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Agenda item 5

Nuclear Disarmament Verification (NuDiVe) Exercises**Submitted by Chloé Le Nalbaut and Irmgard Niemeyer**

1. France and Germany have engaged since 2019 in the organization of two on-site verification exercises entitled NuDiVe (Nuclear Disarmament Verification) in the framework of IPNDV.
2. After the first NuDiVe exercise in September 2019, a second exercise took place from April 4th to April 8th 2022 at Forschungszentrum Jülich (Germany). As practical activities, the two NuDiVe exercises have provided an important input to ongoing work on nuclear disarmament verification, both on the technical side (testing the procedures and technologies) and the political side (ensuring capacity-building).
3. As part of this GGE, this working paper aims at analyzing the two NuDiVe exercises and their outcomes through the lens of the “what/who/how/why” questions, to better understand how exercises focusing on specific steps of monitoring and verification activities can contribute to the larger goal of “further consider(ing) nuclear disarmament verification issues”.

I. What

4. The NuDiVe exercises built on previous international initiatives of nuclear disarmament verification – in particular the UK-Norway Initiative (UKNI) and the Quad Nuclear Verification Partnership (Norway, Sweden, United Kingdom, United States) – and were designed to address some issues that were still to be explored further in the field of verification.
5. Similar to the 2019 exercise, NuDiVe 2022 focused on step 8 of the 14 key steps in the process of dismantling nuclear weapons, as identified by the International Partnership for Nuclear Disarmament Verification (IPNDV), i.e. the actual dismantlement of a nuclear weapon. While the exercise in 2019 worked with the scenario of a the fictitious Republic of Urania that was supposed to reduce its nuclear arsenals down to 50 weapons, the exercise of 2022 used the revised initial scenario for IPNDV’s Phase III: the fictitious State of Ipindovia is under an obligation to reduce its arsenal from 1000 to an agreed limit of 500 warheads under a binding disarmament agreement.

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6. However, both exercises sought to simulate inspection procedures designed to ensure that nuclear materials were not being diverted during the dismantlement process. Contrary to 2019, the scenario in 2022 assumed that other inspections had previously taken place in the facility. Therefore, NuDiVe 2022 included, inter alia, a verification of the seals remaining from the last inspection.

7. This actual dismantlement step is not accessible to inspectors but takes place behind closed doors in order to respect non-proliferation and national security constraints of the inspected state. It is particularly sensitive, as the chain of custody of the treaty accountable item (TAI) is broken temporarily and needs to be re-established afterwards. This must be done in a way that does not hamper confidence in the disarmament process.

8. The NuDiVe exercises thus focused on testing the procedures and applying certain technologies that are intended to provide sufficient confidence about the absence of diversion of nuclear materials during the dismantlement of a nuclear warhead within a treaty-related verification regime. NuDiVe 2022 introduced some new technologies and procedures as compared to the exercise in 2019, with on-site presence of technical experts to operate these technologies (see below).

II. Who and How

A. Organizational settings

9. NuDiVe provided the first genuinely multilateral exercises on NDV that gathered, next to the German and French organizers, a large number of experts, showing diverse professional backgrounds (technical experts, diplomats, other policy officers) from various countries (13 in 2019, 10 in 2022 – Australia, Canada, Hungary, Japan, Netherlands, Norway, Sweden, Switzerland, South Korea, United States) both nuclear (NWS) and non-nuclear-weapon States (NNWS).

10. Participants were separated into three teams, with a good mix of nationalities and professional backgrounds: a team of inspectors (8 people in 2019, 6 people in 2022), a team from the host country (8/6), and a team of evaluators (6/4), in charge of assessing the exercise itself. Additionally, two observers attended the exercise in 2022 and technical experts (2/6) assisted the participants with some of the technologies. Teams were assigned a team leader and were self-organized. Throughout the week, arrangements were made to avoid any not role related information exchange among the teams in order to maintain a high level of realism in the exercise.

11. The dismantlement area was simulated in a controlled area that allowed the use of radioactive sources and required strict procedures for entering, staying and leaving, and this environment also added realisms to the exercise.

12. NuDiVe specifically focused on the inspection procedures related to the dismantlement of the fictional nuclear warhead and the management of the special nuclear material (SNM), with a view to ensure that no diversion of fissile material had occurred. For realism and safety purposes, the SNM and other material were simulated with proxies (surrogate radioisotopes with similar gamma and neutron intensity as 50 grams of Plutonium - Barium-133 and Californium-252), and the dismantlement of the high explosives component, that would require a different type of facility, was excluded from the scenario.

B. Technologies

13. As compared to NuDiVe 2019, some additional technologies were introduced, with a view to save time, on the one hand, and test some different technologies, on the other hand. Next to the mobile radiation portal monitor system provided by the German Federal Office for Radiation Protection (BfS) and two handheld detectors for gamma and neutron measurement respectively, two new technologies were used to measure the gamma radiation: a Gama-ray Imager provided by the Japanese Atomic Energy Agency (JAEA) and the

Trusted Radiation Identification System (TRIS) provided by Sandia National Laboratories. A more advanced type of sealing, the Electronic Optical Sealing System (EOSS), specifically intended to seal the SNM box once the dismantlement process is completed, was used to complement and partly replace the plastic seals.

C. Course of events

14. After the first day and a half of training, the game started and inspectors were allowed to access the dismantlement area. Inspectors were kept under visual monitoring all the time by the host team and were not allowed to enter the dismantlement area without special equipment (Tyvek suit, gloves, overshoes) to avoid any voluntary or involuntary swiping of nuclear particles.

