National Nuclear Security Administration

Office of Nonproliferation and International Security (NIS)

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Defense Nuclear Nonproliferation

July 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 Plays Key Role in New START Negotiations

Nuclear Verification

Presidents Obama and Medvedev signed an historic strategic arms reduction treaty in Prague on April 8, 2010. The Treaty between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, also known as the New START Treaty, was developed and negotiated with significant assistance from the NNSA Office of Nonproliferation and International Security (NIS).

New START is a bilateral nuclear arms reduction treaty that will replace the 1991 START Treaty, which expired in December 2009, and supersede the 2002 Strategic Offensive Reductions Treaty or Moscow Treaty. New START will reduce strategic delivery vehicles by more than 50 percent compared to START, and will reduce deployed strategic nuclear warheads by 30 percent compared to the Moscow Treaty. Specifically, New START limits: (1) deployed and non-deployed launchers of inter-continental ballistic missiles (ICBM), submarine-launched ballistic missiles (SLBM), and heavy bombers equipped for nuclear armaments to 800; (2) deployed ICBMs, deployed SLBMs, and deployed heavy bombers equipped for nuclear armaments to 700; and (3) deployed strategic nuclear warheads to 1,550.

The U.S. New START Delegation was headed by Assistant Secretary of State for Verification, Compliance and Implementation Rose Gottemoeller who was formerly Deputy Undersecretary of Energy for Defense Nuclear Nonproliferation. NIS served as the DOE/NNSA lead for New START negotiations, participated in key aspects of U.S. policy development, and was responsible for negotiation activities from the onset. Kurt Siemon, Director of the Office of Nuclear Verification, served as the senior DOE/NNSA representative to the negotiations and as a Special Counselor to the U.S. Negotiator. He led the four-person team representing DOE/NNSA on the U.S. Delegation throughout the ten-month negotiation, which took place primarily in Geneva, Switzerland, and drew upon NIS Headquarters and National Laboratory experts to ensure that NNSA's expertise and knowledge base supported U.S. negotiating objectives.

"NIS ... played a vital role on the U.S. delegation for the New START negotiations. We couldn't have done without the technical expertise that NIS staff and its National Laboratory partners brought to the table."

- Rose Gottemoeller, Assistant Secretary of State for Verification and Control

NIS had lead responsibility for negotiating three of the seven major components of the Treaty—definitions, notifications and telemetry. The Definitions Working Group was responsible for identifying and defining all key terms contained within the Treaty. The Notifications Working Group was responsible for identifying and organizing all notifications required to support treaty implementation and verification activities. The Telemetry Working Group was responsible for negotiating an exchange of telemetric information from ballistic missile flight tests, which the United States and Russia agreed to include in the Treaty as a transparency measure.

Throughout the negotiations, NIS Headquarters staff supported the Geneva-based team and the broader U.S. Interagency by providing reach back into NNSA, working with the Office of Defense Programs and other NNSA elements to develop and coordinate positions, providing guidance to the delegation, advocating NNSA positions within the U.S. Interagency, and preparing for the Treaty's eventual signature and ratification.

NIS, working with the Office of Defense Programs and other NNSA elements, will continue to support the larger U.S. Interagency effort to shepherd the New START Treaty through Senate advice and consent to ultimate ratification and entry into force. This significant effort will include preparing principals for testimony, briefing Congressional members and staff, and responding to detailed Congressional questions. ■

The first page of the New START Treaty, signed by members of the U.S. and Russian negotiating teams upon conclusion of the Treaty.

NIS representatives at the U.S. Mission in Geneva with Assistant Secretary of State Rose Gottemoeller, the U.S. Negotiator. From left to right are: Carolyn Pura (SNL-CA), Kurt Siemon (NIS HQ), Rose Gottemoeller, Mona Dreicer (LLNL), and Greg Dwyer (NIS HQ).

