BUILDING TRANSPARENCY IN NUCLEAR-WEAPON STATES: THE POLITICAL AND TECHNICAL DIMENSIONS

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Abstract

Peaceful nuclear programmes in non-nuclear-weapon states are fully transparent, largely because of the application of international safeguards administered by the IAEA. By contrast, military nuclear activities have traditionally been shrouded in secrecy. All aspects of fissile material and warhead production, warhead numbers, deployments and capabilities, were and, to a great extent, continue to be closely guarded and classified as national secrets. The aim of this paper, which draws upon a recently completed SIPRI study, is to illustrate a range of technical and non-technical issues related to establishing transparency for nuclear warheads and associated materials in nuclear-weapon states, having in mind two overarching considerations: achieving deeper and irreversible nuclear reductions.

1. INTRODUCTION

Following the end of the cold war and the successful implementation of arms control treaties, the risk of a large-scale nuclear confrontation has been drastically diminished. The nuclear arms race has been effectively curbed and arsenals have been reduced by almost one half. During the second part of the 1990s, although the aggregate number of deployed nuclear weapons continued to decline slowly but steadily, prospects for further success were stalled. It has become increasingly evident that complete elimination of nuclear weapons at an early stage is not realistic. Regrettably, few of the transparency measures that have been promoted since the late 1980s are fully implemented. Nevertheless, arms control and co-operative nuclear security have amply demonstrated that accumulated expertise and available technologies hold great promise, when political circumstances so permit, for building and institutionalising transparency.

2. NUCLEAR WEAPONS AND FISSILE MATERIALS: A BRIEF OVERVIEW

The nuclear-weapon states (NWS) recognized under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), China, France, Russia, the United Kingdom and the United States, possess sophisticated nuclear weapons. Three other states have nuclear capabilities. India and Pakistan tested nuclear weapons in 1998. In addition, Israel is widely believed to have nuclear weapons.

It has been estimated that more than 128,000 nuclear weapons were built between 1945 and 2000. [1] In the end of the 1980s, the world nuclear stockpile peaked at close to 70,000 warheads. At present, according to open sources, the aggregate number of operational, reserve or retired nuclear weapons in the NWS is more than 30,000. Over 97 percent belong to the Russian

and US arsenals. A significant fraction, of the order of several thousands, is tactical weapons.[1] The downward trend in the number of warheads will likely continue in the future as Russia and the USA further reduce their stockpiles. Implementation of the START II Treaty -- a distant possibility -- would limit deployed strategic arsenals in Russia and the US to a maximum of 3,500 warheads each, a ceiling significantly lower than the 6,000 allowed under START I. Both countries, nevertheless, plan to retain large inventories of strategic reserves, comprising both intact warheads and warhead components. Preliminary discussions held in 1997, in the framework of START III, for further reducing strategic weapons envisioned numbers of 2,000 to 2,500 warheads. Views have been expressed, however, that Russia will not be in a position to maintain more than 1,500 warheads, or even less, by 2010 because of the obsolescence of its systems and for financial reasons. In the US, the Bush Administration is currently conducting a nuclear posture review that reportedly contemplates deep cuts in strategic forces.

There are no official statistics on the exact numbers, categories and types of warheads in the inventories of the NWS.[2] The NWS are not legally obliged to declare or submit to any kind of control the production or destruction of their warheads. Moreover, existing bilateral treaties, like the INF and START I, do not specifically call for the elimination of warheads. Nevertheless, following the implementation of these treaties and unilateral pledges, thousands of old, obsolete, redundant, and entire classes of tactical warheads have been dismantled.

Countries with military nuclear programmes produced, starting in the 1940s, vast quantities of fissile materials which are the basic ingredients for manufacturing nuclear weapons. [2] They hold in total approximately 260 tonnes of weapon-grade plutonium, either in operational, reserve or retired weapons, weapon components, solutions, scrap and waste material. [3] The aggregate military HEU inventory is of the order of 1750 tonnes (not including submarine fuel or waste). Published estimates show that most fissile material is outside nuclear weapons, varying, for example, between 65 and 75 per cent for the US and Russian stockpiles, respectively. As with warheads, the USA and Russia are the possessors of the largest stockpiles of fissile materials, exceeding by at least one order of magnitude those of the other three NWS.

