9 April 2019

English only

Group of Governmental Experts to consider the role of verification in advancing nuclear disarmament
First session
Geneva, 14-18 May 2018
Agenda item 5
Consideration of the role of verification in advancing nuclear disarmament, taking into account the report of the Secretary-General on the development and strengthening of practical and effective nuclear disarmament verification measures and on the importance of such measures in achieving and maintaining a world without nuclear weapons

Considerations on the role of verification in advancing nuclear disarmament: background paper

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I. Introduction

1. The objective of this background paper is to first provide an analytical overview of the most significant milestones in advancing nuclear disarmament verification. This legacy is significant because many of the issues raised in those early years persist today and will also have to be addressed in the future. It then continues to analyse past and present verification initiatives, techniques and agreements with regards to nuclear disarmament for the upcoming first session of the Group of Governmental Experts (GGE) in Geneva in May 2018. It explores different propositions made over the years by nuclear weapon States (NWS) and non-nuclear weapon States (NNWS) and aims to outline possible starting points and lessons learnt for future negotiations. As was mentioned many times before, the GGE does not start discussions on a blank sheet of paper, instead, it should make best use of and learn from already existing processes and technical knowledge where applicable. It is important to understand how these processes and this know-how contribute to verification ensuring that the GGE does not duplicate previous efforts. This will be reflected under the section pertaining to the analysis of various initiatives and agreements. Nevertheless, it is also important to keep in mind that the work already done in the nuclear disarmament community and as part of non-nuclear agreements should inspire the GGE and outcomes should balance the realistic and ambitious. The paper will proceed with an examination of the existing verification principles in the light of the changed international political, legal and security environment. Moreover, the different propositions made by States with regards to the scope of a verification mechanism will be demonstrated. These proposals will be examined in light of their feasibility and their political, financial and technical implications on the verification toolbox and verification authority. Finally, it will be shown that a multilateral verification entity would be more inclusive than current partnerships and provide added value for the purpose of building global capacity and trust.

A. General Remarks

2. Verification is commonly understood as a process that is built into an arms control treaty to enable inspections or other means of assuring other parties that treaty obligations are being implemented to ensure compliance with the provisions of the treaty and also enable enforcement if possible. In the nuclear disarmament realm, verification can additionally serve as an important confidence-building measure which seeks to reduce misperceptions and misunderstandings, as a first step towards replacing suspicion with confidence, by enabling the parties to be more transparent. Thereby, verification in nuclear disarmament processes instils trust among nuclear weapon States (NWS) and among NWS and non-nuclear weapon States (NNWS) that they comply with the treaty provisions.

3. Today, nuclear disarmament is seen as a reduction process of weapon-related items such as nuclear warheads, fissile material, delivery systems or production and storage facilities leading to the realization of the ultimate goal of a world without nuclear weapons and measures contributing hereto. This process can be unilateral, bilateral (as within the START-process) or multilateral. Core principles such as verifiability, transparency and irreversibility are key for future disarmament regimes as well as effectiveness, completeness, correctness, enforcement, safety / security and non-proliferation. Esp. the dismantlement or destruction process of a nuclear warhead between NWS and NNWS raise important challenges in the NPT context. The balance is here to provide enough information regarding the identification of a nuclear warhead on one side without providing proliferation-sensitive information to the Inspecting party in violation of the Article I of the NPT on the other side.

4. As the number of nuclear weapons decreases during the disarmament process, the strategic value of a single nuclear warhead will increase, as will the level of assurance required for verification on disarmament treaties. Confidence-building measures for reducing uncertainties and concerns of other states and reliable and effective verification methods will thus become increasingly important. In addition, in order to realise the goal of a world without nuclear weapons, a robust and reliable international verification system with involvement of NWS and NNWS will need to be established. While verification is not an aim in itself, work on developing and strengthening verification measures including new protocols and verification technologies will be a necessary part on the path towards a world free of nuclear weapons. The verification objectives will change during the different phases of the global disarmament process. Verification of reducing nuclear arsenals is different from the verification of reaching a world totally free from nuclear weapons. Even the last phase, the verification of maintaining global zero will in clued different verification objectives. The assurances that verification can provide will be vital in establishing confidence that all States are maintaining their obligations under future disarmament agreements. Without such verification, States will not be able to be fully assured of their security, and the incentive to proliferate and develop nuclear weapons again may be present.

5. The next step in the disarmament process is establishing and handling the multilateral warhead dismantlement and the verification of fissile material permanently removed from military programmes. Key challenges across the full nuclear life cycle in terms of methods, protocols and technologies remain. A verification regime in this context would need to be effective and credible, while respecting the requirement to maintain confidentiality with regard to sensitive weapons design and composition given the obligations under articles I and II of the Non-Proliferation Treaty (NPT).[1]

B. Historical milestones in verification to advance nuclear disarmament

6. The concept and purpose of verification has gradually but steadily evolved over the nuclear era. The first resolution adopted by the General Assembly on 24 January 1946 not only addressed the goal of eliminating nuclear weapons and other weapons “adaptable to mass destruction”, but it also called for specific proposals “for effective safeguards by way

[1] Nuclear Weapons Non-Proliferation Treaty (NPT) of 5 March 1970.

of inspection and other means to protect complying States against the hazards of violations and evasions."[2]

7. Further important steps on the way to establishing a full-fledged concept on verification, its methods, purpose and institutional framework were marked by the 1946, "Acheson-Lilienthal Report"[3] and the Bernard Baruchspeech 1946, both calling for the establishment of an international authority to control the nuclear fuel cycle.

8. After the early demise of both plans, the United Nations General Assembly Resolution (UNGA Res) 1378 (XIV) of 20 November 1959 explicitly stated for the first time that "general and complete disarmament under effective international control" was the aim of the United Nations disarmament efforts.

9. In 1961, the importance of verification of disarmament measures was further reiterated in the Joint Statement of Agreed Principles for Disarmament Negotiations (McCloy-Zorin Accords)[4], which was submitted by the Soviet Socialist Republics and the United States of America (USA) to the UNGA.

10. The next important milestone was the entry into force of the first major multilateral arms control agreement, the Nuclear Weapons Non-Proliferation Treaty (NPT) on 5 March 1970 which contained as a main objective "to prevent nuclear energy being diverted from peaceful uses to nuclear weapons or other nuclear devices." Verifying that states party to the NPT fulfil their obligations is entrusted to the International Atomic Energy Agency (IAEA), under the "safeguards agreements". The principal method used is comprehensive material accountancy, complemented by surveillance and control techniques.

11. In 1978, the UNGA, in its first special session devoted to disarmament outlined several broad principles on which verification provisions should be based in order to serve their intended purposes and gain general support of the parties to the agreement.[5] This subsequently lead to a new resolution in 1985, entitled "verification in all its aspects".[6] The resolution requested the Secretary-General to prepare a report to the UNGA at its 41st session containing the views and suggestions of Member States on verification principles, procedures and techniques for prompting the inclusion of adequate verification in arms limitations and disarmament agreements and on the role of the UN therein.[7] The following UNGA Resolutions, 41/86 Q[8] and 42/42 F[9], requested the Disarmament Commission to consider the issue of verification in all its aspects. The latter resolution was particularly significant, as it established for the first time the subject of "verification in all its aspects" as an independent item in the provisional agenda of the 43rd session of the UNGA.

12. In 1988, the Disarmament Commission reached agreement on a text containing a set of 16 principles of verification, a section on provisions and techniques of verification, and views on the role of the UN and its Member States in the field of verification.[10] On 7 December 1988, the UNGA adopted resolution 43/81 B[11], which requested the Secretary-General to undertake, with the assistance of a group of qualified governmental experts, an in-depth study of the role of the UN in the field of verification that would: a) identify and review existing activities of the UN in the field of verification of arms limitation and disarmament;

[2] UNGA, A/RES/1 (I) (24 January 1946) Establishment of a Commission to Deal with the Problem Raised by the Discovery of Atomic Energy.

[3] The Acheson-Lilienthal Report on the International Control of Atomic Energy Washington, DC, 16 March 1946 <http://fissilematerials.org/library/ach46.pdf>.

[4] http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/arms-control-disarmament/mccloy-zorin-accords_1961-09-20.htm.

[5] UNGA Resolution S-10/2.

[6] UNGA Resolution 40/152 O of 16 December 1985.

[7] The report was issued in 1986 as a document of the UNGA (A/41/422 and Add. 1 and 2).

[8] UNGA Res 41/86 Q of 4 December 1986.

[9] UNGA Res 42/42 F of 30 November 1987.

[10] UNITED NATIONS DISARMAMENT COMMISSION PRINCIPLES OF VERIFICATION (1988), available at <http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/arms-control-disarmament/verification/pdf-art2097.pdf>.

[11] UNGA Res 43/81 B of 7 December 1988.

b) assess the need for improvements in existing activities, as well as explore and identify possible additional activities, taking into account organisational, technical, operational, legal and financial aspects; and c) provide specific recommendations for future action by the UN in this context.[12]

13. The study had been conceived in 1988 when the effects of the Cold War were still very tangible. As political conditions changed dramatically, and the UN was entrusted with a wider range of activities in the fields of disarmament, confidence-building and conflict management, in 1995, the Secretary-General, in Report UNSG A/50/377 reviewed the conclusions of the 1990 study.

14. In 1997 the IAEA member states adopted new safeguards arrangements in the Model Additional Safeguards Protocol (INFCIRC/540) to strengthen the effectiveness and improve the efficiency of the safeguards system.[13] The NWS made a commitment to increase transparency in excess fissile material at the 2000 NPT Review Conference: "We are committed to placing as soon as practicable fissile materials designated by each of us as no longer required for defence purposes under the International Atomic Energy Agency (IAEA) or other relevant international verification."[14] In 2004, the UNGA requested the Secretary-General to set up a panel of experts to explore once again the question of verification in all its aspects.[15] In 2007, the Panel of Government Experts on verification in all its aspects, including the role of the United Nations in the field of verification in its report, examined what had changed in 10 years and discerned new trends and developments. The experts examined the purpose of verification; its conceptual evolution; developing methods, procedures and technologies; and verification and compliance mechanisms. The Panel offered 21 generic recommendations for active consideration by Member States, treaty bodies or the United Nations.[16]

15. In 2010, the NPT Review Conference reiterated the commitment to nuclear disarmament and the "total elimination of nuclear weapons", applying "the principles of irreversibility, verifiability and transparency in relation to the implementation of their treaty obligations."[17] In 2016, the General Assembly again called upon all States to work together to identify and develop practical and effective disarmament verification measures facilitating the objective of achieving and maintaining a world without nuclear weapons.[18] Pursuant to resolution 71/67, the Secretary-General published an overview of replies from several governments on 8 August 2017.[19]

[12] UNGA A/45/372 of 28 August 1990.

[13] IAEA, Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, INFCIRC/540, September 1997, and subsequent corrections, available at <https://www.iaea.org/publications/documents/infcircs/model-protocol-additional-agreements-between-states-and-international-atomic-energy-agency-application-safeguards >.

[14] Letter dated 1 May 2000 from the representatives of France, the People's Republic of China, the Russian Federation, the United Kingdom of Great Britain and Northern Ireland and the United States of America addressed to the President of the 2000 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/Conf.2000/21, available at <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N00/411/96/PDF/N0041196.pdf?OpenElement>.

[15] UNGA Res A/RES/59/60 of 3 December 2004.

[16] UNSG A/61/1028 of 15 August 2007.

[17] Final Document of the 2010 Review Conference of the parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/ CONF.2010/50, 18 June 2010, available at <http://www.un.org/en/conf/npt/2010/>; Preparatory Committee for the 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Multilateral nuclear disarmament verification: applying the principles of irreversibility, verifiability and transparency, Working paper submitted by South Africa on behalf of Brazil, Egypt, Ireland, Mexico, New Zealand and Sweden as members of the New Agenda Coalition, NPT/CONF.2015/PC.I/WP.30, 26 April 2012, available at <http://undocs.org/NPT/CONF.2015/PC.I/WP.30>.

[18] UNGA Res 71/67 of 14 December 2016.

[19] UNGA Report of the Secretary General A/72/304 of 8 August 2017.

II. Building on existing experiences

A. Recent proposals, international meetings and other initiatives on disarmament verification

16. In the context of nuclear disarmament verification there have been various formats of government-to-government arrangements and interaction so far. Questions arise as to their sustainability, coherence and inclusivity (or lack thereof). In order to overcome these shortcomings, the process to develop methodologies that enhance transparency and trust needs to be perceived as problem oriented, effective, legitimate and internationally "owned". Article VI of the NPT calls on all States to take measures towards nuclear disarmament. It implies that taking practical steps towards nuclear disarmament is a shared responsibility, and not one that falls on the NWS alone. For this, the international community is in need of a coordinated and comprehensive approach that is assured of long-term commitment (funding and other resources) and includes all relevant stakeholders. There is currently no umbrella forum to share the results of the different initiatives and research activities nor a place to comprehensively identify gaps in the current body of knowledge or to initially assess which verification solutions may be politically acceptable for NWS and NNWS. In this context it would be important to explore past and on-going initiatives to be captured, preserved and shared. The following section aims to give an overview of recent constructive proposals and valuable initiatives dealing with nuclear disarmament verification. They will be further analysed in the following Chapters 3 and 5, when discussing verification principles, verification methods and technologies and their role in balancing intrusiveness of safeguards with the desire to protect secret information.

