National Nuclear Security Administration

Office of Nonproliferation and International Security (NIS)

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Defense Nuclear Nonproliferation

March 2010

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

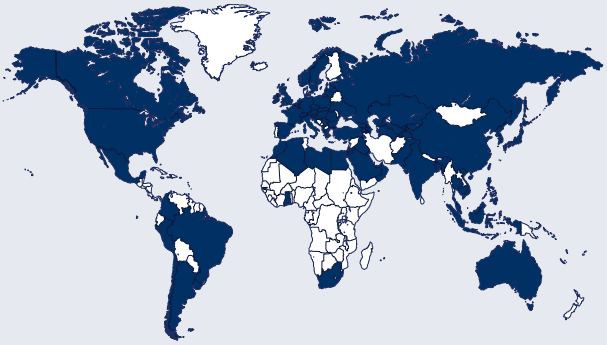
- **Safeguard** nuclear material to prevent its diversion for illicit use.
- **Control** the spread of WMD-related material, equipment, technology and expertise.
- **Verify** nuclear reductions and compliance with international nonproliferation treaties and agreements.
- **Develop** and implement nonproliferation and arms control policy.

NIS Responds to Critical National Security Threats

President Obama has characterized the possibility of terrorist weapons of mass destruction (WMD) acquisition as the "most immediate and extreme threat to national security." Under the Deputy Administrator for Defense Nuclear Nonproliferation, the mission of the NNSA Office of Nonproliferation and International Security (NIS) is to prevent the proliferation of materials, equipment, technology and expertise needed to manufacture WMD. Working alongside NNSA's international partners, NIS provides leadership in the formulation and implementation of governmental nonproliferation strategies, deploying a unique variety of technically based national security programs. To fulfill this role, NIS draws on and contributes to a wide range of technical resources within the U.S. national laboratory complex and with various international organizations in pursuit of four broad goals:

Safeguard nuclear material to prevent its diversion for illicit use. Nuclear safeguards are vital in ensuring that nuclear materials, technology and expertise are not diverted for illicit use. NIS is addressing evolving proliferation threats from the Democratic People's Republic of Korea, Iran and Syria; expanded responsibilities within the International Atomic Energy Agency (IAEA); the diffusion of sensitive technology through illicit networks; a retiring safeguards workforce; and inadequate research and development funding. The Next Generation Safeguards Initiative (NGSI) is charged with revitalizing the U.S. Government's safeguards capability, as well as strengthening and sustaining the international safeguards system. NGSI supports the development of sound U.S. Government safeguards policies, concepts and approaches. Human capital will be developed through education and training, and new safeguards systems, technology and infrastructure will be developed and implemented. Finally, NGSI will support the global nuclear infrastructure in its aim to emphasize safeguards, security and nonproliferation objectives.

Control the spread of WMD-related material, equipment, technology and expertise. Strong national systems of control are critical elements of a multilayered strategy aimed at preventing state and non-state actors from obtaining WMD. NIS provides a comprehensive response to this threat through a series of interrelated programs designed to increase the probability that illicit WMD-related transfers will be detected and deterred. At home, NIS provides licensing, enforcement and interdiction support to multiple governmental agencies as well as to the U.S. nuclear industry. Overseas, NIS works with over 60 international partners to strengthen national capacities in the areas of export control licensing, interdiction and physical protection. All of these activities are pursued in accordance with international laws, regulations and standards promoted by NIS specialists within various international supplier regimes like the Nuclear Suppliers Group and with treaty-based organizations like the IAEA. By simultaneously advocating and seeking consensus for stronger international controls and then enabling national partners to implement these controls, NIS represents a critical element of the government's strategy to combat illicit WMD procurement networks worldwide.



Dark blue indicates areas of NIS engagement.

Verify nuclear reductions and compliance with international nonproliferation treaties and agreements. The United States must maintain the ability to verify nuclear reduction agreements and detect violations of treaties and other commitments, as well as other activities in violation of international law. NIS is developing and deploying transparency measures to ensure verifiable adherence to treaties and other obligations in a number of ways. NIS is developing technologies tailored for application at specific foreign facilities, as well as technologies designed to detect potential clandestine weapons programs or illicit diversions. NIS continues to provide technological and policy support to assist other Federal agencies in meeting treaty and agreement obligations. This technology development and active participation in policy formation contributes to the goal of transparency.

