MATTER

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Fall 2025

Artificial Intelligence and Machine Learning at SRNL

PAGE 6

Quantum Computing Research

PAGE 10

Advances in Chemical Detection

PAGE 12

Savannah River National Laboratory®

Above: Secretary of Energy Chris Wright (right) and SRNL Laboratory Director Johney Green at the opening of the new Advanced Manufacturing Collaborative on the campus of USC Aiken. (Photo: Laura Russo, SRNS)

Cover: AI researcher Nicolas Issa stands next to a Criticality Control Overpack drum and robotic arm in an SRNL engineering lab. (Photo by LJ Gay, SRNS)

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Savannah River National Laboratory is a United States Department of Energy multi-program research and development center that's managed and operated by Battelle Savannah River Alliance, LLC (BSRA) for the Department of Energy's Office of Environmental Management. SRNL puts science to work to protect the nation, protect the environment and ensure energy resilience.

From the Director

I'm pleased to share this edition of MATTER. As laboratory director, it is a privilege to highlight the research we are doing that demonstrates SRNL's leadership, impact and commitment to serving the nation. This issue explores how SRNL is embracing the future as one of the nation's key innovation hubs with stories detailing our expanding research missions, infrastructure and partnerships.

One story features our growing Joint Appointment Program, which strengthens ties between SRNL and leading universities, provides a more cohesive exchange of knowledge and fosters the next generation of scientific leaders. You'll also find a story about our Hanford Tank Waste research and development, where SRNL is applying decades of expertise to address one of our nation's most complex legacy waste cleanup challenges.

We're also spotlighting our leadership in artificial intelligence and machine learning—tools that are transforming how we approach research, analyze data, and identify solutions more quickly. Our work in quantum computing is pushing those possibilities even further, opening new frontiers for AI applications in areas from materials science to national security.

Finally, we share an exciting update on the Advanced Manufacturing Collaborative facility that opened in August with U.S. Secretary of Energy Chris Wright and other key stakeholders at a much-anticipated ribbon cutting ceremony. This state-of-the-art facility is poised to become a hub for innovation, bridging research with real-world manufacturing solutions and strengthening our role in the region's economic and technological growth.

This edition's stories underscore the breadth and depth of SRNL's impact—rooted in science, driven by collaboration, and focused on solving the nation's toughest challenges. I am proud of our team's dedication and inspired by the possibilities ahead.

Thank you for your continued interest in SRNL. I hope this edition informs, inspires, and reaffirms the vital role our laboratory plays in shaping a safer, secure, and more prosperous future.

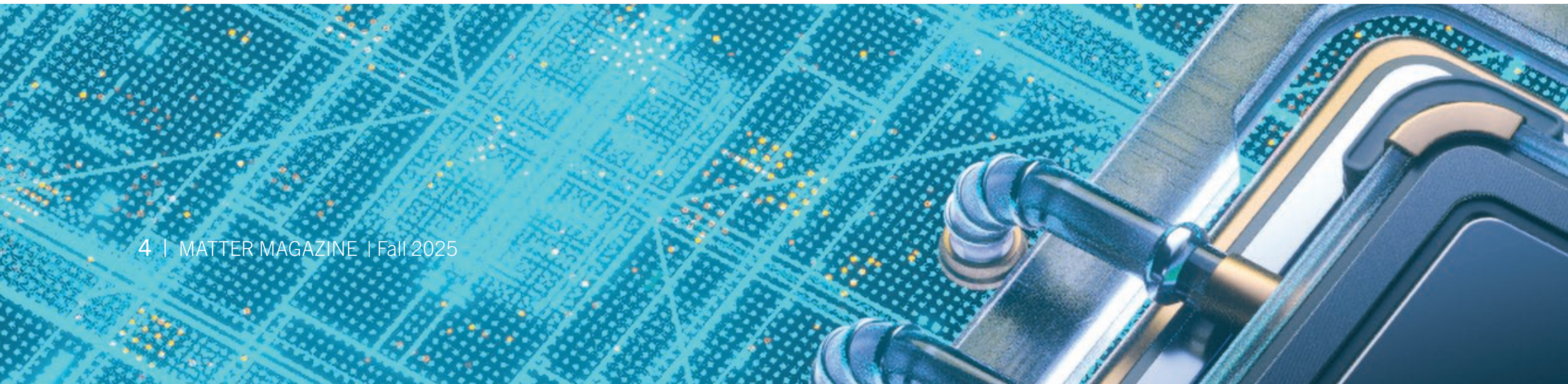
Regards,

Johney Green

Laboratory Director

CONTENTS

FEATURES



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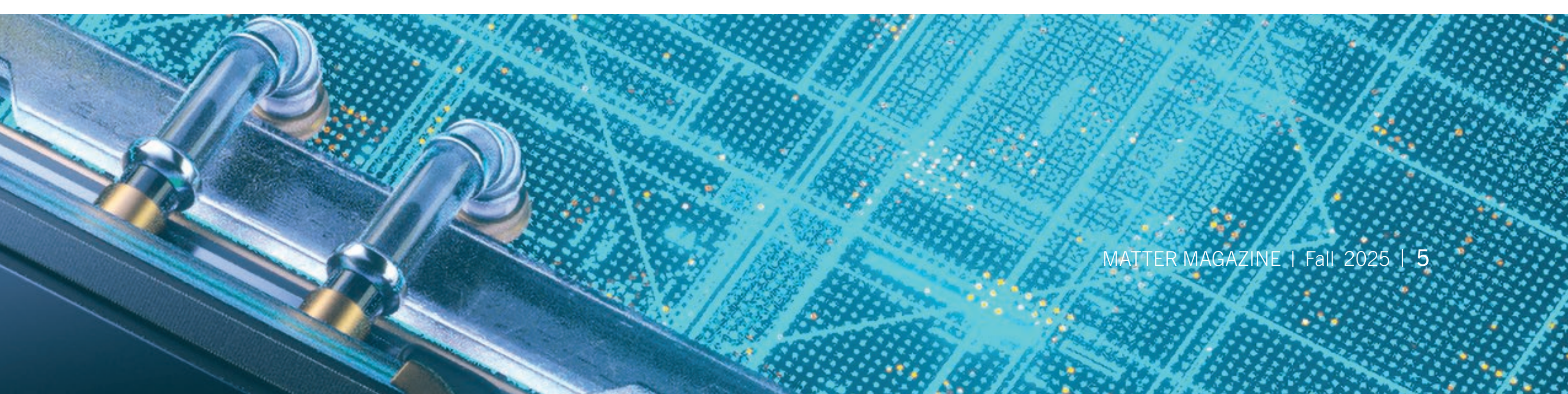


Innovative Artificial Intelligence and Machine Learning Applications at SRNL

by Kent Cubbage

Illustration by Alphonzo James and Elyssa Burgess, SRNL

AI Changes the Landscape

The previous century saw a multitude of technological revolutions that changed the way we all experience the world – how we live, work, travel and even defend our nation. Among these were the splitting of the atom, the invention of the transistor and microchip, the development of vaccines, and humans and satellites in space. All of these advancements were accomplished thanks to the magic of human intelligence.

