



OFFICE OF
**NONPROLIFERATION AND
ARMS CONTROL (NPAC)**

FY 2020 IMPACT REPORT

YEAR IN REVIEW

National Nuclear Security Administration

The National Nuclear Security Administration (NNSA) is responsible for strengthening our nation through nuclear security. NNSA maintains and enhances the safety, security, and effectiveness of the U.S. nuclear weapons stockpile without nuclear explosive testing; works to reduce the global danger from weapons of mass destruction; provides the U.S. Navy with safe and effective nuclear propulsion; and responds to nuclear and radiological emergencies in the United States and abroad.

Office of Defense Nuclear Nonproliferation

NNSA's Office of Defense Nuclear Nonproliferation (DNN) works to develop and implement policy and technical solutions to eliminate proliferation-sensitive materials and limit or prevent the spread of materials, technology, and expertise related to nuclear and radiological weapons and programs around the world.

Office of Nonproliferation and Arms Control

Within DNN, the Office of Nonproliferation and Arms Control (NPAC) works to prevent proliferation, ensure nuclear material and capabilities are used only for peaceful purposes, and enable verifiable reductions in nuclear weapons.



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IMPACT AREAS

WHY IT MATTERS

WHAT NPAC DOES



INTERNATIONAL NUCLEAR SAFEGUARDS

The International Atomic Energy Agency (IAEA) uses a set of technical measures, or safeguards, to provide credible assurances to the international community that nuclear material is accounted for and not being diverted for illicit purposes.

The Office of International Nuclear Safeguards builds capacity of the United States, International Atomic Energy Agency (IAEA), and partner states and organizations to detect and deter diversion of nuclear material and undeclared nuclear activities.



NUCLEAR EXPORT CONTROLS

Threats of nuclear proliferation and nuclear terrorism are ongoing challenges to U.S. national security and to the international community. In particular, the risk of nuclear and dual-use materials, equipment, technologies, or information being diverted to non-peaceful purposes persists.

The Office of Nuclear Export Controls builds U.S. and global export control capacity to detect and prevent the illicit or inadvertent transfer of nuclear and dual-use materials, equipment, and technology.



NUCLEAR VERIFICATION

Extensive technical expertise is vital to prepare for and implement nuclear monitoring and verification activities with foreign partners, including the development and implementation of arms control treaties and other international agreements focused on nuclear weapons and materials limitations.

The Office of Nuclear Verification supports the development and implementation of arms control and other government-to-government agreements focused on weapon limitations and weapons material monitoring and verification. The Office of Nuclear Verification monitors compliance with and implementation of treaties and other international agreements, supports the negotiations of nuclear weapon reduction initiatives, and develops and exercises the U.S. capability to monitor and verify compliance.

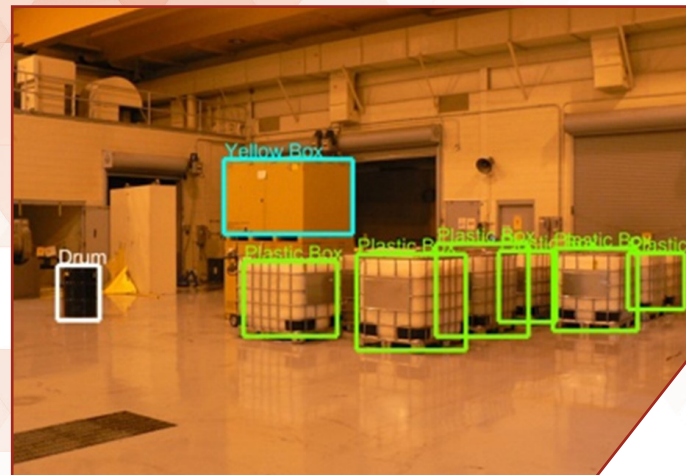
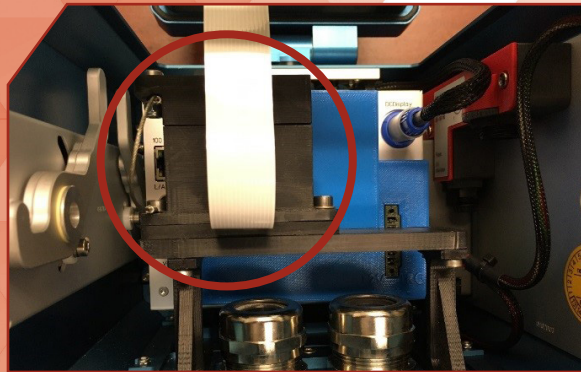