Develop and implement nonproliferation and arms control policy. Containing global proliferation and implementing presidential initiatives requires development of innovative policies and approaches. NIS focuses scientific and technology capabilities to advance U.S. nonproliferation and arms control policy in several ways. NNSA expertise is marshaled into key U.S. Government decisions, programs and policies. NIS advises the U.S. Government interagency process when treaties and agreements are being negotiated and developed. NIS facilitates engagement in proliferation-sensitive regions and pursues active participation in the multilateral supplier regime. Nonproliferation and arms control policy must incorporate NIS scientific, technology and policy input in order to be effective.

This bulletin highlights information about current NIS activities being implemented to advance the United States' nonproliferation and arms control agenda.

Innovative Technologies Assist in Detection of Nuclear Materials

Nuclear Safeguards

Developing and improving technologies to detect, identify and inspect nuclear materials and activities is a critical component for strengthening the international nuclear safeguards system. The Next Generation Safeguards Initiative (NGSI) was launched in 2008 and charged with developing the technology, concepts and expertise necessary to strengthen the international safeguards system. Within NGSI, the Safeguards Technology Development Program focuses on developing advanced nuclear measurement technology, unattended and remote monitoring systems, data integration and authentication applications and field-portable detection tools to help inspectors verify the absence of undeclared nuclear materials and activities. To this end, NGSI launched or accelerated 10 new technology development projects in 2009 with the objective of developing advanced tools and methods to detect undeclared production and processing of nuclear materials. One technology—the GeMini Spectrometer—was selected as a 2009 R&D 100 Award Winner, a recognition by *R&D Magazine* as being one of the top 100 revolutionary technologies newly introduced to the global market.

Developed at the Lawrence Livermore National Laboratory and co-funded by NNSA and the Defense Threat Reduction Agency, the GeMini Spectrometer is a portable gamma-ray spectrometer based on germanium technology. The instrument is so small that it fits in the palm of a hand and is outfitted with an innovative low-powered, miniature cooling mechanism. Because radioactive materials can be difficult to recognize unless specifically and correctly marked as radioactive, a handheld, noninvasive sensor—such as the GeMini—that measures the release of gamma rays from a source is an invaluable new tool that can be used to help detect the unauthorized transfer and distribution of nuclear materials. GeMini also has uses beyond the nonproliferation arena.

A portable Laser Induced Breakdown Spectroscopy (LIBS) device under development by NGSI.

It is currently collecting the first-ever gamma-ray data of the planet Mercury following its launch on NASA's Mercury MESSENGER spacecraft.

The NGSI Safeguards Technology Development Program also completed the prototype development of a portable Laser-Induced Breakdown Spectroscopy (LIBS) system for in-field analysis of inspection samples. LIBS is a laser-based technique that uses a focused pulse laser beam to generate a microplasma. The emission from the plasma is wavelength-resolved using a system that combines a spectrograph, detector and computer to determine the elemental composition of material samples of interest. The advantages of LIBS include little to no sample preparation time, analysis in real time (minutes), high configurability, high sensitivity (ppm–subppm), ratios of elements, ability to conduct isotopic measurements of actinides and an ability to analyze all the elements in the periodic table.

Portable GeMini instrument.

LIBS can also be applied to remote analysis in harsh environments using conventional or fiber optics in hot cells and gloveboxes. While LIBS technology is already being used, the development of additional LIBS instrumentation will provide the next step in LIBS technology development allowing for greater application. Its novel application under NGSI, in a portable/backpack-mounted configuration, will make it especially useful for measurements of nuclear materials in the field. ■

NIS Plays Key Role in Moving Test Ban Treaty toward Ratification

Develop Policy

NNSA has played a key role in shaping the Comprehensive Nuclear Test Ban Treaty (CTBT) since its inception. NNSA policy and technical expertise informed and guided the negotiations and continue to support preparatory efforts surrounding ratification and implementation. As a result, in April 2009, when President Obama committed to "immediately and aggressively pursue U.S. ratification of the CTBT," NNSA's Office of Nonproliferation and International Security (NIS) was already well-positioned to assist in related U.S. Government efforts.

