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Possible methods and approaches for verification of undeclared and decommissioned sites for verifying nuclear disarmament, the reasons to employ them, and the dissemination of findings

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Abstract

Objectives: The future verification of the nuclear disarmament poses different challenges. The International Partnership for Nuclear Disarmament Verification is working on these challenges. The verification methods and approaches are very different so they can greatly influence the outcome of the inspection activities.

Methods: These methods and approaches can be identified in other, already functioning arms control arrangements and confidence and security building measures. The methods and approaches have their advantages and disadvantages, so the planning of different verification activities have to take into account these aspects.

Results: The future nuclear disarmament verification can be achieved by combining the methods of verification. The availability of technology also can contribute for verification of nuclear disarmament without entering sensitive areas, thus the states can comply with the provisions of the Non-proliferation Treaty. The use of different sensors for verification can complement the on-site inspection activities by providing for the inspectors data on the outline of specific site. After the certification of the sensors, states can use those under specific information barriers. The recording of findings of a verification activity also important for planning future inspection missions, and in case of non-compliance they can be used as factual evidence in different negotiations.

Conclusions: For this purpose the network maintained by the Organization of Security and Cooperation in Europe can be viewed as a model that ensures the confidentiality of the notifications.

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Introduction

According to Jozef Goldblat arms control, is, "…a wide range of measures have come to be included under the rubric of arms control, in particular those intended to: (a) freeze, limit, reduce or abolish certain categories of weapons; (b) ban the testing of certain weapons; (c) prevent certain military activities; (d) regulate the deployment of armed forces; (e) proscribe transfers of some militarily important items; (f) reduce the risk of accidental war; (g) constrain or prohibit the use of certain weapons or methods of war; and (h) build up confidence among states through greater openness in military matters." (Goldblat, 2002, p. 3). It is generally assumed that states enter into international treaties in good faith and intend to abide by their obligations. This has ramifications for such vital matters as national security, and requires special assurances that the parties will not engage in violating or circumventing their contracted commitments (Goldblat, 2002, p. 309). Verification has the following functions:

- deterrence;
- confidence building.

Verification deters state parties to an arms control (disarmament) arrangement from violating or circumventing the agreed provisions. This role is used only in case of agreed arrangements, and the control body of those arrangements can serve as a forum to discuss the concerns regarding assumed violations and circumventions. Verification is also a vital tool for confidence building, since confidence builds up over time among the state parties of an arrangement. For confidence building state parties agree on different methods of and approaches to verification.

In this article I use a fictional treaty with the label of Future Nuclear Disarmament Treaty (FNDT)[i], to elaborate the possibilities of verification activities. Verification under the FNDT provides the right for the inspectors (IT) to gain access to and get information from the whole territory of the inspected state (Host), in order to get assurance that the Host complies with the provisions of the Treaty. The Host, has a concern based on the security of the state, if verification is excessively intrusive. Nuclear disarmament verification is a joint endeavour of the IT and the Host, and it is in the interest of all, that the disarmament is irreversible and complete. The arms control arrangements, historical and current ones, have provisions to allow the IT to challenge the declarations made by the Host. The baseline, annual and ad-hoc declarations on the status of the Nuclear Weapons Enterprise (NWE) are just snapshots,

and the IT's assumption that the host "cheated" has to be dispelled. The desired end state (DES) is that the commitments to nuclear disarmament are adequately fulfilled, and the states under the FNDT completely and irreversibly comply with their obligations. For the verification of the declarations the IT can choose the most adequate method and approach, in order to accomplish the mission on the territory of the Host guided by the provisions of the FNDT.

Methods of verification:

- "Point";
- "Lines of communication" ("LOC");
- "Area".

These methods are picked by the IT based on the objective of the particular mission. These three methods have different shortcomings and advantages. The chosen method is dependent on the particular level of confidence and the ongoing activities declared by the Host. The IT plans the method of the mission based on declarations and other official sources (i.e.: State media) regarding the Host's NWE.

This article is not to be considered as an official statement of Hungary. This article contains elements of own research of the Author on the future of arms control, confidence and security building measures, and does not endorse any existing or future treaties arrangements.

1. The 14 Steps of Nuclear Weapons Dismantlement

Each step from the 14 Steps of the Dismantlement Lifecycle that were identified by the International Partnership for Nuclear Disarmament Verification (IPNDV) requires different methods, and due to that other issues regarding the use of verification technology will arise.