3. WHY IS TRANSPARENCY NEEDED?

In the context of arms control, transparency is often linked with confidence-building and co-operation. Transparency measures result in greater predictability about the capabilities of states, thus facilitating common understandings, easing tensions and decreasing nuclear dangers. Accountability can help prevent theft and diversion of nuclear warheads and materials. The ensuing co-operation at the political and technical levels builds confidence, both domestically and internationally, gradually creating a positive environment in which new initiatives can be effectively negotiated and pursued. Moreover, continuous public debate and scrutiny of government activities are essential in democratic systems.

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[1] Published estimates vary widely. For instance, according to different sources, Russia's tactical nuclear weapons force comprises from 2,000 to 10,000, or more, warheads.

[2] States parties to START I exchange data, semi-annually, about their accountable, under the treaty, deployed strategic warheads. The US declared it had a total stockpile of 22,229 warheads at the end of 1961. In 1986 the Russian stockpile reached its maximum at 45,000 warheads. The UK currently has less than 200 operationally available warheads.

The overriding argument for transparency, however, derives from the need to demonstrate that NWS comply with their obligations and pledges to reduce and eventually eliminate their nuclear forces. Scarcity of information about a country's nuclear programme and capabilities fosters perceptions about its unwillingness to engage in and advance disarmament. Currently, no treaty or agreement obliges the NWS to limit or accept controls on their nuclear warheads. Under the START I Treaty, several hundred nuclear delivery vehicles and their launchers have been destroyed in accordance with the strict monitoring and verification provisions of the treaty. Similarly, the INF-mandated bilateral elimination of all intermediate and shorter-range missiles was effectively carried out. These reductions in delivery systems were irreversible. The fate of removed warheads, however, remained outside agreements. According to several accounts, a major part of these warheads have already been voluntarily destroyed but, due to lack of transparency, there is no evidence as to the remaining numbers. The potential therefore always exists that non-deployed warheads can be used to quickly reconstitute nuclear arsenals.

Elimination of tactical weapons is also worth noting. The true extent of the implementation of the 1991-92 informal Bush-Gorbachev and Bush-Yeltsin initiatives to withdraw from active service and destroy large numbers of tactical nuclear weapons is not known. Moreover, since the unilateral measures undertaken by some NWS are not codified in legally binding agreements, there can be no confidence that they have actually taken place.

Poor transparency also extends to military fissile materials. Statements about fissile material holdings and declarations about production moratoria alone are only politically binding. Though valuable first steps indicating the intentions of the NWS, they have a limited practical impact, unless they can be effectively verified. For example, fissile material designated excess to military needs can be easily used again to manufacture warheads unless it is permanently withdrawn from national stocks and managed under international supervision.[3]

4. ELEMENTS OF TRANSPARENCY

Building a transparency regime for warheads and fissile materials in NWS would likely go in parallel with measures to limit and monitor allowed numbers and types of nuclear delivery vehicles and launchers. Such provisions could be complemented by sharply diminishing the role of nuclear weapons in defence strategies and halting their modernization, and by monitoring restrictions on their deployment and operational status.

A comprehensive nuclear transparency scheme could, at least conceptually, extend to full accounting of warheads and fissile materials, and monitoring of production facilities and associated complexes. It could broadly comprise the following main elements:

- First, establishing declarations of fissile material stockpiles and warheads and verifying their accuracy and, more importantly, their completeness.

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[3] Towards the high end of what its surplus fissile holdings may be, Russia could field a force four times the size of its current deployed strategic arsenal. See: The Wassenaar arrangement and the future of multilateral export controls, Hearing before the Committee on Governmental Affairs, United States Senate, 106 Congress, second session, 12 Apr. 2000, p. 84

- Second, providing assurances that warheads earmarked for elimination are what they are claimed to be.
- Third, ensuring that all warheads designated for dismantlement are, in fact, destroyed and not otherwise diverted or replaced by decoys.
- Fourth, guaranteeing that no new warheads are manufactured and no new fissile materials are being produced.
- And fifth, disposing of material from dismantled warheads, including that which has been designated excess, in an irreversible way.

