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

DNN Sentinel

DEFENSE BY OTHER MEANS

VOL. IV, NO. 2

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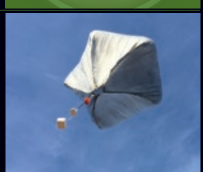

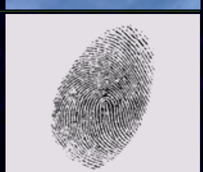

From the Deputy Administrator

It is with great excitement that I introduce my first issue of the Sentinel in my new role as Deputy Administrator for Defense Nuclear Nonproliferation (DNN). After more than thirty years working in NNSA laboratories across the United States, I am familiar with the dedication DNN staff, U.S. government partners, and M&Os apply to their work advancing our Nation's interests. This quarter, we focus our attention specifically on how we leverage advanced technologies and technical expertise internationally to achieve the United States' goals of protecting our national security.

I am proud of the leadership role DNN plays through its partnerships around the world with states and international organizations. By identifying opportunities where our nonproliferation capabilities align with our international partners' interests and executing on them credibly and swiftly, we demonstrate our prowess as a global leader in nuclear security. Whether through regional engagement on safeguards, capacity-building exercises in combatting nuclear smuggling, or training opportunities administered to share best practices and expertise in highly enriched uranium removal with our international counterparts, DNN's approach to nuclear security is cooperative, collaborative, and partner-oriented.

This issue of the Sentinel underscores the meaningful cooperation our programs achieve with our foreign partners in support of a wide range of nonproliferation activities. I find the work our programs accomplish remarkable, and I am inspired by those working within DNN and NNSA to implement all of these activities. I truly look forward to the continued opportunity to work with all those involved in implementing DNN's innovative approach to national and international nuclear security through nonproliferation. Through this issue of the Sentinel, I hope you will come to appreciate, as I do, the value of DNN programs and the excellence they exhibit working to bolster nuclear security around the globe and keep our nation safe.

DNN SENTINEL:
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https://www.energy.gov/nnsa/missions/nonproliferation

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NNSA ARTICLES

DNN QUICK LINKS

Follow the links below to learn more about recent NNSA and DNN activities.

Press Releases

NNSA breaks ground on Albuquerque Complex Project

https://www.energy.gov/nnsa/articles/nnsa-breaks-ground-albuquerque-complex-project

NNSA launches redesigned website for migration to Energy.gov

https://www.energy.gov/nnsa/articles/nnsa-launches-redesigned-website-migration-energygov

Articles

National Lab IT specialists connect and network at annual summit

Information technology depends upon interconnected systems sharing capabilities and transmitting information – the same is true of the National Laboratories.

The National Laboratories Information Technology (NLIT) Summit has taken place annually since 2000, when it first began as the Tri-Lab Summit. The event facilitates the exchange of best practices and ideas between IT professionals within the Department of Energy (DOE) complex, strengthens IT infrastructure, and reduces costs within the DOE system.

https://www.energy.gov/nnsa/articles/national-lab-it-specialists-connect-and-network-annual-summit

NNSA joins INTERPOL to enhance radiological security in Africa

NNSA and the International Criminal Police Organization-INTERPOL are continuing their work teaching countries around the world how to conduct effective investigations into acts of terrorism that involve radioactive and nuclear materials and technology.

NNSA and INTERPOL teamed up for a five-day Radiological and Nuclear Prevention and Response course in Accra, Ghana, last April. The training was specifically aimed at promoting increased cooperation at a national and regional level. Eight African countries – Ghana, Nigeria, Burkina Faso, Senegal, Mauritania, Niger, Cameroon, and Uganda – sent representatives from law enforcement and regulatory agencies and other relevant government organizations.

https://www.energy.gov/nnsa/articles/nnsa-joins-interpol-enhance-radiological-security-africa

Opening New Doors Through Regional Safeguards Engagement

By Karyn Durbin

Over the last several years, the Office of Nonproliferation and Arms Control's International Nuclear Safeguards Engagement Program (INSEP) has built productive relationships with partner countries and organizations across the globe. In recent months, INSEP capitalized on these relationships to reach new potential partner countries through regional engagements. Through these engagements, attendees from multiple countries in the region participate in workshops where they learn about international safeguards implementation globally and regionally.

