Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 23-24, 2019

Nuclear Disarmament Verification Approach: The Black Sea Experiment and UKNI

Hojung Do [a*], Young Wook Lee[a], Minsoo Kim[a], Jung-hyun Lee[a]
[a]*Korea Institute of Nuclear Non-proliferation and Control, 1534 Yuseong-daero, Yuseong-gu, Daejeon, ROK*
[*]*Corresponding author: hojungd@kinac.re.kr*

1. Introduction

Article VI of the Nuclear Non-Proliferation Treaty(NPT) states that all parties both Nuclear Weapon States (NWS) and Non-Nuclear Weapon States(NNWS) have an obligation to pursue effective measures related to arms control and disarmament. Nuclear disarmament verification approach has been developed in many forms, through the Black Sea Experiment between the US and the USSR in the late 1980s to the more recent UK-Norway Initiative (UKNI). Both cases differ in their scope, principle actors and verification subjects. For example, the Black Sea Experiment was conducted between two NWS while the UKNI was between a NWS and a NNWS. While both cases deal with verifying absence or presence of a nuclear warhead, the former verified it on a deployed missile while the later verified it in a dismantlement facility. However, both provide insight on how future nuclear disarmament verification teams might be constructed, which technologies might be allowed on-site, the location and time allotted to the inspectors. This paper seeks to provide a summary on the key objectives and of the Black Sea Experiment (US-USSR) and the UKNI (US-Norway) exercises. It will then conclude with potential implications of these cases in constructing a comprehensive nuclear disarmament verification model.

2. Black Sea Experiment (1989)

In July 5, 1989 the US and USSR cooperated in an experiment known as the Black Sea Experiment to verify the presence or absence of a nuclear warhead on a deployed missile on the *Slava*. *Slava* was a flag ship of the Soviet Black Sea Fleet which carried a medium range (300 nautical miles) anti-ship cruise missiles with a nuclear warhead onboard during the experiment. US scientists from the National Resources Defense Council (NRDC) and Soviet scientists from the Kurchatov Institute of Atomic Energy conducted a set of seven experiments "study the utility of different radiation detectors for detecting the presence or absence of nuclear warheads on ships." [1]

During the negotiation of the Strategic Arms Reduction Treaty (START), an issue arose between the US and USSR on placing a limitation on long-range sea-launched cruise missiles (SLCMs). As the US had deployed nuclear and non-nuclear variants of SLCMs on many platforms, the USSR saw the SLCMs as a serious threat to their security. [2] Hence, USSR argued that limiting strategic nuclear weapons would be rendered ineffective should there be no limit on nuclear SLCMs and proposed to eliminate all Soviet nuclear cruise missiles should the US do the same. The US on the other hand had no reason to agree to such limitations and such limitation was vehemently opposed by the US Navy.

While the Black Sea Experiment consisted of seven experiments, according to Thomas B. Cochran, a senior researcher at NRDC at the time and one of the participants, the NDRC experiment and the Kurchatov Institute Experiment are worth noting. [1] First, the NRDC experiment team(US) consisted of 5 members and utilized a portable high purity germanium detectors and a portable channel analyzer. The team could only record the measurements for 10 minutes with a KGB officer standing by to enforce the time limit. The detector was placed on the launcher at a location directly over the warhead which was designated by the USSR. [2] The US team took three measurements at about 70centimeters from the center of the warhead using the germanium detector for a total of 24 minutes. [3] The US team concluded that utilizing passive radiation detectors can preserve sensitive weapon design information should the location and time of the measurement be constrained.

The Soviet scientists utilized helium-3 neutron detectors mounted in two separate helicopters that flew near the *Slava*, around 50-100 meters away to demonstrate remote monitoring of the presence or absence of nuclear warheads. While the detectors are designed to detect neutron flux from 100-150 meters away, during the experiment they detected warhead pit-plutonium from about 70 meters away. [4] The neutron detector, equipment for recording and preliminary processing of initial information is located on the helicopter. Additional equipment is stationed in an accompanying ship which completes a more detailed analysis as well as another neutron detector which measures the background while the helicopter is in operation. This ensures three sets of information: background measurements, measurements taken from helicopter 30 meters from the ship (measured for 107 seconds) and measurements 76 meters (measured for 83 seconds) from the ship. [4]

The Black Sea Experiment verified that passive radiation detectors had limited range when detecting nuclear weapons. Although both teams (the US and USSR scientists) agreed that high-resolution portable gamma-ray detectors and helicopter-based neutron detectors were sufficient enough to identify the presence and location of a nuclear armed and deployed SLCM, they also noted these techniques might be ineffective if the warheads were shielded, stored near nuclear reactors or did not contain uranium-232 or plutonium-240.