NIS Supports Novel Safeguards Measurements at the Chornobyl Nuclear Power Plant

Nuclear Safeguards

In 1986, the Number 4 reactor at the Chornobyl Nuclear Power Plant (ChNPP) exploded, scattering nuclear material all over the site and surrounding communities. The Chornobyl disaster is the worst nuclear power plant accident in history. After the disaster, the Soviet Union built a temporary sarcophagus around the damaged reactor to shield what was left of the unit from the intense, emanating radiation and contain the contamination. Recently, the international community started building a more stable and permanent structure—the New Safe Confinement—over the damaged sarcophagus and reactor to mitigate the environmental results of a possible sarcophagus collapse.

Excavation for the construction of the New Safe Confinement will likely unearth significant amounts of irradiated nuclear fuel and fuel fragments, containing both uranium and plutonium, which was ejected from the reactor during the 1986 explosion. Unearthing this nuclear material presents complex nuclear safeguards problems for the ChNPP, the State Nuclear Regulatory Committee of Ukraine, and the International Atomic Energy Agency (IAEA) because the nuclear material in the dirt must be measured and declared to the international community.

Chornobyl authorities contacted the NNSA Office of Nonproliferation and International Security (NIS) International Safeguards and Engagement Program (INSEP) for assistance. After surveying the problem, INSEP's technical experts at Los Alamos National Laboratory modified an existing nuclear material measurement instrument to measure and account for the dispersed nuclear material in the dirt.

Over the next year, ChNPP will use the Chornobyl Drum Assay System (CDAS) to analyze the unidentified material for fissile content and add this material to its inventory declaration to IAEA, in accordance with the requirements of Ukraine's Comprehensive Safeguards Agreement. The CDAS was heralded by ChNPP and IAEA as a major success.

As a major sub-program under NNSA's Next Generation Safeguards Initiative (NGSI), INSEP draws on the unique expertise of the DOE's National Laboratories to engage partner countries to improve the development and application of international safeguards through all stages of nuclear development. The Chornobyl episode is just one example of the support INSEP provides to IAEA member states to strengthen their systems of nuclear material accounting and control. Through regional and bilateral engagements, INSEP provides training, equipment and expertise needed by international partners to resolve specific safeguards challenges like those at Chornobyl. INSEP also develops and tests next-generation safeguards technologies through collaborative technical projects with foreign partners. These technologies are intended to reduce the requirement for on-site inspector presence at particular facilities and increase the consistency of international safeguards reporting. ■

INSEP provides training, equipment and expertise needed by international partners to resolve specific safeguards challenges, like those at the Chornobyl Nuclear Power Plant (Photo courtesy of Pacific Northwest National Laboratory).

INSEP-developed Chornobyl Drum Assay System during December 2009 acceptance testing at ChNPP.

The Next Generation Safeguards Initiative's Human Capital Development Program Cultivates the Next Generation of Safeguards Professionals

Nuclear Safeguards

The international safeguards system is under more strain today than at any point in history due to constrained budgets, demanding high-profile non-compliance investigations, and an expanding list of day-to-day activities. Over the last 25 years, the quantity of highly enriched uranium and separated plutonium under International Atomic Energy Agency (IAEA) safeguards has increased by a factor of 10, the number of safeguarded installations is up 40 percent, and the number of states with comprehensive safeguards agreements is up from roughly 40 to more than 150. Looking ahead, the number of states operating nuclear power plants may double by the year 2050. A growing volume of data will come from environmental samples, commercial satellites and open-source documents. In fact, IAEA estimates that by 2030 it will need to increase its desk evaluation activities at headquarters by up to 50 percent. At the same time, an estimated half of safeguards professionals, both in the United States and at IAEA, will reach retirement age. This growing imbalance between demand for safeguards human capital and its supply must be addressed if international safeguards are to continue to play their key role in the international nonproliferation regime.

One key element of the Next Generation Safeguards Initiative (NGSI) is the Human Capital Development (HCD) Program within the NNSA Office of Nonproliferation and International Security (NIS), which is developing sustainable academic and technical programs to support the recruitment and training of the next generation of international safeguards professionals. Specifically, the HCD Program aims to develop additional human resources to address current shortfalls, encourage U.S. experts to seek employment at IAEA, and identify and train a new cadre of safeguards experts to meet future U.S. and IAEA needs.