Human intelligence, however, has developed sophisticated artificial intelligence to augment the mind and, in some cases, fully take its place. While rudimentary AI goes back several decades, the last few years have seen a true revolution in this technology. AI platforms, such as ChatGPT, Microsoft Azure, Google Cloud and several others, have permeated our society. The average person can use these tools to accomplish everything from constructing an email to writing music. In addition, proprietary AI platforms have been developed and deployed by private companies to greatly increase efficiency and the speed of product invention and improvement.

"We are using existing models but being very innovative in how we put it all together."
- Tom Danielson

It's critical that AI be used also to defend our nation and solve its biggest problems, and Savannah River National Laboratory has stepped up to meet the challenge. SRNL has recognized the value of AI, as well as related machine learning, and is using the latest in AI/ML capabilities to keep the U.S. on the forefront of discovery. In doing so, the lab is answering the call from the Secretary of Energy to prioritize AI/ML development and lead the world in this developing technology.

AI has been incorporated into all manner of relevant projects and use cases throughout the lab. All three SRNL mission areas - national security, environmental stewardship and energy resilience - are making use of AI/ML tools. Each of the lab's three directorates are contributing to this revolution.

Leveraging AI/ML for Environmental Stewardship

SRNL's Environmental Management and Legacy Management directorate is employing AI to solve challenging environmental problems. This includes the AI Accelerated Strategies and Solutions in Environmental Technology, or AI-ASSET, initiative. AI-ASSET is based on an existing project known as the Advanced Long-Term Environmental Monitoring Systems, or ALTEMIS, which has been used to predict the behavior and movement of contaminated groundwater plumes. Sensors embedded around the plume use geochemical, hydrological and geophysical data to passively monitor and predict contaminant movement. In doing so, long-term monitoring, which is a substantial portion of the GAO-estimated $550 billion liability for the DOE-EM cleanup mission, can be performed at a fraction of the cost.

ALTEMIS, which SRNL developed over the course of about fifteen years, has been used at a contaminated groundwater plume at Savannah River Site. AI-ASSET uses AI/ML technology to make ALTEMIS usable at other contaminated sites. These sites have their own specific environmental conditions and unique contaminant data, which creates applicability challenges.

"What we want to do is shorten that time span such that a site could get ALTEMIS up and running within a year, if not under a year," said SRNL Scientist Tom Danielson. To achieve this, AI is being brought to bear. AI/ML tools such as generative AI and large language models are being used to tailor the approach on a site specific basis.

"We are leveraging many existing models in our approach," Danielson continued. "And it's our responsibility as a national lab to determine which models can be deployed in, and then improved for, AI-ASSET. So, we are using existing models but being very innovative in how we put it all together."

The AI-ASSET team hopes to deploy the system at the Moab site in Utah and expand into different sites around the Department of Energy Complex. The AI/ML software being developed by SRNL Scientist Alejandro De La Noval can hopefully transition the technology from groundwater projects to monitoring contamination at physical facilities themselves. This includes a building with legacy mercury contamination at Oak Ridge National Laboratory. International sites are also targets for AI-ASSET deployment in the near future, making it applicable across the globe.

AI/ML to Help Efficiently Dispose of Excess Nuclear Material

The Weapons Production Technology directorate is using a novel AI/ML approach in the disposal of some of the nation's legacy plutonium surplus. SRNL engineers Corey Hopper and Nicolas Issa are operationalizing the concept.

The plutonium is first downblended to eliminate its potential misuse. Then it must be packaged safely and effectively before it can be transported to permanent storage. An outer storage container used for the downblended plutonium is called a Criticality Control Overpack, or CCO, drum and the inner container is called a Criticality Control Container, or CCC. Then, a canister inside the CCC holds the material proper.

"You can think of it like a Russian nesting doll," said Issa. "In that there are three layers to the ultimate container."

The CCO drums are received onsite and must be inspected for quality control and security. When approved, a tag is placed on the container signifying the drum is safe for use. Approved CCOs are transported to a holding pad until they are ready for packing.

The inspection and readiness activities are tedious and time consuming when done manually. Thus, ML techniques are used to greatly improve the speed and accuracy of the process. A robotic arm, cameras and laser scanners open and manipulate the drum to look for anomalies. The automation learns exactly how the drum should look, and what defects and damage should look like, before approval.

"The first ML algorithm is an anomaly detection algorithm that takes a picture of the inside of the CCO and compares it to what it knows is a good CCO," said Issa. "If the CCO inspection goes well, it does the same thing to the CCC, which should be empty at that point. The next ML algorithm is called OCR, Optical Character Recognition model, and it reads the date, model number, serial number and the like on the CCC to verify it's all as it should be." From there, the containers are ready for use to dispose of the nuclear material.

A Role for AI/ML in Cybersecurity

SRNL's Global Security Directorate is also rapidly moving forward with AI/ML technologies. The development of secure, AI-enabled cybersecurity in the national interest is the focus of a major initiative at the lab. The project is known as the Threat Hunting Representations for Embedded-system Anomaly Tracking, or THREAT, effort. THREAT's focus is cybersecurity associated with energy and nuclear infrastructure. It is supported by an integration of investments in high-performance computing infrastructure, workforce development and key external stakeholder collaboration.

Nicolas Issa stands next to a CCO drum and robotic arm in an SRNL engineering research lab. (Photo: LJ Gay, SRNS)

Work is being conducted via partnerships with Sandia National Laboratories, Idaho National Laboratory and several universities in the southeast. In late 2024 SRNL deployed the lab's first Graphics Processing Unit, or GPU computer, which is named Raptor. It will soon be moved to SRNL's new Advanced Manufacturing Collaborative facility. This unique computer is being used to develop AI models for cybersecurity. It will play a pivotal role in enabling large language model research.

"Models are needed for AI to ingest and process cyber data," said Glenn Fink, SRNL researcher. "They live, eat and sleep, so to speak, on data. Raptor gives us a powerful tool to process those data with GPU-based computing."

While Raptor can develop the necessary models and store the data, it is being utilized also to train researchers on AI-enabled skills. Thus, the THREAT project is preparing a cybersecurity workforce that is able to leverage AI.