15. The first task in the dismantlement area consisted in sealing authentication and application to ensure that no diversion pathways remained open. The rooms were then scanned with handheld gamma and neutron detectors and the gamma-ray imager, with special attention being given to the dismantlement room. The TAI was brought inside the dismantlement area and monitored using a portal monitor (detecting neutron and gamma), the TRIS system, and inspector presence (visual observation), as well as CCTV surveillance.

16. The dismantlement happened in the dismantlement room behind closed doors in order to comply with confidentiality and non-proliferation imperatives, and the TAI components were brought outside of the dismantlement room in several boxes that were checked with the portal monitor. After the SNM container was brought outside of the dismantlement area, the inspectors checked the dismantlement room again using the handheld detectors and the gamma-ray imager for any left or hidden SNM and verified all the seals for integrity.

17. Contrary to NuDiVe 2019, the inspector team could not conclude with enough certainty that no diversion had occurred, due to a confusion in the game, whereby the SNM container was moved in the equipment room to be sealed, instead of sealing it before leaving the dismantlement room as required. As the equipment room was under CCTV surveillance, the inspectors asked to watch the CCTV footage to compensate for the failure of the chain of custody, but one of the cameras blacked out for some time while the container was inside the room. Therefore, the inspector team concluded that the chain of custody was irreversibly broken once the SNM container left the dismantlement room. Though the transport of the SNM container was monitored visually by one inspector, the inspectors' confidence that no fissile material had been diverted during the movement of the SNM container was therefore insufficient to eventually assert that the inspection was successful.

18. While this course of events was unexpected, it was also very instructive, as the teams had to negotiate together in order to re-establish a form of mutual confidence. Although no dispute-settlement mechanism was needed, it is particularly useful to note that the host and inspector teams had, in the end, two different understandings of how such an event impacted the inspection. While the hosts considered that the inspection was successful, the inspection team deemed that the failure of the chain of custody and the lack of material at their disposal to make up for it prevented them from concluding this inspection positively.

III. Why

A. NuDiVe within the IPNDV

19. The NuDiVe exercises were jointly organized by Germany and France within the framework of their national commitment to the IPNDV, and more generally to nuclear disarmament as enshrined in Article VI of the NPT. Developing a capacity to robustly verify nuclear disarmament is key to progress towards our shared goal of nuclear disarmament. In that regard, the NuDiVe exercises, focusing on a particularly sensitive step of the process, have contributed to this progressive approach.

20. The IPNDV scheme of monitoring and verification activities for the 14 key steps in the process of dismantling nuclear weapons relies on a complete and robust chain of custody from the registration of a warhead until the final disposal of its components. The NuDiVe exercises have sought to simulate a step when the chain of custody has to be interrupted to preserve confidentiality and proliferation-sensitive information, and re-established in a way that provides enough confidence to the inspecting party that the dismantlement has been processed without diversion.

21. While there is a good understanding and great confidence in the technologies used to track and account for items sealed in specialized containers, the dismantlement operation itself, which implies opening the seals without any inspector being present in the room who could ensure the continuity of the chain of custody, presents a greater challenge. Simulating and “playing” this step is therefore important to better understand those challenges and find ways to overcome them.

22. The work done in the NuDiVe exercises and in IPNDV more generally aims, to some extent, to facilitate negotiators’ work in the future for a thoroughly verifiable disarmament treaty. However, this exercise is not intended to create a model for multilateral verification of nuclear disarmament. Any verification of a treaty or international arrangement will result from the negotiations of the instrument in question and will have to be agreed by the parties.

B. NuDiVe’s objectives

23. NuDiVe exercise pursued several objectives:

- Verify that the chain of custody is reestablished after the nuclear warhead’s dismantlement and that no diversion of fissile material could have taken place during the dismantlement operation. Otherwise, ensure the timely detection of any failure of the chain of custody;
- Ensure that there is no way the inspection team can obtain proliferation-sensitive or confidential information;
- Conduct the dismantlement procedure in a constrained timeframe;
- Foster exchanges between participants on the conditions of a realistic scenario;
- Verify that the scenario and procedures developed by the organizers to achieve the goals here above where appropriate and identify where and how they could be refined.

C. NuDiVe as a contribution to capacity-building on nuclear disarmament verification

24. NuDiVe is a direct contribution to capacity-building, which has been identified as one stream of work for this GGE. Several elements that directly contribute to capacity-building should be highlighted:

- Nuclear disarmament verification is a crosscutting issue which requires expertise in several fields: political (political feasibility and willingness), scientific and technical (technologies), and psychological (confidence). The NuDiVe exercises gathered professionals with various backgrounds, which informed one another all throughout the exercise and enabled people with a political background to better understand the technical challenges and vice-versa.
- As the widest multilateral exercise on nuclear disarmament verification, NuDiVe fostered exchanges between NNWS and NWS, thus enabling on the one hand NWS to better understand NNWS’ expectations regarding nuclear disarmament verification, and on the other hand NNWS to better understand the challenges and limitations that may be encountered during the process.
- NuDiVe was useful to test some concepts and procedures developed in the IPNDV. Applying them in a field exercise enabled to highlight where they are operative, and identify where they can still be improved.

- NuDiVe confirmed the complexity of any nuclear disarmament verification process and especially underlined the importance of following the procedures that were agreed by the parties to the treaty.
 - NuDiVe proved valuable in trying to find solutions to unplanned events. As described in the above section, an unexpected chain of events occurred, which compromised the re-establishment of the chain of custody and the success of the inspection as a whole. While this reminded us how difficult and challenging nuclear disarmament verification is, it also provided a good opportunity to learn lessons. Participants had to negotiate together and to make their own decision as to how to carry the inspection work forward, which is also, as such, a valuable experience. During the feedback session, some participants suggested that some of these unplanned events should even be voluntarily incorporated in the scenario by the organizers to stimulate the problem-solving aspect of field exercises.
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