SYSTEMS STUDY

OF AN

INTERNATIONAL VERIFICATION ORGANIZATION

ON

CHEMICAL WEAPONS

OCTOBER 1987

CANADA

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EXECUTIVE SUMMARY

This paper explores the nature of an International Verification Organization which could oversee the implementation of a Chemical Weapons Convention. The intention is to bring into focus an understanding of the obligations that the verification provisions place on States Parties to the Convention. Such provisions necessitate that personnel from the Technical Secretariat inspect stockpiles, chemical weapons destruction facilities, chemical weapons production facilities, and the civilian chemical industry in order to ensure that signatories are fulfilling their obligations. The analysis of the various verification projects leads to a description of the skills and personnel needed by an International Verification Organization (IVO), providing a basis for estimates of the resources needed by this sub-organ of the Consultative Committee.

The approach used in this work was that of a "Systems Study", as a qualitative variant of a "Systems Analysis." The systems analysis approach involves a rigorous, step by step procedure for selecting a 'best' solution to a problem, with the first step being a clear identification of the problem. In this case, the problem of defining the nature of an IVO was found to be so broad or 'fuzzy' that it was not amenable to such rigorous treatment. Consequently, a systems study approach was adopted, utilizing the formal steps of the systems analysis approach wherever applicable.

The study began with a review of the documents submitted to the Conference on Disarmament (and its predecessors) on the attributes of a Technical Secretariat or International Verification Organization. Such papers are few; it was often necessary

to infer the responsibilities of such a Secretariat from the duties assigned to the Consultative Committee and to its Executive Council.

The theoretical under-pinnings of the study were two important papers, i.e., CD/500, the U.S.A. draft Convention, and CD/734, the current draft Convention before the Committee on Disarmament (1987). Contents of the articles of these two papers were organized into a more functional format, suitable for an analysis of the operation and function of an IVO. Projects necessitating verification or inspection by an IVO were defined accordingly and were grouped together under appropriate program headings, thus highlighting operational connections between projects in a given program in terms of specific verification operations (see the overview chart on pages viii and ix).

A chart of methodological options was developed to represent all verification schemes potentially applicable to the CW Convention (see pages 29 to 31). A checklist was created as an alternate form of the chart, suitable for practical use (see pages 32 to 36). Many alternative schemes and combinations exist as possibilities for satisfying, to a greater or lesser extent, the verification requirements of each project, as the checklist shows.

Close consideration of the various methodological options permitted the development of listings of functions and skills necessary within an IVO (see section 3.4). The functions list was found to be of general applicability to each of Programs 1 to 3, with specific functions relating to at least one, but not necessarily to all of the projects. The skills list parallels the functions list.

A correlation analysis of projects, methodological options and IVO functions was then carried out and led to the creation of the lists in Appendices 1 to 3, illustrating all of the alternative verification schemes which are applicable to each of the projects within the programs of "Chemical Weapons", "CW Production Facilities" and "Activities not Prohibited".

The next step involved the documentation and formulation of restrictions, including physical restrictions, state-imposed restrictions, and logical arguments indicating inherent flaws in those schemes which could not adequately satisfy the verification requirements of the Convention. The purpose of developing such sets of restrictions was to eliminate unsuitable alternatives, by applying restrictions to each project separately, and to aid in ranking the remaining verification schemes. These identified restrictions were applied to the lists in Appendices 1 to 3. The result was the creation of a series of condensed lists of suitable options for each of the projects under Programs 1 to 3 (see section 3.7).

The "potential solutions" described in section 4.0 indicate practical interpretations of the results of the systems study, i.e., they provide detail and flesh to the skeleton of text, correlating projects with 'best-choice' verification schemes, from section 3.7. It must be emphasized that the solutions presented are not unique solutions, but they are the result of a rational investigation of the various verification tasks. The process applied allowed enumeration of the inspection requirements of a Technical Secretariat.

The program of "Challenge Inspection" (see section 5.0) was not dealt with as part of the systems study of this paper for two reasons. First, because challenge

inspection necessitates immediate and full on-site inspection, the number of methodological options is reduced to one. Second, regarding the project "Allegations of Use," a separate study, previously conducted by the Canadian government, provided a very specific set of recommendations concerning the personnel and resources needed for such inspections.

The elaboration of the operational aspects of a Technical Secretariat led to a general examination of the skills, personnel and resources required by an IVO. The resource requirement proved to be most difficult to quantify at this stage without carrying out trial inspections of existing facilities. Once more details on the verification provisions to be implemented are agreed upon, it will be possible to have a better idea of all of the functions which come into play and which must be clearly allowed for when developing resource requirement projections. These projections will be a function of an inspectorate and the total task of operating an International Verification Organization.

A glossary is appended to the text and was deemed to be necessary since we attach a specific meaning to certain technical words which have sometimes been used to describe different situations in the labyrinth of chemical disarmament discussions.

The study has led to a number of important findings; among these are:

1) the distinction between a functional or operational format (e.g., as defined by the programs and projects detailed below) and a treaty format (e.g., as defined by the articles of CD/500 or CD/734);
2) the compilation of lists of functions and skills of an IVO, having general applicability to all projects;

3) the realization that a limited number of verification schemes, for each project, serve the purposes of the convention;

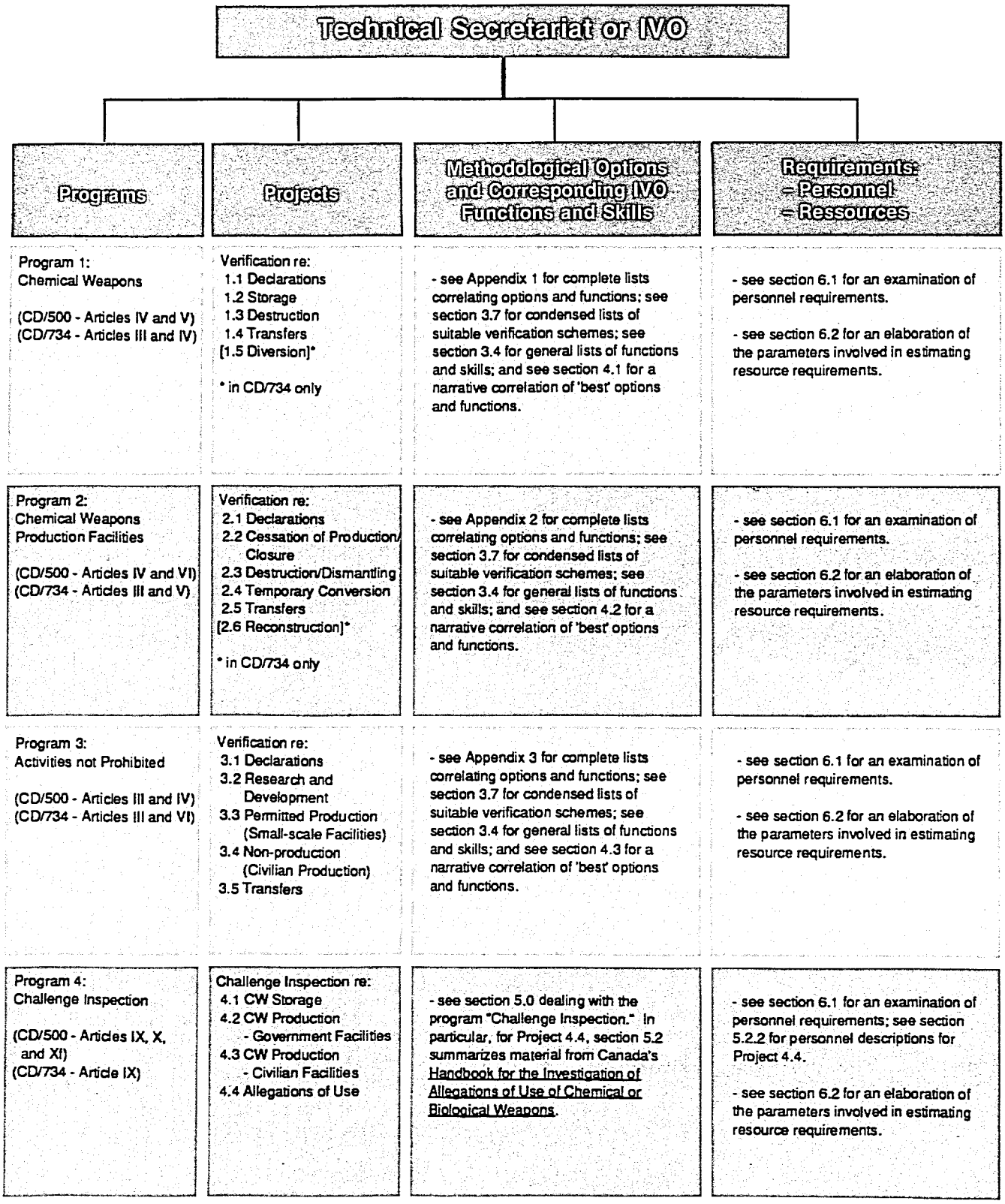
4) the identification of specific parameters - a number of which can only be quantified after obtaining further information (e.g., the number of facilities falling into a given inspection regime), and a number of which are defined through a decision-making process (e.g., the specific functions to be carried out at each facility) - needed to estimate, with any precision, the resource requirements of an IVO.

