MATTER

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Fall 2026



Advanced Manufacturing Innovations

PAGE 10

All About Grout

PAGE 7

Keeping the Grid Online

PAGE 14

Savannah River National Laboratory®



The Advanced Manufacturing Collaborative celebrated its one year anniversary in August. Left: The AMC exterior. Right: AMC Director Jeremy Leong meets with researchers in the High Bay laboratory. (Photos: SRNL staff)

Cover: An additively manufactured copy of the SRNL logo. (Photo: LJ Gay, SRNS)

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From the Director

As our nation commemorates America 250 this year, we have an opportunity to reflect on what has always helped move the country forward: innovation, service and a commitment to solving challenges that make an impact.

At Savannah River National Laboratory, that mission is part of our daily work. Whether we are advancing technologies that strengthen national security, support environmental stewardship, or enhance energy resilience, our focus remains the same, delivering science and engineering solutions that help meet the nation's most pressing needs.

This issue of Matter Magazine highlights several examples of that mission that drives us.

You'll read how SRNL is advancing super intelligence to address some of the nation’s toughest clean up challenges as part of the Department of Energy’s Genesis Mission. We also dive into how our grout and cement technologies are helping to ensure the safe and efficient storage of nuclear materials, supporting a critical national responsibility. You'll learn how our Advanced Technology Proving Ground is focused on accelerating the deployment of critical solutions that will improve grid resilience and strengthen America's energy infrastructure. We also spotlight the exceptional talent of our early career researchers and scientists and how they are sharing their technical research so it’s more accessible to the broader public.

In addition, this issue celebrates SRNL’s Advanced Manufacturing Collaborative’s one-year Anniversary and explores how SRNL is helping advance additive manufacturing capabilities and developing automation technologies that improve worker safety. These stories highlight how we are applying science, technology and innovation to solve real-world challenges, while creating lasting value for our nation.

As we celebrate America's 250th Anniversary, I'm reminded that the strength of our country has always been built on the willingness of people to tackle difficult problems, pursue new ideas and serve something larger than themselves. I see that spirit every day at SRNL. Thank you for your continued interest in the work of our laboratory and the people behind it. I hope you enjoy this issue of Matter Magazine.



Johney Green

Laboratory Director

CONTENTS

FEATURES



SRNL's Grout and Cement Technologies Ensure Safe and Efficient Nuclear Material Storage

SRNL's grout science expertise is paving the way for safe nuclear waste disposal, a critical step in powering America's nuclear renaissance.

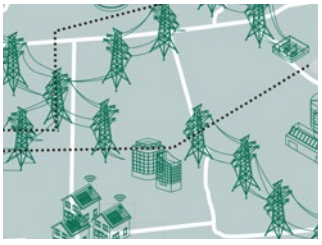
PAGE 7



How Savannah River National Laboratory is Supporting Additive Manufacturing

Researcher Samuel Leguizamon is leveraging additive manufacturing to revolutionize nuclear fuel fabrication, fusion energy research, and materials recovery—building innovative solutions layer by layer.

PAGE 10



Advanced Technology Proving Ground Accelerates Grid Resilience

SRNL's Advanced Technology Proving Ground combines high-voltage testbeds, SI-driven digital twins, and quantum computing to tackle one of the nation's biggest challenges: protecting America's electrical grid.

PAGE 14



Research SLAM Highlights SRNL's Early Career Talent

The annual Research SLAM challenges early career scientists to distill complex research into three-minute, jargon-free presentations—launching careers and earning national recognition along the way.

PAGE 17



Developing Automation to Improve Worker Safety

SRNL is integrating robotic arms into nuclear gloveboxes, reducing radiation exposure and repetitive injury risks while modernizing plutonium handling for safer, more efficient operations.

PAGE 20



Q&A with G. Jeremy Leong

G. Jeremy Leong is the research director at SRNL's new Advanced Manufacturing Collaborative, a 63,000 square-foot facility on the campus of the University of South Carolina Aiken.

PAGE 23

Also in this issue

Director's Note	PAGE 3
Genesis Mission	PAGE 6

Find the latest news and more at srnl.gov.

SRNL Leans into Genesis Mission

by Kent Cubbage and Catelyn Folkert

Savannah River National Laboratory was awarded funding from the Department of Energy's groundbreaking Genesis Mission initiative, leveraging SRNL's expertise in super intelligence for environmental cleanup to drive a paradigm shift in restoration and revitalization.

The SRNL-led projects directly support critical national security and environmental stewardship goals for both DOE's Office of Environmental Management and the National Nuclear Security Administration (NNSA). By uniting over 70 years of knowledge and capabilities in nuclear sciences with its unique, site-specific datasets, the laboratory is developing first-of-its-kind super intelligence (SI) models. These tools are designed to solve complex challenges in environmental remediation, waste management, and infrastructure resilience—ultimately safeguarding national security assets while yielding over $150 billion in lifecycle cleanup savings.

These projects include:

- The VITA-SCALE project, led by Nathan Morgan and includes Gene Ramsey, Mike Stone and partnerships with ORNL, PNNL, NVIDIA, and PrimaLabs, leverages physics-based SI to accurately predict how nuclear waste behaves during vitrification at full scale. Vitrification, the process of converting waste materials into glass, is used by DOE for long-term storage. VITA-SCALE overcomes the limitations of small-lab analyses and steady-state models, and accelerates DOE cleanup, reduces costs, and improves safety with plans to open-source its models for broader innovation.
- The SCOPE project, led by Tom Danielson and includes Wesley Woodham and partnerships with ORNL, PNNL, NVIDIA, and PrimaLabs, uses super intelligence, chemistry and physics-based modeling to more accurately predict the behavior of radioactive liquid waste during treatment. This improved understanding can help prevent costly process disruptions, such as unexpected solids formation, reducing operational risk while improving process efficiency.
- SRNL will also partner on a project called WASTECHAT, which is the first tool towards a domain foundational model for DOE-EM led by Pacific Northwest National Laboratory, and a project led by Vanderbilt University to develop an SI-informed, standards-based, model-based systems methodology to enhance fusion power plant life-cycle engineering. Tom Danielson is a principal investigator on the first project, and Luke Olson on the second.

Launched by Executive Order, the Genesis Mission is a nationwide effort to leverage advanced SI technologies to accelerate scientific breakthroughs, enhance national security, and advance energy innovation. The initiative seeks to build a unified platform that brings together resources, facilities, SI systems, and datasets across key scientific fields, with the goal of doubling the productivity and impact of U.S. research and innovation over the next decade.

As one of 17 national laboratories mobilized for this historic endeavor, SRNL brings decades of expertise in nuclear materials management, environmental cleanup, national security, and advanced chemical processing to the Genesis Mission. SRNL researchers and their partners are committed to driving the development of SI models to accelerate research and development in key national mission areas.