1. Trilateral Initiative

17. In September 1996, the Russian Federation, the United States and the IAEA began the Trilateral Initiative in order to examine technical, legal and financial issues associated with IAEA verification of "weapon-origin fissile material deemed excess to military needs."[20] The Initiative also oversaw the development of a verification system under which Russia and the United States could submit classified forms of weapons-origin fissile material to IAEA verification and monitoring without exposing secrets. The objective of the Trilateral Initiative was to create assurances that steps taken in conjunction with the reduction of nuclear arsenals are irreversible.[21] Some of the results of the trilateral initiative have been taken over in consecutive bilateral arms control agreements. Although the completion and implementation of the Trilateral Initiative was one of the 13 agreed practical steps in the 2000 NPT Review Conference's consensus final outcome document[22], the full objectives of the Initiative were not realised as it was suspended in 2002. (See for details also 5.3.2 and 6.1.1)

2. United Kingdom-United States Technical Cooperation Programme

18. Since 2000, the USA and UK have collaborated on technologies and methodologies to enable monitoring and verification of potential nuclear weapons arms control negotiations. They reported in 2015 that this technical collaboration had yielded a number of lessons learned. These involved for example the ability to strike a balance between information

[20] Thomas E. Shea and Laura Rockwood, "IAEA Verification of Fissile Material in Support of Nuclear Disarmament", (Harvard Kennedy Center, Belfer Center), May 2015, available at <http://www.belfercenter.org/sites/default/files/legacy/files/iaeaverification.pdf>.

[21] IAEA, "IAEA verification of weapon-origin fissile material in the Russian Federation and the United States", IAEA General Conference, Press Release PR 99/10, 27 September 1999, available at < http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/30/045/30045328.pdf>; Thomas E. Shea, "Verification of weapon-origin fissile material in the Russian Federation and the United States", IAEA Bulletin, vol. 41, no. 4 (1999), p. 36, available at <https://www.iaea.org/sites/default/files/41403553639.pdf

[22] See step 8 of the 13 "practical steps for the systematic and progressive efforts to implement article VI" of the NPT, in Final Document of the 2000 Review Conference of the parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2000/28, 24 May 2000, available at < https://www.un.org/disarmament/wmd/nuclear/npt2000/official-documents/>.

protection and information sufficiency, which is seen as key to an effective monitoring and verification regime. Overall, the results of the technical collaboration between the UK and the US suggest that future engagement between NWS and NNWS for the purpose of nuclear weapons arms control verification, while exceptionally challenging, is nevertheless desirable and feasible.

3. UK-Norway Initiative (UKNI)

19. This initiative began in 2007 with a technical focus. It aimed at bringing nuclear and non-nuclear States together to explore what verification tools and methods would be required to develop ways to dismantle warheads without compromising nuclear weapon design information. It ran practical exercises and covered technical topics such as managed access, information barriers and confidence in verification processes.[23] The verification exercises also gained empirical data on the development of trust and confidence between inspectors and host personnel. This initiative is remarkable because for the first time, it was explored whether a NNWS could be assured that a warhead has been destroyed without compromising sensitive information. (See more details 3.3; 5.2.4.)

4. Quad Nuclear Verification Partnership (QNVP)

20. The UKNI has transformed into what is known as the Quad Nuclear Verification Partnership (QNVP), with the USA and Sweden also participating. It is aimed at testing and monitoring technologies by conducting highly realistic arms control simulations.[24] The in-field simulations focused on nuclear warhead activities that occurs between the removal of a nuclear warhead at a deployment site to the transport to a dismantlement site.[25] The QNVP is aimed at advancing practical work towards disarmament verification, in view of reducing the stockpiles of nuclear weapons States in a plurilateral setting as well as capacity-building. It entails a realistic testbed for exercising and evaluating monitoring technologies that all States could use to support their work on verification issues and a model verification protocol or standard operating procedure that could contribute to future discussions on how treaty monitoring activities could be implemented in the real world. The reporting of the QNVP is tailored to meet the requirements of the IPNDV.

5. Trilateral German-Russian-US Deep Cuts Commission

21. The on-going trilateral German-Russian-US Deep Cuts Commission, as a Track II initiative established in 2013, seeks to devise concepts on how to overcome current challenges to deeper nuclear reductions by establishing lower and verifiable nuclear weapons ceilings. The Commission strives to translate already existing political commitments to further nuclear reductions into concrete and feasible action. The framework offers independent experts from the three countries the opportunity to analyse a cross-section of interests that are key to arms control and disarmament, including verification lessons learnt from strategic arms reductions such as the N-START-process and the INF-Treaty.[26] Although the main focus of the Commission is not nuclear verification, practical proposals for nuclear arms control have been published in three subsequent reports, numerous working and briefing papers which include verification issues of disarmament.[27] The verification considered in this commission focuses on carriers.

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[23] United Kingdom-Norway Initiative (UKNI), available at <https://www.ukni.info>.

[24] Statement delivered on behalf of the Quad promoting exercise to the 2017 Preparatory Committee for the 2020 Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons, (Vienna 2-12 May 2017), available at <https://papersmart.unmeetings.org/media2/14684342/uk-on-behalf-of-the-quad.pdf>.

[25] Statement by Sweden delivered on behalf of QUAD, 2018 Preparatory Committee for the 2020 Review Conference of the Treaty on Non-Proliferation of Nuclear Weapons, Geneva, available at <http://reachingcriticalwill.org/images/documents/Disarmament-fora/npt/prepcom18/statements/25April_QUAD.pdf>

[26] The Deep Cuts Commission, “Challenges to Deep Cuts”, available at <http://deepcuts.org/purpose>.

[27] Edward M. Ifft, (2014): Verification Lessons learnt from Strategic Arms Reductions. Deep Cuts Working Paper No. 2, Hamburg: Institut für Friedensforschung und Sicherheitspolitik;

6. International Partnership for Nuclear Disarmament Verification (IPNDV)

22. The IPNDV was launched by the US Department of State in partnership with the Nuclear Threat Initiative (NTI) in December 2014 and has brought together more than 25 nuclear weapon and non-nuclear weapon States. [28] Initial membership of the IPNDV consisted largely of States that have expressed an interest in verification and were able and willing to provide technical expertise. The Partnership formed three working groups to assess approaches to monitor and verify various stages of the entire nuclear weaponisation lifecycle.[29] Germany supports the International Partnership with three external technical experts and hosted one of its working Group meetings in March 2017 and is planning a joint practical verification exercise in 2018/2019.

23. Phase I of its work addressed the most important, complex, and challenging topic related to future arms control reductions: monitoring and verifying the physical dismantlement of a nuclear weapon, which is just one element of a broader disarmament process.[30] IPNDV concluded that 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.

24. The Phase II working groups will focus on verification of nuclear weapons declarations, verification of reductions, and technologies for verification. During the course of the second phase, the Partnership will facilitate interaction with the UN GGE on Nuclear Disarmament Verification and will ensure that outputs from this Phase are finalised and can be shared at the 2020 Nuclear Non-Proliferation Treaty Review Conference (NPT RevCon). However, the IPNDV can only be seen as a facilitator and provider of ideas to the GGE as it has a limited membership and suffers from the withdrawal of Russia and China at the end of 2017. Nevertheless, it provides a lot of useful information on the state of the art and will probably be very useful to the GGE.

B. Lessons learnt from arms control and reduction instruments (nuclear and non-nuclear)

25. Verification regimes have often been developed as an integral part of arms control treaties, as part of the overall negotiations. A political agreement has often preceded the development of verification methods and technologies, as being the case for the START treaties and the INF Treaty. There are, however, examples where the technical solutions have preceded and paved the way for a treaty. Technical solutions have in these instances helped to create necessary confidence and helped parties to agree politically, such as during the CTBT negotiations. This section aims to provide an overview of various nuclear and non-

<http://www.deepcuts.org/images/PDF/DeepCuts_WP2_Ifft.pdf>; Thomas E. Shea./ Laura Rockwood (2015): Nuclear Disarmament: The Legacy of the Trilateral Initiative. Deep Cuts Working Paper No.4, Hamburg: Institut für Friedensforschung und Sicherheitspolitik <http://www.deepcuts.org/images/PDF/DeepCuts_WP4_Shea_Rockwood_UK.pdf>

[28] Australia, Belgium, Brazil, Canada, Chile, China (only Phase I), Finland, France, Germany, Hungary (from Phase II), Italy, Japan, Jordan, Kazakhstan, Mexico, Netherlands, Nigeria (from Phase II), Norway, Pakistan (from Phase II), Poland, Russian Federation (only Phase I), Republic of Korea, Sweden, Switzerland, Turkey, United Arab Emirates, United Kingdom, United States, the Holy See, and the European Union.

[29] www.ipndv.org

[30] IPNDV, "Phase I Summary Report: Creating the Verification Building Blocks for Future Nuclear Disarmament", November 2017, available at <https://www.ipndv.org/wp-content/uploads/2017/12/IPNDV-Phase-I-Summary-Report_Final.pdf>; Statement by Sweden delivered on behalf of QUAD, 2018 Preparatory Committee for the 2020 Review Conference of the Treaty on Non-Proliferation of Nuclear Weapons, Geneva, available at <http://reachingcriticalwill.org/images/documents/Disarmament-fora/npt/prepcom18/statements/25April_QUAD.pdf>.

nuclear treaties' verification mechanisms. While there are many other relevant treaties and instruments[31] that also contain important verification methods, the analysis will focus on a few that could provide the GGE with significant lessons learnt about data exchange, procedures, inspection protocols or applied technologies. These examples relate to the disarmament or arms control of nuclear weapons within frameworks of different scope (INF,Start, New Start, NPT, CTBT, JCPoA, FMCT), as well as other weapons of mass destruction (CWC, NWFZs, CFE).

1. Intermediate-Range Nuclear Forces Treaty (INF), START, New START

26. The 1987 INF and the 1991 START Treaty can provide an important precedence for verification mechanisms, which have led to the development of verification and monitoring instruments, although only for the parties involved.[32] The INF treaty includes an elaborate system for verifying compliance, involving five different types of on-site inspections, regular exchanges of information, and other cooperative measures. Monitoring was left to national technical means such as satellite photography. Between its operation period 1988-2001, the parties conducted 851 inspections. The INF-Treaty eliminated an entire category of nuclear-equipped delivery vehicles in the arsenals of the Soviet Union and the United States. Nearly 2,700 ballistic and cruise missiles with ranges between 500 km and 5500 km were destroyed. The treaty also established various verification and monitoring measures, which provide precedents for provisions in the 1991 Strategic Arms Reduction Treaty (START) — the first arms control agreement to require reductions in strategic nuclear arms. From the standpoint of today's nuclear verification requirements, however, the INF Treaty and subsequently the START-process was limited in that it did not address the direct dismantlement, destruction and disposition of the warheads of those missiles.

27. The bilateral 2010 New Strategic Arms Reduction Treaty (New START) between the United States and Russia entered into force on February 5, 2011. It constrains each side to no more than 1,550 deployed strategic warheads, no more than 800 deployed and non-deployed launchers for ICBMs and SLBMs plus deployed and non-deployed nuclear-capable bombers. The Treaty took full effect on February 5, 2018 and expires in 2021. New START provides a variety of verification and transparency measures. The most important objective is to establish a baseline of data which includes the number and locations as well as technical characteristics of the treaty accountable items or photographs of the operation basis. The sides exchange detailed data regarding their strategic offensive forces every six months. They exchange notifications — at a rate of about 2,000 per year — regarding certain changes to their strategic forces. Each side is permitted to carry out 18 inspections per treaty year of the other side's strategic forces.[33] New-START includes two types of inspections: (1) at the operating bases of ICBM, ballistic missile submarines and nuclear capable heavy bombers and (2) at the conversion and elimination facilities. New Start is the most intrusive verification system ever implemented for counting nuclear warheads. Verification measures include individual tagging of carriers by unique identifiers and notification of movements of vehicles. Most notably, the verification enables the counting of individual warheads, in contrast to the old START Treaty whose verification often led to an overestimation of numbers.

2. Non-Proliferation Treaty (NPT)

28. This 1968 treaty, which entered into force in 1970, established an extensive multi-layered nuclear safeguards system to verify compliance with the NPT through inspections conducted by the IAEA. The system is designed to ensure that NNWS are prevented from

[31] Other treaties and instruments include: Partial Test Ban Treaty (PTBT), 1963; Outer Space Treaty, 1967; Seabed Treaty, 1971; Anti-Ballistic Missile Treaty (ABM), 1972 (no longer in force); Convention on the Prohibition of Military or any Hostile Use of Environmental Modification Techniques (ENMOD Convention), 1977; Convention on the Physical Protection of Nuclear Material, 1980; Missile Technology Control Regime (MTCR), 1987; Hague Code of Conduct (HCOC), 2002.

