12. Conclusions

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The chapters in this volume demonstrate that greater transparency in the management of nuclear warheads and materials would genuinely contribute to the strengthening of international security, the reduction of nuclear-related threats and the enhancement of predictability in inter-state relations. Transparency would gradually introduce accountability in the nuclear weapon states (NWS) and thus contribute eventually to reducing the asymmetries between them and the non-nuclear weapon states (NNWS). It would facilitate arms control and oversight of the irreversibility of reductions. Ultimately, transparency would help to pave the way for nuclear disarmament.

Today, societies are becoming increasingly open and interdependent, and, as in other areas, they demand greater transparency in the domain of nuclear weapons. A wealth of tried and tested technical means and technologies are available to serve the purpose of transparency and to ensure compliance with nuclear arms control agreements, and more methods are under development. Paradoxically, despite the ever-increasing sophistication of technical capabilities, progress towards enhanced transparency has been limited and the political commitments to this goal have largely been unfulfilled.

This volume maps out in detail the advances that have been made and identifies and discusses the broad reasons for promoting or impeding transparency. However, many important questions remain unanswered. Will the NWS accept more openness and accountability in the future, or will the trends of the 1990s towards greater transparency be halted or even reversed? In particular, will Russia and the United States eventually agree to address the issue of non-deployed warheads, including warheads for their tactical nuclear weapons? To this end, will they adopt some of the proposed transparency technologies, strengthen cooperation and agree to assign a more prominent role to the International Atomic Energy Agency (IAEA)? Finally, what type of action can China, France, the United Kingdom and the three de facto NWS—India, Israel and Pakistan—be expected to take?

I. Progress

Because of the importance attached by the NWS to nuclear weapons, they do not easily accept any disclosure of information that may increase the vulnerability of the weapons or impede their readiness for use. However, there has been an evolution in transparency over the years as the concept, together with the progress made in arms control, has slowly become a central feature of nuclear

diplomacy and found its way into the policies of the NWS. In a largely uncoordinated and informal manner, the NWS have released information about their nuclear histories, including information on nuclear tests, doctrines and strategies, and weapon and fissile material inventories, and about the status of their production facilities. Most importantly, they have shared information about their disarmament efforts. Although the information which has been made public varies widely, in both extent and quality, between countries, the UK and the USA have gone a step further in a difficult area in which progress has been particularly constrained. They have provided precise, albeit limited, official data on their nuclear assets.[1] In contrast, in the de facto NWS secrecy remains the norm even today.

Important events took place during the first half of the 1990s, when transparency in nuclear reductions was elevated to one of the primary means for building a stable post-cold war international order. Together with the implementation of their formal nuclear arms control agreements, Russia and the USA pursued a complex and ambitious agenda, closely cooperating on a number of new fronts. They enhanced warhead and fissile material security, improved material accounting and jointly evaluated innovative approaches to providing assurances about the disposition of excess nuclear warheads and materials. Between 1994 and 1997 Russian President Boris Yeltsin and US President Bill Clinton issued a number of summit declarations and official statements calling for, to cite one example, 'measures relating to the transparency of strategic nuclear warhead inventories and the destruction of strategic nuclear warheads'.[2] The two presidents agreed to develop processes for the regular exchange of classified data on their countries' nuclear stockpiles, reciprocal inspections of material originating from dismantled warheads and the establishment of a dialogue at the expert level to propose specific transparency measures. The formal implementation of such provisions, leading to what might be called a 'nuclear glasnost', was never successfully accomplished, mainly because of the sustained resistance to openness in Russia and to a lesser degree in the USA and their rapidly deteriorating relations during the second half of the 1990s.

Nevertheless, the momentum was not entirely lost, because the unprecedented technical cooperation between the two countries led to the pursuit of a number of fragmented initiatives. These mainly involved the monitoring of the disposition and storage of excess fissile material and the closure of related production facilities. Moreover, a framework was conceived for assigning an initial verifi-

[1] It should be underlined that, more than half a century after nuclear weapons were invented, there are significant uncertainties about their numbers and operational status and about the stockpiles of military fissile materials. Fortunately, academic research based on open sources has addressed this gap in knowledge. Although the precision of the findings has often been remarkable, such research cannot replace voluntary, orderly state transparency. See Albright, D., Berkhout, F. and Walker, W., SIPRI, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press: Oxford, 1997).