The Genesis Mission exemplifies the spirit of discovery and collaboration that defines SRNL. Together, we are advancing the solutions that will define the next era of innovation.

SRNL's Grout and Cement Technologies Ensure Safe and Efficient Nuclear Material Storage

by Catelyn Folkert



Researcher Will Jolin displays a chunk of grout made by his team. (Photo: Brad Bohr, SRNS)



Above, right: Katie Hill prepares grout in the SRNL lab. (Photo: Brad Bohr, SRNS)

Executive Order 13972 was issued in January of 2021 and presented a call to action for the development of small modular nuclear reactors to help ensure the nation's energy flexibility and security. An additional series of executive orders issued in May of 2025 targeted the revitalization of nuclear energy efforts across the United States in a "nuclear renaissance," including the goal of quadrupling the nation's nuclear power output by 2050. SMRs will be a vital component of this effort. SMRs function similarly to traditional nuclear reactors, but their smaller size and modularity allow them to be integrated into existing power grids or be deployed into remote locations.

Critical to this bold initiative is the advancement of the nuclear fuel supply and its reprocessing. Savannah River National Laboratory is positioned to lead the way in these areas. Drawing upon its many decades of world-class experience in the nuclear world, SRNL is providing innovative materials for fuel fabrication, such as High-Assay Low Enriched Uranium.

While SRNL is fueling the nuclear movement, its expertise in waste nuclear material decommissioning is equally as important. Some of the used nuclear fuel can be reprocessed back into usable nuclear fuel, but some cannot. Environmental considerations for handling and disposing of materials that cannot be reprocessed into additional fuel must be made before SMRs and additional reactors can be brought online.

SRNL's unique capabilities in grout science offer a cost-effective approach to accomplish this. Grout science is the study of cementitious (cement-like) material that can be used for in-place site decommissioning or nuclear waste tank closure across the Department of Energy complex and beyond. Grout is used to create barrier walls around waste material. The main difference between grout and household concrete found in roadways and sidewalks is the absence of aggregate, gravel and stone, in grout. The grout must be a flowable material that can hold as much waste as possible to immobilize and safely store . The waste first gets mixed with cementitious materials - then the grout is added. Any formulation of grout is assessed to determine its useful lifespan, which is usually 500-1,000 years, and possibly more.

SRNL has played a leading role in the study of grout-based waste forms, starting in the 1980s with the Saltstone Production Facility and the Saltstone Disposal Units on the



Savannah River Site in Aiken, SC. The Saltstone Production Facility mixes decontaminated salt waste from the Salt Waste Processing Facility with cementitious materials (blast furnace slag and fly ash) and transfers the treated waste to the SDU. SDUs are massive concrete structures each holding up to 33 million gallons of grout waste in perpetuity. SRNL developed the original grout recipe used at these SRS facilities in conjunction with SRS Liquid Waste Operations. SRNL also developed the clean grout fill for the first million-gallon nuclear waste tank closures in 1997.

The lab has a multitude of talented grout scientists to develop and implement its many uses. "I got into grout science in my post doc days by looking at the interaction of radionuclides and concrete," said SRNL Grout and Cementitious Materials group manager Will Jolin. "After coming to SRNL, I wanted to understand the possibilities within grout to address storage and transport concerns for contaminants and bad constituents. As an environmental engineer, my focus has been on the safety and security of people and the environment we live in. I'm drawn to grout because of its nature as a sound and secure waste form."

Nuclear energy applications result in various types of waste, typically categorized as low- or high-level waste. Because the radioactive materials within the waste cannot be completely removed, processes and techniques were developed to convert liquid waste into safer forms for long-term storage. This effort protects the environment from spills and leaching and makes tank closure possible. High-level waste is only addressed through vitrification, which immobilizes the radioactive materials within a glass structure.

Much of SRNL's grout work involves technology development beneficial for current and future nuclear power applications, but this can also be used at medical and isotope production facilities and defense programs. There are numerous other potential applications for the cementitious materials developed at SRNL. Because grout provides technology to process the dregs from other processes that do not require vitrification, it serves as a safe and reliable solution to a developing waste supply in the US. A current effort to help support DOE's Hanford Site Washington includes analysis of cementitious reactions within glasses to address future waste forms.

The national supply of fly ash, a powdery residue produced by coal plants and typically used as a pozzolanic (silica- and aluminum-containing) material in concrete, is limited. SRNL is exploring natural pozzolans, a material that reacts chemically with calcium hydroxide and develops cementitious properties, to determine viability as a fly ash replacement.

SRNL is also considering potential applications of grout science to support the Genesis Mission. The potential development of a virtual cement laboratory could streamline the identification process for constituents through super intelligence to create new grout recipes.

"SRNL has the expertise from a long history to solve forward-facing problems in grout science waste form technologies," said Jolin. "Grout provides a tunable and robust media to close and secure waste forms and other contaminated areas that can help the overall DOE mission."

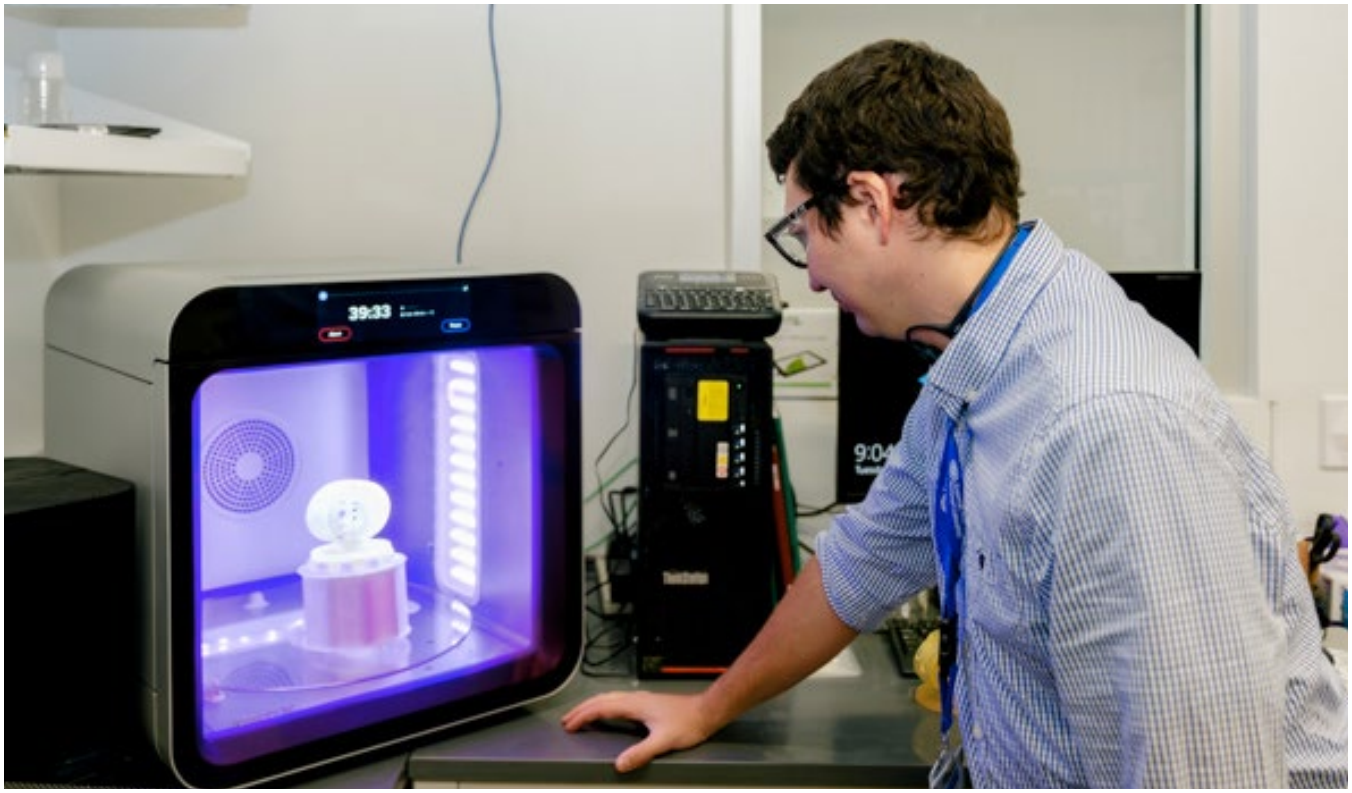
While it's not used for your neighborhood's sidewalk, grout still provides the path to innovations in the nation's nuclear renaissance.

