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Verifying nuclear arms control and disarmament: United Kingdom perspective and research

Working paper submitted by the United Kingdom of Great Britain and Northern Ireland

Why is verification important?

1. Effective verification is vital to the success of arms control and disarmament agreements. We cannot achieve enduring, global and complete nuclear disarmament without an effective verification regime, as both nuclear-weapon States and non-nuclear-weapon States must have confidence that others are upholding their treaty obligations. Crucially, confidence must be gained without sharing sensitive or classified information, including proliferative nuclear weapon design information.

2. The principle of verifiability is relevant at all stages of the step-by-step nuclear disarmament process and for both bilateral and multilateral treaties. Current and past treaties covering nuclear capabilities have largely focused on verifying delivery vehicles over more sensitive warhead verification. To advance nuclear disarmament beyond the existing model, various challenges to warhead and fissile material verification need to be overcome. We do not have to wait to understand the exact treaty or agreement that may occur to develop options to address this issue. It is a problem that the international community can and should work to solve now, ensuring that a key enabler is available for future treaties when called upon, while also building trust and dialogue between States.

The verification programme of the United Kingdom

3. The United Kingdom has researched nuclear arms control and disarmament verification for over 20 years, principally through the technical research programme at the Atomic Weapons Establishment. The Establishment is the arms-length body owned by the Ministry of Defence and responsible for developing and producing warheads for the nuclear deterrent of the United Kingdom. It also uses its unique expertise to support nuclear threat reduction. Over the years, this has allowed for the development of a cadre of verification subject matter experts at the Establishment who are also able to reach back into the wider skills and experience of other Establishment teams. This work is overseen by the Ministry of Defence, with support from the Foreign, Commonwealth and Development Office.



4. The programme of the United Kingdom has two main aims:

(a) To understand how to facilitate a verification regime in the United Kingdom while protecting sensitive and proliferative information;

(b) To understand how to design a verification regime in another State that provides sufficient confidence that treaty obligations are being upheld.

5. These aims reflect the dual roles that nuclear-weapon States will need to play in future verification regimes as both host and inspector. As host, we must ensure that we can continue to uphold our Non-Proliferation Treaty obligations and protect national security during inspections at sites in the United Kingdom. As inspector, we must ensure that other States continue to uphold their obligations to prevent the disarmament process from being undermined. Furthering our understanding of verification also ensures that the United Kingdom is prepared to participate effectively in future treaty negotiations.

6. The programme of the United Kingdom is designed to address all stages of the step-by-step disarmament process, from nuclear arms control agreements to a fissile material cut-off treaty to complete nuclear disarmament. To accomplish this, the Establishment programme is currently divided into five research areas:

(a) Inventory verification;

(b) Containment and surveillance;

(c) Equipment integrity;

(d) Facility and process verification;

(e) Verification theory and modelling.

7. These areas cover cross-cutting principles and technologies applicable to multiple treaties and scenarios, but individual arms control and disarmament scenarios are also investigated as necessary.

8. The United Kingdom undertakes research both nationally and internationally to achieve its programme's aims. National research is often the most effective route when exploring how verification would function at United Kingdom sites. In the recent past, we have undertaken research on signatures of nuclear material and explosives that can be measured without revealing sensitive information, as well as the detectors required to measure those signatures. We have also investigated trust in sensors and how to design equipment in which both parties have confidence. This is important because confidence in the tools of verification will translate into confidence in compliance by all observers.

International collaboration

9. Other topics in the five research areas listed above are instead fulfilled in collaboration with other States bilaterally and multilaterally. The past seven years have seen the creation of multiple new international initiatives which we believe serve specific and complementary functions. For the United Kingdom, these initiatives help us to achieve specific technical programme goals while also building capacity, dialogue and trust among the wider international community on disarmament issues.

10. The United Kingdom-United States bilateral technical cooperation has been our longest-running partnership, beginning in 2000 and covering a wide range of topics including managed access to facilities, joint measurement campaigns and portal

monitoring for arms control.¹ The partnership has been particularly useful for investigating some of the most sensitive verification issues, including research and tests on actual warheads and components. The ability to exchange classified nuclear weapons information in accordance with the terms of the Mutual Defence Agreement of 1958 allows this to be done in a secure environment, where technologies and methods designed to protect classified or sensitive information can be tested without risk of proliferation or unauthorized disclosure.

