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

DNN Sentinel

DEFENSE BY OTHER MEANS

VOL. II, NO. 1

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From the Deputy Administrator

At DNN, we recognize the value of thinking creatively about how to accomplish our mission. From working with our lab partners to develop and leverage new technical approaches to holding workshops and dialogues at varied venues, sometimes getting people out of their comfort zone can bring new thinking to the fore and reinforce lessons learned. Most recently, the Department of Energy and The Netherlands' Ministry of Foreign Affairs co-hosted Apex Gold, a scenario-based policy discussion on nuclear security at the Lawrence Livermore National Laboratory in California. Ministerial-level participants and other senior representatives from 37 countries and four international organizations—the United Nations, INTERPOL, the European Union, and the International Atomic Energy Agency—were presented with a hypothetical scenario on the loss of civilian highly enriched uranium from regulatory control and worked together to determine how each of their nations might respond at each step as the scenario was rolled out. An important element of Apex Gold was the half day of tours at Lawrence Livermore National Laboratory. The tours helped participants to better understand some of the technical tools available for detecting and analyzing nuclear material, and informing decisions in the event of a terrorist event involving nuclear material, and also allowed them to get to know each other better prior to the scenario-based discussion. (http://nnsa.energy.gov/blog/apex-gold-discussion-fosters-international-cooperation-run-2016-nuclear-security-summit)

The exercise, led by DNN in partnership with the team at NNSA's Office of Nuclear Counterterrorism and Counterproliferation, laid important ground work for the forthcoming, and final, Nuclear Security Summit, which President Obama will host on March 31–April 1 in Washington. At the Summit, global leaders will discuss the threat of nuclear terrorism and identify steps to minimize the use of civil highly enriched uranium; secure nuclear materials; counter nuclear smuggling; and deter, detect,

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

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NNSA BLOG

Letter from the Deputy Administrator – *Continued*

and disrupt attempts at nuclear terrorism. Leaders will also discuss how the vital work catalyzed by the Nuclear Security Summit process can be sustained once the formal summit process concludes. (https://www.whitehouse.gov/the-press-office/2015/08/10/statement-press-secretary-2016-nuclear-security-summit)

Many of the articles in this issue highlight the important work DNN undertakes in support of the goals President Obama outlined in Prague seven years ago. American leadership and technical expertise, found within the Department of Energy's national laboratories, will continue to be essential to meeting and responding to global proliferation challenges and respond to new threats that will emerge in the future.

Anne Harrington
Deputy Administrator
Defense Nuclear Nonproliferation

DNN QUICK LINKS

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

Press Releases

Consortium Led by University of California, Berkeley Awarded $25M NNSA Grant for Nuclear Science and Security Research

http://nnsa.energy.gov/mediaroom/pressreleases/consortium-led-university-california-berkeley-awarded-25m-nnsa-grant-nuclear

NNSA Labs host U.S. and Nuclear Non-Proliferation Treaty (NPT) Non-Nuclear Weapon State Representatives

http://nnsa.energy.gov/mediaroom/pressreleases/nnsa-labs-host-u.s.-and-nuclear-non-proliferation-treaty-npt-non-nuclear

Blogs

NNSA Administrator Klotz Tours Argonne National Laboratory in Demonstration of Lab's Critical Scientific Work Supporting Nuclear Threat Minimization

http://nnsa.energy.gov/blog/nnsa-administrator-klotz-tours-argonne-national-laboratory-demonstration-lab%E2%80%99s-critical-0

Working With PNNL Mentorees, Engineering Students Deliver Prototype Safeguards Fixtures

http://nnsa.energy.gov/blog/working-pnnl-mentorees-engineering-students-deliver-prototype-safeguards-fixtures

NNSA reorganizes Office of Emergency Operations (NA-40), Office of Counterterrorism and Counterproliferation (NA-80)

http://nnsa.energy.gov/blog/nnsa-reorganizes-office-emergency-operations-na-40-office-counterterrorism-and

DNN Plays Central Role Before, During, and After Nuclear Security Summits

By Corey Hinderstein

More than 50 world leaders will gather in Washington, DC, on March 31–April 1, 2016, for the fourth Nuclear Security Summit (NSS) to strengthen the global nuclear security architecture. DOE/NNSA has played a central role in developing and implementing the commitments of the previous Summits and in planning the 2016 NSS. Secretary of Energy Dr. Ernest Moniz will again join the President for what is expected to be the final Summit under the current format.

In preparation for the 2016 Nuclear Security Summit, 37 countries and 4 international organizations participated in *Apex Gold*, a ministerial-level, Scenario-Based Policy Discussion.

The Summit process was launched in President Obama's Prague speech in April 2009, in which he identified the risk of nuclear terrorism as the most immediate and extreme threat to global security. The President then laid out a four-pronged nuclear policy agenda, describing U.S. policies and initiatives towards nuclear disarmament, nonproliferation, security, and energy. The President's call to action on global nuclear security in Prague reinvigorated existing bilateral and multilateral efforts and challenged nations to re-examine their own commitments.

Since the first Summit in April 2010 in Washington, DC, President Obama and his counterparts have built an impressive track record of meaningful progress towards nuclear security. These actions have included removing and eliminating highly enriched uranium (HEU) and plutonium, converting reactors using HEU to use low-enriched uranium, strengthening national regulations, creating nuclear security "Centers of Excellence," upgrading security at facilities using nuclear and radiological material, and preventing illicit trafficking in these materials. These are all concrete threat reduction steps. DNN's offices of Material Management and Minimization, Global Material Security, and Nonproliferation and Arms Control have played central roles in the success of NSS efforts.

