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

DNN Sentinel

DEFENSE BY OTHER MEANS

Vol. II, No. 3

IN THIS ISSUE:

From the Deputy Administrator

When people ask me what I like best about being DNN's Deputy Administrator, the answer is easy: the hundreds of dedicated professionals who devote their time, energy, and expertise to making the world a safer place. A recent one-month period brought into sharp focus just how diverse and creative our nuclear nonproliferation community is.

At Washington State University (WSU) in Pullman, WA, I had the opportunity to interact with students and professors, as well as visit laboratories – including the research reactor that DNN had converted in 2008-2009 from highly enriched uranium fuel to low enriched fuel. I was already aware of some of the nonproliferation work done there, but was fascinated to see the extensive shock physics lab and to learn about contributions that this lab is making to NNSA's stockpile stewardship efforts. WSU has many links to Pacific Northwest National Laboratory (PNNL), and during my stop at PNNL, we discussed the importance of those university links, as well as the need to nurture and mentor new generations of professionals entering the national laboratory system. While at PNNL, I also had a chance to join a meeting (via VTC) at the University of Michigan of the Consortium for Verification Technology (CVT), one of three consortia supported by the DNN R&D program. CVT includes some of the world's best universities (with six of the 13 consortium members in the top 25 of the QS World University Rankings). It focuses its science and technology capabilities on contemporary nonproliferation challenges, and it was exciting to hear the accomplishments of the past year and the plans for the future.

From Washington State, I traveled to New Mexico where Sandia National Laboratories (SNL) and Los Alamos National Laboratory (LANL) were hosting a nuclear security exchange with a senior delegation from Argentina. While at SNL, we signed a new memorandum of understanding with Argentina's Department of Energy and Mining to further our joint

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http://nnsa.energy.gov/aboutus/ourprograms/nonproliferation-0

Letter from the Deputy Administrator – *Continued*

work on advancing nuclear and radiological security. I then joined colleagues at LANL to officially open a new exhibit at the Bradbury Museum on LANL's 50 years of contributions to international safeguards. While at LANL, I also met with a truly outstanding group of women lab leaders, who manage major elements of work at the lab.

The Nevada National Security Site (NNSS) was next. There we hosted a delegation of a dozen senior diplomats to show how we have transformed our former nuclear test site into a center of science that maintains a safe, secure and effective nuclear stockpile without nuclear explosive testing, and supports advances in nonproliferation science and technology. The feedback from the participants was overwhelmingly positive and confirmed that visits like this can make a real contribution to understanding each other's challenges and perspectives.

Then, it was on to London to meet with colleagues from the UK and France to discuss how we can further cooperate on nuclear security and related issues aimed at keeping nuclear materials and capabilities out of the hands of terrorists. While in London, I was honored to be the first woman invited to give the Vincent Briscoe Security Lecture, an annual event at Imperial College London.

The last milestone in my one-month tour was a meeting of the DNN Lab Science Council. Several years ago, a small group of senior lab representatives responsible for their respective global security programs met with DNN leadership to explore whether a mechanism for bringing us all together, at a strategic level, several times a year would be useful. Several years into the process, the group has identified the need for joint work in a variety of areas from identifying cyber risks specific to the nuclear nonproliferation mission, to how best to manage program travel-related risk, to how to develop more effective metrics for training and education programs. In each case, the efforts are co-led by lab and headquarters staff, whose efforts have resulted in practical and actionable recommendations.

When I reflect on this four-week whirlwind, I also have to recognize that these were just the highlights. At the same time, preparations were underway to support the Secretary and Administrator at the December IAEA International Conference on Nuclear Security, transition materials were being finalized for a new Administration, and countless other taskings were being managed every day. And none of this happens without the work of a remarkable team, from scientists at the labs, site and field office staffs, travel and support personnel, fellows, the DNN program staffs, colleagues in other offices across DOE and NNSA, to our whole network of international partners. It is humbling to be a part of this extended family and as we approach the end of the year, I want to express my deepest gratitude to all for what you do.

Anne Harrington
Deputy Administrator
Defense Nuclear Nonproliferation

A Perfect Fit: Customizing the New Radiological Alarm Response Training Course

DNN's Office of Radiological Security (ORS) within the Office of Global Material Security has developed the Customized Alarm Response Training (cART), a one-day tailored version of its three-day, in-resident Alarm Response Training course.

Working in close cooperation with police officers from around the country, ORS designed the one-day cART so that local authorities can incorporate specific facility, site, and city information into a course that prepares local law enforcement officers and security personnel to respond to an attempted theft or intentional misuse of radiological materials of concern. The course is designed to be taught by local law enforcement officers with assistance from ORS partner sites in their community. To prepare the police officers who will serve as instructors, ORS also has developed a two-day cART "Train-the-Trainer" course.

The Department of Homeland Security (DHS) approved the cART course, which is now listed in the Federal Emergency Management Agency/National Training and Education Division State/Federal Sponsored Course Catalogue as DOE-003-PROT, an awareness-level course. With cART approved by DHS and listed in the course catalogue, municipal law enforcement partners can request DHS grant funds to offset any local costs, such as overtime pay, incurred when teaching the course. DHS approval of the cART Train-the-Trainer course is pending.

Municipal police agencies in the United States that agree to undertake cART assume a city-wide responsibility for training their patrol officers. Current ORS cART partners include:

- City of Philadelphia and University of Pennsylvania Police Departments
- University of Cincinnati Police and University of Cincinnati
- Los Angeles County Sheriff and University of Southern California and University of California Los Angeles Medical Centers
- Washington DC Metro Police Department and Georgetown University and George Washington University and Hospital

To date, these ORS municipal police partners have conducted nine cART classes for 154 police officers and police dispatchers. In addition, the New York Police Department agreed to implement cART and a Train-the-Trainer course in fall 2016.

