Sustaining a Verification Regime in a Nuclear Weapon-Free World

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VERTIC is an independent, non-profit making, non-governmental organisation. Its mission is to promote effective and efficient verification as a means of ensuring confidence in the implementation of treaties or other agreements that have international or national security implications.

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Contents

Preface

In 1996 VERTIC launched a project funded by the W. Alton Jones Foundation and the Ploughshares Fund on Verification of the Transition to a Nuclear Weapon-Free World and Sustaining the Verification Regime for an Indefinite Period.

The aim of the project is to investigate the verification challenges facing the transition to complete nuclear disarmament and how a verification regime might be sustained once zero nuclear weapons had been achieved. Verification is clearly the key to achieving nuclear disarmament, since without it the risk of 'breakout'—the illicit retention or production of nuclear weapons—would be high and the inclination to actually abolish nuclear weapons low. Verification of nuclear disarmament therefore needs to be highly intrusive and thorough, allowing for as little margin of error as possible. Given the extreme sensitivity of the nuclear weapon states about their security requirements, especially regarding their nuclear capability, this will be enormously difficult.

Many questions are pertinent: how should a verification regime be structured so that there is a high degree of confidence that no country or organisation could be hiding or manufacturing a stockpile? what technologies and techniques are most appropriate? how can one build on the precedents set by other nuclear agreements such as the Intermediate Nuclear Forces (INF) Agreement and START (Strategic Arms Reduction Treaty) I and II and non-nuclear agreements such as the Chemical Weapons Convention and the Biological Weapons Convention? how is the verification regime to be staged to match the gradual dismantling and destruction of nuclear arsenals? what does one do about nuclear materials, nuclear laboratories and nuclear knowledge? how is the verification regime to be implemented so that it builds trust and confidence? how are the de facto nuclear weapon states to be brought into the process and will the same verification provisions apply to them as to the declared nuclear weapon states? are nuclear and non-nuclear confidence-building measures required to supplement the verification regime? how can the regime cope with breakout should it occur?

Not only does the verification of nuclear disarmament have to be effective and efficient during the process of getting to a nuclear weapon-free world, it is also vital that there is confidence in the verification regime's ability to survive indefinitely. Questions here include: for how long do we need an intrusive verification regime? 50 years? 100 years? can nuclear weapons be re-manufactured by a former nuclear weapon state within a short time-frame or would they have to be essentially re-invented? what happens if the international situation seriously worsens? how do we implement the regime so that enthusiasm, expertise and funding are maintained?

should the strictness of the regime be eased over time as a nuclear weapon-free world becomes the norm?

The research product of the VERTIC's 'Getting to Zero' project comprises four reports dealing with:

1) verification of the transition to low levels of nuclear weapons, covering the period in which the nuclear weapon states would be expected to cut their nuclear warheads to below 1000 each;
2) verification of the transition to a nuclear weapon-free world, covering the period when complete nuclear disarmament is achieved and detailing the type of treaty and accompanying verification arrangements likely to be required;
3) management and verification of virtual nuclear deterrence, whereby residual nuclear capabilities (such as skilled personnel, fissionable materials and general industrial capacity) would give some states, especially former nuclear weapon states, the edge in any attempt to reconstitute nuclear weapons, thereby giving them a form of nuclear deterrence; and
4) how to sustain the verification system for a nuclear weapon-free world into the indefinite future.

This report, by Suzanna van Moyland, former Arms Control and Disarmament Researcher at VERTIC, is the fourth in the series.

Executive Summary

- Sustaining high levels of commitment to and enthusiasm for the verification regime in a nuclear weapon-free world (NWFW) would be a considerable challenge, but the price of failure would be high. No verification system for a complete ban on a whole type of weapon of mass destruction (WMD) has been in existence long enough to provide a precedent or the requisite experience. Nevertheless, lessons from the International Atomic Energy Agency's (IAEA) nuclear safeguards system are instructive.
- A potential problem over the long haul is the gradual erosion of the deterrent effect of verification that may result from the continual overlooking of minor instances of non-compliance.
- Flaws in the verification system must be identified and dealt with early lest they also corrode the system. To achieve this the verification organisation's inspectors and analytical staff will need sustained support, encouragement, resources and training. In drawing attention to weaknesses, they must be supported by management and at the political level.
- The leaking of sensitive information, either industrial or military, by staff of the verification regime is a potential problem. 'Managed access' techniques should be constantly examined and improved. The verification organisation and states parties will need to sustain close co-operation with the nuclear and related industries.
- Frequent review mechanisms must be established. States must invest time and effort to make them effective.
- Another potential problem is the withering of resources for sustained verification. Verification organisations tend to be pressured by states to cut or at least cap costs, even if the verification workload increases.
- The verification system must be as effective as knowledge and experience allows. The organisation will need continuously to update its scientific methods and technology. This requires in-house resources plus external research and development (R&D). Universities, laboratories and industry need incentives to participate in such collaborative efforts. Co-operative international or regional projects are a particularly good investment as they can build confidence and lead to a pooling of resources.
- The verification organisation must use effectively all information available, including from government intelligence-gathering organisations, multi-national institutions and open sources. Scientists, academics, journalists, non-governmental organisations and industry should be encouraged to volunteer information. Their capacity to do so should be developed and sustained.