The CTBT was adopted by the United Nations General Assembly and opened for signature in September 1996. The treaty calls for a global ban on nuclear testing whether surface, atmospheric, underwater or underground. Many experts believe that the entry into force of the CTBT will play an essential role in driving forward global nonproliferation efforts. According to the CTBT Organization Preparatory Commission, the goal of the treaty is "to obstruct the development of nuclear weapons: both the initial development of nuclear weapons as well as their substantial improvement." As of November 2009, 151 states have ratified the CTBT and an additional 32 states have signed but not yet ratified the treaty. All 44 countries listed in Annex 2, those states who were members of the Conference on Disarmament and had nuclear power or research reactors at the time of the negotiation, must ratify the treaty before it can enter into force. There are currently six Annex 2 countries that have yet to ratify the treaty: China, Egypt, Indonesia, Iran, Israel and the United States. Three Annex 2 countries have neither signed nor ratified the treaty: North Korea, India and Pakistan.

The U.S. Government is working to ensure the effectiveness and efficiency of the CTBT Organization Preparatory Commission and its Provisional Technical Secretariat and the verification regime once the treaty enters into force. In support of the administration's policy objectives in this area, NIS is coordinating NNSA efforts to work with the U.S. interagency to address concerns that might prevent the Senate from ratifying the treaty while ensuring a U.S. stockpile that is safe, secure and effective. These efforts include collaborating with the Department of State and the National Academy of Sciences to review and update aspects of the 2002 National Academies report *Technical Issues Related to the Comprehensive Nuclear-Test Ban Treaty*, drawing on the latest evidence. NIS also provides policy and technical expertise to help the CTBT Organization Preparatory Commission develop and manage the treaty's verification regime through participation in international workshops, exercises and meetings, and by sharing appropriate information about how best to ensure the effectiveness and efficiency of the Technical Secretariat and the verification regime once the treaty enters into force. Furthermore, NIS is leading the interagency effort for U.S. re-engagement with the international community on the establishment and operation of the CTBT On-Site Inspection regime after an absence of many years due to previous policy restrictions.

The CTBT Organization Preparatory Commission, an international organization headquartered in Vienna, Austria, was established to build the verification regime, including the establishment and provisional operation of the International Monitoring System (IMS)—a network of monitoring stations, the creation of an international data centre, and the development of the On-Site Inspection capability. The IMS is a critical component of the CTBT given the necessity of reliable verification to the treaty's nonproliferation goals.

As of 2010, over 90 percent of the planned 321 international monitoring stations are complete or under construction. Radionuclide monitoring stations—such as the RN15 station located in Resolute, Nunavut (Canada)—help detect nuclear explosions worldwide.

The IMS system is the heart of the verification regime and uses four state-of-the-art technologies—seismic, hydro-acoustic, infrasound and radionuclide—to monitor nuclear weapons testing. There are plans for 321 IMS stations located throughout the world, of which 244 have been certified. Many of the IMS stations are located in the United States and its territories and send data to the International Data Centre in Vienna, Austria. These stations and the experts who analyze the data collected play an instrumental role in the detection of nuclear explosions worldwide with the intended effect of deterring countries, like North Korea, from pursuing nuclear weapons programs. NNSA, through the certified Radionuclide Laboratory at Pacific Northwest National Laboratory, is uniquely qualified to provide radiological monitoring capabilities in support of CTBT verification. This type of technical expertise is critical in ensuring a verifiable treaty and plays a key confidence-building role.

As a strong sign of U.S. Government support for the CTBT, Secretary Chu and NNSA Administrator D'Agostino visited the CTBT Organization Preparatory Commission in September 2009 and committed to full engagement in all CTBT activities. The United States is once again helping to pave the way toward what has been called the "longest sought, hardest fought prize in the history of arms control"—a global ban on testing nuclear weapons. ■

