

# 1. The TPNW and nuclear disarmament verification: shifting the paradigm *Sébastien Philippe and Zia Mian*

The 2017 Treaty on the Prohibition of Nuclear Weapons (TPNW) represents a major shift, long in the making, in how states organize themselves and the international order on the issues of the prudential and moral risks associated with nuclear weapons, as well as the responsibilities for their elimination. The preamble to the treaty and its core obligations reflect the states parties' recognition of the "catastrophic humanitarian consequences that would result from any use of nuclear weapons" and that "any use of nuclear weapons would be contrary to the rules of international law applicable in armed conflict, in particular the principles and rules of international humanitarian law". It makes clear that, for states parties, "the risks posed by the continued existence of nuclear weapons" for "the security of all humanity" outweigh any possible benefits, and there are thus "ethical imperatives for nuclear disarmament", which is "a global public good of the highest order, serving both national and collective security interests".<sup>1</sup>

By joining the Treaty, states signal to their national populations and institutions, to each other and to the broader international community that they fully adhere to these principles. This would also be the case for a nuclear-armed state acceding to the Treaty. In publicly preparing itself to join the Treaty, a nuclear weapon state would need to go through transformative processes involving its national decision-making to confront and renounce its nuclear weapon status, as well as the related steps involved in complying with the Treaty's core prohibitions and disarmament obligations. It is in this context of high-level political debates and decisions to remake national identity, national priorities, and

national security institutions, practices and ideas, and to cultivate a sense of belonging to a trusted international political community that a former nuclear weapon state would need to cooperate with other state parties and a TPNW-designated competent authority or authorities for "the purpose of verifying the irreversible elimination of its nuclear weapon programme".<sup>2</sup>

This essay reflects on the nature, significance and implications of this approach to disarmament and the paradigm shift in verification it allows. It outlines a perspective on what the Treaty describes as "irreversible, verifiable and transparent" disarmament leading a state through to the "elimination of its nuclear weapon programme". It outlines how TPNW verification processes could reflect this paradigm of irreversible and transparent disarmament that focuses on the nuclear weapon programme level, rather than copying verification measures from agreements to restrain or limit nuclear weapon numbers – the latter being shaped by ideas and practices of distrust, opacity and secrecy involved in protecting weapon stockpiles, nuclear deterrence policies and related programmes.

Unlike past nuclear weapon agreements, TPNW disarmament-verification arrangements would not be the result of a bargaining process for the purpose of regulating the nuclear weapon capabilities and competition relationship between competing adversarial states. On the contrary, the purposes of verification would be to demonstrate the profound ongoing reforms – political, legal, military, institutional, social and technological – that a state is undertaking to demonstrate adherence to the Treaty's core principles

1 Treaty on the Prohibition of Nuclear Weapons, A/CONF.229/2017/8, 7 July 2017, <https://undocs.org/en/A/CONF.229/2017/8>, Preamble.

2 Treaty on the Prohibition of Nuclear Weapons, Article 4.

and prohibitions at home and abroad. Such arrangements may be different whether a nuclear weapon state disarms first and then joins the Treaty, or vice versa. In the latter case, the disarming state is required to play a proactive role in the verification process by submitting the first version of “a legally binding, time-bound plan for the verified and irreversible elimination of that State Party’s nuclear-weapon programme, including the elimination or irreversible conversion of all nuclear-weapons-related facilities” to a competent authority designated by the state parties.<sup>3</sup> The Treaty requires the International Atomic Energy Agency (IAEA) to be involved in monitoring the enduring non-nuclear status of states that had nuclear weapons and that disarmed before or after joining the Treaty.

Here we understand verification as the combination of national political, institutional and technical arrangements and mechanisms that are leveraged to demonstrate – domestically as well as internationally – a state’s transformation into one that is transparently and irreversibly in compliance with the obligations it undertakes as part of the TPNW. This is similar to the model of verification as “active reassurance” regarding disarmament commitments through public voluntary unilateral steps described by Bruce Larkin.<sup>4</sup> The emphasis in such active reassurance measures would be showing to all concerned the scope of the public renunciation and transformation of the particular policies, institutions, technologies, investments and capabilities that constitute a nuclear weapon programme and allow a state to be a nuclear-armed state.

As we will discuss, beyond familiar approaches that focus on nuclear weapons and nuclear weapon material, disarmament verification can leverage these profound political, institutional and legal transformations that are expected to take place as a state renounces nuclear weapons. We will then show how important these transformations can be in

shaping the judgement of others who must decide on the adequacy of this disarmament process in terms of the TPNW goals and obligations. Understanding the implications of this paradigm shift is useful for the future institutionalization of the Treaty and the development of disarmament-verification arrangements that would best fit its goals and purpose. It is also a chance for TPNW state parties to offer a new practical path towards disarmament, rather than wait for the nuclear-armed states to continue stumbling along the stop–start, one step forward two steps back journey of adversarial arms control put in place 50 years ago, in May 1972, with the first US–Soviet Strategic Arms Limitation Treaty (SALT I) and the Anti-Ballistic Missile Treaty.

