
   - 8f. NCS of Advanced Fuel Cycles, LEU+ (~8-10%) or HALEU (<20% Triso)
   - 8g. Fundamental physics of NCS
   - 8h. NCS Qualification at different sites
   - 8i. ANS-8 Standards Forum
9. NUCLEAR INSTALLATIONS SAFETY (NISD)
   - 9a. Technical Issues Faced in the Non-LWR PRA Standard Development (P)
   - 9b. Nuclear Installations Safety: General
   - 9c. Current Topics in Probabilistic Risk Analysis
   - 9d. Safety and Security Challenges for Micro-reactors
   - 9e. RIPB Approaches for Non-LWR External Hazards (P)
10. NUCLEAR NONPROLIFERATION POLICY (NNPD)
    - 10a. Technology and Policy Advancements in Nuclear Nonproliferation
    - 10b. International Safeguards and Treaty Verification
11. OPERATIONS AND POWER (OPD)
    - 11a. Operations and Power: General
    - 11b. Advanced Nuclear Reactors and Power Systems
    - 11c. Energy Storage Integration with Nuclear Power Plants
    - 11d. Hybrid and Integrated Energy Systems
12. RADIATION PROTECTION AND SHIELDING (RPSD)
    - 12a. Dosimetry and Shielding for Accelerator Facilities
    - 12b. Radiation Protection and Shielding General
    - 12c. Radiation Detection for Homeland Security
    - 12d. CAD-to-Transport for Radiation Protection and Shielding
    - 12e. Computational Methods in Radiation Protection and Shielding
    - 12f. Artificial Intelligence in Radiation Protection and Shielding
13. REACTOR PHYSICS (RPD)
    - 13a. Reactor Physics: General
    - 13b. Reactor Analysis Methods
    - 13c. Reactor Physics Design, Validation and Operational Experience
    - 13d. Reactor Physics of Micro Reactors for Terrestrial and Space Applications
    - 13e. Reactor Physics of Advanced Reactors
    - 13f. Advances in Reactor Design Methods
    - 13g. Versatile Test Reactor - Current Developments
    - 13h. Versatile Test Reactor - Current Developments (P)
    - 13i. Current Issues in LWR Core Design and Reactor Engineering Support
    - 13j. Transformational Challenge Reactor - Current Developments
    - 13. Transformational Challenge Reactor - Current Developments (P)
    - 13l. Calculations of Energy Deposition in Nuclear Reactors
    - 13m. Machine learning and Artificial Intelligence in reactor physics and design
    - 13n. Machine learning and Artificial Intelligence in reactor physics and design (P)
    - 13o. NuSTEM: Nuclear Science, Technology and Education for Molten Salt Reactors
    - 13p. NuSTEM: Nuclear Science, Technology and Education for Molten Salt Reactors (P)
    - 13q. Education in Criticality Evaluations and Reactor Physics (P)
14. ROBOTICS AND REMOTE SYSTEMS (RRSD)
    - 14a. Robotics and Remote Systems Development for the Nuclear Industry
15. THERMAL HYDRAULICS (THD)
    - 15a. Two-phase flow and heat transfer fundamentals
    - 15b. Computational Thermal Hydraulics
    - 15c. General Thermal hydraulics
    - 15d. Experimental Thermal Hydraulics
    - 15e. Thermal Hydraulics Research and Development in the Versatile Test Reactor
    - 15f. Challenges and Opportunities in Thermal Hydraulics of Load-Following Nuclear Systems (P)
    - 15g. Thermal-hydraulics research in ARPA-E programs (P)
    - 15h. Thermal-hydraulics for advanced reactors
    - 15i. Thermal-hydraulics research in TCR
    - 15j. Thermal Hydraulic R&D Activities in Printed-Circuit Steam Generators for Advanced Nuclear Reactors
    - 15k. Machine Learning for nuclear thermal-hydraulics

2021 ANNUAL MEETING: TECHNICAL DIVISIONS

AEROSPACE NUCLEAR SCIENCE AND TECHNOLOGY (ANST)
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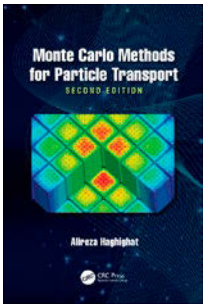
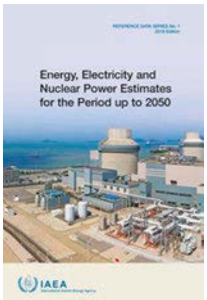
Timothy Crook, timothy.m.crook@gmail.com
Matt Wargon, mdwargon@gmail.com

