# Working Group 4 Deliverable
# Part III. State-Wide Verification of Absence of Undeclared Weapons

Working Group 4: Verification of Nuclear Weapons Declarations

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## Abstract

This paper contains an exploration of the concept of verifying the absence of nuclear weapons at undeclared locations in the State as a whole. This requires the inspecting entity to (1) determine that there are no undeclared nuclear weapon-related facilities and (2) reach a conclusion regarding the absence of nuclear weapons at any other sites. Questions regarding the significance of diversions becomes pertinent in a State-wide setting, especially as arsenal sizes decrease over time. This paper explores some major challenges in terms of verifying State-wide absence of nuclear weapons. These are first related to the size of the inspected area versus that of the subject of inspection, which implies a near-endless range of possible locations are subject to verification. This, in turn, creates very real complications in terms of potential inspection burdens, effectiveness, and the interests of the inspected State, which could be addressed by innovative ways of looking at inspection regimes. Second, the vast range of potential sites of interest means that State-wide verification will involve plenty of site-specific inspection challenges that warrant further research and analysis. Notwithstanding these complications, this paper concludes that State-wide verification of the absence of nuclear weapons at undeclared locations in the context of nuclear disarmament is conceptually and hypothetically possible and sets out recommendations for further work.

## Introduction

This paper focuses on the verification of the absence of nuclear weapons at undeclared locations in a possessor State as a whole. It provides an overview of the relevant discussions on this issue in Working Group 4 (WG4), focusing on useful generally applicable concepts and the main challenges involved. Although there was only enough time to scratch the surface of this complicated matter, this paper does attempt—where possible—to set out the general direction in which solutions could be sought. The paper concludes by outlining some general reflections on this issue and sets out guidance and suggestions for further work, either inside or outside the context of the IPNDV.

In the scenario considered, a State has declared all of the nuclear weapons in its stockpile and agreed to keep its total stockpile below an agreed number.[1] This declaration could be the first action by that State in a process leading to significant reductions and disarmament. The State in question is envisaged to have some weapons deployed at sea on naval submarines, in fixed ground launched silos, on road mobile launchers as well as in storage for deployment by land-based aircraft. Further systems may be located on central storage and/or production, refurbishment, and dismantlement sites.

It was assumed that when more than one nuclear weapon possessor State is involved in the disarmament process, that a number of States—both possessor and non-possessor States—are involved in the inspection process, and that any successful verification mechanism would have to be a cooperative arrangement. The concept of reciprocity between participating possessor States plays an important role, because these States will have to make decisions between transparency allowed within their own States and their confidence in other possessor State compliance. Finding effective and efficient solutions will also be essential given the significant efforts and costs that may reasonably be expected to be involved in such State-wide verification efforts.

## Lessons from Other Verification Regimes

The issue of verifying the absence of nuclear weapons at undeclared locations on a State-wide scale has not been explored before. In discussing this issue, WG4 considered the applicability of various other verification regimes such as the International Atomic Energy Agency (IAEA), the Organization for the Prohibition of Chemical Weapons (OPCW), the Conventional Forces Europe (CFE) and the Strategic Arms Reduction Treaty (START) Treaties. Discussions of existing regimes have helped to clarify some useful concepts related to scope, inspection parameters, and flexibility in verification efforts for different types of information. An example is the CFE, where a number of individual concepts were found to form a useful starting point for analysis.[2] However, none of these regimes would be directly suitable for application to the verification of

[1] See WG4 Deliverable Part I, Disarmament Scenario Used by Working Group 4.
[2] For more information, see WG4 Deliverable Part V.

nuclear weapons; the mechanisms for the detection of undeclared locations and items, in particular, are not transferable.

## Scope of "State-Wide" Verification

The IAEA, in its safeguards conclusions, makes a distinction between its ability to conclude that all of a State's declared nuclear material remains in peaceful activities (correctness), and that there are no undeclared materials or activities in a State (completeness). This terminology, although logical in IAEA-context due to the particular development of its safeguards system, has proven less useful during discussions in WG4, which has instead made a distinction between the verification of declarations pertaining to nuclear bases and the verification of State-wide nuclear weapons declarations.

