Technical challenges and Opportunities in Future Multilateral Nuclear Disarmament Verification

Name: David Keir

Conference Title: Workshop Meeting, Vienna

Date: May 2012

Development House, 56-64 Leonard Street, London EC2A 4LT United Kingdom Tel: +44 (0)20 7065 0880 Fax: +44 (0)20 7065 0890 Web: www.vertic.org

Future Nuclear Disarmament Verification Scenarios

1. Verifying retirement of nuclear warheads by removal from delivery systems and storage of warheads in a jointly-monitored store;
2. Verifying dismantlement of a declared batch of nuclear warheads of declared type (output to be fissile components for monitored storage);
3. Verifying dismantlement – as above - followed by reduction of the fissile components to bulk, unclassified material;
4. Verifying decommissioning and permanent retirement of weapons production facilities.

Future Nuclear Disarmament Verification Scenarios

1. Verifying retirement of nuclear warheads by removal from delivery systems and storage of warheads in a jointly-monitored store;
2. Verifying dismantlement of a declared batch of nuclear warheads of declared type (output to be fissile components for monitored storage);
3. Verifying dismantlement – as above - followed by reduction of the fissile components to bulk, unclassified material;
4. Verifying decommissioning and permanent retirement of weapons production facilities.

Focusing on No. 2 – possibly the most challenging – a future treaty on warhead dismantlement

1. Essential that a team of **inspectors** is formed in advance, well-briefed and given the opportunity of working together – even if this is in the form of simulation exercises.
2. Essential to get advance information from the hosts, at an early stage in treaty negotiations:

- **DECLARATIONS** of what is there and where it is to be located
- **AGREEMENT** on access and ground rules
- **INFORMATION** about the facility, and the process flow that the declared items will follow;
- **ESTABLISHMENT** of a jointly-co-operative technical basis .

For multi-lateral verification Who should the inspectors be?

1. The inspection team needs to credibly represent the states who are stakeholders to the dismantlement operation and be technically credible also. This means:

- Formed of personnel recognised as competent to carry out the agreed verification measures;
- Formed of personnel who do not have any other conflicted affiliations;
- (in the special case where weapons design information may be intentionally revealed) – one or more inspectors may have to be from an NPT Nuclear Weapons State.

Homing in on the need to track items through dismantlement, ensuring no material diversion:

1. Requirement to secure boundaries and sweep the dismantlement areas as free from radioactive sources, before and after process;
2. Requirement to take custody of declared items and establish confidence that they are genuine warheads, as declared (NDA measurements);
3. Requirement to verify Tamper-indicating Devices (e.g. by imaging/ change-detection) & control opening of containers;
4. Requirement to maintain chain-of-custody through re-packaging and movement of accountable, fissile, items (NDA again, plus TID protocols).

THREE KEY REQUIREMENTS
1. Taking custody and applying Tamper Indicating Devices

Reality of TID (tags, seals and tamper-indication enclosures) – status of technology

1. Despite talk, in the New START follow-up context, of "applying unique identifiers to warheads and containers", **there are no such unique identifiers** which are:

- Demonstrated to be tamper-proof (note there is not even a protocol of types of attack on TIDs which they can be assessed against);
- Authenticated and certified for use in a nuclear facility (note the requirement for 'reader' hardware, cameras, laptop computers and sometimes change-detection software).
- 2. Policy people need to know this level of detail. Assuming that the chain of custody challenge can be met by current technology is a mistake.

2. Establishing identity, along the way, via verification of declared attributes using radiometric NDA

Reality of current NDA technology available for verification of warheads and components

1. Non-Destructive Assay is a fairly mature technology field. Well-understood for Safeguards;
2. The issue is in the special application to identifying nuclear warheads or fissile components; that of intrusiveness;
3. Information barriers have been developed over the years but **none is yet fit for purpose** – especially as regards authentication. None has yet been shown capable of handling NDA data sufficient for determining conformity to attribute declarations while, in an authenticated fashion protecting classified data (NPT Article 1 issue);

- Again, policy people need to be aware of this level of detail.

3. Radiation sweeping the 'before and after' empty disassembly areas and containers

Reality of current NDA technology for radiation sweeping areas, containers and personnel

1. Better news here. The technologies available are well-developed and characterised. The equipment is also simple enough to be certified and authenticated using current technology.
2. However, certification and authentication of specific equipment must be completed before they are fit for purpose in a real verification scenario. May take up a year per item of technology.
3. A comprehensive and multilaterally-agreed 'protocol for use' would be required for each type of technology in a genuine scenario. Model protocols should be developed and trialled in a realistic exercise.

Preparation for the activities above, in a future treaty scenario

Requirement for **Host** and **Inspector** teams to reach agreement on technical issues:

- What equipment is to be used and how is it to be authenticated and certified for use in the facility?, including:

i. NDA measurement equipment;

ii. Radiation sweep equipment

iii. Tamper-indicating devices

iv. Cameras

v. Computers and software.

Method and timing of joint preparations in a future treaty scenario

1. Possibly by joint technical Working Groups, in parallel with negotiations of the treaty, or agreement.
2. An ideal scenario would be an already-established, multilateral verification body (possibly an IGO), with:

- An established and well characterised set of equipment;
- A well-understood set of verification protocols;
- A system for regularly updating the above;
- A system for interacting effectively with dismantler states, through initial engagement, joint protocol agreement and resolution of technical differences.

What kind of capability building for the future now? – Identifying possible work streams

1. Technology development in multilateral collaboration – areas identified above;
2. Grasp the nettle of demonstrating authentication of real hardware (and software if applicable);
3. Technical personnel training – (including areas relevant to other scenarios, e.g. shape-destruction of components, reduction to bulk material, - and even reprocessing plant de-militarisation, enrichment plant de-militarisation and decommissioning);
4. Focussed collaboration on protocols for use of NDA equipment and Chain-of-Custody technologies and procedures; with multilaterally-agreed goals;

What kind of capability building possible work streams - continued

5. Training of future inspectorate via collaborative research projects (like the UK-Norway initiative), plus targeted training courses in state nuclear facilities – (e.g. BNFL/Nuclear Decommissioning Authority), plus:
6. Running a realistic multilateral verification exercise – partly as a shop window and proving ground for the outputs of 1. and 2. above. Around 2015?
7. Personnel training on negotiation of technical issues and liaison with policy negotiators.

2009 Exercise in Norway

Conclusions

1. Significant technology development in the last thirty years; but it has been unilateral (mostly US national Labs.) or bilateral at best;
2. There is much more to be done to develop usable technology and it needs to been done with multilaterally-agreed goals;
3. There are hard physics constraints which mean that perfect solutions are unlikely;
4. People need to be trained and protocols need to be devised and tested, alongside equipment development;
5. We have identified possible work-streams.