NONPROLIFERATION POLICY

Containing global proliferation and implementing U.S. nonproliferation initiatives to address enduring and emerging challenges requires the development of innovative policies and approaches.

The Office of Nonproliferation Policy develops technical and policy solutions to address enduring and emerging nonproliferation and arms control challenges and opportunities.

OFFICE OF
**INTERNATIONAL
NUCLEAR SAFEGUARDS**
(OINS)



COVID-19 IMPACT ON IAEA SAFEGUARDS

OINS sponsored and oversaw a laboratory report on the impact of COVID-19 on IAEA safeguards. The aim of this report was to help the IAEA as it seeks to maintain a viable and credible safeguards system in the face of this unprecedented challenge. The report's set of recommendations for the IAEA to consider addressed preparedness, mitigation, and remediation topics such as limited inspector access, logistics, communication technologies, staffing levels, and staff safety and health.

DATA VISUALIZATION TECHNIQUES FOR IMPROVED REPORTING

OINS's work on ways to improve the IAEA's reporting to member states in the annual IAEA Safeguards Implementation Report (SIR) gained traction with the interagency, UNVIE, and the IAEA. OINS completed a project on data visualization techniques that gleans data from SIRs over the last decade and displays them in color-coded bar charts that show trends in safeguards activities in a user friendly format.

ESTIMATING LEAD TIME FOR ACQUISITION PATHS

OINS sponsored, coordinated, and consolidated lab subject matter experts' feedback on two draft IAEA reports on how to estimate the time it would take a proliferator to build an undeclared gas centrifuge enrichment plant (GCEP) and a reprocessing facility. This work contributed to the IAEA's efforts to further ensure consistency and non-discrimination in

the implementation of state-level approaches through standardizing the formulation and prioritization of technical objectives.

REMOTE HUMAN CAPITAL DEVELOPMENT (HCD) COURSES

In response to the COVID-19 mitigation steps, the HCD program worked with laboratory principal investigators to provide HCD course content remotely, maintaining the outreach and training mission. The Pacific Northwest National Laboratory and Middlebury Institute of International Studies at Monterey summer safeguards courses are two examples where content and pedagogy were effectively adapted for a complete online training environment.

REMOTE INTERNATIONAL SAFEGUARDS ENGAGEMENT

While OINS has traditionally relied on in-person events to engage partners on IAEA safeguards, it has quickly adjusted to the new COVID-19 operating environment. OINS is working to adapt its capacity building activities to include remote online engagements. While not all partners have the infrastructure to support online engagements, OINS continues to tailor its engagements to meet the needs of its partners.

Photo captions: *Top left:* The radiation shield, the black box in the red circle, is designed to protect a sensitive component of the IAEA surveillance camera in high radiation fields. *Top right:* The TDR development team demonstrating the system and training staff at IAEA. *Bottom left:* Representatives of the Mongolian Nuclear Energy Commission upon receiving the Identifier. *Bottom right:* Object detection scene from a mock up facility.

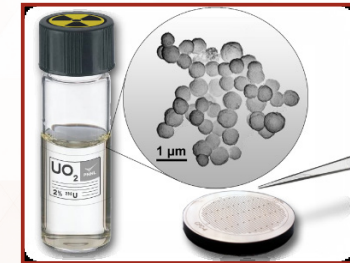
WHAT IS A TECHNOLOGY TRANSFER?