The 2014 Summit in The Hague, Netherlands, included a first of its kind "Scenario-Based Policy Discussion" (SBPD) in which leaders interacted with a fictional emergency event. This exercise illustrated the kind of decisions that leaders would face in such a circumstance and prompted a constructive discussion of steps countries could take before such an event arises. Secretary Moniz participated in that SBPD, and it served as the motivation for him to host *Apex Gold*, a ministerial-level exercise that took place in late-January 2016 at Lawrence Livermore National Laboratory. *Apex Gold*, co-hosted with the Netherlands' Ministry of Foreign Affairs, brought together 37 countries and 4 international organizations to explore a fictional scenario of HEU out of regulatory control and was part of the run-up to the 2016 Summit at which leaders will again participate in an SBPD.

The 2016 Nuclear Security Summit will focus on catalyzing new national commitments and strengthening institutions and initiatives that facilitate nuclear security. These elements of the global architecture will be part of the enduring legacy of the NSS process and form the foundation for countries' commitments to nuclear security in the future.

See the related blog at http://nnsa.energy.gov/blog/apex-gold-discussion-fosters-international-cooperation-run-2016-nuclear-security-summit

Corey Hinderstein is DNN's Senior Coordinator for the Nuclear Security Summit and Nonproliferation Policy Affairs.

Workshop Furthers Goals of Maritime Security Gift Basket

By Kaitlin Oujo

DNN's Office of Global Material Security (GMS) and the UK Department of Energy and Climate Change (DECC) concluded a three-day workshop in November 2015 on the security of the global maritime supply chain at the Wilton Park Conference Centre in the United Kingdom. Fifty participants from 15 countries and 9 international organizations developed recommendations and shared best practices for effectively deterring, detecting, and responding to trafficking of nuclear and radiological materials out of regulatory control (MORC). The participants represented a broad range of stakeholders, including policy organizations, detection operations agencies, regulatory authorities, regional and international organizations, and major terminal operators.

At the 2014 Nuclear Security Summit, 13 countries signed a joint statement recognizing the importance of a national-level approach to combat the illicit transfer of MORC using the global maritime shipping system. In addition to pledging a deeper commitment to detection and removal of MORC, the signatories of the joint statement committed to participate in November's workshop, which sought to identify best practices and actionable recommendations for permanently removing MORC from the maritime supply chain. The outcomes of the workshop were captured in a follow-on joint statement (co-drafted by GMS and DECC) to be presented at the 2016 Nuclear Security Summit in Washington, DC. DNN and DECC are also preparing a best practices guide that will be shared with the workshop participants and will be made publicly available. The joint statement and the best practices guide will provide a framework for follow-on actions aimed at addressing this issue.

The interactive workshop consisted of panelists, speakers, and exercise breakout group sessions, which allowed participants to develop key findings, best practices, and recommendations. The workshop participants reconfirmed that detection systems are one important tool in a nation's approach to combatting nuclear and radiological smuggling. Participants further agreed to the importance of both long-term planning to sustain detection systems and a comprehensive "end-to-end" regulatory framework for all those involved in detecting and responding to MORC. Participants discussed best practices, including regular training and routine exercises of systems to verify that relevant stakeholders understand their roles and responsibilities and maintain a state of readiness. Additionally, the workshop yielded recommendations for the international community to seek opportunities to further share information and develop better technical and operational solutions to reduce the high rate of innocent, naturally occurring radioactive material ("NORM") alarms. These alarms have a negative impact on commerce and detract resources from detecting materials of concern.

Elly Melamed, Associate Assistant Deputy Administrator for GMS, gave opening remarks at the workshop.

Panel discussions with international leaders held during the workshop offered multiple perspectives.

The U.S. Department of Homeland Security, represented by Customs and Border Protection (CBP) and the Domestic Nuclear Detection Office (DNDO), made significant contributions to the workshop. DNDO provided subject matter expertise in exercise design and development, and the Director of DNDO, Dr. Huban Gowadia, participated in a panel discussion on the benefits and challenges to radiation detection programs. CBP also provided subject matter expertise to the workshop content, shared the agency's lessons learned and best practices for operating and sustaining their detection program, and presented case studies of different types of detections.

Best practices and recommendations from the workshop will serve to further enhance collaboration in the area of global maritime supply chain area security and will be formally presented at the 2016 Nuclear Security Summit.

Kaitlin Oujo is an NNSA Graduate Fellow in the GMS Office of Nuclear Smuggling Detection and Deterrence. She recently completed a Master of International Affairs from Columbia University.

See the related press release at http://nnsa.energy.gov/mediaroom/pressreleases/nnsa-co-hosts-nuclear-security-summit-workshop-maritime-security-uk.

Uzbekistan Becomes 28th HEU-free Country Under DNN Partnership

On September 24, 2015, a partnership with DNN's Office of Material Management and Minimization, the International Atomic Energy Agency, and the Russian Federation successfully returned to Russia the final 5 kg of highly enriched uranium (HEU) spent fuel from the IIN-3M "Foton" research reactor in Tashkent, Uzbekistan. This is the eighth shipment of HEU from Uzbekistan since 2004 and marks the removal of all HEU from that country. This HEU removal was notable in that it was the first transport of liquid HEU spent fuel by air. Uzbekistan is the 28th country, plus Taiwan, to become free of all HEU.

Learn more and see additional pictures at http://nnsa.energy.gov/mediaroom/pressreleases/nnsa-partnership-successfully-removes-all-remaining-heu-uzbekistan.

An ISO transport container carrying the SKODA VPVR/M spent fuel shipment cask travels from the Foton reactor facility to Tashkent International Airport under police escort.

The SKODA spent fuel shipment cask is prepared for transfer to its TUK-145/C over-package at Tashkent International Airport.

