U.S. DEPARTMENT OF ENERGY (DOE)
NATIONAL NUCLEAR SECURITY ADMINISTRATION (NNSA)
DEFENSE NUCLEAR NONPROLIFERATION (DNN)

DNN Sentinel

DEFENSE BY OTHER MEANS

VOL. III, NO. 2

IN THIS ISSUE:

From the Principal Assistant Deputy Administrator

"What makes you unique?" It is a question that has plagued prospective employees and college applicants for decades. When it comes to DNN, however, I know the answer: the combination of our dedicated headquarters staff and the incomparable science and technology (S&T) base of the national laboratories is what makes DNN a unique tool in our nation's national security toolbox. In this issue of the *Sentinel*, I wanted to highlight the scientific foundations of DNN's work—domestically and internationally—and share some of the exciting, cutting-edge projects that we are executing on a daily basis. We are able to access this S&T base because of long-term investment by NNSA and the larger Department of Energy, which ranges from basic fundamental science to applied R&D. We work hand in glove(box) with the labs, plants, and sites across the DOE complex to scope, design, and implement projects. Sometimes that implementation takes us on the road to conference rooms in Vienna, Austria, or remote locations in the desert or on the steppes. The ability to directly access these world class technical experts and facilities makes us a valuable partner for our international projects and earns us a unique place in the U.S. interagency process. I value our labs, plants, and sites and know that their strength is our not-so-secret weapon.

David Huizenga
Principal Assistant Deputy Administrator
Defense Nuclear Nonproliferation

DNN SENTINEL:
DEFENSE BY OTHER MEANS

VOL. III, NO. 2

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NNSA BLOG

IN THE NEWS

U.S.-China Cooperation Eliminates Weapons-Usable Nuclear Material from Ghana

Reactor conversions and removals, such as the one in Ghana in 2017, eliminate the risk that weapons-usable material could be stolen or diverted for malevolent use.

After a decade of complex scientific and political coordination, DNN's Office of Material Management and Minimization (M^3), in cooperation with Ghana, China, and the International Atomic Energy Agency (IAEA), converted Ghana's GHARR-1 Miniature Neutron Source Reactor (MNSR) in Accra, Ghana, from highly enriched uranium (HEU) to low-enriched uranium (LEU) fuel on June 13, 2017. This marks the 99th successful conversion or verified shutdown of a civilian HEU-fueled research reactor or isotope production facility to date.

The successful conversion of GHARR-1 MNSR showcases M^3's ability to harness the collective technical expertise of a unique group of international participants to further our shared mission of HEU minimization. Reactor conversion eliminates HEU in civilian applications while ensuring that facilities maintain the scientific capabilities they need to meet their vital missions.

Ghana's Chinese-origin HEU was returned to China on August 29, 2017. NNSA technical experts and IAEA safeguards inspectors monitored the process of loading the fuel into a transfer cask, which was transported safely and securely to China. This shipment removes the last known HEU from Ghana, making it the 32nd country plus Taiwan to become HEU-free. To date, M^3 has removed or confirmed the disposition of more than 6,000 kilograms of HEU and plutonium worldwide, reducing the global proliferation threat.

Ghana's MNSR is the first commercial reactor of its type to be converted outside of China, creating a model for similar cooperation on future MNSR conversions. There are five remaining HEU-fueled MNSRs in the world, in China, Nigeria, Pakistan, Iran, and Syria. Work to convert Nigeria's MNSR has already begun, with the goal of converting it in 2018.

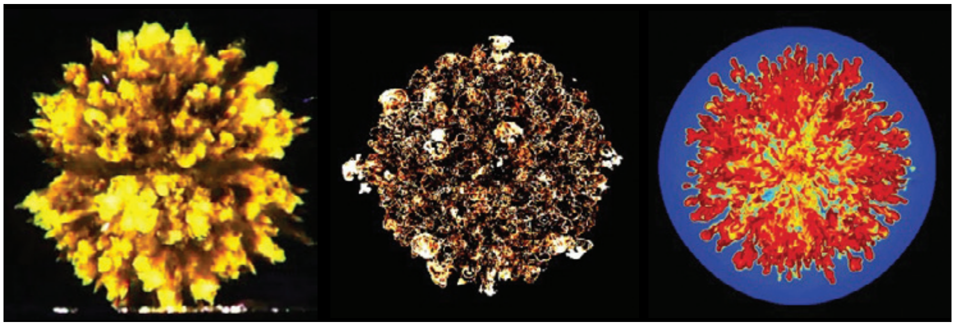
Learn more: https://nnsa.energy.gov/mediaroom/pressreleases/nnsa-removes-all-highly-enriched-uranium-ghana

https://nnsa.energy.gov/mediaroom/pressreleases/nnsa-spearheads-international-effort-convert-ghana-reactor-leu-fuel