NNSA Administrator Tom D'Agostino calls the summer courses "a great example of the steps we're taking to recruit and train the next generation of experts. These students are to be commended for their interest in nuclear nonproliferation and the work we do."

Among its successes since inception through May 2010, the HCD Program has sponsored over 150 interns, offered summer courses (at five locations in 2009) to over 175 participants, funded post-doctoral candidates at eight National Labs, provided more than 50 guest lecturers at universities, developed nine courses in international safeguards for incorporation into graduate and undergraduate curricula, and launched a comprehensive analysis of the current safeguards workforce. Summer courses and internships have been at the heart of the effort to attract and train a new generation of safeguards professionals. Many interns are returning to the National Labs in summer 2010 to continue working on safeguards projects. Some have been converted to Laboratory staff, while others have gone on to pursue nonproliferation graduate degrees. Two former interns are highlighted below.

Former Oak Ridge National Laboratory intern Sinsze Koo now works at Savannah River National Laboratory. She says the NGSI internship experience highlighted for her the many opportunities in the safeguards research field. She is enrolled in a masters program in nuclear engineering and hopes to continue in the safeguards field either in the United States or at IAEA. She also is involved with the Next Generation Safeguards Professional Network.

Lenka Kollar, a nuclear engineering graduate student at Purdue, completed a safeguards internship and summer course at Pacific Northwest National Laboratory in 2009. She says the HCD Program inspired her to focus more on nonproliferation and international nuclear policy in her graduate studies and future career. This summer she will begin a year-long stint as an NNSA Nonproliferation Graduate Fellow supporting the Office of Nuclear Safeguards and Security. She also is considering future application to the IAEA as a Junior Professional Officer.

Sinsze and Lenka are examples of the many NGSI interns who are pursuing a career in safeguards as a direct result of their NGSI internship. NNSA will continue to establish a human capital development system that seeks to staff international safeguards positions at National Laboratories, federal agencies and IAEA with qualified U.S. candidates. The early successes are encouraging. ■

For more information about the HCD Program, contact Dunbar Lockwood at Dunbar.Lockwood@nnsa.doe.gov or 202-586-6951.

Sinsze Koo interned at ORNL and now works at SRNL.

Lenka Kollar interned at PNNL in 2009 and is currently a graduate fellow in the Office of Nuclear Safeguards and Security.

Safeguards by Design Encourages Incorporation of Safeguards in New Facilities

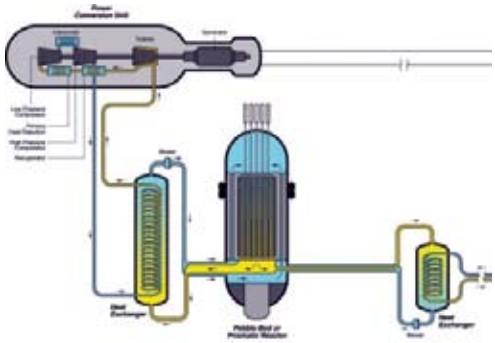
Nuclear Safeguards

In addition to developing new technology and expertise, the NNSA Office of Nonproliferation and International Security (NIS) Next Generation Safeguards Initiative (NGSI) focuses on developing transformational concepts and approaches, such as Safeguards by Design (SBD), to strengthen international safeguards worldwide. The International Atomic Energy Agency (IAEA) describes SBD as a concept in which broad international safeguards considerations and specific safeguards features are taken into account in new nuclear facilities "from initial planning through design, construction, operation and decommissioning." The NGSI SBD effort is working with the IAEA to more clearly define overall objectives, study lessons learned, and develop practical guidance for the application of SBD in different types of nuclear facilities.

International safeguards are a cornerstone of the Nuclear Non-Proliferation Treaty (NPT), which requires all parties without nuclear weapons to conclude safeguards agreements with the IAEA to verify the peaceful nature of their nuclear facilities and activities. Nonetheless, new nuclear facilities around the world have often not been designed in a way that would facilitate the implementation of IAEA safeguards. As a result, nuclear facility operators frequently have to redesign or retrofit their new facilities for safeguards after construction already has begun or has been completed. The objectives of SBD are to make the implementation of IAEA safeguards for civil nuclear facilities more effective and efficient and to help operators avoid costly and time-consuming redesign efforts and retrofits for such facilities. In the long run, the achievement of these goals would save both the nuclear industry and IAEA time, money and effort—a "win-win" endeavor.