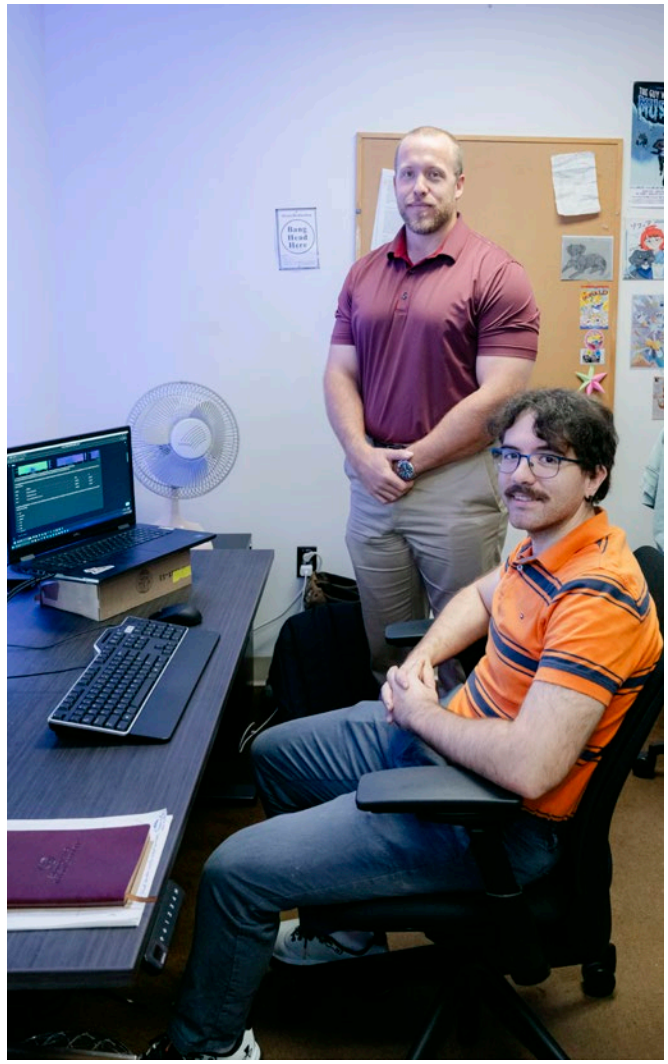
"We need people and computers that can detect data anomalies caused by criminals, nation states and other bad actors that could affect our electric power grid," said Fink. "We are using large language models to ingest cyber data the same way ChatGPT has ingested trillions of words of human languages."

In doing so, SRNL can significantly advance cybersecurity to serve the nation.

AI/ML at SRNL in the Future

The projects described above are highlights from a broad swath of AI/ML applications across the lab. SRNL is rapidly bringing AI/ML to bear, but it's still in its infancy. The lab will relentlessly continue to determine how and where this technology can best be used to serve its mission areas.

While private citizens use AI tools for everyday tasks, they can rest assured that SRNL is on the leading edge of AI/ML applications to keep them safe, protect the environment and enhance their lives.



Tom Danielson (top) and Alejandro De La Noval are creating software that uses AI/ML to monitor environmental contamination. (Photo: LJ Gay, SRNS)

"Models are needed for AI to ingest and process cyber data. They live, eat and sleep... on data."

- Glenn Fink

SRNL Pioneers the Next Generation of Computing

by Kent Cubbage

We all rely on computers as part of our daily personal and professional lives. From engineering to plumbing, hardly a single walk of life is unaffected by desktop computers and handheld devices. The advances in computing capabilities over a few short decades have been staggering. The speed and storage capacity of a typical office computer in 2025 is orders of magnitude greater than computers in the 1990s. It is widely known that the smart phone in your pocket has more computing power than the machines that sent the United States to the moon in the 1960s and 1970s. However, one thing has remained constant during this evolution in computing: information and data have all been based on ones or zeros, or binary bits.

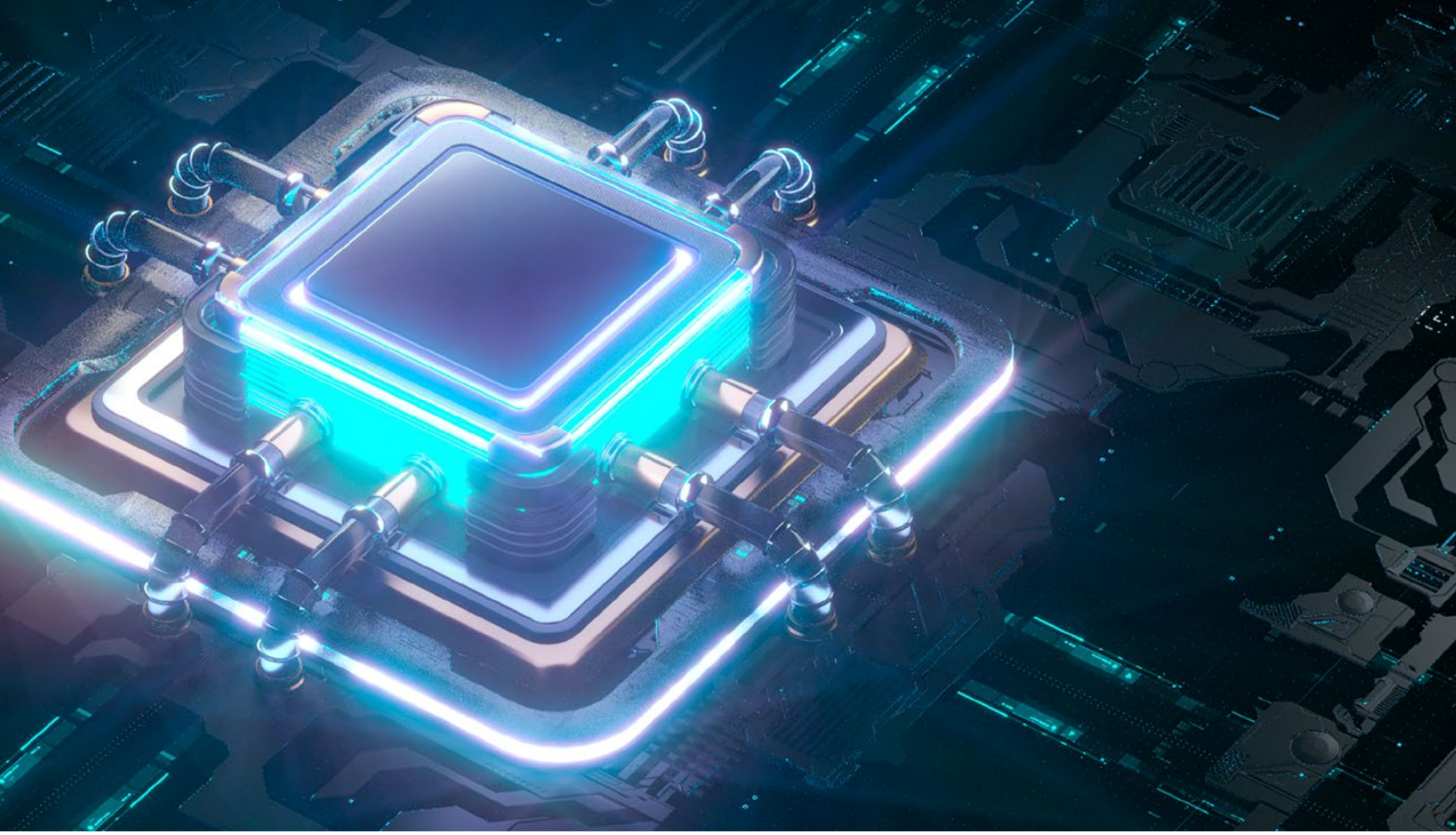
A new type of computing called quantum computing is changing this longstanding archetype. Quantum computing is based on qubits, which can exist in a superposition of both the 0 and 1 states simultaneously. Qubits can interact with each other through a phenomenon known as entanglement, allowing quantum computers to process certain complex problems more efficiently than classical computers. This combination of superposition and entanglement provides vast computational capabilities.