Alexandra Meehan, a Fellow in the Nonproliferation Graduate Fellowship Program with M^3, contributed to this article. She is currently pursuing a Master's Degree in International Security at George Mason University.

Harnessing Weapon Programs for Proliferation Detection R&D: A Benevolent Confluence

By Daniel I. Mattei and Riad Manaa



The attributes of a high explosive test (left) are closely predicted in a computer modeling capability (center) that produces a temperature map (right) of the hot matter and an eventual observed signature.

Countries on the path to developing nuclear weapons conduct non-nuclear explosives testing to develop confidence in nuclear weapon designs and their weapon components without using fissile material. These tests, which vary in purpose, materials, and energy yield, generate unique signatures and "observables" that serve as clues regarding the sophistication of the device tested, the maturity of a country's nuclear weapons program, and possibly the intent behind the tests. Defense Nuclear Nonproliferation's Office of Research and Development (DNN R&D) developed a project to combine advanced physics design codes with newly developed models to advance our capability to monitor and analyze foreign non-nuclear explosives tests.

The United States ended its full-scale nuclear testing program in 1992. Ever since, the country has relied on computational modeling and simulations within the NNSA's Defense Programs (DP) to ensure the performance, safety, and reliability of the nuclear stockpile. DP also regularly conducts sub-critical experiments, partly to improve and validate their models. These efforts present an opportunity for DNN R&D to advance capabilities for detecting signs of non-nuclear testing that indicate early proliferation efforts.

Over the past two years, DNN R&D's nuclear weaponization detection program has sponsored research efforts that tie the observable impacts of high explosive tests to activities associated with a nuclear weapons program. The combined expertise of scientists at NNSA's Los Alamos, Lawrence Livermore, Sandia, and Pacific Northwest national laboratories have jointly developed predictive, end-to-end modeling capabilities that can help differentiate weapons development from conventional high explosive tests. Researchers have developed a science-based simulation framework to model the characteristics and signatures of a non-nuclear test device, from the early detonation to late time combustion, to identify key observable impacts based on the device design. The modeling predictions are then tested against actual data collected from hydrodynamic tests conducted at the Nevada National Security Site.

One of the key objectives of the weaponization detection program is to have a modeling capability that will assist DNN R&D partners to determine whether a proliferator high explosive test was merely a conventional, high explosive test or one of nuclear proliferation concern. The DNN R&D investment, expanding upon DP's efforts, is a beneficial confluence by both mission areas and will guarantee a more robust simulation capability to support national security objectives.

LTC Daniel Mattei is a Senior Program Manager in DNN R&D's Office of Proliferation Detection. LTC Mattei spent the last nine years of military service as a Nuclear and Counterproliferation Officer with assignments at the Defense Threat Reduction Agency and 20th CBRNE Command.

Riad Manaa, PhD, is a Technical Advisor in DNN R&D's Office of Proliferation Detection. As a staff scientist at Lawrence Livermore National Laboratory for 20 years prior, he was principal investigator on several computational and experimental projects in both defense programs and nuclear nonproliferation.

Introducing New Detection Equipment for New START Inspections

By Carolyn Pura

In July 2017, U.S. inspectors successfully deployed a new set of U.S. radiation detection equipment (RDE) on an inspection in the Russian Federation under the "Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms," also known as the New Strategic Arms Reduction Treaty (New START). The introduction of the equipment during this inspection was the culmination of a five-year development effort by Sandia National Laboratories coordinated through the Office of Nuclear Verification within DNN. The new equipment was approved for use under the Treaty in May 2017 and provides a key new technical asset for confirming Russian declarations.