The creation of such an elaborate approach is likely to be a very long and incremental process, consisting of both negotiated agreements and voluntary decisions, which will progressively lay the foundations for verifying nuclear disarmament. Depending on classification requirements, monitoring and verification tasks can be implemented either by inspectors from the NWS or by an international secretariat such as that of the IAEA. To this end, accumulated experience and technical means devised for international safeguards or for verifying bilateral arms control treaties would be valuable. Indeed, the scope, complexity and intrusiveness of verification techniques have progressively increased with time. [4] So has confidence in their accuracy. Revealing of information can be done in different ways, but broadly speaking there will be a sliding scale for introducing transparency, comprising statements of intent, providing of information and the more formal verifying of information. [5]

4.1. Stockpile declarations

Uncertainties surrounding warhead and fissile material inventories must be reduced to a minimum for establishing a meaningful basis for deeper reductions. NWS could fruitfully make a commitment to informally reveal and periodically update their warhead and fissile material holdings. Limited exchanges, a logical next step in arms control, could begin at an early date without lengthy consultations between NWS. [6] Indeed, the US Department of Energy (DOE) has voluntarily published detailed information about its historical production, use and current holdings of weapons plutonium. [7] A similar exercise, but of a more limited scope, was also conducted in the UK. [8] In addition, the US announced its total production of HEU and plans to publish a comprehensive account. This effort has been completed, but data have not yet been made public. Concerning warheads, the US has declassified certain characteristics of its stockpile (total yield, numbers retired) from 1945 to 1994, as well as total numbers produced from 1945 to 1961. [9]

After confidence is gained from exchanging simple aggregate data and information on historical production, NWS may also consider producing more detailed accounts in a phased manner: inventories by types and declared facilities, as well as itemized lists of each warhead and component or container of fissile material, including their locations. Undoubtedly, sharing information of this kind today would be quite premature because of the risk of revealing strengths and vulnerabilities. States with smaller or less survivable nuclear forces than those of potential adversaries may in fact need to rely on quantitative or geographical ambiguity. Thus, special responsibility to move forward rests upon the US and Russia, the possessors of the largest stockpiles of warheads and fissile materials. Developing a process for exchanging classified stockpile information on a regular basis was agreed by the US and Russian Presidents in 1994,

but formal implementation of such transparency provisions has never been successfully negotiated.

More detailed declarations might also involve formal verification arrangements to provide assurances about their accuracy and completeness. Verification will become imperative when stockpiles are substantially reduced or when states agree to impose quantitative limits on them. Two key issues are of concern here: (a) demonstrating the authenticity of a declared warhead without disclosing classified design information (see next section) and (b) providing guarantees about the completeness of declarations. The latter task could be accomplished by challenge inspections, examination of facility operating records and 'nuclear archaeology' techniques. [10]

4.2. Warhead authentication and dismantlement

Controls on nuclear warheads and verification of their dismantlement would pose daunting challenges because of their highly technical and sensitive nature. [11] As units of arms control accountancy, nuclear warheads are too small to be monitored by traditional national technical means of verification. Thus, verifiable warhead elimination would necessarily require unprecedented intrusiveness into what hitherto have been some of the most sensitive segments of national defence establishments.

A warhead destined for elimination could be introduced into the verification regime by affixing a tag and also a seal on its container. Verifying the status of the warhead (i.e. that it belongs to a particular group slated for destruction) could be done either by measuring some of its 'attributes' (at least the presence of a minimum mass of fissile material) or by making use of its detailed spontaneous and/or stimulated radiation spectrum, the so called 'template' approach. Information barrier systems involving both technology and procedural elements could be applied to reliably protect classified design information.[4] Moreover, sampling, the use of portal-perimeter monitoring, as well as more intrusive chain of custody techniques would ensure confidence in the verification of warhead dismantlement.

The US-Russian Laboratory-to-Laboratory Warhead Dismantlement Transparency Programme, which was initiated in 1995, and the domestic US technology developing effort made major advances in many areas, such as radiation measurement, information protection, remote monitoring, disposition of non-nuclear components, and chain of custody, including seals, tags and seal monitoring. However, much remains to be done as the technology base for warhead dismantlement transparency is far from being complete.