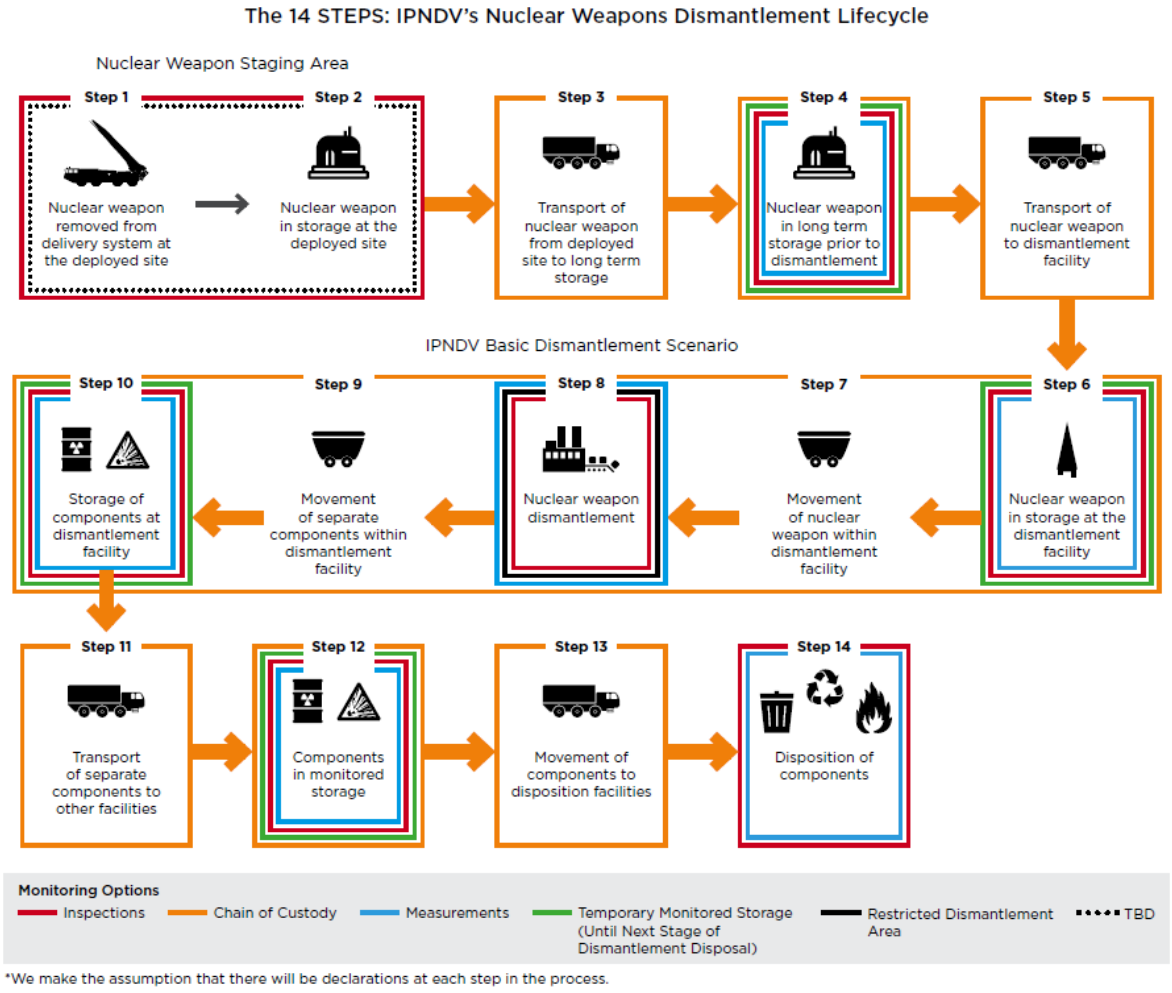

Fig. 1. The 14 STEPS: IPNDV's Nuclear Weapons Dismantlement Lifecycle
Source: IPNDV WG5, 2020

Fig. 1. shows an agreed pathway of the nuclear weapons dismantlement lifecycle from the deployment sites of nuclear weapons all the way to the disposition of their components. This model can provide a rough estimate which methods of verification can be used in order to reach the DES.

From the verification perspective it is also important to consider where and how verification activities can be initiated, and for that different approaches can be identified:

- No access, except to the declared sites of the NEW
- Access granted
  - Limited access to the IT
  - Limitless, total access to the IT

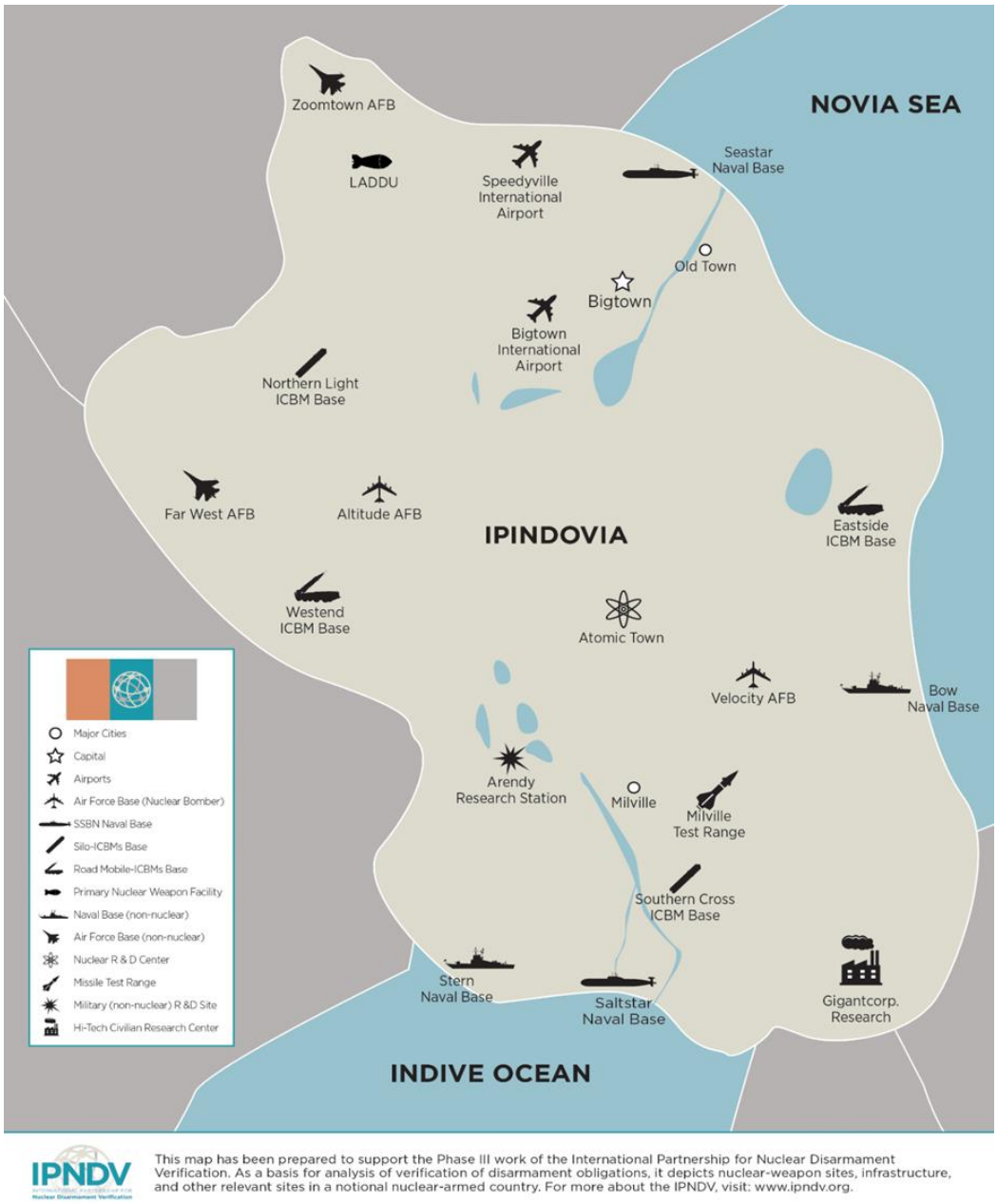

Fig. 2: "Ipindovia Scenario"
Source: IPNDV

Fig. 2. shows the "sketch map" of "Ipindovia" is, with its capital marked by a star and other main cities marked by a circle. On this map the ground transportation infrastructure is not depicted. The locations of the major military and other installations are marked according to the main purpose of the site. The mobile transport-erector vehicle depicts road mobile intercontinental ballistic missile (ICBM) bases. The missiles without fins depict silo-base ICBM bases. The missile with fins symbolizes the missile test area located in "Ipindovia". The submarines depict nuclear ballistic missile submarine bases, the ships are used for non-nuclear capable naval bases. The bomber airplane is used for identifying locations for deployed nuclear weapons for the air force, the fighter plane is for non nuclear