### **Putting disarmament and verification in context**

The notion of nuclear disarmament here is not simply as a policy goal to be reached, but disarmament as processes of profound state transformation involving the unmaking of deeply entrenched and embedded national identity, policy, priorities, and political and institutional commitments and capabilities attached to nuclear weapons and the threat of their use. William Walker has observed that,

The anchors of nuclear weaponry are to be found more within states than in their external relations—in the preoccupation with identity, in vested interests, in entrenched loyalties and bureaucratic processes, in material “facts on the grounds” and weapon succession processes, in cultures of conformity and in factional struggles among other things.<sup>5</sup>

These anchors are what sustain the “thrust of exterminism” in nuclear-armed states, identified by E.P. Thompson as a configuration “whose institutional base is the weapons system, and the entire economic, scientific, political and ideological support system to that weapons system, the social system

3 Treaty on the Prohibition of Nuclear Weapons, Article 4, paragraph 2.

4 B.D. Larkin, *Designing Denuclearization: An Interpretive Encyclopedia*, 2008.

5 W. Walker, “On Nuclear Embeddedness and (Ir)Reversibility”, Program on Science and Global Security”, Working paper, Princeton University, February 2020, <https://sgs.princeton.edu/sites/default/files/2020-02/walker-2020.pdf>.

which researches it, ‘chooses’ it, produces it, policies it, justifies it and maintains it in being”.<sup>6</sup> It is these “internal sources of embeddedness” and this “exterminist” structure that will need “disembedding” as part of a disarmament transition from nuclear-armed state to nuclear weapon-free state in the TPNW. To echo William Walker, “nuclear disarmament and significant steps in its direction must always involve, beyond the traditional effort in persuasion, negotiation and regulation, an exercise in disembedding an enterprise and set of beliefs, attitudes and ideas that have deep and resilient foundations.”<sup>7</sup>

The context in which nuclear-armed states decide to disarm and the political judgements and narratives that are at work to make and justify this decision matter.<sup>8</sup> Policymakers in nuclear-armed states will need to argue for and justify a shift to disarmament as part of their internal policy debates, to domestic public audiences, to rival states and allies, and to the broader international community. They will need to shift away from long-standing official narratives of national security that have served to justify a role for nuclear weapons. The role of national identity and national narratives will be as important for disarmament as it seems to have been for states seeking nuclear weapons and for such states working to maintain their nuclear weapons and status.<sup>9</sup>

In the past, important disarmament debates have been framed in a security-first perspective, with great weight attached to the need to restrain adversaries, the possibility of technological and strategic substitutes for nuclear weapons, and options for keeping or gaining strategic and military advantage.<sup>10</sup> In 1999, the US Secretary of State, Madeline Albright, argued that the 1996 Comprehensive Nuclear-Test-Ban Treaty (CTBT) served to create a major US advantage: “Under the CTBT, America would gain the security benefits of outlawing nuclear tests by others, while locking in a technological status quo that is highly favorable to us. We have conducted more than 1,000 nuclear tests—hundreds more than anyone else.”<sup>11</sup>

For the TPNW, however, the argument for disarmament aims to break the link between nuclear weapons and security and to reject claims about the utility, morality and legality of using and threatening to use nuclear weapons. It relies on making the case that nuclear weapons are intrinsically a crime against humanity and should be seen and treated as immoral, illegal and illegitimate. This allows policymakers in nuclear weapon states to frame arguments for joining the TPNW in ways other than managing national and international security. They could for instance highlight the 1961 United Nations General Assembly resolution that “any state using nuclear and thermo-nuclear weapons

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6 E.P. Thompson, “Notes on Exterminism, The Last Stage of Civilization”, *New Left Review*, no. 121, May/June 1980, p. 22.

7 Walker, “On Nuclear Embeddedness and (Ir)Reversibility”.

8 Z. Mian, “Beyond the Security Debate: The Moral and Legal Dimensions of Abolition”, in G. Perkovich and J. Acton (eds.), *Abolishing Nuclear Weapons: A Debate*, Carnegie Endowment, 2009, <https://carnegieendowment.org/2009/02/13/abolishing-nuclear-weapons-debate-pub-22748>.

9 M.J. Sherwin, *A World Destroyed: Hiroshima and the Origins of the Arms Race*, 1975; D. Holloway, *Stalin and the Bomb*, 1994; S.D. Sagan, “Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb”, *International Security*, vol. 21, no. 3, 1997, pp. 54–86; J.E.C. Hymans, *The Psychology of Nuclear Proliferation: Identity, Emotions and Foreign Policy*, 2006; W. Walker, *A Perpetual Menace: Nuclear Weapons and International Order*, 2011; B. Heuser, *Nuclear Mentalities?: Strategies and Beliefs in Britain, France and the FRG*, 1998; N. Ritchie, “Valuing and devaluing nuclear weapons”, *Contemporary Security Policy*, vol. 34, no. 1, 2013, pp. 146–173; J. Baylis and K. Stoddart, *The British Nuclear Experience: The Role of Beliefs, Culture and Identity*, 2015; B. Pelopidas, *Repenser les Choix Nucléaires [Rethinking Nuclear Choices]*, 2022.