The overview chart which follows on pages viii and ix summarizes the results of this study. It is suggested that the programs and projects listed may be thought of as representing departments within the IVO - that is, they are the framework within which a future IVO is to conduct its operations. The chart is divided into two parts:

(1) projects directly relating to verification or inspection (Programs 1 to 4, page viii);

(2) other necessary activities of the Technical Secretariat or IVO (page ix).

It is hoped that some clarity has been added to the picture of an IVO in terms of its inspection requirements, and the programs, projects, skills, personnel and resources required. Completely defining the IVO still requires a selection among the options, and there remain a number of points which necessitate decision making and therefore, international discussion and agreement.


Technical Secretariat or IVO
Programs
Projects
Methodological Options and Corresponding IVO Functions and Skills
Requirements:
- Personnel
- Ressources
Program 1:
Chemical Weapons
(CD/500 - Articles IV and V)
(CD/734 - Articles III and IV)
Verification re:
1.1 Declarations
1.2 Storage
1.3 Destruction
1.4 Transfers
[1.5 Diversion]*
* in CD/734 only
- see Appendix 1 for complete lists correlating options and functions; see section 3.7 for condensed lists of suitable verification schemes; see section 3.4 for general lists of functions and skills; and see section 4.1 for a narrative correlation of 'best' options and functions.
- see section 6.1 for an examination of personnel requirements.
- see section 6.2 for an elaboration of the parameters involved in estimating resource requirements.
Program 2:
Chemical Weapons Production Facilities
(CD/500 - Articles IV and VI)
(CD/734 - Articles III and V)
Verification re:
2.1 Declarations
2.2 Cessation of Production/ Closure
2.3 Destruction/Dismantling
2.4 Temporary Conversion
2.5 Transfers
[2.6 Reconstruction]*
* in CD/734 only
- see Appendix 2 for complete lists correlating options and functions; see section 3.7 for condensed lists of suitable verification schemes; see section 3.4 for general lists of functions and skills; and see section 4.2 for a narrative correlation of 'best' options and functions.
- see section 6.1 for an examination of personnel requirements.
- see section 6.2 for an elaboration of the parameters involved in estimating resource requirements.
Program 3:
Activities not Prohibited
(CD/500 - Articles III and IV)
(CD/734 - Articles III and VI)
Verification re:
3.1 Declarations
3.2 Research and Development
3.3 Permitted Production (Small-scale Facilities)
3.4 Non-production (Civilian Production)
3.5 Transfers
- see Appendix 3 for complete lists correlating options and functions; see section 3.7 for condensed lists of suitable verification schemes; see section 3.4 for general lists of functions and skills; and see section 4.3 for a narrative correlation of 'best' options and functions.
- see section 6.1 for an examination of personnel requirements.
- see section 6.2 for an elaboration of the parameters involved in estimating resource requirements.
Program 4:
Challenge Inspection
(CD/500 - Articles IX, X, and XI)
(CD/734 - Article IX)
Challenge Inspection re:
4.1 CW Storage
4.2 CW Production - Government Facilities
4.3 CW Production - Civilian Facilities
4.4 Allegations of Use
- see section 5.0 dealing with the program "Challenge Inspection." In particular, for Project 4.4, section 5.2 summarizes material from Canada's Handbook for the Investigation of Allegations of Use of Chemical or Biological Weapons.
- see section 6.1 for an examination of personnel requirements; see section 5.2.2 for personnel descriptions for Project 4.4.
- see section 6.2 for an elaboration of the parameters involved in estimating resource requirements.

