Practical Implementation of the Join-and-Disarm Option in the Treaty on the Prohibition of Nuclear Weapons

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ABSTRACT
The Treaty on the Prohibition of Nuclear Weapons provides a nuclear-armed state that joins the treaty with two options. One is to join after eliminating its weapons and nuclear-weapon program. Alternatively, the state can join the treaty while still possessing nuclear weapons. In this case it must eliminate its weapons in accordance with a time-bound plan approved by the state parties. This option, known as “join and disarm,” provides the disarming state with an opportunity to join the treaty immediately after making the decision to do so and to complete disarmament within a defined time frame. However, it also creates a challenge for the verification program, which has to find a way to protect proliferation-sensitive information about nuclear weapons. This article suggests a verification arrangement that does not require access to sensitive information during the weapons elimination process. This is achieved by containing nuclear weapons and all dismantlement activities in a dedicated segment of the nuclear complex of the disarming state. The only information the disarming state releases at the start of the process is the total amount of fissile materials placed in the segment. The dismantlement of weapons is verified by accounting for the fissile materials that are removed from the segment in unclassified forms.

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Introduction
The Treaty on the Prohibition of Nuclear Weapons (TPNW), which entered into force in January 2021, sets the goal of universal adherence of all states to the key treaty obligation of never to possess nuclear weapons (United Nations 2017). It is an ambitious goal, especially given that none of the nuclear-armed states expressed their support for the treaty. While the prospect of a nuclear-armed state joining the TPNW seems remote today, this possibility should not be ruled out. Political circumstances change over time, and it is possible that in the future nuclear-armed states will come to a conclusion that they need not or ought not to rely on nuclear weapons for their security. While membership in the TPNW may not be the only way for a nuclear-armed state to renounce its nuclear weapons, joining the treaty would provide an opportunity to make a strong political statement and strengthen the norm against possession of nuclear weapons.
The treaty gives nuclear-armed states two primary options for becoming a TPNW party. A state can choose to eliminate its nuclear weapons and its nuclear-weapon program before joining or, alternatively, join the treaty first and then follow the procedure outlined in the treaty to eliminate its weapons. The first option, known as disarm-and-join, has the advantage of following the historical precedent of South Africa, which eliminated its nuclear weapons and nuclear-weapon program before joining the Nuclear Nonproliferation Treaty (NPT) in 1991. It also appears to simplify the TPNW verification mission, which would not have to deal with nuclear weapons or weapon-related sensitive information. At the same time, this path makes it difficult to make the political decision to join the treaty before the disarmament process is complete. The elimination of a nuclear arsenal is a complex undertaking that could take considerable time and that will require sustained political commitment to complete.

In the join-and-disarm option, the commitment to begin and complete the nuclear disarmament process is made at the point the state decides to join the treaty. This creates a single decision point, which changes the political dynamic of the issue. Once the disarming state becomes a party, the weapon elimination program will proceed in accordance with a time-bound plan and with an appropriate oversight. This will provide the state with an opportunity to demonstrate good faith in its commitment to disarmament.

Although the join-and-disarm option offers a clearer political path toward nuclear disarmament, designing a disarmament arrangement that could manage the elimination of nuclear weapons in this way is challenging. There are no historical precedents that could offer guidance for such an arrangement. While a significant amount of research has been done to explore various elements of the disarmament process, this work is not yet completed, and many questions remain unresolved. The join-and-disarm option will remain largely theoretical unless there is a well-defined practical arrangement that could support the elimination of nuclear weapons.

This paper describes a disarmament arrangement that could support the join-and-disarm option and provide a practical way of addressing the issues that the TPNW states parties may encounter when a nuclear-armed state joins the treaty while still possessing nuclear weapons.

**Joining the Treaty**

Each state that joins the TPNW after January 2021, when the treaty entered into force, will follow its own implementation timeline. After the treaty enters into force for that state, the state must submit a declaration in which it declares its status regarding nuclear weapons. In the declaration, the state must report whether it still possesses nuclear weapons or whether it possessed nuclear weapons in the past and eliminated its nuclear program by the date the treaty entered into force for this state. In addition, the state must declare whether it has nuclear weapons of other states on its territory (Article 2.1).

This declaration then serves as a basis for determining the specific actions the state must undertake to fulfill its obligations as a party to the treaty. Any nuclear weapons belonging to other states would have to be removed from its territory. With respect to possession of weapons, a state joining the treaty would fall into one of three categories,
depending on whether its status, as described in the initial declaration, satisfies the conditions in Articles 4.1 and 4.2 of the treaty.