This method was used last year to develop partnerships in sub-Saharan Africa. NNSA worked with Senegal's Authority for Radiation Protection and Nuclear Safety to host a workshop in Dakar and with Zambia's Radiation Protection Authority to host one in Lusaka. These organizations assisted with in-country logistics, including visa acquisition for visiting participants. This event drew representatives from Benin, Cabo Verde, Ethiopia, Guinea, Guinea Bissau, Liberia, Sao Tome and Principe, Sierra Leone, Zimbabwe, and the host countries.

Many INSEP activities, including these workshops, promote entry into force and full implementation of a comprehensive safeguards agreement (CSA) with the International Atomic Energy Agency (IAEA). The CSA provides for the application of safeguards to all declared nuclear material in the state to verify that it is not diverted to nuclear weapons or other nuclear explosive devices. An Additional Protocol (AP) to the CSA gives the IAEA enhanced tools to provide assurance of the absence of undeclared nuclear activities, with the goal of ensuring that all nuclear material is declared and subject to safeguards as required by the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). INSEP has witnessed how successful these regional engagements are in accomplishing this mission. The workshop in Lusaka established Senegal as a leader in the region, with some West African countries requesting to learn from Senegal's recent implementation of the AP.

An International Safeguards Outreach Event in Portugal, February 2018. Photo courtesy of INSEP.

These regional engagements have proven essential to enabling access to strategic partners and in helping to fulfill the NPT's requirement that all non-nuclear weapons states parties conclude a CSA with the IAEA. For example, in February 2018, NNSA sponsored a safeguards outreach workshop in Lisbon, Portugal, for Cabo Verde, Guinea-Bissau, and Sao Tome and Principe, three of the 11 remaining non-nuclear weapons states party to the NPT that have not yet concluded a CSA with the IAEA.

NNSA is also working with regional organizations to host workshops focused on IAEA safeguards implementation. Last year, NNSA worked with the Caribbean Community and the Arab Network of Nuclear Regulators to organize workshops relevant to countries in those regions. In both cases, the regional organizations were instrumental in garnering participants that NNSA may not have otherwise reached. NNSA also maintains a close relationship with the Asia Pacific Safeguards Network (APSN) and periodically co-sponsors regional events for members of the APSN.

Working with regional leaders and regional organizations has proven an effective model for NNSA's safeguards engagements. NNSA will continue to pursue such opportunities to amplify its safeguards engagements around the world.

Karyn Durbin is the Program Director for DNN's International Nuclear Safeguards Engagement Program.

International MNSR Training Center in Ghana Provides HEU Removal Expertise

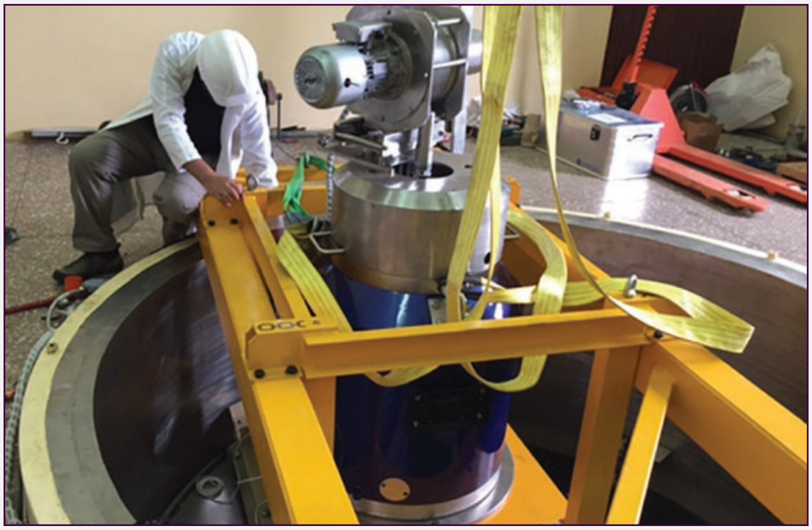
By Igor Bolshinsky, John Dewes, Kris Gaines, and Debbie Browning

Capping a decade of complex scientific and political international cooperation, 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, and returned the Chinese-origin HEU to China.