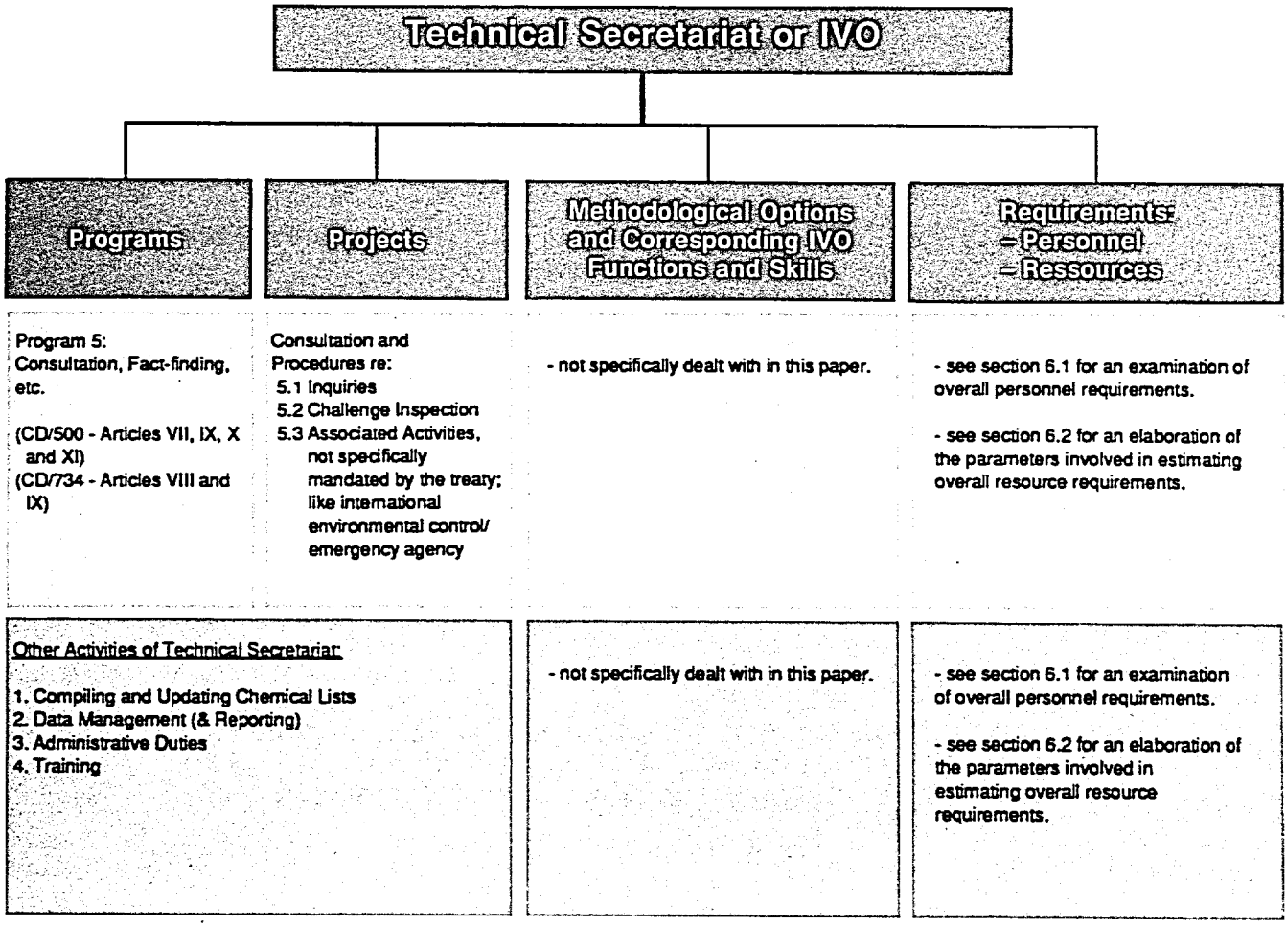

Technical Secretariat or IVO
Programs
Projects
Methodological Options and Corresponding IVO Functions and Skills
Requirements:
– Personnel
– Ressources
Program 5:
Consultation, Fact-finding, etc.
(CD/500 - Articles VII, IX, X and XI)
(CD/734 - Articles VIII and IX)
Consultation and Procedures re:
5.1 Inquiries
5.2 Challenge Inspection
5.3 Associated Activities, not specifically mandated by the treaty; like international environmental control/ emergency agency
- not specifically dealt with in this paper.
- see section 6.1 for an examination of overall personnel requirements.
- see section 6.2 for an elaboration of the parameters involved in estimating overall resource requirements.
Other Activities of Technical Secretariat:
1. Compiling and Updating Chemical Lists
2. Data Management (& Reporting)
3. Administrative Duties
4. Training
- not specifically dealt with in this paper.
- see section 6.1 for an examination of overall personnel requirements.
- see section 6.2 for an elaboration of the parameters involved in estimating overall resource requirements.

TABLE OF CONTENTS

PAGE

PAGE

1.0 INTRODUCTION

The purpose of this paper is to report on a "systems study" of what an International Verification Organization would comprise in terms of skills, personnel, and resources; and how it would be organized to perform its functions in relation to a future Chemical Weapons Convention. The main aim is to provide some measure of precision and clarity to the understanding of the undertakings and/or obligations that the verification provisions would impose on the signatories. The study took as its starting point the US draft Convention, CD/500[1] and the final report of the 1986 Ad Hoc Committee, CD/734[2], and those working papers submitted to the Committee and its predecessors over the period 1980-1986. The study leads step-wise and systematically to an outline of a practical organization which could oversee the implementation of a Chemical Weapons Convention. The organ in charge of the verification of such a Convention is usually referred to as the "Technical Secretariat" in the CD literature. In this report, the terms "Technical Secretariat" and "International Verification Organization (IVO)" are used interchangeably.

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1 CD/500, United States of America, "Draft Convention on the Prohibition of Chemical Weapons," 18 April 1984.

2 CD/734, Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament, 29 January 1987.

2.0 BACKGROUND

Many working papers have been submitted to the Conference on Disarmament, but very little has been written on the Technical Secretariat as such; a few documents dealing with this topic have been submitted by some Western Nations. Still, it is often necessary to infer the responsibilities of a secretariat from those assigned to the Consultative Committee by various groups.

2.1 General Views

Examination of some generally held views on the verification of a Chemical Weapons Convention leads to a preliminary specification of the duties of the Consultative Committee and its secretariat. Five main types of verification have been suggested:

- verification of destruction of stocks;
- verification of destruction of production facilities;
- monitoring of production of "super-toxic," lethal chemicals for permitted purposes;
- verification of non-production;
- special investigations required for fact-finding missions or potential violations.

States Parties would undertake to ensure compliance with the Convention by a system of international verification which comprises:

- data reporting, i.e., the provision of data to the Consultative Committee on production and other information on a periodic basis;
- on-site inspections, i.e., on-site monitoring using automatic instruments and/or inspections by an international inspectorate, either
  - on an immediate basis
  - on a continuous basis
  - on a periodic basis
  - on a quota basis

- on a random basis
- on an agreed basis, either bilaterally or through the Consultative Committee

- "Challenge" procedures - non-routine verification of compliance.[1]

It is a generally accepted principle that a Consultative Committee should be established and that it have the following responsibilities:

"(a) establishing (and revising) procedures for the exchange of information, for declarations, and for technical measures related to the implementation of the Convention;

(b) receiving, keeping, and making available to States Parties, declarations, plans, and notifications presented by States Parties in accordance with the Convention;

(c) carrying out all activities relating to the execution of measures of verification as specified in the Convention; further specifying procedures for conduct of systematic international on-site inspection in accordance with the provisions of the Convention; receiving and considering requests for fact-finding procedures and to conduct such procedures;

(d) cooperating with the national authorities of States Parties in the implementation of the Convention;

(e) facilitating consultations and cooperation among States Parties at their request by means of rendering services to them;

(f) reviewing scientific and technical developments which could affect the operation of the Convention;

(g) encouraging international scientific and technical cooperation in the chemical field for peaceful purposes."[2]

A Technical Secretariat would be established as a sub-organ of the Consultative Committee and its duties would be to provide support to the Consultative Committee and the Executive Council, to provide technical assistance to the States Parties, to

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1 Modified from: CD/416, Report of the Ad Hoc Committee on Chemical Weapons, 22 August 1983, Annex I, pp. 5-6.

2 CD/CW/WP. 122, Ad Hoc Committee on Chemical Weapons, Working Group C, Article VIII, Consultative Committee, 2 August 1985, pp. 1-2. See also CD/CW/WP. 126, Ad Hoc Committee on Chemical Weapons, Working Group C, Report on Working Group C, 9 August 1985, pp. 3-4.

carry out international inspections, and to assist the Consultative Committee and Executive Council in tasks related to information and fact-finding. It is clear that the responsibilities and duties of the Technical Secretariat will depend upon those assigned to the Consultative Committee and its Executive Council. Hence the skills, personnel, and resources required for a Technical Secretariat will be a function of its delegated responsibilities, and its size will be related to the extent of its duties.

The staff of the Secretariat should be chosen among the nationals of the States Parties and should consist of such qualified personnel as needed to carry out the duties of the Consultative Committee. It would:

- carry out all activities relating to the execution of international measures of verification as specified in the Convention;
- develop, and revise as necessary, detailed procedures for exchange of information, for declarations and for technical matters related to the implementation of the Convention;
- review the scientific and technological developments which would affect the operation of the Convention.

These functions were further elaborated in the 1983 report of the Ad Hoc Committee on Chemical Weapons:

"The Technical Secretariat shall:

(a) render technical assistance to States Parties and to the Executive Council in implementing the provisions of the Convention;

(b) receive from States Parties and distribute to them data relevant to the implementation of the Convention;

(c) elaborate technical questions relevant to the implementation of the Convention, such as drawing up for recommendation to the Consultative Committee (or the Executive Council) of lists of key precursors, technical procedures, etc.;

(d) assist the Executive Council as agreed upon in tasks related to information, fact-finding, systematic on-site inspection and challenge inspection."[3]

The 1984 report of the same Committee contains slightly modified functions:

"(a) provide administrative support to the Consultative Committee and the Executive Council;

(b) render technical assistance to States Parties, the Consultative Committee and the Executive Council;

(c) carry out international on-site inspections as provided for in the Convention;

(d) assist the Consultative Committee and the Executive Council in tasks related to information and fact-finding as well as other tasks provided to it by those organs."[4]

The Socialist States suggested the following composition for the staff:

"The staff of the Secretariat shall be appointed on the basis of the principle of just political and geographical representation of the States Parties to the Convention. It shall be composed of inspectors and experts who shall be nationals of the States Parties."[5]

Western States stated:

"The paramount consideration in the employment of the staff of the Secretariat and in the determination of the conditions of service shall be the necessity of securing the highest standards of efficiency, competence and integrity. Due regard shall be paid to the importance of recruiting staff on as wide a geographical basis as possible among States Parties to the Convention."[4]

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3 CD/416 Report of the Ad Hoc Committee on Chemical Weapons, 22 August 1983, Annex II, pp. 16-17.

4 CD/539, Report of the Ad Hoc Committee on Chemical Weapons to the Conference on Disarmament, 28 August 1984, Annex I, p. 23.