U.S. Program Assists in the Permanent Elimination of Over 15,000 Nuclear Weapons

Nuclear Verification

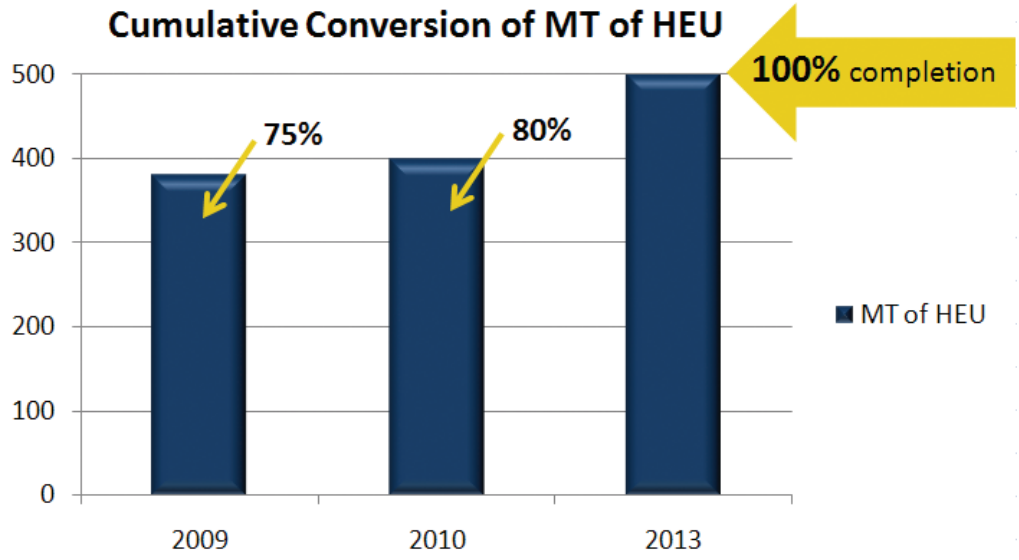
NIS achieved a significant nuclear nonproliferation milestone in 2009—the equivalent of 15,280 nuclear weapons has been permanently eliminated in Russia by converting highly enriched uranium (HEU) into low-enriched uranium (LEU). The milestone was met by successfully monitoring the cumulative "blending down" of 382 metric tons (MT) of HEU from Russia's nuclear weapons program, passing the 75% completion mark of the 1993 HEU Purchase Agreement.

It is estimated that approximately three nuclear weapons are eliminated under the agreement every day, with 30 MT of weapons-usable HEU blended down into LEU annually. Every MT of HEU eliminated under the agreement is one that will not require sustained security upgrades and can never be stolen or diverted for illicit use. As an added bonus, 10% of electricity generated in the United States is from nuclear fuel obtained from the dismantled Russian nuclear weapons.

Under the 20-year HEU Purchase Agreement, Russia removes HEU components from disassembled nuclear weapons and converts the material into LEU for nuclear fuel sold in the United States. The NIS HEU Transparency Program fulfills the agreement's nonproliferation requirements by monitoring the HEU-to-LEU blending-down process in Russia. By comparing Russian process declarations, firsthand observations from U.S. experts, and data from U.S.-designed instruments, the program confirms that the LEU purchased and delivered under the agreement is derived from Russian weapons HEU.

To ensure that LEU derived from Russian HEU is used exclusively for peaceful purposes in the United States, Russia exercises reciprocal transparency rights under the agreement, which involves the program facilitating Russian monitoring activities at U.S. facilities.

The HEU Transparency Program will reach the 80% completion milestone (400 out of 500 MT HEU) in September 2010 and will fully implement U.S. monitoring rights through the agreement's completion in 2013 to ensure that all 500 MT of Russian HEU are blended down subject to rigorous transparency measures and that the agreement's nonproliferation objectives are fully achieved. ■



Blend Down Monitoring System

A great enhancement to transparency and an important technical achievement of the HEU Transparency Program is the successful design and deployment in Russia of a Blend Down Monitoring System (BDMS). The BDMS continuously and independently measures the enrichment and flow rate of HEU as it is diluted to LEU and then delivered to the United States This system allows continuous measurements of HEU blending down to occur even while U.S. monitors are not present.

The United States monitors HEU oxidation.

Strengthening WMD Commodity Interdiction Controls: NIS Cooperation with Overseas Customs Organizations

Nuclear Controls

Customs officials are on the front line of global export control efforts to prevent criminal networks from funneling sensitive commodities to WMD programs. NIS's International Nonproliferation Export Control Program (INECP) has pioneered the integration of frontline enforcement agencies into the global export control community by enhancing customs organizations' ability to detect and deter illicit transfers of WMD-related items.

Through its development of WMD Commodity Identification Training (CIT) for frontline inspectors, INECP is able to train non-specialists to recognize visually distinctive aspects of suspect items and to provide all partner countries with CIT Instructor Training (CIT-IT) so that this capacity can be provided on a widespread basis. INECP national laboratory specialists are now providing CIT-IT to designated specialists in over 30 countries. This CIT "indigenization" approach made important strides worldwide in 2009, with notable progress in China and southeastern Europe.

