



Collaborate. Innovate. Verify.

Pathways to Verifiable Nuclear Disarmament

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**Innovations in Nuclear Disarmament Verification:  
Advancing Technology and Approaches**

AN EVENT ORGANIZED BY  
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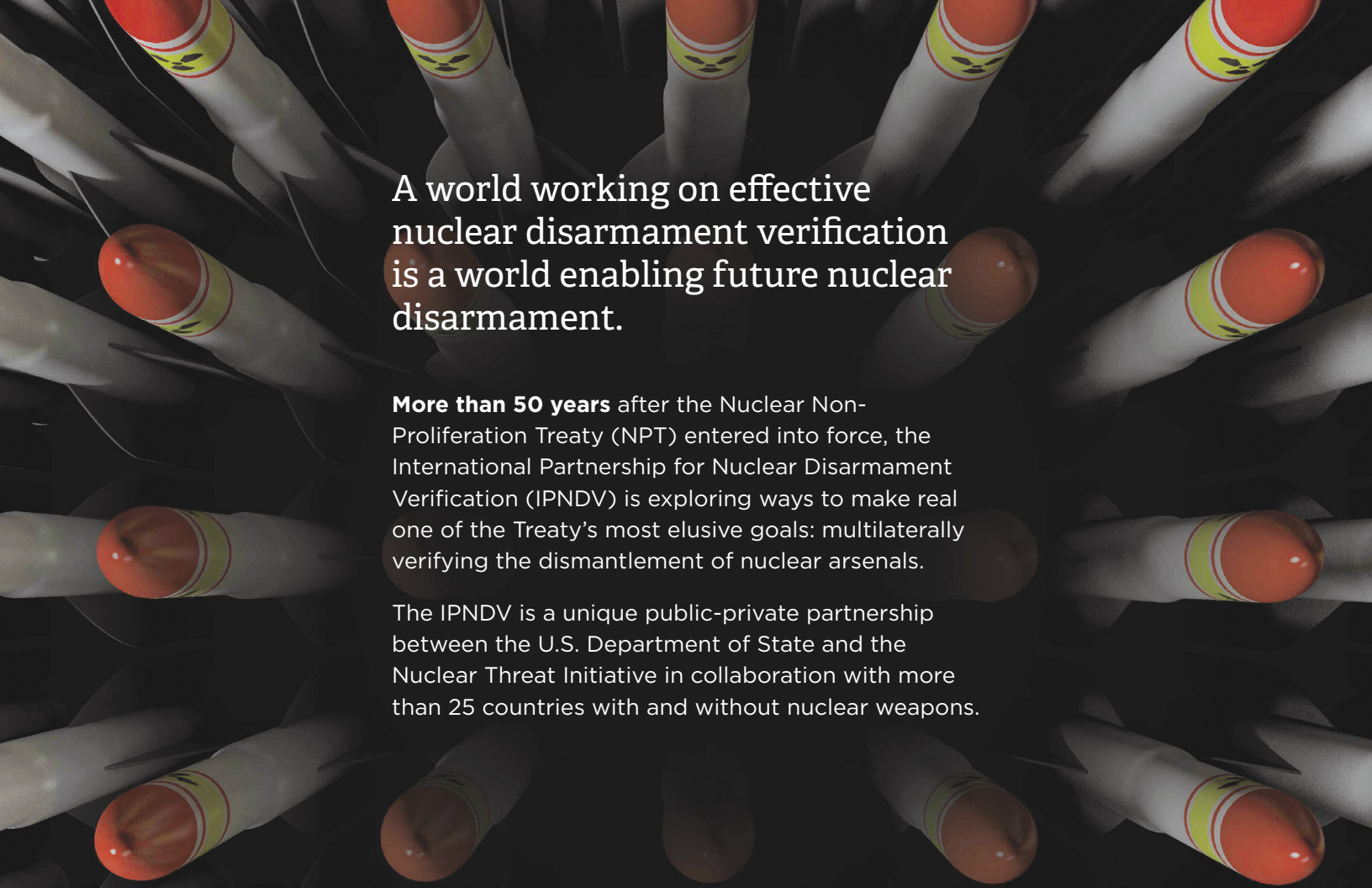
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A world working on effective  
nuclear disarmament verification  
is a world enabling future nuclear  
disarmament.