The customized version of the Alarm Response Training course incorporates information from local facilities and is taught by trained local law enforcement officers.

CTBT at 20: Strong U.S. Support for International Nuclear Explosion Monitoring and Verification

On September 24, 1996, the United States was the first nation to sign the Comprehensive Nuclear-Test-Ban Treaty (CTBT), making clear the U.S. commitment to halt the development of advanced nuclear weapons capabilities and stop the spread of nuclear weapons programs worldwide. Today, a total of 183 countries have signed and 166 have ratified the Treaty, pledging to not carry out any nuclear explosions. Eight remaining "Annex 2" countries, including the United States, need to ratify the Treaty before it enters into force. When the CTBT was opened for signature, the monitoring and verification regime described in the Treaty was a vision and much work remained to make it a reality. This, in fact, was a primary reason the U.S. Senate did not give its advice and consent to U.S. ratification in 1999. Since that time, the international community, backed by robust U.S. support, has developed the significant technical capability to monitor for nuclear explosions around the globe and detect events of interest, which, in turn, will enable CTBT States Signatories to make determinations regarding events of concern.

The U.S. commitment to further the state of readiness of all parts of the CTBT nuclear explosion monitoring and verification regime is strong. As demonstrated by its performance in monitoring the Democratic People's Republic of Korea (DPRK) nuclear explosive tests, this system allows all CTBT States Signatories access to information that in many cases has allowed a large international coalition to condemn the DPRK tests through actions at the United Nations. NNSA experts support current operations of and improvements to the International Monitoring System (IMS) and the International Data Centre (IDC) and preparations to conduct an on-site inspection (OSI) once the Treaty enters into force. The international collaboration resulting in a worldwide network of sensitive nuclear explosion monitoring stations, supported by the IDC and OSI capabilities, means that all participating countries have access to the data that will help them decide whether or not a nuclear explosion has taken place.

Experts from a number of DOE organizations support the CTBT effort, including Idaho, Lawrence Livermore, Los Alamos, Pacific Northwest, and Sandia National Laboratories; the Nevada National Security Site (NNSS); and NNSA's Offices of Defense Nuclear Nonproliferation and Counterterrorism and Counterproliferation. Recently, NNSA hosted 50 international OSI experts at NNSS to enhance their ability to identify evidence of a nuclear explosion. Other NNSA initiatives to support the CTBT effort include a project to re-engineer the capabilities of the IDC and workshops for international experts to assure the continued effectiveness of the IMS. NNSA experts also have been selected to train to be OSI surrogate inspectors, and many NNSA experts design and conduct CTBT-related training at the request of the CTBT Organization Preparatory Commission (PrepCom). NNSA experts have designed many of the most critical components in use in the IMS and IDC and continue to improve the sensitivity, reliability, and performance of the system. NNSA also hosted 12 international diplomats at NNSS in October 2016 to discuss NNSA's Stockpile Stewardship Program and nonproliferation initiatives, including CTBT support and plans to host a CTBT OSI training event at NNSS in 2017.

Trent Otteson of National Security Technologies (NSTec) holds a piston used in the JASPER two-stage gas gun at NNSS. Otteson explains how the JASPER facility works to support NNSA Science-Based Stockpile Stewardship goals to international diplomats during their October 2016 visit at the NNSS.

The international nuclear explosion monitoring and verification regime, essentially nonexistent when the CTBT was opened for signature 20 years ago, has developed substantially over the years, thanks in large part to U.S. support. Whether quickly identifying the location and nature of the five announced North Korean nuclear explosive tests or helping to mitigate the effects of natural disasters such as earthquakes and tsunamis, the CTBT's monitoring and verification elements have regularly proven their value for detecting nuclear explosions and supporting important civil applications.

Universities Partner with Los Alamos for a Unique Hands-On Experience

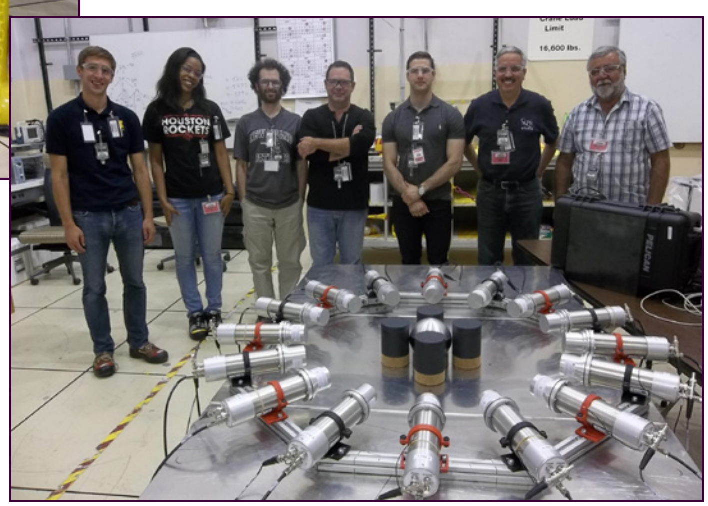
Faculty, students, and post-docs from five universities had the chance to measure radiation signatures from Category I Special Nuclear Material (SNM) at the Device Assembly Facility (DAF) at the Nevada National Security Site (NNSS) as part of a two-week measurement campaign organized by Los Alamos National Laboratory (LANL) and North Carolina State University. This unique activity was organized on behalf of the Consortium for Nonproliferation Enabling Capabilities (CNEC) and Consortium for Verification Technology (CVT) with support from DNN's Office of Research and Development (R&D).

The DAF is home to the National Criticality Experiments Research Center (NCERC), which is operated by Los Alamos. The facility maintains a substantial SNM inventory and expertise to support a variety of nuclear security missions requiring hands-on access to weapons-grade plutonium and highly enriched uranium (HEU) in numerous configurations.