Glossary

BTWC	Biological and Toxin Weapons Convention
CFE	Conventional Forces in Europe
CTBT	Comprehensive Nuclear-Test-Ban Treaty
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CWC	Chemical Weapons Convention
ESA	European Satellite Agency
EURATOM	European Atomic Energy Community
HPTA	High Performance Trace Analysis
IAEA	International Atomic Energy Agency
ICBM	Inter-Continental Ballistic Missile
ICC	International Criminal Court
INF	Intermediate-Range Nuclear Forces
MTM	Multi-national Technical Means
NGO	Non-Governmental Organisation
NNWS	Non-Nuclear Weapon State (s)
NPT	Non-Proliferation Treaty
NRDC	Natural Resources Defense Council
NTM	National Technical Means
NWFW	Nuclear Weapon-Free World
NWS	Nuclear Weapon State (s)
OPCW	Organization for the Prohibition of Chemical Weapons
R&D	Research and development
START	Strategic Arms Reduction Treaty
TTBT	Threshold Test Ban Treaty
UN	United Nations
UNSCOM	UN Special Commission on Iraq
UNMOGIP	UN Military Observer Group in India and Pakistan
US	United States of America
VERTIC	Verification Research, Training and Information Centre
WMD	Weapon(s) of Mass Destruction

1. Introduction

While an effective verification regime is essential for complete nuclear disarmament, the maintenance of support and enthusiasm for such a regime—even though continued assurance of compliance would remain of great importance to world security—will be difficult. Little analytical attention has been given to this issue.

This paper will identify prospects for and problems in sustaining a verification regime in a nuclear weapon-free world (NWFW). It assumes that a nuclear disarmament treaty will have been negotiated and implemented and that all known nuclear weapons will have been dismantled. It also assumes that the verification system for total nuclear disarmament will have been in place for some years, managed by a multilateral verification organisation.

The questions dealt with in this report are two-fold: what are the long-term threats to the sustainability of the verification system in a nuclear weapon-free world likely to be?; and what measures might be taken to ensure that the system is sustained into the indefinite future? These questions must be considered in the context of current and future developments in verification and the international system generally.

Since the end of the Cold War a shift in multilateral verification culture has emerged, marked by the acceptance of increased levels of mutual transparency and intrusiveness. Mutual reassurance of compliance among parties is now expected to involve detailed reporting of information, sophisticated analysis of that information, the use of the latest monitoring technology and methods and more intrusive kinds of inspections. International treaties that demonstrate this phenomenon include the Conventional Forces in Europe (CFE) Treaty, the Chemical Weapons Convention (CWC), the International Atomic Energy Agency's (IAEA) Additional Protocol for strengthened safeguards and the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The best practice of such verification regimes will certainly be required for a total nuclear weapon ban.

The information revolution—the acquisition and rapid transmission of information and its increased volume and availability—has bolstered the power of verification and should continue to sustain it. Information sources include National Technical Means (NTM), Multi-national Technical Means (MTM), non-governmental organisations (NGOs), academic and research organisations, civil society generally, the media and individual citizens.

By the time a NWFW is effected there will have been dramatic developments in the international system that will help sustain verification. As just one example, an International Criminal Court (ICC) is likely to be fully operational and have universal jurisdiction. This would strengthen the deterrent effect of verification as it would establish individual or group liability to prosecution for violating an international ban on nuclear weapons. While normally individual actors involved in illicit activity would face criminal prosecution in the state of which they were a citizen or in which they had committed the crime, if the state was unable or unwilling to perform such judicial functions credibly, the ICC might do so instead. Moreover, if the clandestine activity is undertaken with a state's tacit or partial knowledge, and the state collapses or war occurs, making normal international mechanisms for dealing with non-compliance ineffective, the individuals involved could be tried by the ICC.

The challenge for this study, however, is that no verification system covering a complete ban on a whole type of weapon of mass destruction (WMD) has been in existence long enough to provide a precedent or the requisite experience. The most advanced verification systems dealing with WMD—the IAEA's Strengthened Safeguards System and the verification systems operated by the Organization for the Prohibition of Chemical Weapons (OPCW) and the Provisional Technical Secretariat of the Comprehensive Nuclear-Test-Ban Organization—are relatively new. Nonetheless, the IAEA's experience in operating nuclear safeguards does offer some insights into prospects for sustaining a verification regime. The nuclear safeguards system is not only the international verification regime of longest duration, but is also the most pertinent to this subject since it deals with the non-possession and non-acquisition of nuclear weapons by certain states.[1] The IAEA also has had experience in verifying actual nuclear disarmament in the cases of Iraq, Belarus, Kazakhstan, South Africa and Ukraine, and with the tricky cases of non-compliance with the Nuclear Non-Proliferation Treaty (NPT) by Iraq and North Korea.

Other examples of the long-term implementation of agreements in the fields of arms control and disarmament, the environment and peacekeeping are also pertinent. This is particularly so if the stakes involved in such arrangements are high—if their breakdown risks human security on a large scale—or if verification or monitoring mechanisms have been so far successfully sustained over a long period.

[1] The IAEA's 1957 Statute authorises it 'to establish and administer safeguards designed to ensure that special fissionable and other materials made available by the Agency should not be used in such a way as to further any military purpose'. Its safeguards responsibilities were significantly enhanced when it became the body responsible for verifying compliance with the 1968 Nuclear Non-Proliferation Treaty.