Publications

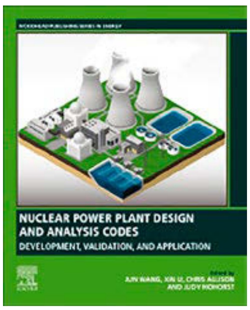
Recently Published



Monte Carlo Methods for Particle Transport, second edition, by Alireza Haghighat. This edition is fully updated with the latest developments in the eigenvalue Monte Carlo calculations and automatic variance reduction techniques and contains a new chapter on fission matrix and alternative hybrid techniques. It explores the uses of the Monte Carlo method for real-world applications, explaining its concepts and limitations. Featuring illustrative examples, mathematical derivations, computer algorithms, and homework problems, this textbook is a practical guide for nuclear engineers and scientists looking into the applications of the Monte Carlo method, as well as students in physics and engineering and those engaged in the advancement of the Monte Carlo methods. (310 pp., HB, $130, ISBN 978-0-367-18805-4. Order from Routledge/CRC Press: routledge.com/our-products/books.)



Energy, Electricity and Nuclear Power Estimates for the Period up to 2050, 2020 edition, from the International Atomic Energy Agency. The 40th edition of the annual Reference Data Series No. 1 contains estimates of energy, electricity, and nuclear power trends up to the year 2050. The publication is organized into world and regional subsections, with global and regional nuclear power projections presented as low and high cases, encompassing the uncertainties inherent in projecting trends. (137 pp., PDF, €20 [about $24], ISBN 978-92-0-118120-6. Order from the IAEA: iaea.org/publications.)



Nuclear Power Plant Design and Analysis Codes: Development, Validation, and Application, edited by Jun Wang, Xin Li, Chris Allison, and Judy Hohorst. This book presents the latest research on the most widely used nuclear codes and the wealth of successful accomplishments that have been achieved over the past decades by experts in the field. The editors and their team of authors provide readers with a comprehensive understanding of nuclear code development and how to apply it to their work and research to make their energy production more flexible, economical, reliable, and safe. This book benefits those working in nuclear reactor physics and thermal hydraulics, as well as those involved in nuclear reactor licensing. It also provides early career researchers with a solid understanding of fundamental knowledge of mainstream nuclear modeling codes, as well as more experienced engineers seeking advanced information on the best solutions to suit their needs. (410 pp., PB, $240, ISBN 978-0-12-818190-4. Order from Woodhead Publishing: Elsevier.com/books.)

The Bridge: Nuclear Energy Revisited, Fall 2020, National Academy of Engineering. This edition of *The Bridge* focuses on nuclear energy. The desire to reduce the carbon intensity of human activities and strengthen the resilience of infrastructure key to economic prosperity and geopolitical stability shines a new spotlight on the value and challenges of nuclear energy. Nuclear-related articles include "Sustaining the Value of the U.S. Nuclear Power Fleet," "The Case for Nuclear as a Low-Carbon, Firm, Widely Available Energy Source," and "Managing Drivers of Cost in the Construction of Nuclear Plants." (92 pp., ISSN 0737-6278. Download free PDF at nae.edu/theBridge.)

ANS Technical Journals

FUSION SCIENCE AND TECHNOLOGY • OCTOBER 2020

Two-Gaussian Fitting Method for Charge Exchange Spectroscopy on Measurements of Ion Temperature and Toroidal Plasma Flow Velocity in the KSTAR Tokamak *H. H. Lee et al.*

Material Characterization of Hierarchical Tunable Pore Size Polymer Foams Used in the MARBLE Mix Morphology Experiment *T. Cardenas et al.*

A Fusion Reactor Scheme Using Magnetic Mirrors *E. Mazzucato*

Comparison of Shadowgraphy and X-Ray Phase Contrast Methods for Characterizing a DT Ice Layer in an Inertial Confinement Fusion Target *D. R. Harding et al.*

Shatter Thresholds and Fragment Size Distributions of Deuterium–Neon Mixture Cryogenic Pellets for Tokamak Thermal Mitigation *T. E. Gebhart et al.*

Fusion–Fission Hybrid Systems: Yesterday, Today, and Tomorrow *B. V. Kuteev, P. R. Goncharov*

Structural Design for ITER Gas Injection System Gas Fueling Gas Valve Box *Z. W. Xia et al.*

Preliminary Experimental Results of Shattered Pellet Injection on the HL-2A Tokamak *H. B. Xu et al.*

Tritium Effects on Aromatic Carbon–Loaded Polymers *D. Hitchcock et al.*

Preliminary Safety Analysis of Tritium Source Term for the CFETR Tritium Plant *S. Wei et al.*

NUCLEAR SCIENCE AND ENGINEERING • NOVEMBER 2020

Selected papers from M&C 2019

Nonlinear Elimination Applied to Radiation Diffusion *T. A. Brunner et al.*

Toward Asymptotic Diffusion Limit Preserving High-Order, Low-Order Method *H. Park*