[2] Joint Statement on Parameters on Future Reductions in Nuclear Forces, The White House, Office of the Press Secretary, Washington, DC, 21 Mar. 1997, available on the Carnegie Endowment for International Peace Internet site at URL <http://www.ceip.org/files/projects/npp/resources/summits6.htm#parameters>.

cation role to the IAEA. At the same time, warheads and warhead production complexes were conspicuously absent from the agenda.

Although such exchanges were not always smooth or free of problems, it should be acknowledged that, overall, they were extraordinarily useful for a number of reasons. Government institutions and nuclear experts jointly explored novel areas of arms control and helped to gradually build trust, a necessary precondition for access to sensitive nuclear weapon facilities. Problem areas were identified and solutions actively sought, and it became evident that future, more intense cooperation would be feasible. It also became clear that it might be possible to expand select programmes to involve other NWS.

II. Technical considerations

In order to establish the basis for deep cuts in nuclear arsenals, uncertainties surrounding warhead and fissile material inventories must be reduced to a minimum. In addition, if the size of the stockpiles remains unknown, progress in arms control and disarmament cannot be measured in any meaningful manner. Indeed, the early exchange of stockpile information constitutes a logical next step in arms control.[3] The declassification of certain characteristics of the British and US stockpiles set an important precedent.

After confidence is gained from exchanging aggregate data, more detailed accounts could be provided by the NWS in a phased manner. These might include inventories by type, as well as itemized lists of warheads and fissile materials, accompanied by information on their locations. When current stockpiles are substantially reduced or when an agreement is reached to impose quantitative limits on them, it will become imperative to be able to verify such detailed declarations in order to provide assurances about their accuracy and completeness.

The direct imposition of controls on warheads and the provision of assurances about their destruction would be an ambitious and challenging technical task. As units of arms control accountancy, nuclear warheads are too small to be monitored by traditional national technical means. Thus, transparency in warhead dismantlement would necessarily require unprecedented intrusiveness into what have been some of the most sensitive segments of national defence establishments.

The US–Russian Laboratory-to-Laboratory Warhead Dismantlement Transparency Programme, initiated in 1995, and US efforts to develop technology for transparency measures made major advances in many areas, including: (*a*) radiation measurement, (*b*) information-barrier systems, involving both technology and procedural elements, (*c*) remote monitoring, (*d*) disposition of non-nuclear components and (*e*) chain-of-custody arrangements, including tags

[3] Müller, H., *The Nuclear Weapons Register: A Good Idea Whose Time Has Come*, PRIF Reports no. 51 (Peace Research Institute Frankfurt (PRIF): Frankfurt, 1998), available at URL <http://www.hsfk.de/downloads/prifrep51.pdf>.

and seals. Nonetheless, the technology base for warhead dismantlement transparency is far from complete.

The implementation of warhead transparency would have a profound impact on warhead production and maintenance complexes. These facilities were not designed to receive foreign inspectors or accommodate any other transparency measures, such as monitoring. Consequently, warhead stewardship and re-manufacturing operations, which are typically carried out in the same buildings in which dismantlement is performed or in adjoining ones, could be seriously disrupted. In addition, the demands on technical, support and security personnel, services and equipment are likely to be significant. The physical segregation of warhead dismantlement processes and the use of dedicated facilities or plants that have been closed are methods that could be used to implement transparency and at the same time comply with the rigorous operational and security standards in force in warhead complexes.

Problems of an even more serious nature would also need to be resolved. Asymmetries in the number, capacity, structure, function and technical organization of both warhead production facilities and dismantlement facilities in the NWS must be clearly identified and well understood before inspection and monitoring arrangements can be formally negotiated. Notable in this regard is the work in the United States of the joint Department of Defense–Department of Energy Integrated Technology Steering Committee, which was established in 1999 to examine monitoring technologies and issues of cost, impact on the facilities investigated and vulnerability of facilities.[4]

The most likely first steps towards establishing transparency in warhead complexes include exchanges of unclassified dismantlement facility diagrams showing layouts and warhead flows. These could be followed by familiarization tours at the facilities, funding of facility-specific studies, cooperative research on chain-of-custody arrangements for warheads, studies of measures to verify the closure or conversion of warhead production plants and the establishment of technology development centres.