10 Z. Mian, “The American Problem: The United States and Noncompliance in the World of Arms Control and Nonproliferation”, in E. C. Luck and M. W. Doyle (eds.), *International Law and Organization: Closing the Compliance Gap*, 2004.

11 M. Albright, “A Call for American Consensus”, *Time*, 22 November 1999.

is to be considered as violating the Charter of the United Nations, as acting contrary to the laws of humanity and as committing a crime against mankind and civilization”.<sup>12</sup>

Humanitarian arguments have the benefit of being about people and not being about “enemies”. These arguments are universal in application and available equally to all states and all audiences. They can be used consistently both at home and abroad. They also serve both to expand the elite policy process and to mobilize domestic constituencies for a policy of disarmament that can help counter opposition from existing entrenched and vested interests. Finally, these arguments serve to strengthen a way of thinking, a set of values and national self-images that allow states to break with the embedded security-dilemma sensibility that today shapes their interpretation of the intentions and actions of others, and their responses to such interpretations. This break and the new structure of feeling it allows can create a particular kind of political community with embedded “properties of trust” that would help restrain states from building nuclear weapons and taking other kinds of hostile action, including resorting to war.<sup>13</sup>

Security-dilemma thinking has been key to approaches towards both arms control and verification in existing nuclear arms control and non-proliferation agreements. As US arms control theorist Thomas Schelling observed, the need in the Cold War nuclear arms race was to find ways to “tranquelize relations... while hating and distrusting”.<sup>14</sup> During the Cold War, verification was often designed as a technical remedy for the absence of US political trust in the Soviet Union and for the lack of transparency that

the United States associated with the Soviet political regime. As Arvid Schors has noted, “The history of nuclear arms control negotiations during the Cold War was, if nothing else, a history of the US government openly flaunting that it could not and would not trust the Soviets under any circumstances.”<sup>15</sup>

In a classic analysis of the US politics of verification as part of arms control, Alan Krass has argued that,

On the US side the almost total absence of trust in the Soviet Union is generally asserted as the foundation of US compliance policy... To the USA, verification must be based on the premise of distrust, that is, the assumption that states (or at least the Soviet Union) sign treaties while maintaining the option, if not the conscious intent, of secretly violating the agreements if an opportunity presents itself in the form of either complacency or irresolution on the other side.<sup>16</sup>

For Krass, “this almost ritualistic incantation” of mistrust and thus verification “serves the purpose of demonstrating that the speaker is not a sentimental disarmer or unwitting dupe of Soviet trickery. To some extent it is a “credibility ritual” which US actors have come to expect of anyone with pretensions to expertise in arms control verification”. Krass also notes that there is also a practical constraint posed by the nature of nuclear arms control, since “Arms control agreements are limited instruments which regulate only relatively narrow aspects of the military and political competition. It is assumed that the competition continues unabated in all areas not covered by the agreement. Anything not forbidden is permitted.”<sup>17</sup>

12 General Assembly Resolution 1653, “Declaration on the Prohibition of the Use of Nuclear and Thermo-Nuclear Weapons”, 24 November 1961, [https://undocs.org/en/A/RES/1653\(XVI\)](https://undocs.org/en/A/RES/1653(XVI)).

13 K. Booth and N.J. Wheeler, *The Security Dilemma: Fear, Cooperation and Trust in World Politics*, 2008.

14 T.C. Schelling, “Reciprocal Measures for Arms Stabilization”, *Daedalus: Proceedings of the American Academy of Arts and Sciences*, vol. 89. no.4, fall 1960, p. 894.

15 A. Schors, “Trust and Mistrust and the American Struggle for Verification of the Strategic Arms Limitation Talks, 1969–1979”, in M. Klimke, R. Kreis and C. F. Ostermann (eds.), “Trust, but Verify”: *The Politics of Uncertainty & the Transformation of the Cold War Order, 1969–1991*, 2016; N.J. Wheeler, *Trusting Enemies*, 2016.

16 A. S. Krass, *Verification: How Much is Enough?*, SIPRI, 1985, p. 161.

17 *Ibid.*, p. 162.

In the Soviet Union, arms control was seen as much more of a political process to address security concerns than a technical approach to managing strategic stability.<sup>18</sup> Technical verification arrangements and, in particular, on-site inspections were often painted as unnecessary and intrusive and providing little benefit as long as both states agreed politically in principle on arms reductions and limitations.<sup>19</sup> This inherent tension could only be resolved through protracted negotiations, which under some circumstances can constitute and reflect practices of trust-building.<sup>20</sup> Even with a view supporting the primacy of reaching political agreement and direct negotiations, the trust is clearly partial since nuclear weapons and adversarial postures remain.