The SKODA VPVR/M spent fuel shipment cask is enclosed in a TUK-145/C over-package, which is licensed for air transport and protects its contents from extreme shocks.

The over-package is loaded onto a cargo plane headed for the Mayak Reprocessing Facility in Russia for final disposition.

INNOVATION: X-Rays that Measure Plutonium Content

By Rollin Lakis

DNN's Office of Nonproliferation and Arms Control (NPAC) is working in collaboration with Los Alamos National Laboratory (LANL) and Pennsylvania State University to build and test an advanced concept Cauchois X-ray spectrometer for nuclear fuel cycle safeguards applications. The unique performance attributes of the instrument may offer new possibilities for verifying plutonium in highly radioactive spent nuclear fuel and nuclear fuel reprocessing solutions.

The majority of plutonium in the world is produced in nuclear reactors and is contained in spent nuclear fuel stored around the globe. The amount of plutonium in a spent nuclear fuel assembly primarily is determined by operator declarations and through computer simulations using a "burnup code." However, the Cauchois spectrometer, which can collect high resolution X-ray and gamma ray spectroscopy data in very high radiation environments, is enabling a new methodology, called self-interrogation X-ray fluorescence (SIXRF), to measure the plutonium content of the fuel directly. The Cauchois spectrometer method takes advantage of the fact that the high intensity scattered radiation from spent fuel interacts directly with uranium and plutonium atoms to create X-rays that can be used to measure the amount of special nuclear material in the fuel. This technique is important for the international safeguards community because it can detect the diversion of nuclear material, in this case plutonium in spent fuel.

Having made final adjustments to the quartz single crystal at the front of the Cauchois spectrometer, LANL post-doctoral researcher Nicola Winch (left) and Penn State research scientist Amanda Johnsen (right) prepare to install calibration filters and bolt on the spectrometer cover. The spent fuel cask (empty) is in front of the spectrometer, and the entire experiment is positioned along the reactor pool wall with the reactor bridge visible beneath the flag.

The ***Cauchois X-ray spectrometer*** is named for French physicist Yvette Cauchois, who made significant contributions to X-ray spectroscopy and X-ray optics.

The new Los Alamos spectrometer was built in partnership with Artep Inc., a small innovative technology company. The first experiments using irradiated nuclear fuel are being performed at the Radiation Science and Engineering Center (RSEC) at the Pennsylvania State University Breazeale Research Reactor. The University-National Laboratory collaboration has created an environment where irradiated nuclear fuel, including fuel removed directly from the university's TRIGA (pool-type) reactor, is available for testing potential safeguards instruments. LANL and Penn State have performed initial measurements on the deck of the pool-type reactor with the intensely radioactive fuel shielded by a lead cask.

The strong collaboration with Penn State University reactor operators, flexibility in the Breazeale reactor configuration, opportunity to perform development work in an irradiator pool where underwater measurement techniques can be performed separate from the main reactor pool, and diverse inventory of irradiated nuclear fuel, combine to create a unique environment at Penn State for nuclear safeguards instrument testing. The academic environment also encourages student participation. This experiment was supported by Ph.D. student Katrina Koehler (Western Michigan University) and post-doctoral researcher Nicola Winch. This work enables increased engagement between Los Alamos scientists and Penn State faculty and students in the areas of spent nuclear fuel characterization, radiation detector development, and international nuclear safeguards. Penn State students also participate in Los Alamos and other laboratory internships and nonproliferation summer schools.

Rollin Lakis is a research scientist in the Safeguards Technology Development Group at LANL. While working in the weapons program, Rollin developed considerable experience in plutonium metallurgy and in leading complex nuclear science experiments before focusing on international nuclear safeguards. He presently works to provide advanced technology solutions to support the International Atomic Energy Agency, U.S. international bilateral agreements, and other domestic sponsors.

Grant to Texas A&M Builds Human Capital

By Melissa Einwechter

From September 14–18, 2015, under a grant provided by NNSA's Next Generation Safeguards Initiative (NGSI), the Nuclear Security Science and Policy Institute (NSSPI) at Texas A&M University coordinated the second Nuclear Facilities Experience (NFE). The first NFE was held in 2013 in Japan; the 2015 iteration was held in the United Kingdom. The NFE provides young professionals within the DOE National Laboratory enterprise and U.S. graduate-level technical university students the chance to visit advanced operating nuclear fuel cycle facilities and discuss topics such as facility operations, responsible nuclear materials management, and the application of international safeguards. Since the International Atomic Energy Agency (IAEA) does not currently conduct routine inspections at any commercial nuclear facilities in the United States, the NFE provides a unique opportunity for American students and young professionals to visit commercial enrichment and reprocessing plants that are under international inspections.

The participants in the NFE in the UK included students from five U.S. colleges, scientists and engineers from three National Laboratories, and faculty members from the University of Utah and Texas A&M University. The group spent time at the URENCO uranium enrichment facility in Capenhurst; the Heysham nuclear power station, one of only seven Advanced Gas Cooled Reactors left operating in the world; and the Sellafield nuclear reprocessing site, including the now-decommissioned Calder Hall graphite-moderated Magnox reactor and the Thermal Oxide Reprocessing Plant. The final day of the NFE was spent in an educational exchange with students and faculty from King's College in London.

2015 NFE groups at Heysham nuclear power plant (above) and at Sellafield nuclear reprocessing site (right).

NNSA Supports Human Capital Development

Since 2008, NNSA's Human Capital Development (HCD) subprogram within NNSA has been building and supporting a sustainable pipeline of international safeguards expertise in the United States and for the IAEA. HCD activities help recruit, educate, train, and retain a new generation of international safeguards specialists in the United States.

