Working Group 1 - Deliverable Three

The Skills, Areas of Expertise, and Resources Needed, and the Way Forward for Building These Capacities

Working Group 1: Monitoring and Verification Objectives

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The skills, areas of expertise, and resources needed for nuclear disarmament verification may be categorized in multiple ways, and may be different at different stages of the process. At present, it is perhaps most relevant to discuss the expertise that is required to *develop* a verification regime for nuclear disarmament, rather than the expertise required to *implement* a future treaty.

In order to develop a verification regime, there is a need for experts who are knowledgeable about the political dimensions of disarmament, non-proliferation, and arms control as well as the many technical aspects of the complex process of dismantling nuclear weapons in a safe, secure, and verifiable manner.

Capacity building for nuclear disarmament verification should be considered in a step-wise approach. Concepts and requirements for verification need to be refined. There will be a need to build a "verification culture" that will facilitate efforts to iteratively develop technologies and procedures that can be implemented in a future treaty. Centers of Excellence should be considered as a way to build the necessary capacity.

Needed Expertise

Political Expertise

Extensive experience relevant for nuclear disarmament verification can be gained from working with experts on previous and current bilateral and multilateral disarmament, non-proliferation, and arms control agreements.

Relevant knowledge in both developing and implementing a disarmament verification regime includes a broad understanding of the functioning of the multilateral machinery on disarmament, non-proliferation, and arms control. Examples include the UN General Assembly First Committee and its relevant resolutions, past outcome documents of the Conference on Disarmament, recommendations and guidelines submitted by the UN Disarmament Commission, and the principles enshrined in the Final Document of the SSOD-I of 1978.[1] In this vein, familiarity with relevant UN Group of Governmental Experts reports on verification, as well as analytical work carried out by think tanks would be useful. An understanding of the dynamics behind past bilateral arms control and disarmament agreements and their implementation is also important.

Another significant requirement is in-depth knowledge of the IAEA comprehensive safeguards agreement and the Additional Protocol. It would also be beneficial to be familiar with experiences gained from UN Security Council-mandated inspections, as well as from the IAEA's monitoring of South Africa's voluntary dismantlement of its former nuclear weapons program.

Knowledge of treaties or accords that have succeeded in setting up credible verification arrangements is essential, including knowledge of their legal character. The same goes for knowledge of arms control treaties that have not included verification arrangements, such as the Strategic Offensive Reductions Treaty of 2002 (the Treaty of Moscow) and the Biological Weapons Convention.

Even more importantly, it is vital to be familiar with the Chemical Weapons Convention (CWC) inspection regime, and experiences gained from the Strategic Arms Reduction Treaty (START) and New START, as well as on-site inspection exercises under the Intermediate-Range Nuclear Forces Treaty (INF) and the Comprehensive Nuclear-Test-Ban Treaty (CTBT), because these represent highly relevant experiences with managed access procedures for sensitive facilities.

Technical Expertise

There are no straightforward solutions to the technical challenges associated with verification of nuclear disarmament, and a broad set of skills are needed to make progress. There are technical challenges relating to the detection of nuclear weapons-related material without revealing proliferative information. There are also challenges relating to the development of technical solutions for surveillance and containment, and maintaining continuity of knowledge of items and components in a dismantlement process. Examples of technical solutions of this kind are

[1] UNGA's first Special Session on Disarmament.

information barriers (for the detection of materials without any risk of proliferation), tags and seals (also in the form of tamper-indicating enclosures), and CCTV technologies that help ensure continuity of knowledge.

However, given the obvious need to protect proliferative and otherwise sensitive information in a nuclear weapons facility, it is necessary to develop specially designed equipment that can take security restrictions into account while still remaining useful to inspectors. Because of a multitude of restrictions, the process of developing such equipment can be quite different from that of developing similar equipment under other circumstances.

The use of inspection equipment, or any other means of collecting information, will also need to be integrated into inspection procedures, and this makes simulations or exercises crucial in determining the usefulness of a certain activity. Due to the difficulties of carrying out exercises in real facilities, virtual technologies should also be considered as a tool for evaluating procedures.