Another clear expression of the intrinsically distrustful dynamics built into arms control and related verification processes can be seen in one particular feature of existing nuclear arms control and non-proliferation agreements: the explicitly or implicitly privileged role of national technical means and intelligence gathering that exists outside and separate from negotiated verification processes. The lead US negotiator of the 2010 US–Russian New Strategic Arms Reduction Treaty (New START), Rose Gottemoeller, has highlighted that,

From the earliest days of negotiated nuclear arms control in the 1970s, non-interference with national technical verification has been a basic principle to which both sides can agree ... Non-interference with national technical verification was one of the earliest and easiest points of agreement in the New START negotiations.<sup>21</sup>

This probably reflects how, in both the United States and the Russian Federation, there is a prevailing view that national technical means and intelligence are a more trusted basis for domestic political judgement about treaty compliance by a treaty partner than the mechanisms under the treaty's agreed verification regime. This reliance on national technical means carries the implicit assumption that a state that has agreed to a treaty and its verification measures is still not to be trusted to comply and that the agreed verification may prove inadequate.

The entrenchment of Cold War nuclear weapon institutions, arsenals, policies and ways of thinking extends to current discussions of the nature, role and practices of arms control and non-proliferation verification, even when it comes to global nuclear disarmament.<sup>22</sup> Post-Cold War agreements dealing with nuclear weapon issues include long and detailed text and annexes on verification. Examples include New START and the 2015 Joint Comprehensive Plan of Action (JCPOA) on the nuclear programme of the Islamic Republic of Iran. Without such specificity, treaties are seen as nothing but an empty shell. For decades, these Cold War arms control verification ideas and practices have served effectively as a paradigm, especially in the United States, in that they have provided shared “model problems and solutions to a community of practitioners” based on “examples which include law, theory, application, and instrumentation together” and have worked “implicitly to define the legitimate problems and methods ... for succeeding generations of practitioners”.<sup>23</sup> One attribute and function of a paradigm is to prepare each new generation to join and build on the work

18 R. Ranger, *Arms and Politics 1958–1978: Arms Control in A Changing Political Context*, 1979.

19 Krass, *Verification*.

20 N.J. Wheeler, J. Baker and L. Considine, “Trust or Verification? Accepting Vulnerability in the Making of the INF Treaty”, in Kimke et al. (eds.), “Trust, but Verify”; Wheeler, *Trusting Enemies*.

21 R. Gottemoeller, “The New START Verification Regime: How Good is it?”, *Bulletin of the Atomic Scientists*, 21 May 2020, <https://thebulletin.org/2020/05/the-new-start-verification-regime-how-good-is-it>.

22 N.E. Busch and J. F. Pilat. *The Politics of Weapons Inspections: Assessing WMD Monitoring and Verification Regimes*, 2017.

23 T. Kuhn, *The Structure of Scientific Revolutions* (2nd edn. enlarged), 1970, pp. 10–11.

of others already in the community “who learned the bases of their field from the same concrete models, [and whose] subsequent practice will seldom evoke overt disagreement over fundamentals”.<sup>24</sup> This all works as ways of “signaling the gestalt in which the situation is to be seen”.<sup>25</sup>

Seeing traditional arms control and its verification as a paradigm highlights the limits of the critique that the TPNW is weak with regard to verification since it does not include the familiar perspectives and arrangements related to verification (including a priori suspicion of possible cheating and requirement to deter non-compliance).<sup>26</sup> This of course shows only that the TPNW is not just another arms control treaty – it is not similar to the earlier models and examples familiar to nuclear arms control and is not intended to be so. The debate does highlight the importance of seeing verification and, in a broader sense, judgments about compliance, as not just the sole product of explicit treaty-specified often-technical arrangements, and of national technical means where available, that are disconnected from existing and emerging institutional, political, legal and technical contexts.

Historically, the United States has relied on its national technical means as a critical source of independent information for its assessments of treaty obligations. In contrast, many other states see such a capability as unnecessary or simply unfeasible. Such states are much more trusting in institutional arrangements between states and with third parties. For example, the non-nuclear weapon states in the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) do not inspect each other; they accept inspection arrangements negotiated with the IAEA.

States within nuclear weapon-free zones accept the commitments made by their neighbours based only on arrangements that these neighbours have made separately through the NPT. It is notable that even the Brazilian–Argentinian bilateral monitoring system, the Brazilian–Argentine Agency for Accounting and Control (ABACC), has the IAEA as a third partner.

The TPNW relies first on a competent international authority (or authorities) to be designated and possibly shaped by the state parties to verify the irreversible elimination of an acceding state’s nuclear weapon programme, and second on the IAEA for the post-disarmament safeguards agreement providing “credible assurance of the non-diversion of declared nuclear material from peaceful nuclear activities and of the absence of undeclared nuclear material and activities in that state [party] as a whole”.<sup>27</sup> In this way, the Treaty recognizes that it is not operating in a vacuum and leverages existing international instruments and institutions. But it also implicitly – and significantly – recognizes the need for dedicated and possibly new institutions to facilitate a disarmament-verification process that has been largely dominated by nuclear weapon states.