Ghana's MNSR is the first commercial reactor of this type to be converted outside of China, establishing this cooperative effort as a model for similar cooperation on future MNSR conversions and HEU removals. There are five remaining HEU-fueled MNSRs in the world, located in China, Nigeria, Pakistan, Iran, and Syria, and the work to convert Nigeria's MNSR has already begun. These reactor conversions and removals eliminate the risk that weapons-usable material could be stolen or diverted for malevolent uses.

Overview

Building on our years of cooperation, the United States and Ghana worked together to construct the International MNSR Training Center (IMTC) at the National Nuclear Research Institute of the Ghana Atomic Energy Commission (NNRI/GAEC) in Accra, Ghana. The IMTC was used for training operators in Ghana to discharge the reactor's HEU core, load it into a shielded transportation cask, and secure the cask for transport. Moving forward, the IMTC will be used to train personnel from the remaining countries with MNSRs to conduct these operations.

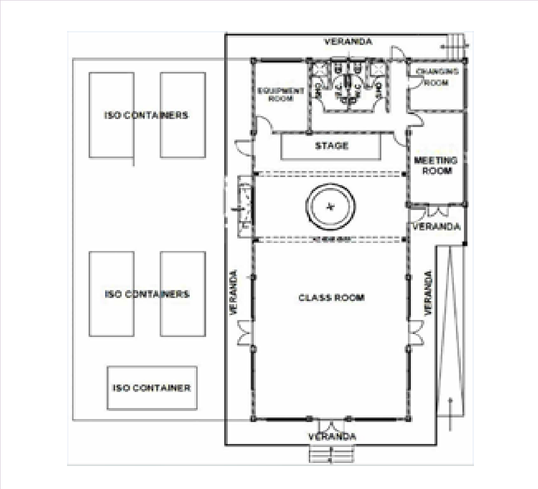


Experts placing the used HEU core of Ghana's MNSR into an interim transfer cask, August 2017. Photo courtesy of the IAEA.

Project Construction

Representatives from the Idaho National Laboratory, Savannah River National Laboratory, and the Oak Ridge National Laboratory supported NNSA in the planning and construction of the IMTC. The 689 m^2 facility consists of a classroom, mock-up of a reactor pool/reactor core, observation stage, 5-ton capacity overhead gantry crane, changing rooms, and an outside cask storage and loading area.

International MNSR Training Center



Location: Accra, Ghana
Construction Start: October 2016
Construction Complete: August 2017
Commissioned: December 2017
Building Area: 212 m^2/2,282 ft^2
Total Area (incl. ISO Pads): 689 m^2/7,416 ft^2
Construction Costs: $120,000 (US)

Training Program

The goal of the training curriculum is to ensure participants are well-versed in MNSR core removal and package loading operations so that they can independently perform these operations without external support. During the training sessions, participants develop proficiency with the components of the technical equipment used to remove the HEU core from the reactor vessel, as well as opening, loading, and closing the SKODA and TUK-145/C shipping casks.

With training for the removal of the Nigerian MNSR core underway, Ghana has demonstrated important leadership to promote global nonproliferation efforts.

Moving forward, DNN will continue to support Ghana and the IMTC in its efforts to minimize the use of, and where possible eliminate, weapons-usable nuclear material, and to build partner capacity to assist in that mission.

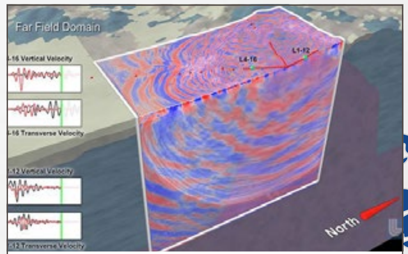
A Nigerian operator in training. Photo courtesy of M^3.