Existing disarmament regimes provided some guidance as to what should be considered as "State-wide" in terms of geographical scope. The obligations of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (CWC), for example, apply to "any place under its jurisdiction or control." The concept of "State-wide" verification therefore does not assess the State as a geographical entity but as an international legal actor. That means that WG4 included in its deliberations not just the territory of a State (minus the parts that are not under its control or jurisdiction) but also any dependent territories, areas under its de facto control, surface ships, submarines, or overseas military bases.

At the same time, WG4 considered potential complications for scenarios in which the area to be verified is a defined geographical area that does not comprise an entire State, but only a delineated part thereof. This may be necessary in disarmament agreements that only focus on a certain area.

## Inspection Parameters

Several other verification regimes contain provisions to inspect undeclared locations in a State. Although it is unlikely that any of these will be directly applicable to the problem at hand, it is worth noting certain concepts and ideas within them.

The IAEA may make use of special inspections, based on its model comprehensive safeguards agreement (CSA), to inspect any location in a State—including undeclared ones.[3] The procedure concerning such inspection involves consultations and agreements with the State involved.[4] According to the related articles of the CSA, in urgent cases, the Board of Governors can get involved. In practice, requests by the IAEA for special inspections have normally led to involvement of the Board of Governors and risk escalating the situation. The Board concluded in 1992 that special inspections should occur only on "rare occasions"; the last formal request to undertake such an inspection was in 1993.

[3] International Atomic Energy Agency, The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/153), paragraph 73.
[4] See WG4 Deliverable Part IV, Paper 3. How to Resolve Inspection Ambiguities.

Under the CWC, States parties can request challenge inspections of undeclared locations in other States.[5] This means that the initiative for the inspection in question lies with other States, not with the verifying body itself. The idea was that this would be a more cooperative way to deal with inspection of undeclared locations, because States are expected to try to resolve any ambiguities through extensive consultations prior to requesting a challenge inspection. Moreover, the CWC contains several clauses that are designed to prevent abuse of the challenge inspection procedures by, for example, asking for inspections for the purpose of hampering the normal operations of locations of facilities. However, challenge inspections have never been used since the CWC came into force, suggesting that the political cost of requesting them is too high to make them an effective verification tool.

In general terms, it emerged from discussions in WG4 that elements of the CFE system of quotas for inspections at undeclared locations may be the most useful mechanism in this context. Under the CFE treaty, States parties have an annual quota of challenge inspections of undeclared sites.[6] These are inspections of any territorial area, not to exceed 65 square kilometers; no access or entry onto any declared site is allowed. The inspected State has the right of refusal, and the number of challenge inspections is limited to a percentage of the quota of inspections for declared sites in the State.

### Flexible Verification Efforts

As discussed in Part II, WG4 recognized that not all information will, or should, be treated equally in terms of corresponding verification effort.[7] This links to the principles of cost-efficiency and non-interference but also effectiveness—the notion that verification consists of cumulative efforts that may yield varying levels of assurance on their own.[8]

Thus, not all information provided by the inspected party is normally verified with the same level of scrutiny. Certain types of information require a higher level of assurance, entailing more rigorous verification and a stricter inspection regime than others, which may not have to be mechanically or systematically verified (e.g., former nuclear weapons storage sites); whereas yet other types may not be verified at all and simply serve as background or additional information (for example, historical nuclear weapon numbers or fissile material production numbers).

## Verification Objectives

The State-wide verification of the absence of nuclear weapons at undeclared locations requires the inspecting entity to (1) determine that there are no undeclared nuclear weapon-related facilities and (2) reach a conclusion regarding the absence of nuclear weapons at any other sites.

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[5] See WG4 Deliverable Part IV, Paper 3. How to Resolve Inspection Ambiguities.
[6] See, for example, Nuclear Threat Initiative, "CFE overview," www.nti.org; see also WG4 Deliverable Part V.
[7] See WG4 Deliverable Part II.
[8] See WG4 Deliverable Part I; see also IPNDV Working Group 1 Deliverable 1.