airbase and the airliner is used for civilian airports. The bomb marks the state's main nuclear weapon facility. The atomic model shows a nuclear research and development (R&D) site, the explosion is the location of a non-nuclear military R&D site. The factory icon depicts the location of a high-tech civilian research center. This example is important to understand the methods and approaches for conducting verification activities under the FNDT.

The assumption is, that the IT can stay in the Host State for limited time specified in the provisions of the FNDT and the Host has the right to limit the equipment used on specific sites of inspection. In this context the site of inspection can mean declared site, dismantlement site, storage site and other specified area.[ii]

2. Description of methods

Hereby the different methods are described regarding the site of inspection. All the methods have their own particular advantages and disadvantages that will be specified. The compendium of pros and cons is in ANNEX 1.

"Point" method of verification

This method focuses on geographically fixed locations that are declared by the Host. According to the "Ipindovia Scenario" these are the military bases where the nuclear weapons are stationed, central nuclear weapon/components storage locations, and the dismantling facility. The "point" method is the basic on-site activity, where the IT verifies the declared Treaty Accountable Items (TAI). This provides a so-called "snapshot" of the NWE of the State, and contributes to the systems approach described in the IPNDV WG5's paper on the verification techniques (IPNDV WG5, 2020). The advantage of this method is that the TAIs are assumed to be on the site of the inspection. Based on agreed information barriers the IT can verify them, and they can either establish Chain-of Custody (CoC), or monitor the CoC and establish Containment and Surveillance (C&S) as agreed with the Host. On the other hand, the IT should have the right to conduct absence measurements on these sites. The method allows the Host, to move the TAIs, according to its internal considerations, thus limiting the access to the declared TAIs that were associated with the specific site. However, the IT can ask the Host, as it is stated in the Protocol to The Treaty Between The United States of America and The Russian Federation on Measures for the Further Reduction And Limitation of Strategic Offensive Arms (Protocol to New START), Section V, para 15:

"Upon completion of pre-inspection procedures, no object, container, or vehicle large enough to be or contain an item of inspection shall leave the inspection site until inspected by the inspection team or released by the inspection team if it does not intend to inspect such object, container, or vehicle. Such inspections shall be conducted so as not to hamper or delay the operation of the facility."(New START)

The largest disadvantage of this method is that the verification activity is too focused on specific locations, and diversion can be made easily, and during the activity the IT will not have any idea what happened. The in country period of the IT is usually limited, and the outcome of such verification method is relatively minor in contrast to the resources allocated for the activity. The information barriers are set by the Host, and the IT has to comply with them in order to accomplish the mission.

"Lines of Communication" (LoC) method of verification

This method provides the tracking of different TAIs across the NWE and the post-dismantlement phase of the 14 Steps. The main goal is to ensure, that the TAIs' CoC is maintained throughout the process, and that diversion has not occurred. The "LoC" method is largely based on the declarations submitted by the Host before actual movements were made. This allows for the IT to apply C&S according to the provisions of the FNDT, and the agreed information barriers. This method can give a broader picture of the NWE of the Host State, but the main constrain is that all movements have to be notified beforehand, and this can cause serious confidentiality and security issues. The LoC method allows for the IT to cover more declared sites, and to monitor the transportation of TAIs. The monitoring of the transportation lowers the probability of the circumvention of the provisions, thus closes some diversion paths. This method has a major disadvantage, if the provisions of the FNDT allow the post-movement notifications. Another constraint is that the tracking of the transportation of the TAIs requires special equipment (i.e.: transponders, unmanned aerial vehicles (UAVs)), and the Host can refuse the application of these equipment.

"Area" method of verification

The "Area" method of verification can cover a specified area within the Host State's territory. The territory is defined by geographical coordinates, and can be based on different approaches. The main goal of the "Area" method is to ensure that the Host does not

circumvent the provisions of the FNDT. The area covered by the IT can be either strictly specified, with parameters like area, distance between points,[iii] or can be vague.[iv] The parameters of the area can also be limited by designating Maximum Flight Distance from specified locations. The "Area" method requires aerial inspection, based on two possible options:

Option 1: The IT decides the overflight route;

Option 2: The Host proposes the overflight route.

In Option 1, the IT submits the preferred flight route, and the Host can either entirely accept the route, or suggest some alterations in accordance with flight security and national regulations, but allows the observation of the Points of Interest (PoI) of the IT, or finally it can also decline the route proposed by the IT.

In Option 2, the Host proposes a route that covers the possible PoIs of the IT. In this case the IT and the Host have to agree, and finalize the overflight route. In case the Host provides the aerial vehicle (plane, helicopter, long-range UAV), if so agreed the overflight can also be denied, due to credible technical reasons. The "Area" method can be used to visually identify the structure of different declared and undeclared sites, as well as to make more accurate mapping of the Host's NWE in a specified territory. This allows for the IT to cover more area, however the exact location of TAIs is usually not observed. For this type of inspection activity the IT heavily relies on imaging sensors, as well as on other sensors. In line with the FNDT the IT and the Host previously agreed on certain information barriers regarding the resolution of the sensors. The resolution limit can be either reached by the altitude of the aerial vehicle, or by built in limitations of the sensors. One example is the Treaty on Open Skies (OS Treaty). The Article IV of the OS Treaty allows State Parties to conduct overflight and to get imagery of other State Parties by using different sensors (optical, with resolution of 30 cm at ground level; infrared (IR), with resolution of 50 cm at ground level and side-looking synthetic aperture radar (SLAR) with a resolution of 300 m at ground level) (OS Treaty). As it is well known, satellites can produce similar results, but the launching and maintenance of the space assets can be very expensive, and the lifetime of these assets is limited. The aerial observation of areas, and declared sites can be more operable than using satellites. An overflight according to the provisions of the Article VI of the OS Treaty can be notified to the receiving State Party at least 72 hours before arrival (OS Treaty). This notification includes the sensors to be used during the observation flight. After arrival of the platform the receiving State Party verifies that the sensors are covered

(during the flight no data are collected) as it is stated in the Article IX, and Annexes E and F in the OS Treaty (OS Treaty).