Controls on warheads alone, with no effect on their entire life cycle and production complexes, would not be sufficient for carrying out deep and irreversible reductions in nuclear arsenals. Detecting the undeclared manufacture of new warheads would not be an easy task, but rapidly advancing technologies, such as high-resolution satellite imagery, remote sensing and environmental monitoring, would be valuable instruments. Societal verification could complement them.

In order to ensure the irreversibility of nuclear weapon reductions, transparency and verification measures should be fully extended to material no longer required for military purposes, covering both its intermediate storage in various forms and its final disposition. Material that is not in warhead components or other classified forms—that is, material irradiated as fuel in reactors,

[4] Concher, T. R. and Bieniawski, A. J., 'Transparency questions looking for technology answers', *Proceedings of the 41st Annual Meeting of the Institute for Nuclear Materials Management (2000)* (on CD), available from the Institute of Nuclear Materials Management, email address inmm@inmm.org.

undergoing processing in bulk-handling facilities or in storage—can, in general, be monitored with confidence with the available technologies used widely by the IAEA, the European Atomic Energy Community (Euratom), and national systems of accounting and control. The Trilateral Initiative, launched in 1996 by the IAEA, Russia and the USA for the voluntary international verification of both classified and unclassified forms of excess fissile material, is an important step in this regard. If it is concluded, an unbiased, independent body would, for the first time, be able to assure the public that the NWS were honouring their commitments. Together with implementation of the Trilateral Initiative, solid progress could be made by harmonizing the technical specifications of its monitoring provisions with those of other bilateral arrangements, such as the Plutonium Management and Disposition Agreement (PMDA),[5] and arrangements for the Mayak storage facility in Russia.

The IAEA safeguards techniques that have long been applied worldwide could also be utilized to verify the closure of production reactors and military fuel cycle facilities. A concrete step towards this end would be the successful negotiation of a fissile material production cut-off treaty, the prospects for which, after several years of fruitless discussion, are currently remote.

III. Obstacles

Warhead and fissile material transparency raises many political questions, economic considerations and technical problems. Indeed, enhancing and institutionalizing transparency may seem to be an impossible undertaking. The debates on transparency often focus on the protection of national sovereignty and highly sensitive data, the need to prevent nuclear proliferation and the technical obstacles connected with the immensity of the task.

The main obstacles, apart from the need to maintain mutual trust and good relations between the NWS and between the NWS and the major NNWS, are summarized below.

Different objectives

The NWS will accept greater transparency only if they see it as clearly reinforcing their national security. Pursuing the goals of arms control and disarmament is important but not as critical. Simply put, pursuing transparency measures cannot be disconnected from strategic and political realities. Transparency measures must not undermine national interests; indeed, they must be guided by national interests. For example, the USA has long called for enhanced transparency in Russia's tactical nuclear weapon force and in its inadequately protected stockpiles of fissile materials. Russia, for its part, has called for the

[5] The US–Russian Agreement Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation, 1 Sep. 2000, available at URL <http://www.ransac.org/new-web-site/related/agree/bilat/pudisp-agree.html>. The PMDA had not entered into force as of Dec. 2002.

extension of controls to the reserve stockpile of US strategic warheads. Moreover, openness and accountability, clearly influenced by culture and tradition as well as by political and legal systems, are perceived very differently by different countries. Even though the British and US declassification of certain characteristics of their stockpiles has not undermined their security in any way, it has not been emulated by the other NWS.