Under the original START Treaty (in effect from 1994 through 2009) and now under the New START Treaty, RDE is used to confirm that an object declared to be non-nuclear is, in fact, non-nuclear. The RDE uses a custom Helium-3-based neutron detector with a commercial electronic counter that counts neutrons over a fixed time period. If the measurement of the declared non-nuclear object is within a defined threshold, after accounting for background radiation, the object is confirmed as non-nuclear. This activity supports the confirmation of the declared number of deployed reentry vehicles, a primary objective of New START inspections.

The new equipment replaces RDE originally developed by Sandia in the late 1980s. Repair and replacement of existing RDE components was becoming increasing difficult due to age and lack of replacement hardware, adding to system reliability concerns. DNN personnel involved in the New START implementation effort worked with Sandia technical experts and inspectors from the Defense Threat Reduction Agency (DTRA) to explore new RDE to replace the aging equipment.

The design for the new RDE received favorable review by the interagency New START team, with the prototype system undergoing successful testing by DTRA inspectors. The new system is considerably lighter in weight (a total of 120 pounds versus 200 for the old system) and is smaller and more easily transportable—a major improvement for U.S. inspection teams. Sandia made the equipment more rugged to support overseas deployment and conducted extensive testing under difficult transport conditions to demonstrate its high reliability. Taking advantage of advances in calibration practices, an operational check using a radioactive source is now only needed once at an inspection site, rather than each time a measurement is made, thereby increasing efficiency of inspectors. With these improvements, the new RDE will provide the United States a valuable verification resource for the remainder of the New START Treaty and potentially beyond.

A developer at SNL demonstrates operation of the New START RDE.

Carolyn Pura has worked on contract as a technical advisor to DNN's Office of Nuclear Verification for 10 years and was a member of the U.S. delegation that negotiated the New START Treaty. Prior to her work with DNN, she had a successful 30-year career at Sandia National Laboratories as a weapon designer and manager of technical development for arms control and homeland security applications.

IAEA Appoints SRNL to Network of Analytical Laboratories

By April R. Gillens

Acceptance as the newest member of IAEA's lab network is a testament to SRNL's strict quality assurance and quality control practices.

Earlier this year, the International Atomic Energy Agency (IAEA) certified Savannah River National Laboratory (SRNL) as a member of its Network of Analytical Laboratories (NWAL). The IAEA collects both environmental and nuclear material samples to verify States' declarations and to provide assurances of the absence of undeclared nuclear materials or activities. While many of these samples are analyzed at the Seibsersdorf Analytical Laboratory in Vienna, the IAEA uses over 20 NWAL laboratories across the globe to support its analysis capabilities.

Four other Department of Energy national labs (Oak Ridge, Pacific Northwest, Lawrence Livermore, and Los Alamos) also are certified NWAL participants, approved to perform analysis on environmental samples. SRNL is the first lab in the United States and second in the world approved specifically to analyze nuclear material.

"An important part of DNN's mission is ensuring that the IAEA has the capacity to implement states' safeguards obligations," said David Huizenga, DNN's Principal Assistant Deputy Administrator. "The technical expertise provided by the national labs in the NWAL goes a long way to helping us support that important mission." International safeguards are the set of technical measures applied by the IAEA to independently and objectively verify that a State's nuclear material is accounted for and not diverted to nuclear weapons or other nuclear explosive devices.

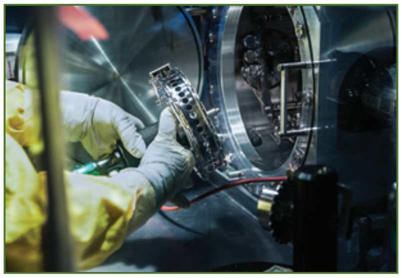
DNN's Office of Nonproliferation and Arms Control (NPAC) supports the U.S. NWAL laboratories by helping maintain their operating capability and proficiency. The U.S. Department of State also supports the laboratories through major equipment acquisitions.

April R. Gillens is a former NNSA Graduate Fellow and current contractor supporting NPAC. She holds a Bachelor of Science degree in Biological Engineering from North Carolina A&T State University as well as a Master of Science and Doctor of Philosophy degree in Environmental Engineering and Science from Clemson University.