In July 2016, consortium participants from the University of Michigan, North Carolina State University, North Carolina A&T, Princeton, and the University of Illinois used different radiation detection systems (gamma spectroscopy, fast-neutron time-correlation, gamma scatter and pinhole aperture imaging, dual neutron-gamma scatter imaging, and neutron coded aperture imaging) to measure kilogram quantities of uranium, plutonium, and other fissile materials in bare, shielded and/or reflected (surrounded with materials that may reflect neutrons back into the SNM) configurations.

This is the second year that LANL has partnered with CNEC and CVT to provide this unique research and training opportunity on SNM detection and analysis. Results from the measurement campaign held in summer 2015 were presented at the 2016 Institute for Nuclear Materials Management Annual Meeting in Atlanta. The consortia plan to publish results from 2016's measurements as well.

A separate DAF tour in July 2016 for several leaders of the new Nuclear Science and Security Consortium (NSSC) focused on exploring collaboration possibilities for critical nuclear data validation experiments. The NSSC is the third university consortium supported by DNN R&D.



Above: The delegation from the NSSC tour in one of the critical experiments buildings at NCERC located at the DAF.

Right: Team of CNEC/CVT faculty, students and post-docs performing active measurements of correlated particle emissions from HEU shells surrounded by americium-lithium sources.

INNOVATION: Training Kits with Simple Props Help Teach Safeguards Principles Outside Nuclear Facilities

By Cornelia Brim

Hands-on and on-the-job training can be very effective means to truly learn a craft. Of course, this can carry a certain amount of risk, especially in nuclear facilities and when using nuclear materials. Classroom learning, on the other hand, sometimes can be dry and lack the realism necessary for students to gain confidence in the practical application of a craft. Mark Schanfein of Pacific Northwest National Laboratory (PNNL) experimented with a variety of concepts for hands-on training of safeguards inspectors outside a nuclear facility. DNN's Office of Nonproliferation and Arms Control, through its International Nuclear Safeguards and Engagement Program (INSEP), sponsored Mark's work to address this training challenge. The breakthrough came when he matched some low-cost measuring devices with simple props to introduce and guide students through the processes of a safeguards inspector's job, and the idea for two separate training kits was born.

Members of the Nuclear Security and Safety Directorate of Jordan's Energy and Minerals Regulatory Commission use the bulk MBA kit for an exercise during a tour at PNNL.

The first kit—the bulk material balance area (MBA) kit—teaches inspection principles in production facilities that handle materials in powder, liquid, or gas. The kit includes small metal cans that contain varying numbers of marbles to represent the nuclear material. Each can has a lid, a seal, and a label with identification number, date of entry, content description, gross weight, net weight, and chemical form. A cloth mat grid is printed with a matrix of squares and an identifier for each square, representing different storage locations in a facility. An electronic scale is included in the kit and serves as the measurement device to address topics such as calibration, measurement, and uncertainty bounds.

The second kit—the item kit—simulates the inspection that might be conducted on a sealed item in a facility like a nuclear reactor. The props are sealed PVC pipes containing shorter wooden dowels representing uranium fuel. Acrylic holders contain the simulated fuel rods in vertical arrays for different fuel rod locations found in a reactor. Student inspectors use the kit's stud finder to represent a portable handheld gamma-ray detector to determine the active length of the "fuel" (wooden dowels) in the "rods" (PVC pipes).

Each kit fits in a Pelican™ case for ease of transportation and contains instructions and a number of exercises. Discrepancies and errors are built in to test students and mimic the types of irregularities inspectors encounter during actual inspections. The kits are versatile enough for instructors to alter the scenarios and adapt the tool—fashioning it as part of a curriculum that is tailored to student needs.

Staff members from Vietnam's Agency for Radiation and Nuclear Safety use the item kit to conduct a mock active fuel length measurement during an INSEP-sponsored training workshop in April 2016.

Inventory items are simulated in the bulk material balance area kit. This kit helps students practice the skills needed to conduct a physical inventory verification and reconcile nuclear material accounting records and reports.

"Although the props are simple and inexpensive, the concepts students learn and practice are complex and true to the job," said Schanfein. The low cost of the kits also makes it possible to leave behind with students so that practical learning can continue after completion of the DOE/NNSA-sponsored training activity.

Exercises using the kits help facility staff support international inspections and help regulatory bodies conduct and support international inspections.

The kits have both vocational and educational applications. They can be used, for example, to practice in a lower-pressure environment the hard and soft skills inherent to an inspector's job, such as:

- Conducting simulated domestic inspections;
- Conducting a physical inventory verification;
- Reconciling nuclear material accounting records and reports;
- Performing inventory reconciliation;
- Performing random statistical sampling and item selection;
- Practicing measurement calibration and control;
- Identifying and resolving discrepancies; and
- Strengthening observation, team building, negotiation, and communication skills.

Participants in the Nonproliferation and International Safeguards Summer Course at PNNL use the item kit to simulate an inspection that might be conducted on sealed items in a nuclear facility.