A group of computer scientists at Savannah River National Laboratory is at the forefront of this quantum computing revolution. SRNL computer scientists Larry Deschaine and Chris Sobecki are leading the charge. "Things that could actually take centuries on a classical computer can now take minutes or even seconds with quantum computers," said Deschaine. "Quantum computing is becoming a reality sooner than many thought."

Deschaine was brought to SRNL to work primarily with artificial intelligence and says that quantum computing is under the lab's AI umbrella. AI can be achieved using quantum computing algorithms. As quantum science and AI grow, so does the need for the workforce to develop these advances. SRNL is poised to provide that well-trained workforce. Quantum subject matter experts will be needed.

"It can take years to train someone in quantum computing," Deschaine indicated. "The need for literally millions of quantum computing scientists will be there, so we want to help create a quantum-enabled workforce that can do the AI."

SRNL is not only training the quantum workforce, but is actively deploying the technology to provide solutions to a vast array of problems and scenarios. This includes prototypes for detecting attacks to the power grid as well as predicting hurricane and tornado



(Illustration: Alphonzo James, SRNL)

development, path and strength. There are several applications in the medical field as well. This includes drug design and molecular science. Quantum computing can also aid in fusion energy science, another area of emphasis and expertise at SRNL. Deschaine has given presentations to business groups touting quantum computing's ability to optimize logistics and supply chains, enhance risk management and accelerate materials discovery.

Although quantum computing has distinct advantages over classical computing in certain use cases, the two are often used in a hybrid approach to maximize the outcome. SRNL has some classical computer codes for AI and machine learning that have worked tremendously well. Quantum can be used to augment the classical approach or provide select improvements.

"More often than not, it's the hybrid – the classical plus the quantum – that provides the best accuracy," said Deschaine. "So, we need to decide if the ensemble of both types, the advantages of each type, works best to solve a problem. And sometimes classical is best, as I don't need quantum computing to create a Word document."

While the approach is critical to each use case, the availability of the physical hardware is paramount as well. Though they are becoming more common, true quantum computers are still rare and highly expensive. Private companies are investing large sums of money into quantum computing and the necessary hardware.

Other challenges with quantum computing remain - current technology still faces significant challenges in being deployed at scale for widespread use - and the aforementioned need for the workforce is an obstacle. Colleges and universities are now beginning to offer courses in quantum computing. Deschaine hopes that these institutions can align their curricula with what the national laboratories and the nation need.

The goal is to continue to build a trained workforce to determine appropriate applications, implement the algorithms and provide quantum advantage solutions to relevant use cases.

"The rewards are incalculable," said Deschaine. "If SRNL can put quantum science to work to do computing better, faster and cheaper, we can create some fantastic things."

Accelerated Analysis: SRNL Scientists Advance Technique for Rapid Chemical Detection

by Charnita Mack

The paper spray ionization (PSI) technique, coupled to a high-resolution ambient mass spectrometer, is widely used for health care diagnostics, drug detection, pharmaceutical development, and food safety by organic fingerprint analyses. Through research supported by the Laboratory Directed Research and Development program at Savannah River National Laboratory, a team of scientists realized the advantages and opportunities of using PSI for analyzing inorganic actinides, demonstrated for uranium. The team has now developed a cost-efficient and time-saving process that is positioned to become the go-to process for the future.

"Uranium enrichment has yet to be demonstrated using PSI, so we are one of the first to use this technology to expedite the analysis," said John Kelly, SRNL scientist and one of the principal investigators on the PSI team. The work was recently highlighted on the cover of the Journal of the American Society for Mass Spectrometry.

The PSI process begins with placing a sample on a type of substrate, like a paper wedge. The substrate is then inserted into the instrument, and within minutes, isotopic signatures are detected and assessed. The ease of collecting samples from very small quantities, like through subsampling from any surface, is what makes this method an open door for future opportunities.

Typically, milligrams of solids or milliliters of solution are necessary to characterize isotopes of interest such as uranium, but with PSI, the sample can be as small as eight microliters. A microliter is one millionth of a liter and about the size of a single salt crystal. Samples of that size don't require upfront chemistry that could take days to weeks to complete.

"This truly is a valuable rapid screening tool that is applicable both in the laboratory and out in the field," said Ashlee Swindle, SRNL radiochemist and PI. "You can collect samples in an emergent fashion, or you can do things more methodically in a fixed laboratory setting, and you would still get your results in about five minutes or less."