A “tool” is a technology, standard, method, or software that is deployed and used in international regimes and other countries that address an identified safeguards deficiency. Examples of tools transferred include the On-Line Enrichment Monitor to the IAEA, the Chernobyl Drum Assay System to Ukraine, and the Aerosol Contaminant Extractor to the IAEA.

FY 2020 OINS TECHNOLOGY TRANSFERS

Reference Materials for Quality Control of Particle Analysis Methods

OINS supported the creation of one set of uranium particles and transferred them to the IAEA for use at the Network of Analytical Laboratories (NWAL). The NWAL requires particle specimens with the desired isotopic content, size, and chemical stability for quality control and proficiency testing.



Reference standards for particle analysis

Time Domain Reflectometry (TDR) System

The Time Domain Reflectometry System incorporates a commercial off-the-shelf device to detect tampering in signal cables for IAEA unattended instruments in the field, including signal cable disconnections, taps to monitor IAEA instrument signals, or the injection of a false signal onto a cable for the purposes of facility misuse. The system was demonstrated at the IAEA with a number of different IAEA instrument configurations.

Machine Learning Software for IAEA Surveillance Image Review

OINS transferred a deep learning algorithm to the IAEA to assist with the analysis of IAEA surveillance camera data to reduce the time IAEA inspectors spend reviewing surveillance images while maintaining high confidence in the results. By the third quarter, IAEA staff successfully used the algorithm, running on IAEA hardware, to automatically analyze over 700 of its own surveillance images. The U.S. laboratory team continues to work with the IAEA to develop and optimize this new capability.

Prototype Radiation Shields to Protect IAEA Surveillance Cameras

OINS sponsored the development of a prototype radiation shield to protect information stored in IAEA surveillance cameras that are subjected to high radiation fields. The IAEA is currently evaluating the performance of the radiation shields installed in IAEA cameras at a nuclear facility.

U-233 Certified Reference Material to IAEA Environmental Sample Laboratory

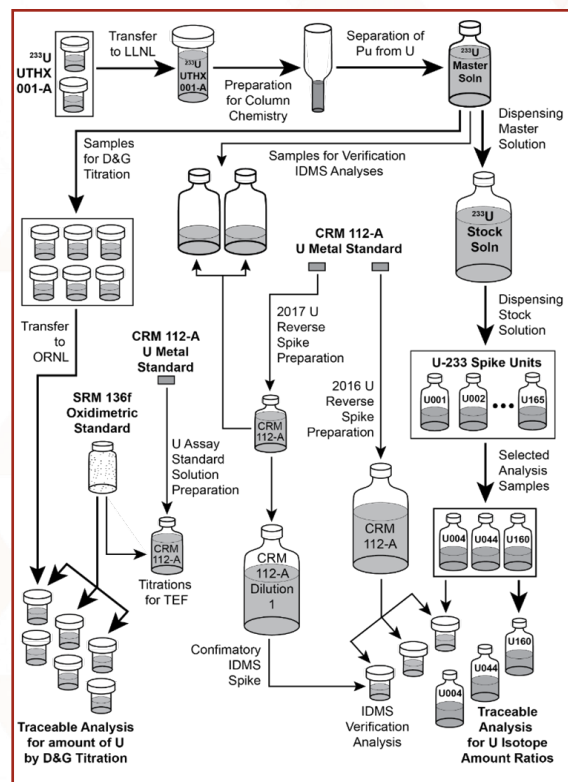
Seven units of U-233 certified spike standards were shipped to the IAEA's Environmental Sample Laboratory for distribution in the IAEA's Network of Analytical Laboratories to support quality control of environmental sample analysis. The U-233 spike standards had been prepared by Lawrence Livermore National Laboratory and certified through coordination with the National Institute for Standards and Technology.

Deep Learning Software for IAEA Surveillance Camera Footage Review

OINS funded the development of a deep learning anomaly detection software package, which Sandia National Laboratories (SNL) virtually transferred to the IAEA for evaluation. SNL's work uses an algorithm that examines image sequences and, once trained, can compare expected sequences with observed activity to validate normal operations or flag anomalies. After testing and optimization, this self-supervised algorithm is expected to save IAEA inspectors time in reviewing surveillance camera footage.