In addition to the multi-year grant to support the NFE opportunity, other HCD efforts include university curriculum development, internships and post-doctoral positions at National Laboratories, short courses about nuclear safeguards, and professional development and outreach to young and mid-career professionals.

Participants expressed high praise for this unique learning opportunity. In particular, they indicated that the ability to interact with facility operators to understand how they apply international safeguards was invaluable, and that the trip expanded their understanding of the complete nuclear fuel cycle, particularly in the workings of commercial facilities. Early career Laboratory staff indicated that what they learned at the NFE would directly benefit their ability to propose, develop, and support the most relevant technologies for safeguards applications.

The next NFE will be held in Japan, May 15–20, 2016. Confirmed facilities include the MONJU Fast Breeder Reactor R&D Center, the FUGEN Decommissioning Center, the Tokai Reprocessing Technology Development Center, and the Rokkasho Nuclear Fuel Cycle Plant (consisting of the reprocessing and uranium enrichment facilities). Participants will also tour Hiroshima and meet with a local atomic blast survivor.

Melissa Einwechter is a Foreign Affairs Specialist in DNN's Office of Nonproliferation and Arms Control, where she serves as Federal Program Manager for NGSI Human Capital Development, NGSI Concepts and Approaches, and Additional Protocol implementation in the United States.

Thor and FACT: Two Efforts Enhancing Monitoring and Verification Capabilities

By Meghan Wool

The Defense Nuclear Nonproliferation Office of Research and Development (DNN R&D) supports U.S. national security goals by advancing technical capabilities to detect foreign nuclear weapons-related activities, illicit diversion of special nuclear materials and nuclear detonations globally. DNN R&D research efforts in nuclear detonation detection include advanced methods in detecting and processing seismic and infrasound signals. From a multilateral perspective, advancements in these areas of research are relevant to the Comprehensive-Test-Ban Treaty Organization (CTBTO), which manages the International Monitoring System (IMS) and the International Data Centre (IDC). The IMS uses several different methods for detecting possible treaty violations, including seismic and infrasound signals, and the IDC provides the analysis of these data. Two such DNN R&D research projects are described below.

About the CTBT, CTBTO, and IMS

When the Comprehensive Nuclear-Test-Ban Treaty (CTBT) enters into force, it will ban all nuclear explosive testing by its member states. The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) was founded in 1996 to promote the Treaty and build-up of the monitoring and verification regime so the regime is operational when the Treaty enters into force. The monitoring and verification regime consists of three pillars to detect violations: An International Monitoring System (IMS) with 337 facilities worldwide to monitor for signs of nuclear explosions; an International Data Centre that processes data from the IMS; and On-Site Inspection of a location where a nuclear explosion is suspected to have taken place. DNN provides support to the CTBTO to strengthen all three areas of the monitoring and verification regime.

DNN's support of the IMS primarily focuses on building capacity in the areas of seismological and infrasound technologies. There currently are 282 certified IMS stations in place with an additional 19 installed, 18 under construction, and 18 planned. The IMS relies on four complementary monitoring methods: Seismological to measure shock waves in the earth; hydroacoustic that listens for sound waves traveling through the oceans; infrasound to detect ultra-low frequency sound waves caused by an explosion; and radionuclide to detect radioactive debris and radioactive noble gases. Data from the IMS stations also can provide information on natural phenomena, such as earthquakes and tsunamis, or accidental releases of radionuclides.

Learn more about:
CTBT—http://www.state.gov/t/avc/c42328.htm
CBTBO and IMS—https://www.ctbto.org/

Thor Wields a Seismic Hammer™

From 1951–1992, the Nevada National Security Site (NNSS) hosted hundreds of nuclear tests. Many of these tests were of high enough yield to be sensed globally. Today, NNSS is available to support national security in many other ways, including as a laboratory of complex geologies for understanding the signatures and signals from underground explosions. Under the Source Physics Experiments (SPE) at NNSS, Los Alamos, Lawrence Livermore, and Sandia National Laboratories, along with the University of Nevada-Reno, are working with the NNSS managing contractor, NSTec, to conduct chemical explosion experiments to increase our confidence in detecting low-yield nuclear events by better understanding how explosions generate shear waves. This is important because the ratio of shear waves to compressive waves is one key discriminant between natural (e.g., earthquakes) and man-made (e.g., mining explosions) seismic signature sources. With each new explosion in the SPE series, researchers get terabytes of new seismic, infrasound, electromagnetic, and other signal data for developing an advanced and predictive modeling capability. However, even the best physics codes cannot faithfully reproduce experimental data without some knowledge of the geology in which the waves propagate. This is where the Seismic Hammer™ comes in.

The thousands of Seismic Hammer™ "hits" made during the "Thor" experiments provide valuable data to better understand the potential behavior of seismic waves after a nuclear explosion.

The Seismic Hammer™ is a "weight-drop" seismic source, designed and operated by HK Seismic under subcontract to Sandia. In concept, it is as simple as it sounds; a weight is picked up and dropped, radiating seismic energy. What sets the Seismic Hammer™ apart from its brethren is its scale. The dropped mass in question is 13,000 kg in weight (approximately equal to the curb weight of 10 mid-sized cars). When this mass is lifted 1.5 meters and then dropped, over 191,000 Joules of potential energy is released. "Because the seismic efficiency of a weight-drop is so much higher than it is for explosives, the peak ground motion output by the Seismic Hammer™ is roughly equivalent to 20 kg of explosives," says Robert Abbott, Principal Investigator of the project at Sandia. Furthermore, unlike explosives, a weight-drop can be deployed in the same exact location over and over, allowing the data to be stacked, improving its signal-to-noise ratio with each successive hit.