Cooperation is essential if we are to position the international safeguards system to respond to present and future challenges. Toward this end, there are a number of steps that we can agree to take…. We can exchange best practices related to the incorporation of safeguards requirements into new nuclear facilities.

- NNSA Administrator Thomas D'Agostino at the 2nd International Meeting on Next Generation Safeguards



However, there has been little guidance developed to date for how key stakeholders (industry, governments and the IAEA) would take safeguards requirements into account when designing and planning new nuclear facilities. To help address this problem, the NGSI SBD project is studying safeguards best practices and lessons learned from former IAEA inspectors and developing draft safeguards guidance documents for designers related to generic facility types, including enrichment plants, reprocessing plants and new types of nuclear reactors. As an extension of that NGSI effort, the 3rd International Meeting on Next Generation Safeguards, to be held December 14–15 this year in Washington, D.C., will gather representatives from the nuclear industry, governments and IAEA to collaborate on substantive guidance for implementation of Safeguards by Design. ■

Conceptual design for the Very High-Temperature Reactor, part of a new generation of nuclear plants that could employ Safeguards by Design. (Source: Idaho National Laboratory)

International safeguards experts gathered at the 2nd International Meeting on Next Generation Safeguards, October 2009.

NIS Responds to Helium-3 Supply Shortage

Nuclear Safeguards

The NNSA Office of Nonproliferation and International Security (NIS) is playing a central role in a vital interagency response to a shortage of the strategically critical helium-3 (He-3) isotope. The national security significance of He-3 derives primarily from its unique suitability for the detection of neutron signatures. Instruments containing He-3 are routinely used for international safeguards measurements at nuclear facilities around the world to ensure that materials such as plutonium that have been declared to the International Atomic Energy Agency are not diverted for nonpeaceful uses.

For more than four decades, the international community has relied on the neutron detection capabilities of He-3 for nuclear material control and accounting activities. Unlike alternative detector materials currently available, He-3 is stable over long periods of time; has high intrinsic neutron detection efficiency with excellent gamma discrimination; and is not reactive, toxic or corrosive. The He-3 shortage poses a significant challenge for U.S. national security and President Obama's call in Prague for "more resources and authority to strengthen international inspections."

He-3 has traditionally been obtained by siphoning off-gas from the decay of tritium, which the United States used to produce its nuclear weapons stockpile. Although the United States ceased reactor-based tritium production in 1988, the more widespread application of portal monitors that detect and locate radioactive materials in trucks, containers and railcars for homeland security and Second Line of Defense efforts has increased the demand for He-3 dramatically over the past several years.

In July 2009, the White House National Security Staff formed an Interagency Policy Committee (IPC) to explore priorities for allocation of existing He-3, investigate potential alternative sources of supply, and invest in the research and development of alternatives. Through NNSA's participation on the IPC, NIS has been working to contribute technical information and guidance to decision makers.

NIS is exploring near-term alternatives to He-3 for some of the more routine types of neutron detection measurements. Through its Next Generation Safeguards Initiative, NIS has targeted three efforts designed to test and field high-performance safeguards equipment that uses alternative materials. The first task is a collaboration between Lawrence Livermore National Laboratory (LLNL) and Los Alamos National Laboratory (LANL). A new type of detector that does not employ He-3 has been developed by LLNL and is being benchmarked against a proven LANL He-3–based detector to determine whether the LLNL detector might be suitable for some safeguards measurements of impure plutonium. Two other tasks involve the examination of commercially developed detector tubes lined with boron-10 and placed in novel configurations. NIS anticipates continuing to seek out and support emerging solutions to the He-3 situation over the next several years. ■

Neutron Multiplicity Counter that uses He-3 detectors in a high efficiency 5-ring configuration for the IAEA to measure cans of impure plutonium in bulk handling facilities.

For More Information
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