How Savannah River National Laboratory Supports Additive Manufacturing

by Federica Staton



Nathan Linton, Haley Jones, and Samuel Leguizamon in the AM lab. (Photo: LJ Gay, SRNS)



Samuel Leguizamon monitors a post-cure of a printed part. (Photo: LJ Gay, SRNS)

Additive Manufacturing (AM), commonly known as 3D printing, was once a futuristic tool seen in movies like Ocean's 8 or Jurassic Park, used to instantly replicate and print on demand. AM has now emerged as a groundbreaking technology that is changing how different industries respond to traditional manufacturing methods. SRNL researcher Samuel Leguizamon has taken that tool of the future to help transform how SRNL puts science to work, enabling entirely new capabilities that were previously impossible using traditional methods.

AM is a production process that creates objects by depositing materials on top of one another, based on a digital design. Unlike traditional manufacturing methods, that remove material to achieve a desired shape through cutting or drilling, AM builds objects layer by layer, offering greater material and energy efficiency and reduced waste. AM uses a variety of materials, including plastics, metals, ceramics and others to enable rapid prototyping of complex geometries or material blends that are difficult to achieve using traditional methods.

One of the most significant advantages of AM is design flexibility. AM allows for increased functionality in parts by enabling design freedoms that are impossible with traditional manufacturing methods. Engineers can create lighter, stronger and even more efficient components by manipulating design elements. "Being able to quickly develop and alter prototypes as we see fit is a key asset of AM," said, Leguizamon. "We can develop prototypes and analyze iterations faster than you can with traditional manufacturing. We can design and test same day and incorporate redesigns quickly." This critical aspect of AM proved essential for the SRNL AM team when approached to replace the traditionally used scintillator disks for H-Canyon after the original manufacturer discontinued production. As the only operational radiologically shielded chemical separations facility in the United States, H-Canyon relies on scintillator disks to detect radiation in process water. Drawing on its in-house expertise, SRNL swiftly designed, prototyped, and refined disks using a variety of material compositions, successfully matching the light output of the legacy disks while also introducing new capabilities to optimize detection performance for future needs. Although SRNL is not yet equipped for large-scale production, the lab excels in producing small batches of high-quality components that match the functionality of those made by industrial manufacturers. This streamlined process significantly accelerates the development and refinement of designs. By utilizing its comprehensive in-house material



Camden Chatham using 3D-printed molds on an injection molder. (Photo: LJ Gay, SRNS)

characterization suite, SRNL ensures the reliability and performance of every part produced. Additionally, SRNL collaborates closely with stakeholders, customers, and partner laboratories to uphold the highest standards of quality and standardization.

For SRNL AM is more than a tool, it is a strategic capability integrated across the lab's mission areas. From rapid prototyping to functional part production, AM is accelerating the pace of discovery and deployment. AM increases the efficiency of fusion fuel fabrication and allows researchers to produce complex fuel targets that are critical for enhancing energy output, yet difficult to create using traditional methods.

SRNL's AM capabilities led to SRNL receiving funding for an Interlaboratory Laboratory Directed Research and Development project to create storage capsules for a viable fuel source for generating commercial nuclear fusion energy, deuterium-tritium. Leguizamon considered AM as the ideal approach to creating the capsules because it allows for rapid construction with precision that is difficult to achieve using conventional chemical processing methods.

Leguizamon, and SRNL scientists Camden Chatham, George Larsen, Haley Jones, Holly Flynn and Tyler Guin are creating additively manufactured fuel capsules for fusion that wouldn't introduce protium impurities during ignition. Utilizing a technique developed by Leguizamon, the team will fabricate lattice architectures within spherical shells approximately 2 mm in size using polyethylene-like materials. Once 3D-printed, the deuterated-polymeric materials are hypothesized to provide more efficient ignition due to their thermal stability, resistance to neutron damage, and lack of plasma contaminating atoms.

SRNL's Future AM Scope

Though AM is a manufacturing process, it also allows researchers to discover unique chemistries and compositions of materials for polymerization or deconstruction of materials. While exploring novel post-processing techniques for 3D-printing, SRNL researchers discovered a method for deconstructing poly(dicyclopentadiene),