[32] UNSG Report A/50/377 of 22 September 1995, p. 32.

[33] Steven Pifer, Daryl G. Kimball, Anatoli S. Diakov (2018): New Start Treaty, Deep Cuts Issue Brief #7, April 2018, Hamburg: Institut für Friedensforschung und Sicherheitspolitik.

diverting nuclear energy from peaceful uses to nuclear weapons or other explosive devices.[34] For that purpose, "each Non-nuclear-weapon State Party to the Treaty undertakes to accept safeguards, as set forth in an agreement to be negotiated and concluded with the IAEA in accordance with the Statute of the IAEA and the Agency's safeguards system, for the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty."[35] The NPT does not establish formal means of verifying compliance by the five NWS with their obligations under the treaty. All of those States, however, have voluntarily concluded safeguards agreements covering some or all of their peaceful nuclear activities.[36] Under those "Voluntary Offer Agreements" (VOAs), the IAEA applies safeguards to nuclear material in facilities that the State has voluntarily offered and the IAEA has selected for the application of safeguards. Verification has been the subject of numerous proposals during the five-yearly NPT Review Conferences including most recently in 2015.[37]

3. Comprehensive Test Ban Treaty (CTBT)

29. The CTBT of 1996 established a verification regime to monitor countries' compliance with the new prohibition on any nuclear explosion, whether for military or peaceful purposes. The regime is designed to detect any nuclear explosion conducted on Earth, underground, underwater or in the atmosphere. The States Parties established a Preparatory Commission (CTBTO) to develop this regime and to ensure that it is operational by the time the treaty enters into force (which will be once the remaining designated eight States have joined it).[38] The near 300 International Monitoring Stations of the CTBTO as well as the planned on-site inspections form the basis of strong verification system which can detect nuclear tests globally and regionally with high confidence using different technologies. The lessons learnt from the CTBT are that there is particular value in pressing ahead with scientific and technical work even when the diplomatic negotiations face a stalemate. The technical preparations, discussions and respective engagement — in the years before actual treaty negotiations commenced — proved essential to keep the momentum going and make it possible to use a political window of opportunity to start negotiations. (See also 5.1.2 and 6.1.4)

4. Joint Comprehensive Plan of Action (JCPOA): Islamic Republic of Iran

30. On 14 July 2015, the five permanent members of the UN Security Council and Germany, the European Union and the Islamic Republic of Iran concluded a JCPOA[39] to ensure that Iran's nuclear programme would be exclusively peaceful. Under the JCPOA, Iran is required to adhere to the Additional Protocol to its Safeguards Agreement with the IAEA,

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[34] Ibid, supra note 1, Art. III.

[35] Ibid, supra note 1.

[36] John Carlson, Expanding Safeguards in Nuclear-Weapon States (Nuclear Threat Initiative, 2012): The first such agreements were concluded by the United Kingdom, with the IAEA and EURATOM, in 1978, and by the United States in 1980 with the IAEA. France concluded a VOA with the IAEA and EURATOM in 1981; the Soviet Union concluded a VOA with the IAEA in 1985, and China did so in 1988.

[37] Recent proposals of relevance include 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Verification: Working paper submitted by the Group of Non-Aligned States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2015/ WP.3, 9 March 2015; Safeguards: Working paper submitted by the Group of Non-Aligned States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2015/WP.6, 9 March 2015; Draft elements for a plan of action for the elimination of nuclear weapons: Working paper submitted by the Group of the Non-Aligned States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/ CONF.2015/WP.14, 13 March 2015; The United Kingdom-Norway Initiative: Further research into the verification of nuclear warhead dismantlement: Working paper submitted by the kingdom of Norway and the United Kingdom of Great Britain and Northern Ireland, document NPT/CONF.2015/WP.31, 22 April 2015; and Transparency, Reporting and Strengthening the Review Process: Working paper submitted by Japan, document NPT/CONF.2015/WP.32, 22 April 2015.

[38] China, Democratic People's Republic of Korea, Egypt, India, Islamic Republic of Iran, Israel, Pakistan, United States.

[39] Joint Comprehensive Plan of Action, 14 July 2015, available at <https://www.state.gov/e/eb/tfs/spi/iran/jcpoa/>.

which provides for extensive access for the IAEA to investigate evidence of suspicious activities anywhere. The IAEA monitors and verifies Iran's supply chain of nuclear materials, centrifuge production lines, and any purchases that might be used for a nuclear programme. The Agency also provides regular updates to the Board of Governors, and, as provided for in the Plan, to the Security Council. The JCPOA with its considerable technical detail and sensitive political underpinnings is another instrument, which provides useful insights for the GGE into the complexities of verification and of ways of overcoming them by negotiation.

5. Nuclear-weapon-free-zones (NWFZs)

31. In the context of global security and nuclear disarmament, Negative Security Assurances (NSAs) are pledges by NWS or international agreements to assure NNWS against the use of or threat of the use of nuclear weapons. NSAs have been granted by NWS to more than 100 States, a.o. in the form of commitments to the various NWFZs: The South Pacific Nuclear Free Zone Treaty (Treaty of Rarotonga), the Treaty on the South-East Asia Nuclear-Weapon-Free Zone (Treaty of Bangkok), the African Nuclear-Weapon-Free Zone Treaty (Treaty of Pelindaba) and the Treaty on a Nuclear-Weapon-Free Zone in Central Asia (Treaty of Semipalatinsk), which gather 115 States, that have freely chosen to form these zones. Additionally, Mongolia has declared its nuclear-weapon-free status.[40] These commitments are legally binding guarantees. NWFZs have provided for regional control mechanisms to be set up to oversee and review the application of the IAEA safeguards system.[41] All States within each zone must implement the Agency's Comprehensive Safeguards Agreements. This includes enabling challenge inspections authorised by the Zones' regional control mechanisms, but carried out by IAEA inspectors. The Latin American Treaty (Tlatelolco) additionally provides for reports and exchanges of information, and special reports requested by OPANAL (the agency for the prohibition of nuclear weapons in Latin America and the Caribbean established by the Tlatelolco Treaty).

6. Fissile Material Cut-Off Treaty (FMCT)

32. The case of the FMCT is providing interesting insights in to the role of verification and its toolbox of an emerging treaty. Previous and ongoing work, especially that of the GGE and FMCT High Level Expert Preparatory Group (HLEPG), have been valuable in gathering more information on technical challenges of verification, which have direct parallels to the broader disarmament verification regime. On a practical level, the discussions during the HLEPG raised various question, a.o. where verification should or could be set out in the text of a treaty: in the main body, or in an annex. This was the result of lengthy discussions on the scope of a future Treaty and diverging views on whether or not to include existing stocks. Also the question has been raised whether there is a role for the IAEA in FMCT verification, or whether a separate, new institution like a stand-alone Fissile Material Cut-Off Treaty Organisation (FMCTO) would be required. The intrusiveness of the future verification of this treaty is contested.

7. Chemical Weapons Convention (CWC)

33. This 1993 treaty prohibits its States Parties (which now number 192)[42] from developing, producing, acquiring, retaining, stockpiling, transferring and using chemical weapons. It also prohibits all States Parties from engaging in military preparations to use chemical weapons, and from assisting or encouraging other States to engage in activities prohibited by the treaty. The Organisation for the prohibition of Chemical Weapons (OPCW) helps States Parties to monitor and verify implementation of the Convention and may serve as a model institutional arrangement for a future verification mechanism.

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[40] Additionally, three treaties established NWFZs in Antarctica (23 June 1961), in outer space (10 October 1967) and on the seabed (18 May 1972).

[41] The policy brief lists the Organisation for the Prohibition of Nuclear Weapons in Latin America (OPANAL), the Consultative Committee of the South Pacific Nuclear Weapon Free Zone, the Commission for the Southeast Asia Nuclear Weapon Free Zone and its subsidiary organ, the Executive Committee, and the African Commission on Nuclear Energy (AFCONE).

[42] As at 25 March 2018.

8. Biological and Toxin Weapons Convention (BTWC)

34. The BTWC of 1972 was the first multilateral disarmament treaty to ban an entire category of weapons. Despite the categorical prohibition verification provisions of the BWC are rather vague and based on indirect measures. Due to this fact direct lessons for the GGE on verification are less obvious, although some do exist that will be explained below.

9. Conventional Forces in Europe (CFE) Treaty

35. The objective of this 1990 agreement is to reduce the possibility for major offensive operations and surprise attacks in Europe through the reduction of troops in central Europe and related areas and the placement of equal limitations on five major weapons systems for NATO and the Warsaw Pact. Its verification regime builds mainly on Information Exchange and challenge inspections. It must be noted that the CFE was not immune to the broader security environment and that political developments and NATO enlargement were damaging for the treaty. This is important to consider when discussing nuclear disarmament verification and the maintaining of a world with lower or no nuclear weapons. The present security situation with regards to non-State actors could have an impact on negotiations and cannot be disregarded.

III. General principles of verification

36. The primary aim of verification under the current political conditions is to ensure compliance with treaty provisions.[43] Already in 1978, the international community attempted to agree on some verification principles pertaining to nuclear disarmament as mentioned in the first Special Session devoted to Disarmament (SSOD I).[44] As a result of this effort, in 1988 the United Nations Disarmament Commission (UNDC) agreed on 16 Principles of Verification While these principles do not represent any significant innovation, the fact that United Nations members were able to agree and endorse them, is strong evidence of the extent to which verification had by that stage become an accepted and necessary part of arms control and disarmament. Through transparency measures and credible verification, assurances can be obtained that weapons are irreversibly destroyed according to treaty obligations.

37. Four core principles are widely seen as fundamental in fostering the necessary confidence for achieving and maintaining a world without nuclear weapons; transparency, irreversibility, non-discrimination and effectiveness. These principles should guide the work, as agreed in the 13 steps at the 2000 NPT Review Conference[45] and the 2010 Action Plan.[46] These norms are repeatedly identified in General Assembly resolutions and in final documents of NPT review conferences. This section aims to explain the rational of these principles and to make them more practical and usable during the GGE about the nuclear disarmament verification framework.

A. Transparency

38. Transparency is the disclosure of information about its nuclear stockpile (e.g. types and operational of nuclear weapons, fissile material, deployment locations, production sites weapons etc.) of a State based on its national security policies. The purpose of transparency is to enhance mutual understanding with other states. Transparency in the NPT context, has historically often competed with secrecy of the nuclear weapons states, while the former was

[43] Ibid, supra note 32.

[44] Final Document of the Tenth Special Session, UNGA Res A/RES/S-10/2 of 30 June 1978.

[45] Arms Control Association, Timeline of the Nuclear Non-proliferation Treaty (NPT), 12 July 2017, available at <https://www.armscontrol.org/aca/npt13steps>.

[46] 2010 NPT Review Conference Action Plan, available at <http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/npt/revcon2010/2010NPTActionPlan.pdf>.

mainly seen in the context of disarmament, the latter mostly figured as a non-proliferation tool. Attitudes towards nuclear secrecy evolved in a radical manner in the 1990s, at least in some NWS.[47] The 2000 NPT Review Conference called for "increased transparency by the NWS with regard to the nuclear weapon capabilities and the implementation of agreements pursuant to Article VI and as a voluntary confidence-building measure to support further progress on nuclear disarmament."[48] Other fora have also called for greater transparency in the stocks of warheads and fissile materials held by the NWS.[49] Transparency measures result in greater predictability with regard to the intentions and capabilities of States, thus facilitating mutual understanding, easing of tensions and reducing misperceptions. The clear lesson emerging from relevant international verification experience is the centrality of transparency to effective and at the same time cost-efficient verification. A verification regime must also be credible, while respecting the requirement to maintain confidentiality in relation to sensitive weapons design and composition. Transparency does not only have benefits for the NWS. It is also important to the NNWS as a CBM and as a prerequisite for further international arms control and disarmament. Transparency measures will have a positive effect on cooperation in arms control but also on their national security by diminishing the security gap that currently exists between the NWS and the NNWS.