5 CD/532, Working paper submitted by a group of Socialist States, "The Organization and Functioning of the Consultative Committee," 8 August 1984, pp. 2-3.

The Technical Secretariat's main duties then are of two kinds: those which are of either an archival or information-processing type; and those relating to inspection functions.

2.2 Specific Views

This section contains national views, presented in working papers, which deal to some extent with the functioning and organization of the Consultative Committee and the Technical Secretariat. Duties and responsibilities proposed for the Consultative Committee will directly affect those of the Technical Secretariat. Working papers which deal with specific aspects of on-site inspection also give an indication of the responsibilities of the Technical Secretariat.

In 1983 the United States[6] presented their views on the functions of the Consultative Committee. It should be responsible for conducting on-site inspection of:

- declared stockpiles, on an agreed basis;
- destruction of stocks, on a continuous basis until destruction is complete;
- closure and destruction of declared production and filling facilities, at an agreed level until the facilities are destroyed;
- permitted small-scale production and facilities for super-toxic lethal chemicals for protective purposes, at an agreed level for as long as the facility is maintained for this purpose;
- production for permitted purposes, of specified types of chemicals which are deemed to pose a particular risk, on a random basis and at an agreed level.

Additionally, the Consultative Committee would conduct ad hoc on-site inspections agreed among two or more parties, if so requested.

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6 CD/343, United States of America, "United States Detailed Views on the Contents of a Chemical Weapons Ban," 10 February 1983, p. 6.

China felt that immediately upon entry into force of the Convention, a Consultative Committee should be set up and that principles of universality and equality of all states should be taken into account when deciding upon the composition. It was suggested that the Consultative Committee should have the following functions:

"(1) To decide, in accordance with agreed procedures, on routine inspection and to oversee its implementation;

(2) To decide, in accordance with agreed procedures, on challenge inspection and to oversee its implementation;

(3) To review, revise or amend, when new developments in science and technology make this necessary, the technical provisions of the Convention, such as toxicity, lists of precursors, etc.;

(4) To examine and consider complaints of non-compliance with the Convention;

(5) To promote the flow of information on implementation of the Convention;

(6) To report on its work to States Parties and to the Depository of the Convention;

(7) To assume all other functions unanimously agreed upon among the States Parties."[7]

The paper submitted by a group of Socialist States[8] on the organization and functioning of the Consultative Committee contained only a passing reference to the Technical Secretariat:

"The Technical Secretariat shall be staffed proceeding from the principle of equitable political and geographic representation of States Parties. It shall be composed of inspectors and experts who shall be nationals of the States Parties."

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7 CD/443, China, "Proposals on Major Elements of a Future Convention on the Complete Prohibition and Total Destruction of Chemical Weapons," 5 March 1984, pp. 5-6.

8 see footnote 5.

The Socialist States proposed the following functions:

"• coordinate all forms of verification and provide for communication between national and international verification bodies;

• elaborate, in agreement with all parties, standard verification techniques;

• receive, store and disseminate information presented by States Parties in accordance with the Convention, including declarations, notifications and statements on chemical weapons stockpiles and production facilities, plans for the destruction or diversion of such stockpiles and for elimination (destruction, dismantling, or diversion) of the facilities, and annual declarations concerning chemicals for permitted purposes that are produced, diverted from stockpiles, used, acquired or transferred;

• verify, in accordance with the provisions of the Convention, reports on the use of chemical weapons;

• determine, on the basis of information presented by the States Parties on chemical weapons stockpiles and the technical characteristics of the facilities for their destruction, as well as on the technical characteristics of the facilities for the production or supertoxic lethal chemicals for permitted purposes, the modalities and time frames for the implementation of international on-site inspections at each individual facility, proceeding from the agreed criteria;

• consider requests for on-site inspection filed by States Parties and, in the event of a positive decision, carry out the inspection, subject to the consent of the host State;

• assign, in cases of on-site inspection by challenge, conducted by agreement directly between the States Parties concerned, inspectors from its Technical Secretariat to participate in such inspections, if this is requested by one or several States Parties."[9]

The United States draft treaty (CD/500) contains a number of suggestions on the duties of the Technical Secretariat:

"(a) conduct on-site inspections pursuant to Articles III, V, VI, X and XI;

(b) provide the necessary administrative support to the Consultative Committee, the Executive Council, the Fact-finding Panel and such other subsidiary bodies as may be established;

(c) render appropriate technical assistance to Parties and to the Executive Council in implementing the provisions of the Convention such as reviewing

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9 see footnote 5.

Schedules A, B, C and D, developing technical procedures, and improving the effectiveness of verification methods;

(d) receive from the Parties and distribute to them data relevant to the implementation of the Convention;

(e) negotiate the subsidiary arrangements for systematic international on-site inspection provided for in Annex II, section B, subsection A, paragraph 3; and

(f) assist the Executive Council on such other tasks as may be agreed."[10]

The Preparatory Commission should elaborate on the composition of the Technical Secretariat, but all inspectors should be qualified and be acceptable to their government.

International on-site inspection of the destruction of chemical weapon stockpiles will require a combination of inspectors and monitoring instruments. Inspection would be continuous during destruction operations for supertoxic lethal chemicals, during draining of filled munitions and during the destruction of filled and drained munitions. There are differing views as to whether inspections should be conducted on a continuous or on a quota basis for the destruction of other chemicals, or whether such inspections could be limited to certain key stages. Inspectors would have to be qualified, impartial and able to make independent judgments. If possible, they should have the opportunity to make a detailed engineering review of a destruction facility before operation commences and they ought to have an up-to-date knowledge of the operation and design of the facility. The data used in verification should be closely linked with the actual destruction phase and the verification procedures should not interfere with the operation of the facility. Decisions as regards destruction methods, etc., are the responsibility of the sovereign State Party but the Technical Secretariat

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10 CD/500, United States of America, "Draft Convention on the Prohibition of Chemical Weapons," 18 April 1984, pp. 4-5.

could, inter alia, assist with the design of destruction facilities and suggest on how to facilitate verification tasks; such assistance would be given only on request.[11]

Illustrative on-site inspection procedures for the destruction of stockpiles were given by the United States in 1983; these were intended to provide a balance between the use of sensors and inspection personnel. The use of instruments reduces the inspection burden, but the continuous presence of inspectors during destruction operations was thought essential. A minimum of two inspectors would be required during each operating shift and one during regular maintenance periods. In total then, the CAMDS (Chemical Agent Munitions Disposal System) facility would necessitate a minimum of three inspectors; a slightly larger number would be required to cover various absences from duty. The inspectors should have technical backgrounds and receive special training.[12]

In 1984, Sweden introduced a paper which analyzed the CAMDS destruction process described in CD/387 and made some suggestions to improve the verification arrangements; they also suggested a more efficient verification system for such facilities. They concluded that on-site visits would be necessary during the construction of destruction plants; if such facilities were built without considering verification requirements, then continuous inspection would be necessary. Such a plant could be modified to permit verification by sensors and periodic on-site visits, but there might be a small risk that some activities would remain undetected. More reliable verification arrangements could be made if they were considered during the

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11 CD/CW/WP. 108, Ad Hoc Committee on Chemical Weapons, Report of the Chairman of Working Group B, 22 April 1985, pp. 4-5.

12 CD/387, United States of America, "Illustrative On-site Inspection Procedures for Verification of Chemical Weapons Stockpile Destruction," 6 July 1983, p. 14.

construction phase. Much technical work would have to be done before the need for continuous on-site inspection could be eliminated. On-site visits would always be necessary during a destruction period to ensure all the equipment was functioning. The presence of inspectors during maintenance would also be necessary.

Sweden suggested the following:

"(1) International on-site inspection is carried out before starting the destruction process in order to check that the facility is built according to declared and submitted plans and drawings, and that the monitoring equipment is functioning properly.

(2) International on-site inspection is undertaken at the start of the destruction process in order to check the monitoring process and compare the results with those obtained and submitted to the Consultative Committee by the national operating teams.

(3) International inspectors should have the right to visit the facility when larger and longer operational stops have to be made, in order to follow repair or maintenance processes. In addition, a number of agreed but unscheduled visits should be made by the inspectors each year.