The verification objective is to deter and detect violations of the underlying nuclear disarmament agreement through diversion of treaty-accountable items at undeclared locations before these violations can become significant. The idea is that the regime in question cannot only detect such violations but also deter cheating because it can detect violations. The regime also deters cheating by making the pathways for cheating costly. The regime must be robust enough in terms of access and numbers of inspections to meet these goals, which will imply a trade-off between effectiveness versus intrusiveness and cost of inspections. The concept of confidence over time will likely play an important role by providing increased assurance that a party to the agreement abides by its obligations.

The question of the strategic significance of diversions in a State-wide setting becomes more pertinent as arsenal sizes decrease over time and small numbers become more significant. IPNDV Working Group 1 Deliverable 1 (2017) relates the principle of effective verification to the concepts of "timeliness" and "significant quantities" as introduced by the IAEA. Whether or not States will have confidence in a verification mechanism depends, among others, on the question, "What are the potential implications of non-compliance with the relevant agreement, and what are the possibilities for adequate individual or collective responses?"

These questions become very relevant on a State-wide scale because it is highly unlikely that any State could be provided with absolute certainty that another State has not hidden a single weapon or a small cache of weapons somewhere at a secret location. Rather than discuss which numbers constitute a significant diversion (which should be left to future negotiators), it is important to determine when a diversion would allow for a significant strategic advantage.

Whether or not a diversion of one or two weapons is strategically significant depends on context, such as the location of the weapon located, and how far it is from being operational and deliverable. This would suggest that State-wide verification of the absence of nuclear weapons at undeclared locations would imply a scenario in which there exists some parallel form of control of delivery systems and other nuclear-military infrastructure. The State-wide verification of the absence of nuclear weapons at undeclared locations also requires some form of monitoring for, or prevention of, the undeclared reconstruction of weapons. This may be a cut-off for the production of nuclear weapons and their components, or some form of control thereof. This may also imply control on the means of delivery, but this will not be considered further here.

Based on these considerations, WG4 observed that sufficient assurance of absence of non-declared items on a State-wide level would be attained only in combination with other verification arrangements. However, more work on the concept of strategic significance in this particular context is necessary.

## Challenges

### Scope of Verification

In comparison to the size of a State, or even to the treaty-accountable items of the CFE, nuclear weapons are relatively small. This means that the range of locations in which a weapon could

be—in theory—stored would be near limitless. In practice, of course, regard for safety/security/environmental norms will put significant limits on the number of potential locations. Under normal circumstances, only a limited amount of locations are connected to a State's nuclear weapons infrastructure. That could change if potential (strategically significant) gains of defecting from a disarmament agreement are high enough. This will also depend on the sort of government involved, and its regard for abovementioned norms.[9] If the stakes are high enough, however, a State could theoretically apply all necessary resources to turn nearly any location into, for example, a hidden weapon storage.

That means that, in order to deter diversion from the underlying disarmament agreement, all locations in a State would, in theory, have to be placed at risk of inspection in one way or another.[10] Such a scope is not unprecedented: as was pointed out in Lessons from Other Verification Regimes above, neither the IAEA, CWC, nor the CFE exclude any type of location from any and all possibility of being inspected. The goal behind this approach is not to inspect all these locations; that would be inefficient, overly intrusive, unacceptable to inspected States, and most likely highly counterproductive. Instead, the aim would be to provide for the option to inspect any location in a State, should that need arise, to avoid creating locations outside the legal purview of the verifying entity.

The point, therefore, is not to create a system of "anytime, anywhere" inspections but to ensure that no location on the territory or under jurisdiction/control of a State is formally exempted from control. The problem with this approach is that it could allow for deliberately disruptive inspections at places such as government offices, military facilities or even schools and hospitals. Yet even such locations cannot be formally excluded from some form of control—even if only to confirm that they are indeed government offices or hospitals as declared. Another challenge is posed by the potential issue of access to privately owned locations.