3. Description of the approaches

The approaches are based on agreements reached prior to the entry into force of the FNDT among State Parties. The possible application and functions of different approaches are clearly defined in different arrangements.

No access granted, except to declared sites of the NWE

The Host allows IT access only to declared sites associated with the NWE in accordance with the provisions of the FNDT. This approach allows only for the "Point" method of verification. The approach that allows access only to sites that are declared limits the possibility of the IT, thus does not increase confidence among the State Parties to the FNDT. This approach seriously hampers the confidence building function of arms control, and the DES will not be reached in good faith. Also this approach is focused on the TAIs.

Access granted to non-declared sites

This approach has historic and working experience in the Treaty on Conventional Armed Forces in Europe (CFE Treaty) and the New START's Inspection Annex, Section VII. Inspections of Non-deployed Strategic Offensive Arms, Converted or Eliminated Strategic Offensive Arms, Deployed Heavy Bombers at Storage Facilities for Heavy Bombers, and Formerly Declared Facilities, Conducted in Accordance with Paragraph 3 of Article XI of the Treaty (Type Two Inspections) are used for verification of other sites than the deployed part of the State's NWE. The access can be limited, if the non-declared site was previously part of the State's NWE, as in New START where inspection, is allowed usually by "Point" method. The CFE Treaty does not specify, which site is off limits regarding the entry of the IT. The CFE Treaty calls this type of inspection "Challenge Inspection" (CFE Treaty). Why should access be granted to "non-declared sites"? The main reason is that the FNDT, if it has provisions on this specific issue granting the right for the IT to conduct inspections on the whole territory of the Host. However, specific constrains can be implemented, usually concerning the use of aerial vehicles (plane, helicopter, UAV) in accordance with ICAO protocols on prohibited and restricted airspaces, that are published in the State's Aeronautical Information Publication (AIP) Part 2, ENR 5, and graphically in ENR 6.

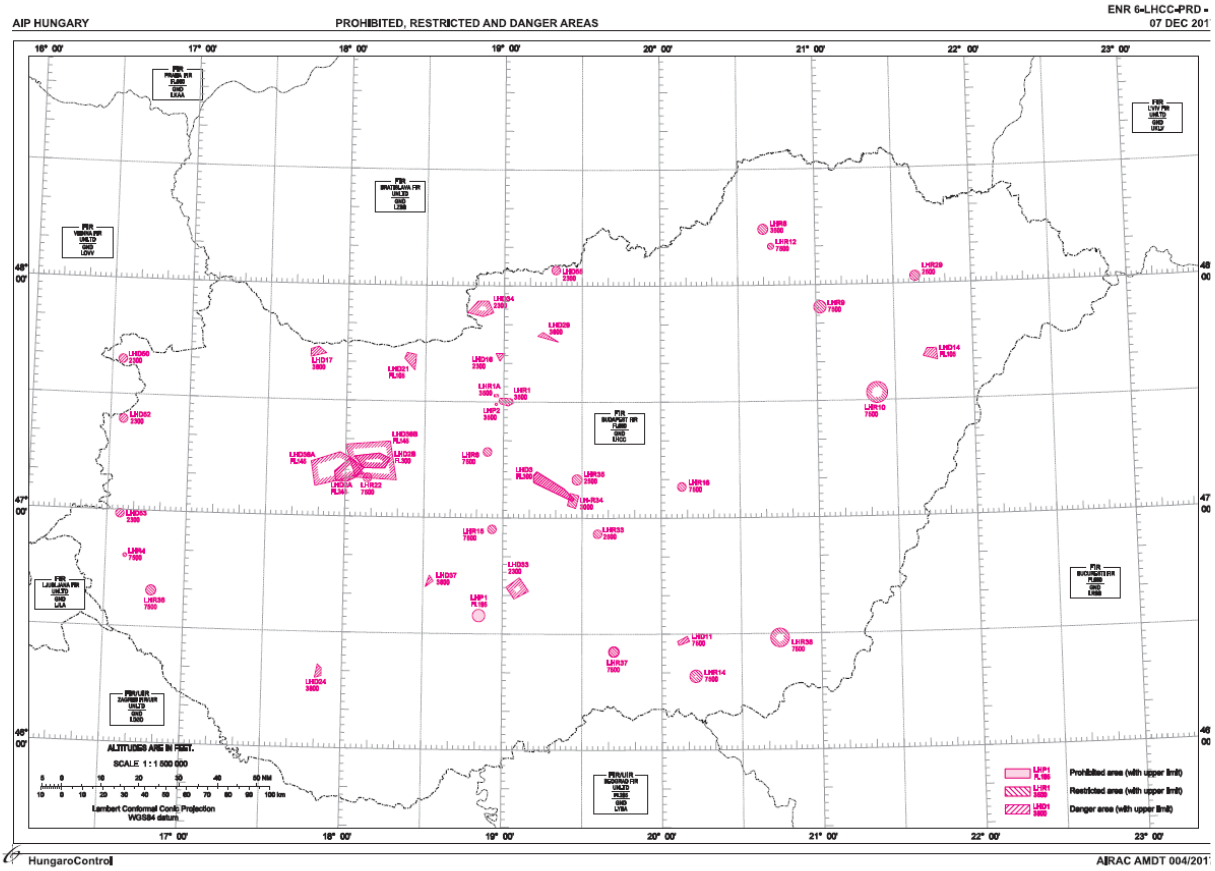

Fig. 3: Hungary AIP ENR 6
Source: AIP Hungary

Fig. 3 is an example, showing Hungary's AIP ENR 6, where the location of Prohibited, Restricted and Danger Areas can be found. The Hungarian AIP provides information on these locations. The Restricted areas can be military installations, specialized factories, and storage sites. The Danger areas are shooting ranges, and other special installations. The Prohibited areas are the nuclear facilities of Hungary that are marked on this map. Also the AIP of the State can provide information on airport, airfields, which can be used for verification purposes.

