DECEMBER 2019

Phase II Summary Report:

Moving from Paper to Practice in Nuclear Disarmament Verification

IPNDV
INTERNATIONAL PARTNERSHIP FOR
Nuclear Disarmament Verification

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"In a world of escalating tensions, lessened trust, and malfunctioning international instruments, the importance of IPNDV and similar initiatives only increase. Even when the work in the IPNDV is considered technical, it serves also a very positive political purpose."

Matti Anttonen, State Secretary Ministry for Foreign Affairs, Finland

Executive Summary

The International Partnership for Nuclear Disarmament Verification (IPNDV) brings together countries with and without nuclear weapons to identify challenges associated with nuclear disarmament verification and develop potential solutions to address those challenges. This unique, multilateral initiative was created as a public-private partnership between the U.S. Department of State and the Nuclear Threat Initiative (NTI), involving 29 countries plus the European Union (EU).

The IPNDV has conducted its work in multi-year phases, to effectively focus on specific issues, concerns, and gaps in the current state of nuclear disarmament verification technology, concepts, and procedures. Phase I, which ran from 2015 to 2017, focused on verification of the physical dismantlement of a nuclear weapon—one of the most important, complex, and technically challenging tasks of nuclear disarmament verification. The Partnership explored how best to include countries with and without nuclear weapons in multilateral, nuclear weapons disarmament verification activities.

Phase II Participants

At the end of Phase I, the Partners made the key judgment: *While tough challenges remain, potentially applicable technologies, information barriers, and inspection procedures provide a path forward that should make possible multilaterally monitored nuclear warhead dismantlement while successfully managing safety, security, non-proliferation, and classification concerns in a future nuclear disarmament agreement.*

When the second phase began in 2018, the Partners chose to build on the first phase of work and decided to identify technologies and procedures that could be applied across all stages of the nuclear weapons dismantlement lifecycle, as well as explore cross-cutting issues that could arise in future nuclear disarmament verification scenarios. Where Phase I identified a conceptual path forward, Phase II began to explore more detailed concepts, technologies, and procedures and put some of these to the test in a series of exercises and technology demonstrations. In short, the Partners have spent much of Phase II taking their work from "paper to practice." This transition tested confidence in the results of expert discussions in Phase I and II, which Partners agreed was crucial to success.

Throughout Phase II, three technical Working Groups drove the substantive work and built on the progress from Phase I. The three Working Groups—"Verification of Nuclear Weapon Declarations" (Working Group 4), "Verification of Reductions" (Working Group 5), and "Technologies for Verification" (Working Group 6)—investigated many of the gaps identified in the first phase.

Five practical exercises and technology demonstrations emerged from their efforts, highlighting the progress that the Partnership has made, while allowing the Partners to more accurately gauge what work remains to be done.

- At the Joint Working Group meeting in Utrecht, the Netherlands in June 2019, more than 40 experts participated in a tabletop exercise (TTX) that explored the cross-cutting elements within the IPNDV's 14-step dismantlement framework.
- The Netherlands Organisation for Applied Scientific Research (TNO) hosted members of the Partnership in June 2019 for demonstrations of high explosives detection methods.
- In September 2019, experts at the Belgian Nuclear Research Centre (SCK•CEN) in Mol, Belgium, organized a technology experiment to investigate methods for verifying the presence and/or absence of Special Nuclear Material.
- The Nuclear Disarmament Verification (NuDiVe) Exercise, co-hosted by Germany and France in September 2019, assessed technology options identified by Working Group 6 coupled with verification approaches developed by Working Groups 5.
- Experts at the Canadian Nuclear Laboratories (CNL) hosted members of the Partnership in December 2019 for a demonstration of the applicability of muon tomography in identifying the presence or absence of Special Nuclear Material in a container.

Credit: Sascha Kreklau, Forschungszentrum Jülich

Team members suit up in protective gear, NuDiVe Exercise, Jülich, Germany.

These practical activities served to reinforce the key judgment of Phase I by demonstrating that multilateral verification of nuclear dismantlement is possible, although it will be challenging and will require a tailored application of verification options—tools, policies, and procedures—that prevent disclosure of proliferation-sensitive information and take into consideration safety and security as well as external factors unique to a given country's nuclear weapons enterprise.