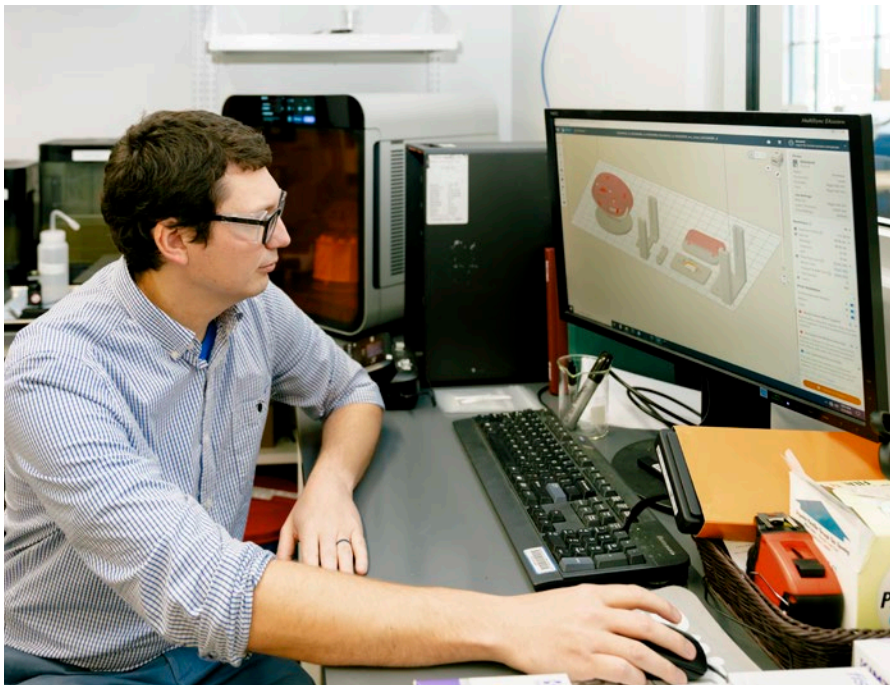
a tough polymer used widely for industrial applications. Critically, this method could be applied at room temperature with relatively benign solvents and enabled the recovery of expensive embedded materials such as carbon fiber or microelectronics for recycling and reuse. This capability to recover pristine glass or carbon fibers from poly(dicyclopentadiene) composites has attracted substantial interest from industry, as fiber production—especially carbon fibers—involves energy-intensive manufacturing processes.

SRNL's recent partnership with a local company that engineers, manufactures, and sells 3D printers and materials provides the opportunity for in-house collaborations as well as industry partnerships. SRNL's location and proximity to university partners including Georgia Tech, University of South Carolina, Clemson, University of Georgia and South Carolina State University positions SRNL to collaborate with students and solicit new prospectives and innovative solutions as well as prepare the next generation of AM researchers.

SRNL is also gaining traction in multi material printing. In traditional manufacturing, parts are produced separately and then manually combined. Multi material printing enables the fabrication of objects using two or more different materials simultaneously, creating complex, multifunctional parts. This manufacturing process enables the creation of parts with diverse material properties within a single print. With multi material printing, products can be more seamless and gradient-like, enhancing the quality and functionality of the final product. Increased functionality provides the opportunity to add unique property enhancers like improved strength, flexibility, or conductivity within specific areas of a single part optimizing the final product's performance.

SRNL is a versatile research and development hub, where skilled scientists and engineers address some of the nation's most complex challenges. SRNL's AM resources and expert personnel make it the ideal lab to counter evolving challenges with innovative solutions layer by layer.

Samuel Leguizamon prepares a digital file for printing. (Photo: LJ Gay, SRNS)



Advanced Technology Proving Ground Accelerates Grid Resilience

by Kent Cubbage

Savannah River National Laboratory aspires to be the premier national laboratory in pursuit of meeting the nation's biggest scientific challenges. Among the Department of Energy's priorities is energy resilience; in particular, the resilience of the electrical grid. To ensure everything from the lights coming on when Americans flip a switch to the country having the energy needed to defend itself and project power, the U.S. must counter threats from nation states, non-nation states, extremists and natural phenomena like storms.

SRNL is positioned to tackle this challenge through its Advanced Technology Proving Ground. The ATPG provides a truly unique mix of capabilities. Located on the 310-square mile Savannah River Site in South Carolina, the ATPG provides an extensive, isolated high voltage testbed. The resource provides 34 miles of instrumented transmission lines, including 17 miles of power lines rated up to 300kV. While other facilities across the nation are of similar or larger size, only the ATPG can operate at the higher voltages needed to conduct vital experiments at-scale.

SRNL has also assembled a top-notch group of scientists to study grid resilience. Rob Hovsapian joined the team last year from the National Laboratory of the Rockies as senior research fellow in the new Science, Energy and Innovation Directorate. Hovsapian is a nationally known energy researcher with decades of experience in the energy industry and the national laboratory system.

"We start by looking at the fundamental physics involved - if we start there, we can design a much better, more resilient grid," said Hovsapian. "And what's unique about the ATPG is that we can provide an at-scale, real world environment testbed that does not exist elsewhere."

The testbed is also using super intelligence and Machine Learning to generate data to prevent disruptions in the grid. Lightning strikes and other natural scenarios can be simulated, thus training the super intelligence (SI)

"What's unique about the ATPG is that we can provide an at-scale, real world environment testbed that does not exist elsewhere."

- Rob Hovsapian

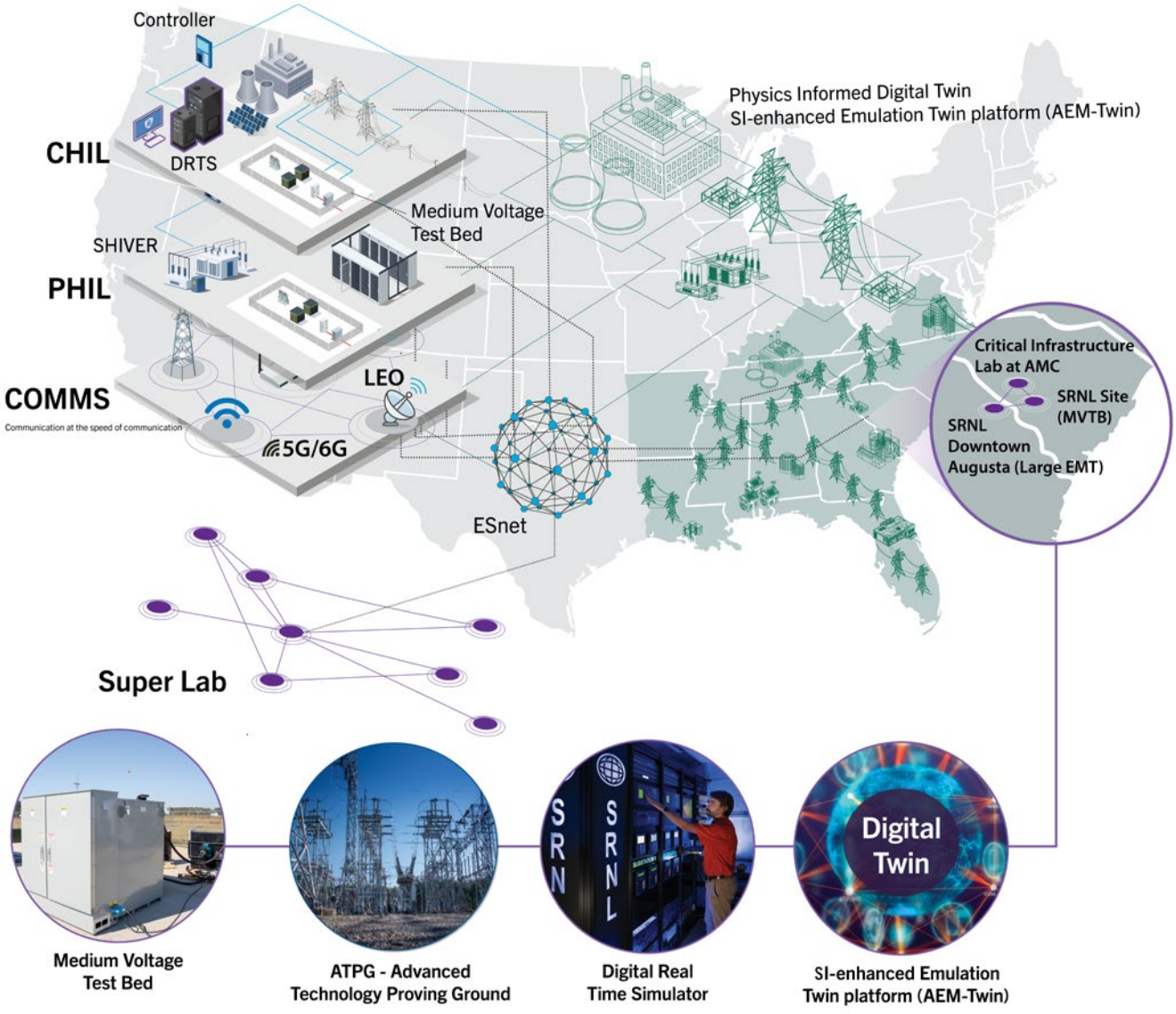
algorithm. This facilitates the development of advanced grid controllers that can self-learn and act quickly to minimize problems. Having access to both the transmission hardware and grid controlling hardware, combined with the SI/ML capability, gives the ATPG additional research advantages.