2. Potential Long-Term Challenges and Responses

This section of the paper considers the potential long-term challenges to a nuclear disarmament verification system and the responses that might meet such challenges. Part 3 of this report will consider the need for adequate resources for the long-term maintenance of such a verification system.

Declining Political Attention

When an international agreement is negotiated and its verification regime established, much attention is paid to it internationally and nationally, by governments, NGOs and the media. However, as attention moves naturally on to other issues there is a risk that the political energy invested by states in an international verification organisation will wane. Diplomatic representatives and advisers appointed by states to attend meetings of states parties or the executive body of the verification organisation may be of a lower rank or calibre than required or they may have inappropriate qualifications. Some states may choose to be unrepresented. This is particularly likely in the case of developing countries with small diplomatic services and limited specialist expertise. One criticism of locating the (OPCW in the Hague is that the bilateral diplomatic missions there are mostly ill-equipped to give expert and sustained attention to chemical weapons issues.

It may be left to a small group of specialists, notably those employed by the verification agency and those in a minority of states parties, in addition to specialist NGOs, to maintain and sustain interest in the treaty and its verification system. It is only they who could be expected to detect weaknesses in the system and alert the international community to the need for action. Weaknesses in a verification system may of course have been known from the outset. The system may have been the best obtainable outcome of a lengthy and tortuous negotiating process. Other flaws may, however, only become clear after the system is established.

A common reaction to evidence of seemingly minor flaws is the claim by the verification organisation and by states parties that the regime works well enough. This complacency may be due to a number of factors, including: inertia; distraction by other international issues; financial concerns; beliefs (rightly or wrongly) that other parties do not have the will to make the necessary changes; concerns about damaging relations with other countries; or fear of detracting from issues considered to be a higher priority. If the rectification of flaws requires additional legal authority, and therefore substantive negotiations, there may be resistance by many states due to the perceived dangers of destroying a carefully bartered treaty by re-

opening it. The absence of a crisis may produce a false sense of security. The few who speak out may be labelled as mavericks. The impetus to rectify any significant flaws will all too often be the eventual arrival of a crisis.

This was the case for IAEA safeguards. While many of the structural and procedural deficiencies of IAEA verification were already known, it took the case of Iraq in the early 1990s to convince the Agency and its member states that if these were not rectified, the credibility of the whole non-proliferation regime and the IAEA would be jeopardised. Even so, it took more than six years to negotiate an Additional Protocol to existing safeguards agreements that broadened the mandate of the IAEA to enable it to detect covert activity more effectively.

Although it often takes a crisis to induce an organisation to rectify weaknesses, the memory of such crises may quickly fade before the appropriate action is taken. Once the Iraq and North Korea crises had been weathered, some decision-makers drew comfort from the fact that the NPT remained intact and the non-proliferation regime had coped reasonably well. Those claiming that safeguards needed overhauling were accused of exaggerating. Even as serious negotiations on the Additional Protocol began, some governments' positions already reflected memory loss about the reasons they were being undertaken. In addition, governments were subject to pressures from the nuclear industry concerning the cost and administrative burden of strengthened safeguards and the maintenance of the confidentiality of proprietary commercial information.[2]

Measures can be taken to sustain political momentum and avoid some of these pitfalls. The UN General Assembly and Security Council should set aside a significant period of time annually to receive reports from the NWFW verification organisation and hear the reactions of governments and accredited organisations, including NGOs. Particular contributions by states and others in sustaining an NWFW should be afforded regular and high-profile acknowledgement by the UN. An annual 'most transparent state' award ceremony could be organised.

Thorough and frequent review mechanisms will be imperative for sustaining the verification system in a nuclear weapon-free world. Again taking the NPT as an example, its 1995 Review and Extension Conference helped focus parties' attention on the serious flaws in the NPT verification regime that had been revealed in the five years since the previous review. Even though the programme to strengthen safeguards had not been fully implemented, the process was speeded up in the run-up to the Conference and the results reported and recorded. The commitments of

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2 Suzanna van Moyland , 'The IAEA's Programme "93+2"', *Verification Matters*, no. 10, VERTIC, Jan. 1997.

states to the programme and to assisting the IAEA in preventing further NPT violations were also placed on the record.

States also have a responsibility to keep all their relevant government departments up to date with verification requirements. This includes ensuring that departments concerned with trade and industry keep abreast of the technology and materials covered by the verification regime. Police must remain alert to any illicit activity that may compromise a state's treaty obligations and know which state authorities to notify. Customs personnel must remain well informed, trained and equipped to halt the entry or transit of technology or material if it is covert or lacks correct documentation. The multilateral verification organisation needs to hold regular workshops for customs and police. States need to ensure that these are well attended.

