Working Group 1 - Deliverable Two

Assessment of Monitoring Objectives and Information Requirements for Each Step of the IPNDV "Basic Dismantlement Scenario"

Working Group 1: Monitoring and Verification Objectives

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Introduction

This paper provides a detailed assessment of the potential monitoring and verification requirements for the dismantlement of nuclear explosive devices (NEDs)[1], including what information might be needed to satisfy those requirements, and an assessment of the kind of assurance that States would likely seek from verification.

Verification is a key part of the nuclear disarmament process, and can enhance credibility, contribute to transparency, and facilitate compliance. It thus complements the key disarmament concepts of "transparency" and "irreversibility." Although not an end in and of itself, effective verification is essential for providing assurance to participating States that disarmament obligations are being observed, and also for deterring non-compliance.

In alignment with the objectives for Phase I of the International Partnership for Nuclear Disarmament Verification (IPNDV), this paper focuses on an assessment of the objectives and requirements for steps 6–10 of the 14-step NED dismantlement process (the "Basic

[1] Throughout this document, the term "Nuclear Explosive Device," (NED) is used to refer to the item subject to monitoring and inspection activities. The term "NED" was used to address specific technical considerations related to the definition of a nuclear weapon that arose during discussions among experts. Other products produced by the Partnership use the more generic term "nuclear weapon." The latter usage is devoid of any specific technical meaning and relies on a general understanding of the term.

Dismantlement Scenario," see Annex 1 of Working Group 1, Deliverable 1). That is, from the transfer of a designated NED from a storage area within the dismantlement facility, through to the storage of the containers holding components from the dismantled NED in the temporary storage area of the dismantlement facility. It will address information requirements at each stage and the level of assurance that could be expected, and provide an assessment of the risks at each stage.

In this context, the key verification principles that are addressed include effectiveness (providing assurance of compliance by ensuring a chain of custody and continuity of knowledge); building confidence (the process of building trust through the implementation of agreed procedures in good faith); non-interference/non-proliferation (the use of non-invasive means of measurement to prevent the release of information that is of importance to national security or that may lead to proliferation); efficiency (balancing the costs of instruments and measures required for verification with the objective of a reasonable level of assurance); and structure (the institutional arrangements for the implementation of verification processes, including models for recording and retaining information, and modalities for resolving differences).

Assumptions

Given the limited scope of the Basic Dismantlement Scenario, it is useful to identify several assumptions underlying the process:

- The inspection process will be governed by a verification agreement, which will detail the rights and obligations of all parties, including those of the inspecting entity and the inspected State;
- Agreements are in place between the verification entity and the inspected State regarding the procedures, equipment, and personnel involved in the process. In addition, the verifying entity and inspected State will agree on the information necessary for both sides to have confidence that the obligations of the verification agreement are being met. In advance of the inspection process, both parties will agree on the specific information to be shared and collected. This will include detailing the range of acceptable measurements, to account for measurement error;
- The authority responsible for the overall inspection process, in support of an overarching verification agreement, could either be an independent agency or the States parties to the relevant agreement; and
- Managed access with respect to certain areas and processes in the dismantlement facility is assumed. The inspection entity will not always be able to observe certain areas or processes. Direct observation of the NED and its components by the inspection entity will not be possible in order to prevent the disclosure of proliferation-sensitive information, such as warhead designs, or information of importance to national security. The NED or its components will always be in containers.

It is important to note that compliance judgements are not part of the inspection process. The Inspection Report will only provide a summary of the findings, and identify any anomalies or

information gaps. Compliance judgements are part of a political process, and will be managed by the terms of the overarching verification agreement, such as through a compliance body.

Uncertainty in Verification

Absolute certainty about the dismantlement process will not be possible given the assumptions above. At best, the inspection process can provide "reasonable assurance" that the dismantlement of a NED has taken place and that components have not been diverted. The fundamental challenge of verification during the dismantlement of a NED is that security and proliferation concerns mean that direct observation of each step of the process is not possible. Inspectors will obtain information used to assess compliance indirectly. That is, they will be observing and measuring containers and not the NED itself or its major components. Confidence that the dismantlement has taken place will only result from an amalgam of indirect measures. Confidence will also be gained as the process is followed over time.