A state that possessed nuclear weapons after 7 July 2017 (the date the treaty text was adopted) and eliminated its nuclear-weapon program before it joined the treaty will be bound by the obligations described in Article 4.1. This state could be defined as a disarm-and-join or, more accurately, an Article 4.1 state. A different set of obligations will apply to a state if it still possesses nuclear weapons at the time it becomes a party to the treaty. This state could be described as a join-and-disarm state, or an Article 4.2 state. The treaty is not entirely clear as to which obligations will apply to a state that does not possess nuclear weapons by the time it joins the treaty but has not completed the elimination of its nuclear-weapon program. The logic of the treaty provisions suggests that it should be treated as an Article 4.2 state.

The third category includes states to which neither Article 4.1 nor Article 4.2 apply. These states will have to place all their nuclear activities under International Atomic Energy Agency (IAEA) safeguards as described in Article 3 of the treaty. This category will include all NPT non-nuclear-weapon states that join the treaty. Theoretically, it can also include some nuclear-armed states outside NPT should they claim that they did not have nuclear weapons or nuclear explosive devices after 7 July 2017. In practice, however, these states are likely to be covered by Article 4 obligations.

According to the treaty, an Article 4 state must complete three distinct processes – destroy its nuclear weapons, eliminate the nuclear-weapon program, and conclude a safeguards agreement with the IAEA. While the destruction of nuclear weapons can be considered part of the elimination of the nuclear-weapon program, the treaty treats it separately by requiring that this process is completed by a set deadline. Article 4 also divides the responsibility for various parts of the disarmament process among the disarming state and organizations designated by states parties.

In the Article 4.1, or disarm-and-join scenario, the disarming state must complete the elimination of its nuclear-weapon program before joining the treaty. Since this includes “the elimination or irreversible conversion of all nuclear weapons related facilities” it is assumed that the destruction of nuclear weapons must be completed as well. Since all elimination activities are carried out by the disarming state, the treaty does not envision oversight of this process by any verification body. It does, however, require the state to cooperate with the competent authority designated by states parties “for the purpose of verifying the irreversible elimination” of the nuclear-weapon program.

A state that follows the join-and-disarm path must immediately remove nuclear weapons, if it possesses them, from operational status and develop a time-bound plan for the verified and irreversible elimination of its nuclear-weapon program. This plan will have to be negotiated with the competent authority and approved by states parties. If the state possesses nuclear weapons when it joins the treaty, the plan should cover the destruction of nuclear weapons. The weapons must be destroyed “as soon as possible but not later than a deadline” established by states parties at their first meeting. Since this deadline will be common for all Article 4.2 states, it would probably have to provide sufficient time for the elimination of the largest nuclear arsenals, such as those of Russia and the United States. An analysis of past experience with weapon dismantlement suggests that the treaty should allow 10 years for the elimination of weapons, with a possibility of a single 10-year extension (Kütt and Mian 2019). For small nuclear-
weapon arsenals, the deadline for the destruction of weapons is likely to be shorter, as it could be determined by the plan for the elimination of the nuclear-weapon program, which will be negotiated separately for each state.

It should be noted that even though the treaty requires an Article 4.2 state to negotiate its disarmament plan with the competent authority and then get it approved by states parties, it does not require the authority to be directly involved in any of the disarmament activities. Aside from negotiating the plan, the role of the authority is to verify the irreversible elimination of the nuclear-weapon program. While this does not preclude the authority from participating in the elimination activities, it suggests that these activities can be carried out in a way that is almost indistinguishable from that of the disarm-and-join scenario. In both cases, it will be the disarming state that will be responsible for the elimination of its nuclear weapons and the nuclear-weapons program, while the authority will verify that the elimination has been done irreversibly.

The final point of the disarmament process for all Article 4 states is the conclusion of a safeguards agreement with the IAEA. The agreement must be sufficient to ensure non-diversion of nuclear materials from peaceful activities and the absence of undeclared nuclear materials and activities in the state. For non-nuclear-weapon states parties to the NPT, this level of assurances is achieved by a comprehensive safeguards agreement with an additional protocol (IAEA (International Atomic Energy Agency) 2002, para 12.25).

The Challenge of Verifying Disarmament

The treaty gives states parties significant flexibility regarding the designation of “a competent international authority or authorities” to negotiate and verify the elimination of nuclear-weapons programs. States parties can designate an existing international organization or create a new entity to carry out these tasks.