The need to protect proliferative and national-security-sensitive information will limit the extent to which it will be possible to prove conclusively whether an object is a nuclear weapon or not. Therefore, the value of any individual inspection activity needs to be considered as part of a whole set of activities, which together are used to build a case for establishing whether a declared activity has taken place or not.

The technical expertise required to develop effective solutions for verifying the dismantling of nuclear weapons will therefore not only relate to specific technologies, but will also require an ability to place the individual technologies, and the information they can provide, into a broader strategy for verification.

Skills in Safety and Security

In order to develop the right technical equipment and procedures, understanding the safety and security constraint in the relevant facilities is crucial. Involvement of and engagement from nuclear weapon states (NWS) personnel is of course important in this area, but non-nuclear weapon states (NNWS) also have relevant personnel skilled in radiation safety, explosive safety, national security, military security, nuclear security, and other aspects of physical and cyber security. Any technologies and procedures must meet requirements in each of these areas in order to be potentially acceptable for use in NWS facilities. Even in NWS there would be multiple people from each of these skill sets required to design, approve, and implement verification techniques and methodologies. In developing verification solutions, involvement of those from safety, security, and military will be critical in ensuring we develop techniques and technologies that will be acceptable and effective in the verification tasks necessary. If the scientists and technical developers do not understand all of the likely constraints they are not likely to develop the right solutions.

Human Skills

Besides the mentioned political and technical expertise, additional skills are needed to conduct successfully verification activities. Future inspectors should also be trained in areas of negotiations, dispute settlement, language skills, communications, intercultural awareness, leadership, and stress resistance. Centers of Electronic Media and Staff Colleges of Armed Forces could for example offer some of these skills.

The Preparatory Commission for the Organization for the Prohibition of Chemical Weapons (PrepCom OPCW) took these human skills into account when elaborating the General Training Scheme for inspectors, which was divided into three modules. Module 1, "Basic Courses," included a lecture on interpersonal skills. The participants were meant to acquire a fundamental understanding and knowledge of interpersonal skills, including governmental, industrial, cultural, and ethnic differences; basic negotiating skills; and inspections ethics. Module 2, "Specialist Courses," focused on team communication and management and deepening the concept of building and leading a team, among other subjects. Module 3, "Inspection Training," further transmitted leadership training for prospective team leaders.

Existing Expertise

The Nuclear Threat Initiative (NTI), in collaboration with Norway, prepared a capacity mapping questionnaire and circulated it to the countries currently participating in the IPNDV. Thirteen countries plus the European Union returned their answers, providing a representative sample of the IPNDV and its diverse capabilities with respect to nuclear disarmament verification.

The responses to the questionnaire help draw a clearer picture of existing capacity, but also identify gaps, in the countries that currently form the IPNDV. Below is a mapping of the existing skills and areas applicable to key monitoring and verification activities, as well as recommendations to build further capacity in the IPNDV and its participating countries.

National Institutions Dedicated to Research and Development

The first question focused on the existence or absence of national institutions dedicated to research and development that could be used for key monitoring and verification activities associated with nuclear arms control and disarmament. Most countries that answered have one or more such institutions. They range from organizations associated with national defense to governmental nuclear laboratories and nuclear regulators, but also research centers and universities. Most of these institutions support the nuclear security and safeguards work of the IAEA and the CTBTO, and this knowledge could be applied to future disarmament verification activities.

Nuclear Material Testing Capability

The second question asked if Partners have nuclear material testing capability. Most respondents have such capability, although not all countries participating in the IPNDV can characterize and

test plutonium samples or sources, and not all countries have weapons-quality uranium or plutonium. Most participants can conduct both destructive and non-destructive assay, and available technologies for these activities include gamma-ray spectroscopy and imaging, neutron detection, dosimetry, alpha spectroscopy, microscopy and microanalysis, radiochemistry, etc. Some countries also can test nuclear material through modelling, simulation, and engineering design.

Practical Capabilities in Systems Analysis

Again, most respondents said they have practical capabilities in systems analysis pertinent to the design of verification and monitoring approaches. Most often these are associated with IAEA or EURATOM safeguards implementation and verification, although several countries have specific projects related to arms control verification. However, the responses to this third question were less detailed than other responses, and the capacity in systems analysis should be explored further.