If the Host allows the IT to conduct verification activities on specific "non-declared" sites, the Host will then act in good faith of the arrangement, which contributes to the confidence building function of the FNDT. This is also elaborated in IPNDV WG4's deliverable Parts III. and IV (IPNDV WG4, 2020).

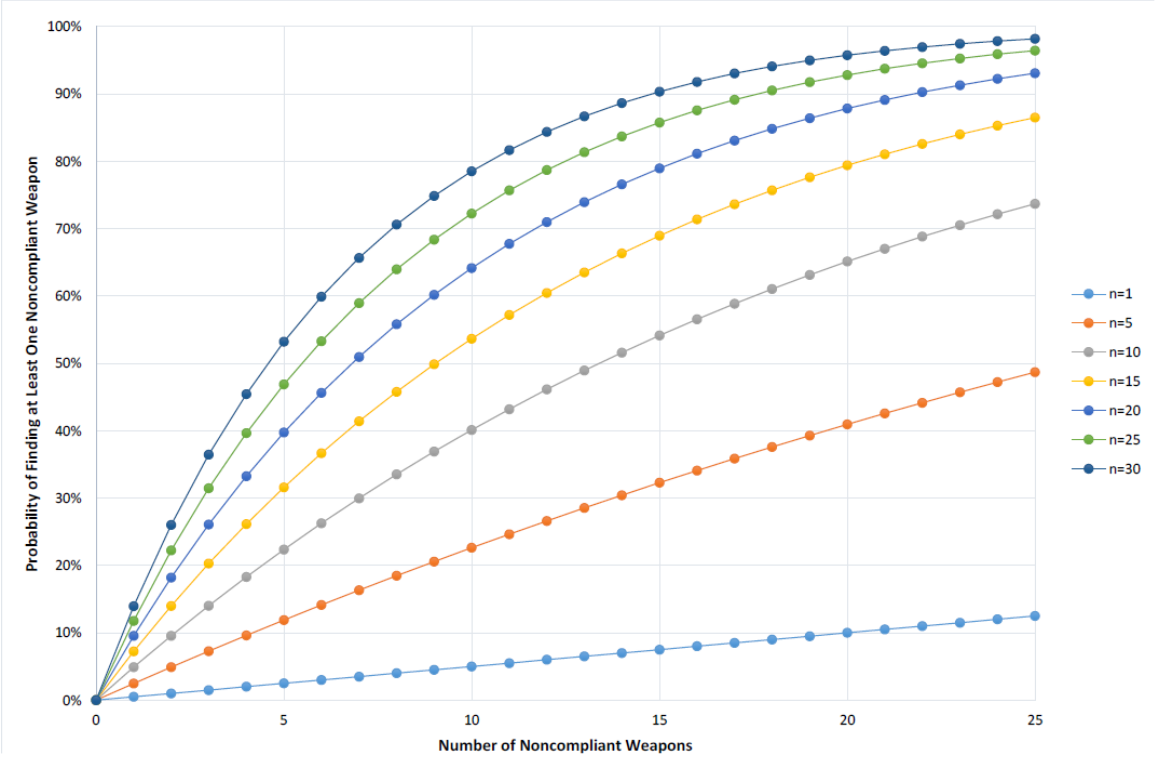

Fig. 4: Probability of Finding at Least One Noncompliant Weapon at a Site with 200 Weapons
Source: IPNDV WG4, 2020

Fig. 4 is showing the probability of finding non-compliance on a d eclared site, where "n" is the number of weapons randomly inspected. If we inspect one, from the 200 TAIs, the IT has to be lucky to find non-compliance. A similar graph can be used also on the inspection of non-declared sites, or withdrawn sites, with regards to non-compliance. As in the "Ipindovia scenario" (see Fig. 2) the NWE sites and other sites depicted are close to each other, and thus the IT can suspect that the Host will circumvent the provisions of the FNDT, and can divert the TAIs. The Host's main concern is security of the State. The allocation of quotas that allow the inspection of non-declared sites should be lower than the quotas allocated from the number of declared sites, or from other basis. If the IT can enter these "non-declared" sites whenever it wishes, and the access is not limited somehow, trust also cannot be built, because the IT does not believe that the Host is acting in good faith. The best option is to somehow limit the access frequency of the IT to the "non-declared" sites, and thus the viability of verification activities will be ensured.

During the inspection of "non-declared" sites the IT is entitled to take absence measurements.

The need to get some, controlled access to "non-declared" sites gains more relevance after Step 8 of the identified 14 Steps of the dismantlement lifecycle. The components of the

Nuclear Explosive Device (NED) are separated, and their disposal needs to be verified. During the entire existence of IPNDV the correctness and completeness of the dismantlement have been in focus, therefore, the information barriers have to be designed accordingly. The Host has the right to reprocess the Special Nuclear Material (SNM) into material employed in peaceful uses under the Safeguards of the Non-proliferation Treaty, or to reprocess to the fuel cycle for naval vessels, or to dispose them in long term storages. Step 14 is not finalized, however in reaching the DES, the possibilities of disposal of the NED components are key elements in achieving the nuclear disarmament.

4. Use of National Technical Means of Verification based on declarations and notifications

Satellite imagery has historically played a unique role in arms control verification, and still plays that role. Recent advances in remote and standoff monitoring may complement on-site inspections, which could make verification approaches more robust, less intrusive (Glaser, Niemeyer, 2021,p. 88).

