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Future Treaties: Chemical Weapons Convention

by L. L. Gaines and E. A. Tanzman

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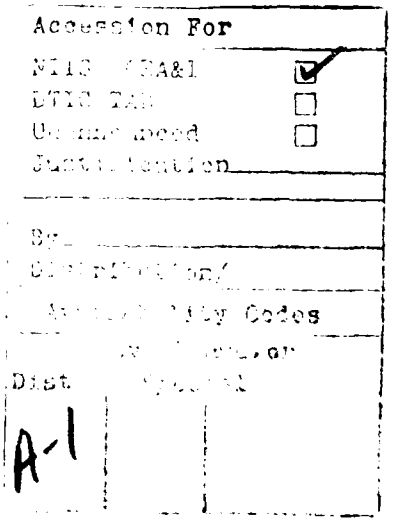
FOREWORD

The purpose of this report is to provide information to the U.S. Department of Energy (DOE) that will enable it to plan for compliance with verification requirements of a possible Chemical Weapons Convention, while still protecting its security interests. Many of the concerns would be relevant to other agencies as well. Appropriate planning includes preparation for possible inspection at DOE and contractor facilities, as well as development of appropriate technology for effective, nonintrusive verification.

None of the options analyzed represent actual U.S. policy or strategy for negotiation. All information was drawn from sources in the open literature.



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FUTURE TREATIES: CHEMICAL WEAPONS CONVENTION

by

Linda L. Gaines and Edward A. Tanzman

ABSTRACT

The recent use and the proliferation of chemical weapons provide impetus to the ongoing negotiations in Geneva to ban the production, possession, and use of all chemical weapons. The provisions of the Chemical Weapons Convention are not all agreed upon yet, challenge inspections and sanctions against violators being two particularly difficult areas. Verification of declared stocks and activities poses no major technical problems, but care in technology development and selection will be required to provide effective verification with minimum intrusion. A carefully designed system will be needed to interpret the extensive data from routine inspections, monitoring, and reporting and to protect company proprietary information. Identification of appropriate sites for challenge poses very difficult technical problems, on which R&D could be fruitful. On-site inspection in the U.S. poses potential problems ranging from the loss of classified or proprietary information to high financial costs for site preparation and lost operating time. Site access for inspection could also violate U.S. companies' freedom from illegal search and seizure; several remedies are considered.

SUMMARY

The purpose of this work is to help the U.S. Department of Energy (DOE) identify potential problems that might arise in verification of a Chemical Weapons Convention (CWC) so that work on solutions can be started now. Although the focus is on DOE interests, the results are applicable to other organizations as well.

The rapid proliferation of chemical weapons (CW), and their recent use in regional conflicts, is a major impetus for a chemical weapons treaty. Negotiations on chemical weapons have been under way in Geneva, Switzerland, at the Conference on Disarmament (CD) since 1980. In 1984, then-Vice President Bush submitted a draft convention that still represents the officially published U.S. negotiating position. Since then, the Conference has developed an evolving working version, called the "rolling text," that is similar in many respects to the U.S. draft. Agreement has been reached on the basic provisions and verification thereof concerning declared stocks and facilities and their destruction, but there is still much discussion of how to handle sites suspected of housing illegal stocks or production.

PROVISIONS OF CHEMICAL WEAPONS CONVENTION

Parties to the CWC would undertake not to use, produce, retain, or transfer chemical weapons. In addition, all chemical weapons and production facilities for such weapons would be destroyed. Within 30 days after the CWC entered into force, each Party would declare any chemical weapons or production facilities for them under its jurisdiction anywhere, as well as any receipts or transfers of such weapons or equipment for production. Access to the sites for the purpose of systematic on-site verification would be provided immediately after declaration.

Each State Party would retain the right to produce and use toxic chemicals for peaceful purposes. In addition, each Party would have the right to produce and use, for research, medical, or protective purposes, one metric ton (1000 kg) per year of CW agents. Toxic chemicals and their precursors, which could be used for purposes prohibited by the CWC, would be subject to international monitoring. Verification activities would be required not to interfere with peaceful chemical activities or endanger confidential information. Verification measures for declared materials and activities would include on-site inspection, on-site monitoring, and data monitoring.

If agreement is reached on challenge inspections, any State Party could have the right to request an on-site inspection of another Party anywhere at any time. A right of refusal may be included. Although the United States and the Soviet Union have endorsed challenge inspections, the issue is still controversial. Alternative or additional types of inspection have been proposed by the West Germans and by the British. Under the West German proposal, facilities to be inspected would be selected at random, thus avoiding the confrontational aspects of challenge inspections. A quota would be included in the British system.

VERIFICATION OF CHEMICAL WEAPONS CONVENTION

Arms control treaty verification should be designed to provide assurance against militarily significant violations, or at least sufficient warning to enable effective response. Careful analysis is required to define minimum activity levels that will constitute a treaty violation. Verification cannot prove conclusively that a CW treaty is being scrupulously observed, but it can be expected to reduce significantly the probability and magnitude of undetected noncompliance. This section provides an overview of the types of verification that are feasible with current technology, but it does not specify instruments. Verification of declared materials and facilities is likely to be much easier than verification of compliance by means of challenge inspections.

Declared Materials and Facilities

Sampling, plus tamper-resistant or -indicating container seals that can be authenticated, would allow high-confidence verification of declared contents of storage facilities with known technology. Sampling before and after destruction, perhaps coupled with video monitoring of the process, would provide sufficient verification of agent destruction. Simple visual inspection might be sufficient to assure that operations have ceased at chemical weapon plants. Various sensors, coupled with facility seals, should

provide high assurance that production does not restart. If the facility were converted to a temporary destruction facility, its operation would require careful monitoring to assure against reconversion. If facility destruction were taken to mean dismantlement or razing, one-time simple visual inspection would be sufficient to assure facility destruction.

Inspection, perhaps including sampling, would be allowed at the one small facility producing CW agents for research or medical purposes that each State Party would be permitted to operate. The inspection could verify plant capacity and assure that significantly greater-than-declared quantities of agent could not be produced without major equipment changes.

Inspection and sampling at key precursor facilities could verify that the declared chemicals were being produced at the time of the inspection but might not be able to detect process modifications. Therefore, techniques to detect residuals from past production would be useful. In addition, chemical monitors could probably be installed at key process locations to detect process stream composition continuously and verify declared activities. Equipment size, coupled with material input and output data, could provide information on the quantity of material produced. However, because of the large volumes involved in commercial chemical manufacture, production uncertainties of even a fraction of a percent could represent a significant quantity of material. This is a possible weakness in verification at declared facilities.

Challenge Inspections

The purpose of challenge inspections would be to minimize the probability and scope of undetected treaty violations. Challenge inspections would presumably be aimed at looking for illicit production or storage of CW agents or key precursors. Relatively small quantities could be militarily significant, and these materials have no simple, common signature that would make them easy to detect remotely. The problems of site identification using technical means would be extremely difficult for suspected production in industrialized nations; for storage, they may be insurmountable, although leaky weapons could probably be detected. Random searches of likely facility types and human intelligence might be the best of many unsatisfactory approaches for maximizing the chances of finding hidden material.

Possibilities for identification of illicit chemical production would be improved if photographs, measurements, and samples could be taken near (or over) potential illicit CW sites. A Chemical Weapons Convention could include provisions for such in-country monitoring. This might allow sufficient information about a large number of sites to be collected to allay suspicions without actually requiring a full-fledged, intrusive challenge inspection.

Agreed procedures for challenge inspections could be expected to be similar to those for scheduled inspections. By visual inspection, inspectors could learn the scale of processing, and they might be able to detect recent changes in equipment configuration. In addition, they could observe any extraordinary measures to protect personnel from toxic compounds or to clean up process effluents.

A prerequisite for challenge inspections is a data base containing information about all known CW agents and their precursors, by-products, and degradation products. Information about standard production processes and their effluents is also needed to define levels of agent-related compounds that could reasonably be expected.

Sanctions

If verification activities revealed evidence of treaty noncompliance, economic and political sanctions could be mandated. The threat of sanctions would provide some disincentive for treaty violation.

IMPLICATIONS OF CWC VERIFICATION

Implications for DOE

DOE and contractor facilities are expected to be eligible for challenge inspections. On-site inspection (OSI) at a DOE or contractor facility could cause loss of sensitive information or materials and direct and indirect financial costs. Possible losses under several alternative inspection regimes should be carefully evaluated, but most DOE security interests may not be put at significant risk during OSI if a few precautions are permitted. Shrouding and containment of sensitive items could be effective in protecting much classified information. Access limitations could be necessary in certain exclusion areas or vital areas if protection were otherwise impossible. Basic nuclear weapons information and materials could be protected from non-nuclear states by limiting inspection teams at weapon facilities to citizens of countries with advanced nuclear weapons capability.

DOE could have a major role in the development of technology for arms control treaty verification. Before specific technologies are developed, it is necessary to determine what requirements verification technologies are likely to encounter. It is also necessary to compile information on existing technological capabilities and on prospects for further development. For verification of the CWC, chemical detection, sampling, and analysis instruments are the most obvious needs. Less obvious, but equally essential, are appropriate computer data-base capabilities to analyze the large amount of data that will be generated for CWC verification.

Implications for Chemical and Other Industries

Any industrial facility could suffer financial losses as a result of scheduled or challenge on-site inspection for verification of a Chemical Weapons Convention. Shrouding and other protection measures could be costly. It is also possible that production would be required to slow down or stop for at least the duration of the inspection. Industrial facilities could also lose several types of information considered vital to their competitive positions. Mere visual inspection of the plant could reveal to an expert observer details of the process used. Sample compositions would reveal

process specifications, but these could be protected by a coding system. Examination of shipping records would reveal customer information as well. Procedures to protect companies against these potential losses must be developed.

Regardless of the commitments made by industry trade groups or the steps that may be taken to limit the extent of on-site inspections, some private firms may attempt to resist an inspection because it allegedly violates their legal rights. In particular, they may assert that the kind of on-site inspection scheme embodied in the rolling text transgresses the Fourth Amendment. Fourth Amendment concerns are more easily integrated into the routine, systematic international on-site verification inspections that are envisioned for declared facilities than they are into challenge inspections. Options exist for reducing the friction between the interests of controlling chemical weapons and protecting privacy, while preserving the general approach to on-site inspections embodied in the 1984 American proposal and the 1989 rolling text. These include (1) development of specialized remote monitoring devices, (2) inducing voluntary consent to be inspected, and (3) enactment of a federal statute to extend pervasive regulation over chemical weapons to the chemical industry and to redefine the legal remedies available to the subjects of on-site arms control inspections.

Implications of Possible Noncompliance

Because complete verification of compliance with a Chemical Weapons Convention would be extremely difficult, it is useful to consider the utility of sanctions and other remedies in the event that the CWC were violated. The chances of undetected violations of the treaty could be reduced, the costs of getting caught raised, and the potential benefits of using the weapons minimized. This combination of factors could help make violation a less attractive option, even for a treaty that was not perfectly verifiable.

Both economic and political sanctions could be envisioned to make the consequences of being caught violating the CWC more costly. Any weapons or facilities found in violation of the convention could be seized and destroyed. Direct financial measures could include retraction of credit and credit guarantees, refusal and calling in of loans, and punitive tariffs. Other economic measures could include restrictions on exports of goods and technologies to the offending Party, as well as curtailing imports from it. Political reprisals, including censure and breaking of alliances or diplomatic relations, are also possible. If the Party violating the CWC actually used chemical weapons, it would be possible to consider military reprisals.

The potential benefits to a violator actually using CW could be minimized by appropriate precautions on the part of any nation judged to be a possible target. Another method for mitigating damage from a CW attack would be aid to the injured Party.

RECOMMENDATIONS FOR DOE ACTION

The recommended actions fall into several categories. These include additional analysis, technology R&D, legal studies, and input to interagency groups advising the

negotiators. Analytical activities should receive high priority, because they serve to identify further actions and to direct other projects to the most fruitful areas for development. The final area for possible action, input to interagency groups, may be the most important, because it represents completion of the feedback loop that enables DOE to influence treaty provisions that might eventually affect it. The following list indicates recommended actions, by category:

- Analysis
  - Verification technology requirements
  - Verification technology capabilities and possible developments
  - Impacts and effectiveness of alternative challenge-inspection regimes
  - Development of model agreements

- Technology R&D
  - CW data base and process model
  - Inventory control system and tags
  - Sensitive remote monitoring
  - Alternatives to process sampling

- Legal Studies
  - Development of contract clause
  - Constraints to OSI in laws of other countries
  - Implementing legislation

- Input to Interagency Groups
  - Access limitations
  - Sanctions
  - Cost-effectiveness of alternative challenge regimes

1 INTRODUCTION

1.1 PURPOSE AND STRUCTURE OF THIS REPORT

The purpose of this report is to help the U.S. Department of Energy (DOE) identify potential problems that might arise in verification of a Chemical Weapons Convention (CWC) so that work on solutions can be started now. Although the focus is on DOE interests, the results are applicable to other organizations as well.

The method is a systematic analysis of the agreed and possible treaty provisions and the appropriate verification methods for them. The analysis reveals which provisions are easily verifiable, which alternatives could lead to difficulties in compliance, and where verification research is needed.

The report's recommendations will enable DOE to provide input to interagency groups advising the negotiating team so that the U.S. position can take into account the most verifiable and readily observable provisions. Agreement on such provisions would allow DOE to plan for compliance with on-site inspection (OSI) requirements at its own facilities with minimal costs and information losses. DOE can also provide information to Congress concerning appropriate legislation to enable treaty compliance with minimal legal difficulties. In addition, the work identifies areas where further technical and legal analysis, data collection and processing development, and verification technology R&D by DOE would enable more reliable, cost-effective, nonintrusive, and trouble-free verification.

Section 1 provides background information on the history surrounding the current treaty draft, which is set forth in Sec. 2. Section 3 examines what types of verification are feasible for the items and activities to be limited. The implications of such verification measures are discussed in Sec. 4. Finally, Sec. 5 presents recommendations for possible actions that could be undertaken by DOE to expedite effective and nonintrusive verification of a Chemical Weapons Convention.

1.2 PURPOSE OF CHEMICAL WEAPONS CONVENTION

The CWC would go beyond the ban on wartime use embodied in the Geneva Protocol of 1925, dismantling the entire structure for manufacture and possession of chemical weapons. The stated purpose of a Chemical Weapons Convention would be a total ban on the development, production, storage, transfer, and use of chemical weapons by any nation. This is in keeping with the overall "objective of general and complete disarmament under strict and effective international control, including the prohibition and elimination of all types of weapons of mass destruction." (The quotation is from the 1984 U.S. draft; the current rolling text uses very similar language.)

While these are obviously admirable goals, it may be worth examining why there is special interest in this one type of weapons by so many nations. First, many regard chemical weapons as particularly horrible. This revulsion is presumably based on a perception of the level of suffering they inflict on civilian as well as military personnel.

Some regard poison as an illegitimate means of warfare. More important, however, is the ease with which these inexpensive weapons can be produced and used, and the effectiveness of small quantities of material. Nations that lack the technological capability to produce nuclear weapons or the capital to purchase significant quantities of conventional arms can easily purchase precursors for chemical weapons and even the weapons themselves or, with a little more effort, the capability to produce them. On October 19, 1988, the acting Commander-in-Chief of the Iranian armed forces said, "Chemical and biological weapons are poor man's atomic bombs and can easily be produced. We should at least consider them for our defense."[1]

Table 1.1 lists countries that have declared they do not possess chemical weapons.[2] Some have also stated that they will not possess them in the future. Although only the U.S. and the Soviet Union have officially admitted possession, "more than 20 nations now possess chemical weapons or the capability to produce them."[3] Figure 1.1 shows countries known or believed to have chemical weapons.[4] Several of the countries believed to possess chemical weapons, including France, Egypt, and Thailand, have declared that they do not. There is considerable uncertainty concerning what is possessed, and additional confusion arises as to whether production capability, stocks, or delivery capability are included. This question is discussed in a recent paper on CW proliferation.[5] The rapid proliferation of chemical weapons, and their recent use in regional conflicts, provide the major impetus for a chemical weapons treaty.