A central part of this work is a new SRNL platform called AEM-Twin an SI-enhanced emulation digital twin. AEM-Twin creates a high-fidelity virtual replica of the grid that runs in real time and is wired directly into the ATPG's physical equipment. Through two complementary techniques, Controller-Hardware-in-the-Loop for grid control systems and Power-Hardware-in-the-Loop for power equipment, actual hardware can be connected to the digital twin and operated as if it were running inside the live grid, without putting the live grid at risk. This combination of real hardware and SI-driven simulation is what allows SRNL to recreate real-world conditions in a controlled laboratory setting.

This novel integration of SI/ML resources and hardware also allows SRNL to partner with experts across the national laboratories who specialize in specific aspects of the power grid. In prior projects, Hovsapian has connected with various assets from other labs. He refers to this dynamic team approach as the Super Lab. This approach is the goal for the ATPG initiative at SRNL.

"Not only are we replicating the real word environment but through this

(Illustration: Anthony Castellano, SRNL)





From left: Ethan Farquar, Baza Somda, Maxwell Hill, and Rob Hovsapian next to the Digital Real-Time Simulation Modeling South Carolina Transmission Line at the Advanced Manufacturing Collaborative. (Photo: Susanna King, SRNL)

integration we are also engaging our multi-disciplinary team here and across other national laboratories," added Hovsapian. "This will also help us accelerate innovation."

The team is deploying quantum computing in addition to the SI aspects of the grid resilience experimentation. Quantum computing to optimize grid operations and balance electrical loads is another new scientific frontier. This quantum-in-the-loop concept greatly enhances the computing power SRNL can bring to bear.

Other, recently-opened SRNL facilities are also contributing to the grid resilience effort. The Advanced Manufacturing Collaborative, located a few miles from the main lab on the University of South Carolina Aiken campus, serves as an innovation incubator where SRNL partners with government, industry, and academia to develop and scale solutions to real-world challenges. With state-of-the-art lab space and equipment, the AMC complements the ATPG by giving SRNL a place to prototype and refine new grid technologies.

"Rob Hovsapian and his team are top notch and poised to make great strides in this field," said Roderick Jackson, associate lab directorate for SEI. "The combination of the ATPG, AMC and rest of SRNL's resources provide an excellent foundation for innovation."

The lab's combination of technologies, facilities and scientists positions it to achieve its goal of solving one of the nation's biggest challenges. SRNL's diverse grid resilience assets and great minds are raising the lab's profile in this national priority and beyond.

Research SLAM Highlights SRNL's Early Career Talent

by Kent Cubbage

2025 first-place winner Austin Abbott, a scientist in the laboratory's nuclear measurements group. (Photo: LJ Gay, SRNS)



A movement emerged in the 1980s to make poetry less formal and more accessible to a general audience, and the poetry SLAM was created. The SLAM concept is a live poetry reading competition judged by a panel and the audience, in which the performers have a few minutes to read their poetry aloud in a compelling, rhythmic and emotional manner. The focus is less about traditional words on paper and more on entertainment, stage presence and impact.

SRNL adapted this format in 2023 to feature its innovative scientific research and the talent that conducts it, and the first-ever SRNL Research SLAM was held. It was a huge success, leading to an annual competition in the ensuing years.

Instead of poetry, competitors give a TEDx-style presentation on a significant scientific project they are working on. They have three minutes to engage,



From left: 2026 second-place winner Bronson Lynn, Deputy Lab Director for Science and Technology Tammy Taylor, Research SLAM coordinator Tania Cruz, and 2026 overall winner Raden Gustinvil. (Photo: Federica Staton, SRNL)

educate and entertain the audience in jargon-free terms using nothing but the microphone and one slide projected behind them. The SLAM is limited to early career SRNL researchers – post-docs and those who have earned their doctorate degree within six years of the competition.

"The competition is a showcase of our young talent at SRNL and the amazing projects that they are working on," said Tania Cruz-Ramos, organizer of the event. "They get to bring their research to the public and tell people how their work could positively impact not just the scientific community, but the country, the world and all of our everyday lives."

Each year, a call goes out at the lab to announce the competition, and an informational session is conducted. Interested participants then sign up to compete. Once the Research SLAM roster is finalized, a preliminary competition is held at SRNL with a live audience. It's judged by a panel of lab staff who rate the participants based on their ability to reach the audience, communicate a clear message and emphasize the potential impact of their work, all within three minutes.

The top eight participants make it through to the SRNL Research SLAM held at the Aiken Community Theater in Aiken, SC. The SLAM has been emceed by local media personalities, and the inaugural SLAM in 2023 was hosted by well known, long-time local TV news anchor Brad Means. Means set the bar high as emcee, introducing each participant and their presentation with pithy scientific puns.

The SLAM is judged by a panel of prominent figures from the area business, political and education communities. The competitors' families, friends and coworkers are in the crowd to cheer them on. At the conclusion of the event, the emcee announces a first and second place winner. Also, as the SLAM concept is designed to fully engage the audience, those in the crowd can vote on their cell phones via a QR code for a "people's choice" winner.

