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A Conceptual Framework for Verifying the Multinational Chemical Weapons Convention

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A Conceptual Framework for Verifying the Multinational Chemical Weapons Convention*

Kenneth E. Apt

I. INTRODUCTION

The United States has for several years sought an effective, global ban on the production, possession, and use of chemical weapons (CW). In 1984, then-Vice President Bush submitted to the ongoing Conference on Disarmament in Geneva a draft comprehensive Chemical Weapons Convention (CWC); since then, he has supported the multinational process for CWC implementation. Given the high visibility of a CW treaty, policy makers face some major questions. Is such a treaty more valuable to national security than a chemical deterrent capability? How useful will the treaty be if key nations or geographical regions are not covered? What constitutes an effective CWC verification regime, and can the objectives of this regime be achieved? How would signatories respond to noncompliance by other signatories? The answers to such questions will be important in determining the level of support, both nationally and internationally, for the multinational CWC.

In addressing the issue of effective verification, it is important to consider how the CWC objectives devolve into general requirements for the verification regime. Translating these requirements into specific monitoring and inspection activities helps in understanding the extent and limitations of effective CWC verification.

II. MULTINATIONAL CWC VERIFICATION OBJECTIVES AND REQUIREMENTS

The general objectives of the multinational CWC[1] are to prohibit the production, acquisition, possession, and transfer of chemical weapons, as well as any belligerent use of such arms. The CWC prohibits states parties from inducing any other nation to violate the terms of the agreement and from making preparations for CW use themselves. Parties could legitimately engage in numerous CW-related activities in industry, agriculture, research, medicine, and law enforcement; and they could have a single, small-scale CW production facility for purely defensive purposes. However, CW-armed states would destroy their CW arsenals and production facilities over a 10-year period after the CWC enters into force.

The United States and the Soviet Union have entered into bilateral agreements on CW reductions in advance of the multinational treaty. The bilateral reduction agreement signed in June 1990 calls for destruction of all but 5000 aggregate agent tons (metric) of CW for each nation by the end of the year 2002. The reserve stocks for each nation will be reduced to 500 agent tons by the end of the eighth year after the CWC enters into force. But at that time, complete CW disarmament by the United States and the Soviet Union will depend on the results of a conference of CWC states parties to determine the breadth of CWC coverage. Also under the June agreement, both nations agreed to cease all CW production (including production within the US binary-munition modernization program) and to cooperate in developing methods and technologies for CW destruction. Inspection provisions, to be established later, will concentrate on confirming the quantities and types of CW stockpiled, monitoring the destruction of CW stocks, ensuring that production is not resumed, and confirming that CW are not being held at former CW storage facilities.

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The CWC, unlike previous agreements to reduce or eliminate chemical and biological weapons, provides for compliance monitoring through an extensive multinational verification regime of accounting and inspection. In principle, the verification regime will provide assurance to member states that other member states are adhering to the tenets of the agreement.

Effective verification of the CWC is the key phrase over which various policy and security views often differ. Because the measures of effectiveness in CWC verification have not been specified, however, verification effectiveness remains highly subjective and open to larger polemics. At the very least, the effectiveness of a verification system must be measured by how well it *detects* violations or other noncompliant actions. Further, a verification regime that can detect noncompliant actions presumably can simultaneously *deter* signatories from violation.

Effective treaty verification must be distinguished from effective monitoring. Verification encompasses a wider range of activities than does monitoring. Monitoring is simply the technical basis for verification, whereas treaty verification involves establishing specific treaty requirements derived from the objectives of the agreement, monitoring or otherwise confirming those requirements, analyzing information obtained through monitoring and inspection, and, finally, assessing compliance. Responding to possible noncompliance is yet another dimension but is subsequent to, not part of, verification. Ultimately, treaty verification is a political process, whereas monitoring is a technical exercise.

The question of effectiveness in verification can be approached by breaking down treaty objectives into component requirements and then assessing each requirement individually and collectively. The verification requirements of the CWC fall into one of two general categories: (1) requirements associated with treaty-related activities and locations declared by member nations and (2) requirements related to possible surreptitious activities and capabilities of member nations outside their system of declarations.

Treaty verification requirements related to declared activities include

- confirming legitimate, treaty-allowed activities, such as industrial production;
- confirming destruction of declared CW stockpiles and production facilities; and
- detecting clandestine, proscribed activities *within* the declared systems of treaty signatories, e.g., production of CW agent at a declared industrial facility and diversion or substitution of declared CW stockpile items.