The competent international authority (or authorities), whose goal is to negotiate verification arrangements related to the elimination of nuclear weapon programmes, has yet to be designated. Proposals have ranged from creating a new dedicated organization to establishing an evolutionary organization that can be adapted to be fit-for-purpose when needed, rather than a permanent set of capabilities given the material and financial constraints of state parties.<sup>28</sup> Whatever models

24 Ibid., p. 11.

25 Ibid., p. 189.

26 NATO, “Speech by NATO Secretary General Jens Stoltenberg at the 16th Annual NATO Conference on Weapons of Mass Destruction, Arms Control, Disarmament and Non-Proliferation”, 10 November 2020, [https://www.nato.int/cps/en/natohq/opinions\\_179405.htm](https://www.nato.int/cps/en/natohq/opinions_179405.htm); Nuclear Threat Initiative, “Treaty on the Prohibition of Nuclear Weapons (TPNW)”, Fact sheet, September 2019, [https://media.nti.org/documents/tpnw\\_fact\\_sheet.pdf](https://media.nti.org/documents/tpnw_fact_sheet.pdf).

27 Treaty on the Prohibition of Nuclear Weapons, Article 4, paragraph 1.

28 T. Shea, *Verifying Nuclear Disarmament*, 2018; T. Patton, S. Philippe and Z. Mian, “Fit for Purpose: An Evolutionary Strategy for the Implementation and Verification of the Treaty on the Prohibition of Nuclear Weapons”, *Journal for Peace and Nuclear Disarmament*, vol. 2, no. 2, 2019, pp. 387–409.

will emerge, the implementation of the treaty is an opportunity for expanding the who (experts) and the what (institutions) that are responsible for crafting disarmament-verification approaches and methods away from existing structures of power that may act contrary to the goals of the TPNW.

Given past experiences with arms control and non-proliferation agreements, the absence from the TPNW of a detailed one-size-fits-all plan for verifying the irreversible elimination of any and all nuclear weapon programmes is more a strength than a weakness. The reason is twofold. First, because verification is political in nature, influenced by both international and domestic politics, and highly contextual, tailoring verification arrangements on a case-by-case basis is a far better strategy for the states parties that agree on the end goal. Second, the Treaty recognizes the prevalence of politics over technical and control arrangements in facilitating disarmament. By asking states to publicly commit domestically and internationally to a process of disarmament and verification upon acceding to the Treaty, rather than signing on to a fixed set of preconditions, the TPNW enables a state to model its verification arrangements as part of its own particular transition from nuclear-armed state to nuclear weapon-free state. This will allow each disarming state to put forward the most appropriate “active reassurance” measures in the form of public voluntary unilateral steps as part of its proposed legally binding, time-bound plan for the verified and irreversible elimination of its nuclear weapon programme.

Part of the paradigm shift enabled by the TPNW is also to change the purpose of verification and thus the relationship of goals, ends and means – the why, what for, and

when, the who, and the what of the verification process. As Nick Ritchie explains in chapter 2, the adversarial framing of verification and its current focus on the dismantlement of nuclear warheads is to a large extent politically motivated. It reflects the entrenched structures of power that assume among other things that nuclear weapons have enormous value and carry very sensitive and by implication valuable and desirable information. Because the assumptions that nuclear weapons have value and are desirable are explicitly rejected in the TPNW, there is no reason to focus so intensely on these aspects when designing disarmament-verification arrangements. As Alex Wellerstein shows in chapter 3, the protection of proliferation-sensitive information is also largely a social construct and there are political and technical ways to deal with it. And, as Togzhan Kassenova discusses in chapter 4, once a state decides to become non-nuclear, it can do a lot to demonstrate that it is serious about this commitment – including by getting rid of material and infrastructure and by getting involved in cooperative verification mechanisms.

### **Shutting down a nuclear weapon programme**

To design the verification arrangements of the TPNW, the first step is to understand the politics and context involved in shutting down a nuclear weapon programme. For disarming nuclear weapon states that would decide to join the TPNW, the Treaty offers two options: to join first, then materially disarm; or to first materially disarm and then join. While the two paths call for possibly different verification arrangements, the end goal of verification remains the same: to verify that all nuclear weapon activities and programmes have been terminated, facilities eliminated or irreversibly converted, and any

nuclear material not disposed of is in peaceful use only. There is a body of technical work and the past experiences of states parties with disarmament and non-proliferation that provide some confidence in verifying compliance with a disarmament process aimed at this goal.<sup>29</sup>

In sum, the treaty demands nothing more than former nuclear-armed states become non-nuclear weapon states in good standing as currently defined by existing international standards.