Ray Effect Mitigation for the Discrete Ordinates Method Using Artificial Scattering *M. Frank et al.*

Parallel Approximate Ideal Restriction Multigrid for Solving the SN Transport Equations *J. Hanophy et al.*

Threadsafe Dynamic Neighbor Lists for Monte Carlo Ray Tracing *S. M. Harper et al.*

serpentTools: A Python Package for Expediting Analysis with Serpent *A. E. Johnson et al.*

Multigroup Constant Calculation with Static α-eigenvalue Monte Carlo for Time-Dependent Neutron Transport Simulations *I. Variansyeh et al.*

Generalized Equivalence Theory Used with Spatially Linear Sources in the Method of Characteristics for Neutron Transport *G. Giudicelli et al.*

Assessment of nTRACER and PARCS Performance for VVER Configurations *M. Papadionysiou et al.*

Neutronic Simulation of Fuel Assembly Vibrations in a Nuclear Reactor *A. Vidal-Ferràndiz et al.*

Sensitivity and Uncertainty Analysis of Neutron Spectrum and DPA in a B&B Core *C. Keckler et al.*

Data Assimilation Using Subcritical Measurement of Prompt Neutron Decay Constant *T. Endo, A. Yamamoto*

NUCLEAR TECHNOLOGY • NOVEMBER 2020

Special issue on Salt-Cooled Reactors

A Critical Review of Fluoride Salt Heat Transfer *K. Britsch, M. Anderson*

Heat-Pipe Heat Exchangers for Salt-Cooled Fission and Fusion Reactors to Avoid Salt Freezing and Control Tritium: A Review *B. Zohuri et al.*

Market Basis for Salt-Cooled Reactors: Dispatchable Heat, Hydrogen, and Electricity with Assured Peak Power Capacity *C. W. Forsberg*

A Stylized 3-D Benchmark Problem Set Based on the Pin-Fueled SmAHTR *K. L. Reed et al.*

Steady-State Thermal-Hydraulic Model for Fluoride-Salt-Cooled Small Modular High-Temperature Reactors *S. Chandrasekaran, S. Garimella*

Convective and Radiative Heat Transfer in Molten Salts *S. Zhang, X. Sun*

Power Profile Reconstruction and Anomaly Detection Approach for FHRs Using Cerenkov Radiation *J. A. Hearne, P. V. Tsvetkov*

Corrosion Behavior of Pre-Carburized Hastelloy N, Haynes 244, Haynes 230, and Incoloy 800H in Molten FLiNaK *K. J. Chan, P. M. Singh*

Electrochemical Separation of Lanthanum Oxide in Molten FLiNaK Salt *Q. Yang et al.*

Fusion Blankets and Fluoride-Salt-Cooled High-Temperature Reactors with Flibe Salt Coolant: Common Challenges, Tritium Control, and Opportunities for Synergistic Development Strategies Between Fission, Fusion, and Solar Salt Technologies *C. Forsberg et al.*

What’s your reaction to recent events surrounding racial justice?

Warren “Pete” Miller

Dr. Miller is retired from Los Alamos National Laboratory, served as U.S. Assistant Secretary for Nuclear Energy, and is presently Professor of Practice at Texas A&M University.

I am emboldened by the recent events and think that the nuclear community has a chance to embrace these changes to become an inclusive and anti-racist community.

I lived through times in which there was overt, unhidden, direct racism directed to people of color. For example, when I was a cadet at West Point in the 1960s, white cadets came into my room to intimidate me with robes and torches. It was very direct, and it was everything I could do to graduate from West Point and become an officer. Then after the civil rights movement, there was a period of affirmative action. During that period, I became a wanted commodity. People wanted to have a diverse workforce, and in the nuclear community there were few people of color. I eventually became a deputy lab director for science and technology under Director Sig Hecker. I am not so humble as to attribute all of my success to affirmative action, but I’d like to think that my advancement was merit-based, too. Sig has confirmed that to me many times. Then there was a period where affirmative action had a bad name, a time in which it was easy to fall back to old habits. There was not much overt racism like when I first started out, but there was a new unconscious racism.

I think we are at a crossroads now, though, and there is an opportunity to leap in a new direction. I want to be able to go up to a young African American and say, “You ought to become a nuclear engineer—you will be solving problems of energy, climate change, desalination, and powering spacecraft. Nuclear is very exciting and very important for our future. Plus, we are in a new era for people of color in our community. The nuclear community is moving rapidly toward being an anti-racist place. In this community, your white colleagues have your back. They are out there protesting injustices and encouraging STEM education in communities of color. This community is making a difference both in the challenges facing our society and in creating a truly inclusive workplace.”

We need to strive to be that kind of community. I want to be able to honestly give such a sales pitch to a Black student. I think that if that message reflected our reality, we would have lots of African Americans applying in the nuclear community, but that’s not our image yet.