11. The United Kingdom also participates in the Quad Nuclear Verification Partnership alongside Sweden, Norway and the United States.² Formed in 2015, this unique partnership brings together experts from each country to research specific verification challenges in a focused manner.³ It builds on previous work by the United Kingdom-Norway Initiative, the first verification research partnership between a nuclear-weapon State and a non-nuclear-weapon State. The Partnership is an integral part of the overall research programme of the United Kingdom. However, beyond this, the Partnership has also allowed the involvement of non-nuclear-weapon States in nuclear arms control and disarmament verification to be explored in greater depth than before, particularly through practical activity such as the exercise LETTERPRESS.

12. Beyond the Quad Nuclear Verification Partnership, we also have a valuable bilateral United Kingdom-Sweden research partnership that forms a core part of the research programme of the Atomic Weapons Establishment. To date, it has investigated two specific aspects of verification: high explosives detection and dismantlement facility design requirements.

13. The International Partnership for Nuclear Disarmament Verification⁴ is another initiative in which the United Kingdom has played an active role since its creation in 2014. With over 25 participating States, we believe that the Partnership has been invaluable in bringing together a wider group of States to consider verification challenges and solutions and beginning to build international capacity. A particular strength of the group is the diverse set of participants, which include government officials, national technical experts and academics. This has helped the Partnership to become an important forum and hub for other initiatives and projects to brief the wider community. As part of its current phase III, the Partnership is applying its work to date to a specific case study of a fictional nuclear-weapon-possessing State, allowing specific policy, procedural and technical solutions to be explored in greater depth.

14. More recently, the United Kingdom has also taken part in the Group of Governmental Experts process of the United Nations to consider the role of verification in advancing nuclear disarmament. We were an active participant in the 2018–2019 Group and look forward to participating in the new Group due to commence in 2022. This process is an important opportunity to work towards recognizing the vital role of verification in nuclear disarmament via the United Nations system, enabling it to promote and support further international research.

Future research

15. Within the national programme of the United Kingdom, we will continue to develop verification approaches that can be applied to the country's defence nuclear

¹ United States of America, Office of Nonproliferation and Arms Control of the United States Department of Energy, *Joint US-UK Report on Technical Cooperation for Arms Control, 2015* (Washington, D.C.).

² See <https://quad-nvp.info/>.

³ The working paper of the Quad Nuclear Verification Partnership will be submitted to the 2022 Review Conference by Norway, Sweden, the United Kingdom and the United States of America.

⁴ See <https://www.ipndv.org/>.

enterprise. In addition to progressing the five core research areas of the Atomic Weapons Establishment outlined above, the programme will build an increased understanding of the infrastructure and processes at all United Kingdom defence sites relevant to future verification regimes. This will enable us to gain a greater understanding of the challenges and impacts of such regimes.

16. Internationally, the United Kingdom is encouraged by the new multilateral nuclear verification initiatives that have emerged since 2014. These initiatives begin to build global expertise and capacity in this specialist field while generating dialogue between States on disarmament issues. They also demonstrate that joint research between nuclear-weapon States and non-nuclear-weapon States is possible while upholding Non-Proliferation Treaty obligations. From a United Kingdom perspective, they help us to deliver important elements of our national research programme. The continued development of these initiatives will be crucial for enabling the practical implementation of disarmament in the future. The United Kingdom will continue to play a full role in all of them.

17. The United Kingdom encourages other States that have yet to get involved in nuclear disarmament verification to reach out to international initiatives such as the International Partnership for Nuclear Disarmament Verification. Nuclear disarmament will impact the security of all States so, in the years ahead, we believe that it is important to build global capacity in a manner that is geographically diverse and includes many different perspectives. We believe that it is particularly important for all nuclear-weapon possessor States to establish government programmes dedicated to nuclear disarmament verification research as well as to support such research internationally. Achieving a world without nuclear weapons will require a verification regime in place on the territory of all possessor States, so it is important that all possessor States understand how this could be facilitated while accounting for national sensitivities.

18. However, the interdisciplinary nature of verification means that research does not need to be confined to those States that have established civil or military nuclear programmes. Expertise from a wide range of technical disciplines will be important for developing effective verification regimes in the future, including explosive detection, material science, physics measurements, unique identification, tamper-indicating materials, computer science, change detection in data including digital photography, software authentication, information theory and system confidence. These skills can be found in both nuclear-weapon States and non-nuclear-weapon States.

19. This demonstrates that all States have a valuable role to play in developing the verification tools and procedures vital for complete and lasting nuclear disarmament. We encourage all States to examine how they can best contribute to this important task with the support of existing international initiatives.