(4) Data produced by the remote-sensing equipment should be transmitted to the Consultative Committee over tamper-proof communication networks, as well as be stored on chips at the site, where they could be checked by visiting inspectors. Also, data from the national operational team should be transmitted to the Consultative Committee in the same way. The log-books should be made available to the international inspectors at their visits.

(5) When work at the facilities is finished, international inspectors should follow the destruction of the facility, or its conversion for other destruction purposes during an initial phase, ensuring that no unauthorized changes have appeared in its construction period."[13]

France submitted a paper on the elimination of stocks and production facilities in 1984. Each State Party should authorize the presence of international inspectors before and during the destruction process. The initial inspection would put the stocks

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13 CD/425, Sweden, "Verification of the Destruction of Stockpiles of Chemical Weapons," 18 January 1984, pp. 1-4.

under surveillance and each operation for the removal of munitions or stocks for destruction would be carried out in the presence of inspectors.

Each destruction unit should be inspected before every round of destruction and sensors installed as provided for under the Convention. The process should be the subject of continuous on-site monitoring by an international agency, in collaboration with the national teams, but the inspectors should not interfere with the destruction process.

The destruction of CW production facilities should be verified by authorized on-site inspections carried out during the interim period and after each destruction operation. Inspections should be carried out at each facility three months after the Convention enters into force. These would confirm that relevant facilities have been closed and placed under international supervision. Provision should be made for on-site checking at the end of each destruction operation, as well as at regular intervals to verify closure.[14]

There is agreement that there should be international on-site inspection of the destruction of CW-stockpiles, the destruction or conversion of CW-production facilities, the production of small amounts of supertoxic lethal chemicals for permitted purposes, and for the investigation of allegations of use. The Western group has also proposed inspection for the verification of non-production, and some of these proposals contain specific recommendations concerning the Technical Secretariat.

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14 CD/494, France, "Elimination of Stocks and of Production Facilities," 3 April 1984, pp. 3-5.

In 1983 the United Kingdom presented a paper dealing with the production of key precursors of chemical weapon agents for non-military purposes and with the production of small quantities of supertoxic lethal chemicals for permitted purposes. An appropriate verification regime would comprise the following:

"(1) declaration of facilities producing the chemicals listed and of facilities designed, constructed or used for such purposes in the past;

(2) periodic random selection of a number of all such declared facilities for on-site inspection;

(3) on-site inspection by a team of inspectors under the aegis of the Consultative Committee.

Inspection should include: examination of production for the facility; visual observation at the site to detect unnecessary stockpiling, munitions filling facilities, overspecialized safety equipment, etc.; and engineering inspections to ensure that the production line is compatible with the declared substance."[15]

A major paper from the Netherlands, in 1984, examined the possible size and structure of an inspectorate. The paper assumed that some inspection of the chemical industry would be necessary to ensure that no undeclared production of supertoxic lethal chemicals or their key precursors took place in quantities relevant to a CW Convention. Hence, inspection should involve all chemical plants capable of such production. A Technical Secretariat could probably draw upon past experience of relevant international organizations which employed independent inspectors working under strict rules, but with a certain degree of diplomatic immunity. The Technical Secretariat would have to consider the inspectors' rights, as well as the rights of countries to refuse inspectors, and questions as to how inspectors are to be designated for specific countries.

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15 CD/353, United Kingdom, "Verification of the Non-production of Chemical Weapons," 8 March 1983, pp. 2-4.

Three types of on-site inspection were identified:

"A. Systematic continuous

B. Systematic non-continuous

(i) Regular
(ii) Random

C. Ad Hoc (Challenge)"[16]

These categories have a direct bearing on the types of inspectors needed as well as on the modus operandi.

Systematic, continuous inspections would occur at destruction facilities. Systematic, non-continuous regular inspections would take place: (a) at closed-down production plants and during their destruction, (b) at stockpile depots until the stocks were destroyed, (c) at facilities producing CW-agents for protective purposes. Systematic, non-continuous random inspections would take place at plants producing certain supertoxic lethal chemicals and key precursors for permitted purposes. This verification scheme would have two components: a check that the quantity of declared production is in accordance with permitted purposes and a qualitative check that no undeclared production is taking place. Random inspections would also take place at plants which had the capability of producing the relevant chemicals. Ad hoc inspections could occur anywhere under a challenge system.

Resident inspectors would be needed for continuous inspections and recruitment schemes would have to take into account the hardships of working in possibly remote locations.

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16 CD/445, Netherlands, "Size and Structure of a Chemical Disarmament Inspectorate," 7 March 1984.

Non-continuous inspections would be less routine in nature and would require a broader expertise than that needed in verifying stockpile destruction. Some experience in civilian chemical production would be needed in order to be able to inspect a variety of plants and look for possible clues for noncompliance; extensive travelling would also be required.

Challenge inspection would either use inspectors employed by the Secretariat or use experts designated by the States Parties. It is hoped that the number of challenge inspections will be low and so no inspectors would be assigned that task solely. A standing list of experts should be compiled so that they could be selected quickly when needed.

Systematic inspection can be either regular or random, but inspections of the chemical industry would be most effective if held on a random basis since this injects the notion of chance. Inspections for the non-production of other supertoxic lethal chemicals or key precursors produced for permitted purposes could be accomplished by the same team that verifies declared production.

The Technical Secretariat would need the assistance of States Parties in several complex areas; one form of assistance might be a "technical support programme" in which new verification equipment and methodology developed by States Parties could be transferred to the Secretariat.

Based on the above, the following rough calculation of the size of an inspectorate was made:

- A permanent staff of at least 50 inspectors and 90 support staff is required.
- Up to 115 inspectors and 100 or so support personnel will also be needed for the first 10 years.
- The size of the organization depends greatly on the answer to the question on what scale inspection is planned for plants that are declared not to produce supertoxic lethal chemicals and their key precursors, but to be capable of synthesizing organic chemicals in relevant quantities.
- After the 10 year period, during which the destruction of CW stockpiles and plants has taken place, the envisaged CW secretariat will in any case be smaller than the part of the IAEA secretariat, including the inspectors, involved in the application of nuclear safeguards.[17]

In 1985, the United Kingdom[18] submitted proposals for inspection and data exchange for the verification of non-production. In devising an inspection system for a Chemical Weapons Convention, they drew upon the safeguards experience of the International Atomic Energy Agency (IAEA). Verification of non-production would be based on routine inspections of declared sites, carried out on a random basis. The purpose of these inspections would be to obtain information which could then be compared with the data submitted by the State Party. Detailed principles for inspection procedures would be agreed upon in advance and be incorporated into the Convention, while inspectors would be chosen on the basis of their integrity and competence. Appointments would also take the principle of geographic representation into account. An inspector might be authorized to carry out the following functions:

- examine relevant records held on the site;
- make independent measurements of all substances;
- check measurement and control equipment;
- observe facility measurement, sampling and calibration procedures;

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17 see footnote 16.

18 CD/575, United Kingdom, "Verification of Non-Production of Chemical Weapons: Proposals for Inspection Procedures and Data Exchange," 6 March 1985, pp. 2-3.

- take duplicate or additional samples and measurements and arrange for the transfer of such samples for analysis.

Inspectors' rights of access, privileges, and immunities would be described in the Convention and agreed to by the Executive Council and the States Parties. A representative of the State might accompany the inspectors on site visits. Information obtained by the Inspectorate through inspections and reports must remain confidential to the organization.

A United Kingdom working paper in 1985[19] dealt with the Technical Secretariat. It proposed, inter alia, that the Technical Secretariat be responsible for the conduct of routine inspection of declared chemical facilities and for immediate challenge inspections of declared and undeclared facilities and locations. The paper also contained proposals for the organization and functioning of the Secretariat and the Director General. The U.K. suggested that an International Inspectorate be part of the Secretariat staff and that a special challenge panel be created. This panel would consist of a pool of senior inspectors with special responsibilities for sensitive inspections carried out by ad hoc teams of at least seven members. It might also be appropriate to maintain lists of qualified experts who would be immediately available to conduct challenge inspections. The involvement of inspectors on challenge teams would not preclude their participation in regular inspections.