Operational Complacency

Although weaknesses in a verification regime may be apparent at the operational level, nothing done to rectify them. There may be an unwillingness on the part of inspectors, analysts or managers to raise potential or actual problems, either formally or informally, with higher-level management or with diplomats accredited to the verification organisation. This may be because the problem may not be judged serious enough. Alternatively, it might be judged that the political will to make the necessary changes does not exist and therefore reporting the flaws would serve no purpose.[3]

Analysts might be overwhelmed by the sheer volume of data. Advanced computer programming can help with this problem. However, over-reliance on automated analysis can lull analysts into a false sense of security. Computers only process information according to how they have been programmed and such programmes may have overlooked important aspects. Under its Strengthened Safeguards System the IAEA is preparing to handle a much broader range of information than before, for instance in relation to imports, exports and manufacture of nuclear-related equipment and materials. The IAEA has also created an open-source database. However, all databases require significant personnel resources for their maintenance. Close interaction between headquarters personnel and inspectors who

[3] A conscious decision to let some aspects of verification atrophy because circumstances have changed may also arise. For example, in Ukraine, portal monitoring at a missile manufacture site, which is part of the verification arrangements for the Intermediate-Range Nuclear Forces Agreement, has ended because it is judged that Ukraine no longer has the capacity to manufacture such missiles. In such cases, however, continued vigilance may be warranted because that capacity could change. Decommissioned nuclear facilities or locations that have been used in the past to manufacture nuclear-related technology are two areas relevant to NWFW verification where periodic review of their status would be important.

use such databases is needed so that their utility is sustained.[4] The IAEA has also developed software models of nuclear weapon acquisition 'pathways'. One reason why the clandestine Iraqi nuclear programme remained undetected for so long was that it used an old, laborious uranium enrichment technique that few would have considered an obvious or viable alternative in the 1980s. In conceptualising such pathways there must be awareness of both new and old processes.

The failure of the US to detect Indian preparations for conducting nuclear tests in 1997 has been attributed to the lulling effect of repeated Indian assurances that India would do nothing 'precipitous' while its new government was undertaking its security review.[5] As a result, the necessary support and resources were not forthcoming to permit timely detection.

It is a well known organisational phenomenon that complacency can set in amid the comfort of routine. At the inspectorate level, it is easy for complacency and boredom to occur if nothing appears to be happening for prolonged periods. Repetitive tasks such as checking seals, measuring instruments and cameras can be a natural breeding ground for complacency. There are, however, many ways of reducing the impact of these problems. Inspectors can be rotated more frequently, so they are better placed to spot changes (although this has the disadvantage of reducing any one individual's familiarity with particular facilities and locations). Some inspectors may be better suited to methodical, routine verification tasks, while others who are naturally inquisitive and probing might be better at ad hoc, short-notice, expanded access or challenge inspection tasks involving potentially awkward situations.

Training is clearly an important element in maintaining the proficiency and alertness of inspectors. Exercises that simulate cheating can also be useful in encouraging inspectors and analysts to be creative. Known as 'red-teaming' in the US, a groups of inspector tries to devise evasion scenarios which another group attempts to frustrate. Ironically, too much red-teaming could disseminate knowledge about how to cheat. Any such simulation exercises must therefore be carefully considered.

The involvement of experts from other verification organisations, the military and the scientific community would also be useful in developing training exercises for inspectors. They could provide valuable insights into their experiences and approaches in the areas of technology, analysis and on-sight inspections.

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[4] Suzanna van Moyland, 'Human Factors', presentation at IAEA seminar 'Safeguards: Sources and Applications of Open Source Information', Vienna International Centre, Vienna, 17 September 1997.

'Inspector of the Year' awards would contribute to the morale and status of inspectors as well as raising the profile of verification among citizens, governments and institutions world-wide.

Disregarding Non-Compliance

One of the greatest risks to a verification system occurs when minor instances of non-compliance are disregarded. There are a number reasons why this may occur. Information about a potential or actual violation might have been obtained by covert means. If the means were espionage, for example, any action taken might reveal the identity and location of agents, risking their security and jeopardising the possibility of obtaining further information. If advanced scientific or technical means not in the public domain were used, this could also present problems. A country that has evidence from high-resolution aerial or satellite imagery might not wish to reveal how good their capabilities are. It is often many years before national technical means are made available to international organisations. For example, while nuclear weapon states (NWS) had long developed advanced sampling techniques for analysing radionuclides for their own purposes, these were only made available to the IAEA in 1992.

Another potential problem may occur when non-compliance is judged, either for political or technical reasons, not significant enough to warrant raising politically. Such decisions might be taken at a number of levels, including by an inspector, an inspection team, a national government or a multilateral organisation.

An example is that of Romania. In 1992, three years after the overthrow of the Ceaucescu regime, the new Romanian government requested the IAEA to undertake a special inspection of its nuclear facilities. Following the inspection IAEA Director General Hans Blix reported to the IAEA Board of Governors the discovery that in December 1985 Romania had violated its safeguards agreement by separating about 100 milligrams of plutonium from irradiated uranium. It was subsequently reported that the Agency had been aware of the clandestine activity all along.[6] There are several possible reasons why the violation was ignored: the difficulty of revealing the source of the incriminating information; the assumption that the violation was unintentional or 'technical'; or the assumption that the amount of fissionable material was too small to be useful in producing a nuclear weapon. Alternatively, there is also a possibility that Romania was informally told

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5 *Time*, 25 May 1998.

6 Leonard S. Spector, Mark G. McDonough with Evan S. Medeiros, *Tracking Nuclear Proliferation*, Carnegie Endowment , New York, 1995, p. 83.

that its activity had been detected and warned that further non-compliance would result in overt action by the IAEA.