4.3. Implications for warhead complexes

Implementing warhead transparency would result in profound impacts on warhead production and maintenance complexes. Such facilities were not designed to receive foreign inspectors or accommodate other transparency measures, for example monitoring. Consequently, warhead stewardship and re-manufacturing operations, which are probably carried out in the same or

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[4] The Controlled Intrusiveness Verification Technology (CIVET) system developed at Brookhaven National Laboratory accomplishes this task with a high-resolution gamma-ray detector and a special-purpose computer without permanent memory. The system is designed in such a way as to maximize transparency of all of its hardware and software elements. See: Brookhaven Bulletin, Vol. 52, No. 39 (9 October 1998), p. 3.

adjoining buildings where dismantlement is performed, could be seriously disrupted. Moreover, demands on technical, support and security personnel, services and equipment would likely be significant. Physical segregation of verifiable warhead dismantlement processes, the use of dedicated facilities or shutdown plants are all important tools that could be investigated for meeting the rigorous operational and security requirements in warhead complexes. [12]

Yet more serious challenges are posed by existing assymetries in the number, capacities, structure, functions and technical organization of both warhead production and dismantlement facilities in the NWS. These assymetries must be clearly identified and well understood before inspection and monitoring arrangements are formally negotiated. In the US, a joint DOD-DOE Integrated Technology Steering Committee was established in 1999 to work on monitoring technologies, impact-cost facility studies as well as demonstrations and vulnerability analysis. [13] Proposed possible first steps toward establishing transparency in warhead complexes include: exchanges of unclassified dismantlement facility diagrams showing layouts and warhead flows, followed by familiarisation tours at such facilities; funding of facility-specific studies; co-operative research on chain-of-custody arrangements for warheads; studies on measures to verify the closure or conversion of warhead production plants; and establishment of technology development centres. [14]

4.4. Disposition of excess material and controls on production facilities

Transparency and verification should be fully extended to material no longer required for defence purposes, covering both its intermediate storage (in the form of pits, other components, oxide powders, or fuels) and its final disposition. Material that is not in warhead component or classified forms, that is, material irradiated as fuel in reactors, under processing in bulk handling facilities or in storage, can in general be monitored with confidence by available technologies widely in use by the IAEA, EURATOM and national systems of accounting and control. Both the US and Russia designated hundreds of tonnes of military fissile materials excess to their military needs and agreed to dispose of part of them. [15] The UK also declared excess a quantity of military plutonium. Moreover, the US has placed a small quantity of military fissile material under IAEA safeguards. The Trilateral Initiative, launched in 1996 by the US, Russia and the IAEA to voluntarily place both classified and unclassified forms of excess fissile material under international verification is of paramount importance because it will ensure, when concluded, the irreversibility of the disarmament process.

IAEA-type safeguards could also provide assurances about the closure of production reactors and military fuel cycle facilities. It is worth noting that all the NWS, with the exception of China, have officially declared moratoria on the production of plutonium and HEU; it is believed, however, that none of them continues to produce material for defence purposes. Conversely, this is not likely to be the case with India, Israel and Pakistan. Regrettably, negotiations on a long-proposed Fissile Material Cut-off Treaty banning the production of fissile material for nuclear weapons remained stalled after five years in the Conference on Disarmament. There is no consensus on its scope, application, duration and transparency and verification measures.

More challenging would be, if disarmament advances, the detection of undeclared activities, including the manufacture of new warheads. Satellite imagery, remote sensing and

environmental monitoring, complemented by societal verification, would be valuable tools toward this end. [16]

5. THE US-RUSSIAN NUCLEAR SECURITY CO-OPERATION AND TRANSPARENCY

Despite souring US-Russian political relations, a distinct characteristic of the past few years has been the continued nuclear security co-operation between the two countries in fora principally created for containing proliferation threats posed by the break-up of the Soviet Union. Noteworthy amongst many programmes are the unprecedented large-scale commercial deals to down-blend and transfer to the USA some 500 tonnes of HEU from dismantled Russian warheads, the US–Russian agreement to dispose of 34 tonnes of weapons-grade plutonium each, and sustained efforts to prevent theft and ensure security of Russian warheads, fissile materials and technologies. Additional initiatives include plans for downsizing and consolidating Russia's nuclear weapons complex, ending further production of fissile material and building an advanced storage facility for plutonium and HEU originating from dismantled warheads. In the context of co-operation, it should also be recognized that another bilateral achievement of paramount importance is the successful and smooth implementation of the INF and START I treaties, and the substantial body of accumulated technical, legal and organizational experience gained from it.