One candidate for this role is the IAEA, which administers safeguards for the NPT and has the experience and expertise to verify activities that involve nuclear materials. The IAEA statute gives the organization the authority to participate in disarmament activities, and it has participated in verified elimination of nuclear-weapons programs in the past (Shea and Rockwood 2015, 19). At the same time, the IAEA may not be a suitable candidate for the role of the TPNW competent authority. The governance structure of the IAEA would make it difficult to secure its full cooperation with TPNW states parties (Patton, Philippe, and Mian 2019; Shea 2020). One important factor is the presence of nuclear-armed states in the governing bodies of the IAEA. As long as these states maintain their opposition to TPNW, the IAEA is unlikely to be in a position to support the verification activities that are specific to that treaty (Borrie et al. 2016, 39–45).

The lack of cooperation from the nuclear-armed states or the IAEA as an organization will present a serious challenge for TPNW states parties should they decide to create a dedicated organization that will serve as the competent authority. The history of past efforts to verify the elimination of nuclear-weapons programs, such as those in South Africa or Iraq, suggests that participation of nuclear-weapons experts, as different as it was in these two cases, was essential for their success. In addition, in both cases inspectors benefited from the intelligence information provided by IAEA member states (Albright and Stricker 2016, 233; Findlay 2005, 70). Most importantly, past verification missions
had the full support of the IAEA Board of Governors and the permanent members of the UN Security Council, who are also the five NPT nuclear weapon states.

Even though the nuclear-armed states are unlikely to be actively obstructing the TPNW verification efforts, the competent authority should assume that it will not have access to nuclear-weapon expertise, intelligence information, or personnel from nuclear-armed states. Even if the authority could secure participation of experts with knowledge of nuclear weapons serving in their individual capacity (Patton, Philippe, and Mian 2019), unless these experts are officially delegated by their governments, there are limits to the assistance that they could offer. Even though detailed knowledge of nuclear weapons is not absolutely essential for effective verification of nuclear disarmament, the fact that the competent authority may not have access to that knowledge would seriously undermine the credibility of the TPNW verification program (Highsmith and Stewart 2018, 134; Shea 2020, 16). It is true that the competent authority will be able to count on the cooperation of the disarming state and, quite possibly, on assistance provided by some other nuclear-armed states. This kind of assistance, however, may not resolve the credibility problem as the nuclear-armed states that are not participating in the disarmament process could always challenge the effectiveness of the verification program.

The disarm-and-join scenario of nuclear disarmament appears to address this problem since it assumes that all nuclear weapons will be eliminated by the time a state joins the treaty. In this case, the competent authority need not be involved in the weapon dismantlement process. However, the main mission of the authority – verifying the irreversible elimination of the nuclear-weapon program – will still require knowledge of nuclear weapons in order for the results of this mission to be considered credible. As noted earlier, in South Africa, which is often considered a model for the disarm-and-join scenario, the IAEA mission had access to the nuclear-weapon expertise and intelligence information.

The problem of access to nuclear-weapon information will certainly play a role in the join-and-disarm case, as the presence of weapons creates additional challenges for the verification program. Even though the treaty does not require the authority to be involved in the weapon dismantlement process, some degree of oversight will certainly be expected. For example, it is reasonable to assume that the authority should be able to confirm that nuclear weapons are removed from operational status, as Article 4.2 of the treaty requires. In other respects, the key challenge facing the TPNW authority will remain the same – verifying the irreversible elimination of a nuclear-weapon program with limited access to information about weapons or specific weapon-related activities.

One particularly difficult task is providing credible assurances of the destruction of all nuclear weapons in the disarming state. The immediate issue of defining a nuclear weapon can be addressed relatively easily if it is left to the disarming party to designate objects that should be considered weapons (Glaser 2017; Kütt and Mian 2019, 416–17; IPNDV 2019a, 5). Once this designation is made, the objects identified as weapons could be followed through the dismantlement and elimination process. For some categories of weapons, it might even be possible to develop a procedure that would confirm that they are actual weapons, rather than fakes (Taylor 1989, 8–9).