Igor Bolshinsky from Idaho National Laboratory is a project manager for MNSR HEU removal, John Dewes from Savannah River National Laboratory was the project manager for construction of the IMTC. Kris Gaines from Oak Ridge National Laboratory provided technical support during the construction and manages ongoing operation of the Training Center. Debbie Browning provides project support for Oak Ridge National Laboratory's Global Materials Security Program.

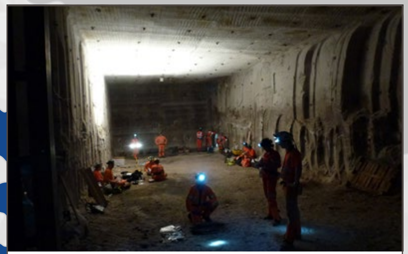
Defense Nuclear Nonproliferation Global Programs

Office of Defense Nuclear Nonproliferation (DNN)

Past and Present Partners as of December 2015



NEVADA
The Office of Defense Nuclear Nonproliferation Research and Development is conducting unique experiments at the Nevada National Security Site to better understand how seismic waves are generated from the source of an underground disturbance and then propagated through geologic media to a sensor. These source physics experiments generate terabytes of data for validating models, testing hypotheses, and improving tools that can be used to increase monitoring confidence at ever-decreasing explosive yields.



ENGLAND
Located on the northeast coast of England, Boulby Mine is the United Kingdom's deepest mine (4,600 ft.). It is also the home of UK's Science and Technology Facility Council's Boulby Underground Laboratory, which will host DNN R&D's Advanced Instrumentation Testbed for nonproliferation research. This is an international collaboration that includes DOE's Office of Science, DOE national laboratories, and universities.

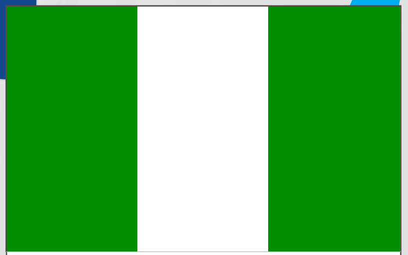
GHANA
DNN's M³, in cooperation with Ghana, China, and the IAEA, converted Ghana's GHARR-1MNSR in Accra, Ghana, from HEU to LEU fuel on June 13, 2017, and returned the Chinese-origin HEU to China.

KAZAKHSTAN
DNN's Office of International Nuclear Security conducted a Basic Instructor Training Course to train experts from Kazakhstan's Institute of Nuclear Physics as instructors for future nuclear security training courses. In February 2018, the course was led by a U.S. instructor and co-taught by two Kazakhstan Nuclear Security Training Center (NSTC) instructors as part of the transfer process. To finalize this process, the NSTC instructors will conduct the basic instructor training with U.S. observers providing feedback.

CHINA
DNN's cooperation with China on nuclear security led to the development and opening of the China Center of Excellence (COE). The United States and China have more than 40 joint activities planned at the COE during FY 2018, covering the areas of nuclear material control and accounting, physical protection, protective force, cybersecurity, nuclear security incident response, transportation security, and nuclear security culture.

INDIA
NNSA/DNN supports technical exchanges with counterparts in India's Department of Atomic Energy, who are responsible for security at India's nuclear facilities. This work with India is coordinated by a joint working group under the auspices of the Indian Global Center for Nuclear Energy Partnership. This bilateral cooperation was formalized at the Nuclear Security Summit in 2010. Collaboration has focused on nuclear and radiological security, nuclear smuggling detection and deterrence, nuclear incident response, and nuclear forensics.

MEXICO
DNN's Office of Radiological Security (ORS) has provided regulatory development and technical support to Mexico, including a "Transport Security Leaders" course and a "Transport Security for Regulators" course. With support and technical advice from ORS, Mexico developed and published transport security regulations for radioactive materials in April 2017.