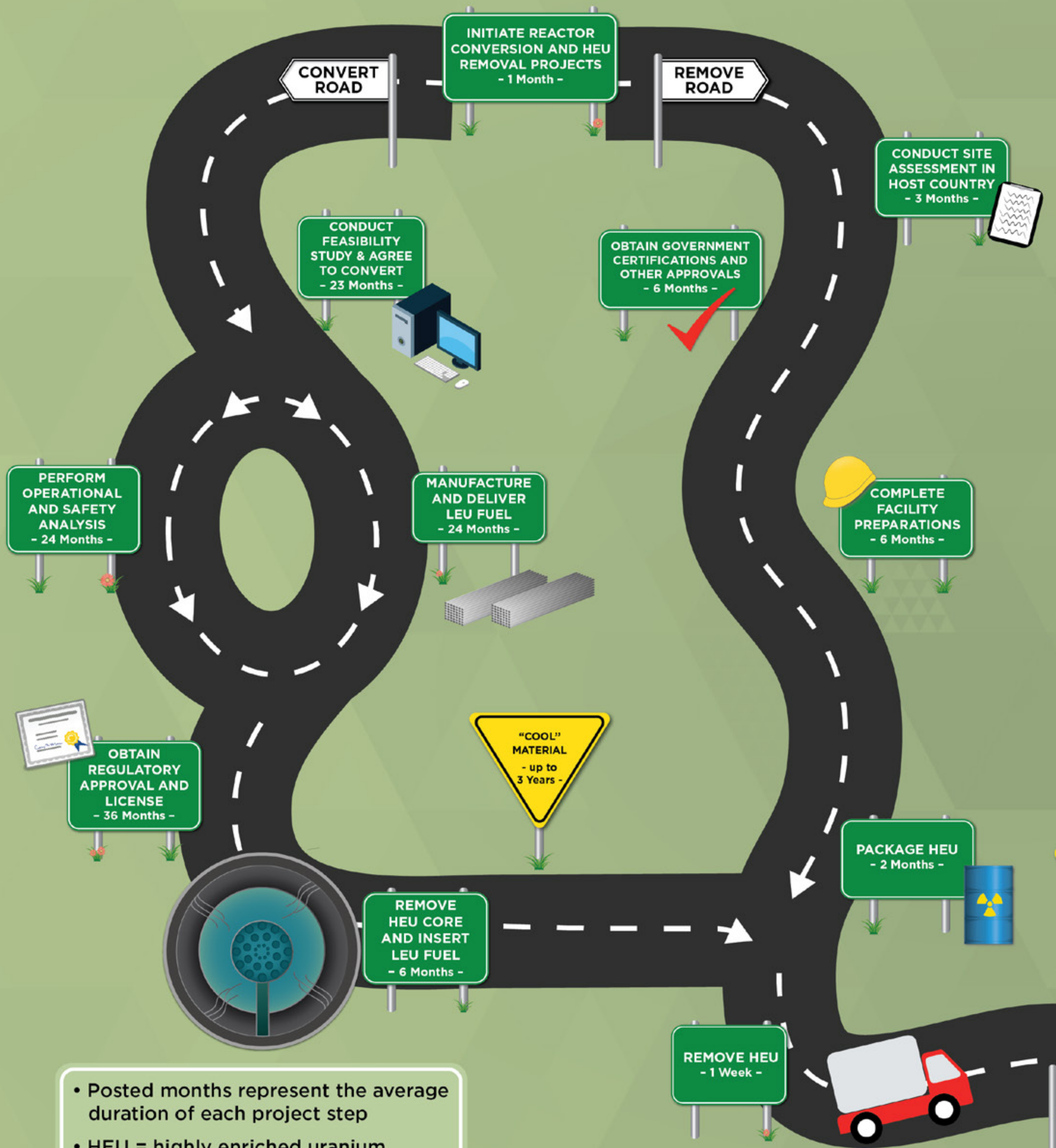
They also can be used in an educational setting to demonstrate the fundamentals of nuclear material accountancy and independent verification.

PNNL is now offering the kits to university professors, DOE safeguards instructors supporting INSEP, IAEA trainers, and centers in the Republic of Korea and Japan. PNNL and Oak Ridge National Laboratory also are using the kits for training courses.

Cornelia Brim is a senior communication specialist at PNNL.

CONVERT, REM

The Roads to HI

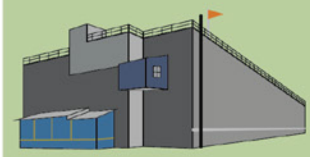


- Posted months represent the average duration of each project step
- HEU = highly enriched uranium
- LEU = low enriched uranium

OVE, DISPOSE
EU Minimization

CONVERT or verify shutdown of civilian research reactors and medical isotope production facilities that use weapon-grade nuclear material.

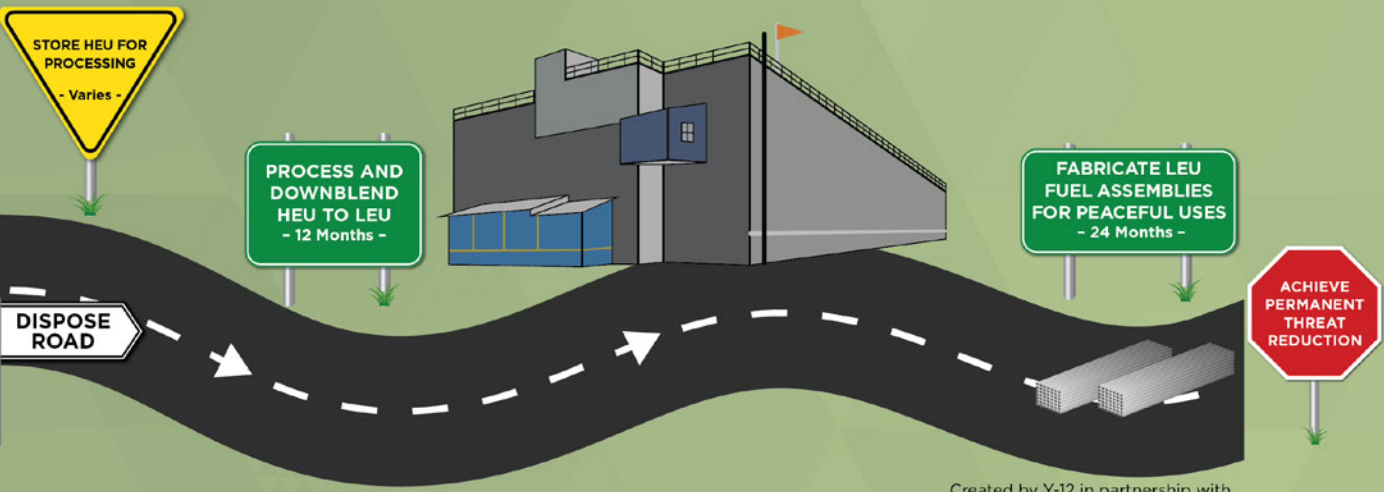
REMOVE or confirm disposition of excess weapon-grade nuclear material.