Sending samples away to be tested, whether radiological or non-radiological,

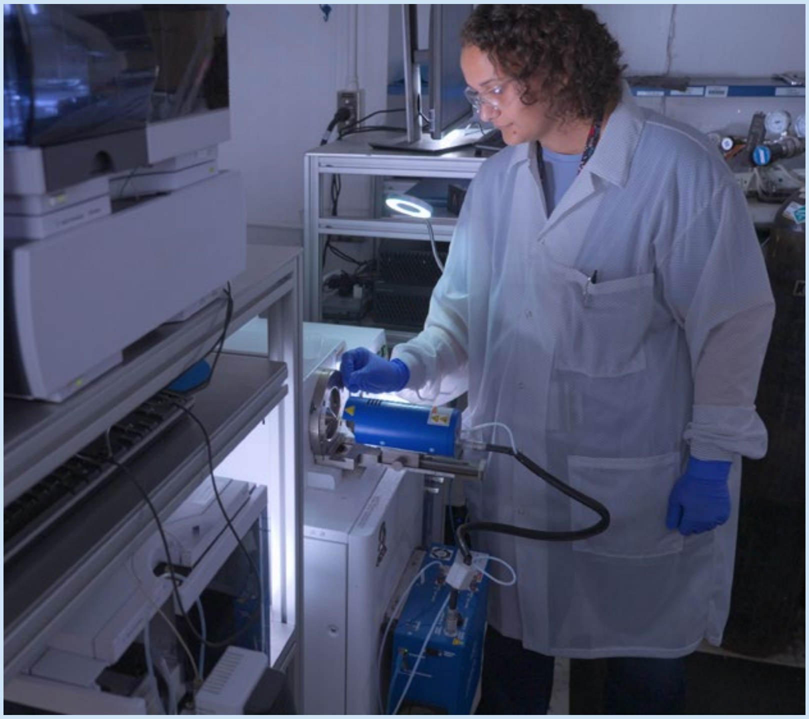
Opposite: SRNL radiochemist Ashlee Swindle and Guido Verbeck, Augusta University joint appointee are working together to provide proof of concept using non-radiological surrogates and ultimately reduce analysis for isotopes. (Photo: Chance Briley, SRNS) comes with a huge cost. Utilizing this capability with already employed field systems and being able to provide analyses in a significantly shorter amount of time eliminates the cost barriers.

The PSI team is partnering with Augusta University through a joint appointment with Guido F. Verbeck, an expert in analytical science with a strong emphasis in mass spectrometry. Together, they will explore inline miniature radiochemical separation of analytes of interest at their original location. The first step is providing proof of concept using non-radiological surrogates, and ultimately reduce analysis for isotopes, like strontium-90, from weeks to minutes.

"To ignite the nuclear energy renaissance, SRNL is accelerating the development and deployment of next generation nuclear technologies. The PSI team is laying the groundwork for expedited analytical support to help pave the way for pilot advanced reactors to achieve criticality by July 4, 2026," Kelly said. The PSI team is preparing for what's to come with further development of the capability focusing on fuel recycling and reprocessing.

"If we're going to lean forward and prepare for the future, we need the capability to reduce complexity, reduce research and development time, and minimize the workforce burden so that people can focus on high-value tasks while automation and artificial intelligence can shoulder the repetitive and time-intensive work," said Kelly. "If we are serious about supporting the nuclear energy renaissance, ensuring abundant, reliable, and affordable energy for the United States, these types of technologies must be operational today, not tomorrow."

SRNL scientists prepare a sample on a paper wedge to be inserted into the mass spectrometer. (Photo: Brad Bohr, SRNS)



SRNL scientist Katelyn Smith places a paper wedge into the mass spectrometer to perform the paper spray ionization technique. (Photo: Brad Bohr, SRNS)

The SRNL Joint Appointment Program

Expanding Research and Developing Tomorrow's Workforce

by Jeff Carter

Savannah River National Laboratory has long been at the forefront of addressing national challenges in energy, environmental stewardship, and national security. A pivotal component of SRNL's strategy to enhance its research capabilities and foster innovation is its Joint Appointment Program. This program, which partners university faculty with SRNL researchers, offers benefits to both the laboratory and participating academic institutions.

The program serves as a conduit for developing a skilled workforce adept in addressing national laboratory missions. Joint appointees often involve students in their research projects, providing them with hands-on experience and fostering the next generation of scientists and engineers. This collaborative environment ensures a continuous influx of talent into SRNL and the Department of Energy.

University faculty engaged in joint appointments benefit from strengthened ties with a leading national laboratory. These partnerships facilitate collaborative research opportunities, joint research publications, and access to SRNL's state-of-the-art facilities. Such affiliations enhance the university's research profile and enable new opportunities through access to national laboratory resources.

"One of the great outcomes of our Joint Appointment Program is the publication of research, which furthers scientific understanding," said SRNL Director of Innovation and University Engagement Liz Hoffman. "This program gives the lab an opportunity to increase our ability to put science to work."

Faculty members involved in the program can integrate their SRNL-based research experiences into their teaching, providing students with exposure to real-world applications of theoretical knowledge. This integration enriches the educational experience, preparing students for careers in research and development.

SRNL gains access to the latest academic research and methodologies by collaborating with faculty members from leading universities. This infusion of new ideas and perspectives is crucial for tackling complex scientific and engineering challenges. For example, the appointment of Dr. Guido Verbeck from Augusta University, an expert in mass

Guido Verbeck (left) and Dale Hitchcock (second from right) participate in SRNL's 2025 Joint Appointment Workshop. (Photo: LJ Gay, SRNS)

spectrometry instrument design and development, demonstrates how such collaborations can bolster SRNL's research, particularly in advanced chemical analysis and detection techniques.

"Academia spends time on fundamentals while SRNL can focus on specific problems to solve," said Verbeck. "As a result of this collaboration, things can move quickly, allowing academic research to be translated to real world solutions. SRNL has an award-winning drone program, and I am currently working on a fire detection program to assess individuals and fires through the use of drones by integrating mass spectrometry readings from the field. This technology will also eventually allow us to address emerging threats to protect first responders, the environment and our borders."

