NNSA National Nuclear Security Administration

Office of Nonproliferation and International Security (NIS)

Spring 2013

Highlights

NIS Builds First Boron-10 Safeguards System as a Replacement for Helium-3 Technology

BY DAVID PERANTEAU

The high demand for helium-3 gas for scientific and global security applications has exceeded its supply, which has resulted in the depletion of helium-3 stockpiles and a consequent shortfall in its availability. The Office of Nonproliferation and International Security (NIS), working to mitigate the impact of the helium-3 supply shortage on international nuclear safeguards (see *Highlights,* July 2010, page 6), has constructed the world's first complete neutron coincidence counter instrument based on a helium-3-alternative technology.

This achievement was the result of a systematic, multi-year effort sponsored by the Safeguards Technology Development

Replacement Helium-3 Technology, Page 3...

NNSA, Thailand, CTBTO Hold ASEAN Nuclear Explosion Monitoring Workshop

BY STEPHEN HERZOG

Workshop participants inspect CTBT International Monitoring System seismic instrumentation.

The National Nuclear Security Administration's (NNSA) Office of Nonproliferation and International Security (NIS) supported a National Data Center (NDC) Development Workshop for the Association of Southeast Asian Nations (ASEAN) in Chiang Mai, Thailand, from November 26-28, 2012. The workshop was jointly planned and implemented by NIS's Seismic

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Also In This Issue:

From the Editor: With each new *Highlights*, there is no shortage of information to report. The challenge is fitting it all in! On any given day, NIS staff is conducting discussions with one or more international organizations and some 70 countries; reviewing export license applications; tapping into the unique capabilities of the U.S. National Laboratories; providing specialized expertise to the interagency; and so much more. Our Spring edition offers a look at just some of the activities NIS engages in every day to support global security through the peaceful use of nuclear materials and technology.

The Office of Nonproliferation and International Security applies program, technology and policy expertise to:

- **SAFEGUARD** AND **SECURE** NUCLEAR MATERIAL AND FACILITIES TO PREVENT DIVERSION, THEFT AND SABOTAGE.
- **CONTROL** THE SPREAD OF WMD DUAL-USE MATERIAL, EQUIPMENT, TECHNOLOGY AND EXPERTISE.
- NEGOTIATE, MONITOR AND **VERIFY** COMPLIANCE WITH INTERNATIONAL NONPROLIFERATION AND ARMS CONTROL TREATIES AND AGREEMENTS.
- DEVELOP AND IMPLEMENT DOE/NNSA NON-PROLIFERATION AND ARMS CONTROL **POLICY** TO REDUCE THE RISK OF WEAPONS OF MASS DESTRUCTION.

Design and layout by Brooke Yaeger

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Monitoring Workshop - *CONTINUED*

Cooperation Program (SCP) and the Provisional Technical Secretariat (PTS) of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). It was hosted by Thailand's Office of Atoms for Peace and funded by the Department of State's Bureau of Arms Control, Verification and Compliance through U.S. Voluntary Contributions to the PTS. More than 50 experts attended from seven ASEAN states and three regional neighbors: Australia, Burma, Cambodia, Indonesia, Japan, Malaysia, Mongolia, the Philippines, Thailand, and Vietnam. The workshop's curriculum focused on building technical capacity among participating states to more effectively monitor for nuclear explosions.

The NDCs operated by CTBT signatory states are a critical element of the CTBT system of monitoring and verification. NDC functions may include sending CTBT International Monitoring System (IMS) data to the CTBTO's International Data Centre (IDC) in Vienna, Austria and receiving data and compiled data bulletins from the IDC. When complete, the IMS will be a global network of 337 seismic, infrasound, hydroacoustic, and radionuclide monitoring stations—as well as radionuclide laboratories—that provide around the clock monitoring for the CTBTO and CTBT signatory states. Today, the IMS is more than 80 percent complete. NDC analysts evaluate IMS data and other national network data to verify that nuclear explosions are not occurring.

The Chiang Mai workshop featured presentations by technical experts from the United States, the CTBTO, and ASEAN member states and their neighbors. The content of presentations primarily highlighted analytical techniques for evaluating waveform and radionuclide data, regional data-sharing mechanisms, and the use of three-dimensional earth models in monitoring the globe, to include the Southeast Asia Nuclear-Weapon-Free Zone. Other presentations highlighted the civil scientific applications of IMS data, which also can be used for activities as diverse as earthquake hazard mitigation, tsunami warning, and studying whale migration patterns.