Preliminary results from the recent DNN R&D-sponsored experiments (dubbed, "Thor") are excellent. In total, over 4,500 Hammer "hits" were recorded on approximately 360 geophones along two long intersecting Seismic Hammer™ tracks totaling over 36 km in length. (The next phase of SPE will be conducted where these two lines intersect.) Initial analysis of the data by Sandia validates the use of this tool by showing that the variation of compression-wave velocity with depth faithfully matches the geologic reconstructions inferred from borehole logs as compiled by geologists at NNSS. This newly validated, high-resolution, compression-wave velocity profile will enable researchers to remove uncertain propagation effects from the future explosion dataset, and thereby focus on the physics of the explosion source itself.

Sensing Seismic and Infrasound Phenomenon at FACT Site

Under Secretary of State Rose Gottemoeller visited the FACT Site in September 2014.

Researchers at the Sandia National Laboratories Facility for Acceptance, Calibration, and Testing (FACT) Site in Albuquerque, New Mexico, evaluate and characterize seismic and infrasound sensor systems used for nuclear explosive test monitoring. These sensors enable detection of underground or near-surface nuclear explosions because signals from these large events can travel thousands of miles through the earth or atmosphere until a monitoring station detects them. Existing sensors have provided scientists with valuable data about large bolide explosions, such as the one caused by the Chelyabinsk meteor in 2012.

Looking forward, the U.S. Department of State has provided Sandia with funding for upgrades to the FACT Site and for evaluation of components to improve the capability of the IMS. DOE/NNSA recently received approval from the U.S. Air Force to extend Sandia's monitoring footprint from the initial 45 acres to additional sites within a 516-acre boundary. The additional space allows the team to set up and test larger sensor arrays with greater station spacing, which allows for performance evaluation of entire systems used for monitoring. The expanded FACT Site provides a unique testing capability to both the United States and international community.

When completed, the infrasound wind-filter testbed at the FACT Site will facilitate side-by-side testing of existing and potential new sensors for detecting nuclear explosions.

Meghan Wool is a Leidos contractor supporting DNN's Office of Research & Development.

CTBTO Head Visits Sites Significant to U.S. Nonproliferation

By Cornelia Brim and Maren Disney

Dr. Lassina Zerbo, Executive Secretary of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), visited three NNSA sites in November 2015—Lawrence Livermore National Laboratory (LLNL), the Nevada National Security Site (NNSS), and Los Alamos National Laboratory (LANL)—to discuss NNSA's support for Comprehensive Nuclear-Test-Ban Treaty-related efforts.

Learn more about Dr. Zerbo's visit at:

http://nnsa.energy.gov/mediaroom/pressreleases/head-comprehensive-nuclear-test-ban-treaty-organization-ctbto-preparatory
http://nnsa.energy.gov/blog/nnsa-sites-host-head-comprehensive-nuclear-test-ban-treaty-organization-ctbto

CTBTO Executive Secretary Dr. Lassina Zerbo (center) during his visit to NNSS.

CTBTO Executive Secretary Dr. Lassina Zerbo (center) was joined by DNN Deputy Administrator Anne Harrington (third from right) and Defense Programs Acting Deputy Administrator Gen. S.L. Davis (second from right) during his visit to NNSS.

CTBTO Executive Secretary Dr. Lassina Zerbo (right) during his visit to the National Ignition Facility at LLNL.

Nancy Jo Nicholas, LANL's Associate Laboratory Director for Threat Identification and Response, joined CTBTO Executive Secretary Dr. Lassina Zerbo during his visit to New Mexico.

Cesium Irradiator Replacement Preserves Health Benefits, Promotes Radiological Safety

By Malika Taalbi

Radioactive materials play a critical role in medical, industrial, and commercial applications. Technology advances, such as in the case of blood irradiation, have led to the increased availability of non-isotopic alternatives. As part of its mission to protect, reduce, and eliminate radioactive materials, DNN's Office of Radiological Security (ORS) within the Office of Global Material Security leads efforts to reduce the need for high-activity sources by supporting viable non-isotopic alternative technologies to replace the most common devices that use high-activity sources. The result is permanent threat reduction through the elimination of risk-significant radioactive materials.

A common application of high-activity radioactive material is the irradiation of blood components to prevent transfusion-associated graft vs. host disease (TA-GvHD), an extremely rare, yet nearly always fatal, disease in which white blood cells from a donor's blood attack host tissues in a recipient patient. The potentially harmful cells can be inactivated through the application of ionizing radiation. Approximately 20% of blood products in the United States are irradiated for use in patients at greatest risk, such as those who are immunocompromised, or patients with similar genetic components to the blood product donor.

Historically, the most common method of preventing this disease is through the application of gamma radiation by self-shielded irradiators containing cesium-137. However, non-isotopic technologies, such as X-ray irradiators or ultraviolet pathogen reduction, have become increasingly available in the U.S. commercial market.

Under NNSA's voluntary Cesium Irradiator Replacement Program (CIRP), ORS partners with commercial licensees to replace their cesium-137 irradiators with X-ray irradiators.

ORS is helping medical facilities switch to X-ray irradiators for preventing TA-GvHD, a serious disease that can result from blood transfusions, instead of irradiators that use the high-activity radioactive material cesium-137.

Through CIRP, NNSA provides a financial incentive toward the purchase of an X-ray irradiator, contingent on the disposition of the cesium-137 irradiator at the site. Disposition is facilitated through NNSA's Offsite Source Recovery Program.