Lack of technological readiness and protection of classified information

It is clear that, apart from the political difficulties, various technical obstacles have also impeded the extension of the bilateral security and nuclear arms control agenda to include the elimination of nuclear warheads.[6] One of the key challenges has been to develop cooperative arrangements for effective transparency in warhead dismantlement that would not inadvertently reveal design strengths and vulnerabilities or disrupt routine nuclear weapon maintenance and stewardship activities. The asymmetries that exist in warhead production and dismantlement capabilities and in the availability of secure storage for nuclear materials and warheads have been identified as posing some of the most difficult challenges to introducing transparency. Moreover, the sheer size of military fissile material stockpiles presents additional barriers. There must be accountancy, with a reasonable degree of confidence, for the inevitable uncertainties and the lack of historical data will have to be addressed. Finally, even if monitoring and inspection activities were performed by an international inspectorate there would still be legitimate concerns about the leakage of classified data, in particular if inspectors from the NNWS were involved.

Reciprocity and multilateral engagement

Past efforts have quickly stalled when there was not enough progress, support or interest from the other side. It is unlikely that any of the NWS will forcefully pursue measures if the other NWS do not readily reciprocate. By and large, only Russia and the USA have maintained a dialogue and technical exchanges on transparency. Although these two states bear the primary responsibility for reciprocal transparency because of the size of their nuclear assets and should naturally lead the way, no framework has been devised for engaging, politically or technologically, the other three NWS. The lack of discernible progress on a

[6] See the contributions in Part II of this volume. See also British Atomic Weapons Establishment, *Confidence, Security and Verification: The Challenge of Global Nuclear Weapons Arms Control*, AWE/TR/2000/001 (Aldermaston: Reading, Apr. 2000), available at URL <http://www.awe.co.uk/main_site/scientific_and_technical/publications/pdf_reports/awe_study_report.pdf>; Bukharin, O. and Luongo, K., *US–Russian Warhead Dismantlement Transparency: The Status, Problems and Proposals*, PU/CEES Report no. 314 (Princeton University, Center for Energy and Environmental Studies: Princeton, N.J., Apr. 1999), available at URL <http://www.ransac.org/new-web-site/pub/reports/transparency.html>; Norris, R. S. *et al*., 'Techniques and procedures for verifying nuclear weapons elimination', *Background Papers*, Canberra Commission on the Elimination of Nuclear Weapons, Aug. 1996; and Taylor, T., 'The verified elimination of nuclear warheads', *Science & Global Security*, vol. 1, nos 1–2 (1989), pp. 1–26.

fissile material production cut-off treaty, the sole multilateral initiative to limit the production of military fissile materials, further aggravates the situation.

Bureaucracy

Promoting transparency involves many complex political and technological issues that affect vested interests, including those of government departments and agencies, national legislatures and institutions. Direct and sustained attention at a high level is imperative for overcoming bureaucratic inertia and deeply rooted secrecy policies and for ensuring the necessary government coordination.

Funding

Although the NWS continue to allocate large sums of money to the maintenance and upgrading of their nuclear arsenals, strengthening transparency would result in additional financial burdens. These would be dependent on the complexity and extent of the measures to be implemented, the infrastructure necessary for undertaking them and the possible involvement of an international body. While the level of available funding would vary substantially from country to country, the state of the Russian economy is likely to continue to present serious challenges. Clearly, without foreign assistance, only limited advances could be made in Russia. Financial aid and other incentives are therefore essential preconditions for breaking down both the political and the technical barriers.

IV. Looking ahead: prospects and proposals

The prospects for immediate progress in strengthening transparency in nuclear warheads and materials appear poor. The 'comprehensive transparency regime' advocated in the second half of the 1990s by arms control scholars is unlikely to be instituted in the near future.[7] Although Russia and the USA have agreed to substantially reduce their deployed strategic nuclear weapon forces over the next decade, they have moved away from negotiated agreements and thus missed a historic opportunity to address the future of their reserve and redundant warheads. Building transparency in nuclear warheads and materials would complement and strengthen treaties imposing numerical limits on strategic nuclear delivery vehicles and the warheads attributed to them.[8] Unilateral actions, on the other hand, could result in less transparency and more reversibility. More dangerously, the existing mechanisms and accomplishments

[7] Fetter, S., 'A comprehensive transparency regime for warheads and fissile materials', *Arms Control Today*, vol. 29, no. 1 (Jan./Feb. 1999), pp. 3–7.