In addition to classroom instruction, participants visited the Chiang Mai Seismic Research Station, operated by the Royal Thai Navy's Hydrographic Department. The station's staff maintains a seismic array that serves as part of the IMS Primary Network of Seismological Stations (PS41). This array transmits seismic event data to the IDC in real-time, which is then compiled with other data and sent to NDCs around the world for analysis.

Participant evaluations of the workshop were very positive, with representatives from both the CTBTO and ASEAN countries expressing interest in a follow-on workshop emphasizing advanced NDC analytical techniques. This training marked the first time that NIS has been involved in CTBT capacity building in Southeast Asia. The NIS Seismic Cooperation Program hopes to build upon the success of the Chiang Mai workshop by collaborating with ASEAN states on technical projects that ensure robust monitoring of the CTBT and meet the civil scientific needs of countries in the region.

Stephen Herzog is a policy analyst in the NIS Office of Nuclear Verification (ONV), where he focuses on the Seismic Cooperation Program. Prior to joining ONV in December 2012, he worked in the NIS Office of Nuclear Controls, where he started as a Nonproliferation Graduate Program Fellow in 2011.

Replacement Helium-3 Technology - CONTINUED

subprogram of the Next Generation Safeguards Initiative (NGSI). The underlying goal of this effort, undertaken by researchers at Los Alamos National Laboratory (LANL), was to evaluate and demonstrate near-term replacements to helium-3-based safeguards systems. NIS has pursued one technology in particular—the boron-10-lined proportional counter—because of its technical maturity and potential for near-term deployment. While boron-10 counters are less efficient than their helium-3 counterparts, they offer faster response times such that their overall performance can be comparable if a system is well designed.

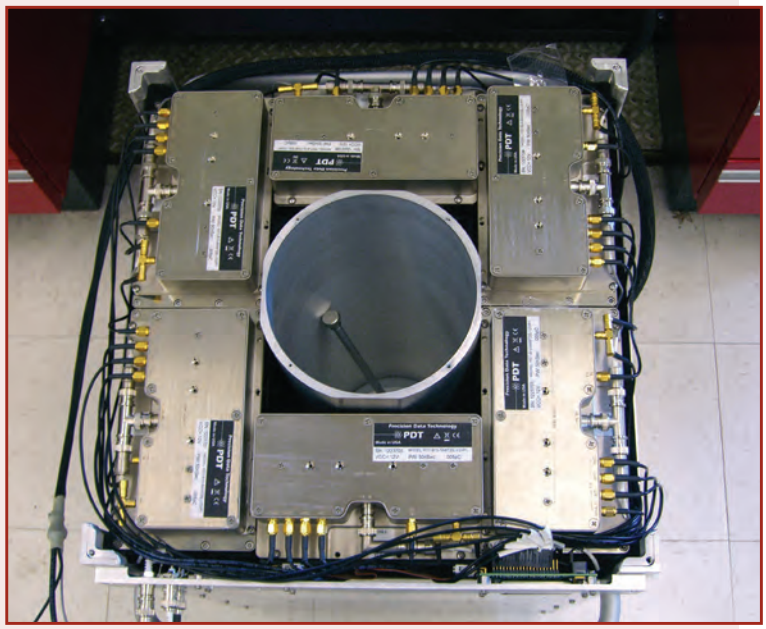
This NIS effort began in FY 2011 with a systematic evaluation of boron-10-based technologies within a safeguards context. The evaluation program included a side-by-side comparison of several commercially available boron-10 detectors, as well as reference helium-3 detectors, to determine which boron-10 detectors were best suited for safeguards-specific applications. Evaluation criteria were derived using decades of U.S. National Laboratory experience with safeguards and helium-3-based systems.

In FY 2012, the most promising boron-10-lined proportional counter was selected and integrated into a full-scale neutron coincidence counter, now known as the High-Level Neutron counter Boron (HLNB). LANL researchers used modeling to optimize the design of the HLNB and to predict its performance relative to the helium-3-based equivalent High-Level Neutron Coincidence Counter (HLNCC). Researchers then worked with a commercial partner, Precision Data Technology, Inc., to fabricate a working prototype HLNB.

In FY 2013, the HLNB will be tested extensively, alongside the HLNCC, to verify its ability to measure plutonium-based safeguards samples. It also will serve as the centerpiece for the technology demonstration portion of a meeting between experts on neutron detection for safeguards from Europe and several U.S. National Laboratories. In the future, NIS is contemplating field trials with international partners to demonstrate the HLNB in real-world operating conditions.