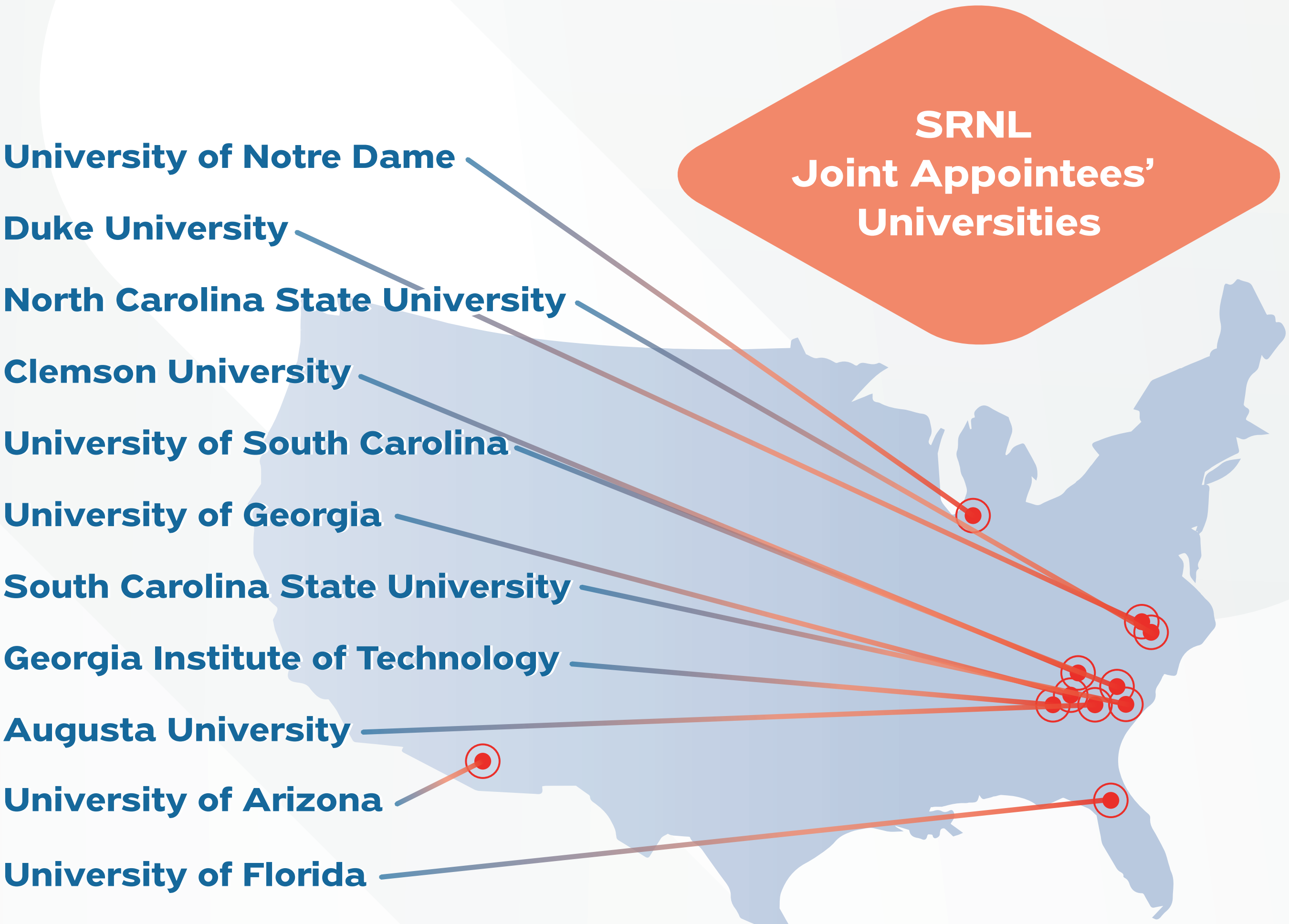
Joint appointments often lead to collaborative research projects, increasing the number of novel research solutions to complex national and energy security challenges.

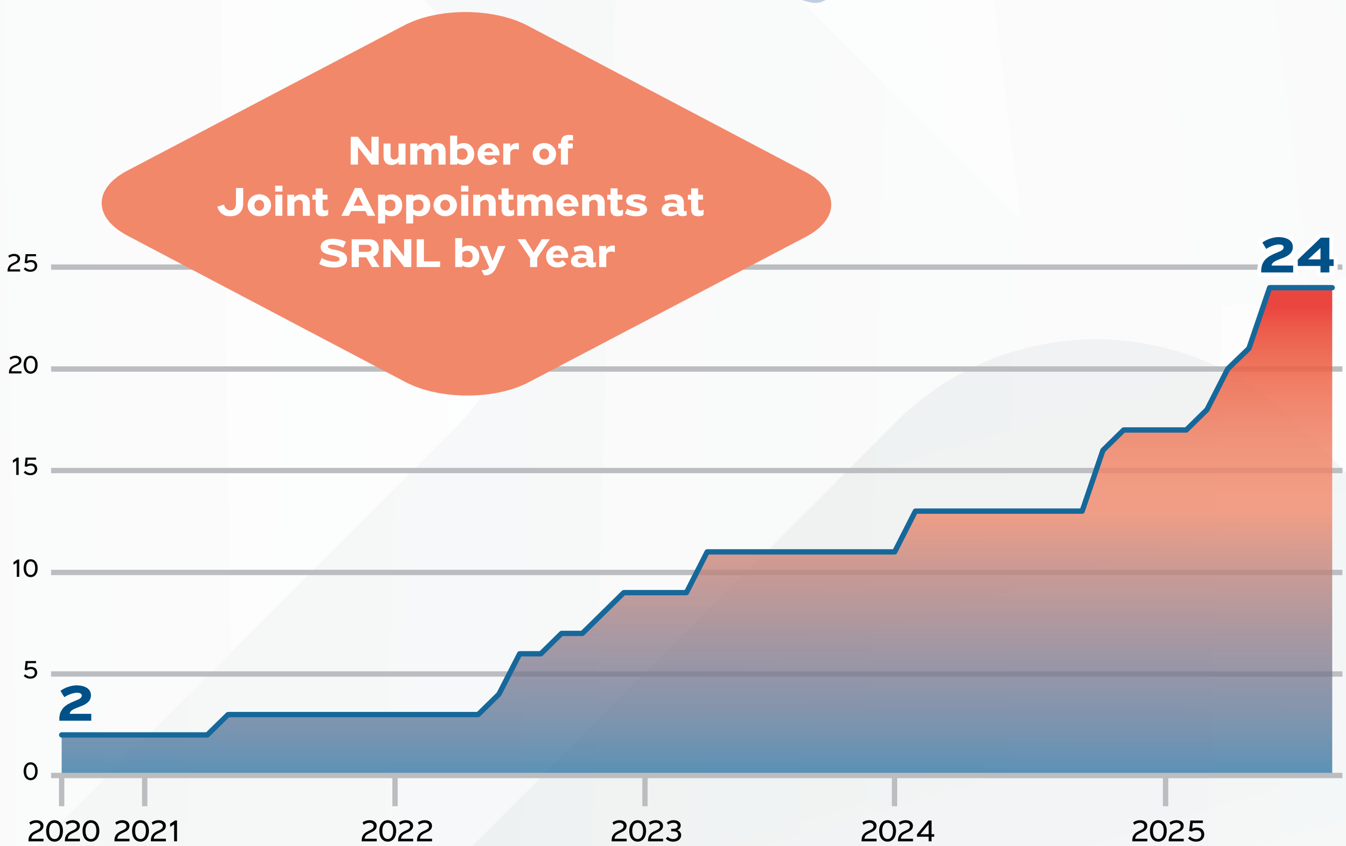
In addition to collegiate faculty, SRNL employees can also be jointly appointed at universities. Integrating SRNL researchers into universities can lead to opportunities for increased collaboration, student engagement, and ultimately, increased solutions for the DOE and the National Nuclear Security Administration.

