Food-for-Thought Paper: Technical Requirements for Application of Verification Technologies

Working Group 3: Technical Challenges and Solutions
May 2017

Background

The IPNDV Working Group 3 has identified numerous technologies that have the potential of being applied in the process of nuclear disarmament verification. These include technologies (1) for authentication of a Nuclear Explosive Device (NED, before dismantlement), (2) for authentication of Special Nuclear Material and High Explosives (after dismantlement), and (3) for maintaining chain of custody (CoC) throughout the process.

In addition to the criteria developed by Working Group 3, ranking the available technologies requires information on various technical requirements that must be developed together with Working Group 2. Based on the Basic Scenario defined during IPNDV Phase 1, such additional information shall be gained during the Walkthrough Exercise. This paper addresses issues that should be clarified in order to enable Working Group 3 to make proper choices of technologies for an onsite inspection (OSI). Most questions listed are related to practical prerequisites, but some conceptual aspects are also addressed.

The following is based on the Working Group 2 paper "Schematic Diagram of Dismantlement Phase (Walkthrough OSI Exercise)" (Version 03/14/2017).[1] Position numbers used here follow those used in that paper. However, the scheme presented in the Working Group 2 paper may need to be slightly modified as outlined below (Position No. 4).

1. Standard Specification Requirements

There are various technical/practical requirements that, at each position of the dismantlement process, need to be taken into account for ranking the verification techniques identified by Working Group 3. These are listed as follows.

[1] See attachment, "Schematic Diagram of Dismantlement Phase (Walkthrough OSI Exercise)."

(a) Verification of Nuclear Material

(1) How much time will be available for measurements?

(2) Are there restrictions with regard to radiation safety?

(3) Are there restrictions with regard to criticality safety?

(4) Is necessary electric power available?

(5) Is equipment present for handling the container (e.g., for moving and turning or rotating it)?

(6) What is the size of the container?

(7) What is the material of the container (high/low Z material, single-/multi-layered)?

(8) Are there safety requirements for a minimum distance between container and detector?

(9) What are the limitations for access by inspectors?

(10) In case of a multi-purpose facility:

(i) Could an elevated (neutron and gamma) radiation background be present at this position?

(ii) Could this radiation background be measured during an OSI (intensity and energy distribution), or is such information considered too sensitive?

(iii) Will there be routine operations going on during the inspection, and, if so, will they limit access to any of the positions 1–6 within the Dismantlement Building?

(b) Verification of High Explosives

(1) How much time will be available for measurements?

(2) Are there restrictions with regard to radiation and explosives safety?

(3) Is necessary electric power available?

(4) Is equipment present for handling the container (e.g., for moving and turning or rotating it)?

(5) What is the size of the container?

(6) What is the material of the container (high/low Z material, single-/multi-layered)?

(7) Are there safety requirements for a minimum distance between container and detector?

(8) What are the limitations for access by inspectors?

(c) Maintaining Chain of Custody

(1) How much time will be available for measurements and other procedures?

(2) Are there restrictions with regard to radiation and explosives safety?

(3) Is necessary electric power available?

(4) Is equipment present for handling the container (e.g., for moving and turning it)?

(5) What is the size of the container?

(6) Are there safety requirements for a minimum distance between container and measurement equipment?

(7) Are there restrictions on the use of information acquired by surveillance technologies (e.g., CCTV cameras)?

(8) How will data storage and transmission work? What are the limitations for access by inspectors?

(9) In case of a multi-purpose facility:

(i) Are there procedures available that facilitate establishing a CoC for disarmament activities without inference with other, potentially sensitive activities (e.g., by dedicated storage areas allowing for permanent surveillance)?

(ii) Will there be routine operations going on during the inspection, and, if so, could they limit access to any of the positions 1–6 within the Dismantlement Building?

2. Requirements at Individual Steps/Positions

2.1 Onsite Storage (Steps 6–7 of the Basic Scenario)

For this process step, maintenance of CoC is essential. Requirements are listed above (Section 1(c)).

2.2 Temporary Holding Area (Step 8, Position No. 1)

Again, maintenance of CoC is essential. Requirements are listed above (Section 1(c)).

In addition, Working Group 3 requires information on residence times of a NED at this position for choosing adequate surveillance technologies.

2.3 NDA Check Point (BEFORE) (Step 8, Position No. 2)

At this process step, authentication of the presence of the NED as well as continued CoC is to be provided. Thus, all the requirements compiled in Section 1 apply.

2.4 Dismantlement Station (Step 8, Position No. 3)

It is understood that this process step is highly proliferation-sensitive and thus must be considered as a "black box." As a consequence, during an OSI the following activities may be performed:

(1) Inspectors have access to the dismantlement cell before starting and after completion of dismantlement operations.

(2) Surveillance of all doors and of host personnel entering or leaving the "black box" area during or after the dismantlement process. This requirement includes any pipelines (e.g., water lines, ventilation ducts, etc.) entering or leaving the Dismantlement Station that allow transfer of sensitive material.[2]

Requirements are listed in Section 1(a) and 1(c).

2.5 Dismantlement Station (Step 8, Position No. 4)

Some conceptual questions should be clarified:

(1) There are three types of materials[3] leaving the Dismantlement Station: Special Nuclear Material (SNM), High Explosives (HE) and other components of the dismantled NED (OTHER). Contrary to the scheme given in the Working Group 2 paper "Schematic Diagram of Dismantlement Phase (Walkthrough OSI Exercise)" (Version 03/14/2017), containers with other materials must pass through the NDA Check Point (AFTER) (Position 5), because the absence of sensitive materials in these containers must be verified.