However, complete confidence or assurance that dismantlement has taken place is not necessary. An inspected State that intends to evade detection of non-compliance has several options: diverting a critical component of a NED during or immediately after the dismantlement monitoring process; constructing NEDs outside of declared facilities; or not declaring NEDs. For dismantlement in a declared dismantlement facility, the inspection process must make the costs or complications of diverting the NED or NED components during the verification of dismantlement greater than achieving the intended non-compliance by other means. Although it will generally be easier to evade detection outside of the process in which inspectors are monitoring the dismantlement of a NED, for an effective verification regime, procedures must also be in place to assure the verification entity that undeclared production can be discovered before any significant military advantage can be obtained.

Factors Affecting the Level of Assurance

Several factors will affect the level of confidence or assurance in the verification of NED dismantlement. These apply both to States party to the verification agreement, and to those outside of the regime. These factors are technology, information management, the dispute settlement process, and risk management.

Technology

Having a solid understanding of the capabilities of the equipment being used is important for providing assurance that the inspection process is credible. The availability and cost of the equipment can also affect the efficiency of the verification process.

Information Management

There are three models that could be applied for recording and retaining information collected during the inspection process. In the models, the information is summarized in the Inspection Report—a fact-based report documenting observations during each step of the dismantlement

process. This information includes measurements that have been agreed upon, *a priori*, using equipment also agreed to by the parties. Anomalies found during the inspection (such as measurements beyond the acceptable ranges of error, or gaps in video recordings) are also recorded by the inspectors, along with any comments from the inspected State on those anomalies.

In the first model, the report is only conveyed to the inspected State, which retains the information in confidence. On the one hand, this model limits the risk of the proliferation of sensitive information. On the other hand, such an approach is less likely to provide full assurances to States outside of the verification agreement. An example of this arrangement is the START treaty.

In the second model, the inspecting entity collects the information and submits its report to an independent authority, such as the International Atomic Energy Agency, responsible for the verification of the agreement. The independent authority may be required to maintain the confidentiality of the information obtained during the inspections. The advantage of this model is that it allows for increased transparency—given the involvement of an independent authority—and may provide a high level of assurance to both parties participating in the verification agreement, and those outside of it. However, this approach may be much more costly than the first model—possibly requiring funding for a standalone agency—and raise concerns about the adequacy of the capacity and expertise available for such a specialized process.

The third model is based on the Comprehensive Nuclear-Test-Ban Treaty Organization. Unlike the previous two models, in this version the data is collected and is given to all State parties. The advantage of this model is that by giving the data to all, full transparency, and therefore confidence, is gained by all parties and not just the inspectors, the States from which the inspectors come, or the verification entity itself. The downside of this model is the lack of confidentiality for the inspected State. As a result, in a verification agreement or during an inspection itself, the potential inspected States may try to impose a greater degree of control on the inspectors as to what data can be collected. This may impact the effectiveness of the verification and the confidence that can be gained by those that review the data. Under the other models, in particular the START inspection model, if only a few States get the data, confidentiality agreements may be easier to be reached. As a result, a greater degree of intrusiveness and data collection may be possible. However, as noted above, it may be difficult to provide information, and thus confidence, to the States beyond those directly involved. Given the fact that nuclear disarmament will require a high degree of confidence across a wide range of States, how transparency, confidentiality, and confidence can be balanced will be critical to successful verification.

Dispute Settlement

As noted in the assumptions, generating compliance judgements or assessments is part of a political process. A verification regime should include mechanisms to resolve disputes between States parties. Where anomalies or gaps in information lead to disagreement during dismantlement monitoring and inspection, a robust dispute settlement mechanism is necessary to provide continued assurance in the verification process, both to any independent authority

and other States participating in the disarmament regime. It should include a mechanism to allow for the inspected State to explain the anomaly, or to resolve differences in assessments about the Inspection Report. Possible options for such mechanisms are addressed in the Working Group 2 Deliverable – Chapter 13.

Regardless of the modalities used for implementing an inspection process, experience with a verification agreement and its implementation over time will normally strengthen confidence in the findings of inspections, and provide steadily increasing assurance about compliance with the obligations of the agreement.

Risk Management During the Inspection Process:

An inspection may not always go smoothly, or as expected. Numerous factors or behaviors, inadvertent or otherwise, could result in anomalies, gaps, or incomplete information in the Inspection Report. These include lack or denial of access; failure to implement agreed procedures; non-functioning, malfunctioning, or compromised equipment; and disputes that are not resolved over time, undermining the credibility of the disarmament regime.

These factors could reduce the level of confidence in the verification process, and could potentially lead to States questioning the credibility of the purported dismantlement.