1.3 STATUS OF CHEMICAL WEAPONS CONVENTION

Although their widespread use in World War I resulted in more than 100,000 deaths and a million casualties, gas weapons were not sufficiently predictable or effective to justify their continued use. The Geneva Protocol, banning the use of gas and bacteriological weapons by all Parties, was written in 1925 and approved by 118 countries by 1980, including Iraq, Iran, and the Soviet Union. The total number of signatories was 129 by 1989, according to the French foreign minister, and increased by nine at the January 1989 Paris Conference, with three more nations stating their intentions to sign. However, many signatories qualified their accord to permit use against Parties not abiding by the protocol.

Few incidents of chemical or biological weapons use were reported in World War II, although there was intensive research and development on new and more lethal nerve gases, and stockpiles were produced by both sides. These weapons were discussed in the general disarmament talks following the war. Eventually, it was determined that an agreement on biological weapons alone would be easier to negotiate, and the Biological Weapons Convention was first signed in 1972. This agreement, eventually approved by more than 120 countries, banned development, production, and stockpiling of bacteriological and toxin weapons, mandated destruction of any existing stocks, and bound the treaty Parties to continue to negotiate for a similar ban on chemical weapons. No verification provisions were included.

TABLE 1.1 Countries That Have Declared Nonpossession of Chemical Weapons

Declare Nonpossession Only	Disavow Intent to Possess	Exclude Future Possession
Argentina	Bahrein	Afghanistan
Bulgaria	Belgium	Australia
Chile	Brazil	Austria
China	Canada	Burma
Cook Islands	Denmark	Federal Republic of Germany (FRG)
Cyprus	Guinea-Bissau	Finland
Czechoslovakia	Kenya	Hungary
Egypt	Malaysia	India
Ethiopia	Mexico	Indonesia
France	Mongolia	Japan
German Democratic Republic (GDR)	Netherlands	Morocco
Greece	Nicaragua	South Korea
Iceland	Pakistan	
Italy	Poland	
Kuwait	Senegal	
Madagascar	Spain	
Malta	Sweden	
New Zealand	Switzerland	
Norway	Tanzania	
Panama	Togo	
Papua New Guinea	Turkey	
Peru	Venezuela	
Romania		
South Africa		
Thailand		
Uganda		
United Kingdom		
Vietnam		

Source: Ref. 2.

Chemical weapons negotiations have been under way in Geneva, Switzerland, at the Conference on Disarmament (CD) since 1980, when a working group was established. The U.S. joined the Ad Hoc Committee on Chemical Weapons in 1983. The 40 member States of the Conference on Disarmament and the 26 observers who are not members of the CD are listed in Table 1.2.[6,7] In 1984, then-Vice President Bush submitted a draft convention for consideration.[8] This draft still represents the officially published U.S. negotiating position. Since then, the CD has tentatively agreed on an evolving working version, called the "rolling text,"[7] that is similar in many respects to the U.S. draft. The rolling text is not binding on any nation. Agreement has been

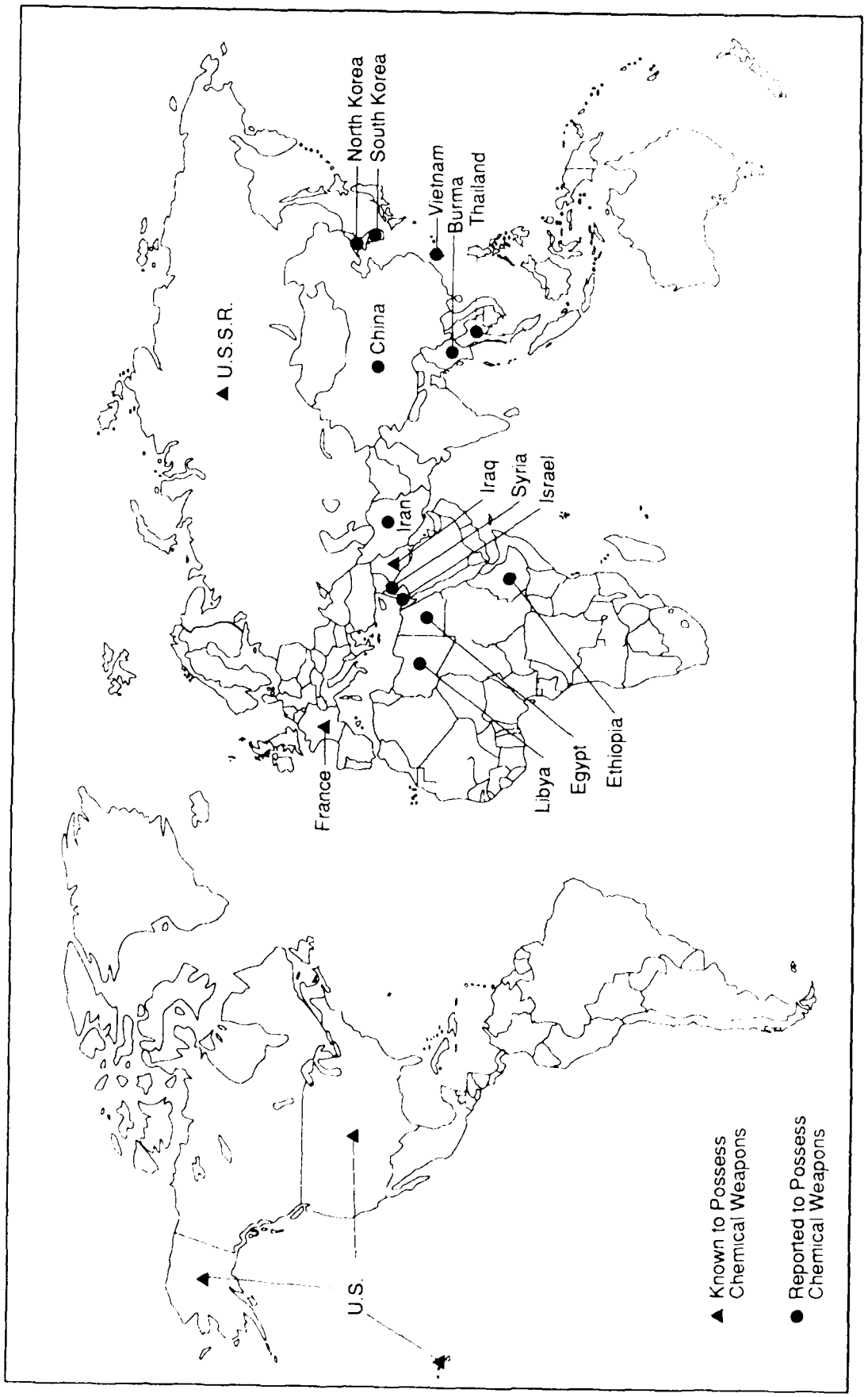

FIGURE 1.1 Countries Known or Reported to Possess Chemical Weapons (Source: Ref. 4).

TABLE 1.2 Members of the Conference on Disarmament and Observers Participating in Work of the Ad Hoc Committee on Chemical Weapons

Members			
Algeria	Czechoslovakia	Italy	Poland
Argentina	Egypt	Japan	Romania
Australia	Ethiopia	Kenya	Sri Lanka
Belgium	France	Mexico	Sweden
Brazil	GDR	Mongolia	U.S.S.R.
Bulgaria	FRG	Morocco	United Kingdom
Burma	Hungary	Netherlands	United States
Canada	India	Nigeria	Venezuela
China	Indonesia	Pakistan	Yugoslavia
Cuba	Iran	Peru	Zaire
Observers			
Austria	Ireland	Oman	Syria
Bangladesh	Iraq	Portugal	Tunisia
Chile	Jordan	Qatar	Turkey
Denmark	Libya	Senegal	Vietnam
Ghana	New Zealand	South Korea	Zimbabwe
Greece	North Korea	Spain	
Finland	Norway	Switzerland	

Sources: Members, Ref. 6; Observers, Ref. 7.

reached on the basic provisions and verification thereof concerning declared stocks and facilities and their destruction, but there is still much discussion of how to handle sites suspected of housing illegal stocks or production. Numerous details remain bracketed due to disagreement. Inspection protocols and other lengthy addenda remain to be written. Trial inspections were held or planned in 18 countries (listed in Table 1.3)[7,9] by the spring of 1989 to help develop appropriate inspection procedures. The Swedish delegation to the Conference on Disarmament is culling the best features for inclusion in the inspection protocol.

In addition to the multilateral negotiations, the U.S. and the Soviet Union have been pursuing bilateral negotiations on chemical weapons. The twelfth round of bilateral talks took place in August 1989. The Soviet Union agreed to exchange data and accept inspections before a multilateral treaty is formally concluded.[10] U.S. Secretary of State James Baker and U.S.S.R. Minister of Foreign Affairs Eduard Shevardnadze signed a memorandum of understanding on September 23, 1989, at their Jackson Hole, Wyoming, meeting. Data exchanges will begin before the end of 1989, and visits to military and civilian chemical weapons production and storage facilities chosen by the host countries will begin by June 30, 1990. When a multilateral treaty is deemed imminent, detailed data will be exchanged and challenge inspections permitted.[11]

TABLE 1.3 Countries Conducting Trial Inspections of Chemical Plants

Country	Facility Type	Inspection Date	Report No.[a]	Report Date
Australia	Multipurpose (batch production) plant	Late 1988	234	April 4, 1989
Austria	--	--	260	Aug. 14, 1989
Belgium	--	--	243	April 17, 1989
Brazil	--	Dec. 1988	266/Rev.1	March 2, 1989
Czechoslovakia	Dimethyl phosphite plant	--	229	March 14, 1989
FRG	Multipurpose production facility	Feb. 1989	235	April 7, 1989
Finland	Civilian plant producing two related chemicals	March 1989	233	April 4, 1989
France	--	Early 1989	240	April 11, 1989
GDR	Pharmaceutical plant	Oct. 1988	227	March 10, 1989
Hungary	Pharmaceutical-chemical complex	Dec. 1988	223	Feb. 20, 1989
Italy	Two chemical facilities	Dec. 1988	224	Feb. 24, 1989

TABLE 1.3 (Cont'd)

Country	Facility Type	Inspection Date	Report No.[a]	Report Date
Japan	Three facilities	Nov. 1988	[illegible]	March 13, 1989
Netherlands	Civilian chemical plant	1988(1), 1989(2)	[illegible]	June 23, 1989
Sweden	Multipurpose (batch production) facility	Nov. 1988	216	Dec. 9, 1988
Switzerland	Multipurpose facility	Spring 1989	247	June 16, 1989
U.K.	Military facilities	--	245	June 14, 1989
U.S.	W. Va. plant making flame-retardant chemicals	Feb. 1989	256	June 22, 1989
U.S.S.R.	Chemical production facility	Dec. 1988	2[illegible]	Feb. 28, 1989

Sources: Refs. 7 and 9.

[a]Working Papers of the Ad Hoc Committee on Chemical Weapons, Conf. on Disarmament. Document numbers take the form "CD/CW/WP.xxx," where "xxx" represents a three-digit number.

The U.S. and the U.S.S.R. have also announced plans to destroy significant stocks of chemical weapons. President Bush, in his address to the United Nations,[3] offered to destroy 80% of our stocks if the Soviets reduced to the same level and if verification were agreed on. However, the U.S. had already scheduled 25,000 tons of obsolete unitary weapons (about 80% of common estimates of current stocks) to be destroyed by April 30, 1997, and partially replaced with a smaller stock of modern binary weapons. The Soviet Union was scheduled to begin destroying its stocks in 1989, at a rate dependent on the progress of the CW negotiations, but has announced that it will not begin until the U.S. ceases production.[12]

An international conference was held in Paris on January 7-11, 1989, with 149 nations represented, many by their chiefs of state. The Paris Conference on the Prohibition of Chemical Weapons condemned the use of chemical weapons, reaffirmed the 1925 Geneva Protocol (adding 12 nations to the list of those formally adhering or declaring their intentions to do so), and urged conclusion of the proposed CWC. Although they did sign the Paris statement, several Arab nations argued "that they were entitled to develop and possess chemical weapons as long as Israel was allowed to have nuclear arms."[10] (More details on the status of events related to chemical weapons are available in a continuously updated chronology of recent events, kept by the University of Sussex and Harvard and excerpted quarterly in the Chemical Weapons Convention Bulletin.)

World reaction to reported use of chemical weapons by Iraq has been very mild; they have not incurred the stringent economic and political sanctions or the widespread moral denouncements that might have been expected. The U.N. Security Council condemned chemical weapons use in the Persian Gulf War and stated it would consider "appropriate and effective measures" if this happened again.[13] The European Parliament called for suspension of weapon and relevant chemical shipments by the 12 European Community members.[14] Japan increased restrictions on chemical exports.[15] The United Kingdom, however, declined to condemn Iraq for use of CW against the Kurds pending the results of a U.N. investigation. The U.S. Senate and House of Representatives both passed bills in 1988 condemning Iraq and imposing unilateral sanctions, but a conference version was never passed. A group of U.S. senators also called on the United Nations to impose international sanctions on any CW user.[16] The Senate bill would have cut loans, credit, credit guarantees, and exports of sensitive equipment to Iraq and stopped petroleum imports. The House bill would have restricted exports only.[17] Former President Reagan opposed the bills. New legislation has been introduced this session by Senator Claiborne Pell of Rhode Island, aimed at CW users, and by Senator Jesse Helms of North Carolina, aimed at suppliers of CW capability. Another bill, dealing with sanctions, has been introduced in the House by Representative Mel Levine of California.[18] President Bush stated during the election campaign that "the nations guilty of chemical warfare must pay a price.... Any government that resorts to such an outrage must face the censure of all nations."[19] National Security Advisor Brent Scowcroft has confirmed that the President would support sanctions against nations defying international control of chemical weapon stocks.[20]

An informal group, now including 19 nations, chaired by Australia, has worked since 1985 to prevent shipment to probable users of chemicals that can be easily converted to chemical weapons. Other members of the group include the 12 European Economic Community nations, Canada, Japan, New Zealand, Norway, Switzerland, and

the United States. The group has imposed voluntary export controls, but this effort has obviously not met with complete success.

In view of the blatant violations of the Geneva Protocol by Iraq, and probably others, it is important to consider how as many nations as possible can be persuaded to approve and observe a CW treaty. It has been suggested that some developing countries could be induced to sign in exchange for technical or economic assistance for their chemical industries. Brazil and Argentina might need assurances that the rapid development of biotechnology industries in their countries would not be hampered by the treaty.[21] Some nations would be likely to sign only if their neighbors did so also. Egypt has stated that it is "imperative that certain key countries, including those in 'hot' regions, should become Parties simultaneously."[22] Bilateral U.S.-Soviet agreements are expected to provide impetus for the multilateral agreement. With the 149-nation Paris Conference endorsing a CW treaty, it is likely but not certain that the number of willing signatories would be large; there are some potentially recalcitrant nations. A former ambassador to the Conference on Disarmament has been quoted as saying that Iran, Iraq, Syria, and Israel would not be among the nations to sign, and that the total number of signatories would be less than 60.[4] American officials are reported to hope that 60-80 countries will eventually sign.[23]

1.4 REFERENCES

1. From Islamic Republic News Agency (Tehran) [reported in Chemical Weapons Convention Bulletin No. 3, Oct. 19, 1988].

2. Federation of American Scientists Fund, Washington, D.C. (Aug. 1989) [reported in Chemical Weapons Convention Bulletin No. 5].

3. Bush, G.H.W., address to U.N. General Assembly, New York City (Sept. 25, 1989).

4. Ember, L.R., *Fashioning a Global Chemical Weapons Treaty*, Chemical and Engineering News 66(13):7 (March 28, 1988).

5. Harris, E., *Chemical Weapons Proliferation: Current Capabilities and Prospects for Control*, in New Threats: Responding to the Proliferation of Nuclear, Chemical, and Delivery Capabilities in the Third World, University Press of America and Aspen Stategy Group, Lanham, Md. (in press).

