

# **Workshop on Technical Approaches to Support Nuclear Arms Control and Nonproliferation**

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## **Introduction**

The next decade will bring increased demands for improving the security and accountability of nuclear weapons and material, for reducing nuclear weapons stockpiles, and for strengthening the global nuclear nonproliferation regime. As states consider options for addressing these challenges they will need to consider how technology can help in the implementation of new approaches.

Nuclear arms reduction treaties are likely to involve only the U.S. and Russia in the immediate future. However, as nuclear stockpiles are reduced to low numbers, all states with nuclear weapons will likely be brought into the process. In the context of Article VI of the Nuclear Nonproliferation Treaty, states without nuclear weapons will require a high level of confidence that nuclear reductions are taking place. Therefore all states have a stake in understanding and developing options for verification and transparency.

In the 1990's there were significant efforts to develop technical approaches to the next generation of nuclear arms control. Many of these efforts involved collaboration between U.S. and Russian nuclear laboratories. In addition there have been numerous academic studies of monitoring nuclear weapons and nuclear materials. Although much work remains, these past accomplishments provide a strong basis for moving forward.

This workshop brought together a small group of technical experts from Russia, France, the United Kingdom and the United States to review past and ongoing work, to exchange information about technical approaches to verification of nuclear arms reductions, and to consider areas for international technical cooperation. Technical experts from China also planned to participate, but last-minute administrative difficulties prevented their attendance.

This Summary provides a flavor of the discussions during the workshop, including key observations and ideas for next steps. It does not follow the order of the workshop agenda, nor does it represent a consensus view of participants. More information about the workshop and copies of presentations are available at: [http://www.carnegieendowment.org/verification\\_resources](http://www.carnegieendowment.org/verification_resources).

## **The National Academies Study: Monitoring Nuclear Weapons and Nuclear Explosive Materials**

This study, published in 2005, explores how existing technical approaches to transparency and monitoring can support verification for all categories of nuclear weapons, and nuclear-explosive components and materials. It provides a thorough analysis and documentation of existing approaches and has received international attention, including being translated into Chinese. Although it draws on the work of some of the U.S. and Russian workshop participants, many were not familiar with it. Concerns were raised about the theoretical nature of some of the study's conclusions, and some questioned whether all of its recommendations were compatible with the real arms control environment. It was suggested that an international peer review of the study would be a valuable next step, which could include testing and evaluation of some of the approaches.

## **Protection and accounting of nuclear weapons and fissile material: international principles and technical approaches to information security.**

For as long as countries retain nuclear weapons, high standards of security and accountability will be needed to protect against their inadvertent transfer, theft or sabotage. In addition, such measures can help prepare countries for making accurate declarations of their nuclear stockpiles in future treaties. However, unlike standards for protecting civilian nuclear material, there are no internationally agreed standards for the accountability and security of nuclear weapons and weapons material. Workshop participants discussed the need for such international standards, and possible contexts for their implementation. Most discussion, however, focused on technical approaches for sharing information about nuclear stockpiles while controlling access to sensitive information. Such information-sharing could be relevant to assuring that accounting and security standards were being implemented appropriately, and would also be needed for verification of nuclear stockpile declarations under possible future treaties.

The National Academies Study suggested several methods for controlling access to and securing information, which provided a basis for discussions. Some technical experts at the workshop expressed significant concerns about the vulnerabilities of current approaches to information protection. They cautioned that the NAS Study conclusions should be evaluated carefully, and updated based on current knowledge. It was also noted that no approach is completely invulnerable, and that policy makers will need to understand the strengths and weaknesses of a range of options to make decisions.

## **Nuclear stockpile reductions: transparency needs, technical challenges, and the value of international cooperation.**

In the context of bilateral U.S. / Russian arms control treaties, verification measures will be a means for providing mutual confidence that nuclear reductions are taking place. Transparency among all states with nuclear weapons and the broader international community will also be needed when more states begin to reduce stockpiles, and to assure non-nuclear weapon states that the provisions of NPT Article VI are being taken seriously. The need to protect classified information significantly constrains possible technical approaches, which is further complicated by the fact that classification guidelines are not the same in all countries.

The first step in developing approaches to transparency is to understand what information will be required to assure other parties that reductions are taking place. Requirements likely will depend on whether the context is a bilateral treaty or less formal arrangement with a larger community and whether the aim is to build confidence among nuclear-weapon states, non-nuclear weapon states or both. In addition, constraints on sharing information will vary with context. Weapon states will need to work with each other and with non-nuclear weapon states to develop a common understanding of transparency needs and to enhance mutual understanding of technical approaches and constraints.

The U.S. and Russia have a long history of working together to develop technical approaches to transparency that protect classified information. These include template and attribute methods for assuring that items slated for dismantlement are indeed nuclear weapons. Information barriers that prevent the transmission of classified information to inspectors are a key element of these approaches. Technical challenges include methods for establishing baselines for weapon templates and developing information barriers that are understood and trusted by all parties.

The U.K. and Norway have initiated a cooperative effort to develop technologies and procedures for facilitating greater transparency between a nuclear weapon state and a non-nuclear weapon state. Experts from both countries are working together to establish solid technical understanding about transparency technologies, and also to raise Norwegian awareness about the complexities of protecting classified information. A simulated exercise, in which Norway plays the role of a nuclear weapon state that must provide transparency without revealing classified information, formed the basis for one recent and one planned exercise. Both sides feel that the exercise has been valuable and plan to document lessons learned in the near future. Because the needs of non-nuclear weapon states for transparency

about nuclear arms reductions are not well-understood, it was suggested that other weapon states could enter into similar cooperative efforts with non-nuclear weapon states.