Ready-to-Deploy Technologies

All IPNDV countries who responded to the questionnaire except one have at least some ready-to-deploy technologies to support monitoring and verification activities at different stages of the dismantlement effort, particularly at the stage of materials production and after warhead disassembly. However, there is a lack of ready-to-deploy technologies to support monitoring and verification activities associated with nuclear weapons in storage or to authenticate an item declared to be a nuclear weapon.

In addition, while most IPNDV countries have ready-to-deploy monitoring and surveillance technologies, environmental sampling techniques, and radiation measurement equipment that can be applied to at least one stage of the nuclear weapon lifecycle, there is a general gap in technologies associated with tags and seals, open source research and geospatial analysis, statistical analysis, and sample planning.

Prioritizing Activities and Coordination

Most respondents have not yet established a domestic coordination mechanism to prioritize research and to coordinate various nuclear arms control and disarmament verification efforts among ministries and departments. The establishment of a coordination and information exchange mechanism is an IAEA recommendation in most of its nuclear security guidance documents, and delineating clear roles and lines of responsibility should be encouraged for nuclear disarmament verification.

In addition, a significant number of respondent countries have not established a formal coordination mechanism with other States and international organizations on the topic of prioritizing research needed for nuclear arms control and disarmament verification, and to coordinate various nuclear arms control and disarmament verification efforts globally. We can note, however, that a number of Partnership countries have a formal Safeguards support

program to coordinate with the IAEA. Certain countries also coordinate their verification efforts bilaterally or as part of small groupings of countries, such as the UK-Norway initiative and, potentially, the IPNDV.

Existing Training Programs

Most countries in the Partnership offer technical training courses specifically designed to train current or future inspectors of the IAEA, the OPCW, or other international verification bodies or efforts. For instance, Canada trains its nationals as well as IAEA inspectors at Chalk River Laboratories, Canada's main R&D center dedicated to nuclear research, whereas Japan offers training on nuclear safeguards and security at its Integrated Support Centre for Nuclear Non-proliferation and Nuclear Security (ISCN).

Furthermore, most Partners have research centers and academic programs that can be used to further develop verification capacity within the IPNDV, but also with the broader international community. For example, Aachen University and the University of Hamburg in Germany offer technical modules on nuclear science specifically addressing nuclear Safeguards and non-proliferation.

However, outside of NWS, few IPNDV partners offer policy courses that can be used to further develop verification capacity. Australian National University has a Center for Nuclear Non-Proliferation & Disarmament in its Crawford School of Public Policy. The Carl Friedrich von Weizsäcker-Centre for Science and Peace Research at the University of Hamburg offers, in cooperation with Norway, simulation exercises of nuclear disarmament verification following the UKNI scenario. Otherwise, existing nuclear policy courses are found mostly in NWS.

In the United States, the James Martin Center for Nonproliferation Studies at the Middlebury Institute of International Studies offers several Master-level courses where students are taught about the science and technology of verification. In one of these courses, students participate in a three-month long simulation where they simulate the verification of the dismantlement of a nuclear weapon at the Institute of Energy Technology in Kjeller, Norway. Another Masers-level course teaches the physics of missiles and nuclear weapons. Other classes teach students about open-source analysis and geospatial tools for non-proliferation analysis, both gaps that have been identified in the questionnaire. In addition, the James Martin Center for Nonproliferation Studies offers several policy courses on arms control treaties, safeguards, and diplomacy that can be used to build capacity.

In the United Kingdom, in partnership with the Atomic Weapons Establishment (AWE), the Department of War Studies and Defence Studies at King's College London has developed a practically oriented Masters in Arms Control, aimed at the practitioner community, to train current and future generations of arms control experts for the particular challenges of nuclear disarmament. The goal of the program is to build expertise in the fundamentals and history of arms control, while also exposing students to the issues and challenges associated with design, implementation, and verification of arms control agreements.

In France, the University of Montpellier holds a school on international nuclear law once every summer. It covers topics such as international radiological protection standards, international safeguards, liability in the case of nuclear accidents, and the rules covering international notification in the case of a nuclear accident. The school is open to students from all over the world.