While nuclear weapon programmes it seems are always launched in secret, terminating them will be, to a much larger extent, a public and transparent process. For each of the current nuclear weapon states, shutting down and eliminating their nuclear weapon programme in a process of nuclear disarmament would be a major endeavour involving largely unprecedented political, economic, military and administrative processes. Important historical precedents exist but have been limited in scope and scale. Three former Soviet republics – Belarus, Kazakhstan and Ukraine – returned nuclear warheads to Russia and destroyed legacy weapons and infrastructures after the collapse of the Soviet Union.<sup>30</sup> South Africa unilaterally dismantled its clandestine nuclear weapon programme before revealing officially its existence.<sup>31</sup>

In addition to these four cases, China, France, Russia, the United States, and the United Kingdom are known to have stopped and dismantled some infrastructure associated with nuclear activities (e.g., fissile material pro-

duction and nuclear weapon testing), as well as scrapped various types of nuclear weapon either unilaterally or as part of arms control agreements. None of these experiences have led to fundamental changes in the role of nuclear weapons in these states' national security strategies, but they are indicative of what public signalling can look like when eliminating weapon systems and infrastructure.<sup>32</sup>

The renunciation of nuclear weapons by one, several or all nine current nuclear weapon states would be likely to involve major speeches and decisions by government leaders, parliamentary votes, the enactment of new legislation, the signature of new or accession to existing international agreements, the opening of nuclear sites for visits and possible inspections, the removal of delivery vehicles from operational status, public displays of weapon destruction and dismantlement, and the closure, clean-up, elimination or conversion of facilities associated with nuclear weapon activities. The latter would include weapon deployment sites, warhead assembly and storage facilities, weapon component design and manufacturing facilities, research and development centres, and even private companies involved in the nuclear weapon enterprise.

The fact is that most facilities associated with existing nuclear weapon programmes are known through the numerous public sources that have documented these programmes over time, combined with today's information landscape and the democratization of space-based assets that allow for the global daily

29 IPFM, Global Fissile Material Report 2009: A Path to Nuclear Disarmament, October 2009, <https://fissilematerials.org/library/gfmr09.pdf>; H. Feiveson, A. Glaser, Z. Mian and F.N. von Hippel, *Unmaking the Bomb: A Fissile Material Approach to Nuclear Disarmament and Nonproliferation*, 2014; Z. Mian, T. Patton and A. Glaser, "Addressing Verification in the Nuclear Ban Treaty", *Arms Control Today*, vol. 47, no. 5, 2017, pp. 14–22; P. Podvig, "Practical Implementation of the Join-and-Disarm Option in the Treaty on the Prohibition of Nuclear Weapons", *Journal for Peace and Nuclear Disarmament*, vol. 4, no. 1, 2021, pp. 34–49; J. Scheffran, "Verification and Security of Transformation to a Nuclear-Weapon-Free World: The Framework of the Treaty on the Prohibition of Nuclear Weapons", *Global Change, Peace & Security*, vol. 30, no. 2, 2018, pp. 1–20..

30 M.D. Skootsky, "An Annotated Chronology of Post-Soviet Nuclear Disarmament 1991–1994", *Nonproliferation Review*, spring–summer 1995, pp. 64–105; M. Budjeryn, "Was Ukraine's Nuclear Disarmament a Blunder?", *World Affairs*, vol. 179, no. 2, 2016, pp. 9–20; T. Kassenova, *Atomic Steppe: How Kazakhstan Gave Up the Bomb*, 2022. On the case of Kazakhstan see also chapter 4 in this volume.

31 P. Liberman, "The Rise and Fall of the South African Bomb", *International Security*, vol. 26, no. 2, 2001, pp. 45–86; N. Von Wielligh and L. Von Wielligh-Steyn, *The Bomb: South Africa's Nuclear Weapons Programme*, 2015.

32 K. Egeland, "Who Stole Disarmament? History and Nostalgia in Nuclear Abolition Discourse", *International Affairs*, vol. 96, no. 5, 2020, pp. 1387–1403.

(if not hourly) monitoring of the Earth's surface.<sup>33</sup> This suggests that most of the material steps of the disarmament process would happen in plain sight.

Some past disarmament and dismantlement experiences have shown the importance of performative behaviour and the need to publicly exhibit truthfulness when engaging in the deconstruction and destruction activities associated with disarmament measures. For example, the United States and Russia have both displayed disabled long-range strategic bombers in aircraft “boneyards” in accordance with arms control treaties for instance under the 1991 START agreement: “A heavy bomber or former heavy bomber shall remain visible to national technical means of verification during the entire elimination process”, a process that can take no longer than 60 days.<sup>34</sup> This facilitated verification from satellite imagery. By 1992, the United States had terminated fissile material production for weapons and naval nuclear reactors and by the end of 2020 the public demolition of the Oak Ridge gaseous diffusion uranium enrichment plants was complete, with hundreds of buildings removed, and the site is now being redeveloped into an airport.<sup>35</sup> After France closed its fissile material production facilities, it invited international experts to witness the dismantlement of key sites.<sup>36</sup> It also closed

down its former silo-based missile forces, filling up silos and firing missile engines on the ground.<sup>37</sup> After Ukraine renounced nuclear weapons in 1994, it blew up missile silos and returned nuclear warheads to Russia in front of international media and politicians.<sup>38</sup>