As it is shown in Fig. 3, some sites are declared in accordance with ICAO regulations, which can be monitored using National Technical Means (NTM). Similar information can be submitted by the Host presumably in the "Ipindovia Scenario". As it is stated in multiple arms control agreements, in confidence and security building measures, and was identified by IPNDV WG5:

> *"Information from national technical means of verification or from open sources is already embedded in arms control agreements and could have a role in verification of NED dismantlement, subject to the terms of a verification agreement. For example, in certain circumstances satellite observations might provide additional information about the location of some accountable items." (IPNDV WG5, 2020)*

In the Vienna Document 2011 on Confidence and Security Building Measures (VDoc'11) also acknowledges the value of NTMs:

> *"The participating States recognize that national technical means can play a role in monitoring compliance with agreed confidence- and security-building measures." (Vienna Document 2011, para 74)*

The use of NTM for verification has to be agreed among State Parties to the FNDT, otherwise the use of sensors can be viewed as intelligence gathering (Бужинский, 2020) State Parties have to clearly specify the resolution of the acquired data using the NTMs. The NTM is not solely based on sensors attached to a satellite, it can incorporate other, ground-based and aerial sensors. In case of the IPNDV's scope the ground-based sensors are not to be used, since these sensors have to be installed on the territory of the "owner" of that sensor. Aerial sensors, like those used for the OST, and other, agreed sensors can be used. The use of agreed aerial sensors is a considerable added value to satellite based sensors. The main reason for that is that the lifecycle of space assets is limited, and the cost of these assets is not affordable to all states. The other reasons for using aerial sensors, is that not all aspects of a NED can be viewed, sensed from space. The space assets are not capable of collecting samples from the atmosphere, which also can be used as a possibility to gain confidence in the absence of the nuclear weapons. The aerial platforms can be fitted with different sensors in order to additionally gather environmental information supplementing the imagery.

The use of satellites can play crucial role to monitor fixed, long term storage areas, similarly to the monitoring use of commercial satellite imagery used by the International Atomic Energy Agency (IAEA) to monitor specific nuclear sites. The capabilities of the satellite in this area are truly increased during the past 30 years (Niemeyer, 2009). The quality of the imagery, and the availability of them provides more information on nuclear sites, and the analysis of the data collected can provide a tool for verification of certain commitments (Nussbaum, Niemeyer, 2009).

In the military of the United States of America, the term of NTM is no longer used, but still referenced in New START (Aftergood, 2019). In its Field Manual 3-14, Army Space Operations, the US Army uses the following definition on this issue:

> *"National Reconnaissance Office overhead systems (known as NOS)—formerly referred to as national technical means—are spaced-based sensors designed to collect data in order to support intelligence analysis."(FM 3-14)*

The Nuclear Threat Initiative defines NTM the following way:

> *"Satellites, aircraft, electronic, and seismic monitoring devices used to monitor the activities of other states, including treaty compliance and movement of troops and equipment. Some agreements include measures that*

explicitly prohibit tampering with other parties' NTM." (Nuclear Threat Initiative, 2021)

This definition encompasses all types of sensors that can collect data, so the on-site inspections can be minimized. The Article V. of the Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms (SALT I) the use of NTMs are clearly identified for verification purposes. The SALT's provisions of Article V para 2 clearly state that "Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article." (SALT I)

The NTM's "[…]vital task for the geospatial intelligence (GEOINT) community remains collecting, analyzing, and exploiting data for the monitoring of international agreements and informing verification decisions concerning compliance with those agreements." (Ulrich *et al.*, 2019, p. 7)

So, the use of NTMs for verification purposes is based on the agreement among states, and the optical part of it can be achieved based on the goodwill of the states. The measures regarding the camouflage and concealment of different objects have to allow the NTMs to monitor them with taking into consideration of the agreed information barriers. Historically the SALT I's provisions and the SALT II provisions were adhered by the states.

Fig. 5: Davis-Monthan AFB
Source: done by author

Fig. 5 is a screenshot done with GoogleEarth, shows a part of the Davis-Monthan Air Force Base in the United States of America. The main reason of this picture is to show the possibilities of the NTM. On the picture, there are intact airplanes and on the left and right side of the picture there are aircraft, which wings are away from the fuselage. These aircraft are B52 strategic bombers that were reduced under the Strategic Arms Reduction Treaty (START I Treaty), and left outside, so the verification of reduction of those planes can be accomplished.

Fig. 6: Mobile ICBM basing area
Source: done by author

The screenshot made with GoogleEarth on Fig. 6 shows a Mobile ICBM basing area that belongs to the 54th Guard Missile Division (Teykovo, Russian Federation). The picture shows one of the locations, where mobile ICBMs are based, This example shows one of the major disadvantages of using NTMs solely for verification purposes, since the interior of the structures can not be seen, also the mobile ICBMs are not visible.

The NTM can be used to gather information on missile test sites, in “Ipindovia Scenario”, in “Milville”, by gathering telemetry data. Also gathering signals intelligence and employing tracking devices can be used to conduct inspection activities on CoC of the TAIs, and ensure C&S, especially during Steps 3; 5, and after the dismantlement at Steps 11 and 13. The NTM’s use can also have other impacts. The confidence building function of the arms control arrangement is supported by the use of NTM, however the large amount of data collected needs to be interpreted, and the analysis of the data can not always provide

sufficient information either. The other problem of using NTMs is the available resolution of the images taken. The warheads, and the components of it, are considered as "fine-grain" objects, so to find these is very difficult, or we can say it is impossible solely relying on NTMs.

Fig. 7: Uranium entering and leaving a large enrichment plant over a two-week period
Source: Glaser, Niemeyer, 2021, p. 101

On Fig. 7 it is shown on the left are the feed cylinders needed to supply natural uranium for a one-million separative work units (SWU)/year plant and the product cylinders that can be produced with this material. Shown on the right is a misuse scenario, where one significant quantity of highly enriched uranium (HEU) is produced. While it may be difficult to detect the removal of small HEU cylinders from the plant, a significant amount of low-enriched uranium (LEU) product is unaccounted for (Glaser, Niemeyer, 2021, p. 101). The verification the quantity of HEU produced need other methods and approaches, that can be accomplished by gaining access to the enrichment sites and by installation of portal devices.

The NTMs' capabilities are adequate to locate and verify some delivery systems, the weapons production facilities' activities (Glaser, Niemeyer, 2021). The other concerns of using satellites only are that satellites can be vulnerable to space debris and not all states posses the needed orbital assets (Várdai, 2020). The other concern is the availability of images for specific states and locations can be limited, and the commercial satellites are not providing adequate imagery. The use of new technologies to enhance analysis capabilities of the information gathering is under development (Lindebaum *et al*, 2019). The OS Treaty's rules and procedures can be renegotiated and the observation aircraft can be tailored for specific missions over specific locations (Gottemoeller, Marvin, 2021). For the aerial monitoring long range, long endurance UAVs also can be used based on the future agreements.