David Peranteau is a program analyst in the NIS Office of Nuclear Safeguards and Security, where he supports the Safeguards Technology and Policy subprograms. David has a Masters degree in International Policy and Nonproliferation Studies from the Monterey Institute and a Bachelor's degree in Government from Dartmouth College. He joined NIS as a Nonproliferation Graduate Program Fellow in 2009.

The High-Level Neutron counter Boron (HLNB) in an experimental set-up.



A horizontal cross-section of an HLNB.

New Prototype Safeguards Technology Offers Improved Confidence and Automation for Uranium Enrichment Facilities

BY CORNELIA BRIM

An important requirement for the international safeguards community is the ability to determine the enrichment level of uranium in gas centrifuge enrichment plants and nuclear fuel fabrication facilities.

However, measurements to verify the uranium enrichment level in gas centrifuge enrichment plants or nuclear fuel fabrication facilities are technically challenging and resource-intensive. NNSA's Office of Nonproliferation and International Security supports the development, testing, and evaluation of future systems that will strengthen and sustain nuclear safeguards and security capabilities—in this case, by automating uranium enrichment measurements.

One such system is HEVA—the hybrid enrichment verification array. This prototype was developed to provide for automated, nondestructive assay for uranium hexafluoride (UF_6) cylinders. Specifically, HEVA is an array of four sodium iodide detectors, mounted between two polyethylene reflectors, designed to detect gamma radiation in UF_6 cylinders. The development of HEVA was funded through the Safeguards Technology Development subprogram of the NIS Next Generation Safeguards Initiative (NGSI) and the work was done by researchers at the Pacific Northwest National Laboratory.

Currently, International Atomic Energy Agency (IAEA) inspectors conduct nondestructive assay of UF_6 cylinders by using a handheld device containing one detector. The handheld instrument detects the gamma radiation from the decay of uranium-235.

Measurement from these handheld detectors is limited to a small area near the inside surface of the cylinder, requires an inspector's presence as opposed to an automated system, and can be affected by variations in the wall thickness of the cylinder.

In contrast, the prototype HEVA, with its four detectors, measures four independent points along the length of a UF_6 cylinder. The array also detects the high-energy gamma rays produced by interactions between uranium-origin neutrons with the steel of the cylinder walls. The neutrons themselves are produced when the alpha particles emitted from uranium-234 interact with fluorine-19. (Uranium-234 reveals information about uranium-235 content.) HEVA uses the combination of these various signatures to perform higher-precision measurements that have lower uncertainties than measuring any one signature independently.

PASSIVE NEUTRON ENRICHMENT METER

HEVA is one of two complementary methodologies under development by NIS. NGSI also is supporting development of the Passive Neutron Enrichment Meter (PNEM) at Los Alamos National Laboratory.

HEVA's four detectors along the length of UF_6 cylinders improve measurement of uranium enrichment levels.

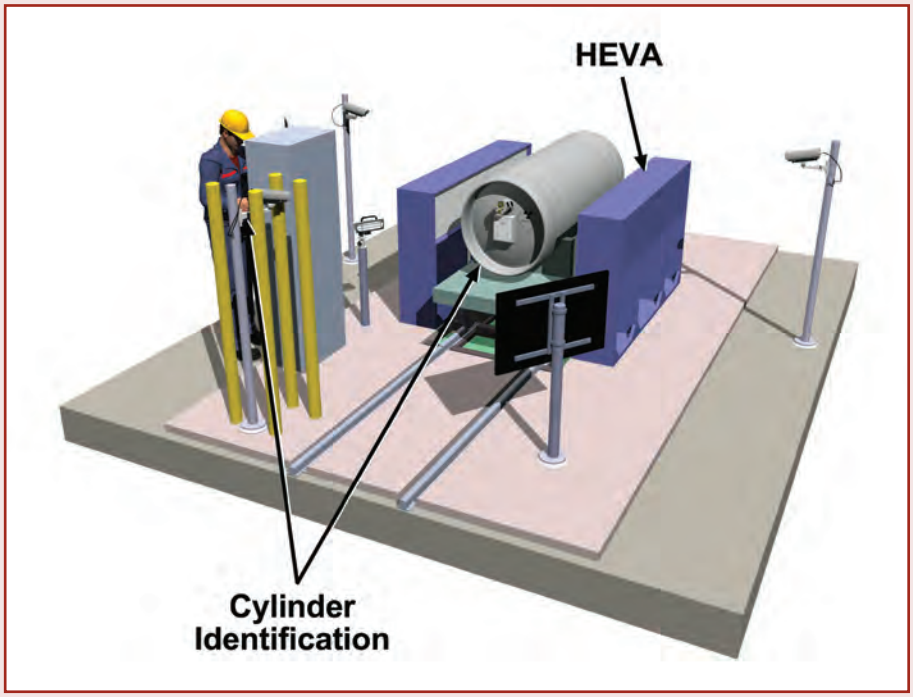
New Prototype - CONTINUED

Preliminary measurements for HEVA resulted in lower uncertainty levels for enrichment measurements that are well below the values routinely obtained by IAEA inspectors.