(2) When leaving the Dismantlement Station all containers must be equipped with technical provisions (e.g., tags, seals) required for maintaining CoC. Will these be provided within the Disarmament Facility or at Position No. 4?

2.6 NDA Check Point (AFTER) (Step 8, Position No. 5)

[2] Experience gained during the exercises based on the UK-Norway Initiative scenario indicate that these requirements may pose a challenge in multi-purpose facilities.

[3] The number of containers, however, may differ for each type of material.

Working Group 3 must know whether absence measurements are required for fissile material only or should they include HE also? In addition, information is needed regarding which sensitivities (e.g., detection limits) need to be achieved.

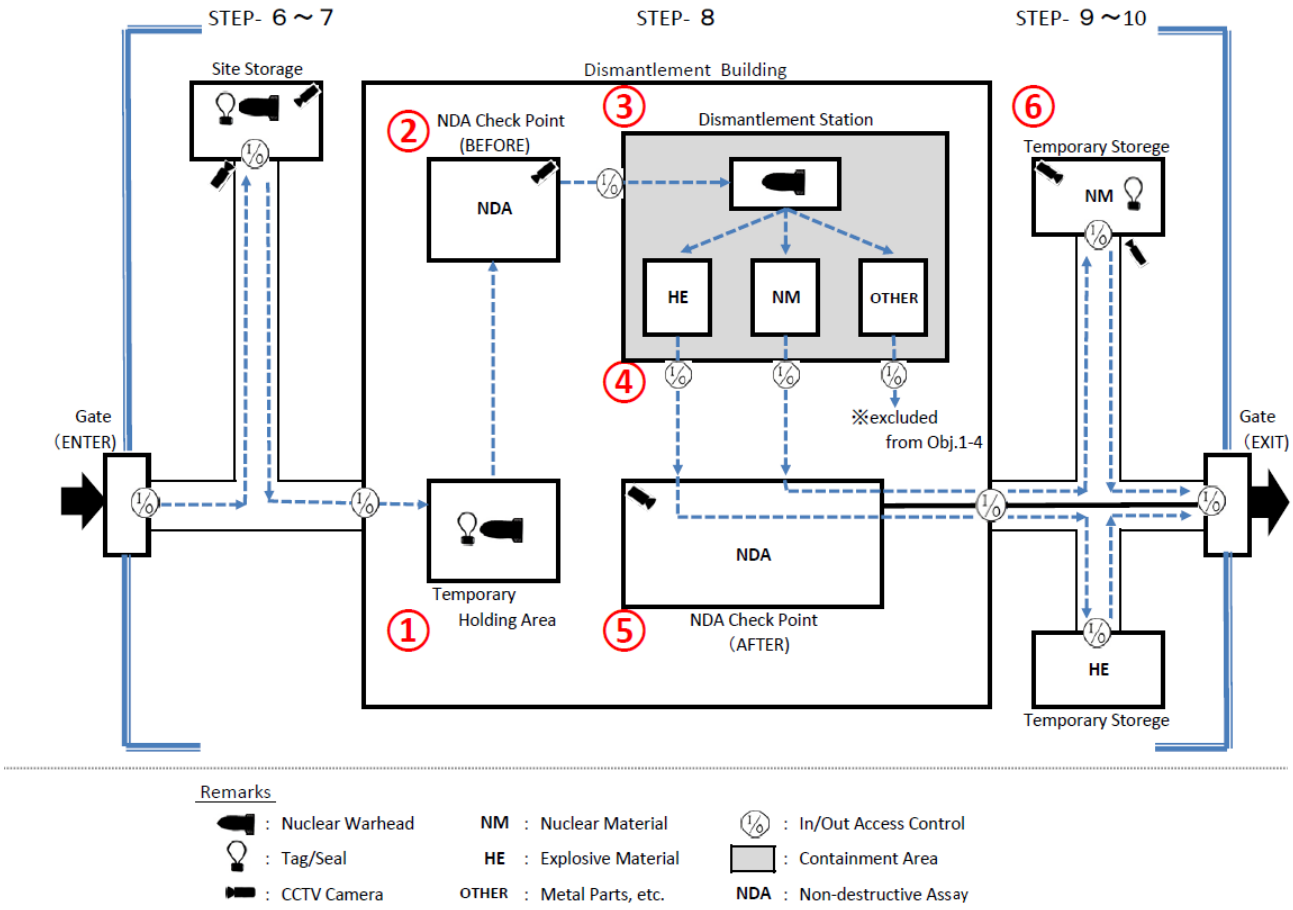
At this process step, authentication of the presence or absence of NM and, if required, HE in the individual containers leaving the Dismantlement Station needs to be provided. Also, CoC has to be maintained for the NM containers. The requirements compiled in Section 1 apply.

2.7 Temporary Storage (Step 9–10, Position No. 6)

At this position, maintenance of the CoC is essential. Requirements are listed above (Section 1(c)).

Attachment

"Schematic Diagram of Dismantlement Phase (Walkthrough OSI Exercise)" (Version 03/14/2017), developed by IPNDV Working Group 2



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 3: Technical Challenges and Solutions

Throughout Phase I, the IPNDV Technical Challenges and Solutions Working Group has investigated effective technologies, methods, and procedures that can be used for the specific technical challenges in the dismantlement process, such as identifying a nuclear device, maintaining chain of custody, and protecting proliferation sensitive material. This group is co-chaired by Sweden and the United States.