The successful outcomes of the Partnership's first two phases are directly attributable to the work and cooperation among Partner countries, Working Group participants, and everyone connected to the work of the Partnership. Phase III will build on these efforts, and the multilateral cooperation which has become a centerpiece of the IPNDV will continue to be critical for future success. As the Partnership noted at the end of Phase I, confidence-building is the key to success for any nuclear disarmament verification effort, and the IPNDV will continue to build confidence and strengthen the capabilities for future nuclear disarmament verification.

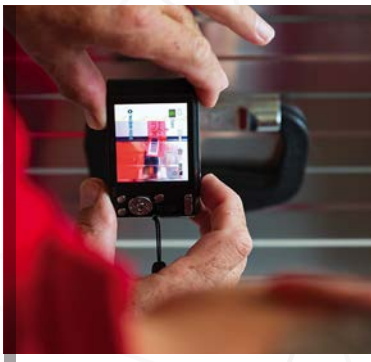
"The four meetings we have participated in so far reinforced our conviction that nuclear and non-nuclear weapon states can work together on nuclear disarmament verification, in conformity with their obligations under the Nuclear Non-Proliferation Treaty, and that non-nuclear weapon states can also make an important contribution to this complex endeavor."

Ambassador Dr. György Molnár, Special Representative of the Minister of Foreign Affairs and Trade for Arms Control, Disarmament and Non-Proliferation, Hungary

History and Approach

The number of nuclear weapons has decreased dramatically from the peak arsenals of the Cold War. However, as the number of nuclear weapons decreases further, countries will need assurance that reductions are being made in a verifiable way. Key to that assurance is a better understanding of the technical challenges and possible solutions of such verification.

The IPNDV was born out of independent efforts and recommendations from the U.S. Department of State and a pilot project run by NTI, both of which advocated for the convening of an international group of experts to investigate technical and procedural challenges and solutions associated with nuclear disarmament verification and monitoring. The U.S. Department of State officially announced in December 2014 that the U.S. Government would lead the IPNDV in cooperation with NTI. The first meeting of the Partnership was hosted in Washington, DC, in March 2015.



Checking seals during NuDiVe Exercise, Jülich, Germany.

Credit: Sascha Kreklau, Forschungszentrum Jülich

Today, 29 countries plus the EU have taken part in this continuing multilateral initiative. This includes two new partner countries that took part in activities in Phase II, Hungary and Nigeria. The scale of this multilateral commitment to and collaboration in nuclear disarmament verification activities among countries with and without nuclear weapons is unique to this Partnership, and crucial to its success; it helps build trust and transparency at a political level and increases global capacity at the technical level. However, the Partners recognize that they are neither the first to tackle these complex issues, nor are they the only ones currently doing so. The IPNDV's work builds on and intends to complement other previous and ongoing verification and monitoring initiatives, including the:

- U.S.-Russia monitoring and verification experience
- U.S.-UK technical cooperation on nuclear disarmament verification
- UK-Norway Initiative on Nuclear Warhead Dismantlement Verification
- Norway, Sweden, UK, U.S. Quad Nuclear Verification Partnership
- United Nations Group of Governmental Experts to consider the role of verification in advancing nuclear disarmament.

Credit: Dutch Ministry of Foreign Affairs, Kick Smeets

Ichiro Akiyama offers remarks during the IPNDV Joint Working Group Meeting, Utrecht, the Netherlands.

Structure and Timeline

The Partnership has divided its work into multi-year phases with work guided by Working Groups. Meeting at least three times a year, each Working Group has brought together technical experts and officials from across the Partner countries, often supported by colleagues at home. Together, the Working Groups have produced more than 50 analytical papers and reports, which are all available on the IPNDV website (www.ipndv.org). Phase I and II Working Groups were