Regarding verification outside the system of declarations, several treaty requirements emerge:

- addressing possible clandestine CW stocks and production capability not originally declared by signatories;
- detecting clandestine, proscribed activities at facilities or sites that are not declared, and hence not subject to routine inspection; and
- investigating and evaluating allegations of belligerent use of CW.

By assessing the ability of the multinational CWC to detect noncompliance actions for these verification requirements *in toto*, one can gain a measure of overall verification effectiveness of the treaty.

Of additional concern to national security, although not specifically to treaty verification, is the problem of possible CW production and use by nonsignatories. If certain nations do not sign the CWC or if the treaty does not enter into force because of an insufficient number of signatories, security concerns that might have been assuaged, in part, by the CWC verification regime will have to be addressed through intelligence measures and perhaps through defense preparedness.

III. CRAFTING A TECHNICAL VERIFICATION REGIME FOR THE CWC

The effectiveness of a treaty verification regime rests on the judicious allocation of monitoring and inspection resources. In gen-

eral, verification effectiveness is related to the level of resources applied to the problem; however, other factors, such as inspection access, are equally important. In crafting a CWC verification regime, the treaty verification requirements are translated into specific inspection and monitoring activities that address those requirements. Once the verification regime is operating, its overall performance in meeting the requirements is assessed. The results are used to implement modifications, thereby improving the performance of the regime. Although the design of an effective CWC verification regime involves these very simple principles, translating principle into practice may prove difficult.

Closely related to verification requirements for a treaty is the issue of material breach, normally defined as a significant violation of a provision that is essential in accomplishing the purpose of the treaty. Identifying a material breach of the CWC, particularly one involving the intentions of a nation, could be quite subjective. Certain actions, such as the belligerent use of a proscribed CW agent, undoubtedly constitute a material breach by violating a central purpose of the treaty. But as demonstrated in the Gulf war between Iran and Iraq, as well as conflicts in Angola, Afghanistan, Laos, and Cambodia, conclusive evidence of belligerent use is not easily obtained. For other treaty objectives, such as the requirement that signatories not induce another nation to violate the terms of the treaty, the determination of a material breach might be far more ambiguous.

For the CWC objective outlawing possession, production, or diversion of treaty-limited material, the magnitude of the discrepancy (for example, the quantity of material and/or its CW utility) combined with the intentions of the suspect party would be important in determining whether a discrepancy constitutes a material breach. Not all noncompliant actions, even those appropriately confirmed, would necessarily be considered material breaches of the treaty. Although possession or production of even one kilogram of a proscribed agent (outside the legitimate, declared activities of a member nation) might represent a technical violation, anomalies of this magnitude could result from material accounting errors. In such cases, a finding of material breach would have to be based primarily on the perceived intentions of the noncompliant party rather than on the military or security significance of the material in question. However, other discrepancies, in which the quantities of proscribed material are large, e.g., hundreds to thousands of tons, would be much harder to justify on the basis of technical or accounting errors and might be considered *prima facie* evidence of material breach.

For the foregoing reasons, *quantity* of treaty-limited material will be one of several important criteria used in designing an effective CWC verification regime and in assessing compliance. Amounts of material considered significant from a security standpoint will have to be established. Verification detection goals for observing violations involving these significant amounts will then have to be set. These detection goals might be different from significant amounts, which are related to military or tactical significance.* and they might vary for agents of different physiological effectiveness or for materials of widely differing convertibility to agent. They are simply those quantities of treaty-limited chemicals the diversion or production of which must be detected by the regime. Compliance monitoring and inspection activities would be designed around the detection goals.