First place, second place and people's choice winners are awarded a trophy and monetary prize. The tangible prizes are incentive enough to participate and try to win the competition, but all the SLAM participants walk away with much more. It raises their profile as researchers, burnishes their resume and polishes their presentation skills, all of

which greatly advance their careers.

However, the benefits do not stop there. The winner of the SRNL Research SLAM receives an invitation to participate in the annual National Lab Research SLAM competition in Washington, D.C., against the winners of Research SLAMs at the other national laboratories. The national SLAM rolls out the red carpet. There is a fun agenda of activities and presentation coaching for the participants, and they get to meet members of Congress. The competition is stiff at the national SLAM, but SRNL winners are up to the task. Sean Noble, the 2023 winner at the SRNL Research SLAM, took home first place in the Environmental Resilience category at the national competition.

"It was such a great experience that I will never forget," said Noble, a researcher in SRNL's Chemical Flowsheet Development group. "Everybody there was talented and polished, but I was able to make a connection and entertain the judges and audience, even give them a few laughs, and bring the first-place trophy back to SRNL."

The 2024 and 2025 SRNL SLAMs were won by Colleen Hilla and Austin Abbott, respectively, who also represented SRNL with pride in Washington, D.C. The lab holds a SLAM watch party at SRNL to root for its local winner remotely during the national SLAM each year, including those who participated but did not win. Several of those researchers compete in the SLAM again the following year.

This year's winner achieved a first-of-its-kind feat for the SLAM. Raden Gustinvil won first place honors as well as the audience choice award.

The popularity of the SLAM shows no signs of slowing. It may not be poetry, but the SLAM lets young SRNL scientists bring artistry to their scientific pursuits.

2024 Research SLAM contestants and hosts onstage at the Admentum Theater in Aiken, South Carolina, the downtown venue where the annual event is held. (Photo: LJ Gay, SRNS)



Re-imagining Workplace Safety: How SRNL is Advancing Safety Through Automation

by Federica Staton



Purpose-designed robotic end effector operates screw jack in glovebox. (Photo: Brad Bohr, SRNS)

Throughout Department of Energy facilities, personnel routinely perform specialized tasks in gloveboxes — sealed, enclosed workspaces — that protect personnel from radiological materials. While these enclosures provide a critical layer of protection, operators can still be exposed to radiation and suffer injury from repetitive motions and awkward positioning.

To overcome these obstacles, researchers at Savannah River National Laboratory are developing robotic and automation technologies to increase operational efficiency and create safer, more ergonomic working conditions. This effort supports the missions of the Department of Energy's Office of Environmental Management and the National Nuclear Security Administration by reducing worker exposure and enhancing safety in some of the most demanding environments.

Integrating Robotics into the Glovebox

SRNL is accustomed to utilizing robotic technology to improve efficiency and worker safety. In 2021, SRNL partnered with Sandia National Laboratories to develop wearable tools to prevent injury and muscle fatigue. SRNL also employs Boston Dynamics' Spot, a dog-like robot monitoring device, to provide operational awareness to reduce exposure to radiation and other hazards.

SRNL's newest automation project differs from previous technology in that it integrates a collaborative robotic arm into a nuclear glovebox system. Using a commercially available Universal Robots UR5e Collaborative Robot Arm, researchers customized the system to operate within existing infrastructure without requiring major modifications to the structure of the glovebox.

"We started by developing a direct mockup of an existing process, along with all the interior tools and elements within the glovebox," said SRNL engineer Rodrigo Ramon. "Then we retrofitted the tools without modifying the glovebox itself to enable automation."

The project focuses on automating repetitive portions of plutonium handling and processing operations. While the system automates only part of a larger workflow, it demonstrates how robotics can successfully be integrated into nuclear operations while maintaining productivity.

SRNL's approach emphasizes collaboration between humans and machines. The system uses a collaborative robot, or "cobot," specifically designed to operate alongside people. These robots feature built-in collision detection and avoidance systems that continuously monitor for abnormal conditions. If an unexpected interaction occurs, the robot immediately stops to prevent injury or damage. Currently, the robotic arm helps alleviate potential radiation exposure by performing many repetitive manual tasks while operators supervise the process and advance operations as needed.

Solving Unique Challenges

Unlike traditional manufacturing environments, glovebox operations are difficult to precisely replicate. Small changes in equipment positioning and consumable materials can occur over time, creating challenges for automated systems. In response, SRNL developed adaptive programming techniques that allow the robot to continuously recalibrate itself using reference points located throughout the glovebox. These capabilities allow the robot to perform tasks repeatedly and consistently, even when minor shifts occur, ensuring the precision required for nuclear operations.

"Robots are easy to set up and program for generic applications," said Ramon. "But their physical location must be optimized for the process, and special considerations must be made for glovebox operations."

SRNL's advanced machining capabilities allowed researchers to address those challenges by developing specialized tooling and support equipment tailored to the operating environment. "We spent a lot of time developing custom tools and adapters," said Ramon. "Using our rapid prototyping and state-of-the-art machining capabilities allowed us to quickly manufacture and improve the components needed for automation." This ability to rapidly iterate designs helped accelerate development while allowing the team to identify and solve challenges throughout the process.

"Using our rapid prototyping and state-of-the-art machining capabilities allowed us to quickly manufacture and improve the components needed for automation."

- Rodrigo Ramon

An advantage of creating in-house parts is building dependability into the design components. To prevent