A central feature of these programmes was to establish transparency in the nuclear reduction process. Apart from agreements for implementing specific transparency measures[5], the bilateral co-operative agenda comprised technical exchanges on potential warhead dismantlement monitoring technologies and, more importantly, the ill-fated Joint Working Group on Safeguards, Transparency and Irreversibility (ST&I). This forum, launched in 1994 for negotiations to establish a new arms control regime extending to US and Russian stockpiles of nuclear weapons and fissile materials, was the only bilateral initiative clearly aimed at promoting what might be called 'nuclear glasnost'. Deliberations broke down in the autumn of 1995 and have not resumed since then. Although the pace of nuclear co-operation has somehow slowed in recent years, overall progress has been unprecedented. Even in the absence of formal negotiations, extensive and innovative technical work has been performed on joint approaches for monitoring warhead dismantlement and storage of fissile material. For further advancing this agenda, issues that need to be tackled include: granting access rights to critical sites in Russia, equally extending monitoring rights to US facilities, overcoming exaggerated secrecy and ensuring sustained leadership. In addition, as an influential committee recommended, expanded funding would be indispensable. [17]

6. THE WAY FORWARD: OBSTACLES AND OPPORTUNITIES

Any discussion about warhead and fissile material transparency raises a host of problems. There are political questions, economic questions and issues connected with technology. Debates often focus on national security and sovereignty, the need to protect sensitive information, and the myriad of inevitable technical obstacles which exist in connection with the immensity of the task: the sheer size of nuclear complexes and the vast inventories of nuclear warheads and materials.

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[5] These include, most notably, monitoring arrangements connected with the implementation of the 1993 HEU purchase agreement and the 1997 plutonium production reactor shutdown agreement, as well as with the Mayak storage facility and the processing and packaging implementation agreement for pit destruction. Similar provisions are being developed within the framework of the Trilateral Initiative with the IAEA.

In the period which immediately followed the end of the cold war, efforts to combat proliferation and advance multilateral arms control, and the intense debate on completely eliminating nuclear arsenals, all pointed in the directions of co-operation, transparency and verification as the necessary means for achieving them. Indeed, pursuing common objectives through greater openness marked the relationship between Moscow and Washington. However, the deterioration since the mid-90s in the relations between the two nuclear superpowers and unilateralist moves resulted in the current stagnation in arms control. Disarmament fell off the agenda and interest in expanding transparency followed suit. Not only long-negotiated arms control treaties were not ratified, but also the major part of the fragmented initiatives to introduce transparency to limited segments of military fissile stocks and facilities were not implemented. This is quite paradoxical in an era of advanced technologies which have been extensively tried and tested.

To move forward, trust needs to be restored and this will likely take time. First and foremost the differences between Russia and the US over missile defences would have to be resolved. The way the two countries proceed with the next round in their nuclear arms reduction and its extent will be crucial. Making progress will require strong leadership, good will, flexibility and ingenuity. Perhaps international crises, like those resulting from the recent terrorist attacks in the US, will pool efforts in the fight against common threats and galvanise again interest in co-operative measures.

The smaller three NWS lack the technical and negotiating arms control expertise of Russia and the US. It remains to be seen how they will meet their commitments undertaken during the 2000 NPT Review Conference which highlighted for the first time, albeit in an abstract way, the notions of transparency and irreversibility in nuclear reductions. NWS are acutely aware that transparency alone will not eliminate the security gap between them and NNWS, but it will be one of the principal factors in ensuring the continued support of 182 countries to avoid destabilisation of the NPT regime.

Transparency will essentially remain a long-term goal. In the meantime, all NWS may well consider certain measures, the implementation of which would require neither extensive negotiations nor prohibiting costs. These measures would call on them to: (a) reaffirm their commitments to transparency and support to multilateral institutions; (b) preserve accomplishments and continue to engage to this end funding and expertise; (c) make voluntary stockpile declarations and transfer excess material to the civilian sector; and (d) establish national capabilities for undertaking R&D work in nuclear arms control and disarmament. [18]

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