For the verification requirements associated with production or possession of proscribed

*Militarily significant amounts of CW might vary greatly, depending on the perceptions and intentions of the user. In a conventional East-West conflict involving the Soviet Union, the United States, and their allies, CW would be used (if at all) as tactical weapons, potentially advantageous in impeding maneuverability, disrupting command and control, degrading soldier performance, and denying access to areas such as airfields. The quantities needed for such deployment are well codified in military field manuals. Third World nations, however, tend to view CW as weapons of mass destruction usable for strategic attack against the civilian populations of adversaries. The quantities needed for this horrific usage are not easily quantified

material, the quantities specified in the detection goals could not, realistically, be in the kilogram range because of the general inability to reliably detect small, surreptitious quantities of material. In fact, the *detection* of a hidden CW agent is a far greater technical challenge than is the *identification* of such material. Therefore, realistic detection goals would specify larger amounts of treaty-limited materials for purposes of compliance monitoring. If the monitoring system identified an anomaly in quantity comparable to the amount specified in the detection goal, policy makers would have a strong technical basis needed to conclude that a violation had occurred. Furthermore, because the quantity specified by the detection goal would have a certain probability of being detected, a demonstrated capability for such detection would give some quantitative measure of monitoring effectiveness.

At present, militarily significant amounts and subsequent quantities for detection goals of the CWC monitoring system are difficult to estimate. Amounts between 2% and 20% of current US CW stocks might be militarily significant. These amounts have been targeted by the Bush administration in bilateral US-Soviet CW reduction agreements, and they are apparently considered to be significant in a security context. Widely published, yet unofficial, estimates place the US CW stockpile at 25,000 agent tons (metric); therefore, 2% would be 500 tons. By comparison, approximately 500 tons of Sarin nerve agent would be needed to obtain a casualty rate of 50% over an area about twice the size of the District of Columbia. Also, 500 tons is approximately equal to Iraq's estimated annual CW agent production capacity.

Establishing detection goals for CW is more difficult than establishing such goals for nuclear materials. In the case of nuclear materials, the quantity of fissile material needed to attain a critical mass guides the definition of a significant quantity. The detection goal of 8 kg of plutonium oxide, stipulated by International Atomic Energy Agency (IAEA) safeguards under the Nuclear Nonproliferation Treaty (NPT), for instance, represents the quantity needed for a weapon of mass destruction.

For chemical agents, there is no threshold amount above which a major threat is constituted. The military and security significance of CW is more or less proportional to the total quantity amassed. And other factors, such as delivery systems, support infrastructure, and protective systems, come into play. Nevertheless, the CWC verification regime will need clearly defined detection goals, and these will no doubt be related to judgments of amounts considered to be militarily significant.

An effective CWC verification regime must also define other criteria. The *time* needed to detect the diversion or production of a goal quantity of agent is important. If the time required for clandestine production or diversion of CW is short (as might be the case for a large-capacity, Schedule 2 facility* or a declared CW stockpile), the time criterion for detection likewise should be short. Additional factors would influence the criterion of detection time. The time needed to weaponize an agent, an activity that might, for example, require blending with stabilizing or thickening chemicals to increase battlefield effectiveness, would be a consideration. Of course, the availability of delivery vehicles (munitions, launchers, missiles, and so forth) is an important consideration.

Another important verification criterion is the *probability* of detection. A specified detection probability would provide signatory nations with some quantitative measure of the effectiveness of the monitoring system and hence its value to their national security. The likelihood of detecting significant CWC violations at an inspected site or facility under the monitoring system must be established. This criterion will depend on the established detection goal quantities and detection times, the

*Chemicals covered by the CWC are sorted into three groups: Schedule 1 includes known CW agents; Schedule 2 covers precursors of agents, as well as super-toxic lethal chemicals not listed in Schedule 1; and Schedule 3 lists large-volume industrial chemicals with CW potential. The rolling text of the CWC contains some uncertainty as to the inclusion of certain key precursors (including key binary components) in Schedule 1.

types of facilities being inspected, and the inspection and monitoring resources available to do the job. The CWC verification system might have as its objective a 90% probability, as with IAEA safeguards, of detecting a violation involving a detection goal quantity. Because the probability of detection is highly dependent on available resources, the level of confidence, as a precise percentage, is difficult to determine in advance. Recall that over the last decade the IAEA has revised downward its probability for detecting fissile material goal quantities from 95% to 90% percent, even as it has increased its inspection resources.

The intelligent application of inspection efforts requires a description of the verification context. Knowledge of plant physical layout, processes and equipment, and material inventories and flows would be necessary in devising an inspection and monitoring network capable of detecting diversion or production. Inspection activities would be directed at key measurement or surveillance points, such as process lines, storage containers, entry and exit points, and records.