6. *Geneva Conference on Disarmament*, U.S. Arms Control and Disarmament Agency Issues Brief, Washington, D.C. (undated).

7. *Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament*, Conf. on Disarmament Document CD/952 (Aug. 18, 1989) [generally called "rolling text"].

8. *Draft Convention on the Prohibition of Chemical Weapons*, Conf. on Disarmament Document CD/500 (April 18, 1984).

9. Hyltenius, C.M., Swedish Delegation to Conf. on Disarmament, Geneva, Switzerland [reported in Chemical and Engineering News, March 6, 1989].

10. Gordon, M.R., *Kremlin Accepts Early Inspection of Chemical Arms*, New York Times (Aug. 3, 1989).

11. *U.S.-Soviet Memorandum of Understanding on Chemical Weapons*, U.S. Arms Control and Disarmament Agency Issues Brief, Washington, D.C. (Sept. 23, 1989).

12. Moseley, R., *Soviets Provide Own Plan for Chemical Arms*, Chicago Tribune, p. 1 (Sept. 27, 1989).

13. United Nations Security Council Resolution S/RES/620 (Aug. 26, 1988).

14. London Times (Sept. 16, 1988) [also in Financial Times, London (Sept. 19, 1988), as reported in Chemical Weapons Convention Bulletin No. 2].

15. The Guardian, London (Sept. 17, 1988) [as reported in Current News, published by U.S. Department of Defense, American Forces Information Service (Sept. 21, 1988)].

16. Associated Press wire-service story [as reported in Current News, published by U.S. Department of Defense, American Forces Information Service (Oct. 14, 1988)].

17. The Congressional Record, pp. S12133-8 (Sept. 9, 1988) and pp. H8427-8 (Sept. 27, 1988).

18. Simpson, G., *Chemical Weapons Subject of Legislation*, Insight, p. 24 (Feb. 20, 1989).

19. Bush, G.H.W., speech at the University of Toledo, Ohio (Oct. 21, 1988).

20. Hoffman, D., *Bush Urges Chemical Arms Cuts*, Washington Post, p. 1 (Sept. 26, 1989).

21. Chemical and Engineering News 66(13) (March 28, 1988).

22. *Final Record of the Five Hundred and Third Plenary Meeting*, Conf. on Disarmament Document CD/PV.503 (April 13, 1989).

23. Pear, R., *U.S. and Moscow Settle Key Issues on Chemical Arms*, New York Times, p. 1 (July 18, 1989).

2 PROVISIONS OF CHEMICAL WEAPONS CONVENTION

The Chemical Weapons Convention would go beyond the ban on wartime use embodied in the Geneva Protocol of 1925, dismantling the entire structure for manufacture and possession of chemical weapons. Parties to the CWC would undertake not to use, produce, retain, or transfer chemical weapons. In addition, all chemical weapons and production facilities for them would be destroyed. The term "chemical weapons" is taken to mean both toxic chemicals and munitions, but precise definitions of treaty terms are not yet entirely agreed on. Basic agreement has been reached on provisions concerning declarations of and destruction of existing CW agent stocks and production facilities, on permitted activities, and on organizational structure. Those tentatively agreed-upon provisions that are relevant to verification are discussed in Sec. 2.1 and summarized in Table 2.1. Areas where negotiations are still needed are discussed in Sec. 2.2.

2.1 PROVISIONS ON WHICH BASIC AGREEMENT HAS BEEN REACHED

Much of the language in the August 1989 rolling text (Ref. 1) is identical to that in the U.S. draft (Ref. 2). The discussion here is based on the rolling text; differences in the U.S. draft and other nations' positions are noted.

2.1.1 Entry Into Force (EIF)

The CWC would become binding and enter into force when signed by a specified number of nations. Numbers between 40 and 60 are being considered at the Conference on Disarmament. The current rolling text has 60 bracketed; the number in the U.S draft is 40.

2.1.2 Organization

The Organization for the Prohibition of Chemical Weapons would be established to implement the Chemical Weapons Convention. This organization would consist of three bodies with clearly defined responsibilities: the Consultative Committee or General Conference, the Executive Council, and the Technical Secretariat, which includes the International Inspectorate. Table 2.2 summarizes the functions. Under the American draft, there would also be a Fact-Finding Panel, composed of five diplomatic members and a chair, to be established by the Consultative Committee within 45 days after the treaty enters into force, and a Preparatory Commission, to function during the period from initial agreement until EIF. A proposal for a Preparatory Commission is also appended to the August 1989 rolling text.

TABLE 2.1 Provisions Included in the Rolling Text and the U.S. Draft Covering Declared Facilities and Stocks

Rolling Text Article No.	Title	Content
III	Declarations	Each Party must declare all chemical weapons and facilities for their production or development.
IV	Chemical Weapons	Access must be granted to declared stocks for on-site inspection/on-site monitoring (OSI/OSM). Plans for destruction of stocks are required.
V	CW Production Facilities	Facilities must be closed and made available for on-site inspection and monitoring until their planned destruction.
VI	Activities Prohibited	Defines chemical schedules 1-3. Declarations and data monitoring will be checked by OSI/OSM not impairing processing. One small facility is permitted for research or medical purposes.
VII	National Implementation Measures	Each Party must adopt internal measures to enable treaty implementation.
IX	Consultations, Cooperation and Fact-Finding	Parties may initiate and must comply with requests for clarification of ambiguous situations.

Sources: Refs. 1 and 2.

2.1.3 Chemical Weapons

Within 30 days after the convention entered into force, each Party would be required to declare whether it had any chemical weapons under its jurisdiction anywhere, and whether it had received or transferred any such weapons since a date to be agreed on. The location, quantity, and composition of the weapons would also have to be declared.

Access to the sites for the purpose of systematic on-site verification would be provided immediately after declaration. As in the Intermediate-Range Nuclear Force (INF) treaty, initial "baseline" inspections would be carried out to verify the declarations. A team of international inspectors would verify the quantity and identity of chemicals and munitions at each location and seal and mark treaty-limited items

TABLE 2.2 Organization for the Prohibition of Chemical Weapons

Organ	Description
Consultative Committee	Principal decision-making body, with ultimate authority. All Parties represented.
Executive Council	Oversees central management and promotes treaty implementation and compliance. Smaller number of representatives.
Technical Secretariat	Executes verification measures and ensures compliance. International agency, headed by Director. Reports to Executive Council.

Source: Ref. 1.

(TLIs) for inventory control. Storage facilities would be subject to continuous on-site monitoring (OSM) and systematic on-site inspection (OSI), with 48 hours notice and at a frequency to be determined, to ensure against undetected removal of materials. If OSM were not possible, inspectors would remain present. Removal to destruction facilities would be verified by inspection of the shipment before and after transit.

A general plan for the destruction of declared materials would also be provided within 30 days of EIF. Destruction would begin no later than 12 months after EIF and finish not later than 10 years after EIF. The Netherlands has questioned whether that long a period is really required.[3] International inspectors would have access to CW destruction facilities 30 days prior to the commencement of active destruction and during the entire destruction operation. They would monitor the activities either by physical observation or with devices. The schedule for destruction remains a subject of debate, because each Party's security must be assured during the destruction period. U.S./Soviet agreement may lead the way to a resolution. France had suggested that Parties be permitted to retain capability for producing a "security stock" for up to eight years after EIF, but the idea has since been abandoned.

2.1.4 Production Facilities

Within 30 days after the CWC entered into force, each Party would declare whether it had any chemical weapons production facilities under its jurisdiction anywhere, and whether it had received or transferred any equipment for production since a date to be agreed on. The locations and scope of activities for any chemical weapons development facilities would also be declared. Activity at all production facilities, except that required for closure, would be required to cease immediately at EIF.

Within 30 days, a declaration would be submitted specifying actions taken for closure, outlining plans for facility destruction, and outlining plans for temporary conversion of any production facilities to weapons destruction facilities. Production facilities would be closed within three months after EIF, in a manner that rendered them inoperable. Closure of weapons production facilities would be accomplished by such measures as prohibition of building occupation, disconnection and disabling of equipment, and interruption of road and rail access. On-site inspection to verify cessation of activities would occur within 60 days after submission of the initial declarations. A combination of inspection and continuous monitoring with agreed-upon devices would be used to indicate any resumption of activity until the facility was destroyed. OSI would also be used to verify temporary conversion for the purpose of CW destruction.

Facility destruction would begin within 12 months and finish within 10 years after EIF, with the latter deadline also applying to destruction of converted production plants. Plans for facility destruction would be submitted to the Technical Secretariat for approval between three and six (not agreed) months before initiation of destruction. These plans would include appropriate verification measures using on-site inspectors. The U.S. draft specifies that facilities would be razed.

2.1.5 Permitted Activities

Each State Party would have the right to produce and use toxic chemicals for peaceful purposes. In addition, each Party would have the right to produce and use, for research, medical, or protective purposes, one metric ton (1000 kg) per year of "super-toxic lethal chemicals" (these include CW agents). Toxic chemicals and their precursors, which could be used for purposes prohibited by the convention, would be subject to international monitoring. Verification activities would be required not to interfere with peaceful chemical activities or endanger confidential information. The degree of monitoring would differ for the several chemical categories or "schedules" that are defined (see Table 2.3). The U.S. draft proposed slightly different definitions for the schedules. The compounds to be included in each schedule have not yet been agreed on, but it has been decided that Schedule 4 will not be required. Inclusion of Schedule 4 would have greatly magnified the verification workload because of the increased number of compounds to be tracked.

Verification measures for declared materials and activities would include on-site inspection, on-site monitoring, and data monitoring. Only general guidelines for verification are included in the CWC annexes; detailed model agreements would be concluded by each Party with the treaty organization within three months after EIF. The general guidelines would include granting inspectors unimpeded access to all parts of facilities, permission to bring necessary instruments, and taking of samples for on- and off-site analysis. Monitoring equipment and seals would be specified to be tamper-revealing. Technological improvements could be adopted as they became available.

The single, small-scale permitted Schedule 1 facility would be visited by inspectors promptly after declaration to verify the quantity and nature of the material produced. The inspectors would also verify that the equipment capacity would not permit excess production and would obtain additional information to allow planning of

TABLE 2.3 Definition of Chemical Schedules

Schedule		Description
Rolling Text	U.S. Draft	
1	A	Super-toxic lethal chemicals produced for weapons, and immediate precursors
2A	C	Key precursors that could be diverted to CW production
2B		Other super-toxic lethal chemicals that pose a significant risk
3	B	Dual-purpose chemicals that could be used as weapons
4[a]	D	Other super-toxic lethal chemicals, not listed in Schedule 1

Sources: Refs. 1 and 2.

[a]Not included in August '989 rolling text (Ref. 1).

future verification activities at the facility. Schedule 2 chemical-producing and -consuming facilities would also be subject to on-site inspection, on-site monitoring, and data monitoring. There would be initial visits to verify declarations, and further verification measures to be included in model agreements. Development of procedures to be included in model agreements will be difficult, and should be started before the CWC is signed to assure that they can be completed on time. The U.S. draft specifies periodic inspection of facilities, on a random basis, also using procedures to be agreed upon. Schedule 3 facilities would be subject to data monitoring only.

2.2 AREAS OF NONAGREEMENT

2.2.1 Challenge Inspections

2.2.1.1 Status

Although the United States and the Soviet Union have endorsed challenge inspections, the issue is still controversial. President Bush publicly stated his support for challenge inspections in a speech before the 1988 election, stating that "on-site

inspection on demand of suspicious facilities or plants must also be part of this verification regime."[4] Challenge inspections are not included in the rolling text, but they are discussed in an appendix to the Ad Hoc Committee report, which was written by the chairman after consultations with the members; this appendix does not necessarily represent a consensus. Brazil, China, and India have opposed challenge inspections, and Sweden is concerned about frivolous challenges.[5] It is likely, but not entirely certain, that the treaty finally agreed on will include provisions for challenge inspections.

The provisions for challenge inspections proposed in the 1984 U.S. draft (Articles X and XI), which represents our official negotiating position, and those appended to the August 18, 1989, rolling text of the Chemical Weapons Convention are basically similar, but some important differences exist. In both versions, any State Party has the right to request a short-notice on-site inspection of another Party anywhere at any time.* Instruments and procedures are not specified.

2.2.1.2 Consultations

Both the U.S. draft (Article IX) and the rolling text (Article IX) provide for consultations as the first resort to resolve compliance questions. The American draft allows the questioned Party seven days to respond. If consultation does not resolve the question, or is not chosen, challenge inspections are possible.

2.2.1.3 Eligible Sites

Although all facilities would be liable to be challenged, including those normally slated for scheduled inspections, several possibilities for exempting facilities or limiting the scope of inspection permitted could be considered. Facilities could be exempted by inclusion on a list (presumably held as a secret), by facility type, or by criteria. However, each of these approaches has disadvantages, and adoption of exemptions would require backing down from "anywhere at any time" by both the U.S., which proposed it, and the Soviet Union, which has publicly agreed to it.

2.2.1.4 Alternatives

Alternatives to full on-site inspection include explanations by the challenged Party, proposal of a less intrusive inspection method (e.g., perimeter measurements instead of OSI), and limiting access to less sensitive parts of the facility. Both the appendix to the rolling text and the American draft include some provision for alternatives to on-site inspection of challenged facilities.

Under the version appended to the August 18, 1989, rolling text, all challenges are relayed to the challenged Party, which in exceptional cases may propose an

*The Soviets have made it known that they will allow exemptions of private living quarters from this provision; the official U.S. position is not known.

alternative to full access. If the requesting Party rejects the alternative, the inspection may proceed without undue delay. This procedure has potentially serious implications for facilities with sensitive security, commercial, or privacy interests, because it eliminates the right of refusal.

Article X of the 1984 U.S. draft (Special OSI) offers no alternatives or exemptions for declared and government-owned or -controlled facilities. Government-controlled facilities include agencies like DOE and contractors, which are broadly defined to include anyone supplying goods and/or services to the government. Heavily regulated industries are also considered to be government-controlled.[6] Any Party may solicit from any member of the Fact-Finding Panel a request for an inspection of any other Party. However, under Article XI (Ad Hoc Inspections), which covers facilities not included in Article X, only those challenges deemed appropriate by the Fact-Finding Panel are presented to the challenged Party. Article XI also permits the challenged Party to propose an explanation and an alternative to full access; these are assessed by the Fact-Finding Panel. If they are rejected, the request can be repeated; if it is denied for a second time, the U.N. Security Council is notified. Referral of the problem to an oversight body presumably does not result in inspection, but the appropriate consequences are not yet defined. Thus, the U.S. draft incorporates a qualified right of refusal for undeclared facilities not owned or controlled by the government.

2.2.1.5 Procedures

A time limit would be specified, according to the appendix to the Ad Hoc Committee report, for the inspectors to be allowed entry. Under the American draft, the Technical Secretariat would notify the Party to be inspected within 24 hours of the request (or the decision by the Fact-Finding Panel to make such a request), and access would be granted to inspectors within 24 hours after notification. The appendix also states that inspectors would be granted access to the site area they deem necessary, while the U.S. draft leaves definition of the area to be inspected to an unwritten Annex. Abuse of this privilege could lead to overly intrusive inspections. The inspected state could propose how the inspection would be conducted, but the decision would be the inspectors'. Inspectors would be expected to inspect in the least intrusive manner. Again, under the appendix, inspectors would be in control in a potentially very intrusive situation.

The American draft calls for agreement in advance on procedures for all on-site verification. Strict guidelines for all decisions to be made during inspections would provide consistency and predictability and would help to preclude confrontations on site. The United States and the Soviet Union are reported to have "reached agreement on a very complete, detailed proposal for the conduct of challenge inspections."[7]

2.2.1.6 Number of Challenges

No treaty language exists on the subject of the number of challenges that would be permitted, but the U.S.-Soviet memorandum of understanding allows each side five challenges in the four-month period before a multilateral treaty is initiated.[8] The

number of challenges any Party could call for, the number of times a Party could be challenged, or both, could be limited by the treaty. Having a specific numerical limit would open the possibility that a nation wishing to violate the treaty could first trick other treaty Parties into exhausting their allowed challenges. If no numerical limit were specified by the treaty, the number would probably be limited by the costs of inspection and the fear that a Party challenged excessively would retaliate in kind.