During the pilot phase in FY 2015, NNSA partnered with one of the country's premier blood facilities, OneBlood, Inc., to install one X-ray irradiator at a new facility in Florida. OneBlood is a not-for-profit 501(c)(3) community asset responsible for providing safe, available, and affordable blood to more than 200 hospital partners and their patients throughout most of Florida, parts of Georgia, Alabama, and South Carolina, distributing nearly one million blood products annually. "By implementing the X-ray irradiator, OneBlood has further enhanced the safety of the blood supply and increased the security of our facilities. At the same time, the X-ray irradiator has enabled us to increase our blood irradiation throughput and has exceeded our expectations for performance and reliability. OneBlood remains supportive of using non-isotopic alternatives and remains vigilant in seeking alternatives to cesium-137 irradiators as we go forward," said Alicia Bellido Prichard, OneBlood Senior Vice President of Biologics.

NNSA plans to engage with additional sites in FY 2016 to expand the CIRP program and continue supporting the mission of permanent risk reduction.

Malika Taalbi is a former NNSA Graduate Fellowship Program participant and current contractor in ORS. She holds her B.A. from Marquette University in Political Science and her Master of International Public Affairs from the La Follette School of Public Affairs at the University of Wisconsin-Madison.

Expert Profile: The JCPOA Technical Support Team

Focusing on Arak Modernization

The P5+1 (China, France, Russia, the United Kingdom, United States, and Germany), the European Union, and Iran reached a Joint Comprehensive Plan of Action (JCPOA) last summer to ensure that Iran's nuclear program will be exclusively peaceful. The JCPOA prevents Iran from getting the capability to build a nuclear weapon and includes strong measures to detect violations. On January 16, 2016, the International Atomic Energy Agency reported that Iran had completed all the necessary nuclear steps required to reach "Implementation Day" under the JCPOA.

In a number of speeches and while testifying before Congress, Secretary Moniz made clear that the JCPOA is based on hard science. Nuclear experts from DOE/NNSA and DOE's National Laboratories were essential to evaluating and developing technical proposals in support of the U.S. delegation. The list of labs and sites that provided support included Argonne National Laboratory, Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratories, Savannah River National Laboratory, the Y-12 National Security Complex, and the National Security Campus near Kansas City, Mo.

Throughout the negotiations, Kevin Veal of DNN's Office of Nonproliferation and Arms Control served as the primary technical advisor. When JCPOA negotiations encountered some challenges, for example those related to the potential for plutonium production at the Arak Heavy Water Research Reactor in Iran, the negotiators reached back to additional experts at DNN and the National Laboratories.

The individuals featured here formed the core team addressing technical issues surrounding modernization of the Arak Reactor, a process that will eliminate a potential source of weapons-grade nuclear material. The redesign specified in the JCPOA will allow effective peaceful uses of the reactor and minimize accumulation of plutonium suitable for weapons. With their substantial technical expertise and experience with reactor conversion, these DNN and National Laboratory staff provided their support at critical points in the JCPOA negotiations and will be joined by additional experts to provide ongoing implementation support.

Learn more about the JCPOA at http://energy.gov/search/site/jcpoa.

Meet the Technical Team

CHRISTOPHER LANDERS

Organization

DNN's Office of Material Management and Minimization, Director of Reactor Conversions

Background in Brief

- Currently serving as one of the initial cohorts for the White House Leadership Development Fellowship (https://www.whitehouse.gov/participate/whldp) while continuing to support JCPOA implementation.
- Initially joined NNSA through the NNSA Graduate Fellowship Program supporting what was then the Global Threat Reduction Initiative (GTRI).

Role on JCPOA Technical Team

U.S. Primary Representative for the Arak Modernization Project

In His Own Words

"Having us be able to take the pressure off the political aspects for a moment by focusing on the technical components of the reactor seemed to help improve the negotiating environment. We were not only able to discuss the technical topics in the larger experts meeting, but we were also able to have a handful of break-out side meetings where the tension really seemed to lift and progress was achieved on getting to the agreement for the conceptual design parameters of the Arak redesign that would meet the performance needs of Iran, and of course the nonproliferation needs of the U.S. and others."

> *"What would typically take a week or more, we were able to get turned around in a day or two. Big thank you to Argonne and Savannah River National Labs for their support."*
>
> Christopher Landers
> DNN's Office of Material Management and Minimization

JOHN STEVENS, Ph.D.

Organization

Argonne National Laboratory, Manager of the Research and Test Reactor Department in the Nuclear Engineering Division

Clockwise around table: John Stevens at the keyboard and Roger Blomquist, joined by several members of Argonne's Arak analysis team: Rich Lell, Arne Olson, and Mohammad Kalimullah.

Background in Brief

- Joined Argonnne in March 2005.
- Previously worked on light water reactor reload optimization for 14 years at Studsvik Scandpower, Inc., in Idaho Falls, ID.

Role on JCPOA Technical Team

Technical Lead for the Arak Modernization Project, coordinating the design and analysis work of the Argonne team and participating as reactor conversion subject matter expert for the interagency team.

In His Own Words

> *"... the sun never set on our work for weeks at a time. That is an exciting way to work toward a big impact in the pursuit of peace and science."*
>
> John Stevens, Ph.D.
> Argonne National Laboratory

"In addition to working at a much quicker pace than is typical for engineering design, our team had to consider evolving goals and constraints. ... Fortunately, our reactor conversion tool sets (in terms of methods, software, and expertise) have been developed and refined for a significant variety of applications, since each of the 67 reactor conversions led by Argonne to date has been unique. We were able to wrap tools in a rapid-prototyping framework to deal with the different goals and constraints for experimental performance."

ROGER BLOMQUIST, Ph.D.

Organization

Argonne National Laboratory, Nuclear Engineering Division

Background in Brief

- A former U.S. Navy nuclear submariner who has been at Argonne for 36 years.