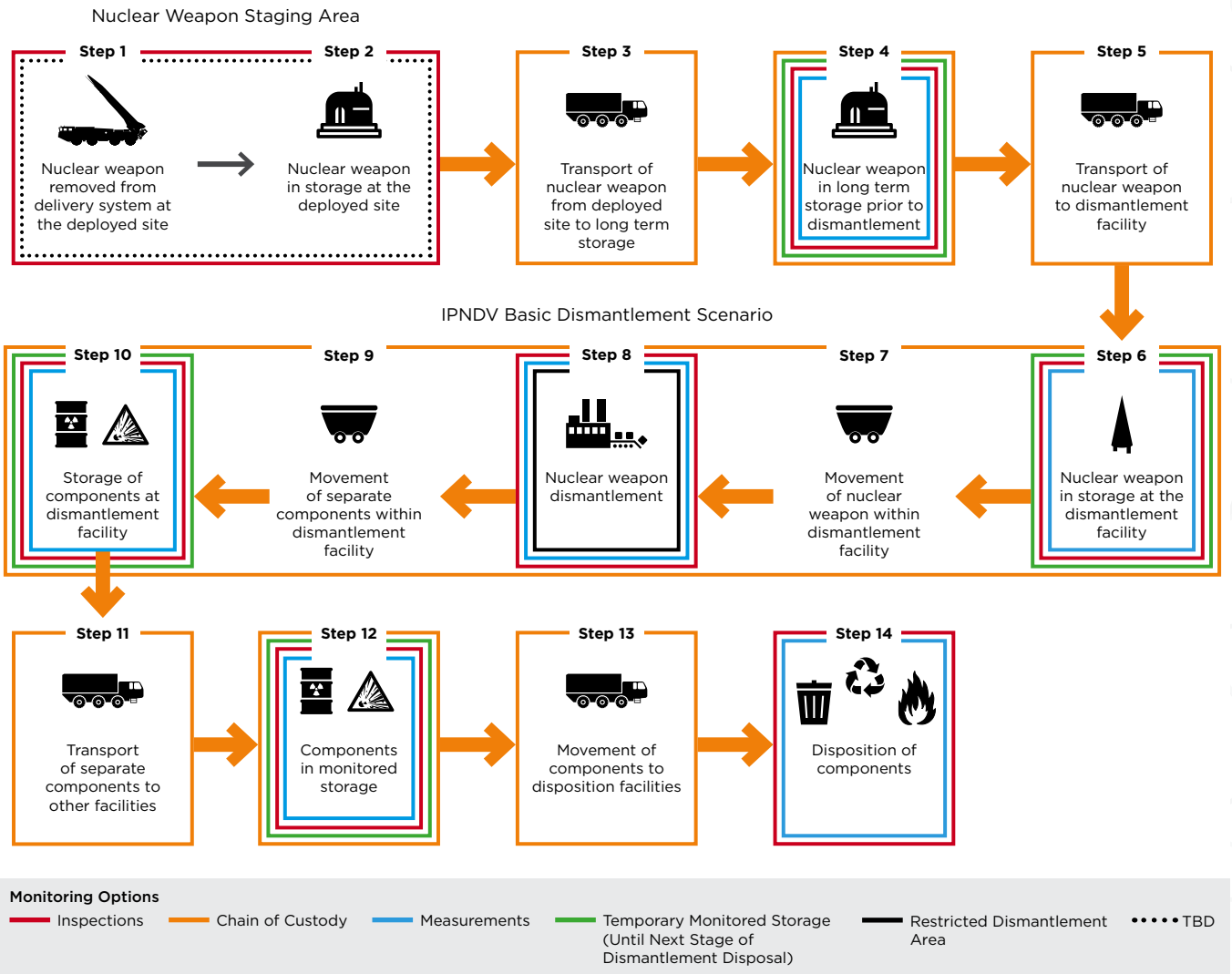
Phase I (2015–2017)	Phase II (2018–2019)
Working Group 1: Monitoring and Verification Objectives *Co-chairs:* the Netherlands, United Kingdom	**Working Group 4: Verification of Nuclear Weapon Declarations** *Co-chairs:* Poland, United Kingdom
Working Group 2: On-Site Inspections *Co-chairs:* Australia, Poland	**Working Group 5: Verification of Reductions** *Co-chairs:* Australia, the Netherlands
Working Group 3: Technical Challenges and Solutions *Co-chairs:* Sweden, United States	**Working Group 6: Technologies for Verification** *Co-chairs:* Sweden, United States

co-chaired by experts from Australia, the Netherlands, Poland, Sweden, the United Kingdom, and the United States.