Specific Objectives for Each Step of the "Basic Dismantlement Scenario"

Under the Basic Dismantlement Scenario, Working Group 1 addressed information requirements at each step and the level of assurance that could be expected, and provided an assessment of the risks at each stage. Given the restrictions on direct observations, the overarching objectives for monitoring and inspection are ensuring that the chain of custody[2] is not broken anywhere in the process, and that the inspecting team is reasonably confident in the continuity of knowledge.[3]

Pre-Inspection

Pre-inspection routines will play an important role in the outcome of an inspection. For example, inspection equipment will be required to identify a NED in its canister. Equipment testing would be required prior to the dismantlement steps in the Basic Dismantlement Scenario. Testing the inspection equipment could occur at the dismantlement facility, which would require that it be stored at potential sites or the equipment could be brought to the site with the inspecting entity and inspected State escorts. In the latter case, the equipment could be stored under dual control

[2] Chain of custody refers to the procedures and documents for confirming the identity and integrity of an item by tracking its storage and handling from its entry into the verification or monitoring process to its final disposition.

[3] Continuity of knowledge is the confidence provided by chain of custody and other measures to confirm the identity and integrity of an item during movement and periods between inspections, to allow inspectors to confirm that the item has not been diverted, modified, or otherwise subjected to tampering.

at a point of entry (POE), which would not require storing sets of equipment at every dismantlement facility. Inspection equipment could also be stored under dual control at the dismantlement facility. Inspection equipment could be tested at either the POE or the dismantlement facility.

Objectives

The objectives for the inspectors at this pre-inspection step would be to confirm that the inspection equipment is operating as designed and that tampering has not taken place. For the inspected State, the objective would be to confirm that the equipment is functioning, is safe, and that information that might reveal proliferation-sensitive or national security information is not being purposefully or inadvertently disclosed.

Assurance

Inspectors will need to determine that the inspection equipment is functioning properly and, in the case of radiation detection equipment, correctly calibrated. They will also need to be able to determine that no tampering has occurred. The inspected State will also need to determine whether the equipment is functioning properly, and that it does not collect or store proliferation-sensitive information or national security information unrelated to the inspection.

Information Requirements

The information requirement for this step includes determining that any equipment, sensors, and photographic or video equipment are functioning and able to obtain the information to which the States party to the verification agreement have agreed.

Step 6: NED in Storage at the Dismantlement Facility

Under the Basic Dismantlement Scenario, the NEDs to be dismantled are assumed to already be located at a temporary storage site located within the dismantlement facility. The inspection would begin at that temporary storage location.

Objectives

The objective during this step will be to confirm that each NED presented for dismantlement is indeed a NED. The inspected State or the inspecting entity may be allowed to randomly choose a NED in the temporary storage area of the dismantlement facility, and in the queue for dismantlement, to follow during the dismantlement process.

Assurance

During this step, the inspecting entity will seek assurance that the items presented as a NED can be identified as a NED through means other than direct observation. The inspecting entity will also seek assurance that the item presented is not a decoy or a container with a simulator.

Information Requirements

Information requirements at this step will be the confirmation that certain measurements and other indicators that have been agreed to establish whether an item is a NED are within agreed tolerances. In addition, the inspectors will seek to use any agreed means of identifying the

association of a container with a NED generally, or a specific NED. This could include the possible use of unique identifiers and documentation associated with the NED or its components.

Risks

The main risk is that the container does not contain a NED and the agreed measurements do not provide any way of distinguishing whether or not a NED is present.

Step 7: Movement of a NED within the Dismantlement Facility to the Dedicated Dismantlement Area (DDA)

This step entails the movement of the declared NED within the dismantlement facility to the DDA. In addition to monitoring the declared NED, there is also a need to observe the exterior of the empty containers that will be used for storing components once the NED has been dismantled and proceed to necessary measurements in order to verify that the containers entering the DDA are empty.

Objective

The objective in this step is to confirm that the NED arriving at the DDA from the storage area is the same as the declared NED in its container or the NED selected for dismantlement. In other words, the objective is to make certain that the NED has not been diverted during the movement to the DDA.

Assurance

The inspecting entity will seek assurance that the container containing the NED has not been diverted during the movement to the DDA. They will seek assurance of an unbroken chain of custody with respect to the NED during the movement. Additionally, they will seek assurance that no simulator is introduced through other means such as through the introduction of the empty containers for the NED components.