39. Although there are widely acknowledged legitimate reasons for maintaining certain confidentiality in military nuclear inventories, there are a number of important reasons to increase transparency in these inventories. The overriding argument stems from the need to demonstrate that the NWS are moving forward to meet their pledges and obligations to reduce and eliminate their nuclear arsenals. At present, no multilateral treaty obliges the NWS to declare, directly limit or accept controls on their nuclear warheads. The nuclear warheads that are/were removed from delivery systems vehicles scheduled for elimination under the INF and START I and New START treaties are/were not subject to any agreed regulation or control. Many of these warheads have already been voluntarily destroyed but, owing to the lack of transparency, there is no publicly available information on how many warheads remain in stockpiles. The potential exists for non-deployed warheads to be re-used or recycled. Knowledge of the exact size of the warhead stockpiles is essential and, in addition, a precondition for proceeding with deeper reductions. Transparency in military fissile materials is also limited and knowledge of the inventories of the NWS remains incomplete. Statements about fissile material holdings and declarations about production moratoria are only politically binding. Although such statements are valuable first steps indicating the intentions of the NWS, they will have limited practical impact unless they can be effectively verified and thereby also made legally binding. In addition, fissile material designated excess to military needs can easily be used again to manufacture warheads, unless it is permanently withdrawn from national stocks, destroyed or/and stored under international supervision. With regard to transparency of fissile material holdings, some NWS have released information, while others have been more restrictive. If a Fissile Material Cut-off Treaty (FMCT) ever comes into force, it might eventually also include provisions for increasing transparency in fissile material stockpiles in order to have a more explicit focus on nuclear disarmament rather than on arms control only.

40. Past transparency measures especially in the context of conventional arms control have been helpful in building confidence and security.[50] Some NWS routinely produce

[47] The unprecedented Openness Initiative of US Secretary of Energy Hazel O'Leary can in this context be seen as a major policy shift, even though its scope seems to have been subsequently restricted, precisely in order to address national security concerns. For more about the Openness Initiative see the statement of 15 Jan. 1997 by US Secretary of Energy O'Leary in DOE Press Release R-97-003, in Disarmament Diplomacy, no. 12, January 1997, pp. 38–39.

[48] Ibid, supra note 17, para. 15, step 9.

[49] E.g., the Tokyo Forum noted that "irreversible reductions in nuclear forces require great transparency": Tokyo Forum for Nuclear Non-Proliferation and Disarmament, Tokyo Forum for Nuclear Non-Proliferation and Disarmament, Facing Nuclear Dangers: An Action Plan for the 21st Century (Ministry of Foreign Affairs of Japan, 25 July 1999), available at <http://www.fas.org/news/japan/forum.htm> .

[50] The Vienna document requires States to: provide each other with information about their military forces annually, including about manpower and major conventional weapon- and equipment systems,

reports and brochures for international events, such as the 2000 NPT Review Conference, in order to publicise their efforts in the field of disarmament. Also, nuclear policy speeches and the publication of defence White Papers can all provide an opportunity for increased transparency. The same applies to opening of facilities to foreign visitors or inspectors as a transparency measure. It would be important to make transparency a vital part of NWS' nuclear policy in efforts to move from nuclear secrecy to nuclear accountability.

B. Irreversibility

41. The 2000 NPT Review Conference agreed that a programme of action for nuclear disarmament will comprise, inter alia, "the principle of irreversibility to apply to nuclear disarmament, nuclear and other related arms control and reduction measures."[51] Irreversibility is often viewed as a desirable tool in order to make sure that there is no "roll-back" from a certain achieved disarmament step or stage. As such it is also a direct response to the disarmament obligation of Art. VI of the NPT. Different definitions of the principle of irreversibility exist but most experts agree that irreversibility will be essential in all future nuclear disarmament treaties.[52] In the nuclear disarmament context it can be said that as a minimum there seems to be a general understanding that irreversibility in most cases is associated with the fissile material extracted from warheads. The Trilateral Initiative still represents one of the most important efforts aiming at achieving irreversibility in nuclear disarmament. Many scientists have suggested to use the Model Verification Agreement developed by the parties in the Trilateral Initiative as a basis for future agreements between the IAEA and other States.[53]

C. Non-discrimination but differentiation to achieve universality

42. The principle of non-discrimination seeks to create a more symmetrical relationship between the NNWS, which are under IAEA full-scope safeguards, and the NWS, which are not. The overwhelming international community is of the opinion that future multilateral arms limitation and disarmament agreements must be non-discriminatory in their restrictions and their verification regimes, notwithstanding necessary differentiation between NWS and NNWS. Some recent experience suggests that, in designing and implementing verification obligations, it is important to ensure an equitable distribution of the burden among the parties. Many NNWS share the view that they, in contrast to NWS, already have taken more and sufficient steps to facilitate a nuclear-weapon-free world. Therefore, they believe it is unfair and unrealistic to expect NNWS to take new steps until NWS succeed in meeting agreed

as well as deployment plans and budgets; notify each other ahead of time about major military activities such as exercises; accept up to three inspections of their military sites per year. Some sensitive areas are excluded; invite other States to observe certain activities. It also encourages States to permit journalists from all participating States to cover the activities; to consult and co-operate in case of unusual military activity or increasing tensions; Treaty on the Open Skies 1990; The Code introduces transparency measures such as annual declarations and pre-launch notifications regarding ballistic missile and space launch programs.

[51] Final Document of the 2000 Review Conference of the parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2000/28, 24 May 2000, available at <http://www.un.org/en/conf/npt/2010/>.

[52] US Department of Energy, Transparency and Verification Options: "The measures should build each side's confidence that the nuclear arms reductions being carried out are irreversible, and in particular that fissile materials declared excess to military needs (including civilian weapons-usable material) are not being used to build new nuclear weapons."; IPNDV, "Food-for-Thought Paper: Achieving Irreversibility in Nuclear Disarmament" January 2018, available at <https://www.ipndv.org/wp-content/uploads/2018/01/IPNDV-WG1-FFT-Irreversibility-Final.pdf>; David Cli , Hassan Elbahtimy and Andreas Persbo, "Irreversibility in Nuclear Disarmament", September 2011, available at <http://www.vertic.org/media/assets/Publications/Irreversibility_Report_Sept_2011.pdf>.

[53] See for example Thomas E. Shea and Laura Rockwood, "Nuclear Disarmament: The Legacy of the Trilateral Initiative," March 2015 (Deep Cuts Working Paper 4) available at <https://www.files.ethz.ch/isn/192450/DeepCuts_WP4_Shea_Rockwood_UK.pdf>.

disarmament benchmarks, which would narrow existing gaps and be in line with the principle of non-discrimination. Therefore, any future disarmament framework should create a non-discriminatory verification regime under which no further verification obligations for NNWS will be imposed, as the IAEA comprehensive safeguards agreement (CSA) and Additional Protocol (AP) could be considered as sufficient standard for verification. On the other hand, some NWS hold the view that if NNWS are not subject to the future verification regime, there will be not the same guarantee that they adhere to their obligations as some may even withdraw from the NPT. The increased application of safeguards in NNWS and NWS underpins their relevance to building the confidence, transparency and trust required to further support the development of verification mechanisms.

43. A key lesson learnt from the UK-Norway initiative was that the participants of this initiative expressed their strong belief that there are no barriers, in principal, to collaboration between nuclear-weapon States and non-nuclear-weapon States in effective nuclear disarmament. They also found that their respective obligations under articles I and II of the NPT on transfer, control, acquisition, etc., will not be compromised by such cooperation.[54] Furthermore, Norway expressed the view that although NWS bear the prime responsibility for reducing and eventually eliminating their nuclear arsenals, NNWS should also contribute to this end. Recalling the 10th principle of the UN Disarmament Commission, which reads "all States have equal rights to participate in the process of international verification agreements to which they are parties."[55] It follows that NNWS are legitimate in their claim to be assured that NWS actually carry out their obligations under future multilateral nuclear disarmament regimes. Any involvement of NNWS in verification and inspection arrangements must, however, comply with the non-proliferation obligations of the NPT.

D. Effectiveness

44. The effectiveness of verification will depend on the availability of appropriate technical equipment and proven and tested methods as well as the expertise of technical and other experts. There is a wealth of experience suggesting that effective verification can be undertaken and agreed-upon access allowed without necessarily compromising security relevant national or commercial secrets.[56] Innovative ideas, notably from the NTI with regard to baseline declarations, global verification capacity and societal verification, will be very beneficial for future discussions.[57] These considerations are also intrinsically linked to the future verification organisation, which will be examined in Chapter 6. An already well-established and experienced verification organisation like the IAEA would therefore naturally have more procedural and technical expertise and equipment than a newly founded organisation (e.g. a possible Fissile Material Cut-Off Treaty Organisation (FMCTO), which is one of the options envisaged for a future FMCT). Expertise has been established in the United States and the Russian Federation through collaboration in implementing bilateral agreements such as INF and START and should be appropriately considered for further action. Similarly, cooperation between the US and the UK as well as between the UK and Norway has helped built up useful experience.

[54] 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, The United Kingdom-Norway Initiative: Further research into the verification of nuclear warhead dismantlement: Working paper submitted by the Kingdom of Norway and the United Kingdom of Great Britain and Northern Ireland, document NPT/CONF.2015/WP.31, 22 April 2015.

[55] United Nations Disarmament Commission Principles of Verification (1988) <http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/arms-control-disarmament/verification/pdf-art2097.pdf>

[56] Nuclear Threat Initiative, "Innovating Verification: New Tools & New Actors to Reduce Nuclear Risks: Verifying Baseline Declarations of Nuclear Warheads and Materials" July 2014, available at <http://www.nti.org/media/pdfs/WG1_Verifying_Baseline_Declarations_FINAL.pdf>, p.25.

[57] Malte Göttsche, Moritz Kütt, Götz Neuneck and Irmgard Niemeyer, Advancing Disarmament Verification Tools: A Task for Europe?, EU Non-Proliferation Consortium, Non-Proliferation Paper no. 47, October 2015, p. 2.

IV. Scope of verification

45. Like in many other verification contexts there is the central question whether the whole life cycle of the verified product or related processes need to be verified in order to obtain sufficient assurances or if the result would be the same through a more selective but targeted approach. Previous disarmament agreements between NWS have only verified the disarmament and limitation of nuclear weapon delivery systems (i.e. missiles of a certain range), but not the dismantling and/or destruction of the associated nuclear warheads. Future discussions will need to go further and define the nature and scope of verification processes so that they would be politically acceptable and provide sufficient confidence that disarmament is actually taking place and is irreversible. Many argue that verification should cover the entire nuclear weapon lifecycle including delivery systems. This will likely include the need to reach an agreement on facilities including operational bases, activities and inventories to be verified during the nuclear weapons life-cycle (from delivery systems, warhead assembly, deployment to storage, material inventories, dismantlement and disposition) including the toolbox that will serve this purpose best.

46. For practical reason the nuclear weapon lifecycle related to facilities can be divided in three phases[58] :

(a) Upstream; including all processes to the start of the weaponization in specific locations (e.g. reprocessing and enrichment, reactors etc.);

(b) Midstream; including the whole weaponization process until the start of dismantlement until the deployment of the warhead;

(c) Downstream; covering the dismantlement/destruction process of nuclear weapons at end of which there are no directly usable weapons or materials left (e.g. fissile material storages, waste facilities etc.)

47. Verifying the entire lifecycle will be extremely difficult and complex as inspectors would have to get access to detailed records of a state's total warhead and weapons-usable material inventory as well as all relevant facilities, including military. Verifying the declaration of past fissile material production is called "nuclear archaeology".[59] This echoes the importance of the principle of transparency. Comprehensive baseline declarations are seen as key in this regard whose accuracy will need to be later confirmed. Such records will take time to develop, and there are currently no agreed mechanisms for recording, sharing, or verifying this information. As the verification annex of the CWC is very comprehensive and detailed with regard to verifying all chemical weapons related activities, the GGE could considerably benefit from it. In the CWC context all States Parties are required to make detailed declarations providing information on chemical weapons, production, storage, destruction and facilities used in the past for their development. Ideally, these mechanisms could be applied to the entire cycle of nuclear weapons as well. In addition to security/intellectual property and non-proliferation also practical considerations, such as costs and the availability of technical means, logistical elements and expertise may oblige negotiators to prioritise some parts rather than others of the nuclear weapon lifecycle that will be governed by verification. Additionally, the safety and security of the inspected locations and the personnel has to be assured. Depending on negotiations, if the goal will be to verify the dismantlement of an agreed number of warheads, the verification authority may not need to access the entire nuclear weapons complex, but only some specific sites, activities, and personnel. Under such a structure, the verification authority might wish to freely choose which sites to visit, although NWS may be reluctant to grant this privilege. By contrast, a comprehensive verification scheme is likely to require NWS to grant access to all relevant facilities, a large selection of relevant personnel, and a wide range of documentation, many of which may be considered military or commercial secrets. Hence, once again, it will be

[58] https://www.ipndv.org/reports-analysis/deliverable-one-principles-nuclear-disarmament-verification-key-steps-process-dismantling-nuclear-weapons-14-step-diagram/

[59] Steve Fetter: Nuclear Archaeology: Verifying Declarations of Fissile-Material Production, Science and Global Security, Vol. 3(1993) 237-259.

important to find the right compromise between intrusiveness and the protection of sensitive information.[60]

48. Also experiences from the IPNDV may help the GGE shed light on these factors as it covers the whole life cycle of nuclear weapons. One important achievement of the IPNDV is that it brings together States who support the Treaty on the Prohibition of Nuclear Weapons, as well as States staunchly opposed to it. Despite the diversity of its members, it has also succeeded in building, broadening and diversifying international capacity and expertise.