Phase I

During the first phase of work (2015–2017), the three Working Groups specifically investigated monitoring and verification objectives, on-site inspection principles and procedures, and technical challenges and solutions. To create a common foundation for further work, the Partnership identified 14 key steps in the nuclear weapons dismantlement lifecycle (see Figure 1), beginning when a nuclear weapon is removed from a delivery vehicle and concluding with the final disposition of the components. These 14 steps serve as an analytic framework of dismantlement-related activities

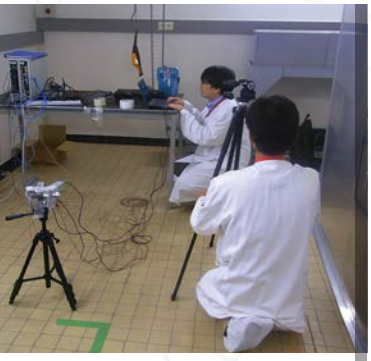
Figure 1: Monitoring and Verification Activities for Key Steps in the Process of Dismantling Nuclear Weapons



*We make the assumption that there will be declarations at each step in the process.

Credit: Sascha Kreklau, Forschungszentrum Jülich

Team members check portal monitor alarm, NuDiVe Exercise, Jülich, Germany.



Demonstrating technolgies, Mol, Beligium.

Credit: SCK•CEN Used by permission Mol, Belgium

under a future nuclear disarmament agreement and the basis of outputs from the Working Groups. The first phase addressed monitoring and verification activities across steps 6–10, which includes the physical dismantlement of a nuclear weapon (step 8), one of the most important and complex challenges related to future nuclear disarmament verification.

The Partners came to an important key judgment at the end of Phase I: *While tough challenges remain, potentially applicable technologies, information barriers, and inspection procedures provide a path forward that should make possible multilaterally monitored nuclear warhead dismantlement while successfully managing safety, security, non-proliferation, and classification concerns in a future nuclear disarmament agreement.*

Phase II

Phase II of the Partnership (2018–2019) extended the work done in Phase I, identifying technologies and procedures that can be applied at each of the 14 steps of the nuclear weapons dismantlement lifecycle, as well as characterizing other monitoring and verification considerations such as state declarations and treaty limitations. The three Phase II Working Groups focused specifically on verification of nuclear weapons declarations, verification of reductions, and technologies that can be used for verification.

Partners began advancing their work from "paper to practice" in this second phase. This meant putting their conceptual work to the test through the development and execution of several hands-on and collaborative tabletop and physical exercises, as well as technology demonstrations.

PHASE II MEETINGS

MAR 26–28 2018
Joint Working Group Meeting
Stockholm, Sweden

JUL 10–12, 2018
Joint Working Group Meeting
Seoul, South Korea

DEC 4–7, 2018
Plenary Meeting
London, United Kingdom

MAR 5–7, 2019
Joint Working Group Meeting
Helsinki, Finland

JUN 17–21, 2019
Joint Working Group Meeting
Utrecht, the Netherlands

TNO Tech Demo
The Hague, the Netherlands

SEP 2019
NuDiVe Exercise
Jülich, Germany

SCK-CEN Tech Demo
Mol, Belgium

DEC 2–5, 2019
End of Phase II Plenary Meeting
Ottawa, Canada

DEC 3–6, 2019
CNL Tech Demo
Chalk River, Canada

2018 — 2019

Results

Building on the Phase I key judgment, Phase II demonstrated that successful multilateral verification will require the tailored application of a suite of verification options. These options include declarations, inspection procedures and technologies, associated systems, and analytic concepts. In other words, Partners have now identified pieces of the puzzle that could be applied to the overall process of monitoring and verifying nuclear disarmament. However, work still remains to refine these pieces and fit them together.

Working Groups and Products

Working Group 4: Verification of Nuclear Weapon Declarations

One of the objectives for Phase II was to broaden the scope of work and look at wider aspects of nuclear disarmament verification. In response, Working Group 4 focused on how to verify a declaration of the total number of nuclear weapons in a state, including both how to confirm the number present at declared sites and how to confirm the absence of weapons in other locations.

"Given the current atmosphere, even small but concrete breakthroughs can make a difference, and that is where I find the value and strength of IPNDV."

Lim Sang-Beom, Director-General for Nonproliferation and Nuclear Affairs, Republic of Korea

Credit: Sascha Kreklau, Forschungszentrum Jülich

Exercising inspection procedures during the NuDiVe Exercise, Jülich, Germany.

