

The challenge of verification: The UK-Norway Initiative on Non-Nuclear-Weapon States' participation in the verification of nuclear disarmament

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Background: What is UKNI?

Article VI of the Nuclear Non-Proliferation Treaty (NPT) states that the parties to the treaty, nuclear-weapon states (NWS) and non-nuclear-weapon states (NNWS) alike, undertake to pursue effective measures relating to arms control and disarmament "under strict and effective international control".

Verification of nuclear disarmament can be considered to be more a matter of gaining *sufficient confidence* in the disarmament process than about *total certainty* that all weapons-usable nuclear materials have been rendered useless for military purposes. How much confidence is needed in a given case will always be a political question, while defining how to achieve that confidence level will be a question of a more technical nature.

The UK-Norway Initiative (UKNI) is an on-going cooperation where scientists and technical experts from the UK (a NWS) and Norway (a NNWS) are working together on practical problems associated with a possible future nuclear disarmament verification regime that can be defined inside the boundaries set by the NPT and national security issues. The cooperation has been able to shed light on issues that have been considered as impediments to verification as well as suggesting methods to overcome these impediments.

From the UK side, two organizations (The Ministry of Defence (MoD) and The Atomic Weapons Establishment (AWE)) have participated in the initiative, and from the Norwegian side, four organisations (Institute for Energy Technology (IFE), NORSAR, Norwegian Radiation Protection Agency (NRPA) and the Norwegian Defence Research Establishment (FFI)) have been involved.

Defining the problem: Why is verification of nuclear disarmament difficult, and which added difficulties does involving NNWS create?

The NPT limits cooperation between NWS and NNWS in the nuclear field. NWS are strictly forbidden to do anything to assist a NNWS to manufacture nuclear weapons, and NNWS are likewise forbidden to seek such assistance. This means that during a verification process, disarmament inspectors from a NNWS must be prohibited from gaining any information about nuclear weapons that could potentially help them, their state or a third party to develop nuclear weapons of their own. Nevertheless, in any future meaningful verification

activity, the inspectors must receive enough information to convince themselves and the international community that disarmament of actual nuclear weapons is indeed taking place as the NWS is claiming.

In addition to the challenges related to the proliferation risk, a NWS undergoing a nuclear disarmament process under international scrutiny will also have very real national security concerns that cannot be ignored. Information that would be a risk to national security may include the location of the nuclear device at any given time, what containers or vehicles used to transport it looks like, which buildings are used to store or process weapon parts, and even the layout and construction details of those buildings.

To be able to verify that the dismantlement of a nuclear weapon has taken place, inspectors need to be convinced of two main points: That the item that the host state is presenting is indeed the declared nuclear weapon containing weapons-usable fissile material (known as the *Initialisation problem*), and that the same weapon is in fact dismantled without any diversion of fissile material at any point (*chain-of-custody aspects*). To achieve this, inspectors will need information about the item and its history, and methods to ensure chain-of-custody of the initial weapon and various weapon parts throughout the dismantlement process. If the inspectors lose track of the item or of the container in which it resides, it cannot be ruled out that it has been tampered with or switched completely. In areas where they cannot be present, the inspectors must instead rely on different forms of surveillance, sealing and tagging of containers or other types of measurements that would reveal tampering.

The UKNI has so far focused on two aspects of the larger problem of nuclear dismantlement verification, *Managed Access* and *Information Barriers*.

What has been done?

Managed Access:

During a disarmament verification inspection, inspectors must enter highly secure facilities. In a future disarmament verification regime, the inspectors' access to these facilities and their movements within them will therefore in all likelihood be tightly managed by the host. To investigate the problems surrounding such inspections, the UKNI has arranged exercises where participants from the two states have played out verification inspections, using managed access procedures subject to negotiations between the two parties. While no real nuclear weapons or fissile materials have been used in these exercises, the group has used real buildings and nuclear facilities with all the extra practical complications this leads to.

Since the UKNI started in 2007, three Managed Access exercises have taken place. In the first two, in 2008 and 2009, facilities in Norway were used as a mock nuclear weapons facility, while participants from the UK played the part as disarmament verification inspectors from a fictional NNWS. The first inspection was a "familiarisation visit," where the inspectors were allowed to see the facilities where the nuclear weapons were to be dismantled, while the second one was a "monitoring visit," where the inspectors were present during the dismantlement of a (mock) nuclear gravity bomb. A few changes were made between the

two visits, for example more inspectors were allowed to be present during the second one, because it was concluded after the first visit that more people were needed to ensure chain-of-custody of the device.