Role on JCPOA Technical Team

Performed reactor physics calculations during negotiations that assessed the isotope production potential of the converted reactor compared to the original, nearly completed unit.

In His Own Words

"It was very rewarding to be involved in a process that was so critical to the interests of the United States and the world. We strived to provide our negotiators and national security professionals with the most accurate, complete information possible to foster a successful negotiation and an effective, enforceable agreement."

> *"This was a true team effort, and all the team members contributed hugely to the success of the negotiations."*
>
> Roger Blomquist, Ph.D.
> Argonne National Laboratory

NATRAJ IYER, Ph.D.

Organization

Savannah River National Laboratory, Associate Laboratory Director, Nuclear Materials Management Programs

Background in Brief

- Has been at Savannah River National Laboratory for 24 years.
- Previously worked with the Westinghouse Research and Development Center in Pittsburgh, PA.

Role on JCPOA Technical Team

Senior Technical Advisor to the Arak Modernization Project

In His Own Words

"We are very fortunate to be working with some of the brightest people in DOE and across the interagency. I was able to see firsthand the depth of competency on the U.S team whose expertise and efforts were the key to successful negotiation."

> *"The most memorable and satisfying moment was to see the gradual conversion of naysayers to buy into the modernization concept proposed by the U.S. team."*
>
> Natraj Iyer, Ph.D.
> Savannah River National Laboratory

An Alternate Path to Relationship Building

Typically countries interact by following formal government channels. These "Track I" interactions take place between lawfully elected or appointed officials authorized to represent their countries. But sometimes, international relationships can be enhanced through "Track II diplomacy," informal and unofficial interactions that take place between private citizens who are not employed by a government. An example of a Track II exchange might include retired officials and non-governmental organizational representatives meeting to share specific technical expertise and gain common understandings. The 1993 Israeli-Palestinian Oslo Accords are widely considered the biggest success ever begun through Track II engagement. Interactions that involve both official and non-official actors are sometimes called "Track 1.5" engagements.

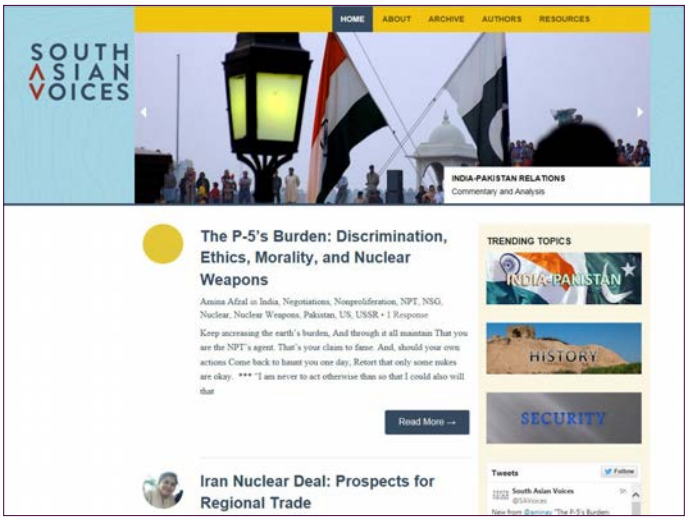
In the area of nuclear nonproliferation, DNN supports both Track II and Track 1.5 activities to address emerging challenges and opportunities in nonproliferation and arms control, and foster cooperation in areas where more formal government-to-government interactions are inappropriate or do not take place.

India-Pakistan Relations

DNN's Office of Nonproliferation and Arms Control (NPAC) supports Track 1.5 and Track II events in South Asia with the ultimate goal of lessening the danger of nuclear conflict and seeking nuclear stability in the region. A large part of these efforts includes online initiatives and other social media activities intended to encourage dialogue among young South Asian strategic analysts and aspiring policy practitioners who will be the "heirs" to India and Pakistan's nuclear weapons and challenges.

Recognizing the need for a virtual space for young Indian and Pakistani strategic analysts to interact, NPAC, in partnership with the Stimson Center, launched the South Asian Voices website initiative to allow greater visibility and means of expression to a rising generation of strategic analysts in Pakistan and India. Since its inception, South Asian Voices has gained significant attention, with over 70 thousand unique visits, nearly all of them by readers from India and Pakistan. South Asian Voices complements NPAC's support for the Colombo Confidence Building Process, a social media and video project focusing on confidence building measures in South Asia that is managed by Sandia National Laboratories

Learn more about DNN's work with India.



The South Asian Voices website is at southasianvoices.org.

and has hosted 2.3 million unique viewers. NPAC also is working in partnership with the Stimson Center in organizing a Massive Open Online Course on South Asian Nuclear Deterrence Stability, and in partnership with the Middlebury Institute of International Studies, conducts workshops for Urdu language Pakistani journalists on the fundamentals of nuclear technology and policy to enable technically sound coverage of nuclear issues by vernacular media in Pakistan.

Jason Portner contributed to this article. He is a Nonproliferation Graduate Fellow supporting NPAC's Regional Analysis & Engagement Track 1.5 and Track II diplomatic efforts. A proficient Mandarin speaker, Jason holds a Master of Arts in International Relations from the Johns Hopkins School of Advanced International Studies.

A Critical Player in Regional Stability

President Obama has called India one of the defining partnerships of the 21st century, one which will be vital to strategic interests in Asia-Pacific and across the globe. The United States supports India's critical role as a leader in maintaining regional stability, and our security ties are reflected in growing bilateral defense and counterterrorism cooperation.

India and the United States share membership in a variety of international organizations, including the United Nations, International Atomic Energy Agency (IAEA), G-20, and the Association of Southeast Asian Nations (ASEAN) Regional Forum. In February 2016, India ratified the Convention on Supplementary Compensation for Nuclear Damage (CSC), a multilateral treaty relating to liability and compensation for damage caused by a nuclear incident. Over the past year, the CSC has entered into force in the United States and several other countries.