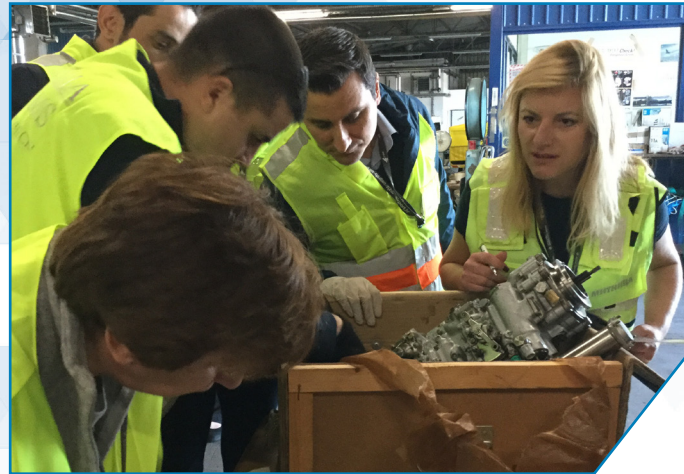
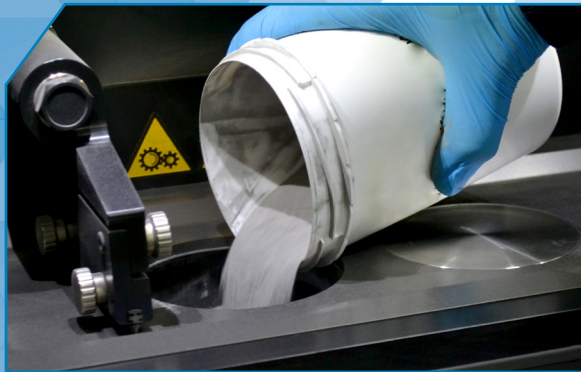
Identifinder for Mongolia

OINS transferred the Identifinder R400 handheld gamma spectroscopy detector to Mongolia for use as an inspection tool for measuring and analyzing nuclear material, thereby strengthening the Mongolian safeguards system.



Schematic of the production and characterization process for determining the attributes of the U-233 Spike reference material

OFFICE OF NUCLEAR EXPORT CONTROLS (ONEC)



UNITED STATES AND UKRAINE HOLD EXECUTIVE DIALOGUE ON STRATEGIC TRADE CONTROLS, FURTHER STRENGTHENING NONPROLIFERATION AND THEIR PARTNERSHIP OVER 20 YEARS

The United States and Ukraine held an executive dialogue on strategic trade control issues and best practices to stem proliferation of WMD-related goods and technology. NNSA Deputy Administrator for Defense Nuclear Nonproliferation Dr. Brent Park led the U.S. delegation, which included leaders and experts from the Departments of State, Commerce, Homeland Security, and Justice. Representatives from Ukraine's Parliament, Presidential Administration, and ministries responsible for Scientific and Technical Center of Export and Import of Special Technologies, Hardware, and Materials (STC) implementation attended. Both countries agreed to further strengthen STC collaboration.

FIRST TRADE COURSE

The International Nonproliferation Export Control Program (INECP) partnered with the Export Control and Related Border Security (EXBS) program to conduct the first deployment of INECP's new Technical Risk Assessment of Dual-Use Exports (TRADE) workshop with Malaysia. The TRADE workshop is INECP's first workshop to be completed using Instructional Design best practices to ensure that the course is optimized for adult learners and is designed to train to the specific skills needed to conduct technical reviews of dual-use license applications.

COUNTER-DPRK TABLE-TOP EXERCISE (TTX)

INECP partnered with the Export Control and Related Border Security (EXBS) program and an interagency team of U.S. experts to conduct a Counter-Democratic People's Republic of Korea (DPRK) TTX for participants from Singapore, Malaysia, and the Philippines. The TTX covered two scenarios focused on UN prohibited ship-to-ship transfers by DPRK and on DPRK's proliferation finance tactics. The TTX raised awareness on the threat posed by DPRK proliferation activities and

enabled a discussion on potential ways to improve policies and procedures to counter DPRK's illicit activities.