DISPOSE of surplus weapon-grade nuclear material in the United States and process and downblend material for peaceful uses.

MATERIAL MANAGEMENT & MINIMIZATION (M3)

M3 uses an integrated approach to achieve permanent threat reduction by minimizing and, when possible, eliminating weapon-grade material from civilian use around the world.



Created by Y-12 in partnership with DNN's Office of Material Management and Minimization.

R&D Improves Ability to Geo-Locate the Origin of Nuclear Materials

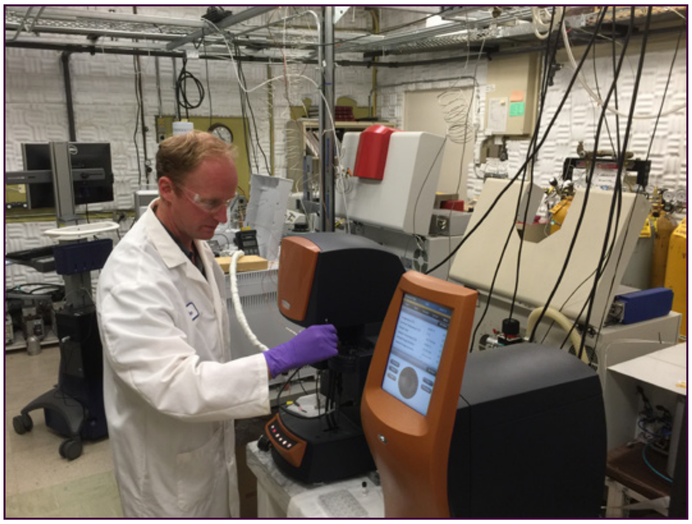
Nuclear forensics research makes it harder for traffickers to hide their activities. DNN has a research and development (R&D) program focused on improving nuclear forensics methods, in concert with partners within DNN, NNSA, and the interagency.

Interdictions of unsecured nuclear material have occurred worldwide, with many cases recorded in the International Atomic Energy Agency's Incident and Trafficking Database. These events are stark realities showing that even as the international community is working toward securing all vulnerable materials, items outside of regulatory control pose a risk.

National Laboratory-based nuclear forensics research is generally led by world-class scientists able to apply advanced methods and research ingenuity to develop new insights. The DOE/NNSA National Laboratories have the required expertise and infrastructure to tackle such hard problems.

One area of focus for the R&D program is how the surface of a nuclear material sample interacts with its environment to retain impurities and create other features that help characterize the environmental conditions that the sample has recently experienced. This research is enabled by the reactive surfaces of uranium and plutonium metals and oxides and by the analytical power of modern microscopic techniques.

The measurements and analyses of Lee Davisson and colleagues from Lawrence Livermore National Laboratory (LLNL) is seeking to confirm a hypothesis that measuring hydrogen and oxygen "uptake" from water on uranium surfaces can enable geo-location of recent environments. "If you measure oxygen in water across the globe using a mass spectrometer, which separates an element into its isotopes, you'll find very different ratios of the two main isotopes of oxygen, ^{16}O and ^{18}O, depending on just where you take the measurement. It is this difference that enables you to geo-locate a sample found in one place to the place where it originally 'uptook' its water oxygen," he explains.



Dr. Michael Singleton of LLNL loads a uranium sample into a thermal gravimetric analyzer attached to an isotope ratio mass spectrometer

"It's exciting to research the fundamentals and develop methodologies on this type of project," says Davisson. "This could only happen with sponsors who invest in challenging R&D that attracts and retains the talent at the National Labs utilized in this work."

National Laboratory Expert on Loan to DNN

In addition to tapping into specialized expertise resident at the National Laboratories, DNN also invites National Laboratory staff to temporarily relocate to Headquarters. A case in point is Debbie Dale, who is currently on detail to the Office of Global Material Security's Nuclear Smuggling Detection and Deterrence program from Los Alamos National Laboratory (LANL). Debbie leads efforts in China, Japan, Algeria, France, and the European Union to improve indigenous nuclear forensics capabilities. She has a Ph.D. in physical chemistry and has supported weapon, nonproliferation, and threat reduction programs during her 26 years at LANL. In addition, Debbie was a nuclear safeguards inspector at the IAEA.

DNN Expert Profile: Rilla Hamilton

By Cassandra Peterson

NNSA's Rilla Hamilton recently was appointed to Chair the Organization for Economic Cooperation and Development's High Level Group on the Security of Supply of Medical Radioisotopes (HLG-MR).

Rilla has represented the United States at the HLG-MR since its founding in 2009, when the group began evaluating issues related to the reliable supply of the medical isotope molybdenum-99 (Mo-99), a key component of nuclear diagnostic medicine procedures worldwide. Members of the HLG-MR selected Rilla to lead the group comprising 40 delegates from 17 countries, 20 independent entities from the medical industry, the European Commission, and the International Atomic Energy Agency. She will be the third person to serve as the HLG-MR Chair.

The announcement of Rilla's selection follows more than eight years of unflagging dedication to the NNSA's Office of Material Management and Minimization (M3) work in the Convert program to reduce and eliminate the use of weapons-usable uranium at civilian sites around the globe.