Credible CWC noncompliance scenarios must be defined. In the general treaty context, these include

- clandestine material production or diversion at declared industrial facilities;
- diversion and/or substitution of CW from declared stockpiles;
- production or storage of CW or other treaty-limited material at surreptitious, undeclared sites; and
- belligerent use of CW.

Only the first two scenarios apply to declared sites and activities under the CWC.

These general scenarios must be translated into individual noncompliance actions that would be specifically addressed by the inspection regime. For example, diversion of material at an industrial facility might be accompanied by falsification of inventory and process records. Process lines might be reconfigured to move material without detection. Idle reaction vessels might be put to use for proscribed synthesis. Dummy munitions might be substituted for declared stockpile items at storage facilities. The inspection effort would have to address such actions in a coherent way.

The relative importance, or weight, of these noncompliance scenarios and their component actions will dictate the best use of the undoubtedly limited inspection resources (inspectors, analyses, monitoring equipment, etc.). Further analysis will be required to determine, for instance, whether clandestine production within the declared chemical industry, diversion of CW from a declared stockpile, or establishment of a surreptitious production plant poses the greatest threat. In any case, the level of inspection effort must be allocated commensurate with the perceived importance of the threat.

To address these scenarios, the draft CWC envisions a verification system of inspections, measurements, and audits at the declared facilities of member nations. Routine, on-site inspection would include continuous or intermittent presence by inspectors, sample collection and analysis, instrumental monitoring, and records and reports auditing. Routine inspection would be augmented by any time, anywhere "challenge" inspections, currently understood to have no right of refusal. Finally, *ad hoc* reviews might be used to monitor a large number of facilities and sites without conducting cumbersome routine inspections or politically costly challenge inspections.

The inherent intrusiveness of the foregoing measures into operations and transactions of the inspected facility is not likely to be readily accepted by the chemical industry because of the risk of disclosure of proprietary information. Although the chemical industry has been an active participant in establishing the CWC, the acceptance of technical verification activities by industry, as well as by the international community, will be a limiting factor in the overall effectiveness of the verification regime.

Two conceptual extremes for monitoring the declared activities of CWC member states, which presumably will cover nearly all of the vast operations of the world chemical industry, exemplify the complexity of effective verification.

At one extreme is a comprehensive materials accountancy approach that would be used to

establish a global mass balance of all treaty-limited chemicals. Detailed reporting of transactions involving these materials, combined with on-site inspection, would confirm their production, storage, transfer, and end use. The verification criteria of timely detection of significant quantities of material with a given probability would guide the inspection effort in confirming this mass balance. The same accountancy approach also would be applied to the destruction of declared CW.

Because this approach is extremely resource intensive, it may be too expensive for the international community to adopt. It would require extensive field and laboratory equipment and a large inspectorate comprising hundreds of inspectors and substantial administrative and logistical support. The intrusiveness of such an approach might lead to disclosure of sensitive commercial information, or perhaps even compromise of national security information. In addition, such a regime would require several years to fully implement.

By comparison, the material accountancy approach as applied by the IAEA to special nuclear materials (SNM) is most strained in bulk reprocessing facilities. Unlike facilities where SNM is stored or handled as discrete items, reprocessing facilities have greater difficulty in closing a mass balance because of the chemical processing of the safeguarded material. Under the CWC, chemical facilities would be even more difficult to bring under a tight mass balance regime because of the greater variability in production parameters.

At the other extreme, CWC monitoring would involve the tightly focused objective of discovering a "smoking gun"—direct evidence of a specific violation related to the production, diversion, or possession of treaty-limited material. In this approach, a limited number of inspections would be conducted for the express purpose of taking measurements and collecting samples that would show evidence of production or possession of proscribed CW-related material. The inspections could be designed to be blind to legitimate material quantities and flows of the inspected facility so as to reduce the likelihood of compromise of proprietary information. Inspections would, of necessity, be unannounced (within general provisions) and would employ statistical sampling methods. The verification criteria of timeliness, significant quantity, and probability might still be addressed, but only to a limited extent. The approach would cover not only declared Schedule 2 and 3 facilities, but alleged use scenarios as well. If challenge or *ad hoc* inspections were permitted, this approach could address treaty verification requirements for activities outside declarations. Violations involving clandestine stockpiles or production facilities might thus be detected.