A. Upstream facilities

49. Concentrating on the upstream activities (i.e. uranium enrichment, plutonium reprocessing and fuel fabrication and power as well as research reactors) associated with disposition (spent fuel) would focus the effort on the material flows that lead to the fabrication of nuclear weapons, something which would reduce the costs of verification accordingly. Concentrating on material and material flows would have the advantage that respective efforts could build on results from the FMCT process where this issue has progressed significantly. Such an approach is considered by many to give sufficient assurances that the amount of material is not increased (make it legally and technically impossible) after entry into force of the agreement. This would make it consistent with the principle of irreversibility, which is shared by many as a minimum demand for robust disarmament.

50. Verification of fissile material production facilities will cover military reprocessing and enrichment plants, civilian commercial plants, pilot plants, and research installations, including hot cells. An estimated 195 facilities in the states possessing nuclear weapons would be covered by this approach.[61] The separated direct-use material produced at these facilities would then be followed further mid- and downstream until the defined termination of verification measures. As a consequence, all facilities that store, process, use or dispose them after entry into force of the agreement must be included, such as MOX and HEU fabrication facilities.

51. The disadvantage of this selective approach would be the inability of detecting diversion of irradiated direct-use material for reprocessing in clandestine facilities. It would also not provide the verification agency with any capability to detect (get access to) undeclared plutonium production at declared reactors, undeclared chemical reprocessing or undeclared uranium enrichment. Furthermore, it would not provide a comprehensive material accountancy and only cover newly produced fissile materials. Therefore, the focused approach would only give a reasonable level of assurances and lack credibility with many participating states.

B. Midstream facilities

52. This approach would mostly follow and trace all agreed-upon materials during their weaponization. It would thus mainly cover the absence of production of warheads and the monitoring during various phases of deployment and storage. Due to military secrets involved and respective non-proliferation requirements this approach would require rather sophisticated and tailored solutions. Those could notably build on experiences made during bilateral arms control and reduction agreements. Despite its likely high costs and the complex requirements of extensive institutional backup, this approach is considered by many as a necessary requirement to detect any possible secret production or diversion of actual nuclear weapons and provides a very high level of assurances on a non-discriminatory basis. According to the philosophy behind, anything less than verifying a state's entire fuel and weapons cycle, including the most sensitive phases, could not give the same level of

[60] This was stressed by several NWS in response to UNSG Report A/72/304.

[61] UNIDIR, A Fissile Material Cut-off Treaty Understanding the Critical Issues (2010) available at <http://unidir.org/files/publications/pdfs/a-fissile-material-cut-off-treaty-understanding-the-critical-issues-139.pdf>.

assurances of compliance. This would not be possible if a big black box of previously excluded materials would be left out.

53. Nuclear warheads are generally mounted on delivery vehicles or located in storage bunkers. The exact number transported with delivery vehicles could be verified using procedures similar to those established by the bilateral START I Treaty. For example, START I provides for visual inspections of the front sections of ICBMs and submarine-launched ballistic missiles (SLBMs) to verify that they are not armed with more than the permitted number of warheads. In START I, radiation measuring devices were used to confirm that certain objects are or are not nuclear warheads. In this case, the only attribute would be the presence of radiation. Another way to verify the authenticity of a declared item makes use of surface feature tags, also called "fingerprints" or "templates" for particular types of warheads or fabricated components. For example, Russia could present one or more SS-18 warheads for fingerprinting, or warheads could be selected from a deployed missile by inspectors. A set of agreed characteristics could be measured: length and diameter; mass and centre of gravity; neutron and gamma-ray emissions; heat output; or its ultrasonic signature. A template based on a variety of characteristics would make it extremely difficult to cheat. Again, weapon-design information could be protected with an automated system ("information barrier") that would compare an object with the template and produce a "yes" or "no" answer. There are many historic precedents that involve frictions between intrusiveness of safeguards and the desire of States to protect secrets. The fact that zero missiles would be easier to verify than allowing a small number to remain, encouraged negotiators to ban all intermediate-range nuclear missiles under the 1987 INF Treaty. Similarly, in the case of the CWC, because it is impossible to keep track of every chemical that might be used for chemical weapons, it was agreed to divide the potential "problem chemicals" into three different schedules/categories and apply different levels of verification to each. Another important source of best practices is START I and New START. One method that was used by Russian and US laboratories to confirm the authenticity of nuclear weapons declarations, i.e. plutonium pits from RUS nuclear warheads to be placed in a US-funded storage facility near Chelyabinsk is that of attribute verification. Both parties agreed on a set of attributes that each type of item should display. To protect sensitive information, an automated system could be used to measure the attributes and produce a simple "yes" or "no" answer to the question, "Does the object display the agreed set of attributes?".

C. Downstream Verification

54. This segment covers the dismantlement processes to the point when nuclear weapons and the fissile materials contained therein are destroyed, consumed, diluted, or made practically irrecoverable, e.g. by mixing it with high active nuclear waste during its vitrification process, by down blending, vitrification or by mixing it with high active nuclear waste. There are several other potential measures. The disposition decisions are made by the respective states. This method is mostly seen by NWS but also others as the preferred one as it demonstrates the will to actually destroy nuclear weapons and irreversibly remove the fissile materials essential to them.

D. Deferred Verification

55. From a practical point of view, it can be argued[62] that all materials and facilities that cannot be made available for verification would constitute a distinct "closed" segment of the nuclear complex. The rest of the nuclear complex would be considered an "open" segment, which is open to verification and inspection activities. For verification purposes the amount of material or weapons in the closed segment should be known and declared with a high degree of accuracy for proper accounting in the material balance. The material in the closed

[62] Pavel Podvig, Joseph Rodgers, "Deferred Verification Verifiable Declarations of Fissile Material Stocks" UNIDIR 2017**,** available at <http://www.unidir.ch/files/publications/pdfs/deferred-verification-verifiable-declarations-of-fissile-material-stocks-en-694.pdf>.

segment would be considered as part of a measured inventory, even though it would not be available for verification through actual measurements.[63] The lack of access to the closed segment does not mean that the declaration of the amount of material would not be verified. Verification would only be deferred to the time the material is sent to disposition or elimination. At this point, all sensitive attributes would be removed, so that all its characteristics can be accurately measured. At the end of the elimination process, the sum of all removals would ideally correspond to the amount of material in the closed segment that was declared in the beginning of the process. Since at this point the closed segment would no longer contain any fissile material, it would be open for verification to confirm the correctness of the declaration.

56. The key feature of the deferred verification arrangement is that it would not rely on access to classified nuclear weapons and materials information. It builds on the assumption that nuclear weapons are subject to relatively fixed life cycles with overseeable known intervals. This method would not require an exchange of data about locations of nuclear weapons or their numbers and attributes, which are often considered an essential starting point of most baseline declarations. Neither would it require monitoring of the weapon dismantlement process, implementing elaborate information barriers or managed access procedures. As a result, this arrangement would be compatible with NWS maintaining active nuclear arsenals for a certain period of time. In order to be credible this method would require a strong commitment to nuclear disarmament in the long-term. It would also require that no undeclared production of fissile material is possible in the "closed segment".

57. In case a deferred verification method is adopted, an initial verification mechanism may verify the open segment and later on also include verification of the closed segment. A practical reference to this method might be the NPT, where CSAs and additional protocols agreed between states parties and the IAEA, based on model agreements provided for respective baseline declarations An advantage of this approach is that it separates political issues from technical issues and allows for an adaptable verification system that is sufficiently flexible to be updated over time. This becomes increasingly important the further the international community comes to reaching "global zero".

E. Safety, security and non-proliferation issues

58. Security and political developments, including terrorists and non-state actors gaining access to nuclear material, also need to be considered when discussing the scope of verification. Since the scope of the NPT from 1968 does not consider non-state actors, there is an increasing need for physical protection of such material from misuse. The Convention on the physical protection of nuclear material (CPPNM)[64] provides some kind of physical protection of nuclear material from theft or misuse. Yet, it only provides protection for transborder nuclear transports or storage during transborder transport. It does not provide for processing, storage or transport on the territory of the signatory State itself. Instead, it makes no mention of terrorist attacks or sabotage of nuclear facilities. As a result of the 9/11 attacks, in December 2001, the IAEA assembled an expert group with the aim of expanding and improving the CPPNM. The goal was to also cover civil nuclear material during processing, storage and transport within the signatory states. It would be important to determine an international minimum standard for protection and security measures against sabotage of nuclear facilities and other civil nuclear facilities in signatory states, like the Code of Conduct

[63] This is similar to the approach that was taken by the United States when it concluded an additional protocol with the IAEA. The additional protocol allows the IAEA to inspect any US facility, but the United States reserves the right to invoke the national security exclusion if a facility is not available for verification; INFCIRC/288/Add.1., "Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America", IAEA, 9 March 2009, Article 1.b.

[64] IAEA, Convention on the Physical Protection of Nuclear Material INFCIRC/274/Rev.1, 1 May 1980, available at <https://www.iaea.org/sites/default/files/infcirc274r1.pdf>.

on the Safety and Security of Radioactive Sources.[65] Since the code of conduct constitutes soft law, it is not binding nor can sanctions be imposed on those that act in a way that is incompatible or below the advised optimal code of conduct. Such considerations should therefore be included in binding multilateral future nuclear verification instruments. Another way would be to expand the current CPPNM as originally envisaged by the IAEA and to establish an international verification mechanism even though signatory States have no strategic interest in violating the treaty.

59. Moreover, disarmament verifications activities will be based on pre-agreed procedures, in which the safety, security, and non-proliferation concerns of both the inspectorate and the inspected State have been taken into account[66].

V. Developing an effective, reliable and efficient verification toolbox

A. Methods for effective verification

60. In order to provide credible assurances that states parties comply with their obligations and treaty verification requirements, a diverse and tailored verification toolbox would be necessary, which is capable of supporting the verification standard agreed by states parties with respect to the implementation of their obligations. No single verification measure by itself, be it a black box approach, information barriers, managed access procedures during on-site inspections, societal verification, the use of blend stock, national technical means, or environmental sampling, will be enough on their own. It is assessed that in the end only the sum of various complementary methods and technologies will constitute an effective verification system. As a result, while these methods alone will be useful in attempting to solve some of the major challenges of verification, at the same time they should be seen in light of the need to be possibly supplemented by other technologies.

1. Declarations

61. One way of filling the transparency gap with regard to nuclear material inventories described above is through verifiable baseline declarations as they were promoted by the Non-Proliferation and Disarmament Initiative (NPDI). While accurate baseline declarations of inventories held by possessing States will be the foundation for verification, the real test for any mechanism that accounts for reductions and eventual elimination of weapons-holdings will be whether it manages to lift the veil of secrecy that surrounds those warhead arsenals and the very materials within them. As regarding baseline declarations a first step would be a “statement of the number or quantity of accountable items or materials—perhaps specified by parameters such as type or category—against which other information may be compared and future progress may be measured.”[67] Such a declaration which needs to be harmonized for future comparability is seen as an essential first step for constructive cooperation and confidence-building because “without a clear understanding of warhead and nuclear material inventories, it will be nearly impossible to confirm that there are no hidden items or clandestine activities.”[68] For effective verification procedures under a future disarmament treaty a detailed baseline declaration about the treaty accountable items is a key requirement for inspections and further monitoring.

[65] IAEA, Code of Conduct on the Safety and Security of Radioactive Sources, January 2004, available at <https://www-pub.iaea.org/MTCD/Publications/PDF/Code-2004_web.pdf>.

[66] IPNDV Working Group 2 - 2016–2017 Output Report: Inspection Activities and Techniques, Chapter 15, available at http://ipndv.org/wp-content/uploads/2017/11/WG2-Deliverables-Four-Five-Six-Final.pdf

[67] Ibid, supra note 55, p.12.

[68] Ibid.

2. National Technical Means (NTM) and Multinational Technical Means (MTM)

62. National technical means of verification (NTM) are nationally owned and operated technologies and techniques used to monitor the treaty obligations of another State. Altough NTM are considered by some as a euphemism for all sources of information available to a State "in accordance with international law"[69], including information obtained by intelligence organisations using all of the methods at their disposal, they can be used for a variety of purposes, of which arms control verification is only one. For this reason, arms control negotiators have tended to avoid attempts to define NTM. States may use NTM to verify compliance with a treaty in the absence of other measures, or to supplement the level of reassurance they receive from a cooperative verification system. In some instances, States are permitted to submit information obtained from NTM to a multilateral verification organisation to support a request for clarification of the activities of another State, including an on-site inspection. NTM include satellites, high-altitude and other aircraft and land-based remote detection systems, electronic signals intelligence (SIGINT) and electronic intelligence (ELINT) collection systems, as well as systems that collect open source information. NTM, therefore, also may be assumed to include the facilities and personnel involved in collating, analysing and interpreting information from such technologies. However, the initial reflex with regard to NTM might be not to trust the NTM of other states, especially if those states find themselves in an adversarial relationship. Therefore, the purpose, role and acceptance of NTMs have to be debated within the context of a new nuclear verification framework.