She received her BA in Foreign Affairs and a Master of Public Policy from the Frank Batten School of Leadership and Public Policy at the University of Virginia, where her thesis focused on permanent threat reduction alternatives for disused commercial radiological sources. In 2008, she began her work at NNSA by providing special project support under M3's—then the Global Threat Reduction Initiative's—Convert Program. She initially expected to stay with the NNSA for three months, but found that she loved the work.

Rilla was with NNSA in 2008 when the Canadian and Dutch reactors that supply the United States with most of its Mo-99 supply unexpectedly shut down. Patients around the world were forced to cancel or delay important, life-saving diagnostic medical procedures. This large-scale shortage changed the way that the world viewed the small network of medical radioisotope producers and drove a new call for domestic Mo-99 production.

Rilla's hard work, leadership, and commitment to avoiding future shortages elevated her to a position as the Mo-99 Program Director. Internationally, the program supports multiple projects to convert the production of the isotope from highly enriched uranium (HEU) to low enriched uranium (LEU), thereby permanently reducing threats to peace and security. The program is also on the forefront of establishing a safe, dependable capacity to produce non-HEU-based Mo-99 within American borders.

When asking about her daily life at NNSA, Rilla said "I often get teased for how much I enjoy my job. But not only do I get to help reduce the threat of nuclear terrorism, I get to help ensure that patients in the United States and around the world have access to an isotope that helps to save lives. It's incredibly rewarding."

In October 2016, Rilla was detailed to the Office of the Administrator as the Special Assistant to the Chief of Staff.

Cassandra Peterson is an NNSA Graduate Fellow currently serving in DNN's Office of Material Management and Minimization.

HLG-MR Chair Rilla Hamilton of the United States and Vice Chair Tina Eboka of South Africa

The decay product of Mo-99, technetium-99m (Tc-99m), is used to diagnose heart disease and cancer, study organ structure and function, and perform other important medical procedures. For example, patients who have had a myocardial perfusion imaging test—otherwise known as a cardiac "stress test"—have likely benefitted from Tc-99m.

Read the related article in the DNN Sentinel, Vol. II, No. 2, page 13.

Adding Uniqueness to Safeguards with Cylinder Identification

By Tara Chandra and Michael Whitaker

A key component of the International Atomic Energy Agency (IAEA) inspection regime is material accountability—that is, ensuring that whatever material the facility operator *reports* to be present on site is actually there. While this may seem like a relatively easy task, there are unique challenges that inspectors face in verifying facility compliance with this safeguards requirement.

Reading the serial numbers engraved on cylinder nameplates from a distance presents a challenge for inspectors.

One challenge is labeling uranium hexafluoride (UF_6) cylinders. Uranium hexafluoride plays an important role in the early stages of the nuclear fuel fabrication process. Natural and low-enriched UF_6 is typically stored and transported in very large steel cylinders. There are approximately 20,000 cylinders in active use at any time, plus those in storage. Each cylinder has a nameplate welded onto it during its manufacture that contains identification and certification information, including a serial number. However, the stamped or engraved serial number is generally very small—only ¼ inch tall—and cylinders can be in circulation for 30 to 40 years while the lettering degrades over time.

To mitigate the challenge of reading the cylinder number on the nameplate, individual companies have implemented various supplemental labeling and marking practices for identifying cylinders while they are at their facility—but as cylinders are circulated among facilities over decades, they can accumulate myriad labels. Each company can easily distinguish its own label, but IAEA inspectors must sort through the various labels and relate them to the small, difficult-to-read serial number permanently engraved on the official nameplate during the inspection. This adds time to the inspection effort—especially when some sites contain thousands of cylinders to be verified.

To facilitate greater efficiency and effectiveness for the IAEA in verifying the non-diversion of nuclear material and the absence of undeclared activities, a multi-laboratory team sponsored by DNN and led by Oak Ridge National Laboratory (ORNL) is working on a new standardized identifier for UF_6 cylinders. These '*global identifiers*' would supplement the current nameplates, but would contain the identification information in a standardized, larger, more readable form, and in a two-dimensional barcode enabling direct scanning. This would prevent current reading and transcription challenges. An essential benefit of the global identifier is that it could be independently usable by both the IAEA and industry. Deployment of the global identifier by industry will greatly benefit the IAEA by enabling inspectors to conduct current cylinder verification activities more quickly and reconcile cylinder-related information reported from different sources more effectively. More strategically, the ability to read the cylinder identification from the barcode will enable the IAEA to pursue more automated inspection methods for some routine, time consuming, labor-intensive inspections activities.

IAEA inspectors conducting a simulated cylinder inventory to evaluate potential benefits from the global identifier being pursued by industry.

There are challenges involved in creating these global identifiers. They are not simply stickers that we might envision as a "label." These identifiers must be permanently associated with the container and readable up close when the cylinders are stored in tight configurations and from a distance when the cylinders are stacked two or three high. For full benefit to the IAEA, the identifiers need to be tamper indicating and not able to be counterfeited. They also must endure a 40+ year life cycle in harsh environments experienced by a typical UF_6 cylinder. There is also enormous inertia in a heavily licensed and regulated industry to deviate from any accepted and approved practice that has been in place since the dawn of the industry.

Because the cylinders are owned by facility operators and the IAEA cannot mandate how facility operators identify containers of nuclear material, it was essential that industry be part of developing a common approach to standardizing the cylinder identifier. The DNN team worked to engage both the IAEA and industry leaders on that approach. The World Nuclear Transport Institute (WNTI) has established a working group to develop guidelines for UF_6 cylinder identification and recommendations for managing the identification numbers. The WNTI guidelines are expected to be published in 2017. The next milestones will be the adoption of the guidelines by companies, the production of UF_6 cylinders with the global identifiers, and the implementation of barcode scanning technology to confirm cylinder inventories by the IAEA during inspections.