In addition to transparency of the process of warhead dismantlement, transparent closure of warhead and fissile material production facilities will eventually be required to provide confidence that weapons are not being clandestinely produced to replace those dismantled. This is an underexplored issue, although some states (like France) have experience with facility closure transparency.

## **The Group of Scientific Experts (GSE) as a precedent for international technical cooperation on nuclear arms control.**

The Group of Scientific Experts (GSE), an international group of seismic experts, developed and tested approaches to seismic monitoring of nuclear test explosions from the mid 1970s to the early 1990s under the auspices of the Conference on Disarmament (CD) in Geneva. This group met independently of the status of negotiations of a Comprehensive Test Ban Treaty (CTBT) and is an example of how international technical cooperation can support arms control, even when the political climate is not conducive to treaty negotiations. By the time the CTBT was negotiated in the mid-1990s the seismic verification protocols, including information sharing and analysis, were well-established and internationally accepted. Discussion suggested that a GSE-type group might be valuable for nuclear arms reduction efforts, particularly in coordinating technical work. However, more analysis would be required to develop a concept that would make sense for nuclear arms control.

## **Key Observations**

All workshop participants agreed that international technical cooperation can be valuable in developing tools and approaches to nuclear arms control. In particular, joint technology development and evaluation assures that experts from all sides understand basic technical capabilities and limitations. In addition to technical experts, cooperation should include perspectives of other relevant stakeholders, such as security, safety, operational and legal personnel, to assure that technical measures are evaluated under realistic constraints. A number of factors must be considered, however, for collaborations to produce politically meaningful benefits. These include:

- Government support is needed to assure that funding is sufficient, that results are incorporated into the political process, and that technical experts have the appropriate legal framework for cooperation. However, micromanagement by governments could interfere with technical work and should be avoided.
- Non-governmental organizations, international organizations, and academic institutions can play a key facilitating role, especially in the initial stages of cooperation. For example, VERTIC, a U.K. NGO is the facilitator of the U.K./Norway collaborative effort; the U.S. National Academies are actively engaged with their Russian and Chinese counterparts on arms control issues; and the IAEA cooperated with the U.S. and Russia on monitoring of excess fissile material under the Trilateral Initiative.
- Technical experts should strive to provide a range of options to policy makers, rather than focusing on developing perfect, or fool-proof, solutions. Policy makers need to understand the trade-offs among issues such as complexity, vulnerability, cost, and overall level of confidence provided. Technical experts are advised to work together to develop a common technical language for discussing these tradeoffs.
- Cognitive diversity will be required to develop creative solutions to difficult challenges (corollary to the previous point). Not all challenges can be addressed through purely technical means. This is particularly true when it comes to gauging the levels of confidence imparted by certain technical solutions. The degree to which policymakers trust their negotiating partners is a key consideration, and other disciplines outside the hard sciences (e.g. cognitive science, psychology, and sociology) may provide valuable insight.

- Effective technical collaborations depend on a number of factors, including the level of technical expertise of participating experts, mutual interest in the topics for collaboration, and the degree of trust between participants. In some cases, bilateral partnerships might be preferable to multilateral ones, especially when dealing with sensitive issues.

## Next Steps

A number of possible activities for future cooperation were suggested, but achieving government support of continued cooperation will be necessary for substantive efforts. For example, a new legal framework is needed for technical cooperation between the U.S. and Russian laboratories. Developing a common terms of reference for future activities (e.g., follow-on workshops, technical collaborations, demonstrations/exercises), that clarifies objectives could be a good first step.

A number of suggestions for follow-on cooperation were suggested. These include:

- Review and compare classification, safety, and security guidelines in the five NPT nuclear weapon states, and assess the impact of these guidelines on verification and transparency activities. Results could be shared at a future workshop and would provide a common basis for future cooperation.
- International peer review of the National Academies Study. An experimental peer review could move beyond conceptual analysis, and test technologies and methodologies in realistic environments.
- Develop a 4-language glossary (Chinese, French, Russian, and English) of arms control and verification relevant terminology, to create a common vocabulary for future cooperation. The starting point could be the Chinese / English glossary developed by the National Academies of Science. Establishing a common database of currently available verification technologies, translated into the same four languages, might also be valuable.
- Establish additional bilateral partnerships between nuclear weapon and non-nuclear weapon states, based on the model of the U.K. / Norway cooperation, to develop common understanding of transparency needs and technical challenges. Establishing criteria for effective partnerships and evaluating a range of potential pairings could be a first step.
- Engage with non-nuclear weapon states, possibly through a series of workshops, to understand their needs for transparency and hence how verification and transparency can best be employed to demonstrate the commitment of nuclear weapon states to NPT Article VI.
- Convene a focused international technical workshop on information barriers to compare approaches, identify key challenges, and explore opportunities for technical cooperation. Such a workshop could be conducted under the auspices of an international technical organization, such as the INMM.
- Convene an international workshop among the NPT nuclear weapon states to discuss international principles for nuclear weapons/fissile material security and accountability. A “straw-man” set of principles could be developed as a framework for discussion.

In addition to these specific activities, more work needs to be done to develop a “model” for expanded cooperation to support nuclear arms control, drawing on the GSE experience and that of previous bilateral efforts. The model would consider issues such as membership, venue, and technical focus.

International technical cooperation on nuclear arms control can send a clear signal that states with nuclear weapons take their NPT Article VI obligations seriously. As new activities are developed, consideration should be given as to how their results might be presented in future NPT preparatory and review conferences.