2.3 Conclusions

It is generally agreed that a Technical Secretariat should be a sub-organ of the Consultative Committee and that it will provide support to the Executive Council and

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19 CD/589, United Kingdom, "Chemical Weapons Convention: the Organs and Constitution of the Organization," 11 April 1985, pp. 3-5.

the Consultative Committee, render technical assistance to States Parties and the Executive Council, provide necessary on-site inspections, assist in tasks related to information and fact-finding, and assist in other tasks as provided to it.

The responsibilities and duties of a Technical Secretariat will be primarily dependent upon those assigned to the Consultative Committee and the Executive Council under the Convention. The skills, personnel and resources required depend upon the nature of the verification provisions within the Convention.

The literature on the Technical Secretariat deals almost exclusively with the nature of the inspection functions, but there has been no elaboration of the personnel required to carry out these tasks. There has been almost no discussion of the problems associated with its informational and archival functions, nor those which will arise if the methodologies of materials accountancy or remote sensing are used in verification.

There is agreement that there should be international on-site inspection of the destruction of stockpiles, of the destruction or conversion of production facilities, of the production of small amounts of supertoxic lethal chemicals for permitted purposes, of the non-production of supertoxic lethal chemicals or key precursors in civilian industry, and for the investigation of allegations of use of chemical weapons, but the details have yet to be worked out.

3.0 THE SYSTEMS STUDY

3.1 Introduction

The system under study is an "International Verification Organization" (IVO) or, alternatively, a "Technical Secretariat." Both names are currently used to describe that sub-organ of the Consultative Committee which will be responsible for the activities necessitated by the articles of a Chemical Weapons Convention. As we have seen, these activities are of two types, but the most important involve verification of compliance with the Convention. CD/500, the US draft Convention, and CD/734, the current draft text, define the starting point for this study in that the verification needs of the Convention are spelled out in their various articles.

3.1.1 Articles Which Demand Verification of Compliance

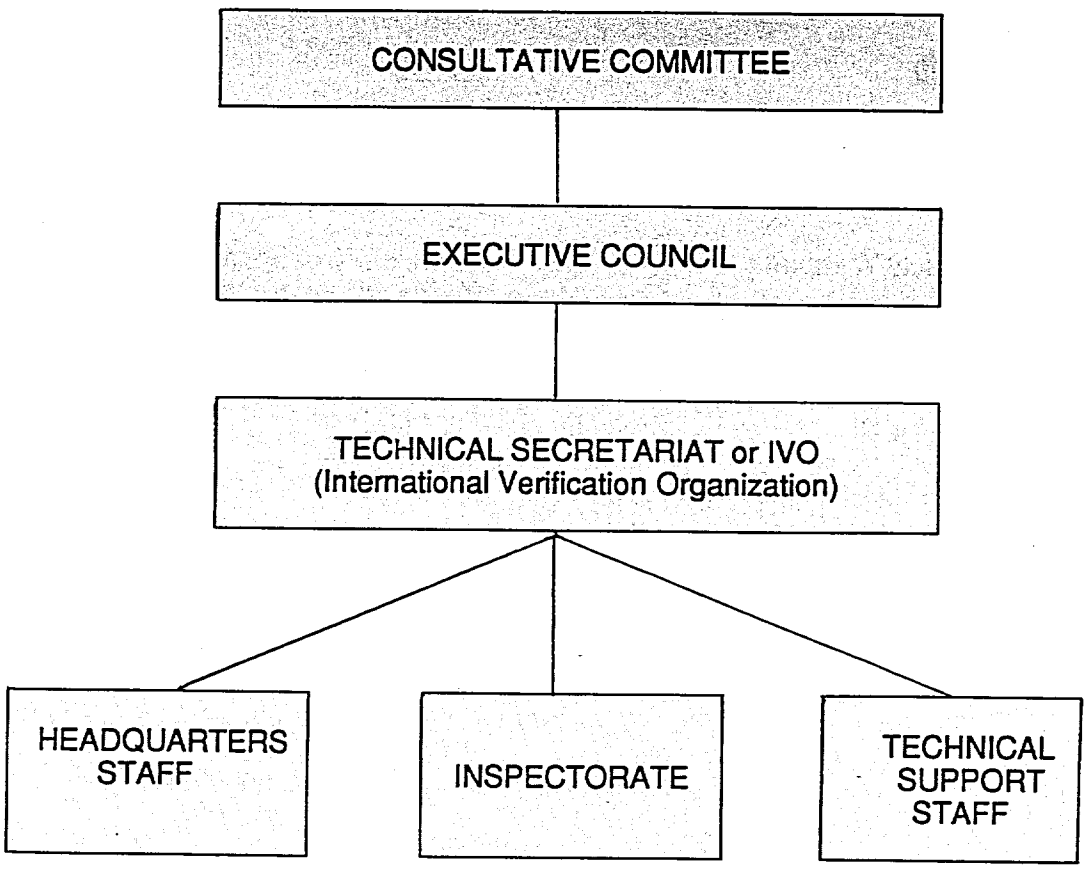
	CD/500		CD/734
III.	Permitted Activities	III.	Declarations
IV.	Declarations	IV.	Chemical Weapons
V.	Chemical Weapons	V.	Chemical Weapons Production Facilities
VI.	Chemical Weapons Production Facilities	VI.	Activities not Prohibited
IX.	Compliance	IX.	Fact-finding
X.	Special On-site Inspection		
XI.	Ad Hoc Inspection		

The skills, personnel and resources needed by a Technical Secretariat can best be determined by an in-depth analysis of the inspection requirements of these articles.

CD/500 shows the Technical Secretariat as a creature of the Consultative Committee in Article VI and gives details in Annex I. CD/734, the current negotiating document, also places the Technical Secretariat under the Consultative Committee (described in Article VIII). It should be noted that the idea of the structure and organization of an inspectorate is still very vague in this document; nevertheless, it is clear from the various articles and annexes as to what tasks will have to be carried out under the supervision of the Executive Council/Consultative Committee.

3.1.2 Organizational Structure for Implementation of a CW Convention

The following flowchart indicates the relative positions of the primary organs needed to effectively implement the provisions of a CW Convention.



3.1.3 Approach to Define the Inspection Requirements of an IVO

3.1.3.1 The Approach of Systems Analysis

Systems analysis is a logical technique for solving problems by identifying, organizing and developing ideas and information. Ideally, it provides the best possible solution to a problem for which there is no obvious or unique answer. The emphasis, however, is on generating information that will help the decision-makers better understand the decision which they must make.

The initial step of the analysis involves defining the problem. In the case at hand, the problem can be stated as follows: The inspection requirements of an IVO are not specified in any detail anywhere. Therefore, the problem is quite broad and as a result, a strict systems analysis is difficult to apply. It is much more useful to examine a series of sub-problems (referred to later as projects), created from divisions within the articles of CD/500 and the CD/734. For example, one sub-problem may focus on the inspection requirements in relation to the destruction of CW stockpiles.

The second step is to state an objective or a focal point for the eventual solution of the specific problem, e.g., one objective would be to define an appropriate verification scheme for CW destruction - one which would be agreeable to all Parties to the Convention.

The third step involves listing all conceivable methods by which the objective might be reached. For example, a number of different alternative verification schemes are possible for the verification of CW destruction. Each may correspond to a different set of inspection requirements.

The fourth step is to determine the restrictions on the methodological options identified in the previous step. Boundary conditions for determining restrictions are very vague in this study, since there are few, if any, guidelines for restrictions found in the draft Convention or in working papers.

Next, information is gathered to assess the value of each of the alternatives. In this instance, much background information was required before the problems, objectives, and restrictions could be stated clearly. Consequently, information gathering was a parallel step.

The sixth step is the elimination of alternatives which are unrealistic, i.e., incapable of reaching the objective under the given or perceived restrictions.

The remaining two steps, the selection and implementation of a solution(s) have not been explicitly considered, since those are, ultimately, functions of the decision-makers.