CHEMICAL AND BIOLOGICAL WEAPONS (CBW) NONPROLIFERATION SEMINAR

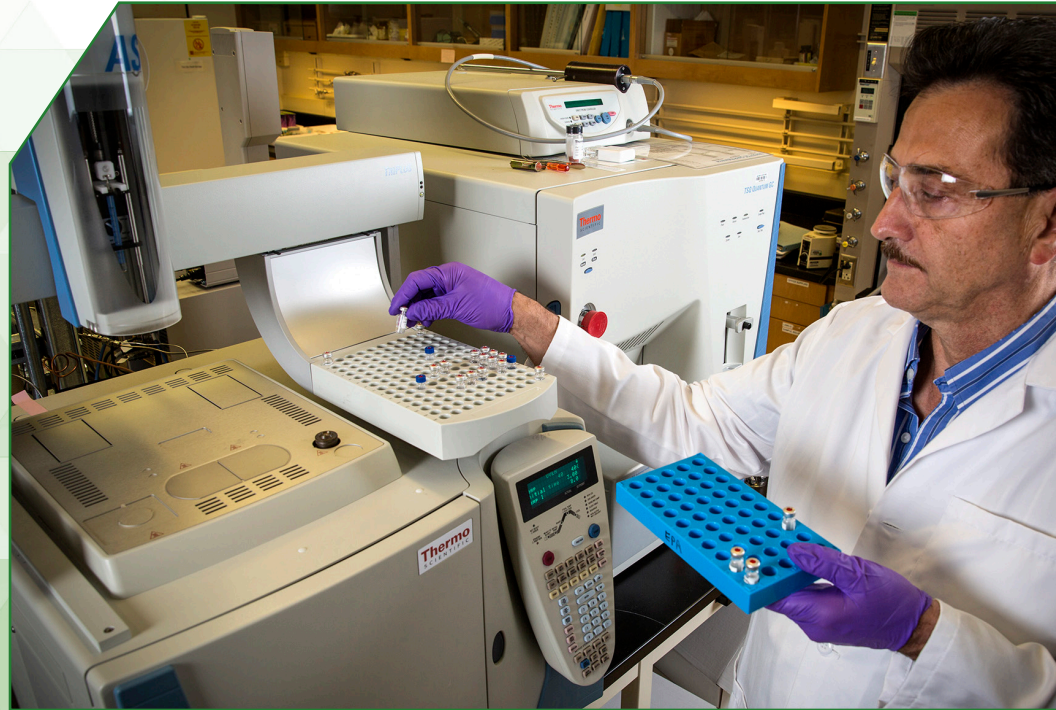
In response to COVID-19 mitigation steps, Argonne National Laboratory hosted Export Control Review and Compliance/Interdiction's (ECRC/I) first virtual training seminar on CBW Nonproliferation. The seminar focused on: 1) the fundamentals of dual-use biological and chemical materials, technology, and equipment; 2) understanding the role of export controls and treaty obligations; and 3) understanding personal responsibilities for implementing export control obligations. The course covered briefings on emerging technologies including additive manufacturing of biological and chemical equipment, chemical micro-reactors, artificial intelligence and machine learning, synthetic biology, and advances in bioautomation. The course accommodated 47 participants, with an additional 16 people on a waitlist that will hopefully attend in the future.

OUTREACH SEMINARS ON ADDITIVE MANUFACTURING

ECRC/I conducted two seminars on advances in additive manufacturing (AM). The first was delivered to the Department of State's Bureau of International Security and Nonproliferation, Office of Missile, Biological and Chemical Nonproliferation, and the second was delivered to an internal DNN audience. The seminar focused on advances in AM that may pose a dual-use proliferation concern for chemical manufacturing and missile related applications. The research is based on open-source, published work conducted at Argonne National Laboratory and Kansas City National Security Campus. This is a follow-on of NPAC's presentation at the Australia Group (AG) New and Evolving Technology Technical Experts Meeting in February 2020 in Bratislava, Slovak Republic and expanded to include missile related applications. The AG is the multilateral export control regime for dual-use biological and chemical equipment, materials, and technology.