This solution of the definitional issue, however, does not address another problem: confirming that items that are not declared as weapons are indeed not nuclear weapons.
For assembled weapons, it is possible to use a simple approach that relies on the presence of both fissile material and high explosive. An inspected object that does not have both of these properties cannot be a nuclear weapon (Hauck and MacArthur 2013). This approach, however, does not work for weapon components (both nuclear and non-nuclear), that could be stored separately. Setting a limit on the size or shape of, say, components that are made of fissile materials, is unlikely to help since it would require access to proliferation-sensitive information about nuclear weapon design. For example, the information available in the public domain cannot definitively answer whether a plutonium sphere of a certain mass is a component of a nuclear explosive device. It is also worth noting that information obtained from one nuclear-weapon program may not be directly applicable to another. So even if some nuclear-weapon states are willing to share their expertise, it would not help resolve this issue.

This suggests that the mission of the TPNW authority will be doubly challenging. In addition to confirming that all objects identified as weapons have entered the elimination process, it must also be able to verify that no object left outside of that process is a weapon or a weapon component. And while addressing the first challenge does not require nuclear-weapon expertise, dealing with the second one does, even if the inspection mechanism provides a reasonable degree of access to all locations where weapon components might be stored (IPNDV 2019a, 34–36). Unless the TPNW authority can independently verify that objects in storage are not weapon components, the credibility of the verification process, and therefore its value, will be questioned.

**Disarming a Nuclear-armed State**

**Key Principles**

Despite these challenges that the TPNW authority is certain to encounter, it is possible to design a verification arrangement that will allow states parties to the TPNW to create a dedicated organization capable of providing credible assurances of the elimination of the nuclear-weapon program in a nuclear-armed state that joins the treaty. In order to do so, states parties to the treaty should clearly define the mission of the verification organization, be open about the limits of its expertise, and build constructive relations with the IAEA. These principles are reflected in the following key elements of the arrangement described in this paper:

- The TPNW organization should not be involved in monitoring of the nuclear warhead dismantlement process.
- In verifying the irreversible elimination of the nuclear program, the TPNW organization should focus on the closure or conversion of fissile material production facilities.
- TPNW states parties should not ask the IAEA to implement measures beyond those applied in non-nuclear-weapon NPT states that have a comprehensive safeguards agreement and an additional protocol.

If a state joins the treaty following the disarm-and-join path, these elements will be applied almost automatically. In that case, the state will have eliminated its nuclear weapons before joining, and it will be required to conclude a safeguards agreement
with the IAEA that would be equivalent to a comprehensive safeguards agreement with an additional protocol. The application of these principles would also allow a state to choose the join-and-disarm option and implement its disarmament program after joining the treaty. The join-and-disarm option has significant advantages, since in this case the disarmament program would be carried out in accordance with an approved time-bound plan that would provide greater confidence in the elimination of the nuclear-weapon program.

**Dismantlement of Nuclear Weapons**

If a state that joins the treaty possesses nuclear weapons, Article 4.2 requires these weapons to be immediately removed from operational status and then destroyed as soon as possible. The destruction of weapons must be conducted as part of the time-bound plan to eliminate the state’s nuclear-weapon program, but it must be completed no later than a certain deadline established by states parties.

The dismantlement and subsequent destruction of nuclear weapons is a complex process that includes several stages. Normally, a weapon is disassembled to separate nuclear and nonnuclear components that can be destroyed, damaged in a way that precludes their use in other weapons without significant remanufacturing or reduced to basic materials such as plutonium metal or highly enriched uranium (HEU) (Kütt and Mian 2019).

Most elimination scenarios assume, often explicitly, that the process will start with a set of objects identified as nuclear weapons. For example, the disarming state could submit a declaration that lists all such objects, which become “treaty obligated items.” The declaration may need to include detailed information about all nuclear weapons produced or dismantled in the past. The state would then present all treaty obligated items to inspectors, who would tag and seal them. A significant amount of work has been done to develop procedures that would confirm that an object presented to inspectors has attributes of a nuclear weapon or, in some cases, is indeed a nuclear weapon removed from the active arsenal (Bukharin 2003; Yan and Glaser 2015; NTI 2014). Once the initial inventory is taken, all objects identified as weapons are followed through the dismantlement process, which can be designed to allow inspectors to verify that the weapons and their components have been eliminated (Taylor 1989; IPNDV 2020; US Department of Energy 1997).

One of the most challenging issues in verified dismantlement of weapons is the need to protect information about nuclear-weapon design, weapon components (nuclear and nonnuclear), and fissile materials used in weapons. The disarming state would normally consider this information classified and, in any event, it should be protected as proliferation sensitive. Researchers have explored a variety of technical tools that could help protect information about weapons and fissile materials during the warhead dismantlement and material disposition process. The general approach to the problem is that the information collected in the process of authenticating a weapon, either by measuring its attributes or by comparing it to a known weapon, should be protected by an information barrier.