More About NWAL

NWAL participants specialize in bulk, particle, and nuclear material analyses. Bulk analysis laboratories receive environmental samples, which are destructively analyzed by mass spectrometry for trace levels of radioactivity. Particle analysis laboratories identify and analyze particles on environmental samples. Nuclear material laboratories analyze in-process and inventory production samples, such as nuclear fuel pellets. Samples sent to the NWALs for analysis are blind—there is no attributable information about the location from which the sample was taken. The IAEA only sends instructions on the type of analysis required to be performed.

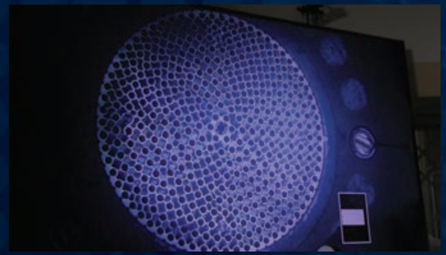
The NWALs also measure pre-inspection check samples (PICs), swipe samples taken by an IAEA inspector prior to an inspection to prevent cross-contamination. The High Flux Isotope Reactor at Oak Ridge National Laboratory screens PICs for fissile material using delayed neutron activation analysis, a process that exposes each sample to a thermal neutron flux and measures the neutron-rich fission products to determine the Uranium-235 fissionable equivalent mass from the post-irradiated sample.



SRNL's TRITON™ thermal ionization mass spectrometer sample wheel.

SCIENCE THAT SUPPORTS THE MISSION

National laboratories, plants, and sites across the country conduct research, development, testing, and operations activities that support DNN's nonproliferation capabilities. (See DNN Sentinel, Vol. III, No. 1.) Look through some examples below, and turn to page 12 to learn about how DNN works with the national laboratories, plants, and sites.



ARGONNE NATIONAL LABORATORY

Minimize Nuclear Materials – Conduct high-fidelity simulations of complex physics and chemistry that enable facilities, such as GHARR-1 research reactor in Ghana, to convert nuclear fuel or isotope processes to low-enriched uranium while maintaining mission effectiveness and safety.

BROOKHAVEN NATIONAL LABORATORY

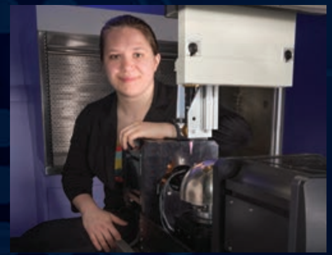
Detect Proliferation – Advance gamma and neutron detection technology, including characterizing new detector materials

PACIFIC NORTHWEST NATIONAL LABORATORIES

Counter Nuclear Smuggling – At the radiation detection test bed, test new equipment, procedures, and technology for next-generation tools to detect radiological or nuclear materials and explosives.

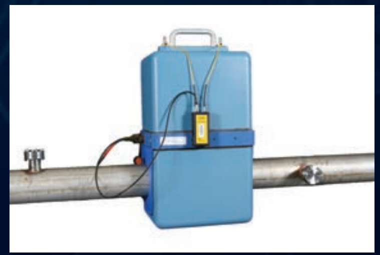
IDAHO NATIONAL LABORATORY

Minimize Nuclear Materials – Conduct performance tests of low-enriched uranium fuels to replace high enriched fuels using the BONA4INL measurement bench at the Hot Fuel Examination Facility.



KANSAS CITY NUCLEAR SECURITY CAMPUS

Detect Proliferation – As a recognized leader in developing additive manufacturing processes and applications, provide expertise on its application to nonproliferation policy initiatives.



OAK RIDGE NATIONAL LABORATORY

Detect Material Production – Develop next-generation technology for safeguarding nuclear materials on-site, such as the Online Enrichment Monitor, which continuously measures the relative enrichment of UF6 gas flowing through process pipes in uranium enrichment plants.

LAWRENCE LIVERMORE NATIONAL LABORATORY

Counter Nuclear Smuggling – Guide advanced research and development for new detection technologies, such as developing the first plastic material capable of efficiently distinguishing neutrons from gamma rays.

NEVADA NATIONAL SECURITY SITE

Detect Nuclear Explosions – Detect Underground Nuclear Explosions: Support DNN's Underground Nuclear Explosion Signatures Experiment by drilling into the collapsed chimney of a legacy underground nuclear explosion to enable predictive models of gas migrating to the surface.