2.2.1.7 Ad Hoc Inspections

Alternative or additional types of inspection have been proposed by the West Germans and the British. The ad hoc inspections proposed by West Germany would have the limited purpose of verifying that no unreported production of scheduled chemicals was occurring. The eligible sites would include declared and nondeclared facilities; each nation would be required to submit a national register of its chemical industry to the Technical Secretariat. Facilities to be inspected would be selected at random (but with a weighting factor included), thus avoiding the confrontational aspects of challenge inspections.[9] These routine inspections could perhaps be less intrusive than scheduled or challenge inspections, possibly limiting measurements to the site perimeter if no evidence of noncompliance were found.

Under the British proposal, ad hoc inspections would be initiated by State Parties, rather than by an international authority. Both civil and military facilities would be eligible, and each Party would be obliged to receive an annual quota of inspections.[10] U.S. Ambassador Friedersdorf has stated that "while the two approaches are somewhat different, both have strong points that could be incorporated in an eventual provision for ad hoc verification. We hope that such a provision can be developed relatively soon."[11]

2.2.2 Sanctions

If verification activities revealed evidence of treaty noncompliance, sanctions could be mandated by the Organization for the Prohibition of Chemical Weapons, on the basis of carefully specified guidelines governing conditions under which they would be imposed. The threat of sanctions might be expected to provide some disincentive for treaty violation. The question of sanctions is not addressed in the American draft of the Chemical Weapons Convention, but it is discussed in an appendix to the rolling text. Current draft provisions at most refer possible violations to an international body (e.g., the U.N. Security Council), but no action is suggested. Egypt has called for insertion of sanctions for treaty violation, to be applied without discrimination or delay, and France has suggested an embargo on all product and technology deliveries to any state using chemical weapons. East Germany has called sanctions a key issue to be discussed. The head of the Iranian delegation to a recent conference in Australia on CW has stated, "If a violation is discovered and nothing is done, then the treaty is a waste of time and money."[12] The U.S. State Department accepts "in principle that some form of sanctions, if appropriately formulated, would give the Administration an additional instrument against countries that use chemical weapons and companies that aid proliferation.

Application of such sanctions must be subject to executive discretion, and there must be no automatic triggering or retroactive application."[13]

A series of economic and political sanctions can be envisioned. Some could be imposed by the U.N. Security Council, which has the authority to adopt international sanctions in response to a threat to peace and could adopt a resolution declaring violations of the Chemical Weapons Convention to be such a threat. First, any weapons or facilities found in violation of the CWC could be seized and destroyed, perhaps along with any support facility so that it would be more difficult to replace them. This could be done in an orderly way under U.N. authority. The second, and probably the most important, threat is economic sanctions. Imposition of such sanctions by a large number of nations could make them highly effective. Direct financial measures could include retraction of credit and credit guarantees, refusal and calling in of loans, and punitive tariffs. Other economic measures could include restrictions on exports of goods and technologies to the offending Party, as well as curtailing imports from it. Political reprisals by individual treaty Parties, including imposing travel restrictions, censure and breaking of alliances or diplomatic relations, are also possible, but these might have limited effectiveness. Another possibility would be revocation of any privileges granted under the treaty, such as the right to call for challenge inspections. This sanction would be imposed by the treaty organization itself.

2.3 REFERENCES

1. *Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament*, Conf. on Disarmament Document CD/952 (Aug. 18, 1989) ["rolling text"].

2. *Draft Convention on the Prohibition of Chemical Weapons*, Conf. on Disarmament Document CD/500 (April 18, 1984).

3. *Final Record of the Four Hundred and Ninety-Eighth Plenary Meeting*, Conf. on Disarmament Document CD/PV.498 (March 28, 1989).

4. Bush, G.H.W., speech at the University of Toledo (Oct. 21, 1988) [quoted in Chemical Weapons Convention Bulletin No. 3].

5. Chemical and Engineering News *66* (March 28, 1988).

6. Tanzman, E., *Constitutionality of Warrantless On-Site Arms Control Inspections in the United States*, 13 Yale J. International Law *21*:34-35 (1988).

7. Pear, R., *U.S. and Moscow Settle Key Issues on Chemical Arms*, New York Times (July 18,1989) [quoting Ambassador Max Friedersdorf].

8. *U.S.-Soviet Memorandum of Understanding on Chemical Weapons*, U.S. Arms Control and Disarmament Agency Issues Brief, Washington, D.C. (Sept. 23, 1989).

9. Conf. on Disarmament Document CD/869 (Sept. 6, 1988) [reported in Chemical Weapons Convention Bulletin No. 2].

10. Conf. on Disarmament Document CD/909 (March 30, 1989) [reported in Chemical Weapons Convention Bulletin No. 5].

11. *Final Record of the Five Hundred and Twelfth Plenary Meeting*, Conf. on Disarmament Document CD/PV.512 (June 27,1989).

12. Scott, D.C., *Chemical Industry Joins Fight to Ban Weapons*, Christian Science Monitor, p. 6 (Sept. 25, 1989).

13. Holmes, H.A., Assistant Secretary of State, prepared statement to a subcommittee of the House Foreign Affairs Committee (May 4, 1989) [reported in the Washington Post (May 5, 1989)].

3 VERIFICATION OF THE CHEMICAL WEAPONS CONVENTION

This section examines how a Chemical Weapons Convention might be verified. First, in Sec. 3.1, we consider the purposes that verification should serve. Then, in Sec. 3.2, we consider how -- and if -- the proposed CWC provisions could be verified so those purposes were fulfilled at declared and undeclared sites. The approach is to examine technical feasibility and determine if appropriate technology is available or could be developed, rather than to select the most appropriate instruments. A complete survey of both requirements for and capabilities of verification technology is recommended before specific instruments are selected.

3.1 PURPOSE OF VERIFICATION

Arms control treaty verification should be designed to provide assurance that no militarily significant violations of the treaty are occurring, and that any attempts at violation are discovered in time to allow effective treaty-mandated response.* For the purpose of this discussion, a militarily significant violation is defined as one that would give one treaty Party a significant advantage over another in armed conflict or in negotiations. The magnitude of CW activity that constitutes a militarily significant amount differs according to the location and the scenario for weapon use. One author, from Czechoslovakia, considers militarily relevant quantities of chemical warfare agents to be on the order of 100 metric tons,[1] while another source in France estimates approximately 10 times this amount of agent to be the minimal militarily significant quantity.[2] The current U.S. stockpile is commonly reported to be about 30,000 metric tons, and the Soviets claim stocks amounting to 50,000 metric tons.[3] Careful analysis is required to define minimal levels that will constitute a militarily significant treaty violation.

Verification cannot prove conclusively that a CW treaty is being scrupulously observed. However, it can be expected to reduce significantly the probability and magnitude of undetected noncompliance. It does this in several ways. First, by providing a systematic regime of observation of each treaty Party, verification increases the probability of detecting unauthorized activities. Second, verification would force the potential treaty violator to take extraordinary measures to avoid detection. Such measures might include covering or disguising the purpose of a facility, operating in a remote or other unusual (and presumably inconvenient) location, running at night, capturing all effluents, etc. All of these measures increase the cost of clandestine operation and make it more difficult to accomplish widespread or large-scale violations. Finally, the economic and political costs of being caught violating a treaty could be made large enough to further discourage potential noncompliance. The combination of higher costs and lower probability of success reduces any expected gain and makes noncompliance a less attractive option.

*For some treaties, but not a Chemical Weapons Convention, it might also be expected to provide complete assurance that the letter of the treaty was being observed exactly.

Insistence on verification does not imply that treaty Parties expect noncompliance. Noncompliance by another treaty Party is a potentially high-consequence event to consider ensuring against as long as its probability of occurrence is nonzero. If verification can prove or build confidence that other treaty Parties are complying, no Party has an incentive to violate the treaty to ensure against possible breakout by others. Confidence can be further enhanced by data exchanges, joint experiments, site visits, and other measures outside the scope of formal treaty verification. Mutual confidence also enhances the path of negotiation on additional arms control treaties.

Some areas of the world might be considered to be more of a threat than others with respect to chemical weapons. Verification in such areas should be designed with particular care. There is a question as to whether chemical weapon use by the superpowers represents a real military threat. The Soviet Union could possibly achieve significant advantage in Europe by using chemical weapons, but with other types of weapons at its disposal, and the high assurance of escalation, the CW threat is relatively low. As stated by a career foreign-service officer with the State Department, "Bluntly, neither NATO nor the United States will lose Europe because of Soviet chemical weapons use."[4] The greatest threat arises where CW represents a significant force multiplier to the military power of a nation, as in the Middle East, where some Arab nations claim to view chemical weapons as their counter to Israel's presumed nuclear force. In such areas, verification must assure all treaty Parties that their neighbors (who represent a real and present threat) do not have a CW capability. Verification of nonproduction in these areas, which are not highly industrialized and would probably use the simplest processes, should be a much easier task than in nations with large chemical industries in which to hide illicit production activities. Treaty verification could also uncover some illicit CW activities by terrorist groups and thereby reduce their chances of obtaining significant quantities of CW materials.* Strict export controls could be expected to deter shipments of CW precursors into these areas.

3.2 HOW (AND HOW WELL) A CHEMICAL WEAPONS CONVENTION COULD BE VERIFIED

Verification of declared materials and facilities is likely to be much easier than verification of compliance by means of challenge inspections. Declarations represent a cooperative measure. The host has identified what to look for and where; it is likely to be there. Only facilities whose other interests can be protected satisfactorily are likely to be declared. A challenge inspection, however, constitutes by definition an adversary relationship; the inspecting Party is looking for something the host has, by omission, declared not to be there. Not only must the challenging party identify something unknown, but it must locate the site at which to search. The host may have other interests there to protect, even if no proscribed activities or materials are present. It is for these reasons that the provisions for inspection at declared facilities have been agreed on, while challenge inspections are still the subject of debate.

*The problem of terrorism is beyond the scope of this report.

3.2.1 Declared Materials and Facilities

There are not likely to be many facilities declared worldwide to handle Schedule 1 chemicals. The number producing Schedule 2 chemicals has been estimated to be on the order of 100, with on the order of 500 users.[5] The number of Schedule 2 producers and users is very similar to the total number (600) of facilities inspected by the International Atomic Energy Agency (IAEA) Department of Safeguards in 1987.[6] Many chemical manufacturing plants in the private sector will be declared as Schedule 2 or 3 producing or using facilities. DOE has few facilities that would be declared to hold or have the capability to produce chemical weapons agents or related compounds. The U.S. Department of Defense (DOD) controls CW production and storage facilities.

This section outlines possible methods for verification of the types of materials, facilities, and activities that would be declared under a Chemical Weapons Convention.

3.2.1.1 Verification of Chemical Weapons

Stockpile, Transport, and Storage Prior to Destruction. The purpose of verification procedures would be to verify the identity and quantity of CW materials and munitions in storage or transport.

Sampling, plus tamper-resistant or -indicating container seals that can be authenticated, would allow high-confidence verification of declared contents of storage drums with known technology. Careful handling and sealing techniques are needed to ensure the safety and integrity of samples. Gas chromatography and mass spectrometry are two technologies suggested in the rolling text for materials identification.[7] Assurance would be needed that material could not be removed from drums without tampering with the seals. Facility seals (similar to those used by IAEA for fissile-material accounting) would assure that the contents of a storage facility or transport vehicle remain undisturbed. Improvements are possible in sample-taking and -handling techniques, potentially important because of the highly toxic nature of the materials to be sampled. In addition, development of techniques to determine the contents of a sealed storage container would provide a safer, less intrusive means of verification. One possibility would be to use infrared or ultraviolet spectroscopy to identify process materials by means of optical fiber links.

The rolling text suggests but does not specify inventory-control procedures. Data on facility contents should be entered into a carefully engineered computerized data base that automatically adjusts totals and appropriately handles material movements and destruction. Cross-checks to determine any material unaccounted for could also be included. The data base could also include information on the scheduled destruction dates for each batch of material and flag those coming due. Some individual facilities are known to have already computerized data handling. The rolling text suggests development of procedures for data protection, authentication, and transmission. This is one area where IAEA experience can provide useful guidance.

Destruction. The purpose of verification procedures would be to verify the identity and quantity of CW agents and munitions destroyed.

Sampling before and after destruction, perhaps coupled with video monitoring of the process, would provide sufficient verification of agent destruction. More sophisticated and less intrusive methods, such as chemical sniffing of combustion gases if the material were to be burned, could be used as they were developed in place of sampling, provided the treaty and model agreements are not made too specific regarding actual methods of verification. The rolling text would allow inspectors to request samples, but it would not require them to do so. Safe methods for destruction of chemical weapons agents and munitions must be assured. Some people in the U.S. believe that current methods for opening old containers and destroying the contents do not sufficiently protect against material releases.[8] The method currently used in the U.S. for destroying old munitions and bulk agents is high-temperature on-site incineration, but other, chemical methods are possible. The quantities of material to be destroyed are sufficiently small and low-value that recycling need not be considered for economic or conservation purposes.*

3.2.1.2 Verification of Production Facilities

Facility Closure. The purpose would be to verify that CW production operations had ceased at declared facilities.

Simple visual inspection would be sufficient to assure that operations had ceased at chemical weapons plants. Permanent surveillance would not be needed, because these plants would be scheduled for destruction after closure. Various sensors, such as closed-circuit TV and/or motion detectors at key internal locations and portals, continuity sensors to detect door opening, microwave or infrared intrusion sensors, and strain gauges to detect vibrations, coupled with facility seals, could provide high assurance that production did not restart. In fact, surveillance by national technical means (NTM) would probably be sufficient to detect activity at a site, unless extraordinary measures were taken to hide traffic in and out and process effluents and heat. If the facility were converted to a temporary destruction facility, its operation over that period would require careful monitoring to assure that it weren't converted back.

Facility Destruction. The purpose would be to verify that CW production facilities had been rendered permanently inoperable.

The ease with which facility destruction could be verified would depend on the definition of destruction adopted in the treaty addenda. If destruction were taken to mean dismantlement or razing, one-time simple visual inspection would be sufficient to

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*This is not the case for materials in warheads taken out of deployment under the Strategic Arms Reduction Treaty (START).

assure facility destruction. If less extreme damage were permitted, some monitoring would be required to assure against restarting.

3.2.1.3 Verification of Permitted Activities

Small Permitted Facility. The purpose would be to verify the identity and quantity of the materials produced.

Inspection, perhaps including sampling, would be allowed at the one small facility producing Schedule 1 chemicals for research or medical purposes that each treaty Party would be permitted to operate. The issue here would not be what was being produced -- it would be known to be CW agents -- but how much. Monitoring of plant data would help raise confidence levels that agreed production was not exceeded, but data monitoring could only be expected to assure approximate quantities; deviations of several percent from declared quantities would probably be undetectable. In the case of the small facility, deviations would not be militarily significant (the one-metric-ton maximum annual total production is defined to be insignificant; small deviations from this are even more so). Inspection would verify the plant capacity and assure that significantly greater-than-declared quantities of agent could not be produced without major equipment changes. Visual inspection of reactor vessels, piping, storage areas, etc., perhaps coupled with some measurements of reaction vessel size, should provide sufficient verification.

Production of Precursors and Related Chemicals. The purpose would be to verify the identity and quantity of the materials produced.

The rolling text specifies on-site inspection and monitoring and data monitoring for Schedule 2 facilities. As with any regime permitting sampling, less intrusive alternatives would be desirable, especially since inspection must not impair processing. Inspection and sampling could verify that the declared products were being produced at the time of the inspection, but they might not be able to determine whether the process had been modified. Techniques to detect residuals from past production would be useful to provide evidence of prohibited activities no longer in progress. Their effectiveness would depend on how well the area had been cleaned up when the activities ceased. The Finnish trial inspection demonstrated that evidence of production of a related chemical that had ceased two months earlier could be detected in wipe samples, air samples, and waste samples, but not in process samples.[9] In addition, chemical monitors could probably be installed at key process locations to detect process-stream composition continuously and verify declared activities. Optical-fiber probes inserted permanently into process lines could be used to provide infrared or ultraviolet spectra to verify the identity and amounts of materials present.