A commitment to public display and candour and the inclusion of nuclear programme workers, domestic civil society and international visitors as stakeholders in the process – rather than the current practices of secrecy and exclusion – suggests that assessing commitment to and progress towards disarmament would be straightforward for the most part once the political and material processes involved begin. If certain steps of the disarmament process were to happen behind closed doors, such as when South Africa dismantled its small nuclear arsenal, it may be important for TPNW states to make explicit that careful documentation and thorough record-keeping would facilitate post facto verification.<sup>39</sup> It would be even possible for a disarming state to document the entire history of its nuclear program at the onset of the disarmament process and commit to this history and associated digital records using established cryptography techniques, and make them available later as required.<sup>40</sup>

33 I. Moric, “Capabilities of Commercial Satellite Earth Observation Systems and Applications for Nuclear Verification and Monitoring”, *Science & Global Security*, 2022, pp. 1–28.

34 Protocol on Procedures Governing the Conversion or Elimination of the Items Subject to the Treaty between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms”, 31 July 1991, <https://2009-2017.state.gov/documents/organization/27363.pdf>; A.H. Rotstein, “U.S. Air Force Turns B-52 Bombers into Scrap Metal”, *Los Angeles Times*, 11 September 1994, <https://www.npr.org/2013/12/19/255551327/once-a-mighty-bomber-a-b-52-meets-its-end-in-the-desert>.

35 US Department of Energy, Office of Environmental Management, “Workers Achieve Historic Cleanup of Uranium Enrichment Complex”, October 2020, <https://www.energy.gov/em/articles/workers-achieve-historic-cleanup-uranium-enrichment-complex>; “Former US Enrichment Site Ready for Redevelopment”, *World Nuclear News*, 9 September 2021, <https://www.world-nuclear-news.org/Articles/Former-US-enrichment-site-ready-for-redevelopment>.

36 Republic of France, “Dismantling the Fissile Material Production Facilities for Nuclear Weapons”, France TNP 2010, [https://onu.delegfrance.org/IMG/pdf\\_100329PM\\_BD.pdf](https://onu.delegfrance.org/IMG/pdf_100329PM_BD.pdf).

37 Republic of France, “Le Démentèlement de la Composante sol-sol” [The Dismantling of the Ground-Ground Component], France TNP 2010, <https://www.francetnp.gouv.fr/IMG/pdf/06-FR-Albion.pdf>.

38 K. Oliynyk, “The Destruction of Ukraine’s Nuclear Arsenal”, *Radio Free Europe*, 9 January 2019, <https://www.rferl.org/a/the-destruction-of-ukraines-nuclear-arsenal/29699706.html>.

39 This was a decision implemented by South Africa when it dismantled its clandestine programme. Analysis of archival records was key in verifying the completeness of the South African fissile material declaration to the IAEA. See Von Wielligh and Von Wielligh-Steyn, *The Bomb*; A. Allen, *Apparent Discrepancies: The Verification of South Africa’s Nuclear Disarmament*, Princeton University Senior Thesis, 2022.

40 S. Philippe, A. Glaser and E.W. Felten, “A Cryptographic Escrow for Treaty Declarations and Step-by-Step Verification”, *Science & Global Security*, vol. 27, no. 1, 2019, pp. 3–14.

The more limited activities involving the destruction of nuclear weapons are required by the TPNW to be completed “as soon as possible,” and it is proposed that for any weapon state this need not take longer than at most 10 years.<sup>41</sup> Some key facilities involved in the dismantlement of warheads, the storage of weapon-grade material and so on may take the longest to be closed and eliminated, or converted. These would be well-defined places that could be monitored from the outside and eventually safeguarded once a state has completed its disarmament processes and made the required arrangements with the IAEA.<sup>42</sup> National laboratories dealing with nuclear weapon research and development would need to shift the focus of their mission, giving up all nuclear weapon related capabilities, or shut down. Nuclear military commands and capabilities and sites would be reformed or terminated. Bases would shut down and be eliminated or be converted. Personnel would need to be transferred to new units or discharged from duty. National reports on the status of disarmament activities could be regularly made public and discussed openly in parliamentary bodies (or their equivalent). How long this process would take will be dependent on the scope and scale of particular programmes.

There are important terms of reference related to verification that will require working definitions to allow for the design and implementation of the TPNW verification process. These include specifying what constitutes a nuclear weapon programme (people, institutions, facilities, equipment, material, data, software and records), what the elimination or conversion of nuclear weapon-related facilities entails, and what “irreversibly” means in the context of eliminating or converting material, facilities, technologies, and institutions.