At the core of any effective treaty verification regime, a set of criteria defines compliant behavior that requires a declaration made by states of how they are meeting these criteria. For future treaties relating to limiting, reducing, or eliminating nuclear warheads (as opposed to delivery vehicles), one of the first steps would be to verify the initial declaration of nuclear weapon numbers. Such a declaration could take many forms, but by analyzing and applying previous treaty verification regimes, Working Group 4 has identified key criteria that would have to be considered to develop any future nuclear weapon accounting scheme, as well as potential frameworks that could be applied to undertake the verification of such a scheme. While the details of any verification regime would depend on the specific treaty requirements and the individual states involved, Working Group 4 has shown that a number of similarities exist across the many different verification regimes. Using the rules and concepts within the Conventional Forces in Europe Treaty as an example, the group demonstrated how the foundation for a potential verification regime for nuclear weapons may be built.

Working Group 5: Verification of Reductions

Working Group 5 analyzed and described the essential features of multilateral inspections that can address verification in each of the 14 steps in the nuclear weapons dismantlement lifecycle, beginning with monitoring the removal of weapons from delivery systems and ending with the disposition of nuclear material from the weapons. They identified overarching verification objectives across the IPNDV's 14-step dismantlement framework and described inspection activities that address the objectives for each step. The group focused on preparing a detailed description of inspection methodologies and the kinds of technologies required to support them. The group also reviewed a range of cross-cutting issues that would affect the design of a future verification regime.

Working Group 5 also examined options for the disposition of Special Nuclear Material arising from the dismantlement and how it could be verified.

Working Group 6: Technologies for Verification

Working Group 6 focused on identifying and evaluating key verification technologies across the IPNDV's 14-step dismantlement framework. They considered identifying requirements for information barriers to protect proliferation-sensitive information when using some verification technologies.

The group also focused on developing these requirements and evaluating key verification technologies based on the findings from Phase I, where gaps were identified in the ability to detect and monitor a nuclear explosive device and its key components. The other Working Groups provided additional monitoring requirements and Working Group 6 tried to identify verification technologies that would meet their needs. The group also

Phase II Working Group Deliverables
These materials, as well as additional resources, are or will be available at www.ipndv.org

Working Group 4: Verification of Nuclear Weapon Declarations	• A detailed five-part document exploring the role and objectives of declarations in different phases of disarmament; potential options for declarations on nuclear weapons; potential options to verify completeness; overarching issues such as inspection modalities, report sharing, evaluating confidence in compliance, and resolution of ambiguities; and, a walkthrough report of an exercise that dissected the Conventional Armed Forces in Europe Treaty and how aspects of its verification scheme could be useful for a future hypothetical nuclear disarmament verification regime.
Working Group 5: Verification of Reductions	• A thorough description of the verification process for each step of the 14-step dismantlement framework. • A paper evaluating options for disposition of Special Nuclear Material arising from the dismantlement of nuclear explosive devices and for related verification.
Working Group 6: Technologies for Verification	• Executive summary of the series of presentations and papers on key activities and lessons learned from Partners related to dismantlement monitoring and verification technologies and approaches covering the IPNDV's 14-step dismantlement framework. • Summary of lessons learned from the development and execution of two technology demonstrations—one on high explosives and the other on the detection of Special Nuclear Material using muon tomography—and one measurement campaign related to detecting the presence or absence of nuclear material from a nuclear weapon. • In collaboration with Working Group 5, an assessment of existing and potential technical capabilities necessary to enable monitoring and verification over the IPNDV's 14-step dismantlement framework with a list that identifies capabilities and weaknesses. Included in this assessment is a review of monitoring technology gaps to inform future research.

"We all the more welcome the progress we have made both within the IPNDV and the Group of Governmental Experts. These works need to be continued…"

Ambassador Peter Beerwerth, Deputy Federal Government Commissioner for Disarmament and Arms Control, Germany

A sample seal used during the NuDiVe Exercise, Jülich, Germany.

Credit: Sascha Kreklau, Forschungszentrum Jülich

reviewed practical activities, including technology developments by Partner countries, and undertook demonstrations, including an experiment to test the limits of selected passive non-destructive assay nuclear radiation techniques.