Gaps in Current Nuclear Disarmament Verification Capabilities

Based on the comments from IPNDV participating countries themselves, while many respondents have verification capabilities, both technical and institutional, related to their obligations and support for IAEA safeguards, nuclear disarmament verification remains a niche issue, particularly outside of NWS. Many IPNDV countries suggested that new cooperation projects should be established between NWS and NNWS on specific aspects of disarmament verification. One participating country suggested, for instance, that NNWS participate as observers in a START verification activity, under terms to be defined. Many participants recommended developing and conducting tabletop exercises and workshops to demonstrate capabilities. Another participating country highlighted the need for increased funding of verification research and development, and many respondents pointed specifically for the need for research related to information barriers. States should also consider the need for national coordinating authorities. If we are to develop new cooperation projects, it is vital that States have someone delegated to take a proactive lead in making these happen, as well as a point of contact whom others can approach. Such an authority must be aware of the various efforts ongoing within the State such that these can be directed in an efficient and sustainable way. Developing verification solutions will be more about using existing skills, experiences, resources, and technologies (universities, national laboratories, industry, and military) in new ways rather than having to create entirely new ones.

The Way Forward

As lower numbers of nuclear weapons are reached, a credible global nuclear disarmament verification regime will be essential. It will be vital to ensure that all States have confidence in any such regime. To build confidence and ensure that a nuclear disarmament verification regime has credibility, we need to start a process of capacity building that enables States from all regions to be involved in nuclear disarmament verification.

Based on the survey among the IPNDV participating countries, some suggestions for moving forward could be that countries should build on the institutional and technical capabilities they already have for nuclear safeguards and for national security, and expand those resources and experience to nuclear disarmament verification. In particular, cooperation mechanisms domestically and internationally should be established to further collaboration, identify R&D priorities, and share talent and technologies. It will be especially important to form partnerships

between NWS and NNWS, because the NWS have more experience and technical abilities for nuclear disarmament verification.

National coordinating authorities could be a first step to harnessing existing resources to enable capacity building. This could then enable further national, regional, or international efforts again in an efficient and sustainable way. Although it would be a significant resource effort for all countries to have individual verification programs, it would only take a few countries to group together and provide one or two individuals (each with a different skill set) to be based (physically or virtually) at an existing university/national laboratory or other establishment to form a highly effective verification research and development group. Having a few such groups that could interact and build on the work of each other would enable a step change in current global verification efforts.

More efforts could also be made to establish nuclear disarmament and verification policy training courses. As highlighted earlier, much relevant expertise and experience is already available in the areas of disarmament, non-proliferation, and arms control agreements.

In determining the design of a future global nuclear disarmament verification regime, it will be important to draw on the lessons learned from verification of other arms control and disarmament treaties and arrangements as well as how relevant expertise in existing international organizations such as the IAEA, OPCW, and the CTBTO can be used most effectively.

If we look to the CTBT, the Group of Scientific Experts (GSE) of the Conference on Disarmament worked for almost 20 years on the specifics of a verification regime before a window of opportunity to negotiate a treaty opened in 1993. The GSE built a culture of international technical cooperation that led to mutual confidence in the verification solutions developed and tested by the group. The result was a substantial contribution to a credible comprehensive nuclear-test-ban treaty. A nuclear disarmament verification regime would probably need to go through a similar process, establishing what we are calling a **verification culture** among participating states. “Culture” here should be understood in a similar sense to the way it is used in the expression “nuclear safety/security culture.”

The IPNDV—both through the activities already being carried out in line with the agreed Terms of Reference, and as a platform for exchanging information and views on other research and development supporting the verification of disarmament—represents a crucial forum for building a common culture of this kind. It can contribute to developing a common understanding of the needs, requirements, opportunities, and restrictions of nuclear disarmament verification.

About IPNDV: The International Partnership for Nuclear Disarmament Verification

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. Learn more at www.ipndv.org.

About Working Group 1: Monitoring and Verification Objectives

Throughout Phase I, the IPNDV Monitoring and Verification Objectives Working Group has examined key objectives for monitoring and verifying the dismantlement of a nuclear weapon, including the information, skills and expertise needed to support this process. This group is co-chaired by The Netherlands and the United Kingdom.