The viability of this approach has been explored by various national and international projects, such as the US-Russia-IAEA Trilateral Initiative, the UK-Norway Initiative, and the International Partnership for Nuclear Disarmament Verification among others (Shea
and Rockwood 2015; IPNDV 2019b). Researchers have made significant progress in developing methods of protecting sensitive information, but their work also raised questions about potential limits of this approach. One problem is that successful implementation of an information barrier requires trusted equipment, which must be authenticated as well (Immerman 2016). No reliable solution of this problem has been identified yet, and to this day, no state has submitted a classified object to an information barrier system unless this system was built under its full control.

The TPNW disarmament arrangement, however, does not have to rely on following individual weapons through the dismantlement process. It is possible to design a much simpler weapon elimination arrangement that will not require access to nuclear weapons or information about their design. Technical tools for protecting sensitive information, such as information barriers, would be unnecessary as the inspectors would have no need to handle classified items or materials in the course of verification activities.

This arrangement, described below, builds on the concepts of deferred verification and “contain and dispose,” developed in the context of managing weapon-origin fissile materials (Podvig and Rodgers 2017; Podvig and Snyder 2019). The key element of these concepts is the isolation of weapon-related activities in a separate segment of a nuclear complex, followed by a declaration of the total amount of fissile material in the segment. This segment would be closed for verification until the time when all materials, converted to unclassified forms, are removed from the segment, submitted to verification, and accurately accounted for. This approach does not require access to any classified information, which makes it suitable for the nuclear weapons elimination process in the TPNW context.

Instead of asking the disarming state to provide a comprehensive declaration of all its nuclear weapons and then monitoring the dismantlement of each individual item, the TPNW authority would ask the host to transfer all its weapons to the designated closed segment. The segment would probably include the existing weapon and component storage sites, assembly facilities, and some fissile material processing facilities. It would probably consist of several separate areas, but for the purposes of the verification program, the closed segment could be treated as a single entity, as items would be allowed to be freely transferred between its separate parts. For example, nuclear weapons could be consolidated at a central storage site or moved to a dismantlement facility.

Once the boundaries of the segment are established, the state must declare the total amount of fissile materials that are contained inside. From that moment, no fissile material can be added to the segment or removed from it, unless the removed material is submitted to the verifying organization.

The disarming state will not have to provide any additional information about the items that were moved to the closed segment. Since none of these items are inspected or accounted for, there is no need to disclose the number of weapons or any of their attributes, such as the amount of material they contain. This approach to handling nuclear weapons also provides a way of proving that certain objects are not weapons or weapon components. The disarming state should be prepared to disclose all information about any fissile-material-containing item left in the open segment and to place that item under appropriate safeguards. If the state is not prepared to disclose information about an item, it would have to move it to the closed segment. An analysis of information about items in the open segment would help determine whether they are weapon related. If
necessary, this analysis can be done by experts who have knowledge of nuclear-weapon design, for example through the mechanism that has already been used by the IAEA.

The dismantlement of weapons, weapon components, or any other objects placed in the closed segment would be the responsibility of the disarming state, which could choose the appropriate method and ensure that the process is carried out safely and securely. Fissile materials recovered from weapons will have to be converted to unclassified forms so they can be removed from the closed segment and placed under safeguards without any information protection measures such as information barriers.

Conversion of material to unclassified forms as a measure of protecting classified information about weapons and materials has been done before. In the US-Russia Highly Enriched Uranium Purchase Agreement, the amount of HEU that was removed from Russia’s military stock was measured by US inspectors when the material was converted to uranium oxide (Bukharin 2004). Another example is the handling of weapon-origin plutonium that Russia placed in the Fissile Material Storage Facility in Ozersk. Since the facility was constructed with US assistance, Russia and the United States considered an option for monitoring the material placed in storage (Harahan 2014, 282). Anticipating this level of transparency, Russia converted the plutonium designated for storage into 2-kilogram metal spheres, apparently stripping off classified characteristics of the material (NTI 2010). Finally, in the Plutonium Management and Disposition Agreement, the United States and Russia agreed that the disposition process would be monitored by the IAEA. The agreement specified that the material that enters monitored disposition facilities must have no classified attributes, and it included provisions to protect information about the isotopic composition of the weapon material (Podvig and Snyder 2019. 47–48).