[8] Fetter, S. and Feiveson, H. A., 'Verifying deep reductions in nuclear forces', ed. H. A. Feiveson, *The Nuclear Turning Point: A Blueprint for Deep Cuts and De-Alerting of Nuclear Weapons* (Brookings Institution Press: Washington, DC, 1999), p. 215.

could quickly be reversed, in particular if Russian–US relations become adversarial.

In spite of the difficulties, there are still windows of opportunity. In the absence of formal, binding agreements, the implementation of informal, reciprocal transparency and cooperative measures deserves attention. The USA, with its long tradition of openness and accountability, has historically been the most active proponent of transparency. Given the unrivalled military, technological and economic might of the USA, its leadership is a prerequisite for further progress.

Advancing the bilateral nuclear cooperation agenda would be one way to broadly promote transparency and overcome the legacy of the cold war. An increasingly coherent and integrated approach is necessary. This would entail the critical scrutiny of programmes currently under way as well as a stronger sense of direction and substantially increased funding. Successfully implemented initiatives, such as the 1993 Highly Enriched Uranium (HEU) Agreement, must also be accelerated. Finally, the synergies between various proposed measures—notably the monitoring arrangements connected with the 1996 Trilateral Initiative, the Mayak fissile materials storage facility and the 2000 US–Russian Agreement concerning plutonium management and disposition—should be explored further.

A more practical approach would be to revitalize the idea of pursuing phased exchanges of information on aggregate stockpiles of nuclear warheads and fissile materials on a regular basis. Early declarations, even those of a very general nature, would not only build confidence but also help to improve internal accounting systems, a welcome development in the wake of the 11 September 2001 terrorist attacks. In addition, the possibility of conducting reciprocal informal inspections on closed fissile material production facilities could be explored.

In the longer run, as the number of deployed nuclear strategic forces becomes smaller and mutual trust increases, Russia and the USA could make real and sustained progress towards practical measures to eliminate their surplus or obsolete warheads. These could be extended to cover their sizeable stockpiles of tactical nuclear weapons. The only meaningful way to impose limitations on tactical nuclear weapons would be to directly apply controls on their warheads.[9] In this regard, developments in the joint technical work to demonstrate transparent warhead dismantlement would be of vital importance.

Beyond the bilateral context, China, France and the UK, which lack the extensive technical and arms control negotiating expertise of Russia and the USA, would also need to fulfil the commitments they undertook at the 2000 Review Conference of the 1968 Treaty on the Non-proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT) to making transparent and irreversible nuclear reductions. In addition to the recent lack of action, there are no

[9] Zarimpas, N., 'Tactical nuclear weapons', *SIPRI Yearbook 2002: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2002), p. 582.

signs of any short-term plans by these states to reduce their nuclear holdings. At a later stage, however, they would undoubtedly benefit from the exchanges between Russia and the USA in the search for a regime that is applicable to all the NWS. The de facto NWS, on the other hand, will not engage in any framework for nuclear transparency unless major advances are made towards eliminating regional and local tensions.

The NNWS will no doubt continue to press for greater transparency through diplomatic channels and the NPT review conferences, and through other forums such as the United Nations General Assembly and the currently deadlocked Conference on Disarmament. In general, their influence will probably remain rather limited. After the 11 September terrorist attacks and the increased nuclear proliferation threats, the NNWS are confronted by more urgent challenges than diminishing their security gap vis-à-vis the NWS and furthering disarmament. They are now understandably preoccupied with ensuring that the vast stockpiles of nuclear weapons and materials are properly accounted for and held in securely guarded installations.

Increasing and enhancing transparency in nuclear holdings will remain a difficult, complex and long-term endeavour. In the meantime, all of the NWS may find it appropriate to contemplate certain limited steps that would require neither extensive negotiations nor prohibitive costs. In addition to maintaining an active dialogue and sharing experiences, such measures would include: (*a*) reaffirming commitments to transparency and support of multilateral institutions; (*b*) preserving accomplishments and continuing to provide the necessary funding and expertise; (*c*) making voluntary stockpile declarations and transferring excess material to the civilian sector under full IAEA safeguards; and (*d*) establishing national capabilities for undertaking research and development work related to the verification of nuclear arms control and disarmament.[10]

[10] The UK is in the process of establishing such a capability. See British Atomic Weapons Establishment (note 6).