Dale Hitchcock, a staff scientist with SRNL whose work has primarily focused on material interactions with tritium, is jointly appointed to Clemson University and focusing his research on the synthesis and characterization of advanced materials for both energy and nuclear applications.

The SRNL Joint Appointment Program advances scientific discovery while also contributing to the development of a skilled workforce equipped to tackle the nation's most pressing challenges by fostering partnerships bridging the gap between theoretical research and practical application. These valuable collaborations promise to drive innovation and ensure a sustainable future for both SRNL and its university partners.

For more information on SRNL's joint appointment program or to learn more about our joint appointees, please visit https://www.srnl.gov/partner-with-us/academia/joint-appointments.


SRNL
Joint Appointees'
Universities
University of Notre Dame
Duke University
North Carolina State University
Clemson University
University of South Carolina
University of Georgia
South Carolina State University
Georgia Institute of Technology
Augusta University
University of Arizona
University of Florida


Number of
Joint Appointments at
SRNL by Year
25
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5
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2
24
2020
2021
2022
2023
2024
2025

Advanced Manufacturing Collaborative Ushers in New Era of Innovation

by Mike Ettlemyer

The new AMC building on the campus of the University of South Carolina Aiken (Photo: Susanna King, SRNL)

Savannah River National Laboratory opened the Advanced Manufacturing Collaborative on the University of South Carolina-Aiken campus in early August. The event marked the culmination of several years of planning and construction, which begins an exciting new era of innovation through greater engagement between the laboratory, academia and private industry.

The ribbon-cutting celebration was attended by U.S. Secretary of Energy Chris Wright, Sen. Lindsay Graham, Rep. Joe Wilson and our partners from DOE-EM, which provided funding for the facility and shepherded the project to completion. State and local officials who have been steadfast partners in seeing the AMC become a reality were also in attendance.

Described as the new front door to SRNL, the AMC will accelerate the development and deployment of new technologies for manufacturing such as additive manufacturing, AI-driven automation and novel materials for fusion energy and energy resilience. The AMC expands SRNL's footprint beyond the Savannah River Site, reducing barriers to working with its top experts in environmental technologies, energy infrastructure and nuclear energy.

Spanning two stories and covering more than 63,000 square feet, the AMC features diverse lab spaces including bench, high bay, computational and industrial engineering labs. The facility meets or exceeds LEED Silver certification standards with flexible, energy efficient spaces delivered under a DOE contract with North Wind Construction Services. The AMC includes open office layouts, multiple formal and informal meeting areas, a multipurpose classroom and conference rooms, informal meeting spots in public areas, and a versatile collaboration space.

Lab Director Johney Green (center) and engineer Caleb Scott (right) show off the AMC's Advanced Visualization and Analytics Lab to Secretary of Energy Chris Wright (left). (Photo: Laura Russo, SRNS)

The new facility will help SRNL accelerate collaborations with academia, industry partners and government agencies, driving innovation and supporting the Department of Energy mission and the lab's critical work in environmental stewardship, national security and energy resilience.

"The Advanced Manufacturing Collaborative represents more than a building – it represents a bold step towards redefining how our national laboratory works with industry and academia to solve some of the nation's most pressing energy and security challenges," said SRNL Director Johney Green. "We are grateful to everyone across the Department of Energy, the University of South Carolina-Aiken, our partners and dedicated laboratory staff for the many years of work to make this vision a reality."

By bridging R&D with real-world applications, the AMC will serve as an economic catalyst for the Southeast region and its robust manufacturing ecosystem to solve regional and national challenges. It will support job creation, expand industry partnerships and facilitate technology commercialization.

"The AMC is positioned as a cornerstone to the broader work we are doing within the Technology Partnerships Office to engage new external partners for technical work or licensing of SRNL intellectual property," said Daren Timmons, director of Technology Partnerships and the Advanced Manufacturing Collaborative. "We are very excited to have a visible testament to this intentional effort!"

SRNL will operate the facility, which will attract new technology and manufacturing to the region, as well as build a pipeline of talent to the lab and greater Savannah River Site. This will ensure that the AMC will serve the DOE and the nation for many years to come.

SRNL's Collaborative Partnerships Drive Innovation in Environmental Stewardship

by Catelyn Folkert

While partnerships across industry, academia and the Department of Energy complex are a critical component of Savannah River National Lab's future, they also served as a foundational element throughout the lab's history. The 1989 Tri-Party Agreement between the DOE, the Washington State Department of Ecology and the U.S. Environmental Protection Agency brought attention to the critical need for cleanup at the Hanford Site. The decision to pursue vitrification of the waste was in alignment with efforts already underway at SRNL providing an ideal opportunity to continue collaboration with the Hanford Site on waste cleanup and compliance.

Samples of vitrified waste. (Photo: Laura Russo, SRNS)

Tank Waste Remediation System

The Tank Waste Remediation System program began in the early 1990s, strengthening SRNL's working relationship with the Hanford Site and continuing the long-standing relationship with the Pacific Northwest National Laboratory (PNNL). At that time, SRNL was primarily focused on glass formulation and melter technology research and development to support the development of Hanford's waste vitrification facility. By the late 1990s, DOE established the Focus Area program to conduct waste treatment research and development across the DOE complex. The Tank Waste Focus Area facilitated collaboration on tank waste research at Hanford and the Savannah River Site.