Information Requirements

The inspecting entity will need the means to identify that the item arriving at the DDA is the same item that left the temporary storage area and that the container has not been opened during movement. One way to provide assurance that the NED has not been removed and/or replaced with a simulator is to ensure that the container has not been opened. This could be accomplished through the use of a unique identifier or tag for the NED container. This would require an ability to associate a tag with a particular NED container and its content, and the ability to read the tag on the container. The observation of tamper indicating seals on the containers or other mechanisms that ensure that the container was not opened could also provide the necessary information and, thus, assurance. The combination of a unique identifier or tag and seals work together to provide assurance because the presence of a unique identifier prevents swapping of the container while the use of tamper indicating seals prevents opening the containers.

Another possible information requirement would be for a confirmatory reference measurement or template. The measurement would provide assurance that the radiation or other signature of the item had not changed during the movement of the item.

Information regarding the time it takes to move the item from one point in the process to the next is also important for assurance in two ways. First, how long it takes to move an item between points can also indicate whether it has possibly been subject to tampering. For example, an item that has taken substantially longer than the known average time to move between points could raise doubts because given enough time, any seal or unique identifier could be defeated or replicated. Second, if the movement between points in a facility is short and takes a short time, this can mitigate attempts to replace the container or its contents with a decoy. A short movement with relatively cheap unsophisticated seals and simple unique identifiers may be sufficient. However, longer movements may require more sophisticated and complex protection.

Risks

The risk is that the chain of custody could be broken and that it would go undetected. Thus, the NED could be diverted during movement and a decoy or simulator put in its place.

Step 8a: Warhead Dismantlement

During the actual dismantlement of a weapon, it is assumed that the inspecting entity will not be able to directly observe the process. Because of the special nuclear weapons-related equipment in the DDA, it is uncertain whether they would be allowed to observe the inside of the DDA without shrouding or other managed access measures due to proliferation and national security sensitivities. We have broken the dismantlement step into two distinct parts.

Objectives

For the first part of the process, the objective is to confirm that the item declared to be a NED entering the DDA is a NED, and that nothing leaves the DDA unobserved.

Assurances

The inspecting entity will seek assurance that the DDA is secure. That is (1) no other entry/exit can be or is used to move the NED or its components out during the dismantlement process; (2) the DDA has no place to hide components from the NED or the NED itself; and, (3) empty containers to be used for dismantled components do not contain simulators. For the inspected State, sensitive equipment in the DDA would also need to be shrouded or otherwise protected from releasing proliferation or national security-sensitive information.

Information Requirements

The inspecting entity will seek information to confirm that items have not moved unobserved in or out of the DDA. This requires secure continuous surveillance of the entry and exit points throughout the dismantlement process or some other means of monitoring entrances/exists. It will also require means for inspectors to observe video recordings, if used, of entry and exit points and any logs of all items entering and leaving the area during the dismantlement process.

Risks

The main risk at this step is that the chain of custody and the continuity of knowledge may be broken. Without directly viewing or following the process, it is possible that NED components

can exit without the knowledge of the inspecting entity and without being measured. In addition, it might be possible that simulators can be introduced without the knowledge of the inspectors.

Step 8b: Exit of Dismantled NED Components from the DDA

Step 8b represents the second part of the dismantlement inspection process. Once dismantled, the components of the NED will be placed in sealed containers and the containers will be made available to the inspectors for measurements as they exit the DDA.

Objectives

The objectives for the inspecting entity are to confirm that the item has been dismantled; to determine the resumption of the chain of custody by confirming that the containers exiting the dismantlement facility contain NED components as declared; and to confirm that major components of the NED (the Special Nuclear Material (SNM) and high explosives (HE)) do not remain in the DDA once the inspecting entity has left the dismantlement facility.

Assurances

The inspecting entity will seek assurance to confirm that the SNM and the HE are now in separate containers and that no container contains both materials. Such an assurance does provide a good level of confidence that the item is no longer assembled; however, it does not add confidence to whether the original item was a NED or was in an assembled form in its original container. A related objective would be to seek assurance that the containers declared to contain certain components (SNM and HE) from the original NED declared to be in the containers exiting from the DDA actually contain those components and are not being simulated.

Information Requirements

The main information requirement will be to take measurements for SNM and for HE to confirm that those components are in separate containers. Another information requirement is to associate the components in the exiting containers with the original NED in its container. This will require confirmation of agreed measurements or results of measurements (such as a measurement for radiation detection and for HE detection) of the components in the containers and a way of associating that information with the information related to the original NED. There will also be a requirement for information regarding the DDA that would allow the inspecting entity to determine that no SNM or HE remains after the dismantlement.