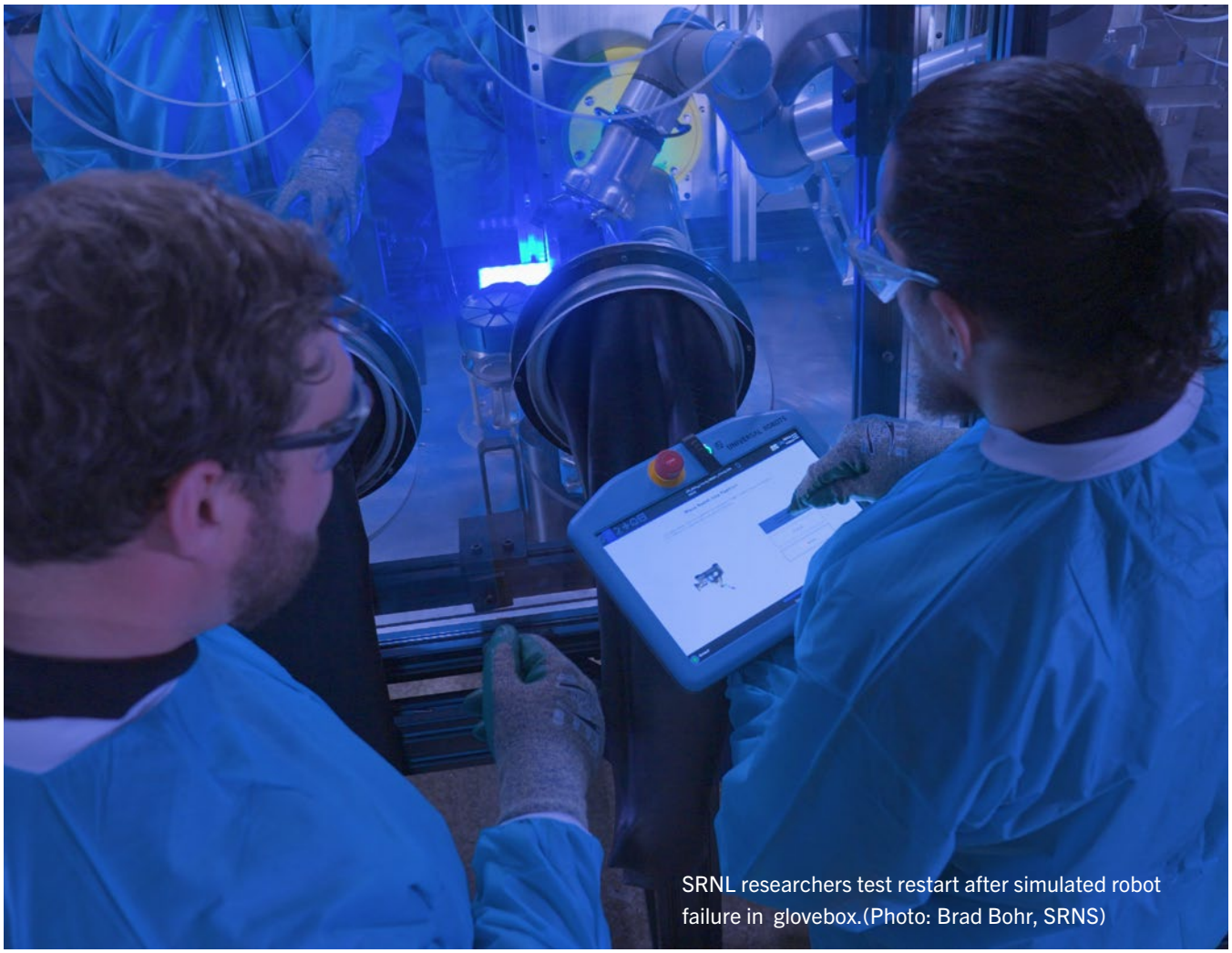
operational downtime from impacting production schedules, engineers-built maintenance and repair capabilities directly into the system. Everything installed within the glovebox can be serviced or replaced. The team developed custom in-glovebox hoists and support systems that allow operators to lower, move, or remove the robotic arm when necessary. This design ensures that automation enhances operational resilience rather than creating additional risk.

Looking Ahead

"What I like is the technical challenge of robot programming and finding creative solutions to solve difficult problems," said Ramon. "Bridging the gap between what humans and robots excel in is the main challenge and goal of automation development."

As the project continues, SRNL researchers see opportunities to apply their experience across a broader range of government missions and nuclear applications. "If we can prove robotic arms are viable in nuclear glovebox applications at a small scale, that builds confidence for their application to other missions," said Ramon.

This effort represents more than a single automation project. Combining human knowledge and skill with robotic precision helps SRNL modernize nuclear operations while improving safety and mission performance. As automation technologies continue to evolve, these efforts are laying the foundation for the next generation of nuclear operations.



SRNL researchers test restart after simulated robot failure in glovebox.(Photo: Brad Bohr, SRNS)



Q&A with G. Jeremy Leong

SRNL's Advanced Manufacturing Collaborative

by Michael Ettlemyer

G. Jeremy Leong is the research director at SRNL's new Advanced Manufacturing Collaborative, a 63,000 square-foot facility on the campus of the University of South Carolina Aiken.

G. Jeremy Leong is a driving force in advancing innovation at the intersection of advanced manufacturing and mission critical research. As AMC director, Leong leads AMC's scientific vision and builds strategic partnerships with government agencies, universities and industry leaders nationwide.

His career includes influential roles at the Department of Energy and the Department of War, where he managed multi billion dollar public private partnerships and guided technologies from concept to deployment in areas ranging from advanced manufacturing to warfighter support applications. Leong holds a Ph.D. in applied chemistry from the Colorado School of Mines and has collaborated with top laboratories including the Air Force Research Laboratory and the National Laboratory of the Rockies. He also received the Secretary of Energy's Honor Award, the highest internal non-monetary distinction available to DOE employees and contractors. With more than 30 peer reviewed publications, internal assessments and congressional reports, Leong brings expertise and vision that will strengthen SRNL's collaborative research efforts.

We sat down with Leong to discuss his vision for the AMC, the future of transformational science, and how he is helping shape the next wave of innovation at SRNL.

It's been said that the AMC is the "front door to the lab." What does that mean to SRNL, the local community and anyone who comes through the front doors at the AMC?

When we describe the AMC as the "front door to the lab," we mean it serves as SRNL's welcoming entry point for the community, partners, students and visitors. It functions like a front porch—an open, inviting space meant to be a true gateway for engagement and collaboration. The AMC is expanding SRNL's reach by opening our doors and highlighting the impactful research happening right here in the region. Our goal is for every visitor—whether a student, local resident or industry leader—to feel welcomed and inspired by the innovative work taking place at SRNL.

The word "collaborative" implies partnerships. What types of partners, and what is the vision for these partnerships?

"Collaborative" is at the core of the AMC's partnership model, which we describe as a "triple convergence." We intentionally build connections between academia, industry and government at the local, regional and national levels, with the goal of creating partnerships that deliver value for everyone involved.

These collaborations take many forms, including joint R&D projects, shared use of specialized equipment,



Jeremy Leong speaks to SRNL employees at the AMC's first anniversary celebration. (photo: Federica Staton)

community outreach and workforce development programs. Guided by SRNL's three mission areas and 10 R&D priorities, the AMC works to leverage these partnerships to expand our impact and accelerate innovation. Ultimately, the AMC serves as a hub where diverse partners come together to advance science, address critical challenges and strengthen our community.

What type of space and resources does the AMC offer that are unique to the facility?

What truly sets the AMC apart is the modular and highly flexible design of its laboratory spaces. These labs are physically interconnected, intentionally fostering integration and collaboration by bringing researchers and partners together in close proximity. Another distinctive feature of the AMC is its location on a public university campus, which greatly enhances accessibility for external partners and stakeholders. This unique combination of adaptable workspaces and an open, accessible setting make the AMC an ideal environment for innovation and collaborative discovery.