There are possible ways to address these complications. Under existing regimes, procedural and legal safeguards were designed to protect States from inspections that are frivolous or intended to be exceedingly disruptive. The CWC, for example, requires some form of information or evidence to be shared before a challenge inspection can be held, requiring the State requesting the inspection to prove that this inspection is indeed necessary. Quota systems may also be effective: if a State only has a limited number of inspections available, it might think twice before using them in a manner that will not provide any assurances regarding non-diversion. Another option is to offer the inspected State to block an inspection in a limited amount of cases, for example, *force majeure*.[11]

The consequence of applying the "everything at risk" concept is that verification options must be defined for a virtually limitless range of locations. Naturally, this does not imply that every

[9] This was, for example, an underlying assumption under the work that was carried out by UNSCOM in Iraq in the 1990s.

[10] See WG4 Deliverable Part IV, Paper 2. Evaluating Confidence in Compliance, as well as WG4 Deliverable V.

[11] Under bilateral verification regimes, moreover, additional protection against disruptive inspections will be afforded by the concept of reciprocity: States would have an incentive not to pursue unduly disruptive inspections in another State because the latter can always retaliate in kind.

location in a State will be inspected regularly—or even at all. The applicable underlying concept is that the mere *risk* of inspection deters a State from diverting weapons to undeclared locations, thereby providing assurance to all parties involved. To avoid unrealistic inspection burdens, one option is to distinguish between less and more "likely" locations for diverting weapons toward (non-nuclear military bases, former storage sites, explosive storage sites, etc.). Parameters that could apply are:

- Presence of security infrastructure;
- Location/remoteness;
- Proximity to military bases; proximity to deployment locations with means of delivery (such as silo launchers for ICBMS.)
- Logistical infrastructure;
- Suitable storage (e.g. hardened shelters for blast containment);
- Availability of security personnel;
- Accessibility;
- Health and safety expertise and capacities on site;
- Emergency response procedures;
- Indications of nuclear accident preparedness;
- Power consumption; and
- Presence of suitable canisters for transport and storage of weapons or delivery systems.

Building on the categorization and corresponding inspection burdens in WG4 Deliverable II, different quotas/inspection burdens could apply to different categories of locations. A quota system of inspections at undeclared locations, based on the CFE verification mechanism, seems to work best as it de-politicizes the process (in comparison with, for example, the IAEA's special inspections and the CWC's challenge inspections). Although no type or category of locations should have an inspection quota of 0 or 1, inspections quotas—also depending on the size and infrastructure of a State—cannot be so high that they go largely unfilled or they constitute severe potential disruption of the inspected State's activities.

During discussions in WG4, it has become clear that State-wide verification of the absence of nuclear weapons at undeclared locations will not be practicable or feasible without significant help from unilateral means of monitoring. National technical measures will be necessary to supplant information yielded by declarations and inspections. Satellite imagery, open source analysis, and big data analysis could help direct inspection activities. Environmental sampling and radio-isotope detection seem, at first sight, less promising because even if there are nuclear weapons on the site, unless there has been processing activities there may be little-to-

no environmental signatures to detect.[12] Certain sites may also not allow such sampling to protect unrelated or historic activities, or have radioactive signatures that confuse or mask detection capabilities. However, it is still worthwhile pursuing further study on these and other means of broad-spectrum data-gathering, as coupled with information barriers these may still hold non-compliant activities at risk.

The IAEA has further built on its existing safeguards system by developing the "State-level concept," which looks at the State as a whole. This includes assessments of so-called "acquisition paths," which help the IAEA direct its verification/inspection efforts.[13] Procedures akin to the "acquisition path analysis" could not only help assess the data gathered by the inspecting entity; they could also provide useful insights and pointers regarding which undeclared location warrants closer attention.[14] The IAEA uses a wide array of publicly available information to get a clearer picture of a State as a whole, which may in turn help with the efficient implementation of safeguards in that State.[15] Although the State-level concept has no direct application to nuclear disarmament verification, some of the underlying analytical models have been relevant to the discussions of WG4.