The removal of material from the closed segment provides the means of measuring progress in eliminating the weapons. When all weapons are dismantled, the amount of material submitted to safeguards must match that listed in the initial declaration. The closed segment will then be inspected to confirm that no fissile materials are left there. This way the competent authority can verify the elimination of weapons without having access to sensitive information or to the weapon dismantlement process.

Since this arrangement deals with fissile materials, it does not provide a natural way of verifying the destruction and disposal of nonnuclear weapon components, such as high explosive, electronics, or deuterium and tritium. However, unlike the disposition of fissile materials, the destruction of nonnuclear components is not an essential part of the weapon elimination process. Besides, even though monitored dismantlement of individual weapons can verify destruction of components extracted from dismantled weapons, it cannot provide assurances that similar components do not exist outside of the dismantlement process.

Finally, since the dismantlement of weapons is fully managed by the disarming state, the state could keep some of these weapons intact until the very end of the process, maintaining a rapid breakout capability. While this is a serious concern, it is not unique to the join-and-disarm arrangement described here. Regardless of whether or not it is monitored, dismantlement of weapons is a long process, and a certain number of weapons are likely to remain intact until the very end. If the disarming state wants to maintain a breakout capability it would be able to find a way of doing so. Monitored dismantlement appears to offer some protection from a breakout by tagging and sealing
individual weapons, but that protection is not stronger than that provided by sealing the entire closed segment.

Additional protection against breakout could be provided by introducing a step that would disable individual weapons, for example by deforming their fissile material components (Kütt and Mian 2019, 419–20). However, the opportunity to do so would only appear at an advanced stage of the dismantlement process, when the weapon is completely disassembled. This means that the breakout capability is unlikely to be significantly affected as weapons will still spend considerable time in the dismantlement queue. Besides, once a weapon reaches that point of the dismantlement process, a much more reliable way to render it unusable would be to reduce it to unclassified material, which then would be removed from the closed segment.

Monitored dismantlement of nuclear weapons might be a useful concept in some circumstances, for example, bilateral arms control and disarmament. However, there is no reason for the TPNW competent authority to get involved in that process. The arrangement described here provides a much simpler and no less reliable mechanism for verifying the elimination of nuclear weapons. It also ensures that the elimination process does not disclose proliferation-sensitive information about nuclear weapons.

**Elimination of the Nuclear-weapon Program**

Regardless of whether a nuclear-armed state joins the treaty before or after eliminating its nuclear weapons, the treaty asks the competent authority to verify the irreversible elimination of the state’s nuclear-weapon program. For Article 4.2 states, the competent authority will approve the plan developed by the disarming state to eliminate its nuclear program. The treaty does not list specific measures that the plan must contain other than that it must include elimination or irreversible conversion of “all nuclear weapons related facilities.” Article 4.1 states must complete this process before joining the treaty and then cooperate with the verification activities of the competent authority.

In carrying out its verification program, the TPNW authority will encounter a problem that is very similar to the one that it would face in dealing with nuclear weapons – determining which facilities and activities should be considered part of the nuclear-weapon program. The disarming state, of course, will be expected to declare all relevant facilities and activities, as part of the disarmament plan for Article 4.2 states or as an account of measures completed before joining the treaty for Article 4.1 states. However, for the TPNW verification program to be credible, the competent authority should be able to make an independent assessment of that declaration. It also should be able to independently determine at what point a facility can be considered eliminated or converted.

As discussed earlier, making a determination of whether certain activity is weapon-related may well be impossible even for an organization that has access to nuclear-weapon expertise. Even the IAEA, which has this access, admitted in the past that “absent some nexus to nuclear material, the Agency’s legal authority to pursue the verification of possible nuclear weapons related activity is limited” (IAEA 2005, para 49).

An attempt to develop a list of activities that may have weapon applications was undertaken in the Joint Comprehensive Plan of Action, which restricts Iran’s nuclear program. According to the agreement, Iran will not engage in specific activities that
“could contribute to the development of a nuclear explosive device,” such as developing computer models to simulate nuclear explosive devices or developing “multi-point explosive detonation systems suitable for a nuclear explosive device” (United Nations Security Council 2015). However, this formula leaves open the question of what kind of systems should be considered suitable for weapon purposes. The issue is left to the Joint Commission, which can approve carrying out certain activities under monitoring. The Joint Commission, however, includes nuclear-weapon states, which have access to the expertise required to make such an authorization. Without access to the expertise, reaching a definitive conclusion about the nature of certain activities appears to be extremely difficult, and perhaps impossible (Albright 2012; Albright and Heinonen 2017). In addition, with the exception of a small number of cases, for example, those based on historical analogies, this determination would probably release proliferation-sensitive information if it is to be conclusive and credible.