As argued above, all this institutional dismantlement and elimination of the nuclear weapon programme would be in the context of a broader national political, legislative and military “disembedding of an enterprise and set of beliefs, attitudes and ideas”. New annual statements of posture or national defence white papers and national budgets would redefine national security strategies and priorities. New domestic laws would codify the TPNW prohibitions and include prohibitions and penalties for acts of commission and acts of omission, as for example in Ireland’s 2019 Prohibition of Nuclear Weapons Act.<sup>43</sup>

Under TPNW Article 5, each state party is required to put in place national measures “to implement its obligations under this Treaty” and to “take all appropriate legal, administrative and other measures, including the imposition of penal sanctions, to prevent and suppress any activity prohibited to a State Party under this Treaty undertaken by persons or on territory under its jurisdiction or control”.<sup>44</sup> Along with undoing the institutionalized secrecy and classification practices typical of nuclear weapon programmes, states could introduce institutional public commitments to nuclear candour. National implementation measures could include a public right to know, and a legal obligation to report any and all information and activities of concern with regard to meeting any of the Treaty obligations and establish protection for such reporting and whistle-blowing.

Such transparency and truth-telling obligations and protections would enable an active citizenry, especially scientists and technicians in the former nuclear weapon programme, to practice societal verification of the disarmament process. They would serve as “the chief guardians of the arrangement”,

41 M. Kütt and Z. Mian, “Setting the Deadline for Nuclear Weapon Destruction under the Treaty on the Prohibition of Nuclear Weapons”, *Journal for Peace and Nuclear Disarmament*, vol. 2, no. 2, 2019, pp. 410–430.

42 Podvig, “Practical Implementation of the Join-and-Disarm Option in the Treaty on the Prohibition of Nuclear Weapons”.

43 See, for example, Republic of Ireland, Prohibition of Nuclear Weapons Act, 11 December 2019, <https://www.oireachtas.ie/en/bills/bill/2019/60>.

44 Treaty on the Prohibition of Nuclear Weapons, Article 5: National.

as proposed in 1946 by physicist Leo Szilard, who first had the idea of a nuclear chain reaction.<sup>45</sup> Joseph Rotblat, the Manhattan Project physicist who co-founded and for many years led the Pugwash movement of scientists against nuclear weapons, proposed in 1993 that any future nuclear disarmament treaty should include the “right and the civic duty of the citizen” to report un-toward nuclear activities and this also should be “part of the national codes of law in the countries party to the treaty”.<sup>46</sup> Since the TPNW is now in force, as part of the enduring practices of active reassurance, disarming states should include such a Rotblat clause as part of their national implementation measures.<sup>47</sup>

## Conclusion

The traditional nuclear weapon-centred model of nuclear arms control verification is shaped by active suspicion and distrust of treaty partners and by national security imperatives to protect nuclear weapon information, arsenals, capabilities and policies. Verification in the TPNW can be distinctly different for a disarming nuclear weapon state, since it involves the presentation of the fundamental transformation of its state identity and national security perspectives, institutions, policies, practices and ideas as it joins a new community.

As a new paradigm, the TPNW opens a new political and technical space for innovation and offers opportunities for a new generation of disarmament science researchers and disarmament practitioners from around the world with different kinds of skills to identify possible disarmament-verification measures that would be significantly different from those identified as part of the existing arms control experience.

Rather than focusing solely on nuclear weapons, their delivery systems and the fissile material that make nuclear weapons possible – all of which have been wrapped in state secrecy for decades – new more holistic disarmament-verification approaches may be possible. These would aim at the TPNW-specified obligation to not just destroy nuclear weapons but to eliminate weapon programmes. This will mean disembedding the long and deeply entrenched military, scientific, political and ideological, and economic support systems that also constitute and sustain such weapon programmes.

There is work to be done in understanding the full repertoire of possible public voluntary “active reassurance” measures from which a state could choose in preparing its initial legally binding, time-bound plan for the verified and irreversible elimination of its nuclear weapon programme. States and publics will need to explore what kinds of public signalling are relevant when renouncing and eliminating nuclear weapon programmes and related infrastructures, ideas and identities. They will also need to understand the national political, institutional and technical arrangements and mechanisms available in any given state to reliably and transparently demonstrate its enduring transformation from a nuclear-armed state to a nuclear weapon-free state in the TPNW.

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45 L. Szilard, “Can We Avert an Arms Race by an Inspection System?”, in D. Masters and K. Way (eds.), *One World or None: A Report to the Public on the Full Meaning of the Atomic Bomb*, 2007, pp. 167–179.

46 J. Rotblat, “Societal Verification”, in J. Rotblat, J. Steinberger and B. Udgaonkar (eds.), *A Nuclear-Weapon-Free World*, 1993, pp. 103–118. See also IPFM, *Global Fissile Material Report 2009*, pp. 114–123.

47 Mian et al., “Addressing Verification in the Nuclear Ban Treaty”.