Relevant information could also include information on the seals for specific containers exiting the dismantlement facility and, if agreed and used, information on the unique identifiers for each component in its container.

Risks

The risk is that the indirect methods do not prevent the actual components from being diverted or hidden and that the containers exiting the DDA do not contain the items declared.

Step 9: Movement of NED Components to Temporary Storage Area

Once removed from the DDA, the component containers are moved to a temporary storage area at the dismantlement facility pending removal for final disposition. Because this step is essentially the same as step 7, we will not repeat the details. The only difference in step 9 is that, rather than one container, there will be multiple containers over which the chain of custody must be maintained.

Objectives

The objective is to confirm that that the chain of custody for the individual components has not been disrupted, i.e., that the component containers observed exiting the DDA are not tampered with.

Assurances

The inspecting entity will seek assurance that the component containers have not been diverted or opened.

Information Requirements

For this step, the information required will be the visual inspection of the seals and any unique identifiers/tags if they are used. Information on the agreed measurements for the containers will also be required for comparison.

Risk

The risk is that the chain of custody could be broken and that the containers could be opened or diverted, and decoys introduced between the times that they are observed at the exit from the DDA and their arrival at their respective storage areas.

Step 10: Temporary Storage of Components at the Dismantlement Facility

Objectives

The objective is to assure that no undeclared movement of components takes place until the components are moved for their final disposition.

Assurances

The inspecting entity will want assurance that the components are not moved or diverted from their respective temporary storage areas until the components in their containers are moved for final disposition. Because temporary storage at the dismantlement facility prior to disposition may represent an extended period, the inspecting entity will want assurance that the storage area can be monitored in a fashion that assures the inspecting entity or entities that nothing has been moved.

Information Requirements

Information requirements include a means of continuous monitoring of entry and exit points of the temporary storage facility and access to any logs of items entering and exiting the storage area(s).

Given that the individual components of the NED may remain at the dismantlement facility for some time prior to final disposition, the inspecting entity could be allowed the opportunity to randomly select a number of containers periodically for re-measurement against their known attributes or a template to provide additional and more direct confidence that nothing has changed at the storage areas.

Risk

The risk is that monitoring is insufficient and that items can be removed unobserved from the temporary storage areas.

Conclusions

Objectives for each step of the dismantlement process are similar and inter-related. The basic objective is to determine that an object declared to be a NED or the components of a NED following dismantlement is what it is declared to be. However, the requirement to protect proliferation-sensitive information and national security information unrelated to the inspection has major implications for the techniques used to acquire the information needed to make a determination. This means that inspectors will be largely limited to obtaining information by indirect measures. They will be observing and measuring containers, and not the NED or its major components themselves.

Given this limitation, the key challenges for monitoring and verification under the Basic Dismantlement Scenario relate to maintaining the chain of custody and continuity of knowledge. Even with the use of unique identifiers inspectors will only be able to determine that the container matches the records for a specific container. Observations of the entrances and exits of the DDA are once again a substitute for direct observation of the dismantlement process.

Confidence that the dismantlement has taken place will only result from an amalgam of indirect measures. As a result, absolute certainty about the dismantlement process may not be possible; at best, the inspection process can provide a “reasonable assurance” that the dismantlement of a designated NED has taken place.

The level of confidence in this process may be reduced by several factors during the inspection, including missing or incomplete information, anomalies or unexplained measurement errors, and gaps in observations or recordings. These issues may be either inadvertent or deliberate, but either could reduce confidence in the findings of the inspection.

Some measures that could mitigate such findings or discrepancies include robust procedures for information management (decreasing the risk that information gathered during the inspection could be subsequently tampered with or destroyed) and dispute settlement. Finally, experience

with the verification agreement and its implementation over time will normally strengthen confidence in the findings of inspections.

About IPNDV: The International Partnership for Nuclear Disarmament Verification

The International Partnership for Nuclear Disarmament Verification (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. Learn more at www.ipndv.org.

About Working Group 1: Monitoring and Verification Objectives

Throughout Phase I, the IPNDV Monitoring and Verification Objectives Working Group has examined key objectives for monitoring and verifying the dismantlement of a nuclear weapon, including the information, skills and expertise needed to support this process. This group is co-chaired by The Netherlands and the United Kingdom.