This approach to CWC verification also has serious drawbacks. First, verification effectiveness would be predicated on analytical sensitivity in detecting trace quantities of material. Because findings of anomalies and noncompliance would be based on highly technical analytical instrumentation, questions of compliance would be taken out of the policy realm and placed *de facto* in the hands of the technologist. The analytical techniques employed would have to be extremely sensitive and have very low false-alarm rates. The forensic quality of state-of-the-art analytical chemical techniques would remain a serious concern. There would be little technical basis for guiding collection forays; if inspectors looked in the wrong place, obviously they would not find evidence of violation. Consequently, the approach could be extremely fragmented, possibly leaving large segments of the system unmonitored.

Preliminary results from the CWC National Trial Inspection for Finland[4] (conducted in support of the Conference on Disarmament) suggest that this approach may provide evidence of prohibited operations even several months after an actual violation. However, much work must be done before the analytically soundness of this technique can be guaranteed for the full suite of chemicals and facility types covered under the CWC.

Neither of these extreme approaches to CWC verification is completely acceptable on its own. Elements of both may be needed to ensure some credible level of violation detection associated with declared activities and with undeclared sites. The mass balance ap-

proach may be better suited for monitoring declared CW inventories and their destruction, as well as Schedule 1 and 3 facilities. But because Schedule 3 facilities would be verified only by audits of reports and records, their material balances would not be independently confirmed through on-site inspection. The smoking-gun approach might be more appropriate in monitoring Schedule 2 facilities, where possession or production of agents would be strictly prohibited and any evidence thereof would point to violation.

Effectiveness in CWC verification is a multivariable function depending on the verification criteria of detection goal quantities, times, and probabilities; verification contexts; noncompliance scenarios; and, most important, inspection and monitoring resources available to do the job. Although the design of a technical CWC verification regime may be relatively straightforward, real-world considerations will make implementation difficult.

IV. DIFFERENCES BETWEEN THE CWC AND THE NPT

The NPT and the associated nuclear safeguards verification regime are often posed as models for the proposed CWC and its verification. Certain similarities and differences are worth exploring. Considering only monitoring of the legitimate, declared operations of the chemical industry, the CWC has *inter alia* the same general objectives as the NPT; namely, to confirm declarations of production, storage, transport, and disposition of treaty-limited material. This is, in effect, the material accountancy approach to verification. But numerous factors call into question the comparability of CWC verification with NPT safeguards in even this limited analog. The sheer complexity and magnitude of the chemical industry as compared to the nuclear power industry indicate that verification efforts for the two treaties are likely to be quite different.

A fundamental distinction is that chemical agents and their key precursors are far more mutable than is SNM, the fissile material under safeguards. Unlike SNM, chemicals are easily transformed from one compound to another: a particular compound can be a precursor to a legitimate industrial chemical or, alternatively, to a proscribed CW agent. Nuclear materials can be transformed to a limited extent, whereas chemical compounds have myriad avenues for chemical reaction, which changes their physical properties. Additionally, industrial chemical processing is much less exact than is nuclear processing; and material accountancy requirements would be far more complicated for treaty-limited chemicals than for treaty-limited nuclear materials.

Not only are chemicals readily changed from one compound to another, their quantities in world trade dwarf total quantities of SNM. Considering only Schedule 3 compounds (large-volume, industrial dual-use chemicals), millions of tons are produced and consumed annually. Hundreds of thousands of tons of Schedule 2 precursor chemicals potentially could be controlled. Monitoring and controlling world quantities of SNM, although difficult, are relatively easy compared to tracking the far larger and more dynamic world chemical trade.

As with the quantities of potentially controlled material, the number of worldwide chemical facilities is far greater than the number of nuclear facilities. Although there is no final agreement on exactly which facilities would be covered under a multinational treaty, those facilities capable of producing treaty-limited or otherwise controlled chemicals far outnumber their SNM counterparts. The US Arms Control and Disarmament Agency estimates that there are about 10,000 relevant civilian chemical plants worldwide (the aggregate of Schedule 1, 2, and 3 facilities), and some 3000 within the United States alone. The Chemical Manufacturers Association estimates that there are only a few hundred facilities that produce or use Schedule 2 chemicals, which presumably would be more heavily monitored.

Interestingly, the Soviet Union reports the aggregate of its Schedule 1, 2, and 3 facilities "exceeds 100": of these, approximately 30 facilities produce, process, or consume Schedule 2 chemicals. These figures may not be comparable with numbers of Western facilities because of the Soviet preference for consolida-

tion of related industries, differences in the Soviet economy, or completeness of their declaration.