Separating the activity that can be potentially related to nuclear weapons in a closed segment of the nuclear complex is unlikely to be a viable solution. There are many legitimate areas of civilian research, theoretical as well as experimental, that can, in principle, contribute to nuclear-weapon expertise and that cannot be eliminated or irreversibly converted.

One way to verify the elimination of the nuclear-weapon program is to focus on the production of fissile materials. Even though fissile materials are not the only components of a nuclear explosive device, they are the essential component. Shutting down or converting facilities that produce these materials for weapons will be a critical step in the elimination of a nuclear-weapon program.

The verification of this step does not require nuclear-weapon expertise or access to proliferation-sensitive information. While some dedicated production facilities could be considered sensitive, the process of closing them down or converting them to civilian use can be completed without revealing sensitive details. For example, the shutdown of a facility would involve verified removal of some nonsensitive but essential equipment that would render it inoperable. This process is well understood and is considered one of the stages in the decommissioning of a facility in IAEA practice (IAEA 2002, para 5.31). \(^1\)

It should be understood that in most cases, the conversion of a production facility to non-weapon use cannot be done in a truly irreversible manner. In most cases, uranium enrichment plants can be relatively easily reconfigured to produce weapon-usable HEU. Reprocessing plants that separate plutonium from the irradiated fuel of nuclear reactors use the same process to separate plutonium of any grade. If these facilities continue to operate, the state will have to negotiate with the TPNW authority a set of measures that ensure that all the material produced there is submitted to appropriate safeguards. This approach could also work in those cases when a shutdown of a production facility is not possible. The experience of ending the production of weapon-grade plutonium in Russia could serve as a precedent. Since 1997, all plutonium that was separated from the fuel of Russia’s dedicated production reactors, which continued to operate until 2010, was

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\(^1\)The terminology here is different from that used by the IAEA. The agency considers a facility shut down when it is not operating. It would be considered closed down when all nuclear material is removed from the facility. Decommissioning adds the removal of essential equipment to the removal of materials.
placed in storage where it is periodically monitored by US inspectors (Dyakov 2012, 250–51).

Perhaps counterintuitively for a process that aims at eliminating a nuclear-weapon program, the competent authority should ensure that the disarming state preserves all program-related records. These records are essential for reconstructing the history of production of fissile materials that will be required to close the material balance and ensure the absence of undeclared materials or activities. This determination will be the primary objective of the activity that the IAEA will carry out in the disarming state after it concludes a safeguards agreement.

It would be impractical and, indeed, impossible to require the disarming state to turn over relevant documents to a third party. The only viable arrangement in this area is the one in which the disarming state maintains control over the records, as the information about past nuclear-weapon activities should be protected by the national system of handling classified information. The TPNW authority could participate in developing general guidance for handling these data and negotiate arrangements that would further restrict access to weapon-related documents.

**IAEA Safeguards**

The role of the IAEA in the disarmament process is absolutely essential. A nuclear-armed state that joins the treaty is required to conclude a safeguards agreement with the agency to ensure non-diversion of nuclear materials from peaceful activities and the absence of undeclared nuclear materials and activities. The agency has the experience and expertise to carry out this task successfully in the states that concluded a comprehensive safeguards agreement with an additional protocol. For those states, the IAEA can draw a so-called broader conclusion confirming the absence of undeclared materials. In 2019, the IAEA drew this conclusion for 69 states that had an additional protocol in force (IAEA 2020, para 1). Among the states for which this conclusion has been drawn are those with substantial fissile material production capabilities, such as Germany, the Netherlands, and Japan. It was also drawn for states that once possessed substantial amounts of weapon-grade fissile materials on their territories, such as Kazakhstan. Most importantly, in 2010 the IAEA was able to draw a broader conclusion for South Africa, which is a non-nuclear-weapon state that had a full-scale nuclear-weapon program (IAEA 2010).

The process of drawing a broader conclusion for any of the current nuclear-armed states is likely to take considerable time and may well be impossible for large nuclear-weapon programs. However, the IAEA process provides a well-developed technical and legal framework for making progress toward that goal.