Photo captions: *Top left:* Additive manufacturing, a process which could pose dual-use proliferation concerns. *Top right:* Participants in Vietnam view their INECP and EXBS counter-parts on the screen during their July 2020 discussion to formulate a path for the launch and sustainment of Vietnam's national Weapons of Mass Destruction (WMD) Commodity Identification Training (CIT) course. *Bottom left:* U.S. Ambassador Kyle McCarter delivers a strategic trade control commodity identification training kit for Kenya on May 15, 2020. *Bottom right:* Participants from the International Joint Field Operation, conducted by INECP and hosted by Croatia's Customs Administration on November 5–7, 2019, are examining a mock shipment and associated paperwork to identify the commodity in question and any proliferation concerns associated with the shipment. The event included participants from Slovenia, Slovakia, Romania, Bulgaria, Poland, Serbia, and Turkey.

OFFICE OF NUCLEAR VERIFICATION (ONV)



ADVANCING NUCLEAR EXPLOSION MONITORING DURING THE WORLDWIDE PANDEMIC

Even with travel curtailed, ONV facilitated international expert collaboration through the Workshop on Signatures of Man-Made Isotope Production (WOSMIP) Remote forum, a series of videos on key topics to bring the isotope production and nuclear explosion monitoring communities together. New radioxenon collection and analysis systems, reactor emissions, and the Source Term Analysis of Xenon (STAX) project were featured, with the goal of better understanding and reducing emissions so they do not adversely affect monitoring.

LAYING THE GROUNDWORK FOR FUTURE ARMS CONTROL

ONV, in close coordination with partners at NNSA HQ, the NNSA laboratories, plants, and sites, and throughout the U.S. interagency, successfully supported efforts by the President's Special Envoy for Arms Control to engage Russia on topics related to future arms control. ONV experts draw from decades of experience in arms control policy, negotiations, implementation, and technical capability development and assessment for treaty monitoring and verification.

RESPONDING TO CHEMICAL WEAPONS CONVENTION IMPLEMENTATION UPDATE

ONV successfully completed a comprehensive assessment of chemical holdings and activities across the entire DOE/NNSA Enterprise to respond to the first amendment to the controlled, toxic chemicals list of the Chemical Weapons Convention (CWC); this was the first update to that document since CWC entry into force in 1997. ONV coordinated with DOE Offices of Energy, Science, and Nuclear

Security in executing the data call and responded to numerous technical questions from the laboratories, plants, and sites to ensure understanding of the changes and continued CWC compliance across the DOE/NNSA Enterprise.

STRENGTHENING VERIFICATION THROUGH INTERNATIONAL PARTNERSHIPS

ONV successfully expanded collaboration with monitoring and verification experts in the United Kingdom, France, and Canada, exercising nuclear material verification equipment and refining verification approaches through peer-to-peer technical engagement. Highlights included exercising reactor disablement equipment at Calder Hall in the UK, completing detailed peer reviews of ONV verification concepts of operations with French and UK experts, and planning future ONV monitoring and verification team exercises in the UK and Canada.

BUILDING AN INDEPENDENT NUCLEAR TEST SITE VERIFICATION CAPABILITY

ONV continued to build an enduring, independent U.S. capability to monitor and verify activities at foreign nuclear test sites. ONV developed concepts of operations to define objectives and requirements for nuclear test site verification, and conducted a thorough technology review to identify equipment needs. The Test Site Verification Team complements ONV's existing Uranium and Plutonium Verification Teams, improving the U.S. capability to implement our verification rights and/or agreements on short notice.