By comparison, out of a total of about 900 sites or locations that are subject to safeguards, the IAEA routinely inspects some 500 facilities annually. Only about 45 of these facilities—the major bulk nuclear facilities—require rigorous on-site monitoring. The IAEA safeguards budget is approximately $50 million per year; therefore, given the greater number of CW sites involved, a comparable CWC inspection effort for Schedule 2 and 3 facilities alone could cost more than ten times this amount.

A further complication in comparing CWC verification with NPT verification is the disparity between detecting SNM and detecting key chemicals. The intrinsic radiations of nuclear materials provide a basis for remote detection and identification, but chemicals have no such signatures. Nuclear-radiation detection instrumentation is more mature than field detection systems for chemicals. Thus, "stand-off" chemical monitors for a smoking-gun approach to CW verification are not in hand, and sample collection techniques would have to be relied upon.

Another distinction is the dual-use nature of chemical production facilities as opposed to the dedicated, single-use nature of their nuclear counterparts. Virtually every nation that currently possesses a significant chemical industry has a *de facto* CW agent production capability. Chemical facilities can switch from legitimate production to CW agent production and back again, although with some effort. Such facilities are far less specialized than NPT facilities such as reactors, reprocessing plants, and fuel fabrication plants.

Because of these major differences between nuclear materials safeguards and chemical arms control, one must remain circumspect about the effectiveness of CWC compliance monitoring. Although the technical community stands ready to provide monitoring systems and hardware, an enormous challenge to develop and adapt technologies to CW verification remains. The costs associated with these technologies and methodologies could be much greater than the costs of other arms control verification regimes. Nevertheless, to provide policy makers with options in this difficult area of arms control, the technical community should explore all avenues that could lead to a higher confidence in CWC verification.

V. CONTROLLING CW PROLIFERATION OUTSIDE THE CWC

In an evaluation of the effectiveness of a multinational CWC, the breadth of the verification regime is as important as its depth; all CW-capable nations should be parties. The existence of individual holdouts or of entire geographic regions of nonsignatory nations could render useless even the tightest CWC verification regime. The effectiveness of the CWC in detecting violations, and thus deterring such, could be more or less irrelevant if only "friendly" nations with no interests in obtaining CW sign.

The problem of nonsignatory nations might be addressed by export controls. A number of Western nations have already established export controls aimed at CW proliferation in the Third World, specifically the Persian Gulf region. Since 1984, the so-called Australia Group, comprising about twenty industrialized Western nations, has agreed to monitor the export of some 50 key precursor chemicals that could be used in the production of CW agents. In accord with Australia Group objectives, the United States exercises foreign-policy export control intended to deny trade of chemical agents and related equipment to nations that are believed to support terrorism, are in sensitive regions, are believed to have CW objectives, or are under the constraints of a general US trade embargo.

Unfortunately, the record of the past several years makes it difficult to place much confidence in export controls. Export monitoring of equipment, chemicals, and technology by Western nations has proved less than adequate, at least in the case of the alleged Libyan CW plant at Rabta, which was supplied in part by a private firm from West Germany, an Australia Group Member.

Possible ways to strengthen CW export controls have been considered. One approach would expand the Australia Group's purview from information exchange to export licensing. A new international licensing agency would be established with expanded abilities to collate and analyze trade information, thus providing greater likelihood that illegal or questionable transactions would be discovered—and deterred. The experience of the Nuclear Suppliers Group, a group of developed nations that have established common conditions and rules for nuclear exports, should provide valuable insight into the effectiveness of such actions directed at CW.

A second approach would expand the list of key chemicals and related equipment the United States and others already control and would establish the authority to impose sanctions against nations and companies found in violation. Any requirement to impose automatic or mandatory sanctions, however, would have the serious disadvantage of limiting flexibility in dealing with individual nations. As in other areas of arms control and proliferation, nations would not likely limit their flexibility to choose between diplomatic exhortation and punitive sanctions in stemming CW proliferation.

Australia has suggested that the existing chemical export control of Western nations be expanded and incorporated into the multinational CWC. Under this plan, the organization implementing the CWC would provide multinational supervision of an export information center and data base so that member nations could take appropriate actions to stem proliferation. Responsibilities in export control would add yet another dimension to the CWC verification regime.