LOS ALAMOS NATIONAL LABORATORY

Detect Nuclear Explosions – Design, develop, manufacture, deliver, and support the operation of detection instrument payloads for the U.S. Nuclear Detonation Detection System.

SANDIA NATIONAL LABORATORIES

Secure Nuclear Facilities – Develop new approaches to make "security by design" an intrinsic component of physical protection for radiological and nuclear materials, devices, and facilities and test them at the Sensor Testing and Evaluation Complex.

PANTEX/Y-12

Minimize Nuclear Materials – Secure, remove, and dispose of nuclear weapons and weapons usable materials around the globe.

SAVANNAH RIVER NATIONAL LABORATORIES

Dispose of Radiological Materials – Reprocess spent nuclear fuel and other nuclear materials for dispositioning.

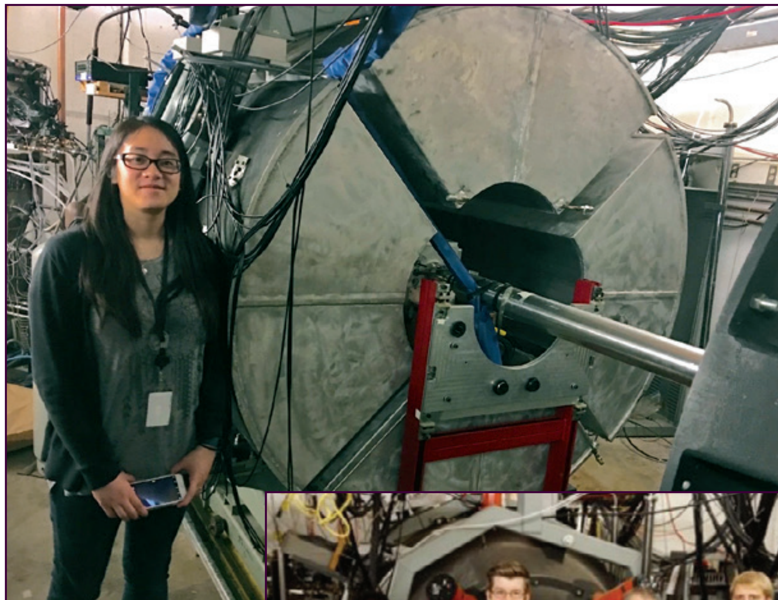
Livermore-Led Team Commissions Largest Charged Particle-Neutron Detector System in the U.S.

By Donna Wilt and Greg Schaaff

Accurate and precise nuclear reaction data are critical to performing nuclear forensics. Practitioners rely on this data to analyze seized material not in the possession of approved individuals. These data also help interpret radiochemical data. In both cases, accurate nuclear data can provide clues to where the material or device may have come from and who may be responsible.

NNSA's Defense Nuclear Nonproliferation Office of Research and Development (DNN R&D) and Defense Programs (DP) jointly funded upgrades to the Texas A&M NeutronBall detector located at the Texas A&M Cyclotron Institute to create a powerful and unique capability to determine the cross sections of short-lived nuclei produced during a nuclear detonation. As one of the largest neutron detectors in the world, and the most massive charged particle neutron detector system in the United States, the NeutronSTARS (Neutron-Silicon Telescope Array for Reaction Studies) system complements a suite of existing irradiation and detection facilities across the country. In addition to nuclear forensics, the nuclear data collected by this instrument will support other NNSA missions, including proliferation detection, international safeguards, and stockpile stewardship.

Led by Dr. Jason Burke, Lawrence Livermore National Laboratory (LLNL) physicists Robert Casperson, Barbara Alan, Richard Hughes, and UC Berkeley PhD student Oluwatomi Akindele, along with collaborators from the Texas A&M Cyclotron Institute, designed the new detector configuration. Half of the NeutronSTARS array achieved "first light" on December 15, 2016, and the full detector array went operational January 5, 2017.



Above: Barbara Alan with the NeutronSTARS detector system on the K150 Cyclotron beam line at Texas A&M Cyclotron Institute. Inset: Some members of the LLNL-led team (from left): Tomi Akindele (UC Berkeley PhD graduate student), Robert Casperson (LLNL staff member), Richard Hughes (LLNL staff member), and John Koglin (Lawrence Graduate Scholar/Penn State graduate student).