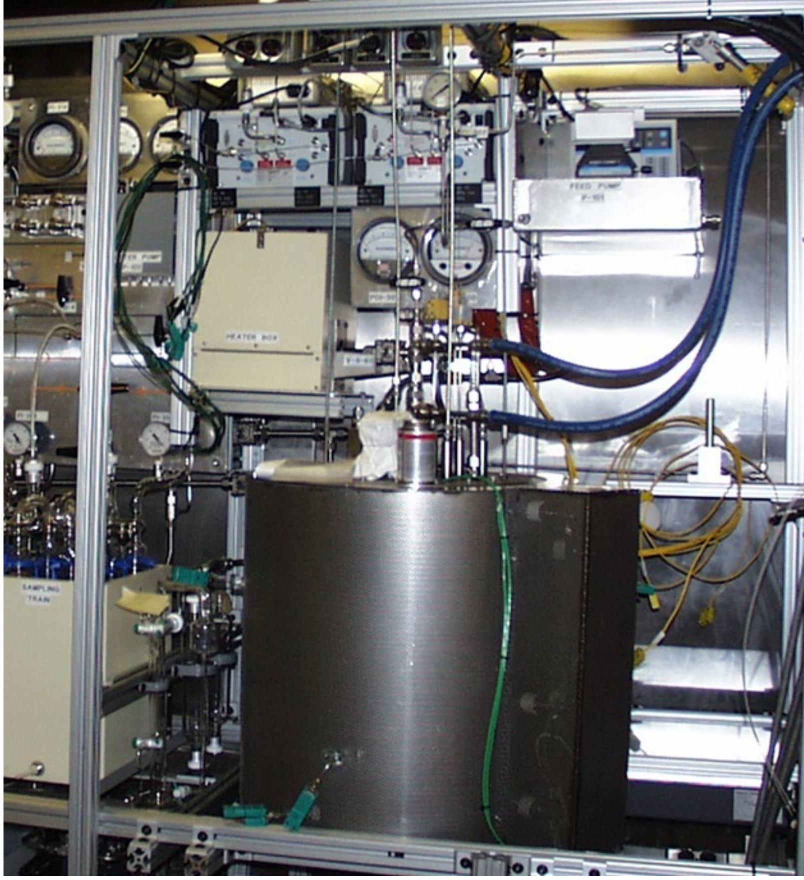
By the early 2000s the DOE's Office of River Protection was established to oversee remediation and waste treatment efforts at Hanford. Several employees from SRS and SRNL transitioned to Hanford to provide support for other contractors on the new Waste Treatment Project (WTP). The WTP research and development program was intended to provide validation for the pretreatment, low-level and high-level vitrification facilities to be conducted at Hanford. Several employees at SRS and SRNL were chosen to go to Hanford to be involved with waste treatment projects. Simulant testing was conducted at SRNL in support of the program. This included near full-scale testing on filtration, precipitation, ion-exchange, mixing and vitrification processes. Actual waste samples were also shipped to SRNL facilities to demonstrate treatment of real waste. Research and testing spanned approximately 5 years. The results were used to validate the process outlines, known as flowsheets, selected by Hanford and to predict challenges the facility could face when brought online.

Large C-Melter

As the tank waste remediation system was being developed, additional SRNL scientists and engineers were leveraging their expertise to support the design and planning of a small-scale melter for testing with actual radioactive samples of Hanford tank waste. The objective was to produce kilogram quantities of waste-containing glass for characterization of metals and radionuclides capable of being archived for regulatory characterization within a continuously fed, resistance heated melter known as the “Large C Melter.” The sample that was vitrified had been subjected to complete pretreatment at SRNL including strontium/transuranics precipitation, filtration to remove entrained solids, cesium and technetium removal by ion exchange and concentration by evaporation. Once the pretreatment process was complete resulting in ~ 6.7 liters of concentrated supernate, glass formers were added to create the melter feed. The glass former recipe was sourced from the Vitreous State Laboratory at the Catholic University of America, who SRNL collaborated with to conduct glass formulation work through sharing of analytical data from samples.

As melting begins, it is critical to sample and analyze the offgas (the release of gas that is produced from heating up and melting the aqueous slurry melter feed material) for metal and radionuclides through EPA methods. Offgas samples must also be analyzed for fixed gasses, organics and combustion gasses to ensure safety standards. SRNL provided support in offgas testing for safety and compliance, which culminated in a 2002 report describing melter tests, glass characterization, offgas analyses and rheology testing of the Large C concentrate and melter feed slurry.

SRNL scientist Charles Crawford was involved in the project from inception. “To do processing on this scale in the late 1990’s was a unique opportunity,” said Crawford. “No other pretreatment or vitrification samples were performed on this scale at the time. It also provided the opportunity to learn more about Hanford’s system and provide analysis of data to positively impact the design and development of their melter. SRNL uniquely possesses both the necessary facilities and the technical expertise required to support Hanford’s efforts, which would’ve been difficult to find elsewhere at that point in time.”



A portion of the Large C Melter (Photo: SRNS)

Pretreatment Facility

SRNL became more closely involved with Hanford’s pretreatment facility technical issue resolution in 2000. The baseline Waste Treatment and Immobilization Plant flowsheet included sending tank waste to the pretreatment facility as a supernate stream, the liquid found above the sediment in a solution, and a slurry stream, a mixture of solid particles suspended in a liquid. The first step of the pretreatment process was to combine these two streams. Step two involved filtration to separate the supernate stream, which would eventually be sent to an additional facility. Before the stream could progress, cesium and solids would be removed, lowering the radioactivity so this could be treated as low-level waste. At this point, the resulting low-level waste would typically be solidified as grout. Grout is cost-effective to incorporate and unlike vitrification, will capture water and is thus a closed system. It’s also a simple process that can be stopped and started without a negative impact to the final product.

The Low-Activity Waste Facility in Hanford, Washington. (Photo: Bechtel)

Through SRNL's supporting analysis, it was determined that the pretreatment facilities mixing technology was not suited for mixing slurries.

Low Activity Waste (LAW) Facility

The concept of a Tank Side Cesium Removal facility was introduced to initiate waste processing with a modular system that could execute the filtration and cesium removal steps to produce low activity waste. The new facility was physically smaller but had a similar throughput. SRNL has a similar tank side system for treating waste.

"Tank waste processing efforts at the Savannah River Site have allowed SRNL to compile decades of knowledge and expertise," said SRNL engineer Mike Stone. "We want to leverage that experience to support efficient and effective tank waste treatment at Hanford."

"SRNL has played a critical role in the success of the Hanford Low-Activity Waste vitrification mission at the Waste Treatment Plant," said SRNL scientist Rich Wyrwas. "Hanford has pursued a more complex approach to treat all its waste through a vitrification facility, driven in part by commitments made to stakeholders. SRNL's role has been to bring hard-earned lessons from other successful DOE projects forward, to help Hanford navigate its technical challenges and to demonstrate that collaboration and support from across the DOE complex can make national missions more achievable."

From 2016 through today, SRNL has been involved with various ongoing projects alongside Hanford. The lab was involved in a panel that developed an integrated control strategy for Hanford's facilities to ensure key facilities effectively communicated with each other. The panel also explored concerns for corrosion in Hanford's LAW facility. SRNL has provided analysis of corrosion samples and glass composition samples from the melter to determine potential impacts and opportunities for improvement.

In addition to the tank corrosion work, SRNL is also collaborating with Hanford on their glass compositions and potential corrosion impacts of those compositions within the melter. SRNL led two teams from the Network of National Laboratories for Environmental Management Stewardship to support waste treatment efforts at Hanford and continues to share knowledge and experience through peer-reviews of work by Hanford scientists and engineers. These teams led to re-evaluation of grout alternatives for the low-activity portion of the waste using options not available at the start of the Hanford mission, and a technology R&D roadmap that could save tens of billions of dollars and many years on the tank waste mission.

Though the shape of the partnership continues to evolve, the spirit of collaboration helps drive SRNL's mission of environmental stewardship and directly impacts the success of the national lab system and the DOE complex.

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