**More than 50 years** after the Nuclear Non-Proliferation Treaty (NPT) entered into force, the International Partnership for Nuclear Disarmament Verification (IPNDV) is exploring ways to make real one of the Treaty's most elusive goals: multilaterally verifying the dismantlement of nuclear arsenals.

The IPNDV is a unique public-private partnership between the U.S. Department of State and the Nuclear Threat Initiative in collaboration with more than 25 countries with and without nuclear weapons.

## Fulfilling Our Collective Responsibility For Verifiable Disarmament

**Signed by nearly all of the world's countries**, the NPT has been the cornerstone of nuclear non-proliferation and arms control since 1970. The treaty encompasses non-proliferation obligations of states both with and without nuclear weapons (Articles I and II). Among other key obligations, each of the State Parties has committed to pursue good faith negotiations on effective measures relating to the cessation of the nuclear arms race and to nuclear disarmament (Article VI).

Thorough and effective verification measures are critical to the success of nuclear disarmament and constitute an effective measure under the NPT. Initiatives like the IPNDV identify and address the challenges associated with verifiable dismantlement of nuclear warheads by developing potential nuclear disarmament verification procedures and technologies.

## Engaging Diverse Countries to Innovate Monitoring and Verification Solutions

**The IPNDV brings together** technical and policy experts from more than 25 countries with and without nuclear weapons. Central to the IPNDV's work is the understanding that countries with and without nuclear weapons have an individual interest in and collective responsibility for verifiable disarmament—and that they can contribute to the process.



## Participating Countries



Argentina



Australia



Belgium



Brazil



Canada



Chile



European Union



Finland



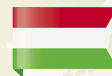
France



Germany



Holy See



Hungary



Indonesia



Italy



Japan



Jordan



Kazakhstan



Mexico



The Netherlands



Nigeria



Norway



Philippines



Poland



Republic of Korea



Sweden



Switzerland



Turkey



United Arab  
Emirates



United Kingdom



United States

A dark background featuring a complex network of interconnected nodes and lines, resembling a molecular structure or a web. The nodes are represented by circles of varying sizes, and the lines are thin and light gray, creating a geometric pattern across the entire frame.

“

IPNDV is the first international initiative of this size that considers verification, that has roles and contributions for both nuclear weapon states and non-nuclear weapon states. And as Phase I demonstrated, multilateral verification is difficult but possible.”

IRMGARD NIEMEYER | GERMANY

## IPNDV PHASE I (2015–2017)

# A Roadmap for Action

**Phase I focused on verification** of the physical dismantlement of a single nuclear weapon—one of the most important, complex, and technically challenging tasks of nuclear disarmament verification. To identify clear goals and actions, three Working Groups were established, each comprising a multinational team of experts from the policy, verification, and scientific communities.

Within the three Working Groups, representatives of countries with and without nuclear weapons brought different perspectives to the work and gained important insights from each other.

They produced a comprehensive 14-step model of the dismantlement process, beginning with the removal of a nuclear weapon from its delivery system and ending with the disposition of its separate components.