Either within the CWC regime or parallel to it, export control for the purposes of limiting the spread of CW would be difficult. Only if an export regime is made tight enough and if all requisite supplier nations participate could the approach have utility in denying CW capabilities to CWC nonsignatory nations. The effectiveness of this approach assumes that nonsignatories do not presently have, nor will develop, an indigenous chemical agent production capability—a relatively straightforward endeavor for resource-rich nations. Thus, it is difficult to predict the effectiveness of an export control system without knowing how consistently it would be applied, how many nonsignatories could serve as clandestine suppliers, and how many nations could develop indigenous CW capabilities.

A related issue deals with the possibility that the CWC could help to arrest or even roll back CW proliferation. If a critical majority of nations endorse the CWC, would they exert international pressure (either active or passive) on others to sign the CWC and adopt its verification regime requirements? There are no clear answers here. For the closest analog, it appears that international pressure over the years has caused a number of nations to sign the NPT, or at least to accept limited-scope nuclear safeguards. But nations reluctant to sign the NPT may have done so only for their own regional security concerns and not for the broader objectives of the NPT. Furthermore, there is little indication that the NPT has been a factor in nuclear arms reductions involving declared nuclear-armed nations.* And, to the extent it is known, the NPT has not influenced nations with unacknowledged nuclear weapons or capabilities to reverse their policies. The extent to which the CWC will create an international normative standard that persuades nations to join the non-CW fold remains to be seen.

VI. CONCLUSION

Returning to the central issue of the effectiveness of a CWC verification regime, we can draw some tentative conclusions. First, verification of CWC-declared locations and activities to detect and deter noncompliance *is* possible. Verification criteria of timeliness, significant quantities, and probability of detecting anomalies can be addressed; but the availabil-

*Article VI of the NPT obligates signatories to undertake measures aimed at nuclear arms control and disarmament.

ity of resources will determine the *level* of effectiveness of the regime. For a system comparable to the NPT, an annual price tag of $500 million or more is not inconceivable. The complexities of the inspected facilities, together with the lack of operational experience, will make it difficult to state monitoring effectiveness in quantitative terms before the regime is implemented. Thus, policy decision makers will have little concrete information with which to evaluate the effectiveness of treaty verification before ratification debates take place.

Second, effective CWC verification aimed at detecting violation outside the declared realm is much less certain. The *ad hoc* nature of the problem does not lend itself to systematic monitoring. Hence, quantitative conclusions regarding the probability of detection—much less deterrence—of noncompliance cannot be made. Effectiveness for this component of the CWC will depend heavily on the final provisions for challenge and *ad hoc* inspections. Furthermore, the technical aspects of monitoring (stand-off detection, ultrasensitive analysis, and others) will be important in addressing verification outside declarations. If noncompliance scenarios associated with undeclared locations are viewed as a greater threat to security than are those associated with declared sites and activities, then the overall effectiveness of the regime will be commensurately discredited.

As with any arms control agreement, the value of the CWC is related to its ability to codify an international normative standard: in this case the renouncement of belligerent use of CW and all preparation toward that end. Recognizing that the CWC verification regime will be imperfect, political leaders must decide whether the treaty's advantages in establishing an international norm outweigh the uncertainties in verification. This issue must be viewed in light of the strategic importance of treaty violation.

Although both chemical weapons and nuclear weapons have been characterized as weapons of mass destruction, they are not necessarily of equal magnitude. Does significant breakout in a CWC context carry the same strategic consequences as breakout of the NPT or the Intermediate-Range Nuclear Forces Treaty, for instance? Are the political and societal consequences of CW attack as great as those of nuclear attack? The effectiveness of treaty verification logically should be concomitant to the significance of noncompliance. If the international community does not view CW proliferation and its attendant security threat with great alarm, it will be difficult to convince those same parties of the need for an effective verification regime for the multinational CWC.

REFERENCES

1. "Report of the *Ad Hoc* Committee on Chemical Weapons," Conference on Disarmament, CD/961, Geneva (February 1, 1990).

2. *The New York Times*, April 3, 1990.

3. IAEA Safeguards Glossary, IAEA/SG/INF/1, 1980.

4. "Report of the National Trial Inspection of Finland," Conference on Disarmament, CD/CW/WP.233, Geneva (April 4, 1989).