India's Nuclear Profile

- **21** Nuclear power plants in operation
- **6** Nuclear power plants under construction
- **35** Planned new nuclear power plants
- **4** Research reactors in operation

India is rapidly increasing the capacity of its civilian nuclear power industry, which is growing to meet the electricity demand. The Government of India has plans to expand nuclear generation to 25% of the energy mix by 2050 through a combination of Russian-supplied light water reactors, French pressurized water reactors, U.S. advanced boiling water reactors, and indigenous designs. Of note, construction of Kudankulam Unit 2 is nearing completion and is expected to begin operation by March 2016.

Several important developments between 2005 and 2008 advanced India's ability to pursue nuclear power. In 2005–2006, India committed to pursue civil nuclear cooperation with the United States and announced plans to separate its civil and military nuclear programs by placing the civil program under IAEA safeguards. The IAEA then approved a safeguards agreement with India, enabling the IAEA to verify the peaceful nature of India's civil program. Soon after, the Nuclear Suppliers Group decided to allow transfers of civilian nuclear technology and fuel to India.

In addition to DNN's cooperative engagement on nuclear security issues, DOE's Office of Nuclear Energy actively cooperates with India on civil nuclear energy topics, and several new areas of collaboration have been identified for further discussion. Some highlights of DNNs recent work with India follow.

123 Agreement

In 2008, the Department of State, with technical assistance from DOE/NNSA, concluded a Peaceful Nuclear Cooperation Agreement (123 Agreement) with India. Since then, India has signed agreements with several other countries

Country Profile: India, Page 16

India's Nuclear History in Brief

- **1948** — Atomic Energy Act passed, leading to the establishment of the Indian Atomic Energy Commission (IAEC)
- **1954** — Department of Atomic Energy established
- **1957** — Apsara research reactor became the first operating reactor in Asia
- **1974** — First nuclear test
- **1998** — Multiple nuclear tests
- **2005–2006** — Announced separation of civil and military nuclear programs
- **2008** — 123 Agreement between United States and India brought into force
- **2014** — Broke ground on the Global Center for Nuclear Energy Partnership (GCNEP)
- **2015** — Full implementation of U.S.-India 123 Agreement
- **2016** — Initial classroom training facilities at GCNEP expected to be completed

FAQs: Nuclear Security Summits

President Obama at the first Nuclear Security Summit in 2010.

President Obama, in his 2009 Prague speech, announced that the United States would host a "Global Summit on Nuclear Security." That summit has since evolved into a series of biennial Nuclear Security Summits.

Who hosted the first three Summits?

The United States hosted the first Summit in Washington, DC, in 2010; South Korea hosted the 2012 Summit in Seoul; and the Netherlands hosted the Summit in 2014 at The Hague.

What is the focus of the Summits?

The Summits bring attention at the highest level to the global threat of nuclear terrorism. They bring world leaders together to publically commit to principles of nuclear security paired with specific actions.

What is meant by "gift baskets"?

Some countries participating in the Nuclear Security Summits have taken the initiative to join together in smaller groups to make collective commitments on specific issues. These joint initiatives are known as "gift baskets." For example, there have been gift baskets on enhancing radiological security, strengthening nuclear security implementation, supporting Centers of Excellence, and developing high density low-enriched uranium fuels.

How does DNN support the Nuclear Security Summits?

DNN's core activities are central to implementing U.S. commitments made at the Nuclear Security Summits. DNN program offices have led the development and implementation of some of the most visible Summit deliverables, both nationally and in cooperation with international partners. In addition, DNN supports the extensive international consultations of the U.S. "Sherpa" team that is responsible for preparing the substantive elements of the NSS. DNN provides expertise before, during, and between the Summits so that U.S. commitments are technically sound and kept on track.

Will the 2016 Summit be the last?

2016 is expected to be the final Summit under the current format. It is possible that a future leader sees the value in reconvening the NSS process to address the evolving nuclear security environment.

To learn more about the 2016 Nuclear Security Summit that begins at the end of March, including the pre-Summit ministerial-level exercise, see the article on page 3.

Country Profile: India – *Continued*

that allow for transfers of nuclear material, equipment, or components for peaceful uses of nuclear energy. In FY 2015, DOE/NNSA concluded negotiations on the Administrative Arrangement to the 123 Agreement to outline the agreed procedures for tracking and accounting of material, paving the way for full implementation of the agreement.

Global Centre for Nuclear Energy Partnership

DNN representatives attended annual meetings of the Joint Working Group (JWG) in support of India's Global Centre for Nuclear Energy Partnership (GCNEP) in Mumbai in August 2015. Once construction is complete, the GCNEP will be India's world-class national nuclear training center and a hub for training and collaboration with international partners. DOE/NNSA works with India's Department of Atomic Energy in support of GCNEP development under a 2010 Memorandum of Understanding.

NNSA officials were impressed in August to learn the breadth of GCNEP development to date, including 2016 construction milestones and training already being conducted for domestic and international audiences. JWG participants discussed previous and planned bilateral technical exchanges in support of curriculum and training facility planning. Future activities may include technical exchanges related to a number of topics, including development of an in-device delay for radiological sources; mobile source tracking and security technologies; and consideration of alternative, non-isotopic technologies for industrial and medical applications that currently require radiological sources. DNN viewed these discussions as a positive step in bilateral relations, as well as a step toward strengthening nuclear security around the world.

See the related blog at http://nnsa.energy.gov/blog/doennsa-visits-mumbai-support-india%E2%80%99s-global-center-nuclear-energy-partnership.