NeutronSTARS consists of a large vacuum target chamber housing a highly segmented (96-element) silicon telescope array. This is surrounded by a large neutron detector and an impressive complement of high-speed digital and conventional electronics. When irradiating a target with the high-energy particle beam, the unique arrangement of the NeutronSTARS system can measure with high precision the time it takes for charged particles, fission products, recoiling nuclei, and neutrons produced by the collisions to reach the various detectors.

"With the addition of NeutronSTARS to the NNSA Complex's available detector systems, the United States has gained a powerful new tool for our investigations into fundamental nuclear reactions supporting stockpile stewardship and technical nuclear forensics," Burke explains.

After a series of calibration runs to verify the NeutronSTARS performance in late January, the research team fielded the first full-up experiment at the Texas A&M Cyclotron Institute in April 2017.

The team is continuing to analyze the enormous amount of data generated in the experiments to more accurately describe plutonium nuclear reaction cross-sections. The team presented their work at the Division of Nuclear Physics Conference in October 2017 and published an article, "NeutronSTARS: A segmented neutron and charged particle detector for low-energy reaction studies," in the November edition of *Nuclear Instruments and Methods*. Ultimately, data gathered from these measurements will update international databases for nuclear reaction cross-sections, enabling nuclear science and engineering studies throughout the world.

Donna Wilt, PhD, is a Senior Program Manager and T. Gregory Schaaff, PhD, is a Technical Advisor for Nuclear Forensics Research and Development in DNN's Office of Nuclear Detonation Detection.

1st Annual Interagency Technical Nuclear Forensics Program Review

Nuclear forensics experts and end users provided perspectives on current nuclear forensics R&D and the challenges that face the field to more than 300 attendees at the Interagency Technical Nuclear Forensics Program Review.

Do you get a different perspective when you look across the totality of effort?

This was the question DNN's Offices of Research and Development posed when suggesting the first-ever joint interagency nuclear forensics research and development (R&D) program review to the National Technical Nuclear Forensic Center R&D Working Group. In July 2017 at Oak Ridge National Laboratory, the 1st Annual Interagency Technical Nuclear Forensics Program Review showcased R&D efforts that support missions at NNSA, Department of Homeland Security (Domestic Nuclear Detection Office and National Technical Nuclear Forensics Center), and Department of Defense (Defense Threat Reduction Agency). In all, there were nearly 300 attendees and more than 90 presentations from academic, industry, and national laboratory researchers resulting in the largest single joint representation of current nuclear forensics R&D results in the world. Nuclear forensic operational practitioners also provided their perspective in a dedicated plenary session and policy discussion. Attendees left the meeting with new relationships and opportunities to collaborate, as well as a better understanding of the challenges in improving nuclear forensics R&D and implementing R&D efforts into operations.

COUNTRY PROFILE: REPUBLIC OF KOREA

A Partner in Science and Technology

For more than 60 years, the United States and the Republic of Korea (ROK or South Korea) have worked together to combat regional and global threats. Much of this collaboration combines the science and technology capabilities of the two countries to advance nonproliferation capabilities.

Testing and Evaluation to Reduce Nuisance Alarms

DNN's Nuclear Smuggling Detection and Deterrence (NSDD) program has a robust relationship with the Korean Institute of Nuclear Safety (KINS) through peer-to-peer technical exchanges related to radiation detection. KINS is responsible for implementing a comprehensive national detection architecture to combat potential nuclear and radiological smuggling and has installed nearly 100 radiation portal monitors (RPMs) to date. KINS is interested in exchanging lessons learned with the United States.

One of the most pressing challenges is reducing the rate of nuisance alarms. To address this, a KINS team is developing an approach that will improve discrimination between nuisance and threat-based alarms based on identifying specific radioisotopes. NSDD is supporting KINS to evaluate modifications to the RPMs that will reduce nuisance alarms while maintaining effectiveness for detecting smuggling.

Earlier this year, an NSDD team visited KINS to learn about their development activity, assess the KINS team's resources and capabilities, and identify a way to collaborate. ROK scientists shared the technical details of their new RPM discrimination function, which includes a signal processing algorithm designed to extract spectral information useful in identifying isotopes. Then, working remotely, the NSDD and KINS scientists jointly developed a testing and evaluation plan that they exercised together during a week-long campaign at Pacific Northwest National Laboratory (PNNL). Representatives from KINS, PNNL, Los Alamos National Laboratory, Oak Ridge National Laboratory, and the Department of Homeland Security's Domestic Nuclear Detection Office used the opportunity to demonstrate and emphasize best practices in testing and evaluation.