Examination of the size of the equipment, coupled with material input and output data, could provide information on the quantity of material produced. If the plant were run at a high capacity factor, total production would be known to within a few percent.

If the plant were declared to run at less than full capacity, it might be possible to produce significantly more material using inputs not on the declared data accounting. However, various forms of monitoring could detect such undeclared production.

It is important to consider the precision to which material flows within a chemical plant are known and recorded. If uncertainties of even a fraction of a percent are the norm, a significant quantity of material could be unaccounted for because of the large volumes involved in commercial chemical manufacture. Systematic diversion of a small percentage of the output from a chemical plant could probably represent a militarily significant quantity of agent-related material. This is a possible weakness in verification at declared facilities. The U.S. Department of Transportation allows a 1% discrepancy in hazardous-material transport data, so shipment records are only accounted for to 1% accuracy. At the National Trial Inspection Site (AKZO Chemicals, Inc., Gallipolis Ferry, W.Va.), this would result in an annual uncertainty of 5-6 tons of trimethyl phosphite (used to manufacture dimethyl methyl phosphonate, a Schedule 2 chemical).[10]

An important point on data from chemical production (Schedules 2 and 3) is that data handling will be a not inconsiderable problem, and compatibility of equipment among treaty Parties must be established. At present, some countries may not even be collecting the relevant data, and infrastructure for measurement and data collection would need to be established. Interpretation of the data would require a process model detailing material flows.

3.2.2 Challenge Inspections

It has been argued that challenge inspections are unlikely to discover treaty violations, which may be true. It is certainly true for scheduled inspections, mainly because violations are unlikely to occur at all with the government's knowledge when nations willingly sign a treaty that is in their best interests, and when the risks of violation are significant. However, individual companies within nations that are Parties to the treaty might be tempted by the high profits associated with dealing in contraband merchandise. The question to be asked is, "If a violation were committed, how could verification maximize the probability of its detection?"

DOE and contractor facilities are expected to be eligible for challenge inspections under either Article X of the 1984 U.S. draft[11] or under the version in Appendix II to the report of the Chemical Weapons Convention Ad Hoc Committee.[7] Both versions allow "anytime, anywhere" inspections. These challenge inspections also include short-notice inspections of declared facilities. "Right of refusal" remains to be negotiated (see Sec. 2.2).

This section discusses what types of violations might reasonably be discovered by means of challenge inspections. Relatively small quantities (compared to production of commercial chemicals) of agents or key precursors could be militarily significant (how much should be determined), and these materials have no simple, common signatures analogous to radioactive emissions that would make them easy to detect. One prerequisite for challenge inspections (this would be useful for scheduled inspections as

well) is a complete data base containing information about all known CW agents and their precursors, by-products, and degradation products. In addition to such obvious requirements as physical properties (color, odor, vapor pressure, boiling and freezing points, solubilities, etc.), which are already tabulated, chemical properties (reactivity, stability) and spectral data would be critical components of the data base. Information about standard production processes and their effluents is also needed. The data base could, of course, be used in two ways: given an agent, all of its properties could be retrieved, perhaps for use at a declared facility; or, given a specific property (e.g. an infrared absorption line), any agent or agent-related compound with that property could be identified. A series of volumes detailing the compositions of known CW agents and laboratory identification procedures for them, plus a computer data base of their characteristics, has been reported in Finland.

Additional study is needed to develop the least intrusive means possible for challenge inspections. This is related to the question of how sites for the presumably limited (either by treaty, by funds, or by the fear of excessive challenges in return) number of challenge inspections could be identified. It is anticipated that challenge inspections would be aimed at looking for either illicit production or storage of CW agents or key precursors. The problems of site identification in industrialized nations using technical means are extremely difficult for suspected production (see Sec. 3.2.2.1); for storage, they may be insurmountable (Sec. 3.2.2.2). J. Miettinen of the Finnish Project on the Verification of Chemical Disarmament has been quoted as saying, "To say we can discover all hidden stockpiles -- well, we can never say that."[12] Random searches of likely facility types, together with human intelligence, might be the best of many unsatisfactory approaches to maximizing the chances of finding hidden material. However, searches at randomly selected sites might be unconstitutional in the U.S. Once sites have been identified, characterization of the activities and materials present is a less difficult task.

3.2.2.1 Suspected Production Sites

Site Identification. The probability of finding illicit production sites would, of course, depend on how much trouble a Party committed to violating the treaty were willing to take to conceal these activities. If verification could not assure full treaty compliance, it could raise the costs of noncompliance high enough to make it less likely. (One possible strategy might be to mandate verification to the level where cheating is not cost-effective at the margin; that is, cheating would cost more than finding the violation.) This discussion considers normal operation of a chemical production plant to be the baseline. Actions that would hinder detection of illicit activity are noted.

Illicit production of CW agents could occur either at a facility purporting to have some entirely different purpose, or at a chemical plant producing other, permitted compounds. Production of proscribed chemicals at a chemical plant would probably be harder to detect, because the general signs of chemical production would be expected there. (Hide a duck in a flock of ducks.) These signs might include tank-truck deliveries, distillation columns, and stacks. While these signs could be sought elsewhere, it might

make sense to concentrate the search for illicit production at chemical plants (and plants using key precursors). This would serve to drastically reduce the number of sites to focus upon. Signs of Schedule 1 production that might be observed during routine visits to chemical plants include isolated equipment, extra scrubbers, protective clothing, tight security, and laboratory-analysis equipment capable of dealing with toxic materials.

Capabilities for site identification in industrialized nations by remote monitoring means (i.e., NTM) are limited, because the processes have no unique signature. Ideally, CW agent production would yield telltale by-products that went up the stack and could be detected by a spectrometer in a satellite. (Not all treaty Parties are likely to have their own satellites, so relevant NTM data might have to be shareable with the CW Executive Council if it were necessary to justify the challenge.) To mask the illicit activity, a carbon-absorption filter could perhaps be added to the effluent line. Heat releases might be detectable by infrared photography, but this would only provide evidence of the existence, not the nature, of a processing activity. Similarly, vehicular movement in and out of a site provides nonspecific evidence for activity. Additional means for remote detection and identification of chemical production could be sought.

Possibilities for identification of illicit chemical production are improved if measurements and samples can be taken near (or over) potential illicit CW sites. The effluent and environmental sampling techniques described in our previous report[13] could all be applied. Effluents could be sampled for routine release of agent hydrolysis products, or monitors could be installed to detect occasional, unplanned releases of agents or precursors. More information is required on the details of CW production processes to assess the effectiveness of such techniques in identifying the activities at production plants. A Chemical Weapons Convention could include provisions for such in-country monitoring. This might allow sufficient information about a large number of sites to be collected to allay suspicions without actually requiring a full-fledged, intrusive challenge inspection. Alternatively, a pre-challenge could be permitted to allow limited data collection at a possible site. The number of such pre-challenges could be considerably greater than the number of actual challenges, because they would likely be considerably less costly and less intrusive.

Inspection at Challenge Sites. Neither the appendix to the Ad Hoc Committee's report nor the U.S. draft specifies procedures for use at challenged facilities. Several uncertainties lead to a wide range of possible scenarios for challenge inspections. The first uncertainty concerns the length of time allowed between challenge notification and inspection, and whether there is a standdown at the challenged facility during that time. A chemical production facility can be switched from one product to a similar one in a relatively short period of time (perhaps 24 hours).[12] If the time between inspection notification and the beginning of the inspection permitted plant personnel to halt illicit production and destroy proscribed materials, it would be more difficult to find, but complete cleanup of any real violation is probably impossible. Techniques for identifying remaining traces of activities that have been halted or materials that have been destroyed would be important here.

Ideally, challenge inspections should take place before the product can be changed, or activity should be stopped to prevent any such change. The appendix to the Ad Hoc Committee's report calls for inspectors to arrive within 24 to 48 hours (not yet agreed) and for the site to be secured. This would prevents removal of materials relevant to the inspection, but it would not stop internal activity.

The inspected facility may have unrelated security interests that it wishes to protect before inspectors are permitted to enter. Sufficient time should be allowed for legitimate site preparation. The goals of inspecting in a timely manner and allowing time to secure sensitive information may be difficult to satisfy simultaneously. Under the appendix, the host may propose protection measures, which the inspecting Party may or may not permit. The U.S. draft calls for protection of sensitive information and therefore embodies less potential for loss of sensitive materials and information.

Once inspectors are permitted to enter a challenged site, several guidelines for their conduct are proposed, but no definite procedures are agreed upon by the Conference on Disarmament. The U.S. and the Soviet Union are reported to have agreed on procedures. Agreed procedures could be expected to be similar to those for scheduled inspections. The U.S. draft states that procedures for collecting samples and taking photographs should be developed, and the appendix could plausibly be interpreted to allow sampling, since the rolling text does so for other scenarios. Otherwise, the equipment to be used is not specified, but both versions of the text suggest that technological developments should be taken into account to maximize the effectiveness of the inspection. This opens the door for use of more sensitive and selective and/or less intrusive instruments that might be developed. It is unclear, however, whether the shift would be to greater sensitivity and selectivity with the same intrusiveness, or to less intrusiveness.

As with the scheduled inspection of chemical plants, substitutes for sampling would probably be safer and less intrusive. These include means for interrogating a vessel without opening it and trace analysis of air samples for signature compounds related to CW agents and for extremely low levels of agents themselves. Information is required on levels of agent-related compounds that could reasonably be expected. (Toxic levels would presumably not be present in a workplace.) Some of the agent detectors described in a recent Chemical Research, Development, and Engineering Center (CRDEC) report might be sensitive enough for this purpose.[14]

Inspectors can learn some things about a facility by visual inspection. They can learn the scale of processing, and they may be able to detect recent changes in equipment configuration. In addition, if they are familiar with chemical process plants, they can tell whether extraordinary measures have been taken to protect personnel from presumably very toxic compounds or to clean up process effluents. Data examination would be a confidence-building measure, but the suspicion that a "second set of books" was being kept just for inspectors would be difficult to overcome.

3.2.2.2 Suspected Storage Sites

Prospects for identification by technical means of locations holding clandestine stocks of CW agents are not promising, because no remotely visible signature is expected

to be present. However, if production is strictly monitored for several years, fears about hidden stocks may be expected to diminish, because such stocks would be aging and therefore might have lower expeeted reliability and utility. In addition, as delivery systems for them become obsolete, the utility of old stocks is further reduced.

The first factor affecting the difficulty of finding hidden stocks is the quantity of material sought (presumably related to however much is determined to be militarily significant). The smaller the quantity, the easier it is to hide; however, the amount must be militarily significant to be worth hiding. The second factor is how well the containers are sealed. Leaky weapons, if not enclosed in larger containers like some old U.S. munitions, could probably be detected from relatively close range with a chemical sniffer. It would be useful to know what leakage, if any, would be expected from more modern standard containers or munitions.

If a suspected storage site were identified and challenged, sampling might be permitted. This would conclusively identify the material present.

3.3 REFERENCES

1. Matousek, J., *Monitoring Methods in Industrial Production Relevant to the Projected Chemical Weapons Convention*, in Non-Production by Industry of Chemical-Warfare Agents, S. Lundin, ed., Stockholm International Peace Research Institute, Oxford University Press (1988).

2. *Chemical Arms Control*, Public Interest Report *40*(10), Federation of American Scientists Fund, Washington, D.C.

3. Gordon, M.R., *Kremlin Accepts Early Inspection on Chemical Arms*, New York Times (August 3, 1989).

4. Jones, D.T., *Eliminating Chemical Weapons: Less Thar Meets the Eye*, Washington Quarterly, pp. 83-92 (Spring 1989).

5. Apt, K.E., *Chemical Warfare Arms Control: Issues and Challenges*, Center for National Security Studies, Los Alamos National Laboratory, Report No. 6 (Nov. 1988).

6. von Baeckmann, A., *The Chemical Weapons Convention and Some IAEA Experiences*, in Non-Production by Industry of Chemical-Warfare Agents, S. Lundin, ed., Stockholm International Peace Research Institute, Oxford University Press (1988).

7. *Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament*, Conf. on Disarmament Document CD/952 (Aug. 18, 1989) ["rolling text"].

8. Smith, R.J., *Army Poison Gas Stockpile Raises Worries in Kentucky*, Washington Post, p. A1 (Jan. 22, 1989).

9. *Final Record of the Five Hundred and Third Plenary Meeting*, Conf. on Disarmament Document CD/PV. 503 (April 13, 1989).

10. Bowen, R., U.S. Department of Energy, personal communication (March 14, 1989).

11. *Draft Convention on the Prohibition of Chemical Weapons*, Conf. on Disarmament Document CD/500 (April 18, 1984).

12. Thatcher, G., *The Sherlock Holmeses of Chemical Detection*, Christian Science Monitor Special Report, *Poison on the Wind*, Part 4 (Dec. 16, 1989).

13. Gaines, L., et al., *Accommodation of On-Site Inspection at DOE Facilities*, Argonne National Laboratory Report ANL/ACTV-88/2, (Oct. 1988).

14. Mengel, R.W., et al., *Compliance Monitoring of a Proposed Draft Convention on the Prohibition of Chemical Weapons: An Update*, Chemical Research, Development, and Engineering Center Report CRDEC-CR-88086 (Aug. 1988).

4 IMPLICATIONS OF CHEMICAL WEAPONS CONVENTION VERIFICATION

This section examines the possible implications of the Chemical Weapons Convention (CWC) verification regime described in Sec. 3. Sections 4.1-4.3 set forth implications for the U.S. Department of Energy, other government agencies, and the chemical and other industries. DOE would be affected because it could take the lead role in development of technology, both for verification and for protection of sensitive information. All organizations share similar concerns about potential losses of information they guard and about potentially large financial costs of being inspected. Private firms subject to inspection could resist on Fourth Amendment grounds; several options are presented for mitigation. There are also potentially high costs involved with carrying out inspections. These include the costs of manpower, travel, and equipment, both for inspection and for protecting the inspectors,* as well as the costs of setting up and operating the appropriate agencies. These costs are not detailed here, but they do require study. The section concludes with an examination of the implications of recognizing the imperfect verifiability of a CWC (Sec. 4.4).

4.1 IMPLICATIONS FOR DOE

4.1.1 OSI at DOE and Contractor Facilities

Inspection at a DOE or contractor facility could have several implications, including loss of sensitive information or materials and direct and indirect financial costs. (See our previous report.)[1] Verification of CW treaty compliance is one of the most difficult technical challenges facing arms control researchers, and relatively intrusive means may be required. In addition to on-site inspection, which permits direct access to anything in a facility, data monitoring of contractors might allow access to a variety of company records that would reveal process information and customer information as well. This will be discussed further, along with possible losses of other proprietary information, in Sec. 4.3.

4.1.1.1 Potential Losses of Material and Information

In the case of DOE and its contractors, it is worth identifying and analyzing the actual dangers involved in potential losses during on-site inspection. What kinds of materials might be lost, and what value might they have to an inspector trying to acquire intelligence information? DOE has responsibility for special nuclear materials (SNM), and facilities housing such materials could be subject to challenge OSI. An inspector could certainly carry and hide on his or her person, in a few trips, enough material to

*Potential health and safety problems are possible during scheduled or challenge inspections for chemical weapons because of the extremely toxic nature of the materials involved. Personnel protection equipment should be used when appropriate to guard against toxic levels of CW agents.

produce a weapon, but several factors make this type of theft highly improbable. Inspectors will be observed by the escort team, but complete reliance on this method is unwise and unnecessary. First, SNM supplies are locked up to protect both them and personnel. Significant quantities are kept only in vaults in material access areas, and these areas are subject to strict access controls, including exit searches and portal monitors.[1] Inspectors could presumably be denied access to vaults, which are generally too small to hold significant quantities of CW agents. Second, inspectors can be required to put on and return after the inspection protective coveralls without pockets to make taking of all but swipe samples very difficult. A swipe sample might allow quantitative determination of the material processed at the facility, but this information probably would be of limited utility. Finally, inspectors can be expected to pass through radiation or metal detectors after the inspection, both for theft detection and for their own safety. Even small samples can probably be detected this way. Therefore, SNM are not likely to be lost during an on-site inspection.