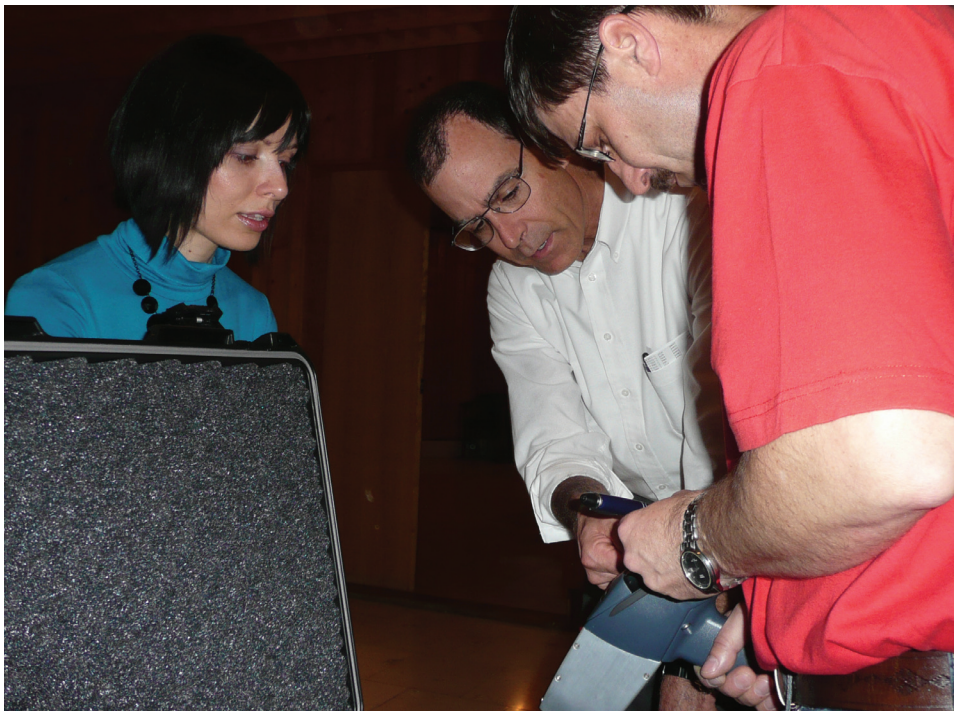
China – In September 2009, a team of NIS specialists provided a two-day WMD-CIT at the Shanghai Customs College. Sixty-one customs officers from 40 Chinese ports attended the course, which is part of an ongoing effort to prepare College instructors in the development and delivery of CIT as a regularly scheduled course. INECP has been working with Chinese customs since 2006 at a variety of locations, including the Chinese border with North Korea, and will next work with Chinese counterparts to develop a nationwide training plan in a number of additional regions.

Southeastern Europe – 2009 also witnessed a resurgence of concern in southeastern Europe about illicit procurement and a resulting rise in requests for exchanges with NIS specialists. Numerous INECP-led efforts, including training for licensing officials and manufacturers, are underway across the European continent to strengthen individual governments' ability to prevent proliferators from exploiting the region's rich manufacturing base.

> **"This partnership will improve regional information sharing and efforts to detect illicit materials – two critical elements in combating illicit transfers of WMD-related commodities."**
>
> *– NNSA Administrator Thomas D'Agostino*

One of these efforts is an emerging partnership with the Southeast European Cooperative Initiative (SECI) Center. SECI is an organization of police and customs authorities from 13 countries that enables law enforcement organizations to build on each others' WMD interdiction capabilities and develop the technical capacity to ensure rapid responses when suspicious shipments are identified. Sharing lessons learned about approaches to training and technical "reachback" with customs organizations has already proven successful for INECP in other parts of Europe, where the detection of illicit shipments has resulted in successful interdictions and prosecutions. ■

See in a future issue: Strengthening WMD Commodity Interdiction Controls: NIS Cooperation with U.S. Enforcement Organizations



INECP specialists demonstrate an X-ray fluorescence (XRF) metal analyzer for Slovakian officials. Customized XRF software enables customs frontline officers to quickly identify bulk metals and equipment used for the manufacture of WMD. Sixteen national customs administrations have obtained metal analyzers and accompanying software from INECP and INECP's Department of State partner, the Export Control and Related Border Security (EXBS) Program.

For More Information

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