Photo captions: *Top left:* The International Partnership for Nuclear Disarmament Verification (IPNDV) held the final Plenary Meeting of its Phase II activities in Ottawa, Canada, December 3–5, 2019. More than 89 experts from 23 countries and the European Union participated. *Top right:* A Lawrence Livermore National Laboratory (LLNL) chemist at the Forensic Science Center. LLNL maintains one of two U.S. designated laboratories certified for environmental sample analysis by the Organization for the Prohibition of Chemical Weapons. *Bottom left:* Participants in virtual roundtable for use of stack monitoring data. *Bottom right:* Canadian Nuclear Laboratory Chalk River hosted a muon tomography technology demonstration for the IPNDV in December 2019, highlighting a possible technique that could be applicable to verifying the dismantlement of nuclear warheads.

OFFICE OF NONPROLIFERATION POLICY (ONP)



e810 is up and running to help you comply with Part 810 requirements!

- Submit applications online
- Track applications
- Manage workflow
- Find ongoing Part 810 activities and reports in one place

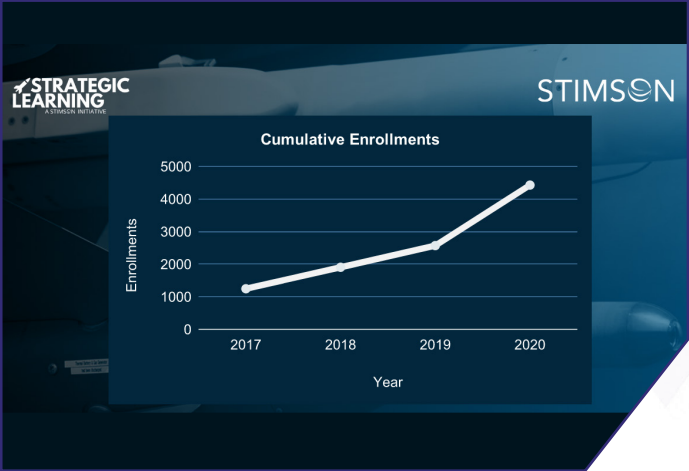
Register at <https://e810.energy.gov>


 Questions? Contact: PART810@nnsa.doe.gov or 202-586-1007

Nuclear Suppliers Group

NSG





FACILITATING CIVIL NUCLEAR COMMERCE

ONP supported legitimate civil nuclear commerce through the interagency review process for over ten Nuclear Regulatory Commission specific licenses under 10 CFR Part 810 for the export of reactors, nuclear material, and major components. ONP also completed four subsequent arrangements that provided consent to the governments of Canada and Japan to retransfer U.S. obligated nuclear material to the European Atomic Energy Community (Euratom) and the United Kingdom. In addition, ONP hosted the Nuclear Cooperation Authorities Group meeting with representatives from five partner countries that focused on addressing policy and technical implementation issues of each members' Administrative Arrangements to their peaceful nuclear cooperation agreements (123 Agreements).

EXPANDING ONLINE TOOLS FOR CONTROLLING EXPORTS OF UNCLASSIFIED U.S. NUCLEAR TECHNOLOGY

ONP worked with the NNSA Office of Information Management to deploy Phase 2 of the e810 system. e810 is an online platform that exporters can use to submit applications and reports to DOE, as required under the Part 810 regulation. The Phase 2 upgrade adds a new workflow capability to the system so that other DOE offices and government agencies can review applications online and provide their concurrence or views directly in the system. This significant upgrade of e810 is important to ONP's ongoing efforts to increase the efficiency and transparency of the Part 810 regulatory process while maintaining strong nonproliferation controls on transfers of unclassified U.S. nuclear technology.

BUILDING GLOBAL NUCLEAR NORMS IN SOUTH ASIA

ONP's Regional Analysis and Engagement program has reached about 3.5 million viewers in South Asia with U.S. driven nonproliferation and arms control analysis. Its online instruction portals providing education on nuclear stability to South Asian viewers and scholars has experienced 1000% growth in the last year.