3. UK-Norway Initiative (2008-2011)

UK-Norway Initiative (UKNI) was the first collaboration between a nuclear weapons state and a non-nuclear weapons state to verify nuclear warhead dismantlement. To adhere to NPT obligations and protect national security, the process utilized managed access procedures and an information barrier system. Based on a hypothetical scenario where there was a hypothetical treaty between a NWS (Torland) and NNWS (Luvania), the two states conducted two exercises on managed access during the course of three years. [5]

The first exercise took place from 2008 to 2009, where Torland invited inspectors from Luvania under a pre-negotiated bilateral protocol to monitor the dismantlement of its nuclear gravity bombs. In place of fissile materials from actual gravity bombs, cobalt-60 was used as an alternative. Hypothetically both teams were consisted of senior, experienced personnel with differing negotiation styles. As Luvania was a NNWS, its team had a clear plan to put responsibility on Torland in verifying that the item shown in the inspection was the same as the one declared. [6] They also conducted mock-up sessions at home before the actual exercise. On the other hand, Torland adhered to a more conservative approach in which they agreed 'in principle' but drew out negotiations by referring to higher authority. Hence negotiations concluded with designing a Joint Information Barrier, Luvania accessing selected documents and using Tamper Indicating Devices only within the facility. [6]

The information barrier system was built based on a jointly agreed design which consisted of a gamma-ray detector and a control unit containing electronics and software. If fissile material (cobalt-60 source used in the exercise) was present, the control unit lit up in green, red if not. The Inspectors (UK team) had to establish confidence in the declaration as well as verify Chain of Custody through the whole dismantlement process. Meanwhile the Host (Norway team) had to demonstrate that it was cooperative with the protocol while trying to protect its national security and sensitive information.

Second, in 2010 both states conducted a focused exercise on managed access based on the exercise in 2008-2009. While the key objectives and assumptions for the Host (UK) and Inspector (Norway) remained the same, this time the scenario increased the level of hostility to maximize interaction between the Host security and Inspection process. During the inspection the Inspectors randomly selected seals for deployment and the Host placed the seals whist the Inspectors checked to make sure it was placed securely (Host operation-Inspector check process).

Upon concluding the initiative, UK and Norway agreed on two points: the verification regime itself is Host driven since inspectors can use only the Host declarations as a source of comparison. Hence, trust and confidence is key in conducting an effective verification. Second, both teams found that the "initialization problem," or the ability to confirm that the item initially presented is indeed the declared nuclear weapon remained unsolved. In terms of the Host team perspective, both found that the line between national security and preventing proliferation is blurry which can make managed access difficult. The Inspectors found that the ability to access all relevant areas of the facility was a key issue especially when considering national security. Also, schematic drawings were insufficient to plan detailed inspection activities which meant to cooperation of the Host crucial. They also found that particular surfaces and vehicles required seals that was not provided during the exercise and that the seals worked only for short durations, requiring additional ideas for long-term monitoring.

4. Conclusions

Given that nuclear disarmament verification will likely take place between a confrontational or less cooperative Host and mistrusting Inspectors, both cases provided sufficient examples and insights into such scenarios. The Black Sea Experiment showed that portable, passive radiation detectors can be used to verify correctness while helicopters or remote controlled vehicles might be applied to verify completeness of the verification. The UKNI 2010 focused exercise showed that a confrontational Host's security decreased Inspector confidence and Host operation-Inspector check process led to inefficient management of equipment and data. However, randomly selecting equipment compensated the fact that all the seals, tags etc. were provided by the Host.

Each case provides insights in fostering future verification approaches. First, the Black Sea Experiment shows that correctness and completeness is possible using passive radiation technologies. Portable detectors can be utilized to check for presence or absence of the nuclear warhead while remote monitoring can support inspectors in maintaining

Chain of Custody while preserving national security in sensitive facilities. This can provide additional measures of confidence to Inspectors should they be limited from accessing the site. Second, it is important to foster rapport with the Host country to ensure that some sort of familiarization visit or exercise is conducted before the actual verification. This is because familiarization exercises are crucial in increasing the confidence of the Inspectors and overcoming the potential time constraint that the Host may impose on the Inspection team. Even though the focused exercise took place after years of planning, the Inspectors felt that schematic drawings did not prepare them enough for the actual verification activities. For future verification activities, the Inspector countries could construct a mock-facility and plan a detailed and concise verification process plan.

Applying the UKNI implication to North Korean denuclearization may be difficult since there is a slim possibility of North Korea allowing access to its facility to various countries. However, utilizing passive radiation detectors in verification may be feasible since nuclear weapon states prefer less intrusive means. Also, allowing drones or remote controlled vehicles to monitor chain of custody in sensitive facilities may be used to protect both North Korea’s national security concerns and the need to continue monitoring.

REFERENCES

[1] T. B. Cochran, The Black Sea Experiment: From Reykjavik to New START, 2011.

[2] S. Fetter and F. von Hippel, The Black Sea Experiment: US and Soviet Reports from a Cooperative Verification Experiment, 1990.

[3] S. Fetter et al, Gamma-Ray Measurements of a Soviet Cruise-Missile Warhead, Science, Vol. 248, pp.828-834, 1990.

[4] S. T. Belyaev et al, The use of helicopter-borne neutron detectors to detect nuclear warheads in the USSR-US black sea experiment, Science and Global Security, Vol. 1, pp. 328-333, 1990.

[5] S. Backe et al, The United Kingdom-Norway Initiative: Further Research into Managed Access of Inspectors During Warhead Dismantlement Verification.

[6] UK, Norway, VERTIC Report, Presentation on the UK-Norway Initiative on Nuclear Warhead Dismantlement Verification, NPT PrepCom, 2009.