## IPNDV Phase I Working Groups

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### WORKING GROUP 1: MONITORING AND VERIFICATION OBJECTIVES

Co-chairs:  
The Netherlands, United Kingdom



### WORKING GROUP 2: ON-SITE INSPECTIONS

Co-chairs:  
Australia, Poland

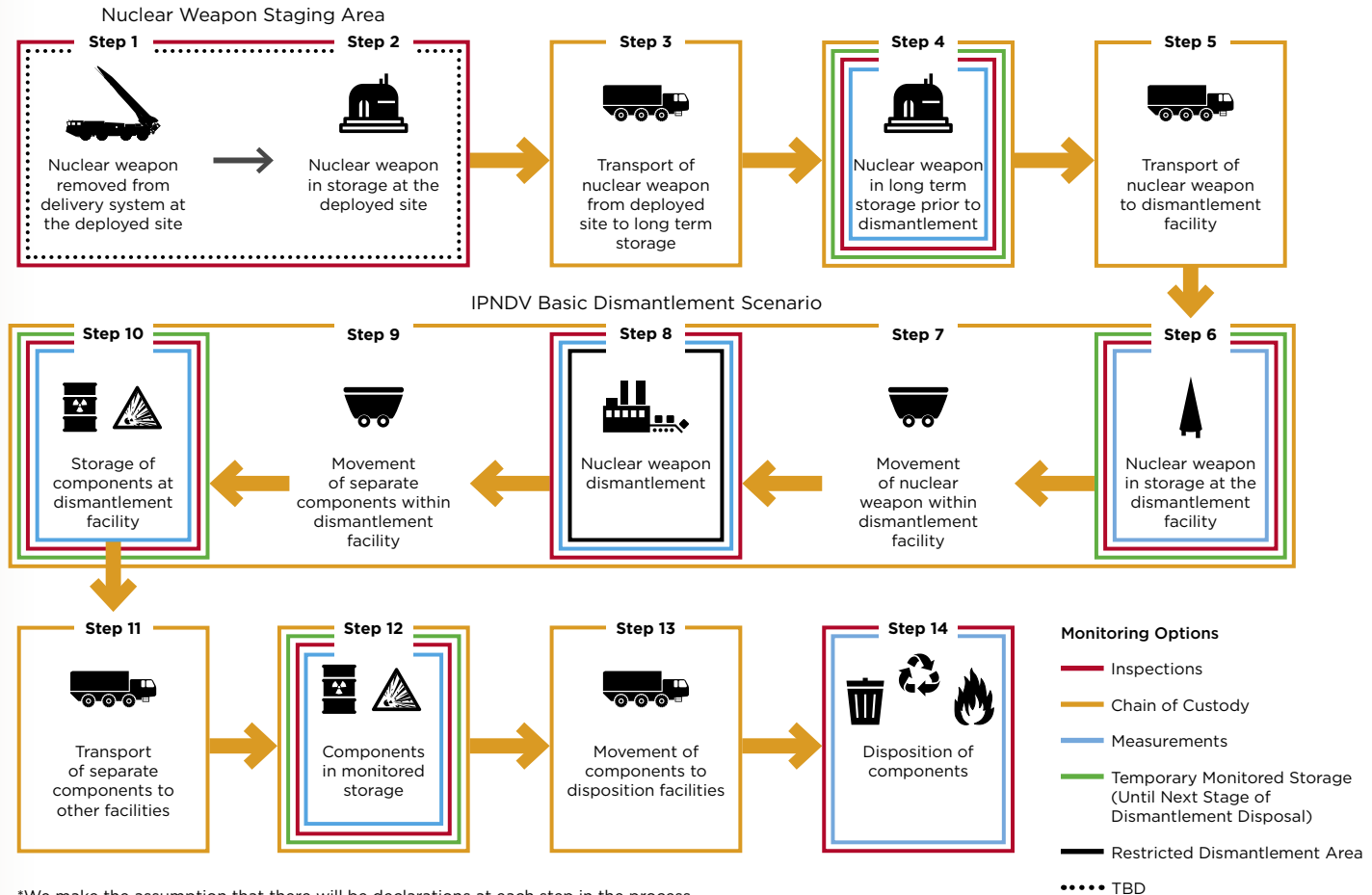


### WORKING GROUP 3: TECHNICAL CHALLENGES AND SOLUTIONS

Co-chairs:  
Sweden, United States



# THE 14 STEPS: IPNDV'S NUCLEAR WEAPONS DISMANTLEMENT LIFECYCLE



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



## KEY JUDGMENT

At the end of Phase I, the IPNDV countries together developed this concluding 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.”*



## IPNDV Phase II

### Working Groups

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#### WORKING GROUP 4: VERIFICATION OF NUCLEAR WEAPON DECLARATIONS

Co-chairs:  
Poland, United Kingdom



#### WORKING GROUP 5: VERIFICATION OF REDUCTIONS

Co-chairs:  
Australia, The Netherlands



#### WORKING GROUP 6: TECHNOLOGIES FOR VERIFICATION

Co-chairs:  
Sweden, United States



## IPNDV PHASE II (2018-2019)

# From Paper to Practice

**Having established the “what”** of IPNDV’s work in Phase I with a conceptual path forward, Partners tackled the next question in Phase II: How?