Several types of classified information could be considered to be at risk during OSI. The most difficult of these to protect concerns design information or the existence of processes or objects that are difficult to cover. An exclusion area is a DOE security area where mere access results in exposure to classified matter. Careful consideration should be given to what value this information would have to a potential enemy. If the sensitive area were really worth protecting and could not be sufficiently shrouded, it might be possible to limit or deny access. Portals, vents, and other facility outlets could be monitored, and probes could be placed inside by authorized personnel. Vital areas (housing equipment that would cause interruption in a national security program if it failed) could be subject to the same access limitations if inspection were judged to pose a real danger to operation.

Access could also be limited by nationality. Even though team members will be carefully chosen and expected to adhere to a strict standard of conduct, they are foreign nationals who will observe and learn from their visits. The level of concern here depends on whether or not the nations represented already know the sensitive aspects of the work conducted at the inspected facility. For instance, a Soviet visitor to a U.S. nuclear weapon factory might conceivably ascertain how to improve weapon-production efficiency (if key weapon-production equipment were not shroudable), but this information probably would be of limited technical value compared with the knowledge that might be gained by an inspector from a non-nuclear state at the same facility. If this is the case, a possible solution to this problem would be to restrict the composition of teams inspecting sensitive facilities. For instance, basic nuclear weapon information could be protected during inspection of nuclear weapons plants and material production facilities by allowing only inspectors from advanced nuclear-weapon states. Compartmentalized data would still require protection. Such a plan may encounter resistance from nations that feel discriminated against by this procedure. The IAEA may have relevant experience.

Classified documents could routinely be placed inside safes, desks, or boxes (as they are in many facilities) and thereby protected from viewing by inspectors. Inspectors would neither need nor be permitted to open the containers, but they could be permitted

to put probes on or in them. This system should be sufficient to satisfy inspectors' legitimate concerns and still safeguard classified information.

The final category of information, which is more difficult to define, concerns operation security (OPSEC). Information about personnel names, facility size, operation schedules, protection procedures, etc. could be useful to a hostile Party. Some information of this type could presumably be protected by covering or disguising sensitive items, such as nameplates, and by altering the procedures used during the inspection, but some of this information may not be protectable. Repeat visits to a site are likely to compound the possibilities for information loss. Further investigation is required to confirm the efficacy of the suggested protection measures and to identify and evaluate any unavoidable losses.

In summary, possible losses under several alternative inspection regimes should be carefully evaluated, but most DOE security interests are unlikely to be put at significant risk during OSI if a few precautions are permitted. Shrouding and containment of sensitive items could be effective in protecting much classified information. Access limitations could be necessary in certain exclusion areas or vital areas if protection were otherwise impossible. Basic nuclear weapon information and materials could be protected by restricting composition of inspection teams.

4.1.1.2 Financial Costs

Financial costs of undergoing inspection include direct and indirect expenditures. Direct expenditures include purchasing and installing shrouds and containers for protection of sensitive items and tagging and sealing TLIs. In the case of a CWC, DOE probably will have few, if any, TLIs. Financial costs for monitoring equipment vary, from simple devices in the $100 range, such as flowmeters, to in-line composition-measurement devices, which might cost thousands of dollars each. Total costs for installation of several monitoring devices at each eligible facility could be substantial. One source estimates the costs for equipment to monitor one plant at about $250,000.[2] It will be necessary to decide who pays these costs. Possibilities include the entities monitored, their national governments, and the international inspectorate.

Shrouding at facilities where there are large numbers of objects to cover could be costly, in part because the materials used must meet flammability standards. DOE has some preliminary cost data for site preparation. Less expensive materials could be sought, as well as other protection measures that might be less time-consuming to implement.

Indirect financial costs result from disruptions of normal operations. Production facility operations might need to be shut down for safety reasons in the event of an inspection, to allow inspectors unrestricted access to equipment areas, or because the facility could not operate with shrouds in place. In addition, the plant operators might not want the inspectors to observe normal operating procedure or have access to plant personnel.

Costs to the inspecting Party or organization of carrying out treaty verification have not been examined in detail. The IAEA conducted more than 2,100 inspections at 600 facilities in 1987, at a cost of over $40 million.[3] The total cost of the U.S. trial inspection, including extensive planning, was estimated at $100,000.[4] No equipment costs are believed to have been included in this estimate. There are additional costs for the infrastructure that will be needed to oversee the verification operations, as well as costs for R&D on equipment and protective measures. Costs for alternative inspection regimes should be estimated, compared, and weighed against the projected efficacy of each alternative. Agreement must be reached on allocation of these costs among treaty Parties. Some nations with no reported CW capability (e.g., Venezuela) may be willing to sign a treaty but unwilling to foot the bill.

4.1.2 Verification Technology Development

DOE could have a major role in the development of technology for arms control treaty verification. The most important reason is the vast array of expertise in basic and applied science available at the DOE national laboratories. Another reason is that DOE has many sensitive facilities that might be subject to inspection under a Chemical Weapons Convention, and the Department therefore has an interest in the development of acceptable, nonintrusive verification technology.

Research is needed in several areas with regard to verification. Before specific technologies are developed, it is necessary to determine what requirements verification technologies are likely to encounter. In the case of CW, this means compilation of an extensive data base of all known agents, their properties, and their production processes, with special emphasis on process effluents. This data base would provide chemical-detector researchers with necessary information about what types of materials they might be identifying, at what concentrations. It is also necessary to compile information on existing technological capabilities, and on prospects for further development (see Ref. 1 for more detailed suggestions for such a survey). Two recent studies surveyed technologies available for agent detection, but these did not include capabilities for detection of production activities.[5,6] Another study has briefly described technologies that could be used for chemical detection.[7] These could be used as the basis for a more complete survey, which would include sensitivity and applicability.

For verification of the CWC, chemical-detection, sampling, and analysis instruments are the most obvious needs. Technologies enabling identification of chemicals by relatively unintrusive means are especially desirable. Examples include radiation interrogation to identify contents of a vessel without sampling or probing and infrared spectroscopy for remote identification of effluent gases. Appropriate, cost-effective, and secure measures to protect sensitive items must be proven.

Less obvious, but equally essential, will be appropriate computer data-base capabilities to track and analyze the large amounts of data that will be generated for CWC verification. Existing stocks and facilities will require inventory control and effective tagging and seals, but this is a relatively minor task compared with tracking production data from the worldwide chemical industry and use data from the myriad industries that use scheduled chemicals. The chemical industry in the U.S., Canada, and

several other industrialized nations is highly regulated, for environmental reasons, and already provides national governments with extensive data, which could be used for verification. Data on raw material use, production volume and method, and effluents are available. However, the data available differ in content and form from nation to nation and may not be entirely compatible or complete from the standpoint of verification. In addition, less developed nations may not collect the data at all.

The system must include an industry process model to account for material inputs and outputs throughout the industry. Not only must the system track these interconnected data and check for consistency or losses, but it must also be compatible with and accessible to all treaty Parties, while still managing to protect from competitors any information that could be considered proprietary. The system must also be sufficiently flexible to be easily usable by less developed countries with small chemical industries, as well as by nations with very complex industries. A prototype data base that may satisfy some of these requirements has been developed by the Finnish Chemical Weapons Disarmament Verification Research Project for storage and handling of CWC verification data. This prototype runs on a MicroVAX II and is available for international experimentation and evaluation.[8]

4.2 IMPLICATIONS FOR DOD AND INTELLIGENCE AGENCIES

Facilities of any government agency or its contractors could be subject to OSI under a CWC, with all of the attendant costs and disruptions of normal operations. The U.S. Department of Defense (DOD) would have special security concerns regarding its classified information, weapon storage and deployment, and all missile-related activities. Analysis of the actual risks of loss would be required to evaluate the seriousness of these concerns and the possibilities for protection measures. Presumably, consideration of the nationality of the inspectors could be a concern for DOD as well as for DOE. DOD would also incur the costs of tagging and sealing any TLIs. It is not yet known who would bear the costs of weapon and facility destruction.

In the U.S., the single, small permitted facility would likely be government-owned and controlled, so legal problems with inspection would be unlikely. In addition, the facility could be either an isolated, single-purpose plant or a plant sufficiently separated from other buildings at its site to alleviate potential information security dangers to unrelated activities from the presence of foreign inspectors.

The U.S. Central Intelligence Agency (CIA) and other intelligence agencies have their own special concerns because of the extreme secrecy not only of the exact nature of their activities, but also of those activities' very existence.

4.3 IMPLICATIONS FOR CHEMICAL AND OTHER INDUSTRIES

4.3.1 Financial Losses

Any industrial facility -- whether a government contractor or supplier, whether in the chemical industry or in an industry using chemicals as process inputs, or even one not in any of these classes but nonetheless subject to challenge inspections -- could suffer financial losses as a result of on-site inspection for verification of a Chemical Weapons Convention. Shrouding and other protective measures could be costly. It is also possible that production would be required to slow down or stop for the duration of the inspection, although this was not necessary at the U.S. National Trial Inspection.[4] This interruption of normal operations could be for safety and logistics reasons; it might be unsafe or physically impossible for inspectors to go where they want to while the equipment is running. Also, plant managers might believe that proprietary information would be at greater risk if the operation were viewed during actual running conditions. Further production losses could be expected if there were a standdown after announcement of the inspection but before the arrival of the inspectors, or if time were required to shroud or otherwise protect the facility prior to inspection, and then to restore normal operating conditions afterward. In addition, some types of processes require fairly long startup periods while temperatures, pressures, or other conditions are brought up and stabilized, during which time the product may not meet specifications. Further financial losses would be possible if any damage were caused by the visitors in the facility.

4.3.2 Information Losses

Industrial facilities could lose several types of information considered vital to their competitive positions. Mere visual access to the plant could reveal to an expert observer details of the process used, such as a unique piping configuration, the use of high pressure, or an extra purification step. If the process were running, exact process conditions and rates would be revealed. Sample compositions would reveal process specifications, but these could be protected by a coding system so that the analyst did not know the source of the sample. Production data would reveal actual quantities and purities of both inputs and outputs, and therefore, process efficiencies. Examination of shipping records would reveal customer information as well.

Procedures to protect companies against these potential losses must be developed. One possibility would be to restrict inspector access to especially sensitive areas, such as control rooms. On the other hand, if sufficient process information, perhaps including remote video monitoring, were available in the control room to satisfy the inspectors, access might be restricted to the control room only.

In addition to proprietary information, the inspection might reveal violations of environmental regulations, and some system of waivers might be needed to induce a facility to allow inspection under these conditions.

In the U.S., the Chemical Manufacturers Association (CMA), which represents 95% of the chemical producers, is providing input to the government to minimize the impact on its member companies. It has committed itself to allowing inspections (including declared and undeclared facilities) and providing data, but it remains concerned about losses of proprietary information. The CMA has contributed papers on draft inspection protocols and on methods of safeguarding proprietary information revealed to the enforcing agency. It has allowed government examination of its plants and procedures to familiarize the examiners with actual industry workings and has hosted a mock inspection of a Schedule 2 site.

National governments have successfully protected company proprietary data from other companies. The U.S. Environmental Protection Agency's Confidential Business Information System could provide a model for the international CW inspectorate to do the same. Extreme care would be required in developing procedures for handling proprietary data and in selection and training of the international staff responsible for the data. Detailed data could be blocked off, with access to specific information restricted to a small, select set of analysts, while only aggregate or processed data would be available to the general inspectorate.

4.3.3 Fourth Amendment Problems of On-Site Arms Control Inspections and Monitoring

Regardless of the commitments made by industry trade groups or the steps that may be taken to limit the extent of on-site inspections, some private firms may not be satisfied with the resulting system. Instead, they may attempt to resist an inspection because it allegedly violates their legal rights. In particular, they may assert that the kind of OSI scheme embodied in the rolling text transgresses the Fourth Amendment.

The Fourth Amendment to the Constitution of the United States has become perhaps the broadest shield protecting private citizens against government intrusion. It states:

> The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

The most often-cited formulation of what the Fourth Amendment covers was written in 1967 by Justice John Marshall Harlan in *Katz v. United States*:[9]

> There is a twofold requirement, first that a person have exhibited an actual (subjective) expectation of privacy and, second, that the expectation be one that society is prepared to recognize as "reasonable."

Other decisions have established that the Fourth Amendment protects private homes and persons, as well as businesses, albeit the latter to a somewhat lesser degree (see, for example, Ref. 10). The general rule is that a valid search warrant, issued by a neutral magistrate upon a showing of "probable cause," is a prerequisite to a

constitutionally valid search. Because judges are institutionally independent of law-enforcement agencies, this is thought to provide a measure of insulation from unreasonable invasions. Exemptions from the warrant requirement exist, but they are not favored by the Supreme Court (see Ref. 11).

The search process also determines, in part, its constitutionality. Searches that are limited in scope and clearly defined in advance are more likely to pass constitutional muster than those that are sweeping or sporadic. Governmental violations of the Fourth Amendment may be met either by a court injunction to prevent a search or by an award of monetary damages to compensate losses if an intrusion has already occurred.

Naturally, the mechanics of on-site inspections for the entire world cannot be expected to bend to the American requirement that a court issue a warrant before the Organization, at the behest of another State Party, could enter an American business or home to enforce its treaty rights. Indeed, neither the 1984 American draft[12] nor the August 1989 rolling text[13] provides specifically for warrants for any of the types of on-site inspection they would create, although both may be sufficiently flexible to accommodate warrants for some inspections.

Yet it seems unwise to assume that nobody would ever resist such an inspection by going to court and demanding an injunction. If it could prove that an impending on-site inspection would violate its Fourth Amendment rights, a private business might be able to obtain a court injunction prohibiting the search.[14] An injunction against an on-site inspection would probably breach a Chemical Weapons Convention resembling either the American draft or the rolling text.

Assuming that such a court fight ensued, it is uncertain whether the Fourth Amendment warrant requirement would apply at all to searches involving foreign affairs. The Supreme Court has never ruled on the question, and lower courts have split on the cases that are most closely analogous. On the one hand, the interest of Americans in privacy is not inherently reduced because the inspection is by an international organization. On the other hand, the international sensitivity of on-site verification pursuant to a treaty would create a strong national-security interest in compliance. Nobody can guarantee the outcome of a test case. Therefore, prudence demands a closer look at what might happen if a court were to decide that the Fourth Amendment applies to on-site arms control inspections.

As was discussed in Sec. 2, the rolling text envisions two distinct types of on-site inspections -- routine, systematic international on-site verification inspections of declared facilities under Article VI and challenge inspections under Article IX -- neither of which is characterized as refusable by the State Party of which inspection is sought. The 1984 American proposal differs insofar as its inspection scheme distinguishes challenge inspections at locations or facilities that are less likely to be involved in illicit chemical weapons production by allowing them to refuse such inspections.[15]

4.3.3.1 Routine, Systematic International On-Site Verification Inspections

Fourth Amendment concerns are more easily integrated into the routine, systematic international on-site verification inspections envisioned for declared facilities (by Article VI of the rolling text) than they are into challenge inspections. It is possible that various provisions in the treaty could be construed to permit American officials to seek warrants prior to such inspections. For example, the rolling text requires execution of a separate agreement between each State Party and the treaty organization to govern the conduct of these verification inspections pursuant to permitted activities under Article VI. This creates the possibility of accommodating a warrant procedure for searches of American firms.[16] If warrants can be sought under the treaty, an administrative search scheme relying on warrants could be devised that might be constitutional.[17] Such a scheme would entail the development of an orderly and logical plan for all similar facilities and its prior approval by a court.