Michael Whitaker manages the ORNL International Safeguards Program. He has more than 30 years of collective experience at ORNL, Y-12 NSC, and Oak Ridge Gaseous Diffusion Plant. Tara Chandra was an NNSA Graduate Fellow in the DNN Front Office in 2016.

New Group of Fellows Join DNN for 2016–2017 Year

By Tara Chandra

All 49 NGP Fellows at Hanford's B Reactor during orientation.

Each year, participants in the NNSA Graduate Fellows Program (NGFP) gather for a one-week orientation at the Pacific Northwest National Laboratory (PNNL) to learn about the organization they're about to join. New fellows participate in a mock congressional hearing, attend a radiation detection training, and visit Hanford's B Reactor. The orientation is also an excellent opportunity for fellows to get to know each other. Fifteen of the 49 Fellows are placed across DNN's programs, making important contributions to their offices' support of the global nonproliferation mission.

"Orientation was a fantastic opportunity to experience first-hand what our program offices do on a daily basis. As a fellow ... doing a simulated radiation detection training really helped me understand how important DNN's work with our international partners is to the DNN mission."

Evan Thompson is an NGP Fellow in DNN's Office of Global Material Security.

To learn more about the NGFP program, see the DNN Sentinel, Vol. I, No. 2, page 10.

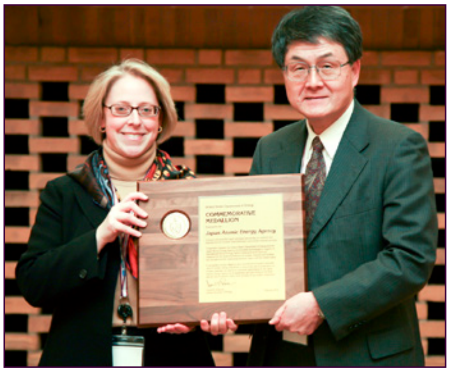
Photos by Maren Disney of PNNL

COUNTRY PROFILE: JAPAN

A Long-Standing Partner in Nonproliferation

Japan is a world leader in the peaceful use of nuclear technology and nuclear nonproliferation. Largely dependent on imports to supply its energy needs, Japan has built an extensive civil nuclear research and power program over the course of five decades. Fifty-four nuclear power reactors were in operation in 2011, giving Japan the world's third largest fleet of power reactors (behind the United States and France). But all of Japan's power reactors were shut down after the Great East Japan Earthquake triggered a major tsunami, severely damaging the Fukushima Daiichi Nuclear Power Station. Five years later, over 90% of Japan's nuclear power plants remain shut down while efforts to obtain regulatory approval for a restart continue.

The Japan Atomic Energy Agency (JAEA) is one of DOE/NNSA's longest-standing international partners in the area of nuclear nonproliferation and nuclear security cooperation, working together on more than 100 successful projects. DOE/NNSA, JAEA, and predecessor organizations have collaborated to pioneer technologies to resolve some of the most difficult safeguards verification challenges, address nuclear security issues, and advance capabilities in the area of nuclear forensics. Specific examples of collaboration and cooperation between the United States and Japan in the area of nuclear nonproliferation are described below.



In 2013, DOE/NNSA and JAEA celebrated 25 years of partnership. Assistant Deputy Administrator Kasia Mendelsohn presented a commemorative plaque to then Executive Director Hideki Namba.

HEU and Plutonium Minimization

At the 2016 Nuclear Security Summit (NSS), the United States and Japan announced the fulfillment of the joint pledge from the 2014 NSS to remove all highly enriched uranium (HEU) and plutonium from Japan's Fast Critical Assembly (FCA). DNN's Office of Material Management and Minimization's (M3) Office of Nuclear Material Removal cooperated with Japan for nearly two decades to remove excess vulnerable nuclear material from Japan. The FCA project was the largest removal in the history of the Summit process, totaling hundreds of kilograms of plutonium and HEU. In addition to the removal, the United States and Japan began a series of joint research collaborations that will allow FCA to restart in the future using low enriched uranium (LEU) fuels. Building on the success of the FCA cooperation, the United States and Japan also announced a pledge at the 2016 NSS to convert the Kyoto University Critical Assembly (KUCA) facility from HEU to LEU fuels and remove all HEU.

Under the U.S.-Japan Plutonium Management Experts Group led by M3's Office of Material Disposition,

Japan's Nuclear History in Brief

- **1955** — Atomic Energy Basic Law restricts nuclear energy use to peaceful purposes
- **1968** — Three Non-Nuclear Principles state that Japan will not possess, produce, or permit the introduction of nuclear weapons into the country
- **1976** — Acceded to the Nuclear Non-Proliferation Treaty
- **1997** — Ratified the Comprehensive Nuclear-Test-Ban Treaty
- **2011** — Accident at Fukushima Daiichi nuclear power station
- **2012** — Stood up new Nuclear Regulation Authority agency
- **2016** — Hosted G7 foreign ministers visit to Hiroshima Peace Memorial Park

the United States and Japan have undertaken informal bilateral discussions on technical collaboration for plutonium management strategies. These efforts help ensure that the two countries continue to work toward a common interest of securing, effectively managing, and—when possible— reducing global stockpiles of plutonium.

Center of Excellence

Japan opened its Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) in December 2010, fulfilling its pledge at the NSS earlier that year. Since opening, ISCN has provided training to thousands of participants from over 20 countries in the region. Prior to and during ISCN's launch, DNN staff worked with JAEA to develop training materials and curricula, a nuclear security test bed, and information technology training tools. DNN continues to work with ISCN to develop the Center's advanced training curriculum, and government agencies from both countries identify goals and coordinate activities through the U.S./Japan Nuclear Security Working Group that meets annually.