63. Multinational technical means (MTM) is sometimes used to refer to internationally owned and operated instruments employed in the monitoring of multilateral treaties. The information from such systems is available to all parties, as well as the verification organisation that manages the system and its technology. An example is the International Monitoring System (IMS) of the CTBTO. One of the advantages of MTM is that they encourage close cooperation between the parties. In addition, MTM are non-discriminatory — all parties may participate and all information derived from the system is available to all parties. Such systems may also provide parties with access to and familiarity with technology that would not otherwise be available to them.

3. Inspections

64. Inspections can be designed to either measure the presence (quantity and quality) or absence of materials, facilities or weapons. By signing the 1996 Comprehensive Nuclear Test-Ban Treaty (CTBT), all the NWS have accepted the principle of on-site inspections as a means to verify the test ban. Another significant achievement in nuclear transparency is the acceptance of on-site inspections under the 1987 Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (INF Treaty) and the 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I Treaty). For example, INFCIRC/153 provides for ad hoc, routine and special inspections.

- Random inspections, such as unannounced or short-notice random inspections would ensure compliance and reduce costs. In order to adopt a non-routine inspection regime, the probability for an inspection to take place should be pre-defined. This could depend on the amount and kind of material involved.
- Routine inspections take place on a regular basis in line with a defined schedule. The frequency of these inspections depends on the amount and kind of nuclear material in a facility. INFCIRC/540 allows access outside the nuclear sites, using the existing right of access at "short notice" or "no notice" during routine inspections.
- Special inspections take place under defined procedures only when the IAEA considers information to be inadequate to fulfil its responsibilities under the safeguards agreement.
- Under the concept of challenge or clarification inspections, a State party has the right to formally request or demand an on-site inspection of any facility or location under

[69] This excludes espionage.

the jurisdiction of any other State party. They can increase the risk of detection and the costs of concealing non-compliant activities, and thus may help to deter non-compliance. For example, under the CWC such an inspection might be conducted anywhere and without delay by an inspection team designated in accordance with the Convention's Verification Annex. Also, the CTBT contains challenge on-site inspection provisions.

- IPNDV WG 2 has compiled an overview on types of inspection activities and techniques available to inspectors, derived from the inspection types, activities, and techniques used under existing multilateral verification regimes listed in Annex IV[70].

65. In the end, the manner in which inspections and other verification procedures are conducted would depend primarily on which states become parties to the regime. In case a future verification regime is limited to the Russian Federation and the USA, inspections could be conducted on a bilateral basis, as in the START process. If any of the other additional NWS are involved, a choice must be made between decentralised and centralised inspection procedures. Decentralised inspection is a simple extension of the bilateral model, where each party would exchange information with every other party and any of the parties could request inspections of any other party. Parties could agree to limit the number of inspections that each party could request/receive and inspections could be conducted jointly by more than one State. This model is used in the CFE Treaty. Following this model would facilitate the protection of weapon design information, however, some would consider it as enhancing asymmetry and protecting the interests of the NWS.

B. Verification technologies

66. What might have been too ambitious politically in terms of verification some years ago, may become more feasible in the future, if the political context of agreements moves from a more confrontational environment to a more cooperative one. Technological developments and advances have also paved the way for new verification methods which might have seemed unfeasible or impossible decades ago. In determining the role of technology, negotiators must balance its advantages and the disadvantages, as well as consider questions of availability, utility, reliability and costs. Technology has some advantages over human inspectors: It can operate without interruption and its data is readily comparable. Moreover, it can be limited or programmed to detecting only treaty-relevant information, while ignoring others. The INF Treaty, for example, permitted an x-ray to be taken of missile canisters to determine the type of missile inside, but the machinery was set to a certain resolution so that sensitive design information could not be obtained.

67. New technologies could be especially helpful in alleviating concerns that have been voiced many times. Inspectors need to be especially recruited, trained and deployed and can be expensive to maintain continuously in the field, even if not being used. Their expertise, skills and dedication can vary considerably, and they can obtain information not related to the treaty that might be highly sensitive to the inspected party. On the other hand, the ability of inspectors to see the broader picture and discover inconsistencies and information that they have not been briefed to expect can be an advantage for obtaining full compliance of keeping the inspected party. IPNDV WG 6 is evaluating promising technologies for nuclear disarmament verification[71].

1. Ground-based technologies

68. Ground-based verification technologies that can monitor remotely or on-site have already proven their utility and enjoy rather wide spread acceptance. The equipment that the inspecting authorities install on-site include sensors, seals, detectors, monitors and optical cameras to record specific activities occurring in a nuclear installation. It will allow the

[70] IPNDV Working Group 2 - 2016–2017 Output Report: Inspection Activities and Techniques, Chapter 6 and Annex IV, available at http://ipndv.org/wp-content/uploads/2017/11/WG2-Deliverables-Four-Five-Six-Final.pdf

[71] www.ipndv.org

detection of undeclared movements of nuclear material and potential tampering with containment and/or surveillance devices. In light-water reactors, for example, the cores are usually not opened more than once per year. This would make it possible to consider sealing the head of the reactor's pressure vessel. The more sophisticated and automated an installation is, the fewer on-site inspections would be needed to provide the same level of assurance that material is not being diverted. The best example of a remote ground-based monitoring system, incorporating a set of monitoring technologies which transmit data via satellite to a central location is the CTBTO's International Monitoring System (IMS), which provides data to an International Data Centre (IDC) in Vienna, Austria. Such integrated data management systems with automated data transfers to a verification agency would allow for continuous monitoring without the need for human intervention, except for periodic visits to ensure the equipment has not been tampered with and is functioning properly. This would also save costs and resources. These data management systems can manage State declarations, maps, satellite imagery, on-site inspection reports and sampling reports and provide Intranet, archival and search facilities.

2. Space-based technologies

69. Monitoring by satellites from outer space is one of the most useful remote monitoring tools. Most satellites are owned and operated by just a handful of States exclusively for their own purposes, including as part of their NTM of verification. Such States may choose to provide limited amounts of information from their satellites for bilateral or multilateral verification purposes. Aerial surveillance using helicopters or fixed wing aircrafts may be a more precise monitoring tool due to their closer proximity even though the State being overflown would need to give its permission, which is not the case for outer space satellites.[72] Commercial companies with their own satellites or with access to data from government-owned satellites are increasingly selling images on the commercial market with resolutions below 0.5 meter for almost any part of the Earth's surface. Prices for such images are decreasing as competition increases. In recent years, the launch of huge constellations of small earth observation satellites has provided global imaging capabilities at various frequency (e.g. daily, weekly) and resolution (up to 0.8 meter).[73] States and organisations without the enormous technological and financial resources needed for developing their own systems can thus now have access to satellite monitoring. However, receiving a continuous stream of images still comes with high costs. Recipients still need to determine which images are required and must have the specialised capability for analysing and interpreting them. Finally, satellites are not suitable for all verification purposes, such as detecting facilities hidden underground or small-scale activities in large building complexes. States may employ deliberate concealment techniques, such as working at sites only at night to conceal activity or hiding illicit activities among legal ones.

3. Air-based

70. Aerial surveillance occurs as part of the 1970s Sinai Agreements between Egypt and Israel. Significant mutual aerial surveillance opportunities are available under the 1992 Open Skies Treaty Unmanned aerial vehicles (UAVs), also known as Remotely-Piloted Vehicles (RPVs), may be increasingly used for aerial surveillance of certain facilities.[74] UAVs can carry a wide variety of sensors, provide high-resolution coverage, cover large and remote areas, are cost efficient and can fly continuously for long periods. In addition, their onboard sensors can provide all-weather day-and-night surveillance and send real-time information to ground stations or satellites.

4. New technologies

71. It is important to be continuously receptive to improvements in technologies. Some of them were advanced by the UKNI and US-UK initiatives mentioned above, as they may also

[72] Aerial surveillance occurs as part of the 1970s Sinai Agreements between Egypt and Israel. Significant mutual aerial surveillance opportunities are available under the 1992 Open Skies Agreement.

[73] http://www.planet.com

[74] Ibid, supra note 32, p. 55.

present more cost-efficient options. One example is the use of muon detectors, technological devices, which detect cosmic particles (muons) that react with fissile materials and that cannot be blocked or shielded and may be used to an increasing extent. Other developments emerged in the areas of acoustic, optical, movement sensors and communications that give the verifiers the capacity to work with much greater speed and efficiency as well as an ability for operations around-the-clock.

C. Verification challenges at different facilities

72. It is important to note that different facilities might require slightly different verification approaches and whilst a narrower focus might require less resources, there is the risk of leaving gaps. The trade-off between this and more comprehensive approaches requiring greater resources is certainly something the GGE should consider. Any future verification mechanism will need to clearly determine and designate the items, activities, and facilities that should be monitored and those that need not be. This section aims to identify some of the major technical and political challenges in designating problematic facilities. It will also mention those methods that could form part of the verification toolbox in order to remedy some of them. While many of the methods and equipment required for verification already exist, some do not.[75] Therefore, decisions about a verification mechanism will need to be based on by what is politically and technically feasible.

1. Facilities not designed for safeguards

73. In NNWSs, safeguards implementation is already taken into account during the planning stage of a plant, and design verification takes place during the construction phase (‘safeguards-by-design’). Consequently, pursuing potentially unknown diversion paths becomes much more difficult than in facilities which were not designed to accommodate safeguards or equipped to facilitate sampling procedures. These latter facilities’ measuring points do not have easy access. Due to the lack of legally binding international verification arrangements, NWS did not need to make physical inventories for safeguards inspectors. It is much more challenging to install technical equipment in an existing facility than to prepare for installation when the facility is being designed and built. Remedies to these technical obstacles may be costly but not impossible. In any way, each such facility that will not be shut down but converted for future civilian use will need to be examined individually and negotiations will need to determine means to establish satisfactory verification. One possibility would be that initial safeguards would treat the whole plant as a “black box”. Adopting an approach involving a black box would mean that everything outside should be verified to make sure whatever is in the black box stays inside and doesn’t enter the production cycle. Important aspects of confidentiality, intellectual property and risk of proliferation would thereby be guaranteed. Even though such an approach would not bring NWS inventories up to symmetry with those in NNWS immediately, it would ensure that no additional undeclared operations take place in operating declared facilities. The argument that there are facilities not designed for safeguards will likely be brought up during discussions on FMCT verification. While there is no consensus on the exact extent of verification, it is clear that at least reprocessing and enrichment facilities should be included.

2. Sensitive sites: i.e. dual-use and military facilities

74. Verification will need to take into account the concerns of states parties (notably NWS) regarding sensitive information, whether related to national security, non-proliferation or intellectual property reasons, in a manner that avoids compromising the credibility and efficacy of verification efforts. This could be achieved through managed access procedures. The sensitive information could include the isotopic composition of nuclear materials, the amount of material needed for one warhead, or the design information of warheads.

[75] Ibid, supra note 55, p. 20.

75. Lessons could be learned from the following[76:] The first is the history of enrichment safeguards, when such problems were successfully solved by the Hexapartite Safeguards Project.[77] The equal treatment of NWS and NNWS in the safeguards domain was firstly realised by the HSP. The project showed the success of a model providing for a limited number of unannounced inspections (Limited Frequency Unannounced Access, LFUA).[78] This is also known as a concept of random inspections, which is more cost effective than the continuous monitoring of facilities. Another case are EURATOM safeguards on the entire civilian nuclear energy in the EU that has two NWS members with dual-use production plants for both nuclear weapon fuel and the civilian industry.[79] This case relates to reprocessing and to military secrets instead of commercial ones: the UK brought a large reprocessing plant (B205) under EURATOM safeguards 20 years after it was designed, and which was formerly used for military production. EURATOM is satisfied that it can verify non-diversion from the plant. Indeed, EURATOM safeguards are applied to all civilian production in the UK and France, and it runs the full accountancy of the entire civilian fuel cycle in the IAEA. It would be worth a study how the UK brought B205 under safeguards, and to investigate which conclusions for other problematic facilities could be drawn. Consequently, NWS can get used to civilian safeguards even at former military production plants. Another historical example includes South Africa's nuclear disarmament, where it granted access to all its former production sites and fissile materials, but only after dismantlement was completed and much of the sensitive information was removed. It also stopped its uranium enrichment. However, there was no verification of any transition period. The lesson in this case is if the cleanup and removal of sensitive information comes first without verification, not much sensitive information is left that could not adequately be protected.