5. Certification of sensors

Sensor technology is vital for inspecting the dismantlement of the NEDs. Especially given their obligations under the Non-Proliferation Treaty, states may have concerns that during the verification of the dismantlement sensitive information can be released. The confidentiality of these data is a matter of state and international security. To allay the concerns of nuclear-weapon states information barriers may have to be used [in a verification regime in which representatives of nuclear weapon and non-weapon states can participate as inspectors]. The history of using sensors for building confidence shows that it is possible to use sensors on a territory of a State without revealing too much information. Under the provisions of the OS Treaty, the sensors have to go through a certification process.

Why is the OS Treaty a good example for International Partnership for Nuclear Disarmament Verification (IPNDV)? How it can help to achieve the goal of nuclear disarmament? The answer is that the OS Treaty, a technical confidence and security building measure, and uses different sensors that are have to undergo a certification.

Certification of the sensors to be used in the verification of nuclear dismantlement as described in the 14 Steps Model, can be useful for proving especially to states with concerns, that activities proposed by IPNDV satisfy non-proliferation requirements.

For the first set of sensors certification has to be done before the verification regime enters into force. States which are signatory to the future verification regime describe in a special format the technologies that they would like to use for verification. The other States can ask either for clarification, or can refuse to accept the technology proposed. The States, which do not raise concerns, also acknowledge that. After a period of time the selected new technologies have to undergo re-certification, as defined by the verification regime. For certification, States organize a two-level event. The first level is the so-called pre-certification, during which they provide the documentation of the technology to be certified, the data collected. The experts from all states participating in this regime will sign/ask for further development of the selected technology/not-sign, depending on the information barriers specified. After this event the selected technology (approved by the experts) undergoes certification, during which the states representatives can also sign/ask for further development of the selected technology/not-sign. After the signature, a silence period will start for the time specified in the future verification regime. After this silence period, the

technology can be used for verification, and the states provide a specific format for each technology that is certified.

6. Information barriers in conventional arms control

The planning, execution and evaluation of the information gathered during verification activities vary depending on the regime. This information can contain sensitive information, starting from participants in the activity, observations. The information regarding the verification activity is transmitted through a specially configured network with pre-formatted notifications. This network also contributes to the confidentiality requirements, since the End-User-Station is maintained in the country by limited number of personnel. The notifications sent by a State have to undergo an authentication procedure at the political level [all messages considered as diplomatic correspondence]. All the information goes through a "mail server", where the contents are checked for information security wise, and this system sets up alarm in case of rogue activity [i.e.: hacking; viruses; unauthorized of the whole system, and after that the recipient receives the notification. The notification requesting for inspection is disseminated to all States except inspection activities under the Treaty on Conventional Armed Forces in Europe in conventional arms control, however the reply on acceptance are disseminated to all States in the regime, to inform about the presence of an inspection/observation team in the State. The information on this network is not "Classified", but treated as sensitive.

7. Access to the data collected during verification

Europe-centered conventional multilateral arms control treaties describe different recording and dissemination methods regarding the outputs of verification activities. The simplest case is the CFE Treaty, where findings are recorded in a pre-formatted report, which is distributed among the inspecting, inspected and stationing parties as it is stipulated in Article XIV and in the Protocol on Inspections, Section XII. (CFE Treaty). According to the CFE Treaty, no other State Parties receive the findings of the verification activities, unless the State Parties involved need to discuss them in a plenary meeting of the Joint Consultative Group under the provisions of the Article XVI, and of the Protocol on Inspections, Protocol on the Joint Consultative Group (CFE Treaty).

Under the OST the data collected by from the sensors are shared between the observing party and the observed party. The State Parties that are not involved in this

observation flight, will receive the flight path followed, and a notification of the (certified) sensors used. During the observation flight the observed party controls the data collection, and ensures that the information barriers are not breached, which is according to the OS Treaty's Annex D, Appendix 1 (OSTreaty). If a State Party is interested in an area or object that was observed, it can ask the observing party to provide the data. But, according to the Open Skies Consultative Commission's Decisions OSCC/I/Dec.1/10, OSCC/I/Dec.5/29 and OSCC/VI/Dec.18/12, it has to be purchased (OSCC).

The results of activities based on the VDoc'11, are distributed in a pre-formatted electronic report, which is shared with all participating states. The content of the report is usually not very specific that is covered in paras 105 and 135 (Vienna Document 2011). The wording of the reports is usually vague, however, the recipients can read between the lines, to get the "perceived real picture" of the activity.

8. Reporting findings and information exchange system

Sharing verification information is an important, and possibly vital, question. Who is allowed to receive the data resulting from the verification of the dismantlement? Can other states obtain information regarding the amount of SNM, and its location after the disassembly of the NEDs, and if so, how? These are tough questions regarding the work to be done by IPNDV. The technical and procedural information barriers have to be solid, and guaranteed. Thinking about these questions can add to IPNDV as a viable and worthy platform for discussing the security of proliferation sensitive information.

The planning and execution of activities, as well as evaluation of the information gathered during verification activities vary depending on the regime. This information can contain sensitive information, starting from participants in the activity, to the findings of the activity. The information regarding the verification activity is transmitted through a specially configured network with pre-formatted notifications. This network also contributes to the confidentiality requirements, since the End-User-Station is operated in the country by a limited number of personnel. The notifications sent by a State have to undergo an authentication procedure at the political level [all messages considered as diplomatic correspondence]. All the information goes through a "mail server", where the contents are checked information security wise, and this system triggers an alarm in case of rogue activity [i.e.: hacking; viruses; unauthorized use of the whole system, and after that the recipient receives the notification. The notification requesting inspections is disseminated to all States

except inspection activities under the CFE Treaty, however the reply on acceptance is disseminated to all States in the regime, to inform about the presence of an inspection/observation team in the State. The information on this network is not "Classified", but treated as sensitive.

During the design phase of a future nuclear disarmament verification regime it is important to specify the methods of collecting data with approved technology to ensure the necessary confidentiality.