NIGERIA
DNN's Office of Material Management and Minimization is cooperating with Nigeria, China, and the IAEA to convert Nigeria's Miniature Neutron Source Reactor from HEU to LEU fuel.

MOLDOVA
DNN's Office of Nuclear Smuggling Detection and Deterrence installed a radiation detection system in Chisinau, Moldova, as an operations and maintenance training aid at the Moldova Customs Service National Training Center.

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Capacity-Building Enables Countries to Effectively Combat Nuclear Smuggling

DNN's Office of Nuclear Smuggling Detection and Deterrence (NSDD) focuses on capacity building in five key areas: detection operations; policies and procedures; human resource development; maintenance management; and continuous improvement.

Detection Operations

NSDD provides radiation detection equipment and training to law enforcement and border security officials in partner countries to prevent terrorists from acquiring nuclear or radioactive material. Equipment may include stationary, mobile, relocatable, man-portable, or handheld detectors appropriate for the operation. NSDD works with its partners to strategize the deployment of technical means to detect illicit movement of these materials across and within the country's borders. Close attention is paid to addressing the highest smuggling risks while establishing sustainable capability for each partner.

Policies and Procedures

NSDD works with relevant in-country agencies to adopt appropriate policies and procedures that encourage sustained use of the equipment. This includes tailoring operating procedures to meet the legislative, operational, and practical needs of each site as well as policies that help ensure host government support for the operation to their detection program.

Human Resources Development

After equipment is delivered, NSDD provides training for staff at radiation portal monitor sites. This training is integrated into the larger program effort to build their agencies' capacity to take on all training responsibilities. This includes the ability to develop and deliver their own training programs and to maintain and improve their indigenous capabilities.

Maintenance Management

NSDD takes a number of approaches to protect its investments in equipment. One approach is to promote the use of regional and local maintenance providers, who are contracted to provide routine maintenance and repair of the equipment. Another approach is to develop this capability within the operating organization's existing information technology or equipment maintenance group. NSDD provides extensive training for all of these providers, coupled with a variety of software-based maintenance tools that assist with identifying, reporting, and seeking assistance on equipment faults. NSDD scientists also review equipment data to identify maintenance issues and develop solutions to improve performance and extend the service life.

A front-line officer in Bulgaria performs a secondary inspection. When people, vehicles, or cargo pass through detection equipment and generate radiation alarms, well-trained officers use handheld instruments to locate and identify the radiation sources.

Continuous Improvement

Continuous improvement is a cornerstone of NSDD's activities, both internally and externally. NSDD's Science and Engineering Team provides technical and analytical support to improve system operation; identify, test, and validate innovations in equipment and processes; and share best practices with scientists in partner countries. The Sustainability Team, meanwhile, works with partners to improve their own skills through drills, exercises, and workshops while employing a rigorous evaluation program to assess the effectiveness of NSDD training and to revise and update materials and approaches where appropriate.

For NSDD, capacity-building is considered successful when partners take on responsibility in these five key areas. Moldova is one such success story. Since 2011 Moldova has worked with NSDD to establish its detection operations, policies and procedures, maintenance capability, and a training program.

FAQs on NSDD

NSDD focuses on building the capacity of foreign partners to deter, detect, and investigate smuggling of nuclear and radioactive materials. The following FAQs describe several approaches the program employs to accomplish this mission.

1. Why does NSDD work in foreign countries?

NSDD works to build the capacity of foreign partners to interdict smuggled nuclear and radioactive materials as far from U.S. borders as possible and before they can cause harm to the United States, our allies, or our interests. Since its establishment in 1998, NSDD has cooperated with over 65 countries.

2. How does NSDD operate and maintain the detection systems?

Systems are operated and generally maintained by the partner country. Of the over 800 radiation detection systems that NSDD has deployed, 667 are maintained by the partner country. In some cases, NSDD will fund and train a local maintenance provider until the partner establishes funding and awards a contract. In others, NSDD will train the partner organization to perform the maintenance and no contract is needed.