## Site-Specific Challenges

Once a site has been selected for inspection for undeclared weapons, the challenge of verifying the absence of nuclear weapons at that particular site could begin. In general, this involves questions of procedure and technology, starting with negotiating access with the State in question.

Credible procedures and arrangements would have to be in place for a large range of different types of locations and terrains (determination of size of sites, transport, observation methods, technology, etc.). It may be worth looking at established CFE procedures in this regard.[16] The next question is how to determine what inspectors would actually do when they get to the area/site they have chosen to inspect, and what (practical, logistical, and other) challenges they would face, such as how to choose what buildings to enter and what to look for. In this context, there could be possible lessons from CWC challenge inspection training, which focuses on medical facilities, health and safety documentation, and explosives areas. Other options could

[12] Radio-isotope detection and environmental sampling could be useful for determining that a site is not an undeclared facility. However, they could show presence of a military activity that is not constrained by a treaty regime; States cannot be sure of preventing cross-contamination from stored items (or even peaceful nuclear activities), given the detection threshold of these techniques is so low, down to the individual particle level. Therefore, its use in determining that a suspect site is an undeclared facility containing nuclear weapons could be problematic. Radio-isotope detection and environmental sampling at a formerly declared facility may only confirm that nuclear weapons were located at the site without providing information on whether or not they are still at the site.

[13] For more information on the APA, see IAEA, "Supplementary Document to the Report on the Conceptualization and Development of Safeguards Implementation at the State Level," document GOV/2013/38.

[14] See WG4 Deliverable Part IV, Paper 2. Evaluating Confidence in Compliance.

[15] See WG4 Deliverable Part IV, Paper 4. Nuclear Cultural Anthropology, for more information that may be pertinent in this context.

[16] WG4 Deliverable Part V.

be to ascertain radiation signatures or swipe sampling, discussions/interviews with staff, or assessment of security arrangements.

Solutions have to be found for specific locations, such as overseas military bases and surface ships, including military ships and civilian vessels.

When inspections are to be carried out in a contiguous geographical area, it is important that some form of "lockdown" can be applied in the time between the announcement of the inspection and the inspection itself, meaning that certain restrictions will apply in terms of moving certain items within or outside the location.[17]

There is also a need for further research into useful technologies for conducting inspections on sites. If a team is inspecting an undeclared site, what type of detection methods could be used? These will be different for highly enriched uranium (HEU) and plutonium sources. The usefulness and feasibility of the collection of radiation and/or heat signatures should be discussed further to assess what the chances are of detecting undeclared weapons in a location. As the inspecting entity should not, in fact, encounter nuclear weapons while verifying the absence of undeclared items, in most cases there should be few limits to the type of measurements that can be arranged.[18] Conversely, when establishing the absence of undeclared weapons in a wider area, radiation signatures from any weapons present may be weak, especially at a distance and with varying level of shielding. For large areas, good survey technology is not available, meaning that locations identified for inspection should be as small as possible.

However, other considerations of safety, security, and information protection would still apply. There will be many sites in a State that are of a highly sensitive nature, whether for military, national-security, or other reasons; at such sites, access and measurements by inspectors could be restricted.

The sheer range of sites that may come into play when verifying State-wide absence of undeclared nuclear weapons at undeclared locations makes it difficult to list all the site-specific challenges that could surface in this context. Although these issues were certainly examined during discussions in WG4, discussions were not exhaustive due to time constraints. Key issues include the following:

- Some sites may host sensitive military-related activities that cannot be accessed by an inspection team made up of foreign personnel;
- Facilities associated with the Naval Reactor Program (fuel fabrication, reactors, etc.) may not be open to inspections;

[17] Compare New START, which includes pre-inspection restrictions in terms of weapons-related activities on sites that have been selected for inspection.

[18] Exceptions may be for facilities with very specific purposes, such as producing highly enriched uranium or low-enriched uranium fuel for naval reactors.

- Techniques, like environmental sampling may not be available at certain sites (e.g., former weapons sites) or would not be conclusive (nuclear sites in general), although they could be useful for absence measurements at other sites;
- Presence of explosive materials at certain sites; and
- Possible presence of depleted uranium.