If an administrative search scheme relying on warrants were inconsistent with Article VI, then the authority to conduct warrantless inspections or monitoring might have to be derived from one of the few recognized exemptions to the normal warrant requirement. Extensively regulated businesses are sometimes subjected to warrantless searches to enforce laws regulating their operations. A line of Supreme Court decisions holds that such "pervasively regulated industries" can be searched without a warrant, essentially because they are Parties to a sort of imputed social contract. In return for society's permission to engage in a business that might otherwise be prohibited altogether, they implicitly agree to warrantless searches as a regulatory cost of doing business (see, for example, Refs. 18 and 19). As the Supreme Court in *New York v. Burger* recently put it, three criteria must be met:[20]

> First, there must be a "substantial" government interest that informs the regulatory scheme pursuant to which the inspection is made. . . . Second, the warrantless inspections must be "necessary to further [the] regulatory scheme. . . ." Finally, "the statute's inspection program, in terms of the certainty and regulatory of its application, [must] provide] a constitutionally adequate substitute for a warrant."

Weapons manufacturers exemplify the kind of pervasively regulated industry that would be subject to warrantless on-site arms control inspections.[21] It is not certain that the same could be said today for the chemical industry. First, although the chemical industry faces federal regulation involving environmental, health, and safety concerns, one recent Supreme Court decision implies that it is not pervasively regulated.[22] Second, even if the chemical industry is pervasively regulated by environmental, health, and safety laws, this does not mean that it has implicitly consented to warrantless searches under a national security treaty. Viewed in terms of an imputed social contract, one might say that there is presently no consideration for implying that the industry has agreed to warrantless searches for this different purpose. Thus, it is questionable whether a court, faced with a resisting chemical company, would uphold warrantless routine, systematic international on-site verification inspections under Article VI.

4.3.3.2 Challenge Inspections

Challenge inspections, as characterized by the Chairman of the Ad Hoc Committee on Chemical Weapons for the 1989 Session, would be even more constitutionally vulnerable than routine inspections.[23] The purpose of these inspections would be to "clarify (and resolve) any matter which causes doubts about compliance" on the part of a requesting State at any site under the jurisdiction or control of the challenged State. (See Ref. 24 for a brief description of the ambiguity of what facilities might fall under the control of a State.) Whether a particular challenge is triggered by an individual State Party or with the concurrence of the treaty organization, the concept appears to exclude any outright refusal by the requested State, except possibly on the ground that the inspection is outside the objectives of the CWC. Allowance appears to be made neither for a showing of objective probable cause nor for review by an independent magistrate of an American court. None of the limitations inherent in the extensive planning for routine inspections (Article VI) would be present. Taken literally, challenge inspections could be open-ended fishing expeditions reaching into both businesses and homes. In short, this form of challenge inspection is vested with almost none of the protection from governmental intrusion ordinarily associated with the Fourth Amendment.[25]

4.3.4 Mitigation

Options exist for reducing the friction between the interests of controlling chemical weapons and of protecting privacy under the Fourth Amendment to the United States Constitution, while preserving the general approach to on-site inspections embodied in the 1984 American proposal and the August 1989 rolling text. These options include development of specialized remote monitoring devices, inducing voluntary consent to be inspected, and enactment of a federal statute to extend pervasive regulation over chemical weapons to the chemical industry and to redefine the legal remedies available to the subjects of on-site arms control inspections. This subsection presents a short explanation of several ideas that might merit further study.

4.3.4.1 Remote Monitoring

Remote monitoring, as distinguished from on-site monitoring, is not considered to be a search within the meaning of the Fourth Amendment when it is conducted from a public place and employs generally available technology (e.g., aerial photography from public airspace).[26,27] Remote monitoring offers the prospect of helping to verify compliance without triggering the need for a search warrant. The development of remote monitors that select only evidence of violations, while excluding extraneous matter, would be of particular benefit.[28]

4.3.4.2 Consent

Consent from the private site of which inspection is sought often can be obtained. Since constitutional rights can be voluntarily waived, such consent can obviate

some of the most difficult constitutional problem . Indeed, the enormous market power of the United States Government could be used to induce consent by requiring contractors to agree to on-site arms control inspections as a condition of any future business, just as affirmative action employment policies are encouraged.

4.3.4.3 Federal Statutes

One or more federal laws could be enacted to provide alternatives to what might otherwise result from litigation. First, an implementing statute might be used to create a system of pervasive regulation of chemical weapons. Second, a new law redefining the remedies available to the subjects of on-site arms control inspections might overcome many of the problems that cannot be solved by other means. Although the specifics such a law would include have not been identified, it appears that the Administration agrees that implementing legislation, setting forth reporting requirements and requirements for on-site inspections, will be needed at the time of Senate approval of a Chemical Weapons Convention.[29]

Pervasive Regulation of Chemical Weapons Production. Passage of a statute might assure that a court would find the declared facilities covered by Article VI of the rolling text to be pervasively regulated, thereby qualifying them for warrantless routine, systematic international on-site verification inspections under the Supreme Court criteria quoted in Sec. 4.3.3.1. Certainly, an enormous government interest exists in eliminating chemical weapons. The necessities of international diplomacy appear to dictate that warrantless on-site inspections be an important deterrent to violations. Finally, a regular and certain inspection program is under development in Article VI.

Nevertheless, difficulties might arise. The Supreme Court has never decided a case where it was asked to uphold a scheme of pervasive regulation that was *sui generis*. However, its opinions in this area look in part to the length of time an industry has been regulated to determine pervasiveness (but the trend recently has been to downplay this as a factor). While chemical-weapons control can be said to date at least from 1925, the CWC itself would initiate the first real internal regulatory scheme.

Assuming this problem can be resolved, the need for extensive declarations under Article VI probably would provide a sufficient rationale for warrantless searches of declared facilities. The rolling text requires each State Party to disclose to the Technical Secretariat various types of production information about private facilities producing chemical-weapons precursors.[30] The federal government would have to obtain such information from the firms themselves in order to declare it.

A statute requiring chemical companies to disclose this information to the federal government would provide the United States what it would need to declare to the Technical Secretariat. Since existing federal laws already require disclosure of information similar to what a Chemical Weapons Convention would require,[31] the nature of the information that would be disclosed should not itself present a constitutional

problem. The scheme of routine, systematic international on-site verification inspections would be justified by the need to double-check these declarations.

Redefinition of Remedies. A statute redefining the remedies available to the subject of an unconstitutional arms control inspection would reduce the possibility that a court would feel compelled to enjoin either routine or challenge inspections. Such a law would not render unconstitutional inspections constitutional. Rather, since the most important diplomatic concern would be that a court injunction might breach the CWC, the object would be to substitute other legal relief.

The Constitution empowers the federal government to enact remedies in addition to those that a court might otherwise have available to assist an aggrieved plaintiff, perhaps allowing the government to "buy its way out" of situations that might otherwise result in an injunction. The Federal Tort Claims Act could be expanded to explicitly provide for federal liability for monetary damages from an illegal on-site inspection. A civil claim could be established for treble damages for misuse by any person, perhaps including inspectors, of any information learned during an on-site arms control inspection. At the same time, application for any injunctive remedy regarding an on-site inspection under the CWC could be made to extinguish any claim that might otherwise have existed to these extraordinary damages. Thus, a plaintiff would have a powerful monetary incentive to avoid seeking an injunction.

A statutory expansion of the existing court-made exclusionary rule for all information uncovered during a consensual on-site arms control inspection would remove a disincentive against allowing inspections to take place. Where a firm might resist an inspection in fear of prosecution for existing violations of environmental, health, or safety laws, a broader exclusionary rule would make such a motive moot. Indeed, since the burden would fall on the federal government to prove that any information used in a subsequent prosecution was not a result of the inspection, a positive incentive to consent might be created. Of course, this assumes that the public interest in the CWC is thought to be higher than in those other laws. Furthermore, exclusion of such evidence might make criminal prosecution for a treaty violation impossible.

The more difficult question is whether these encouragements to allowing on-site inspections can be complemented by a prohibition against injunctions. Ultimately, the Supreme Court would have to answer such a question, and it has not yet had to do so. While the Court has indicated that Congress can substitute other remedies for an injunction (See Refs. 32 and 33*), some commentators have argued strongly to the contrary, contending that the judiciary is constitutionally obligated to select the most appropriate remedy, regardless of what Congress might say.[34,35] This view would hold that an injunction to prevent an unconstitutional inspection is a right that cannot be abridged by statute. Thus, even if Congress were inclined to vote to take such an unusual step, it could be beyond congressional power.

*Reference 33 calls attention to a statement made in a dissenting opinion by Justice J. Brennan: "Of course, . . . any constitutional violation, may be enjoined if and when discovered."

4.4 IMPLICATIONS OF POSSIBLE NONCOMPLIANCE

Complete verification of compliance with a Chemical Weapons Convention will be extremely difficult. Verification of activities and stocks at declared sites can probably be accomplished in a straightforward manner with a high degree of confidence, but challenge procedures are never likely to be good enough to rule out all possibility of noncompliance. Challenge inspections would minimize the probability and scope of undetected treaty violations and build public confidence. As the head of the Austrian observer delegation to the CD said, "We have to admit that 100% verification is not feasible. As a consequence, challenge inspections should be conceived in such a way as to provide a sufficiently high risk for potential violators of the treaty to effectively deter them from doing so."[35] The decision for verification lowers the probability that the CWC will be violated, but it cannot absolutely prevent it. Neither can it be guaranteed that the convention will be written in such a way that all Parties will always find it in their best interests to observe the provisions. Therefore, it is useful to consider what could be made to happen in the event that the CWC were violated.

Because the Chemical Weapons Convention is being designed to ban not only the use of CW, but also their development, production, transport, and storage, there is opportunity to detect illegal activity at each of these stages. In addition, agent production, munitions manufacture, and loading are all required before the weapons are usable. To the extent that these different activities are independent, the probability of actually detecting a violation before the weapons are used is thus increased, and the real danger to other treaty Parties is minimized.

If the consequences of being caught violating the CWC can be raised, Parties are less likely to take the risk. A series of economic and political sanctions could be authorized by the convention. Weapons or facilities found in violation could be seized and destroyed. Probably the most important threat is economic sanctions. Direct financial measures could include retraction of credit and credit guarantees, refusal and calling in of loans, and punitive tariffs. Other economic measures could include restrictions on exports and imports with the offending Party. Political reprisals, including censure and breaking of alliances or diplomatic relations, are also possible, but these might have limited effectiveness.

If the Party violating the CWC actually used chemical weapons, it would be possible to consider military reprisals. These would not need to be retaliation in kind, and an international force could be authorized by the United Nations Security Council. Pakistan has proposed that other treaty Parties supply aid, including provision of protective equipment, to those under CW attack. The U.S. draft convention calls for unspecified aid to Parties "exposed to danger as the result of a violation" of the convention.[12] Similar language is being considered by the Conference on Disarmament but has not yet been agreed on. Military retaliation has serious drawbacks, however, and this option bears more thorough consideration.

The potential benefits to a violator actually using CW could be minimized by appropriate precautions on the part of any nation judged to be a possible target.* Self-defense is only destabilizing if residual offensive capability is retained.[37] Another method for mitigating damage from a CW attack would be aid to the injured Party in the form of food, goods and services, etc.

Thus, the chances of getting away with violation of the treaty can be reduced, the costs of being caught in violation raised, and the potential benefits of using the weapons minimized. This combination of factors can help make violation a less attractive option, even for a treaty that is not perfectly verifiable.

Some thoughts from Freeman Dyson on this subject may be a fitting end to this discussion:[38]

> Arms control agreements do not have to be perfect in order to be useful. Our choice is not between imperfect and perfect arms control agreements; it is between imperfect agreements and none at all. An agreement does not automatically lose its value as soon as it is violated. Verifiability is only one desired quality, and not the most essential, of a satisfactory agreement.... The value of an agreement depends less on its technical verifiability than on its political robustness. A useful agreement is one which not only helps to maintain a stable balance of power, but also helps to build a frame for a new international order.

*These precautions include protective measures (such as gas masks) and remedial measures (such as antidotes and decontamination techniques). It is considerably easier to prepare military personnel to survive a chemical attack than to protect large numbers of civilians. However, if the object is to prevent an attacker from gaining a significant military advantage, protection of the armed forces may be sufficient, because retaliatory capability is maintained.

4.5 REFERENCES

1. Gaines, L., et al., *Accommodation of On-Site Inspection at DOE Facilities*, Argonne National Laboratory Report ANL/ACTV/88-2 (Oct. 1988).

2. Perroni, O.V., *Possibilities for Automatic Monitoring of Chemical Products*, in Non-Production by Industry of Chemical-Warfare Agents, S. Lundin, ed., Stockholm International Peace Research Institute, Oxford University Press (1988).

3. von Baeckmann, A., *The Chemical Weapons Convention and Some IAEA Experience*, in Non-Production by Industry of Chemical-Warfare Agents, S. Lundin, ed., Stockholm International Peace Research Institute, Oxford University Press (1988).

4. *Report on a United States National Trial Inspection Exercise*, Conf. on Disarmament Documents CD/922, CD/CW/WP.250 (June 22, 1989).

5. Mengel, R.W., et al., *Compliance Monitoring of a Proposed Draft Convention on the Prohibition of Chemical Weapons: An Update*, Chemical Research, Development, and Engineering Center Report CRDEC-CR-88086 (Aug. 1988).

6. Maskarinec, M.P., M.B. Wise, and M.V. Buchanan, *Technology Assessment for the Determination of Chemical Agent Vapors in Demilitarization Facilities*, Oak Ridge National Laboratory Report ORNL/TM-10346 (Jan. 1987).

7. Walker, F.E., *Technical Means of Verifying Chemical Weapons Arms Control Agreements*, Lawrence Livermore National Laboratory Report UCRL-96425 (March 1987) [preprint].

8. *Final Record of the Four Hundred and Eighty-First Plenary Meeting*, Conf. on Disarmament Document CD/PV.481 (Sept. 13, 1988).

9. U.S. Reports, Vol. 389, beginning on p. 347, citing p. 361 (Harlan, J., concurring), Washington, D.C. (1967).

10. Donovan v. Dewey, U.S. Reports, Vol. 452, beginning on p. 594, citing pp. 598-99, Washington, D.C. (1981).

11. Koplow, D., *Arms Control Inspection: Constitutional Restrictions on Treaty Verification in the United States*, 63 New York University Law Review 229, p. 311, footnote 504 (1988).

12. *Draft Convention on the Prohibition of Chemical Weapons*, Conf. on Disarmament Document CD/500 (April 18, 1984).

13. *Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament*, Conf. on Disarmament Document CD/952 (Aug. 18, 1989) ["rolling text"].

14. Koplow, D., op. cit., pp. 334-35.

15. Tanzman, E., *Constitutionality of Warrantless On-Site Arms Control Inspections in the United States*, 13 Yale Journal of International Law 21, pp. 38-39.

16. Rolling text, op. cit., pp. 106, 109, 115, 169-184. [But see E. Tanzman, op. cit., p. 37, footnote 113 (inconsistencies between ordinary warrant procedure and 1984 American proposal).]

17. Koplow, D., op. cit., pp. 305-08, 351-53.

18. Marshall v. Barlow's, Inc., U.S. Reports, Vol. 436, p. 307, Washington, D.C. (1978).

19. Tanzman, E., op. cit., pp. 44-48.

20. Supreme Court Reporter, Vol. 107, beginning on p. 2636, citing p. 2644 (1987) [citations omitted; brackets in original].

21. United States v. Biswell, U.S. Reports, Vol. 406, p. 311, Washington, D.C. (1972).

22. Dow Chemical Co. v. United States, U.S. Reports, Vol. 476, beginning on p. 227, citing p. 236, Washington, D.C. (1986). [Compare E. Tanzman, op. cit., pp. 49-52 with D. Koplow, op. cit., pp. 344-46, 351.]

23. Rolling text, op. cit., pp. 197-201.

24. Tanzman, E., op. cit., pp. 33-34.

25. Koplow, D., op. cit., pp. 351-53.

26. Tanzman, E., op. cit., p. 56.

27. Koplow, D., op. cit., pp. 341-44.

28. Tanzman, E., op. cit., pp. 55-58.

29. Mikulak, R., Proc. 1989 American Association for the Advancement of Science Annual Meeting Symp. [Implementing a Global Chemical Weapons Convention], E.H. Arnett, ed., San Francisco, AAAS Publication No. 89-265 (Jan. 16, 1989).