3. How does NSDD know the systems are being operated and maintained?

Most NSDD partners routinely allow program experts to visit the sites, observe operations, and evaluate equipment performance. Many partners also provide data from the portal monitors directly to the program for evaluation of system performance. Through this analysis, NSDD can see that systems are operating as intended and identify any anomalies.

4. How does NSDD build capacity for investigations?

NSDD works with scientists in select countries to help them develop or improve their nuclear forensics capabilities to analyze interdicted materials. This analysis may provide law enforcement with critical information needed for an investigation or prosecution.

5. How does NSDD fit in with the work of other international organizations in this field?

NSDD partners with the IAEA, INTERPOL, Global Initiative to Combat Nuclear Terrorism, and the Global Partnership, which play leading roles in promoting nuclear security. Partnering with these organizations acts as a force multiplier to reinforce the importance of global efforts to prevent nuclear smuggling. Additionally these partnerships can provide NSDD a link with countries that prefer to work through multilateral organizations instead of directly with the U.S. Government.

NSDD's scientists and engineers also collaborate with the U.S. Government and international organizations, such as the IAEA and European Commissions Joint Research Centre technical working groups, to develop international standards and guidelines and to advance nuclear detection and forensics sciences and applications.

6. NNSD has been doing this for a long time. When will the program be done?

While it is true that NSDD and its predecessor program have been around for a long time, a lot has changed over the years. New threats arise and new approaches to addressing them are continually being evaluated. While elements of the program will finish or evolve, the program remains committed to preventing terrorists from acquiring the materials they would need for an improvised nuclear devise or a radiological dispersal devise, such as a "dirty bomb."

New Balloon-Borne Acoustic Sensor Array Detects Explosions from Afar

By Mollie Rappe

Sheets of plastic thinner than grocery bags, packing tape, some string, a dash of charcoal dust, and a white shoebox-sized box are more than odds and ends. These are the supplies Danny Bowman and Sarah Albert, geophysicists at Sandia National Laboratories, need to build a solar-powered hot air balloon for detecting infrasound. Infrasound is sound of very low frequencies, below 20 hertz, which is lower than humans can hear.

This July the pair launched a fleet of five solar-powered balloons that reached a height of 13 to 15 miles, twice as high as commercial jets, and detected the infrasound from a test explosion. This experiment was funded by Sandia's Laboratory Directed Research and Development program.

The most important aspect of this experiment was that the five balloons formed a 3-D array of sensors. One sensor can hear a sound but cannot provide any location information. Multiple microphones in an array, as in this experiment or ground-based sensor arrays, provide the direction of the sound wave. Researchers can coordinate the information from multiple arrays to triangulate the source of the sound.

The solar-powered hot air balloons take three hours for Bowman and Albert to make and use about $50 worth of materials, not including the reusable infrasound sensor or GPS tracker. The charcoal dust helps heat the air inside the balloon, providing lift, without requiring helium gas—a nonrenewable resource. The balloons can be launched by a single person under sunny skies and low ground winds; the current design can deliver 4 lbs. to over 50,000 ft. and 1.5 lbs. to 80,000 ft. The balloons fly at a constant elevation for as long as the sun is above the horizon. Bowman and Albert are developing a new version that can be attached

Above: A Sandia National Laboratories solar-powered hot air balloon taking flight bears sensors including a GPS tracker and reusable infrasound sensor. Photo courtesy of Sandia National Laboratories.

Acoustic Sensor – *Continued*

to an ordinary Mylar weather balloon, then released above the clouds for deployments even on cloudy and/or windy days.

Solar balloon-borne infrasound sensors are a part of the next series of the NNSA's Source Physics Experiment project. This project develops new and improved, physics-based approaches for monitoring underground nuclear explosions. Bowman and Albert aim to capture up going acoustic waves from underground chemical explosions as they enter the lower stratosphere.