There are obvious risks in an international verification agency concealing non-compliance, for whatever reason. The deliberately non-compliant state might be encouraged to cheat further. If other governments suspect or learn of cheating by others they might also be encouraged to cheat. Discriminate treatment, whereby some countries are called to account for non-compliance while others are not, would create resentment. The verification regime's legitimacy would thus be eroded. At the operational level, a failure to deal with incidents of suspected non-compliance would eventually have a demoralising effect on the verification fraternity.

Leaking of Commercial Proprietary and Security-Related Information

Any intrusive verification regime is potentially susceptible to employees discovering and leaking commercially sensitive information, like new reactor designs or manufacturing processes. Frequent leaks could corrode the verification regime. Industrial sectors might respond by being more reluctant to host adequate inspections. Preventing such an incidents would be in the interests of both the verifying organisation and those being verified.

Managed access techniques to protect proprietary commercial and security-related information, such as shrouding sensitive equipment and turning off computer screens, are already commonplace verification procedures. However, they should continue to be refined. Industry must continue to be closely involved in order to sustain confidence in their use. New nuclear facility operators, for instance, must be made thoroughly aware of their right to use managed access techniques as well as of their obligations to the verification organisation. Research into and communication of ideas about how commercial confidentiality can be protected must continue. As on-site inspectors assume increasing responsibility, their profession will be expected to develop codes of conduct regarding protection of confidentiality. An individual caught making such disclosures would presumably be subject to the appropriate penalties.

3. Provision of Adequate Resources

It is critical that the international verification organisation be afforded adequate resources to carry out its mandate.

Financial Resources

The effects of under-funding on a verification organisation could pose a considerable risk to international security in an NWFW. Monitoring equipment, computer databases and laboratories for analysing samples could fall into disrepair. Advances and improvements in technology could remain unexploited. Lower salaries could discourage better quality personnel from joining or remaining at the organisation. This would be a particularly dangerous outcome, as the most important resources in verification are human ones.

Tight budgets can also result in travel limitations which reduce the number of inspections made or the rotation of inspectors, as well as limiting the amount of time inspectors are able to spend at headquarters. Such visits are crucial in enabling them to be de-briefed; report suspicious events and patterns; attend training and language courses; interact with other inspectors and other personnel; and use and provide information for databases.

Maintaining adequate financial resources is a challenge for most international verification organisations. Once an agreement is negotiated and a verification system established, competition for limited resources arises from other international and domestic priorities. Payment of financial dues may be late or non-existent.

IAEA funding provides a good example of how, over time, states may become more resistant to providing the funding necessary for an organisation to perform its duties. Since the 1980s there has been zero real growth in the IAEA's core funding. This is despite a massive increase in the number of facilities and nuclear material (civil and ex-military) that it is obliged to safeguard. While accepting the need for better verification through the Agency's Strengthened Safeguards System, states were largely unprepared to pay for it. Indeed the IAEA felt under so much pressure over its budget that it pledged, as an incentive for states to agree to the new system, that it would be cost-neutral in the medium to long term.

The UN Military Observer Group in India and Pakistan (UNMOGIP), is a good example of an organisation in an area of high tension which should be of great importance to regional and international security but which has been inadequately resourced and left to drift. UNMOGIP was established in 1949 to monitor the sensitive and disputed border area of Jammu and Kashmir. By 1997, however, the

mission had only 45 Military Observers to observe the entire 'Line of Control' between India and Pakistan.

Yet underfunding occurs not only when an international structure has been in place for a while. Despite its current high profile, the OPCW, established in 1997, already has funding problems, exacerbated by the fact that it is now responsible for verifying the destruction of Russian and US stockpiles. Moreover, many states currently advocate zero growth in funding for the Provisional Technical Secretariat of the CTBTO, even though it is apparent that the large start-up costs of technology and training which are necessary for establishing the verification system will not be necessary in future years.

Even under normal circumstances international organisations are financially dependent on the assessed contributions of the wealthiest states, mostly from the Western and Others Group (WEOG). Increasingly, however, they are forced to rely on voluntary funding from the same states to make up the shortfall in assessed contributions. The danger is that these organisations' impartiality will be jeopardised. It would, however, be impossible to require states to contribute equal amounts to the upkeep of a nuclear verification system. Given vastly differing financial contributions from states parties it would be essential for other mechanisms to be in place to maintain the impartiality of the verification organisation at all levels.

Human Resources

The political credibility of an international verification organisation for an NWFW will depend on its staff being geographically representative. This will be particularly important in the inspectorate and in those areas dealing with information analysis. When inspections are being planned it is important that the agency can choose from a wide range of inspectors, especially if states have the right to refuse inspectors from certain countries, as is currently the case in many verification regimes.

The problem of an organisation having too many inspectors from the same country was illustrated in late 1997 when UNSCOM, the UN Special Commission for Iraq, was refused access to so-called presidential sites on the grounds that the vast majority of inspectors were from the US, with some from the UK. While this may or may not have been the real reason for Iraq's actions, it provided an excuse that would have had less credibility had the inspection teams been more multinational. UNSCOM had, however, had genuine difficulty in obtaining personnel with

expertise in the fields of nuclear, chemical and biological weapons from a broader spectrum of countries.[7]

The problem is likely to persist even by the time a nuclear disarmament regime is being established. First, personnel from some states will continue to have more experience in verification than those from other states, especially in conducting on-site inspections. This will put them at an advantage in any recruitment process. Second, although it is hard to judge which countries will in future develop, maintain or abandon civil nuclear energy programmes, in a nuclear weapon-free world it is likely that nuclear expertise will continue to vary between countries. Finally, in an NWFW there will be continuing inequality of expertise between states which developed nuclear weapons and those which did not.