The systems analysis approach is of most value in situations where the problems, objectives, and restrictions are well-defined and based upon physically realizable situations. In the event that the problem(s), objective(s) and/or restrictions are general or imprecise, then the approach is less useful. However, here the initial applications of the analysis, even in a qualitative way, have resulted in the listing of methodological options and corresponding IVO functions and skills (see sections 3.4 and 3.5, and appendices 1 to 4). This represents a considerable achievement in aiding the conceptualization of potential verification schemes determining the operational structure, personnel, and resource requirements of an International Verification Organization.

3.1.3.2 The Programmatic Approach Used

The following four steps outline the approach taken to describe the inspection requirements of an IVO. A systems analysis approach was utilized wherever possible. However, the nature of the system does not lend itself to a strict systems analysis and so the steps actually followed are better described as being part of a systems study, rather than a systems analysis.

Step 1 - Literature Survey: Setting up Programs and Projects

An exhaustive survey was performed using the compilations of Canada's Department of External Affairs, covering the period 1969-1985 on chemical weapons (CD, CCD and CD/CW/WP papers)[1]; current or more-recent CD papers were examined as well.

The study began with a detailed critique of CD/500 and CD/734 where the basic undertakings of the draft Convention are laid out. A complete listing of 'programs'[2] (e.g., "Chemical Weapons Production Facilities" would be described as a program) was drawn up based on the articles in these documents. Some programs were further divided into 'projects' (e.g., the "Destruction of CW Production Facilities" would be a project), corresponding to divisions or sub-sections within the relevant articles. This allowed for easy sorting of reference material under appropriate programmatic headings.

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1 CD: Conference on Disarmament (or prior to 1984: Committee on Disarmament); CCD: Conference of the Committee on Disarmament; CD/CW/WP: Conference on Disarmament/Chemical Weapons/Working Papers.

2 See glossary for definitions of terms used within this paper.

As additional papers were read, any original idea or new piece of information was recorded and filed under the appropriate program or project heading. This procedure started with material from the 1983-1986 period; earlier papers were reviewed and the files were updated as new material was examined.

Step 2 - Determination of Verification Methods[3]

Initially, an attempt was made to formulate a complete set of alternative verification methods and corresponding IVO functions for each project, e.g., one methodological option is continuous on-site inspection, while an IVO function could be the installation of equipment. We began by listing all conceivable methods for the verification of CW stockpiles, production facilities, and permitted production in small-scale facilities. These alternatives were derived from various combinations of frequency and type of data reporting, inspections and use of instrumentation.

It soon became apparent that this approach was repetitious since both specific methodological options and IVO functions were often applicable to a number of projects. A system was then devised to represent these data in a condensed form, consisting of a chart of methodological options and listings of IVO functions and the corresponding required skills (see the chart on pages 29-31 and the listings under section 3.4). The basic chart was converted to a checklist (pages 32-36), suitable for practical use.

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[3] In this study, Program 4: "Challenge Inspection", was considered separately from the other programs which require verification. This is due to the fact that a challenge inspection necessitates immediate and full on-site inspection, thereby decreasing the number of methodological options to one.

A complete study on "Allegations of Use" (Project 4.4) was previously made by the Canadian Government and is published in the Handbook for the Investigation of Allegations of the Use of Chemical or Biological Weapons, dated November, 1985. The optimum method of verification (or investigation) of an allegation of use was summarized from this report, as were the functions of the investigating team and the personnel requirements.

The chart, together with the listings of functions and skills, allowed for the creation of complete, uniform and condensed listings (see Appendices 1 to 3) of verification schemes for the many projects. A detailed example of one general methodological option is given in Appendix 4.

Step 3 - Formulation of Restrictions

Restrictions to the verification schemes were drawn up at random throughout Steps 1 and 2 (see section 3.6). Emphasis was initially placed on compiling lists of physical restrictions, but it became apparent that the bulk of the restrictions relevant to the various programs was largely subjective, drawn from (common) viewpoints expressed by various States or resulting from logical arguments.

Step 4 - Application of Restrictions

The restrictions were applied to eliminate unsuitable verification schemes. First, physically unrealizeable methods were eliminated in designing the lists of verification schemes. Then, schemes judged to be of little potential value to the Convention were removed from consideration, e.g., remote verification is judged to be of little value in verifying civilian production.

Application of the restrictions to the system studied led ultimately to a short list of suitable verification schemes (see section 3.7). These results are interpreted in section 4.0, where potential solutions describing inspection requirements for each project are detailed.

A discussion on skills, personnel and resources can be found in Section 6.0.

3.2 Programs and Projects

The negotiation process involved in elaborating a Convention has led to the United States draft Convention, CD/500, and the current draft text, CD/734. The form of the articles in these papers, although appropriate for negotiations, needs modification for a detailed analysis of the operation and function of an International Verification Organization. The content of the articles was rearranged into a different form - a functional form in which clearly distinguishable programs are further subdivided into projects of an IVO. Projects are areas of concern which will require verification under the Convention, e.g., a program such as "Chemical Weapons" is not verifiable whereas a project such as "Destruction of Chemical Weapons" is verifiable. Thus, a program groups together projects with operational connections in terms of actual verification operations. The arrangement shown below allows easy reference between the programs and projects of this study and the articles of CD/500 and CD/734.

PROGRAM	PROJECT
1. Chemical Weapons (CD/500 Art. IV,V; CD/734 Art. III,IV)	Verification re: 1.1 Declarations 1.2 Storage 1.3 Destruction 1.4 Transfers [1.5 Diversion]
2. CW Production Facilities (CD/500 Art. IV,V; CD/734 Art. III,V)	Verification re: 2.1 Declarations 2.2 Cessation of Production/Closure 2.3 Destruction/Dismantling 2.4 Temporary Conversion 2.5 Transfers [2.6 Reconstruction]
3. Activities not Prohibited (CD/500 Art. III,IV; CD/734 Art. III,VI)	Verification re: 3.1 Declarations 3.2 Research & Development 3.3 Permitted (Small-scale) Production 3.4 Non-production (Civilian Production) 3.5 Transfers

(Cont'd...)

(Continued)

4.	Challenge Inspection (CD/500 Art. IX,X,XI; CD/734 Art. IX)	Challenge Inspection re: 4.1 CW Storage 4.2 CW Production - Government Facilities 4.3 CW Production - Civilian Facilities 4.4 Allegations of Use

3.3 General Methodological Options

The chart which follows on pages 29-31 represents alternative verification schemes for a Chemical Weapons Convention. Various combinations of methods exist as possibilities for each project (e.g., inspection and automated sampling is one combination; data reporting, inspection and no sampling is another).

For methodological options 2, 3 and 4, it is intended that from each row of joined boxes, one and only one box is to be selected, i.e., boxes directly joined along the entire side are linked by the logical operator 'or.' Boxes joined only by dotted lines are linked by the logical operator 'and/or.' For each of options 2 and 4, the decision-maker is to first select one box from the group joined by dotted lines and then choose one appropriate descriptor from each proceeding row of joined boxes. With respect to methodological option 4 ("Verification with Use of Instruments"), this procedure may be carried out up to five times, once for each of the five instrument (and inspectors' activities) options **highlighted** and boxed (e.g., sealing, monitoring, measurement/ monitoring of process variables, measurement of quantity, and sampling). As an example, one option involving the use of instruments would be random, on-site use of IVO instruments for the selective monitoring of areas in a facility.

Some of the methods derivable from the chart may be either physically unrealizeable or obviously of little value. This does not limit the utility of the chart as an aid to developing a complete listing of conceivable methodological options. This type of list ensures that all options are considered at this stage of the proceedings.

The checklist on pages 32-36 is an alternate form of the chart and could be regarded as an operational replacement for it. It gives a clear picture of how the chart is to be used. It may also be a useful tool which international or State authorities can use to examine or summarize information required for the implementation of the CW Convention. This checklist may therefore be used in the discussion or control of activities relating to each project.

To use the checklist, one has simply to fill each box as instructed, or choose between "yes" and "no," or between "non-selective" and "selective," where appropriate. With the checklist, it is sufficient to follow through the sequence of alternative methods once only, from start to finish, in choosing a verification scheme for a given individual facility or operation or for a given type of facility or operation.