DNN continues to provide subject matter experts who assist with curriculum development at ISCN in Japan.

Improving Nuclear Forensics

DNN's Nuclear Smuggling Detection and Deterrence program conducts technical cooperation with JAEA to advance nuclear forensics capabilities. Current activities focus on methods to improve uranium age-dating methods. Uranium age-dating measurements indicate the most recent purification date of the material, information that can help determine the origin and process history of material.

Addressing Nuclear Safeguards Challenges

Over nearly 30 years, DOE/NNSA has cooperated with Japan to address a wide variety of international safeguards challenges, which have evolved alongside Japan's nuclear capabilities. Among the dozens of successfully completed projects, recent accomplishments include working with JAEA to deploy Advanced Technology for Enrichment Monitoring at the Ningyo-Toge Enrichment Plant to monitor uranium hexafluoride (UF_6) holdup and cleanout effectiveness during decommissioning, and on Advanced Holdup Measurement Techniques to improve safeguards measurements at the Plutonium Conversion Development Facility. In addition to addressing safeguards challenges at operating facilities and those nearing end of life, DOE/NNSA also has assisted Japan in developing and maintaining safeguards systems at new facilities, such as the improved Plutonium Canister Assay System (iPCAS) located at Japan Nuclear Fuel Limited's (JNFL) Rokkasho Reprocessing Plant (RRP), and the Advanced Verification for Inventory Sampling System located at JNFL's Mixed Oxide Fuel Fabrication Facility. Numerous nondestructive assay (NDA) tools that the International Atomic Energy Agency (IAEA) now uses were also developed or field tested through U.S.-Japan cooperation.

Training the Next Generation of Nuclear Safeguards Professionals

In May 2016, 20 National Laboratory staff and graduate students participated in the Nuclear Facilities Experience (NFE) in Japan. The one-week intensive training opportunity was sponsored by DNN's Office of International Nuclear Safeguards through its Human Capital Development program. The training course offered in-depth explanations of international safeguards practices at nuclear facilities and the opportunity to see safeguards equipment deployed at facilities first-hand. The group visited the MONJU Fast Breeder Reactor, the FUGEN Decommissioning Center, the Mihama Nuclear Power Plant, the Tokai Reprocessing Technology Development Center, the RRP, and the IAEA's Tokyo Regional Office. Because most facilities were shut down, participants were able to access areas that would normally not be accessible for visits during operations. Additionally, participants visited the Hiroshima National Peace Memorial and met with an atomic bomb survivor. See DNN Sentinel, Vol. II, No. 1, page 7 to learn more about the NFE.

FAQs: IAEA and Nuclear Safeguards

As the world's nuclear inspectorate, the International Atomic Energy Agency's (IAEA) is responsible for verifying that nuclear material, facilities, and other items subject to safeguards are used only for peaceful purposes. The objective of IAEA safeguards is to deter the spread of nuclear weapons by early detection of misuse of nuclear material or technology, thereby providing credible assurances to the international community that States are honoring their legal obligations.

What are IAEA safeguards?

IAEA safeguards are a set of technical measures applied on nuclear facilities and material, through which the Agency seeks to independently verify a State's declaration of nuclear activities, and provide credible assurances that nuclear facilities are not misused and nuclear material is not diverted from peaceful uses to the development of nuclear weapons or other nuclear explosive devices. Technical measures include, for example, on-site inspections, nuclear material accountancy, physical measurements, facility design information verification, containment using tamper-indicating tags and seals, surveillance, and environmental sampling.

Pursuant to the IAEA's Statute, which authorizes the IAEA to establish and administer safeguards, States accept the application of IAEA safeguards through the conclusion of agreements with the IAEA.

Why are nuclear safeguards important?

Peaceful applications of nuclear-related technologies and materials in electricity generation, health, research, and other uses boost States' economies and standards of living. At the same time, proliferation and terrorism threats resulting from theft or diversion of nuclear material and technology continue to evolve. By applying nuclear safeguards measures, the IAEA and Member States can reassure the international community that nuclear materials and facilities are not being used for illicit purposes.

What are Comprehensive Safeguards Agreements (CSA)?

CSA are the legal basis for the IAEA to apply safeguards on all nuclear material in all nuclear activities in a State. It provides the IAEA's right and obligation to ensure that safeguards are applied on all source and special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction, or carried out under its control anywhere.

What is the Additional Protocol (AP)?

The AP to a safeguards agreement enhances IAEA access to sites and information to provide the IAEA with the authority to verify the absence of undeclared nuclear material activities in a State. Through an AP, States provide additional information in expanded declarations and the IAEA may perform complementary access visits in addition to routine and ad hoc inspections.

What is a Small Quantities Protocol (SQP)?

An SQP is a safeguards agreement for States with minimal or no nuclear activities. The purpose of the SQP is to minimize the burden of safeguards activities on States with little or no nuclear activities, while ensuring that the IAEA's safeguards conclusions are soundly based. Modified in 2005 by the IAEA Board of Governors, the modified SQP requires States to provide an initial declaration of any nuclear materials and their locations, which can be verified by the IAEA, and to notify the IAEA as soon as a decision is made by the State to construct or authorize construction of a nuclear facility. The SQP remains operational until such time as the State's inventory of nuclear material exceeds a defined amount, or the State chooses to build a nuclear facility.

What is DNN's role with nuclear safeguards?

DNN supports a number of activities designed to strengthen and encourage IAEA safeguards activities and the ability of Member States to comply with their safeguards obligations. These activities include developing innovative policies and approaches to advance the state of the art in safeguards technologies and safeguards implementation, assisting countries with implementing CSAs and APs, and providing training for the next generation of safeguards professionals. DNN also coordinates the implementation of IAEA safeguards activities at DOE sites.

To learn more about international safeguards activities, see the IAEA Bulletin for June 2016.

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