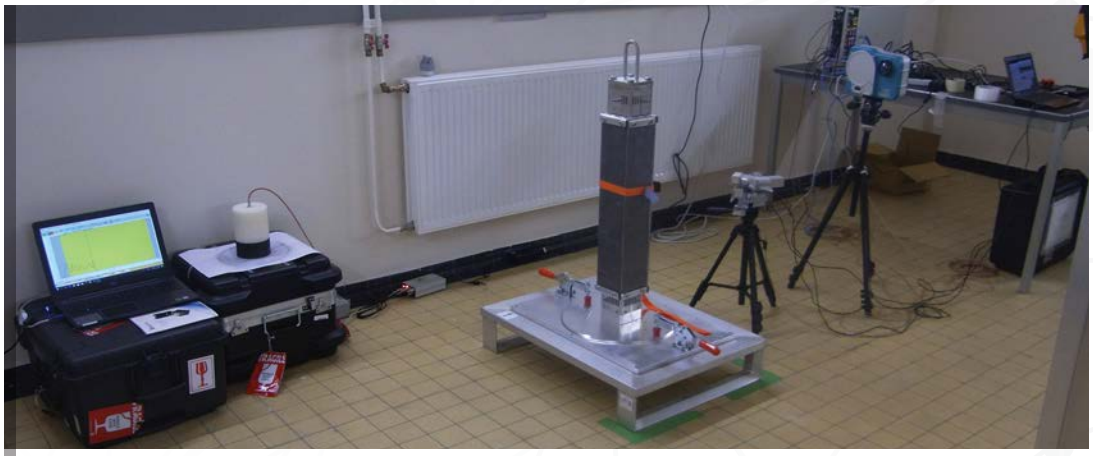
Practical Activities

During Phase II, the Partners conducted five practical exercises and technology demonstrations, starting in June 2019. Lessons learned from these activities are under development and will be made available through papers on www.ipndv.org.

Phase II Tabletop Exercise (TTX)—Insights for Moving from Paper to Practice

The Partnership conducted a day-long exercise in June 2019 to help refine its analysis. More than 40 participants with a mix of expertise and experience, took part in this exercise, which was focused on verifying a declaration of the number of nuclear weapons in a state and the verification of nuclear weapon dismantlement.

The exercise began with a scenario of the multilateral implementation of an agreement that required the total number of nuclear warheads in a country to be declared, and for some of those warheads to be dismantled. Focused on activities at deployment and associated storage sites (steps 1 and 2), participants began by addressing the information requirements and the necessary activities for verification of declarations and to initialize the process of dismantlement. Participants were also asked to identify the most important gaps and challenges for monitoring and inspection technology development. The exercise concluded with a mini-game focused on the dismantlement of hundreds of nuclear warheads over a five-year period. Participants were split into teams of "hosts" and "inspectors" to explore the implications for monitoring and inspection approaches and priorities when dismantling many nuclear warheads. Participants also discussed how to respond to stressful inspection events (e.g., a denial of access by the host country).



Credit: SCK•CEN Used by permission Mol, Belgium

Equipment measurements during tech demo, Mol, Belgium.

Several key insights emerged:

Key Choices of Nuclear Disarmament Verification

For political, technical, conceptual, and practical considerations, nuclear disarmament verification will require making choices. One example discussed in the TTX is whether and when to undertake radiation measurements to build confidence that an item declared to be a nuclear weapon (and subject to verification under an agreement) is actually a nuclear weapon. Another example is the choice among different options for the disposition of Special Nuclear Material from dismantled nuclear weapons. The development of a systems approach to nuclear disarmament verification should be pursued to make such choices. Operational modeling of an entire verification system can inform judgments about what verification options are most effective and how to apply them, as well as why and how best to use limited verification resources. To answer the question of what the system is being built to achieve, a systems approach should be based on a specific and credible scenario for a future agreement and its verification.

Verification Technology Design and Development Requirements

The TTX underscored that technology requirements for verification of nuclear weapon dismantlement and those for the verification of a declaration of numbers of nuclear weapons overlap considerably. To meet them, strengthening the integration of technology expertise with the design of verification mechanisms is essential. Within a comprehensive work program, the development of templates, information barrier concepts and technologies, absence measurement technologies, and technologies for detection of highly enriched uranium are priority problems. In addition, technology research and development needs to include assessment of technology robustness, concept of operations (CONOPS), and how technologies would work in specific "real world" circumstances.