Beyond the immediate detection technology benefits, this scientific peer-to-peer collaboration proved to be a new and valuable model for NSDD partner country engagements. Potential areas of future exchanges with Korea include using operational data to support programmatic efficacy, modeling and simulation techniques, and best practices in managing maintenance and sustainment capabilities. By unifying and understanding testing and evaluation procedures on a peer-to-peer level, NSDD has built a foundation for future scientific and technical collaboration with KINS.

Developing a New High-Density LEU Fuel

Another area where the Republic of Korea has been an outstanding

partner with NNSA is in global efforts to minimize highly enriched uranium (HEU) use in civilian applications, especially through the development and qualification of first-of-a-kind, high-density low-enriched uranium (LEU) fuels for research reactors. As part of the Office of Material Management and Minimization (M^3) Reactor Conversion Program, Argonne National Laboratory (ANL) and Idaho National Laboratory (INL) are cooperating with the Korea Atomic Energy Research Institute (KAERI) to apply KAERI's proven capability to fabricate atomized uranium powder to develop and qualify new dispersion-type LEU fuels.

Atomized powder contains microscopic spherical particles of uranium-molybdenum (U-Mo), which is used to fabricate the densest dispersion-type LEU fuel ever made. KAERI operates the only facility in the world that can produce commercial-scale quantities of atomized U-Mo powder, making South Korea an indispensable contributor to U-Mo fuel development and fuel fabrication efforts.

KAERI provides atomized LEU powder to the HERACLES consortium to support fabrication and irradiation testing for a new very high-density LEU fuel system that will be used to convert a group of European high-flux reactors. This fuel must achieve high flux and burn-up levels to support the performance requirements of these European reactors after conversion. The first two irradiation experiments in the HERACLES fuel qualification campaign using KAERI powder will be inserted into the Advanced Test Reactor at INL and the BR-2 reactor at SCK in Belgium in 2018. Qualification of the fuel and conversion of the European high-flux reactors is planned for the late 2020s.

KAERI's atomized powder also serves as the base material for a new LEU dispersion fuel being tested for the KiJang Research Reactor (KJRR) to be located in South Korea. The KJRR will be a beryllium moderated and light water cooled research reactor and radioisotope production facility. Upon completion of the facility and qualification of the LEU fuel, KJRR will become the first research reactor in the world to use U-Mo fuel. However, due to lower burn-up requirements, the fuel is not directly suitable for the conversion of the European reactors.

The M^3 Reactor Conversion Program is working with South Korea and KAERI to support qualification of the U-Mo fuel for KJRR through several joint efforts. First is a cooperative project to analyze fuel performance to support qualification and use of the KJRR LEU fuel. A second area involves an irradiation experiment at the Advanced Test Reactor at INL to irradiate a lead test assembly (LTA) made from U-Mo fuel fabricated by KAERI for the KJRR. INL completed the irradiation, and the LTA is now being cooled for post-irradiation examinations (PIE) scheduled for early 2018. The PIE will reveal important data that KINS will use to determine whether U-Mo fuel can be safely used in KJRR. INL also will work with KAERI on the PIE to gather important data on U-Mo fuel performance under various irradiation conditions.

A final series of irradiation experiments in the HANARO reactor in South Korea use mini-plates of the KJRR fuel—the same fuel used in the KJRR LTA irradiated at INL, but smaller in scale—to provide supplementary fuel performance information to KINS for regulatory licensing requirements.

Once in operation, the KJRR will be an example of one of the most advanced high-performance research reactors in the world operating successfully on LEU fuel, and the only one using U-Mo fuel. This would represent a significant technological breakthrough for the conversion of other high-performance research reactors (HPRRs), including the few remaining HEU-fueled HPRRs in the United States and high-flux reactors in Europe that cannot convert with existing LEU fuels. This important international scientific collaboration between U.S. national labs and a South Korean research institute is yielding crucial data that will ultimately have a direct impact on furthering DNN's mission for HEU minimization and permanent threat reduction, both at home and abroad.