76. The Trilateral Initiative is also very interesting in this regard. It suggested how to subject excess material to verification at a much earlier time than would have been possible when waiting for the removal of classified information. Verification measures would be applied on tagged and sealed containers that would be transported to facilities where all classified information would be erased. Tags were also used by the United Nations Special Commission on Iraq (UNSCOM) to log and track items which could be used for both civilian and military purposes and are used routinely by the IAEA to safeguard civilian nuclear materials. The use of tags with built-in global positioning systems (GPS) for verification of mobile missiles is provided for in the START I Treaty.[80] Furthermore, information barriers are closed devices involving computers without permanent memories that give out only the minimum information that the verification process needs but protects additional classified information.[81] Such information barriers need authentication and certification procedures that

[76] This is also relevant for facilities not designed for safeguards.

[77] The Hexapartite Safeguards Project (HSP) was created in November 1980 as an international forum consisting of technology holders of gas-centrifuge enrichment and the international safeguards inspectorates in order to develop a strategy for applying effective and efficient safeguards to a commercial centrifuge enrichment plant without compromising the sensitive information related to centrifuge enrichment technology. The participants were Australia, Japan, the so-called "Troika" states, i.e. Germany, the Netherlands and the United Kingdom, the United States, EURATOM and the IAEA.

[78] Wolfgang Fischer and Gotthard Stein, "On-Site Inspections: Experiences from Nuclear Safeguarding" in On-site inspections: Common Problems, Different Solutions, ed. Kerstin Hoffman, Disarmament Forum no. 3 (1999), p. 45-54.

[79] Meanwhile, the production for explosive purposes had ended.

[80] Annex 6 to the Inspection Protocol of START I, which describes procedures for associating unique identifiers with mobile missiles or their launch canisters, defines a unique identifier as 'a non-repeating alpha-numeric production number, or a copy thereof, that has been applied by the inspected Party, using its own technology'.

[81] Oleg Bukharin, "Russian and US technology development in support of nuclear warhead and material transparency initiatives", in Transparency in nuclear warheads and materials, ed. Nicholas Zarimpas, (OUP 2003), p. 32; J. L. Fuller, J. K. Wolford, "Information barriers", available at <https://www-pub.iaea.org/MTCD/publications/PDF/ss-2001/PDF%20files/Session%2017/Paper%2017-01.pdf>; R. Whiteson, D.W. MacArthur, "Information Barriers in the Trilateral Initiative: Conceptual Description", 1998, available at

ensure both, the host country and the inspecting party, that the devices are not manipulated. This is not trivial, but various promising approaches have been investigated and discussed to quite a detailed extent by the IAEA and US and Russian researchers.[82] The methods investigated by the Trilateral Initiative would not be able to establish that the materials submitted actually came from dismantled nuclear warheads. But it would be possible to verify that the amount of plutonium present in a container exceeds a specified minimum mass value. Consequently, it is possible to create assurance that no material is clandestinely diverted, although the verification methods are different from those on unclassified materials.

77. At former military facilities, reprocessing and enrichment plants or nuclear warhead maintenance and dismantlement facilities, verification could reveal sensitive information. In some NWS, the isotopic composition of fissile materials is still regarded as highly classified information. In these facilities, verification and on-site inspections would need specially managed access provisions. Managed access procedures would prevent dissemination of sensitive information, which is particularly important to NWS. Each state party should have the right to establish, in consultation with the future verification agency, arrangements for managed access at facilities in order to protect against disclosure of national, commercial and industrial secrets and other confidential information. At the same time, such arrangements should not preclude the future verification agency from conducting activities necessary to effectively verify. Managed access measures could include the shrouding of sensitive equipment, removal of sensitive documents from offices, shutting down computer systems and data indicators, and ensuring measurements and environmental sampling are limited to the agreed purpose of the access. As a consequence, material accountancy in the interior of such facilities might not be possible for a certain period. However, this period must be limited, declared and extended only as long as needed in order to remove the sensitive data. At former military facilities which are now closed and where there is still sensitive information, verification could use containment, surveillance and additional observation from the outside for a limited period. The question of how much managed access is possible in the event of strong suspicions remains to be investigated.

78. Also the Plutonium Management and Disposition Agreement (PMDA)[83] between the US and the Russian Federation provides some interesting lessons learnt with regard to the protection of sensitive information during inspections. In order to conceal the secret isotopic composition of excess plutonium, the agreement describes how excess plutonium could be diluted with “blend stock” plutonium of a different isotopic composition, so that information about the original plutonium composition is not revealed. Nevertheless, even if the isotopic composition were to be revealed, an additional proliferation risk would probably not be created because it is generally known that the NWS prefer a high plutonium-239 content for their weapon plutonium and a high uranium-235 content for their weapon uranium. It is however possible that material pieces or equipment used to measure the amounts in nuclear weapon components could be found at production sites. This information is regarded as being much more sensitive to be revealed. An urgent task at such a facility would therefore be the withdrawal of such equipment in order to pave the way for safeguards to be applied. The CWC also contains an annex on the protection of confidential information, and provides measures for protecting sensitive installations, which will be useful for future efforts.

<https://www.nti.org/media/pdfs/Whiteson_MacArthur_1998_IBs_in_the_Trilateral_Initiative_-_Conceptual_Design.pdf?_=1439480184>.

[82] Some of the results are presented in: Session 17: Verification Technology for Nuclear Disarmament, Symposium on International Safeguards: Verification and Nuclear Material Security, IAEA, Vienna, Austria, 29 Oct.– 1 Nov. 2001.

[83] Agreement between the government of the USA and the government of the Russian Federation concerning the management and disposition of plutonium designated as no longer required for defence purposes and related cooperation, signed at Moscow and Washington on 29 August and 1 September 2000 and entered into force on 13 July 2011, available at <https://www.state.gov/documents/organization/213493.pdf>.

Undeclared stocks

79. Although important, focusing exclusively on verifying the accuracy of declared information about activities and facilities is not always sufficient for determining compliance. A much more difficult verification challenge is the detection of undeclared stocks. Verification must therefore assure parties that there is a high detection probability for any stocks, which would deter States to hide stocks while pretending to disarm completely. The first step to achieve this is through a gradual process of comprehensive material accountancy of all nuclear materials in possession of a State. Public awareness ("Societal verification"[84]) combined with targeted unannounced inspections represent may contribute to verification regime in some states. In this case the risk of cheating would be too high because of potential defectors. Also, inconsistent material accountancy that does not have a plausible explanation could raise suspicions.

3. Detecting production at clandestine facilities

80. Effective methods for the detection of clandestine production are NTM, including the use of intelligence information, societal verification, environmental sampling, wide area monitoring, and on-site inspections. Since all production requires feed material, also full scope material accountancy and reconstruction of past production will contribute. Also satellite observations or aerial overflights could help in this regard. For less developed states, another verification method is observing international trade, which is also currently being used as an NTM method. The various methods form a synergy that creates a high confidence that an illegal activity can be detected and thereby discourages cheating.

4. Naval Fuel

81. Relatively little is officially known about submarine nuclear reactor designs, production technology, operational data and naval fuel specifications and stocks.[85] States use nuclear reactors in submarines due to their silence and long operation time without refuelling, which is necessary for strategic reasons. If all reactors would be converted to lower enriched fuel, as is envisaged for civilian research reactors, the use of HEU could be phased out altogether during the transition to a nuclear weapon free world. Especially in the last years, new reactor fuels have been developed that allow the conversion of civilian reactors from HEU to LEU fuel. Similarly, it could be envisaged to convert all naval reactors to LEU fuel. This would also facilitate the verification of an FMCT. Yet, the accountancy of naval fuel stocks and production seems to pose a problem for the NWS. The reason for this is related to the secrecy attached to technical details of naval reactors and fuels. In this case, an automated system could use non-destructive assay (NDA) techniques used by the IAEA. This would confirm that the declared amount of HEU or plutonium was present in the fuel without revealing the details of its design.

VI. Institutional arrangements

82. Institutional arrangements for future nuclear disarmament verification agreements will have to be specifically tailored according to their scope and objective.[86] There seems to be broad consensus that a future verification body for nuclear disarmament verification should be politically impartial, technically capable and apply resource-efficient techniques. Verification invariably requires parties to provide information (or data) relating to their compliance. This may be transmitted directly between the parties or via a treaty commission,

[84] Societal verification refers to the process of using information generated and communicated by individuals or expert communities for arms control or non-proliferation treaty verification.

[85] Morten Bremer Maerli, "Deep Seas and Deep-Seated Secrets: Naval Nuclear Fuel Stockpiles and The Need for Transparency", Disarmament Diplomacy 49, August 2000.

[86] States that openly expressed their support for granting a central role for the IAEA in nuclear disarmament verification include Germany, Brazil, Canada, Mexico, Norway, China, Pakistan. States that find the mandate and structure of the IAEA inappropriate for international disarmament verification include the UK and India.

international organisation or the treaty depositary (the State, States or organisation charged with receiving documents from governments indicating their signature, ratification or accession to a treaty). For example, the parties to the INF and START treaties use special government departments and teams within the context of the respective treaty. The parties to the Anti-Personal-Mine-Ban Convention send their declarations to the United Nations Secretary-General, while the parties to the CWC use the OPCW.

83. It was shown above how nuclear verification can be undertaken unilaterally (through NTM) or bilaterally as in the strategic nuclear arms control treaties.[87] Yet it can also be undertaken regionally, as seen in the work of the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL) and the EURATOM. The South Pacific Forum has a mandate under the Treaty of Rarotonga to conduct special inspections under that treaty, and the Pelindaba Treaty established the African Commission on Nuclear Energy (AFCONE) to promote implementation of that treaty. Some States stated that the nuclear disarmament verification process will need to become multilateral before they start reducing quantities of nuclear weapons.[88] The principle examples are the IAEA, the OPCW and the CTBTO. They also include an executive body to provide oversight of the verification system and a conference of States parties to provide broad policy guidance (both bodies also have a role in compliance). International verification organisations help make verification techniques, technology and data accessible to all parties, including those that have no capacity to carry out verification themselves and enhance transparency and symmetry.

A. IAEA

84. Notwithstanding the current mandate of the IAEA, limited to obligations and the rights under the NPT, it has many decades of experience and, on the basis of providing it with the necessary resources and an extended mandate appears well suited to implement and oversee verification provisions, not least because all nuclear possessor states, with the exception of the DPRK, are already members of the organisation.[89] Furthermore, best utilisation of the already existing expertise and infrastructure will save administrative costs and reduce financial burdens on States parties. One could also imagine having an Implementation Support Unit (ISU) tasked with the political aspects of implementation backed by the IAEA as the technical implementation body. The IAEA also has derived relevant experience and has been involved in aspects of nuclear disarmament before: through its role in the dismantlement of South Africa's nuclear weapons in the early 1990s, as part of the Trilateral Initiative from 1996–2002, and, today, as the organisation that is developing a technical verification scheme for the US-Russian PMDA. The annual budget for the IAEA amounts to approximately US$400 million of which $150m were allocated for verification activities in 2016. Depending on the nature of any additional verification activities, resourcing would likely need to be revisited with a view to increasing funding.[90] Involving the IAEA in nuclear disarmament would reduce asymmetries between the commitments of the five NPT-recognised NWS and those already assumed by the NNWS. Establishing another body for this purpose could undermine the IAEA safeguards system and would risk a duplication of efforts.

85. A role for the IAEA could require an adapted mandate which could build on the following provisions:

- Art. III.A.5 authorises the IAEA: "To establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and

[87] Examples are the Special Verification Commission established for the INF Treaty and the Bilateral Implementation Commission established by the 2002 Moscow Treaty.

[88] See the speech by former UK Secretary of Defence Des Browne to the Conference on Disarmament, Laying the Foundations for Multilateral Disarmament, 5 February 2008, available at <http://www.labour.org.uk/des_browne_conference_on_ nuclear_disarmament>.

[89] The Democratic People's Republic of Korea (DPRK), which joined the IAEA in 1974, withdrew its membership of the IAEA in 1994.

[90] UNIDIR, Nuclear Disarmament Verification, 2016, available at <http://www.unidir.org/files/publications/pdfs/survey-of-verification-mechanisms-en-657.pdf>.

information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of that State's activities in the field of atomic energy."

- Art. III.B.1. provides that: In carrying out its functions, the Agency shall: 1. Conduct its activities in accordance with the purposes and principles of the United Nations to promote peace and international co-operation, and in conformity with policies of the United Nations furthering the establishment of safeguarded worldwide disarmament and in conformity with any international agreements entered into pursuant to such policies.

86. Although the IAEA might naturally be seen as the appropriate organisation to receive and verify stockpile declarations, the involvement of personnel from NNWS could present an obstacle for NWS. While it is true that any inspector, from any type of inspection regime, could learn military secrets, this problem is not something that exclusively applies to the IAEA as a verification organisation. Additionally, the IAEA has a long history and experience in handling sensitive or secret information. In order to compromise between these positions, future discussions could consider forming an inspectorate under IAEA auspices exclusively using personnel drawn from NWS. These arrangements could partly address the concerns of the NNWS for wider accountability while protecting sensitive weapon design information at the same time.