The dilemma for an international organisation trying to recruit a geographically balanced staff is that this can often only truly be achieved by lowering entry standards, which in turn risks lowering the quality of its inspectorate.

Another, more delicate issue in relation to the trade-off between a meritocratic system and balanced state representation is the question of how much control states exercise over their nationals who are employed in international organisations. The pool of expert verifiers in an NWFW needs to be large enough to ensure that if problematic national biases emerge, experts from alternative countries can replace them.

An obvious way out of these dilemmas is through training. National and international training programmes would help ensure a growing pool of potential inspectors to choose from in all countries.

It is also important that governments ensure that national authorities designated to deal with the multilateral disarmament organisation in an NWFW are clearly identified and employ skilled personnel who are able to co-ordinate reports and who are knowledgeable about inspection requirements. Such personnel need to be able to work with industry and government departments. It is important that they be given the resources to fulfil their function effectively.

Technical Resources

In order to sustain an NWFW it will be important that verification technologies and methodologies keep pace with, or better still, outstrip, technologies that might aid cheating. Technical means of verification are controlled by many types of

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7 See Tim Trevan, *Saddam's Secrets: The Hunt for Iraq's Hidden Weapons*, Harper Collins, London, 1999.

organisation: governments; regional groups of states; international agencies; and non-governmental organisations.

National Technical Means are routinely used to verify the bilateral US/Russia nuclear arms control agreements. The INF agreement, for example, explicitly permits the use of and forbids interference with such NTM, namely satellites. Moreover, the parties are obliged to slide the roofs off road-mobile, ground-based ballistic missiles at operating bases so that such satellites can check that no illicit changes have been made. In verifying the multilateral CTBT, NTM can be used as evidence for triggering an on-site inspection request. In the case of North Korea, the US provided military satellite images and previously secret environmental sampling techniques to the IAEA, leading the Agency to request a special inspection of North Korean facilities. Both types of information and techniques were also used in the case of Iraq. There the United States loaned a U-2 'spy' plane to UNSCOM to permit it to conduct aerial monitoring of the country. It is inconceivable that an NWFW verification system would not be free to receive similarly vital information and technologies from national (or regional) intelligence agencies.

In a multilateral regime the use of information from the NTM of one country or a very small number of countries could erode confidence in the system. Misinformation or disinformation would be possible. Major information supplier states would need to be kept under scrutiny. One would imagine, however, that by the time an NWFW was achieved many more states and regional groups than at present would have NTM capacities, especially satellites. Healthy competition could help prevent abuses.

The credibility of a verification organisation could also be eroded if it knowingly supplied sensitive information to national intelligence agencies, as was apparently the case with UNSCOM. Such agencies would have to recognise that providing information to an international verification organisation needs to be strictly one-way.

The powerful deterrent and confidence-building value of technical capabilities may be advantageously combined with trans-national, co-operative research and healthy competition among scientists and engineers. These programmes may be supported by the international verification organisation and by governments. Those involved may be from the verification organisation itself, or from universities, other research institutes or industry. Technical and scientific developments are likely to include, for example, better detection equipment at customs and more precise wider-area environmental sampling techniques. Adequate national and international funding for research and development (R&D) will remain important; R&D in these areas cannot be allowed to lapse once a verification system is operating.

The IAEA has long been engaged in co-operative R&D to advance the science and technology of verifying non-diversion of nuclear material. Areas of focus range from recommended specifications for reactors so that diversions can be more quickly and easily spotted to computer software which can rapidly search imagery from digital cameras to pinpoint movement—such as the entry into a room by a person. More recent examples of advances in nuclear safeguarding techniques include remote sensors for measuring uranium enrichment levels in centrifuges.

Another promising example is the technique known either as environmental monitoring or high-performance trace analysis (HPTA). Minuscule traces of nuclear material inevitably migrate beyond the immediate environment where such material is being processed. The particles' radioactivity makes them easy to detect and they have isotopic signatures that identify them with specific nuclear operations, such as reprocessing, enrichment, fuel fabrication or reactor operations. This technique, which constitutes an important element of the IAEA Strengthened Safeguards Programme, enhances the Agency's ability to detect clandestine activity both at declared and undeclared locations. It would be an important element of verification in an NWFW.[8] While this technique was developed by nuclear weapon states, it was not in the public domain until recently and was therefore not available to international organisations. In 1992 the IAEA was able to use evidence from such sampling with regard to Iraq and North Korea. By 1996, with assistance from member states, particularly the US, the IAEA had built a 'clean' laboratory to conduct its own bulk sampling and developed an international network of laboratories able to conduct more specific, particulate sampling. The network includes NNWS, such as Japan, and members of EURATOM. This is an excellent example of both international co-operation in science and technology and of effective capacity-building for an international verification organisation. The products are more credible, fair and legitimate evidence of compliance or non-compliance than if drawn solely from national intelligence sources.