## Conclusion and Recommendations

Having discussed the concepts, objectives, and challenges involved with the State-wide verification of the absence of nuclear weapons at undeclared locations, and conducted a table-top exercise based on a simplified version of the CFE verification mechanism,[19] WG4 made the following general observations:

- It should be possible to credibly, practically, and effectively verify the absence of undeclared items or activities in a State as a whole, without compromising State sovereignty.
- Sufficient assurance of absence of non-declared items on a State-wide level would be attained only in combination with other pre-negotiated verification arrangements.
- The complications caused by the relatively small size of items declared as warheads[20] in combination with the large number of potential undeclared locations in a State should be addressed through the "everything at risk at all times" approach.
- Existing verification mechanisms may form a useful starting point for analysis, but must be adapted to suit the different requirements involved.
- Verification of State-wide completeness will only be possible with the right procedures and technologies, including unilateral means of monitoring.

There was a general convergence of opinion among WG4 members that State-wide verification of the absence of nuclear weapons at undeclared locations in the context of nuclear disarmament is conceptually and hypothetically possible. Of course, whether and how any such mechanism could be set up to be practically viable, without compromising State sovereignty, is a question that can only be answered through more research and analysis.

In general, further effort is needed to work on a general conceptual framework of inspection types and numbers, focused on the "everything at risk" approach.[21] Such a framework should take into account the necessity to protect States from unnecessary or overly intrusive inspections. Existing verification mechanisms such as those of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), CFE, and Convention on the Prohibition of the Development, Production,

[19] See WG4 Deliverable Part V, Report of the CFE Table-Top Exercise.
[20] See WG4 Deliverable Part II, Paper 1, Categorization of Nuclear Weapons.
[21] See WG4 Deliverable Part IV, Paper 2. Evaluating Confidence in Compliance for more details on statistical approaches.

Stockpiling and Use of Chemical Weapons and on their Destruction (CWC), as well as relevant past experiences, would form a good starting point for such work.

It is very likely that scenario-based work would benefit our understanding of the challenges and solutions connected to State-wide verification of the absence of nuclear weapons at undeclared locations. More detailed scenarios and simulations based on the concepts in WG4 Deliverable Part IV Paper 2, including work on acquisition path analysis and table-top exercises, could be helpful in gathering useful insights regarding what types of locations would be most relevant to a State-wide verification effort, which parameters would likely be relevant for finding such locations, or under what circumstances diversions or irregularities would be most strategically or militarily significant.

More research is needed on the question of which types of information are needed for State-wide verification of the absence of nuclear weapons at undeclared locations, including the technologies to acquire that information. The matrix in WG4 Deliverable Part II is a useful starting point for such work. It would also be useful to gain a better understanding of the possible role for National Technical Means (NTMs) as used in existing and previous verification such as the START and CFE treaties. The concepts, processes and data used by the IAEA to form a State-level picture of States' nuclear activities, as well as to direct its verification efforts, should also be taken into account.

Finally, the site-specific challenges outlined above merit further attention, both in terms of procedure and technology.

This is a product of the IPNDV Working Group 4: Verification of Nuclear Weapon Declarations. For more information on the IPNDV Working Groups, please see www.ipndv.org/working-groups.

**About the IPNDV:**

The IPNDV is an ongoing initiative that includes more than 25 countries with and without nuclear weapons. Together, the Partners are identifying challenges associated with nuclear disarmament verification and developing potential procedures and technologies to address those challenges.

The IPNDV is working to identify critical gaps and technical challenges associated with monitoring and verifying nuclear disarmament. To do this, the Partnership assesses monitoring and verification issues across the nuclear weapon lifecycle.

The IPNDV is also building and diversifying international capacity and expertise on nuclear disarmament monitoring and verification. Through the Partnership, more countries understand the process, as well as the significant technical and procedural challenges that must be overcome. At the same time, the Partnership is highlighting the importance of verification in future reductions of nuclear weapons.