The HEVA eventually could be incorporated into an enrichment facility's infrastructure—for example, as part of an unattended cylinder verification system that could strengthen enrichment plant safeguards by reducing the time an IAEA inspector devotes to routine measurements. By co-locating HEVA with an accountancy scale to measure UF_6 cylinder mass and a surveillance system to record its identity, the integrated system could positively identify each cylinder, measure mass and enrichment, store collected data in a secure database, and maintain continuity of knowledge on the measured cylinders until an IAEA inspector arrives to download the information.

HEVA has been tested at the AREVA nuclear fuel fabrication facility in Richland, Washington. There, this new prototype successfully measured the enrichment of UF_6 cylinders used by AREVA to fabricate nuclear fuel. Later this year, HEVA tentatively is slated for international field testing at a European uranium enrichment facility.

Cornelia Brim is a senior communications specialist at the Pacific Northwest National Laboratory with more than 19 years' experience providing communications support in areas of national security, nuclear energy, environmental management, and fundamental science.



HEVA could be incorporated into the infrastructure of uranium enrichment or fuel fabrication facilities to assay and maintain continuity of knowledge of UF_6 cylinders.

Did you know?

NIS has been publishing Highlights since **March of 2010**.

NIS has released its **FY 2012 Annual Report**.

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Training for Nuclear Security Professionals

BY ROSALYN LEITCH

A full spectrum of security professionals from policy makers to inspectors, site designers to security personnel, and many more all play a vital role in ensuring the physical security of nuclear materials. NIS's International Nuclear Security (INS) Program has developed and implemented an extensive array of nuclear security courses and provides expert instructors to train foreign officials and facility staff on the physical protection of nuclear material at facilities and in transport. INS conducts physical protection training both bilaterally and multilaterally in cooperation with the International Atomic Energy Agency (IAEA). Each year, INS trains over 600 foreign officials through nearly 25 courses. The program currently is actively engaged in Asia, Europe, the Middle East, South America, and Southeast Asia.

Martie Larson of the INS Program discusses training courses with Khammar Mrabit, Director, IAEA Office of Nuclear Security at the International Regulators Conference on Nuclear Security. INS hosted a booth at the conference to showcase its program mission and training course offerings and also held bilateral discussions with foreign officials and representatives from the IAEA's Office of Nuclear Security on the margins of the conference.

INS led U.S. efforts to develop and implement the fifth revision of IAEA guidance document INFCIRC/225 for the "Physical Protection of Nuclear Material and Facilities," published in January 2011 (see *Highlights*, October 2011). As part of its mandate from the 2012 Nuclear Security Summit, INS also supports global implementation of INFCIRC/225/Rev. 5 through bilateral engagement, physical protection training and workshops, and development of IAEA Nuclear Security Series documents (see *Highlights*, Summer 2012).

INS provides physical protection training on an array of topics including the following:

- Physical Protection of Nuclear Materials and Nuclear Facilities
- Foundations of Physical Protection Systems
- Design Basis Threat Methodology
- Physical Protection of Research Reactors
- Insider Protection
- Vital Area Identification
- Performance Testing
- Vulnerability Analysis
- Cybersecurity

In October 2012, INS conducted a Vulnerability Analysis workshop in Argentina in collaboration with the Argentinean Nuclear Regulatory Authority (ARN). The course was the first nuclear security workshop conducted in Argentina since 2008, and 20 individuals from ARN and other Argentinean organizations attended.

Rosalyn Leitch is a Nonproliferation Graduate Program Fellow working with the International Security Program.

Training for Nuclear Security Professionals - *CONTINUED*

In October 2012, INS facilitated a Regional Training Course in collaboration with the Japan Atomic Energy Agency which involved physical protection training for implementing the recommendations contained in INFCIRC/225/Rev. 5.

INS conducted a series of workshops on INFCIRC/225/Rev. 5, Contingency Planning, and Nuclear Material Transport Security in October and November 2012, which was intended to facilitate the understanding of changes in the internationally accepted recommended requirements for physical security of nuclear material and facilities.