Credit: Sascha Kreklau, Forschungszentrum Jülich

Participants in the NuDiVe Exercise, Jülich, Germany.

Carrying forward the Partnership's Work

The mini-game highlighted the importance of a more detailed scenario involving the dismantlement of many nuclear warheads over a limited time, the greater complexities of such a scenario, and implications for verification implementation. This experience led participants to conclude that Phase III needs to be grounded in a specific, comprehensive scenario that identifies a notional nuclear weapons state and that state's nuclear weapons enterprise. Such a scenario is essential to determine whether and how specific options developed in IPNDV Working Groups could apply, as well as identify the most significant verification gaps that remain.

NuDiVe

In September 2019, 22 participants representing 11 Partner countries participated in the Nuclear Disarmament Verification (NuDiVe) Exercise, jointly organized by France and Germany and held at Forschungszentrum Jülich in Jülich, Germany. This exercise, focused on the dismantlement phase of the IPNDV 14-step framework, aimed to assess how chain-of-custody concepts developed by the Partners during Phase I and II could be applied to notional nuclear warhead materials during and after dismantlement in a way that strengthens confidence that nothing has been diverted.

Participants were divided into three teams—Inspection Team, Host Team, and Evaluation Team—each with unique duties and responsibilities. Following two days of training, the participants spent three days exercising notional procedures, using actual monitoring and inspection equipment, along with surrogate radioactive materials to replicate the Special Nuclear Material found in a nuclear warhead. Participants from the Inspection and Host Teams followed inspection procedures developed for the exercise while the Evaluation Team critically assessed the exercise (inspection procedures; inspection equipment; and exercise planning, preparation, and training) in order to identify valuable lessons.

The participation of experts from so many different countries marked NuDiVe as different from other exercises and demonstrated the value of the IPNDV model. Some participants had been part of bilateral activities or the Quad Nuclear Verification Partnership (U.S., UK, Norway, and Sweden). These experts were able to share their knowledge with others while learning themselves. Together, the full group was able to test specific concepts that had been worked through over the past four years of IPNDV discussions, with a focus on the technologies and approaches described in the Working Group 5 and 6 deliverables.

Overall, evaluators and exercise participants consider that the exercise demonstrated that the IPNDV-developed inspection concepts and approaches on which it was based are sound. However, they identified ways in which procedures should be refined and augmented, for example, to ensure that inspection effort and resources can be more clearly focused on critical inspection objectives. Inspection equipment employed in the exercise demonstrated value and knowledge gained by the use of this equipment provides ideas for future development. The inspection scenario developed by the exercise organizers, and the facilities offered by the Jülich Research Centre, added realism to the exercise. Useful lessons were learned for how gameplay in future exercises could be enhanced, including how to ensure activities align with the strategic objectives of an inspection. Participants noted the value of practical exercises in future work on nuclear disarmament verification and for building and maintaining the expert capacity needed to advance this work.

Lessons learned from the exercise will be applied to the ongoing work of the Partnership, and they can be used to enrich the collective understanding of the Partnership and inform future TTX or in-field exercises.

Credit: Sascha Kreklau, Forschungszentrum Jülich

NuDiVe teams group picture, Jülich, Germany.

"We consider IPNDV, and verification in general, a crucial element of the implementation of our NPT commitments."

Hester Somsen, Director of the Security Policy Department
Ministry of Foreign Affairs, the Netherlands

Equipment measurements during tech demo, Mol, Belgium.

Credit: SCK•CEN Used by permission Mol, Belgium

Dutch Technology Demonstration

The Netherlands Organisation for Applied Scientific Research (TNO) hosted members of the Partnership in June 2019 for demonstrations of high explosives detection methods. These demonstrations illustrated three categories of technologies—X-ray imaging, neutron detection, and vapor tests—that could be used to detect the presence or absence of high explosives, an element of the 14-step nuclear weapon dismantlement process as outlined by the Partners.