30. Rolling text, op. cit., pp. 30, 103-120.

31. Carpenter, W., *Government Regulation of Chemical Manufacturing in the USA as a Basis for Surveillance of Compliance With the Projected Chemical Weapons Convention*, in Stockholm International Peace Research Institute, Chemical and Biological Warfare Studies, Vol. 5 [The Chemical Industry and the Projected Chemical Weapons Convention], pp. 11-32 (1986).

32. Panzman, E., op. cit., pp. 64-66.

33. United States v. Stanley, Supreme Court Reporter, Vol. 107, beginning on p. 3054, citing p. 3068 (1978).

34. Steinman, *Backing Off Bivens and the Ramifications of this Retreat for the Vindication of First Amendment Rights*, 83 Michigan Law Review, p. 269 (1984).

35. Sager, *Forward: Constitutional Limitations on Congress' Authority to Regulate the Jurisdiction of the Federal Courts*, 95 Harvard Law Review 17, p. 85 (1981).

36. *Final Record of the Four Hundred and Seventy-First Plenary Meeting*, Conf. on Disarmament Document CD/PV.471 (Aug. 4, 1988).

37. Dyson, F., *Weapons and Hope*, Chapters 6 and 7, Harper Colophon Books, New York (1984).

38. Ibid., p. 177.

5 RECOMMENDATIONS FOR DOE ACTION

The purpose of this work is to identify possible actions that DOE or other agencies could take to assure that verification of a Chemical Weapons Convention can be effective, while imposing the least possible impacts on the entities to be inspected. Our methodology is summarized in the flowchart in Fig. 5.1. The recommended actions are described briefly in this section and summarized in Table 5.1. These actions fall into several categories, which include additional analysis, technology R&D, legal studies, and input to interagency groups advising the negotiators.

5.1 ANALYTICAL ACTIVITIES

Analytical activities should receive high priority because they serve to identify further actions and to direct other projects to the most fruitful areas for development. In the case of a Chemical Weapons Convention, several studies are of immediate importance. The first study would examine production processes for known chemical weapon agents to determine inputs, outputs, emissions, and other physical evidence such agents provide of their identity. Militarily significant quantities would also be determined. The results of this study would be requirements that must be satisfied by verification technologies (e.g., ability to detect one part in 10^{13} of a telltale by-product). After the technology requirements are established, a survey of known technologies, and ones that could be readily developed, would provide the basis for determination of how (and if) the requirements could best be met.

Although there is concern about possible losses of information, and even materials, during on-site inspections, there has been no adequate study of the actual risks and of the adequacy of known protection measures. Such a study could be part of a larger analysis of the impacts and effectiveness of alternative challenge-inspection regimes, including ad hoc inspections or pre-challenges. This study could serve as the basis for development of exemplary model agreements to enable verification.

5.2 TECHNOLOGY R&D

In addition to the areas for R&D on verification technology and protective measures that would be identified by the suggested analysis activities, there are specific research projects that were identified by this work. The first is the development of a system to handle the tremendous volumes of data that would be collected for verification of a Chemical Weapons Convention. The system would comprise a carefully designed data base, including limited access blocks, and an industry process model to enable interpretation and analysis of the data. A related technology requirement is inventory control for existing stocks, including an appropriate system of tagging.

Effective verification could benefit from development of sensitive remote monitoring devices. These would help to identify potential CW sites and would also provide information about activities at known sites without intrusive on-site inspection.

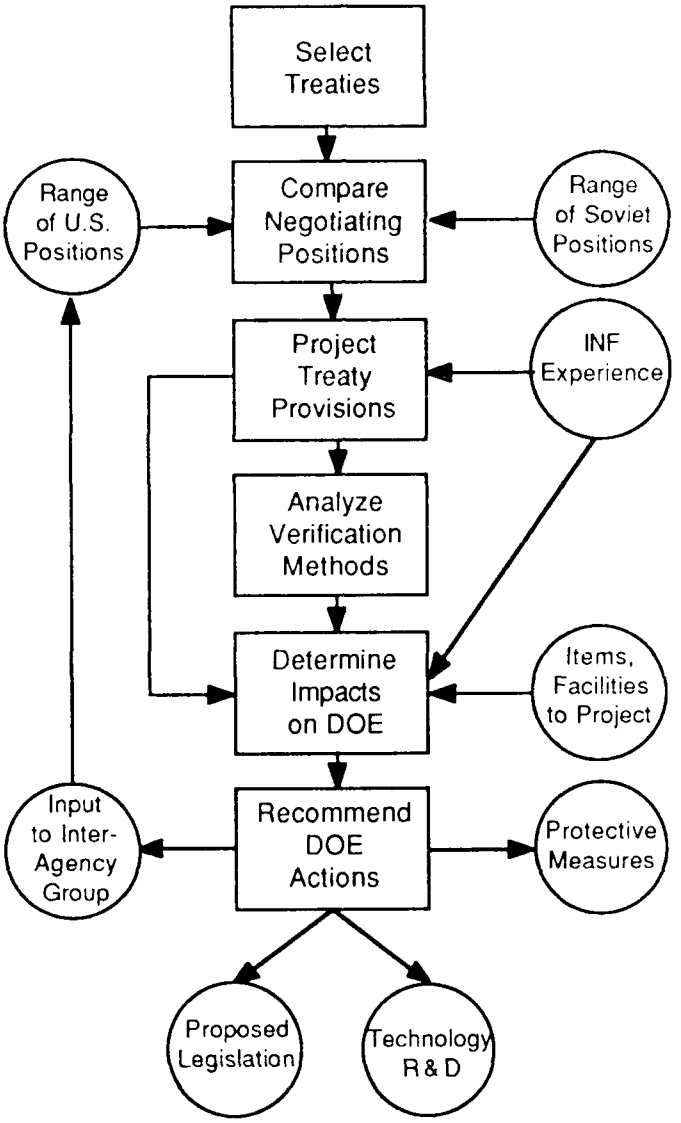

FIGURE 5.1 Future Treaty Analysis Methodology

Another way to reduce intrusiveness and enhance safety of verification would be to develop alternatives to process sampling.

5.3 LEGAL STUDIES

Several avenues are available to ease the potential legal problems that might be caused by on-site inspection. These include development of a clause for inclusion in contracts of private firms with DOE or other agencies that explicitly gives consent to on-site inspections. Potential legislation for implementing the CWC is also possible. Also of importance would be a study to identify possible legal obstacles to implementation of the CWC in other countries. In addition to possible difficulties in inspecting private firms in their own countries, more specific research than what has

TABLE 5.1 Recommended Actions

Action Category	Areas of Concern and Techniques
Analysis	Verification technology requirements Verification technology capabilities and possible developments Impacts and effectiveness of alternative challenge-inspection regimes Development of model agreements
Technology R&D	CW data base and process model Inventory control system and tags Sensitive remote monitoring Alternatives to process sampling
Legal studies	Development of contract clause Constraints to OSI in laws of other countries Implementing legislation
Input to interagency groups	Access limitations Sanctions Cost-effectiveness of alternative challenge regimes

been done to date is needed to address questions of how to handle U.S. firms abroad or foreign firms in the U.S.

5.4 INPUT TO INTERAGENCY GROUPS

The final area for possible action may be the most important, because it represents completion of the feedback loop that enables DOE to influence treaty provisions that might eventually affect it. Possible inputs that DOE might choose to provide include access limitations for particularly sensitive facilities, suggested sanctions for treaty violation, and the results of the proposed analysis of alternative challenge-inspection regimes.

GLOSSARY

Arms control. Any unilateral or multilateral action or process, perhaps based on international agreement, that limits or regulates any aspect of the weapons systems or the armed forces of the involved Parties. Aspects of weapons systems include: production, numbers, size, and performance characteristics, as well as logistics and other supporting activities. Arms control arrangements between two or more countries usually involve unilateral and cooperative means to verify compliance with the rules of the agreement. [Scribner, Ralston, and Metz 1985]

Breakout. A sudden change in the military balance caused when one Party to an arms control treaty quantitatively or qualitatively improves its forces to an important extent by violating an arms limitation agreement. [Scribner, Ralston, and Metz 1985]

Challenge inspections. Inspections allowed by treaty provision that take place when initiated by another Party to the treaty or by a monitoring agency. Challenge inspections differ from mandatory inspections in that challenge inspections are not regularly scheduled and can be used by one Party to question and verify compliance by another. An example is the special on-site inspection (which see) allowed in the U.S. draft of the proposed Chemical Weapons Convention.

Chemical weapons. Weapons designed to disable personnel temporarily or permanently by the release of chemicals or gases into the surrounding atmosphere. These weapons are restricted under the Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous, or Other Gases, and of Bacteriological Methods of Warfare.

Classified information. Top secret, secret, and confidential restricted data; formerly restricted data; and national security information for which DOE is responsible and which requires safeguarding in the interest of national security and defense.

Data monitoring. Examination of facility input and output data on a regular basis to confirm declared production or usage data.

Effective verification. Monitoring means that are sensitive enough to detect militarily significant violations and accurate enough so that other nations are not falsely accused.

Exclusion area. A security area for the protection of classified matter where mere access to the area would result in access to classified matter. When access to an exclusion area is required by persons without appropriate access authorization or need to know, measures shall be taken to prevent access to or compromise of classified information. [DOE 1988c]

In-country monitoring. Placement of manned or automatic instruments in the territory of the host, who is tolerant of the activity, but outside the perimeter of the facility of interest. Using seismic detectors to verify the Threshold Test Ban Treaty would be an example of in-country monitoring. Additional technologies that might be used for in-country monitoring include chemical sniffers and radiation detectors. Drone aircraft and robot sampling devices could also be used.

Information exchange. The exchange of specified technical data as an aid to verification by national technical means. For example, the Threshold Test Ban Treaty allowed the United States and the Soviet Union to exchange information regarding the precise location of the testing areas and various geological data regarding those areas. For calibration purposes, the Parties agreed to exchange precise information -- yield, date, time, and depth -- on nuclear tests. [Eimer 1976]

International Atomic Energy Agency (IAEA). A United Nations-sponsored agency established in 1957 with a twofold purpose: to promote nuclear energy, and to establish and administer safeguards to ensure that peaceful nuclear energy not be used for military purposes. The IAEA has no police power and is not a supranational body, but rather an organization that performs its safeguarding function at the request of the governments concerned.

Mandatory inspections. Inspections provided for by a treaty that occur at declared sites on a regular or scheduled basis. One example is the systematic international on-site verification inspection provision of the U.S. draft chemical weapons treaty.

National technical means. Unilaterally controlled, often sophisticated, methods of data collection that do not operate from installations in the territory of the Parties being monitored. Examples include photographic reconnaissance, radar, electronic surveillance, seismic instrumentation to supply information on the location and magnitude of underground nuclear explosions, air sampling systems of high sensitivity, and advanced techniques for the analysis and evaluation of the data collected. [Eimer 1976]

On-site inspection. The use of inspectors and instruments by one country or an international body to examine, at their location, the installations and activities in another country. [Adam 1986]

On-site monitoring. The use of technical sensors or measuring devices to monitor activities at declared facilities. This is accomplished by placing automatic instruments inside the boundaries of the facility to be examined. These instruments might transmit continuous output or be triggered by specific events, a timer, or received signals. Infrequent maintenance by the Party seeking information could be permitted. Sampling

devices and spectrometers could be used in addition to the technologies applicable for in-country monitoring.

Portal perimeter monitoring. Very similar to on-site monitoring, but accomplished by placing instruments and/or humans at facility entrances and around the facility border. Portal-perimeter monitoring may or may not involve the presence of humans.

Security. Activities through which DOE defines, develops, and implements its responsibilities under the Atomic Energy Act of 1954, as amended, federal statutes, executive orders, and other directives for the protection of restricted data and other classified information or matter, nuclear weapons, and nuclear weapon components, as well as for the protection of DOE and DOE contractor facilities, property, and equipment. Security is also applied to special nuclear materials. When physical, personnel, and technical security are combined with material control and material accountability, the protection is referred to as "safeguards."

Special nuclear material (SNM). Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which is determined to be SNM, pursuant to section 51 of the Atomic Energy Act of 1954, but not including source material, or any material artificially enriched by any of the foregoing.

Special on-site inspection. Under the American draft, any Party to the Chemical Weapons Convention may request special on-site inspection of any "location or facility" owned by any other Party. A type of challenge inspection, special on-site inspection requires justification by the Party who makes the request. The requesting Party is only entitled to an inspection of the facilities of another Party in order to clarify and resolve any matter that may cause doubts about compliance. Once a special on-site inspection has been initiated, the Party being inspected must provide the inspection team unimpeded access to the location or facility being inspected within 24 hours of being notified.

Standdown. Prohibition of the movement of equipment into, out of, or within a facility notified or of undergoing inspection; this can be either total or partial.

Systematic international on-site verification inspections. Inspections of the declared inventory of chemical weapons and facilities, to occur during the destruction of these chemical weapons, at the locations where the weapons were destroyed or stored. Also, on-site inspection of allowed activities, such as the maintenance of limited chemical weapons and permitted chemical precursors. Both persons and instruments are allowed as part of the inspection protocol, and inspections may include sampling of materials, as well as examination of records. [U.S. draft 1984]

Toxic chemicals. Any chemical, regardless of its origin or method of production, which through its chemical action on life processes can cause death, temporary incapacitation, or permanent harm to man or animals. Toxic chemicals are divided into the following categories: (a) "super-toxic lethal chemicals," which have a median lethal dose that is less than or equal to 0.5 mg/kg (subcutaneous administration) or 2,000 mg-min/m^3 (by inhalation); (b) "other lethal chemicals," which have a median lethal dose that is greater than 0.5 mg/kg (subcutaneous administration) or 2,000 mg-min/m^3 (by inhalation) and less than or equal to 10 mg/kg (subcutaneous administration) or 20,000 mg-min/m^3 (by inhalation); and (c) "other harmful chemicals," being any [toxic] chemicals not covered by (a) or (b) above, [including toxic chemicals that normally cause temporary incapacitation rather than death]. [rolling text 1989]

Verification. (1) The process of assessing compliance with the provisions contained in arms control treaties and agreements. The attempt to ascertain whether states are living up to their international obligations. [ACDA 1982] (2) The technological and intelligence process, involving both monitoring and evaluation, that establishes the fact of compliance with arms control agreements. (See effective verification.)

Vital area. A security area for protection of vital equipment (e.g., equipment, systems, or components whose failure or destruction would cause unacceptable interruption in a national security program or harm to the health and safety of the public). Access to vital areas is controlled to limit entry to appropriately cleared or escorted individuals who require admittance to perform their official duties. [DOE 1985]

REFERENCES FOR GLOSSARY TERMS

ACDA, *Arms Control and Disarmament Agreements*, Arms Control and Disarmament Agency, U.S. Government Printing Office No. 1982-361-412/431 (1982).

Adam, J.A., ed., *Peacekeeping by Technical Means*, Institute of Electrical and Electronics Engineers, Spectrum 23(7) (June 1986).

DOE, *Physical Protection of Security Interests*, U.S. Department of Energy Order 5632.4 (Nov. 4, 1985).

DOE, *Physical Protection of Classified Matter*, U.S. Department of Energy Order 5632.5, Feb. 3 (1988c).

Draft Convention on the Prohibition of Chemical Weapons, Conf. on Disarmament Document CD/500 (April 18, 1984) ["U.S. draft"].

Eimer, M., *Verification: The Critical Element of Arms Control*, Arms Control and Disarmament Agency Publication 85 (March 1976).

Gaines, L., et al. *Accommodation of On-Site Inspection at DOE Facilities*, Argonne National Laboratory Report ANL/ACTV-88/2 (Oct. 1988).

Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament, Conf. on Disarmament Document CD/952 (Aug. 18, 1989) ["rolling text"].

Scribner, R.A., T.J. Ralston, and W.D. Metz, *The Verification Challenge: Problems and Promise of Strategic Nuclear Arms Control Verification*, Birkhäuser, Boston (1985).

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