Phase II Working Groups explored in more detail the concepts, technologies, and procedures with the potential to address the verification challenges at each of the 14 Steps. As they moved from “paper to practice,” the Partners put their conceptual work to the test in a series of collaborative tabletop and hands-on practical exercises, as well as through technology demonstrations and experiments.



“

The IPNDV process is important and has been important because it gives the message that you can work together, both nuclear weapon states and non-nuclear weapon states. Showing that constructive message to other disarmament forums is very important.”

PIET DE KLERK, THE NETHERLANDS

## IPNDV IN ACTION

**Five practical exercises** and technology demonstrations emerged in Phase II, highlighting the Partnership's progress, while simultaneously allowing the Partners to more accurately gauge what work remains to be done:

### 1) Dismantlement Tabletop Exercise

At the Joint Working Group meeting in Utrecht, the Netherlands in June 2019, more than 40 experts participated in a tabletop exercise that explored the crosscutting elements within the IPNDV's 14-step dismantlement framework.

### 2) High Explosives Detection Demonstration

The Netherlands Organization for Applied Scientific Research (TNO) hosted members of the Partnership in June 2019 for demonstrations of high explosives detection methods.

### 3) Belgian Technology Experiment

In September 2019, experts at the Belgian Nuclear Research Centre in Mol, Belgium, organized a technology experiment to investigate methods for verifying the presence and/or absence of Special Nuclear Material.

### 4) NuDiVe Exercise

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 Group 5.

### 5) Muon Tomography Demonstration

Experts at the Canadian Nuclear Laboratories 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.

## A TAILORED APPROACH TO MONITORING AND VERIFICATION

**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 more pieces of the puzzle for an overall process of monitoring and verifying nuclear disarmament.

The Partners made steady progress in Phase II, advancing from “paper to practice” over the course of two years, six meetings, and five practical activities that 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.

But how do these pieces fit together? In addition to the exercises and demonstrations, Phase II explored how to characterize other monitoring and verification considerations. For instance, one key question in any future treaty would be 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. Such a declaration could take many forms.

In Phase II, Partners analyzed previous treaty verification regimes to identify key criteria for future nuclear weapon accounting approaches, as well as potential frameworks that could be applied to verify them.



“

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 | REPUBLIC OF KOREA

## PHASE III AND BEYOND

**In early 2020**, the Partnership began to expand its practical work into Phase III, with a goal of incorporating in-depth scenario-based discussions, hands-on exercises, and additional technology demonstrations. Its findings will be presented ahead of the 2025 NPT Review Conference.

With the 14 Steps as a roadmap, the IPNDV continues to explore what it will take to conduct verification at each step and beyond, while addressing new questions and challenges.

Confidence in verification is essential to future nuclear disarmament. Maintaining confidence requires that the many technical and procedural dimensions of monitoring and inspection be identified, understood, and successfully tested.

The work of the IPNDV brings us closer to meeting this challenge.

## MORE FROM THE IPNDV



### Analysis and Resources

More than 50 reports and analytical documents from the Partnership are available on the IPNDV website.



### Global Disarmament Verification Research

Research posters from academics, technical experts, and government agencies showcase the unique nuclear disarmament verification research being conducted around the world.



### In Their Own Words

Listen to what the experts say about the IPNDV as they answer frequently asked questions about the Partnership.

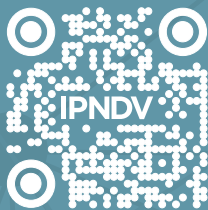




PREPARED BY



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.



[www.ipndv.org](http://www.ipndv.org)