Belgian Technology Demonstration

Experts at the Belgian Nuclear Research Centre (SCK•CEN) in Mol, Belgium, organized a technology experiment to investigate methods for verifying the presence and/or absence of Special Nuclear Material. Over two weeks in September 2019, 30 participants from 10 IPNDV Partner countries used non-destructive, passive methods to investigate detector performance on unirradiated mixed-oxide (MOX) fuel pins with various types of shielding materials. Carrying out this exercise at SCK•CEN's highly secure facilities enhanced the realism of the activity because the conditions were similar to that of a real-life nuclear disarmament verification scenario. The technical data generated by the tests provide a valuable resource for further analysis of related verification challenges by IPNDV partners. Beyond advancing technical knowledge, the measurement campaign underscored the value of international scientific collaboration in developing solutions to complex verification challenges.

Canadian Technology Demonstration

Experts at the Canadian Nuclear Laboratories (CNL) hosted members of the Partnership in December 2019 for a demonstration of the applicability of muon tomography in identifying the presence or absence of Special Nuclear Material in a container. CNL also developed preliminary software for automated determination of the presence of shielded heavy metals. Muon tomography is a technique that uses cosmic ray particles to generate three-dimensional images. Lessons learned from this exercise will help inform whether or how this new technology might be applicable to nuclear disarmament verification.

Credit: Rachel Staley Grant

IPNDV participants visit former nuclear weapons facilities at RAF Honington during the London plenary meeting.

Engagement and Outreach

Throughout Phase II, Partners ensured that the Partnership's work would inform others working on complementary projects. The Partners also have taken steps to communicate their work in ways that can educate audiences new to nuclear disarmament verification topics.

Comprehensive Website

All of the Partnership's work is captured on its website, www.ipndv.org. This includes more than 50 analytical reports from the Working Groups, summary publications, event write-ups, a 14-step dismantlement interactive, and a library of more than 300 resources related to nuclear disarmament verification issues.

Outreach Events

In Phase II, recognizing the important link between the IPNDV and state commitments under the Nuclear Non-Proliferation Treaty (NPT), Partners have hosted annual side events at the NPT Preparatory Committee Meetings. These events have offered an opportunity for engagement with the NPT community about the Partnership's technical work and practical activities. Partners have also engaged with complementary communities such as the Institute for Nuclear Materials Management and the European Safeguards Research and Development Association through outreach events and panel discussions. The Partners intend to host more substantial outreach events with various communities as their work progresses into Phase III.

An Ongoing Commitment into Phase III

The IPNDV has successfully brought together international technical and policy experts to address the process and technical challenges of nuclear disarmament verification. The analytical agenda of the Partnership has been steered by three technical Working Groups that have examined some of the most challenging issues related to nuclear disarmament verification. The Partners have made steady progress in Phase II, advancing from "paper to practice" over the course of two years, six meetings, and five practical activities that have put technologies and concepts to the test. This dynamic work is unique and groundbreaking in many ways, and it would not have been possible without the ongoing commitment and cooperation of all Partner countries.

As the IPNDV moves into a third phase of work, the Partnership will expand its practical work, incorporating scenario-based discussions, hands-on exercises, and technology demonstrations to continue addressing the outstanding challenges of nuclear disarmament verification. Phase III will be another multi-year effort, with the goal of presenting findings ahead of the 2025 Nuclear Non-proliferation Treaty Review Conference.

"Effective nuclear disarmament verification is essential for achieving a world without nuclear weapons. Ongoing work on nuclear disarmament verification, either through the United Nations group of governmental experts or other initiatives, such as the International Partnership for Nuclear Disarmament Verification, is aimed at promoting trust and confidence among States as well as the development of appropriate multilateral technical capabilities."

The Treaty on the Non-Proliferation of Nuclear Weapons at 50: A Brief Assessment by the European Union

The **International Partnership for Nuclear Disarmament Verification (IPNDV)** is an ongoing initiative that includes more than 25 countries with and without nuclear weapons. Together, the Partners are identifying challenges associated with nuclear disarmament verification and developing potential procedures and technologies to address those challenges.

The IPNDV is working to identify critical gaps and technical challenges associated with monitoring and verifying nuclear disarmament. To do this, the Partnership assesses monitoring and verification issues across the nuclear weapon lifecycle.

The IPNDV is also building and diversifying international capacity and expertise on nuclear disarmament monitoring and verification. Through the Partnership, more countries understand the process, as well as the significant technical and procedural challenges that must be overcome. At the same time, the Partnership is highlighting the importance of verification in future reductions of nuclear weapons.

For more information, **visit www.ipndv.org**.

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