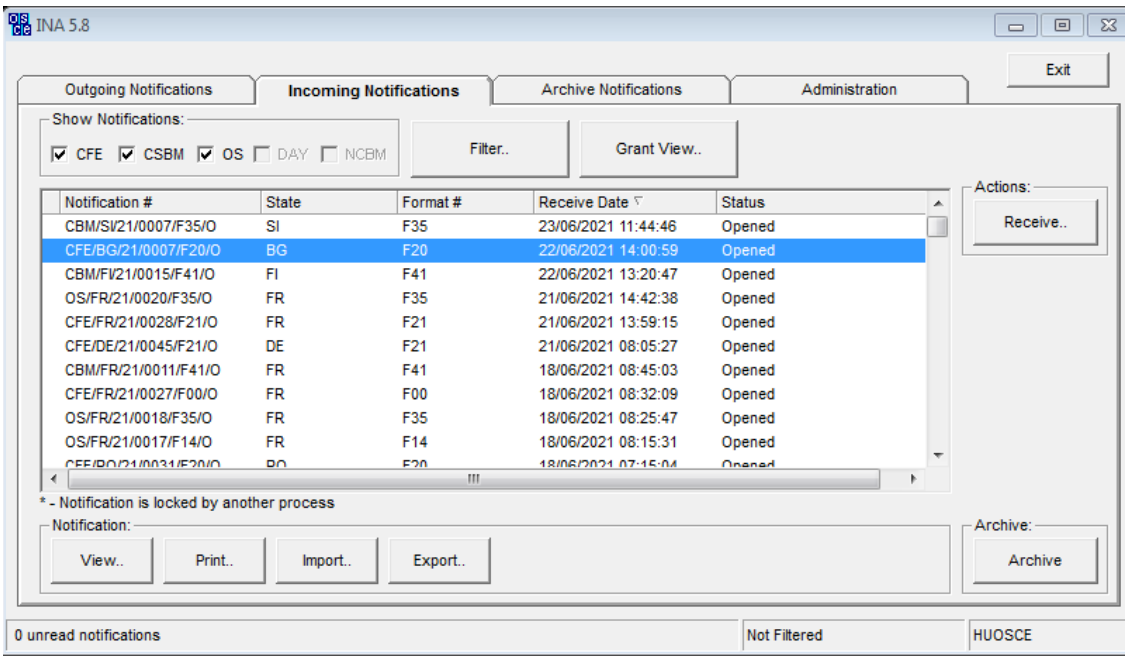

Fig. 8: Integrated Notification Application
Source: screenshot by author

The Fig. 8 shows the graphical user interface of the Integrated Notification Application used by the Organization of Security and Cooperation in Europe. This system is linked with Microsoft Oulook, and the End User Station can view incoming notifications, create and send new notifications.

The New START uses also specific notifications that are transferred using a dedicated network.

The findings of a verification mission also can be considered as factual evidence for arbitration among states in case of non-compliance issues.

Conclusion

During the negotiations phase State Parties to the FNDT will agree on certain provisions regarding the use of NTMs and on inspection of declared and "non-declared" sites.

The drafting of the FNDT will set the goal to reach "Global Zero" level on nuclear weapons, and this will lead to inspection of "non-declared" sites in order to ensure, that the Host did not circumvented the provisions of the Treaty. The choice of method and approach of inspection by the IT will depend on the information made available by the Host. Necessary transparency is needed to achieve the ultimate long-term DES, total and verifiable nuclear disarmament. Further research is needed in the possible technologies that can be used in verification, and further studies required in legal issues regarding the use of those technologies. Arms control, especially in the nuclear field has to be maintained, and IPNDV's work is one of the most promising for the future and survival of the whole mankind. The future of arms control seems quite dark, but this is only a shadow cast by the new bright future of this idea.

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ANNEX 1.

Pros and Cons compendium
Methods of verification

“Point” method			
Pro		**Con**	
IT	**Host**	**IT**	**Host**
TAIs can be counted	security of other warheads maintained	small part of the NWE can be inspected	very intrusive method
CoC can be established	easily agreeable information barriers	high resource allocation needed, small outcome	individual tracking of the TAIs can breach the national security of the State
CoC can be checked	more power over the IT	further activities are limited by time constrains or quota constrains	
“Lines of Communication” method			
Pro		**Con**	
IT	**Host**	**IT**	**Host**
CoC is monitored	less intrusive	need preliminary notifications from Host	security
more opportunity to map the NWE	can contribute to confidence building	Host can conceal movements of TAIs	confidentiality of the NWE can be breached
		tracking technology has to be negotiated	
“Area” method			
Pro		**Con**	
IT	**Host**	**IT**	**Host**
Large part of NWE can be mapped	easier to conceal sensitive items	no details on TAI	deviations can lead to unintended results

“Area” method (continued)			
Pro		**Pro**	
IT	**Host**	**IT**	**Host**
„can be lucky” to see the TAI	flight route is known	special arrangements needed to use special aerial vehicles (i.e.: UAV)	high costs if own equipment is used
	non intrusive	weather influences heavily the activity	
		technical problems can occur	

Approaches

Access granted only to declared sites			
Pro		**Con**	
IT	**Host**	**IT**	**Host**
Fixed locations	Security	Diversion can not be identified	“trust is not built”
TAI centric approach	TAI centric approach		
Access granted to non-declared sites			
Pro		**Con**	
IT	**Host**	**IT**	**Host**
Can deter the Host from diversion	Confidence building measure	Quota	Security issues
absence measurements			

i In the „Ipindovia Scenario” the IPNDV uses Nuclear Weapons Reduction Treaty (NWRT), as a tentative arrangement. (comment from the author)
ii This is based on the provisions of the Treaty on Conventional Forces in Europe (comment by author)
iii In CFE Treaty the specified area is strictly specified, as: „…shall not exceed 65 square kilometers. No straight line between any two points in that area exceed 16 kilometers. See Treaty on Conventional Armed Forces in Europe, Protocol on Inspection, Section I para 1. point (O)
iv In Vienna Document 2011 on Confidence and Security Building Measures (VDoc’11) the area is defined as „…The specified are will comprise terrain where notifiable military activities are conducted or where another participating State believes a notifiable activity is taking place. The specified area will be defined and limited by the scope and scale of notifiable military activities but will not exceed that required for an army level military activity. See VDoc’11 para 80. As a “rule of thumb”, for example the participating States of the former USSR, except the Baltic states, approve and conduct a specified area inspection maximum 20000 square kilometers area. (comment from the author)