Two Fellows in the Nonproliferation Graduate Fellowship Program contributed to this story. Reema Verma is working with NSDD. She holds a Master's Degree in International Affairs from George Washington University and has worked at the Nuclear Threat Initiative and the Stimson Center. Victoria Wu is working with M^3. She is a graduate of Johns Hopkins School of Advanced International Studies.

More S&T Collaboration

Joint Fuel Cycle Study—DNN, DOE's Office of Nuclear Energy, and Korean counterparts are conducting this 10-year collaborative research and development effort to evaluate the technical, economic, and nonproliferation aspects of a commercial-scale electrochemical recycling process. This process, also referred to as pyroprocessing, may prove suitable for recovering usable portions of used nuclear fuel to generate energy in a fast reactor while reducing the volume of high-level radioactive waste requiring disposal.

International Nuclear Nonproliferation and Security Academy—The DNN International Nuclear Security program consulted with the Korea Institute of Nuclear Nonproliferation and Control (KINAC) throughout the design of a "test bed" facility for physical protection sensors and equipment at the Academy, which opened in 2014.

Tracking Systems for Mobile Radioactive Sources—DNN's Radiological Security program and KINS conducted a technical exchange during a 2017 meeting of the Nuclear Security Working Group. The information exchange looked at tracking systems for mobile radioactive sources designed for a field environment. The Republic of Korea presented the Radiation Source Location Tracking System (RADLOT) and the United States presented the Mobile Source Transit Security (MSTS) system. Both systems, which have many similarities, provide significant improvement to the security and accountability of mobile radioactive sources. Information sharing will continue as both countries continue to test and deploy their systems.

FAQs: The Role of National Laboratories in Nonproliferation

What began as a temporary collection of university and secret laboratory sites during World War II continues today as the world's preeminent network of basic research, development, testing, manufacturing, and operations facilities. The DOE complex of national laboratories, plants, and sites also are central to DNN's ability to prevent proliferation and nuclear terrorism and expand and elevate our capabilities to identify and address threats as they emerge. The unique and extensive science, technology, engineering, and manufacturing capabilities that the labs, plants, and sites have developed over decades of nuclear weapons-related research, development, and stockpile management enables them to uniquely understand and address nuclear proliferation and terrorism threats worldwide.

What types of activities do the national laboratories, plants, and sites perform in support of DNN's mission?

They support all facets of DNN's mission, such as:

- Developing technologies for detecting nuclear activities in foreign countries, nuclear detonations worldwide, and illicit movement of nuclear materials.
- Securing and disposing of at-risk nuclear materials around the world.
- Reviewing requests for export licenses involving equipment and commodities that could contribute to nuclear proliferation.
- Providing technical subject matter expertise for negotiating and implementing international nuclear materials and arms agreements.
- Providing workshops and training to help foreign partners enhance their nonproliferation capabilities.

Turn to pages 6 and 7 to see specific examples of each facility's capability for enhancing our country's nonproliferation efforts.

What is the distinction between national laboratories, plants, and sites?

National laboratories are primarily research and development institutions. Plants are primarily production or processing facilities. Sites provide a unique setting for conducting tests and experiments related to nonproliferation activities.

Do only NNSA laboratories support DNN activities?

Of DNN funds provided to DOE labs, NNSA laboratories receive about 35 percent of the funding and other DOE laboratories receive the rest. The "cognizant Secretarial Office" for a given laboratory, plant, or site varies and may be, for example, NNSA, DOE's Office of Science, DOE's Office of Nuclear Energy, or DOE's Office of Environmental Management.

How are projects assigned or awarded from DNN?

National laboratories respond to calls for proposals that describe technical capabilities DNN wishes to advance or the problems it would like to solve. DNN reviews the proposals and makes the awards. DNN also assigns projects outside the proposal process if necessary to address a need that requires the unique capabilities of a particular national laboratory, plant, or site.

Do laboratory experts directly support federal staff at NNSA headquarters?

National laboratories frequently send technical staff to NNSA headquarters to serve as technical advisors during temporary assignments, usually 2–3 years, as detailees or under Intergovernmental Personnel Act (IPA) agreements. These are "win-win" situations. Headquarters gains technical expertise to enhance the capabilities of its in-house staff while laboratory experts obtain valuable insight on headquarters' processes and priorities.