NIS Staff Member Receives NNSA Recognition

BY ELAINE SPECHT

On September 11, 2001, Kirsten McNeil, an engineering student at Washington State University, was horrified when she learned that terrorists had attacked the United States. A day of tragedy for the nation set personal changes in motion for McNeil, who says she decided then that, "I wanted to blend my engineering career with something related to national security." The subsequent invasion of Iraq in 2003 solidified her desire to serve the country by working for the U.S. Government. A professor advised her that, "If you want study nonproliferation, you need to go to Georgetown University," and that is where she headed for a masters in security studies after earning bachelors and masters degrees in mechanical engineering at Washington State.

Her goals established by those fateful events ultimately led to professional recognition for her contributions at NNSA. Last November, she was awarded the 2012 Linton F. Brooks Medal for Dedication to Public Service. Named for

Former NNSA Administrator Linton F. Brooks with Kirsten McNeil, recipient of the 2012 Linton F. Brooks Medal for Dedication to Public Service.

NNSA Recognition, Page 8...

former NNSA Administrator Brooks, the award was established in 2008 to recognize employees with fewer than five years of civilian federal service and fewer than five years of professional experience, whose actions and deeds exemplify the spirit of public service commitment.

As a Foreign Affairs Specialist in NNSA's Office of Nonproliferation and International Security (NIS), McNeil's work helps prevent the spread of dual-use commodities with nuclear applications.

For a number of years, NIS's International Nonproliferation Export Control Program has offered weapons of mass destruction (WMD) Commodity Identification Training (CIT) to customs and border guard personnel in countries around the globe. As part of NIS, McNeil led the effort to adapt the WMD dual-use commodity recognition training course to a broad range of U.S. export enforcement agencies including the Department of Homeland Security's Immigration and Customs Enforcement and Customs and Border Protection and the Federal Bureau of Investigation. McNeil helped strengthen the training program for domestic agencies. "I tried to bring structure to the team and identified and involved a core team," she explains. Lab experts are commonly matrixed among NIS programs to maximize resources.

The course emphasizes hands-on training. "Participants are typically agents who are used to kicking in doors and serving search warrants" McNeil explains. "We needed to make the course relatable to them."

McNeil and the other trainers conduct 6–10 courses each year. Some are done at the U.S. National Laboratories, which McNeil says is beneficial because the labs have a variety of dual-use items right on site where enforcement officials can see them in person and talk directly with the experts that use them. For courses held in other locations, the training team takes the smaller, more portable dual-use items to demonstrate, and tries to arrange tours at local companies.

McNeil says "We definitely see [the courses] making a difference. … Illegal dual-use exports don't get much attention, but they happen every day."

In a related job responsibility, McNeil also is the point person from the U.S. Department of Energy (DOE) to the Export Enforcement Coordination Center (E2C2). The President established the E2C2 by Executive Order in 2010 as part of the Export Control Reform Initiative. The E2C2 is housed within the Department of Homeland Security, with Deputy Directors from the Federal Bureau of Investigation and the Department of Commerce. NIS represents DOE at the E2C2 and coordinates with other relevant DOE offices, such as the Office of Inspector General, to represent all DOE equities.

McNeil says that the award ceremony where she was presented with the medal by both former NNSA Administrator Brooks and then NNSA Administrator Tom D'Agostino was "very humbling." In her acceptance, McNeil made a point to recognize the National Laboratories that have the essential technical expertise necessary to conduct the CIT courses. She also acknowledged Todd Perry, the team lead for the International Nonproliferation Export Control Program, who brought her to NNSA and has been a "great mentor" since then.

Elaine Specht of Battelle has been providing outreach assistance to NIS since 2009 and is the managing editor of Highlights.

NONPROLIFERATION GRADUATE PROGRAM FELLOWS

In addition to her accomplishments within NIS, McNeil personifies other successes at NNSA. She joined the organization in 2009 as a Nonproliferation Graduate Program (NGP) Fellow and then had a two-year appointment with the Future Leaders Program. Both NNSA programs are meant to attract, develop, and retain highly qualified and motivated professionals to sustain the U.S. nonproliferation mission over the coming decades. In keeping with the aims of the programs, McNeil transitioned to a regular federal employee in 2012. The Future Leaders Program has since been combined with NGP.

To read about other young professionals finding opportunities in nonproliferation through NGP, note the author biographies in this issue of *Highlights*.

Kirsten McNeil initially joined NIS as an NGP Fellow and participated in the Future Leaders Program for two years.