How do you see the AMC developing over the next decade?

I see the AMC becoming a true beacon of innovation—not only for the Southeast, but as a national and global leader in advanced manufacturing. It will be a place where today's most pressing challenges are met with bold ideas, breakthrough technologies and a culture of fearless collaboration. Our partnerships with academia, industry and government will continue to grow, creating a vibrant ecosystem that accelerates discovery and delivers real-world impact.

Both physically and intellectually, the AMC will expand its reach. We will drive advances in fusion energy research, robotics and energy resilience, while using advanced computing to unlock solutions once thought unattainable. Just as important, I hope the AMC serves as a catalyst across SRNL, inspiring staff to embrace innovative thinking and pursue transformational science.

The AMC is more than a facility—it is a movement. It is a place where creativity and ambition converge, where transformative ideas take root, and where the future of manufacturing and technology is continually reimagined.

How does the AMC integrate with the main SRNL campus on Savannah River Site?

The AMC is a central pillar of SRNL's new Science, Innovation and Energy Directorate, bringing together all the laboratory's mission areas to create a dynamic environment for scientific advancement. As a cornerstone facility, it unites



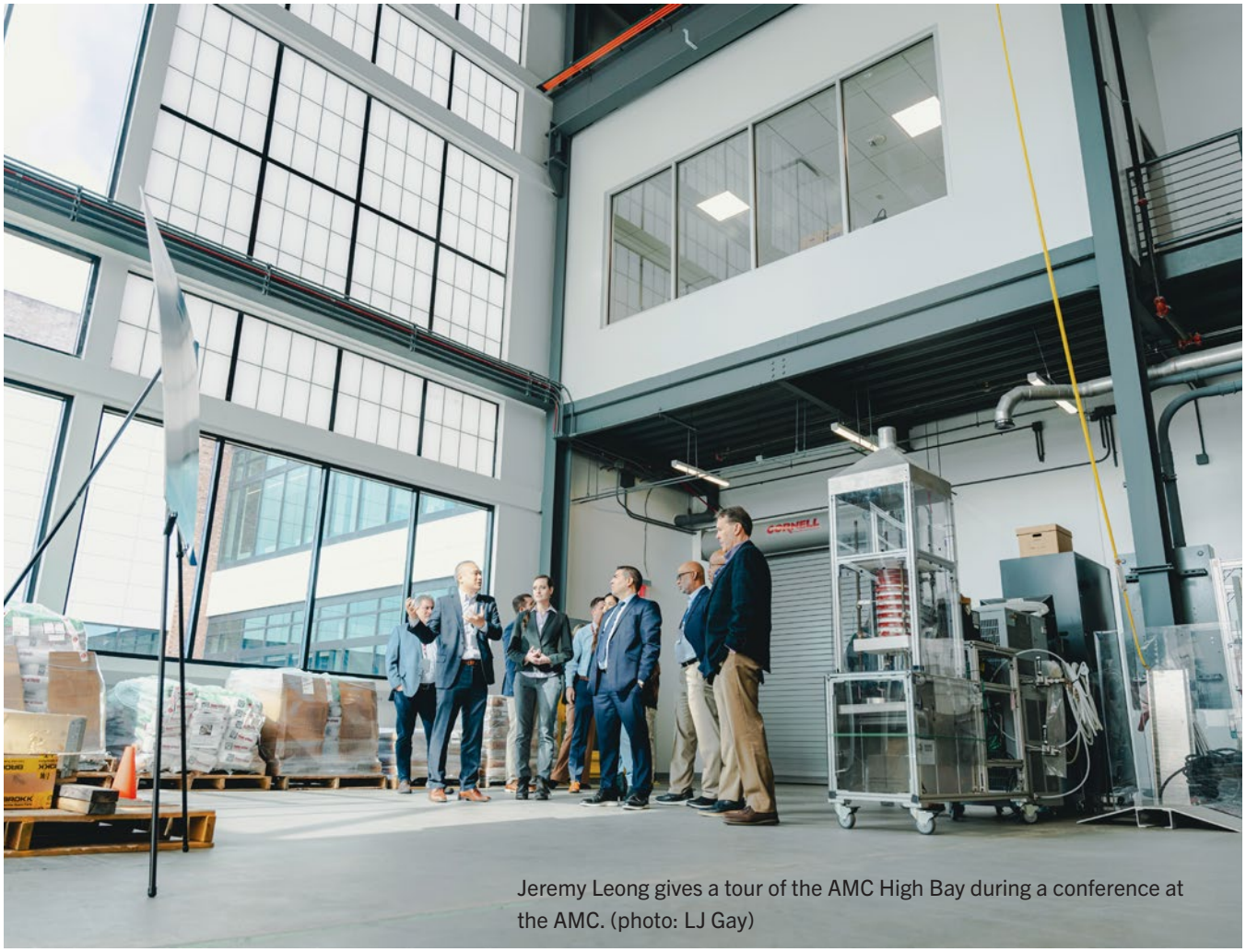
diverse expertise and groundbreaking research, serving as a catalyst for collaborative innovation.

The AMC is also a more accessible entry point to SRNL because it is a non-radiological, non-classified facility, and on a public university campus. This openness allows researchers to explore and refine concepts before moving them to the main Savannah River Site campus for work that requires radiological or classified capabilities. In this way, the AMC integrates seamlessly with the broader SRNL ecosystem, helping accelerate the path from concept to impactful solutions and ensuring innovation thrives across the laboratory.

What's an exciting development coming down the pipeline?

One of the most exciting developments at SRNL is the launch of a state-of-the-art high performance computing system—a major cross-functional achievement involving teams from every SRNL directorate and division. Now housed at the AMC, this system significantly expands our computing power and provides centralized access for researchers, reflecting our belief that integration drives innovation and impact.

This new HPC capability will enable SRNL to tackle increasingly complex, computation-heavy work, from advanced modeling and simulation to SI, machine learning, and the ambitious DOE Genesis Mission. Its scalability and flexibility position SRNL at the forefront of computational science, strengthening our competitiveness and opening the door to new partnerships and collaborative research opportunities.



Jeremy Leong gives a tour of the AMC High Bay during a conference at the AMC. (photo: LJ Gay)



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For two and a half centuries, the spirit of American ingenuity has driven our nation forward, and Savannah River National Laboratory (SRNL) proudly stands at the forefront of that legacy. As we celebrate the United States' Semicentennial, SRNL honors its foundational role in protecting our country and advancing scientific discovery. From our cold war origins to our modern breakthroughs in environmental stewardship, advanced manufacturing, and national security, our brilliant team continues to solve the world's most complex nuclear challenges. Today, we look back with pride at our shared history and look ahead with determination, continuing to pioneer secure, clean energy solutions that will sustain and empower the nation for the next 250 years.