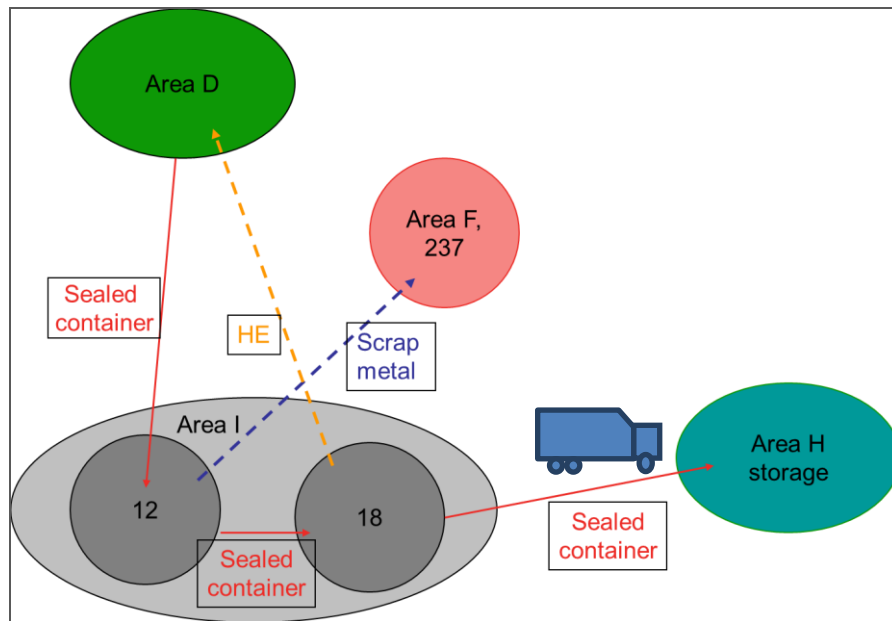


Figure 1: Schematic outline of the transportation of the weapon and various weapon parts through the dismantlement process, used in the planning of the *familiarization visit* exercise in Norway in 2008. The circles represent specific buildings used in the disarmament process while the ovals represent areas with different security levels.

For these two exercises, several buildings and the personnel working there were used to mimic a generic nuclear weapons facility (see figure 1). Among the buildings were a storage building in a real explosives area at FFI, two laboratories for handling civilian nuclear materials at the IFE site, and a low- and medium level radioactive waste storage facility. What the inspectors were allowed to do varied between the buildings and areas.

During these first two exercises, the host was played as welcoming and helpful to the inspectors. For the third exercise, it was decided to explore how a different scenario with a more adversary host would play out. This exercise focused on security measures, related to both non-proliferation and national security issues, as well as more mundane health and safety regulations, and how these measures would affect the inspectors' working conditions and their ability to carry out a proper verification. The third exercise took place in 2010, with Norwegians playing the inspectors, on one of AWE's sites in the UK, although in reality in a low security area of that site.

The Information Barrier project:

Several of the technical problems in the verification of nuclear disarmament relate to control of sensitive information. In a future verification regime, inspectors are likely to request measurements on warheads or warhead components to confirm that they really are what the host declared them to be. However, such measurements may reveal proliferative

information (i.e. give the inspectors information that could be used to develop nuclear weapons) or harm the host's national security. One idea for solving this type of problem is to create a so-called *Information Barrier*, a system that will let through necessary information to the inspectors, but without revealing anything that would be sensitive.

In the UKNI, much work has been done on the joint development of an information barrier system that uses gamma spectroscopy to identify fissile materials of weapons quality. In the beginning the group worked with non-fissile radioactive isotopes (Co-60 and Na-22), to avoid proliferation risk and reduce technical problems. Two different prototypes were developed that could detect the presence of one particular isotope and the ratio between two different isotopes. The group then went on to work on an information barrier system that would work on plutonium, using the same principles. A prototype capable of detecting plutonium and distinguish between different plutonium qualities is currently undergoing testing.

Conclusions so far:

The UKNI collaboration has successfully carried out three Managed Access exercises. This is the first time a NWS and a NNWS have collaborated in this field of research.

During all three exercises, a variety of inspection techniques were deployed to create a multi-layered approach to chain-of-custody and overall inspection activities. It has been noted that to efficiently employ these measures, a rigorous risk assessment considering the potential threats and vulnerabilities needs to be undertaken. Radiation monitoring, sealing and surveillance technologies need to be considered in a unified strategy for securing an area before inspection. The practical application of these techniques have highlighted many lessons; for instance, sealing of containers and doorways and subsequent verification of the seals at a later time is very time and resource intensive, and other approaches need to be considered. Concepts of authentication, certification and chain-of-custody of inspection equipment are recognized to be vital elements within a verification regime.

The exercises have shown that it is possible for a NNWS to contribute to the chain-of-custody aspects of a verifiable nuclear dismantlement process. The technical exchange within the Information barrier project has shown that a NWS and a NNWS can collaborate within this field and successfully manage any proliferation risks. Further, the exercises have also demonstrated that consideration of national security and proliferation permeates everything the host (the NWS) attempts to do and these issues will interact with the whole of a verification regime.

The initialisation problem (the ability of the inspecting party to confirm that the presented item is the declared nuclear weapon) is however an ongoing issue which requires further consideration.