Other regional structures exist that use an array of verification technologies. For instance, the European Space Agency (ESA) uses satellite imagery to aid in detection of false claims to agricultural subsidies under the European Union's Common Agricultural Policy. Again, it is likely that by the time an NWFW is realised more technology resources will be pooled multilaterally, in addition to being available commercially.

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[8] For detail on environmental monitoring see D.L. Donohue and R. Zeisler, 'Behind the Scenes: Scientific Analysis of Samples from Nuclear Inspections in Iraq', *IAEA Bulletin*, no. 1, 1992 and US Congress, Office of Technology Assessment, 'Environmental Monitoring for Nuclear

One can also envisage close future co-operation and information-sharing between all multilateral organisations engaged in verifying agreements on weapons of mass destruction (WMD) because it is likely that in an NWFW it would be a requirement that all states become parties to all such agreements. While WMD agencies would be verifying compliance with different treaties, they could share certain resources which could save time and costs. In the meantime, a small UN agency could be charged with seeking, on a voluntary basis, efficiencies and synergies among the burgeoning but separate verification regimes.[9] Already the Preparatory Commission for the CTBTO and the IAEA are exploring ways in which the IAEA might utilise the CTBTO's radionuclide monitoring facilities for nuclear safeguards and environmental purposes.

Many techniques, such as satellite or aerial imagery and environmental sampling, would, in an NWFW, be widely available to NGOs and academic institutions. In the past both types of organisation have contributed to the evolution of verification. VERTIC's work in the early 1990s on detecting Chinese nuclear tests is an example. In co-operation with University College London, VERTIC analysed commercially-available satellite imagery of test preparations at the Lop Nor test site. It also collated and analysed seismic data from open web sites with support from the Geophysics Department at Leeds University. VERTIC's early detection of Chinese test preparations demonstrated that it was not necessary to be a wealthy state with large intelligence-gathering mechanisms to obtain a degree of assurance about state compliance with a nuclear test ban treaty. The role of the US-based Natural Resources Defense Council (NRDC) in facilitating monitoring of compliance with the Threshold Test Ban Treaty (TTBT) at the height of official US-Soviet suspicion over verification is another example. Research by academics and NGOs could prompt further investigation by the international verification organisation or be used directly to reinforce existing information sources.

Safeguards', OTA-BP-ISS-168, US Government Printing Office, Washington, DC, September 1995.

9 Trevor Findlay, 'Verification Regimes: Commonality, Difference and Synergy' in European Safeguards Research and Development Agency (ESARDA), *Proceedings, Seminar on Modern Verification Regimes: Similarities, Synergies and Challenges', Helsinki, 12-14 May 1998*, Office for Official Publications of the European Communities, Luxembourg, 1999, pp. 93-102.

4. Societal Verification: A Verification 'Force Multiplier'

In an NWFW there is likely to be great hostility within domestic and international communities alike to the re-emergence of nuclear weapons.[10] Information from citizens outside the multilateral verification organisation and government will be an important element of global verification. The illicit production of nuclear weapon would require infrastructure and personnel on a scale that would make the activity vulnerable to detection by ordinary citizens. The scientific community, residents in the vicinity of suspect sites, industry, journalists, and non-governmental organisations could contribute to the likelihood of detection. Individual scientists and scientific associations could be tasked to monitor scientific activity for signs of clandestine R&D activity. A free and investigative press, including one that reports both positive and negative developments, would also be essential. The verification agency should make it known that it would welcome any information on a potential violation of the international prohibition on nuclear weapons.

There is nothing new about 'information from outside' being used in law enforcement. In the case of national law enforcement, virtually all police action against burglary depends on 'information received'. It is also likely that, as in the cases of the CTBT and CWC, a nuclear disarmament treaty would require states parties to incorporate its provisions into national law, making an infringement a national criminal offence.

Examples are numerous of citizens uncovering wrong-doing. Vladimir Orlov, founder of the Centre for Policy Studies in Russia, traced Inter-Continental Ballistic Missile (ICBM) components shipped from Moscow to Iraq in 1995, in violation of the international embargo on the export of military equipment to Iraq. Also, work by UNSCOM and the IAEA in dismantling Iraq's weapons of mass destruction programmes has depended substantially on information and documentation from Iraqi defectors. The Iraqi case highlighted the need for the scientific community to be aware of the potential for foreign students to misuse the knowledge and skills acquired.

Groups which may be particularly useful in societal verification need to be actively encouraged and resourced. Potential 'whistle-blowers' should be made aware that support, funding and, if necessary, protection are available if they were to inform

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10 Much of this section on citizens verification is drawn from a working paper, 'Societal Verification, or Citizens' Reporting' by Frank Blackaby, presented at VERTIC's Workshop on Verifying Nuclear Disarmament, London, 15 May 1998. See also Joseph Rotblat, 'Societal

the international community of clandestine activity.[11] Perhaps a system of rewards could also be instituted. Encouraging societal verification would be a highly economical way of increasing the power of verification.

Verification' in Jack Steinberger, Bhalchandra Udgaonkar and Joseph Rotblat (eds), *A Nuclear-Weapon-Free World: Desirable? Feasible?*, Westview, Boulder, CO, 1993, pp. 103-118.