IMPROVING UNDERSTANDING OF NONPROLIFERATION CHALLENGES

ONP completed 16 studies for the Proliferation Research and Analysis Project (PRAP), which seeks to build deep knowledge on understudied, emerging, or evolving technical, market, or political developments that challenge U.S. nonproliferation policy. Examples include studies on the Russian Build Own Operate model and the Russian fuel fabrication market that address countering Russian influence in the commercial nuclear sector; a study on the global conversion market that assesses U.S. future viability and needs in the market; and an analysis of potential export controls for Additive Manufacturing equipment to help keep Nuclear Suppliers Group export control guidelines up to speed with emerging technologies. The PRAP Program also seeks to develop a community of experts at the National Laboratories to address such challenges into the future.

MODERNIZING THE NUCLEAR SUPPLIERS GROUP INFORMATION SHARING SYSTEM

ONP worked with Lawrence Livermore National Laboratory on the development and deployment of a modernized version of the Nuclear Suppliers Group (NSG) Information Sharing System (NISS), including new capabilities for mobile access. The United States is responsible for the NISS system, which serves to ensure that NSG Participating Governments can share information in a consistent, secure, and timely manner.

Photo captions: *Top left: The e810 system provides an online platform for exporters to submit applications and reports to DOE, as required under the Part 810 regulation. Bottom left: The Nuclear Suppliers Group (NSG) Information Sharing System (NISS) has new capabilities for mobile access. Bottom right: The Stimson Center's instruction portal provides education on nuclear stability to South Asian viewers and scholars.*

FY 2021 PLANS AND PRIORITIES

NPAC follows a disciplined approach for setting, pursuing, and evaluating plans and priorities. Across the spectrum of international nuclear safeguards, nuclear export controls, nuclear verification, and crosscutting policy issues, NPAC staff will continue to provide integrated policy, programmatic, and technical solutions to nonproliferation challenges. Key NPAC priorities for FY 2021 include:



INTERNATIONAL NUCLEAR SAFEGUARDS

- Strengthen the capacity of the IAEA and partner countries to implement and meet international safeguards obligations.
- Support the training of new safeguards professionals in the United States.
- Engage with partner countries to ensure effective and efficient implementation and fulfillment of IAEA safeguards obligations and promote the broadest possible adherence to safeguards agreements.
- Develop mature technologies to support the needs of the IAEA and partner countries in implementing safeguards obligations.
- Engage with and advise the U.S. interagency on safeguards related programs and policies.



NUCLEAR EXPORT CONTROLS

- Perform ~6,000 technical reviews of U.S. export licenses and ~3,000 interdiction technical analyses.
- Develop, maintain, and streamline, as needed, information technology systems to support licensing, interdiction, and multilateral export control regime activities.
- Provide nonproliferation and export control training and analytical support to the DOE complex, U.S. interagency, and international partners.
- Support U.S. Government sanctions activities by providing technical analysis of cases that may be subject to sanctions pursuant to the Iran, North Korea, and Syria Nonproliferation Act.
- Implement OMB metric to complete the review of 85% of dual-use license applications within 25 days of receipt from the Department of Commerce five days ahead of the mandated 30-day deadline.



NUCLEAR VERIFICATION

- Implement arms control agreements and prepare the U.S. Government policy community and DOE facilities for future negotiations and requirements.
- Develop novel technology concepts for warhead verification and nuclear weapon material monitoring and verification.
- Strengthen international partnerships under current and future verification initiatives.
- Implement ongoing monitoring and verification regimes including fissile material monitoring.
- Maintain readiness for on-site monitoring and verification of nuclear programs through enhanced training exercises.



NONPROLIFERATION POLICY

- Support the negotiation and conclusion of peaceful nuclear cooperation agreements (123 Agreements) and associated Administrative Arrangements.
- Conduct technical review of Nuclear Suppliers Group (NSG) guidelines and develop comprehensive updates to the NSG Trigger List & Dual Use List.
- Further strengthen Part 810 regulatory process through the development and implementation of the Part 810 Process Improvement Plan, including the e-licensing system, and the implementation of newly authorized Part 810 civil penalty enforcement functions.
- Undertake analyses in other efforts to support DNN and NPAC strategic planning and risk assessment planning exercises.



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