For an Article 4.1 state that joins the TPNW after eliminating all its nuclear weapons and its nuclear-weapon program, the process of submitting its activities under IAEA safeguards would not be different from that of a state that is joining the NPT as a non-nuclear-weapon state. The IAEA does not require disclosing information about historical activities at the sites that are placed under safeguards, so weapon-related activity would not have to be explicitly reported. The agency, however, reserves the right to request this information and recommends including it in the initial declaration (IAEA 2016, 27). An Article 4.1 state is required to begin negotiating the safeguards agreement within
180 days of the entry into force of the treaty and begin its implementation no later than 18 months from that date.

A state that is joining the TPNW while still possessing nuclear weapons is not required to begin negotiating the safeguards agreement with the IAEA until it completes the implementation of the agreed plan to eliminate its nuclear-weapon program. This provision presumably provides an option of not involving the IAEA in the elimination of weapons or the nuclear-weapon program. However, in the arrangement described here, this involvement is not necessary as all weapon dismantlement activities would be carried out by the disarming state. This means that the state can conclude the safeguards agreement with the IAEA at the beginning of the process. Indeed, it will be important to have that agreement in place since in this case, the materials that are released in the process of weapon dismantlement can be placed directly under IAEA safeguards once they are ready to leave the closed segment.

Once the safeguards agreement is concluded, the IAEA could begin its verification activities aimed at establishing the absence of undeclared materials and activities in the state. The agency will not have access to the closed segment, which will contain all weapons and be where all weapon dismantlement activity takes place. However, since the amount of material in the closed segment will be declared at the start of the process, from the material accounting point of view, the entire segment could be treated as a single material balance area. Since inflows of materials into this area are prohibited and all material removed from it will be placed under safeguards, the lack of access to the interior of the closed segment will not inhibit the agency from closing the material balance on the state level. When all material is removed from the closed segment, the agency will be in a position to draw a safeguards conclusion for the state.

The benefit of this arrangement is that it provides a mechanism for taking advantage of the IAEA’s expertise to support the disarmament process while not placing on the agency an undue burden of supporting weapon dismantlement and other disarmament activities. It also shields the IAEA from making a political decision to provide direct support to the TPNW process.

**Conclusions**

The TPNW contains provisions that make it possible for a nuclear-armed state to join the treaty while still possessing nuclear weapons. In this case, nuclear weapons will have to be destroyed as part of a legally binding time-bound plan for the irreversible elimination of the nuclear-weapon program negotiated with a competent international authority designated by the TPNW states parties. Implementation of this plan is likely to encounter a range of challenges, such as the need to protect proliferation-sensitive information during the disarmament process. It is also unlikely to have access to nuclear-weapon knowledge and expertise or the full cooperation of nuclear-armed states.

The arrangement described here presents a practical path to implementing the join-and-disarm option. It offers the disarming state and the TPNW parties a feasible path to eliminate nuclear weapons in a verifiable and credible manner.

To address the challenges of weapon elimination, the authority could organize its work in a way that contains all nuclear-weapon dismantlement activities in a dedicated segment of the disarming state’s nuclear complex. This segment will remain closed to verification
activities, but its boundaries and the amount of fissile material contained inside will be declared. No material can then be added to the closed segment, and any material that is removed will have to be converted to an unclassified form, accounted for, and placed under appropriate safeguards. Once all weapons are dismantled and all fissile materials released during the dismantlement are removed, the segment will be inspected to confirm the accuracy of the original declaration of the amount of material. This arrangement will allow the TPNW authority to verify the weapon elimination process without having access to proliferation-sensitive or classified information about nuclear weapons.

To verify the elimination of the nuclear program of a nuclear-armed state, the TPNW authority could focus on the shutdown or conversion of the fissile material production facilities. While the production of materials for weapons is not the only component of a nuclear-weapon program, it is the single most important one. Verifying the end of fissile material production at the existing facilities does not require any proliferation-sensitive knowledge.

The final phase of the disarmament process would involve application of IAEA safeguards to all nuclear activities in the disarming state. The agency would not have to be involved in any disarmament activities or implement measures beyond the standard comprehensive safeguards with an additional protocol. With time, the IAEA should be able to conclude that all declared nuclear materials are in peaceful use and that there are no undeclared nuclear materials or activities in the state.

This arrangement could address the key verification challenges that may deter nuclear-armed states from following the join-and-disarm path toward becoming a party to the TPNW. This process offers a significant advantage over the alternative disarm-and-join option, as it provides the disarming state with an opportunity to demonstrate that it is fulfilling its disarmament obligations fully and in good faith by following a time-bound plan and submitting its nuclear activities to verification from the beginning of the process.

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**Notes on Contributor**

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