11 The International Network of Engineers and Scientists (INES) is an international NGO that has established a small fund to assist scientists and engineers who lose their jobs as a result of revealing employer wrong-doing. In the United States the Government Accountability Project (GAP) provides legal and advocacy assistance to concerned citizens who witness dangerous, illegal or environmentally unsound practices in their workplaces and communities and who choose to 'blow the whistle'. See GAP newsletter, 'Bridging the Gap' at www.whistleblower.org/gap/

5. Conclusion

By the time a NWFW is achieved, there will be far greater experience in sustaining complex verification systems for weapons of mass destruction, as well as in other security-related areas. However, even now it is possible to identify many ways that momentum can be sustained so that the verification regime in a nuclear-weapon free world can remain effective and efficient, providing the earliest possible warning of non-compliance and hence providing reassurance to all parties. It is important that the international capacity for constructing such a system be nurtured now in preparation for the day when complete nuclear disarmament becomes a political and practical reality.

About the Author

Suzanna van Moyland has a BA(Hons) in Politics and Philosophy and an MA in International Relations, both from the University of East Anglia. She was Assistant Director, then Acting Director of the Council for Arms Control at the Centre for Defence Studies, King's College London in 1993. From 1994 to 1998 she was Arms Control and Disarmament Researcher at VERTIC. She is currently writing her doctoral thesis on 'International Organisations and Preventive Action in FYR Macedonia' at the Department of War Studies, King's College London.

About VERTIC

VERTIC, the Verification Research, Training and Information Centre, was established in 1986 as the Verification Technology Information Centre. It is an independent, non-profit, non-governmental organisation. Its mission is to promote effective and efficient verification as a means of ensuring confidence in the implementation of treaties or other agreements which have international or national security implications. Along with verification, VERTIC also concerns itself with the negotiation, monitoring and implementation of such agreements and the establishment of confidence-building measures to bolster them.

VERTIC aims to achieve its mission by means of:

- research
- training
- dissemination of information, and
- interaction with the relevant political, diplomatic, technical, scientific and non-governmental communities.

VERTIC's 'clients' are policy-makers, the media, legislators, academics, students and others needing reliable information on and analysis of verification and monitoring issues.

What are VERTIC's research priorities?

While maintaining a watching brief on all aspects of verification and related issues, VERTIC specialises in the following three broad areas.

Peace and Security, including verification and monitoring of international and intra-national peace accords by means of peacekeeping operations and their strengthening through civilian confidence-building measures.

VERTIC's current projects in this area include verification of the decommissioning of weapons in Northern Ireland and the Kosovo Verification Mission.

Arms Control and Disarmament, including the verification of international conventions on nuclear non-proliferation, nuclear disarmament, nuclear testing, chemical and biological weapons and conventional weapons.

VERTIC's current projects in this area are on:

- the implementation and verification of the Comprehensive Test Ban Treaty (CTBT)
- verification of the transition to a nuclear weapon-free world ('Getting to Zero')

- verification of the Landmine Ban Treaty (Ottawa Convention).

The Environment.

VERTIC's current project in this area is on the implementation and verification of the Climate Change Convention and its Kyoto Protocol.

How does VERTIC operate?

VERTIC is based in central London, governed by a Board of Directors and advised by an International Verification Consultants Network.

VERTIC is mostly funded by philanthropic trusts and foundations, currently the Ford Foundation, the John Merck Fund, the Ploughshares Fund, the Rockefeller Family Philanthropic Offices, the Joseph Rowntree Charitable Trust, the John D. and Catherine T. MacArthur Foundation and the W. Alton Jones Foundation. VERTIC also accepts commissions from governments and other organisations.

What are VERTIC's activities?

VERTIC holds its own seminars, workshops and conferences and participates in those organised by other organisations worldwide.

VERTIC's staff publish widely in the general and specialist press, academic journals and books.

VERTIC has its own publications: a newsletter, *Trust & Verify;* a *Verification Yearbook*; a *Verification Organisations Directory*; and *VERTIC Research Reports* and *Briefing Papers*.

VERTIC is often the first port of call for media representatives seeking information on and analysis of verification issues.

VERTIC also has an intern programme.

VERTIC cooperates closely with United Nations bodies, other international organisations, universities, research centres, governments and non-governmental organisations. It has consultative (roster) status with the UN's Economic and Social Council (ECOSOC).

What are VERTIC's publications?

Trust and Verify

Published six times a year, providing analysis and news of verification developments and information on VERTIC's activities. Annual subscriptions for a paper copy are £15 (individual) or £25 (organisation). *Trust & Verify* can also be received via email on request. Each issue may be found at VERTIC's website shortly after publication.

Verification Yearbook

Beginning with 1991, each edition surveys the preceding year's developments in verification and related areas; identifies problems still in need of solution; and draws attention to under-explored possibilities. The 1997 *Yearbook* and copies of most previous editions are available from VERTIC. VERTIC is currently planning a Year 2000 Yearbook.

VERTIC Research Reports and Briefing Papers

These are published on an *ad hoc* basis and cover a range of verification issues.

Verification Organisations Directory

VERTIC annually publishes a directory of all organisations involved in verifying or monitoring arms control and disarmament agreements or which conduct research into verification and monitoring. International, regional, national and non-governmental organisations will be included. The inaugural 1999 edition is now available.

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