B. Regional Organisations

87. Regional safeguards systems could still play an important role in a future verification mechanism. There are several areas in which the organisations could cooperate. These include infrastructure and equipment sharing, global communications infrastructures, as well as training of staff. The success of EURATOM has already witnessed enhanced mutual confidence and cooperation in the region. Also, the ABACC conducts inspections and verifies physical inventories and implements a common system for accounting and control of nuclear materials to enable IAEA verification. ABACC contributed in replacing strong suspicion between the two countries by confidence in their peaceful intentions. Analogous future regional systems could be established in Asia (ASIATOM), in South Asia, in the Middle East, including Pakistan, India and Israel, and in the former CIS and Eastern Europe, including the NWS Russia.

88. Since 1957, one of the roles of EURATOM is to carry out nuclear safeguards inspections to ensure that nuclear materials are used only for the purposes declared by the users. This entails verifying the correctness of European Union nuclear operators' declarations by measurements and by auditing the operators' accountancy and control systems. The facilities where the materials are handled or stored have to be declared to EURATOM in detail and the related activities and processes need to be fully understood by the safeguards inspectors. Compared to those of the IAEA, EURATOM safeguards inspectors claim the additional experience of inspecting nuclear-weapon States (France and the United Kingdom) in a comprehensive and non-discriminatory manner.[91] Indeed, the EURATOM safeguards mandate is identical across NWS and the NNWS of the EU. While military material is not part of the scope of EURATOM safeguards in any State, it is noteworthy that some NWS facilities hold or have held both civil and military material at the same time. The EURATOM safeguards system is thus unique in being an international inspection body with long experience of inspecting mixed facilities whose expertise will be beneficial for the GGE and any future efforts during verification discussions.

89. The ABACC treaty was concluded in 1991 under the Guadalajara Agreement between Argentina and Brazil for the exclusively peaceful use of nuclear energy. The agency is responsible for administering a Common System of Accounting and Control (SCCC), a full-

[91] Peter Schwalbach, "EURATOM Safeguards experience and future verification regimes", Institute of Nuclear Materials Management, 2015.

scope safeguards system established to verify that nuclear materials used in all nuclear activities in both countries are not diverted to purposes prohibited by the agreement. In implementing the SCCC, the ABACC carries out inspections, designates inspectors, evaluates inspections, engages the necessary services to ensure fulfilment of the SCCC objectives, and is empowered to represent Brazil and Argentina before third parties in connection with the implementation of the SCCC. Under a Quadripartite Agreement[92] between the two governments, the ABACC and the IAEA, the IAEA is given the responsibility for applying full safeguards in both countries. If a country were found to be in non-compliance, the IAEA would refer the case to the Security Council. The ABACC's verification process has three distinct stages:[93] examination of material supplied by the country, collection of information by the ABACC as to the outcome of inspections to verify design information and records and reports, and to verify nuclear material, as well as special inspections in case of any serious discrepancy.

90. Such existing regional systems are closely interrelated with respective security arrangements in the respective region and have the advantage of making verification tasks more acceptable and tolerated if conducted by regional authorities rather than IAEA inspectors. They would also play an important role in enhancing mutual trust and in practical cooperation. These regional systems could help implement safeguards in all member states in a non-discriminatory way. As a result, the more verification tasks are assigned to regional safeguards, the lower are the additional costs and work burden that are needed for IAEA verification. Flexibility in cooperation and task sharing between the IAEA and regional systems should be universally allowed and promoted and cooperation between the two could gradually be enhanced, thereby strengthening the roles of both organisations.

C. OPCW

91. The OPCW[94] consists of the Conference of the States Parties, the Executive Council and the Technical Secretariat. The Conference, which oversees the implementation of the Treaty, meets annually and may also convene in special session on request. The Executive Council, the executive body, is responsible to the Conference. It has 41 members elected by the parties according to geographic region and meets in regular session three to four times a year. Decisions in both the Conference and the Executive Council are by consensus or, if consensus cannot be reached, by a two-thirds majority on matters of substance. The Council may take decisions on procedural matters by simple majority. The Technical Secretariat is responsible for implementing the verification regime, including processing declarations and carrying out on-site inspections. The Director-General of the OPCW oversees the Secretariat's daily operations.

92. The first advantage is that using the OPCW-type mechanism would immediately minimise differences in implementation in the three types of states involved: NWS, the de facto nuclear-weapon states, and the NNWS under the NPT. Nonetheless, there are also drawbacks of pursuing such a course. Firstly, establishing an entirely new organisation would complicate (and possibly stall) any future negotiations on verification. Secondly, such a verification system could be very expensive, duplicate efforts, lack the required resources and expertise and create additional layers of bureaucracy. After all, considering the fact that existing international organisations have budget constraints, it remains to be seen where the

[92] Agreement of 13 December 1991 Between the Republic of Argentina, the Federative Republic of Brazil, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials and the International Atomic Energy Agency for the Application of Safeguards, IAEA document INFCIRC/435, March 1994.

[93] Nuclear Threat Initiative, "Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC)", established on 18 July 1991, available at <http://www.nti.org/learn/treaties-and-regimes/brazilian-argentine-agency-accounting-and-control-nuclear-materials-abacc/>.

[94] States that openly expressed their support for granting a central role for the OPCW in nuclear disarmament verification include India.

international community would find the financial resources for a new international multilateral verification organisation.

D. CTBTO

93. Despite the CTBT not having entered into force, another success story is the detailed CTBT verification regime, which consists of three main elements[95]: The International Monitoring System (IMS). The IMS has 337 monitoring facilities, 321 monitoring stations and 16 radionuclide laboratories around the globe. Its verification technologies detect, locate, and identify nuclear explosions: Seismic stations monitor the ground for shock waves generated by explosions; Infrasound and hydro-acoustic stations listen for corresponding sound waves; and Radionuclide stations scan the atmosphere for traces of radioactive particles and gases, which indicate whether a given explosion is nuclear. Data collected by the IMS is transferred in real time via six geostationary satellites and secure terrestrial communication lines of the Global Communications Infrastructure to the International Data Centre (IDC) in Vienna, the second pillar of the verification regime. The data are analysed to detect, locate, and identify natural and man-made events, including potential nuclear events. From the IDC, data and analysis, both automated and human, are forwarded to the CTBTO Member States. The remaining element of the global alarm system is the On-site Inspection (OSI) regime, which provides clarity on an event recorded by the IMS and analysed by the IDC. Although an OSI can be invoked only after entry into force of the CTBT, OSI procedures have already been established and tested in the field.

94. The CTBTO, with international support, has established a monitoring network to globally monitor compliance with the CTBT. The CTBTO has made significant progress in setting up its International Monitoring System (IMS): In October 2017, more than 85 percent of the planned global IMS network of 337 facilities was operational and certified, with four more percent installed or under construction. The IMS impressively demonstrated its abilities, in particular in the six North Korean nuclear tests since 2006, most recently on 3rd September 2017, which was localised and identified in a short time and with great precision as an artificially induced seismic event. Furthermore, the IMS provides valuable civil and scientific data, for example, for tsunami warning and earthquakes of natural origin.

VII. Legal considerations and measures to ensure compliance, including sanctions

95. State parties to a future verification agreement are expected to and must comply with its terms as a matter of international law. There is broad consensus that States parties should play the main role in assessing cases of non-compliance in a non-discriminatory manner. A practical process to address allegations of non-compliance will need to be established and negotiations would need to agree on the procedure to be followed when conducting a clarification measure in the State party concerned. The following procedural elements could form the basis for such discussions:

A. Notification of possible non-compliance

96. Depending on the verification authority, any state party may inform the body in charge of assessing and analysing cases of possible non-compliance. This should be done on the basis of substantiated information of any situation giving cause for concern with regard to compliance by another State party with its basic obligations under the agreement.

[95] Ibid, supra note 32.

B. Examination of a non-compliance claim

97. The relevant treaty body should examine and assess such claims in the light of all the information available to it as received from all relevant sources, such as the IAEA, civil-society or National Technical Means (NTM). The advantage of using a cooperative approach is that in case of serious concern, the body investigating the claim and the state party concerned would consult together. Such serious concern may arise from information received from a state party or in connection with regular verification activities. Following such consultations, the verification authority may request the state party concerned to provide clarifications or take promptly any other measure that may be necessary to clarify the situation and facilitate its resolution. In response, the state party concerned should promptly provide clarifications.

98. In the absence of a response from the state party concerned or in the event that the clarifications provided fail to clarify the situation, the verification authority may initiate a clarification inspection or any other action it may deem necessary in order to clarify the situation. The authority may not reject the explicit request of a state party to conduct a clarification inspection on the territory of another state party unless the former is able to demonstrate that the request is abusive and/or frivolous. Only where serious concerns are identified and where cooperative deliberations are unproductive or inconclusive, would a finding of non-compliance be made. Such a finding would need to be communicated to the body implementing verification and States parties.

C. Measures to redress the situation

99. The verification authority may make detailed recommendations to States parties on appropriate measures within its remit, with a view to redressing the situation and ensuring compliance with the agreement. States parties should then take necessary measures to ensure compliance and redress or remedy any situation, which contravenes the provisions of the agreement. The verification authority should also, based on the inspection report and all other relevant documents relating to the situation that it may receive, determine whether the agreement has been violated. In case of a confirmed violation of the agreement, the verification authority should urge the state concerned to put an immediate end to the situation.

100. If it is not possible to deal with an issue of non-compliance through the above-mentioned procedures and actions the verification authority could bring the issue, including any relevant information and conclusions, to the attention of the UN General Assembly and/or the UN Security Council. The Statute of the IAEA demands that any violation of a safeguards agreement shall be reported to the UN Security Council, which may decide to take further action in accordance with the Charter of the United Nations, such as obligatory sanctions (or even military intervention) under Chapter VII of the Charter.[96] In general, non-compliance should not only be dealt with in the UN Security Council but also in the General Assembly in a non-discriminatory manner. This is mainly because the former would be unsuitable to deal effectively with cases of non-compliance by a permanent veto-wielding member.

D. Sanctions and dispute settlement

101. If after having been requested by the verification authority to redress a situation, a State party still fails to fulfil the request within a specified time (time frame to be negotiated), the authority may decide to restrict or suspend the exercise, by that state, of the rights and privileges it enjoys under the agreement until such time as the verification authority decides otherwise. Measures under the NPT also include the curtailment or suspension of assistance and the return of materials and equipment. Such punitive measures may contain the suspension of membership from decision-making bodies or collective measures, such as

[96] Also under the CTBTO, the Conference and the Council both have the option to bring a case of Treaty violation to the attention of the United Nations, for instance the UN Security Council.

voluntary sanctions or other measures in conformity with international law. Given the experiences with UN security council being involved in the possible sanctioning of violations of the CWC, the involvement of the UNSC in nuclear disarmament verification disputes does not look practical.

102. Any disputes that may arise concerning the application or interpretation of the agreement should be settled in conformity with the Charter of the United Nations. When a dispute arises between two or more states parties, or between one or more states parties and the verification authority, the parties concerned should consult together with a view to expeditious settlement of the dispute. This should involve negotiations or other peaceful means of the parties' choice, including recourse to appropriate organs of the agreement and, by mutual consent, referral to the International Court of Justice (ICJ). The verification authority may separately request the ICJ to give an advisory opinion on any legal question arising within the scope of the activities relating to this treaty. A future verification agreement may take into account already existing dispute settlement provisions of major multilateral arms control and disarmament treaties. For example, under the NPT, the IAEA statute stipulates that when there are disputes over the interpretation or application of the IAEA statute that cannot be resolved through negotiations, and parties are unable to agree on any other forum or mode of settlement, the issue is referred to the ICJ.

E. Possible complications

103. Complications could arise in dealing with non-compliance in states with existing IAEA obligations under multiple regimes, with possibly different executive bodies of divergent membership. This concern merits further consideration during negotiations. Some of the legal points that need to be considered include the compatibility of a future verification agreement with pre-existing legal provisions or restrictions that may constrain the type of verification activities States can commit to. These can include domestic legislation on the handling of sensitive information as was shown above with the McMahon Atomic Energy Act of 1946, and regulations on health, safety, and security at facilities. For example, NWS under the NPT undertake not to transfer nuclear weapons, nor to assist or encourage any NNWS under the NPT to manufacture or otherwise acquire nuclear weapons. A NWS therefore cannot commit itself to disarming by transferring NW to any other party or in any way assist or encourage a NNWS to pursue or acquire NW. Similarly, since the NPT does not include any legal procedure to describe how a NWS might transition into a NNWS through disarmament. A State that has dismantled its unclear weapons may be considered a NNWS, but aspects of the reporting and safeguarding obligations that come with this designation may be incompatible with its NPT obligations not to reveal information regarding the proliferative or sensitive outputs of nuclear weapon dismantlement. Scenarios from the UKNI, in which it aimed at exploring issues relating to nuclear arms control without the risk of transferring information that might violate their non-proliferation commitments under the NPT will be helpful in this regard.