In addition to potential treaty monitoring and national security uses, the team hopes to fly hot air balloons in non-terrestrial experiments. Bowman is assisting a NASA Jet Propulsion Laboratory project to explore the possibility of using balloon-borne infrasound sensors on Venus to listen for Venus-quakes. Another possibility the team is exploring is flying infrasound sensors on Jupiter. Jupiter is a gas giant with open scientific questions about its internal structure and geology that infrasound could help answer.

Whether the mission is on Earth or other planets, the pair is always looking for new opportunities to push the limits of their flight system. "You build a payload, and we'll fly it," said Bowman.

Mollie Rappe is a Public Affairs Specialist at Sandia National Laboratories.

A view of the earth from one of Sandia National Laboratories' solar-powered hot air balloons. The photo was taken last July at a height of about 13 miles. Photo courtesy of Guide Star Engineering LLC.

Sandia National Laboratories geophysicists Danny Bowman and Sarah Albert display an infrasound sensor and the box used to protect the sensors from the extreme temperatures experienced by balloons that take the sensors twice as high as commercial jets fly. Photo by Randy Montoya, Sandia National Laboratories.

INECP Uses Unique 'Fingerprinting' Technique to Analyze Export Declarations

By Chris Walker

The Office of Nonproliferation and Arms Control's (NPAC) International Nonproliferation Export Control Program (INECP) works with U.S. targeting and data analysis specialists to bolster their ability to prevent U.S.-origin exports of dual-use goods from contributing to foreign weapons of mass destruction (WMD) programs. Dual-use goods are commodities with both commercial and WMD applications. Many WMD-related dual-use commodities require an export license from the U.S. Department of Commerce before being transferred. Determined proliferators may seek dual-use items for WMD programs and use several tactics to acquire them, such as avoiding export licenses, falsifying information on an export license request, or using networks of front companies and brokers to disguise the real intent for items they are seeking.

When an item is exported from the United States, an export declaration must be submitted to the U.S. Census Bureau. Other U.S. agencies also have access to the data contained in the declaration for statistical, regulatory, law enforcement, and other purposes. These export declarations typically describe the items in each shipment in general terms and contain a Harmonized System (HS) code—a numerical classification system to facilitate tariff collection—along with the weight, value, and, where applicable, an indicator that the commodity has an export license.

Trade volume leaving the United States daily is extremely high, and U.S. law enforcement agencies must analyze large volumes of export declarations to find potential illicit shipments that could have WMD applications. To aid in this effort, INECP has developed commodity "fingerprints" for dozens of nuclear-, missile-, and chemical/biological-related dual-use goods, which allow law enforcement agencies to pare down thousands of export declarations into a smaller number (i.e., dozens) that may contain commodities of proliferation significance, without having to manually review thousands of individual declarations.

Each fingerprint is a unique profile used to identify a particular strategic commodity in the trade flow using data fields that appear in shipping documents. A good example is pressure transducers, which are a specialized type of sensor used in uranium enrichment. This commodity shares an HS number (9026.20) with all other pressure sensors, such as those used to check pressure in bicycle or automobile tires. INECP's research of this item revealed that sensitive pressure transducers are typically priced around $1,000 to $2,000 each, weigh a couple of pounds, and sell in quantities of a couple dozen at a time. This fingerprint—HS number combined with the aforementioned value, weight, and transaction size—distinguishes it from other pressure sensors that share the same HS number, but are cheaper, lighter, and sold in larger quantities. Applying the fingerprint profile as a filter allows analysts to pare down a few thousand shipments to a hundred or so of potentially sensitive pressure transducers.

INECP shares its fingerprints with the Department of Homeland Security/Immigration and Customs Enforcement's (DHS/ICE) Border Enforcement Analytics Program (BEAP), a large data analytics program that supports ICE's counterproliferation mission, to help them identify suspicious exports leaving the United States. BEAP uses the fingerprints in its review of export declarations flagged by the process for additional signs of proliferation indicators.

Overall, INECP's fingerprinting process has successfully resulted in identifying suspect shipments potentially related to WMD proliferation and is a powerful new way of using big data to pursue counterproliferation investigations.

Chris Walker is a Foreign Affairs Specialist supporting INECP.

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