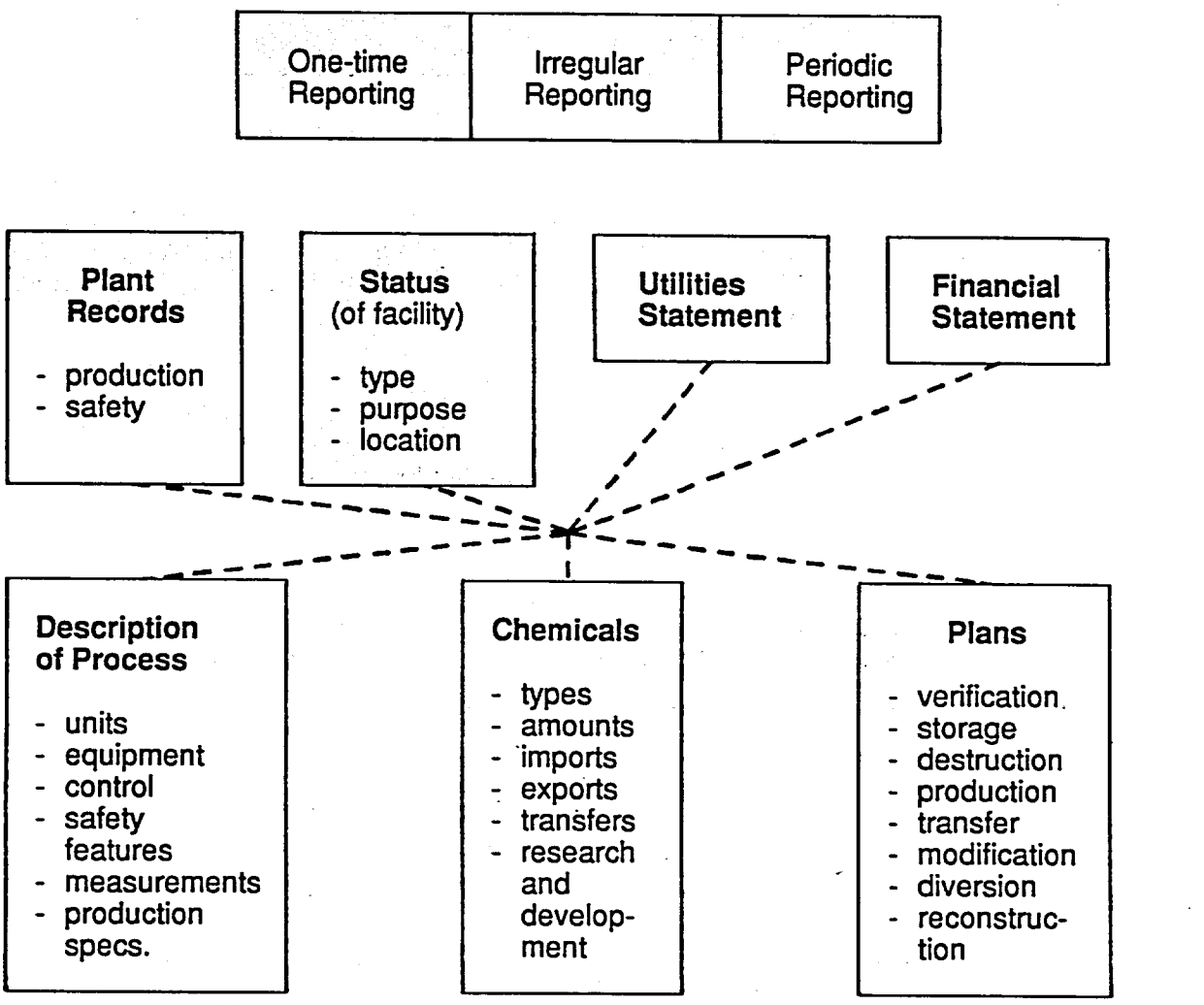
There is an obvious connection between section 3 and sub-section 4.1 in the checklist. Consider, for example, the counting of CW munitions or containers prior to destruction (see 4.1.4). If this option is solely an inspector activity, then the inspection type as determined in 3 should reflect the need for continuous on-site inspection during the (unpacking and) movement of munitions or containers through the destruction process. Alternatively, if the inspection type is fixed in such a manner that complete counting by inspectors is not possible, or if complete counting by inspectors is not a feasible option, then continuous (automated) on-site instrumentation would be required to perform the task.

CHART: Methodological Options

This chart identifies verification schemes which can be applied to a specific facility or operation or to one typifying a specific category or type of facility or operation. In the latter case, if the resulting verification scheme involves inspectors, then it will be implemented according to the appropriate selection, random or otherwise, of which and how many facilities or operations are to be inspected. Either one, a fixed percentage, or all facilities or operations of a given type may be inspected within a given time period.

1. National Technical Means

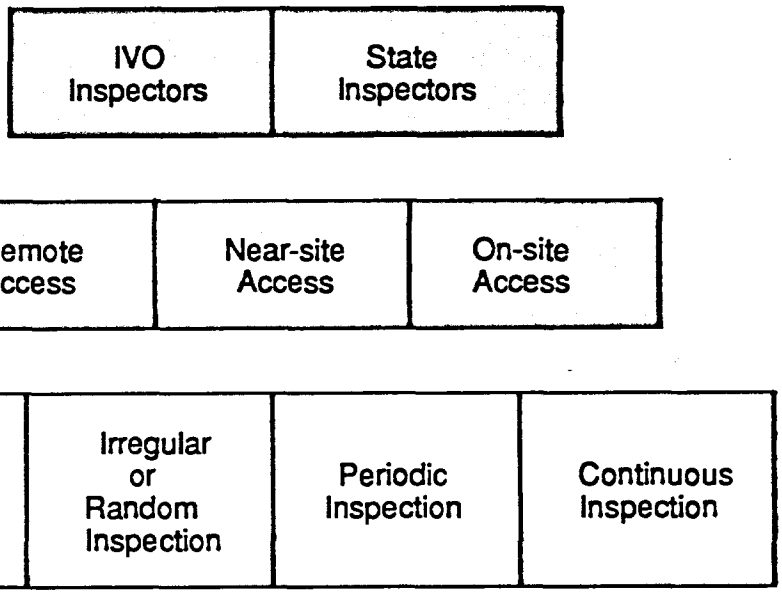
2. Data Reporting for IVO Purposes



(Cont'd...)

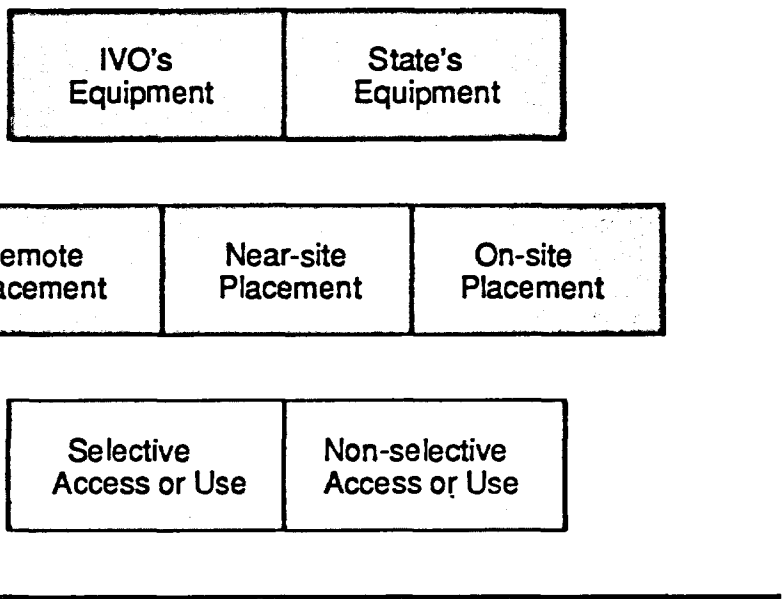
Chart: Methodological Options - continued

3. Verification by Inspection



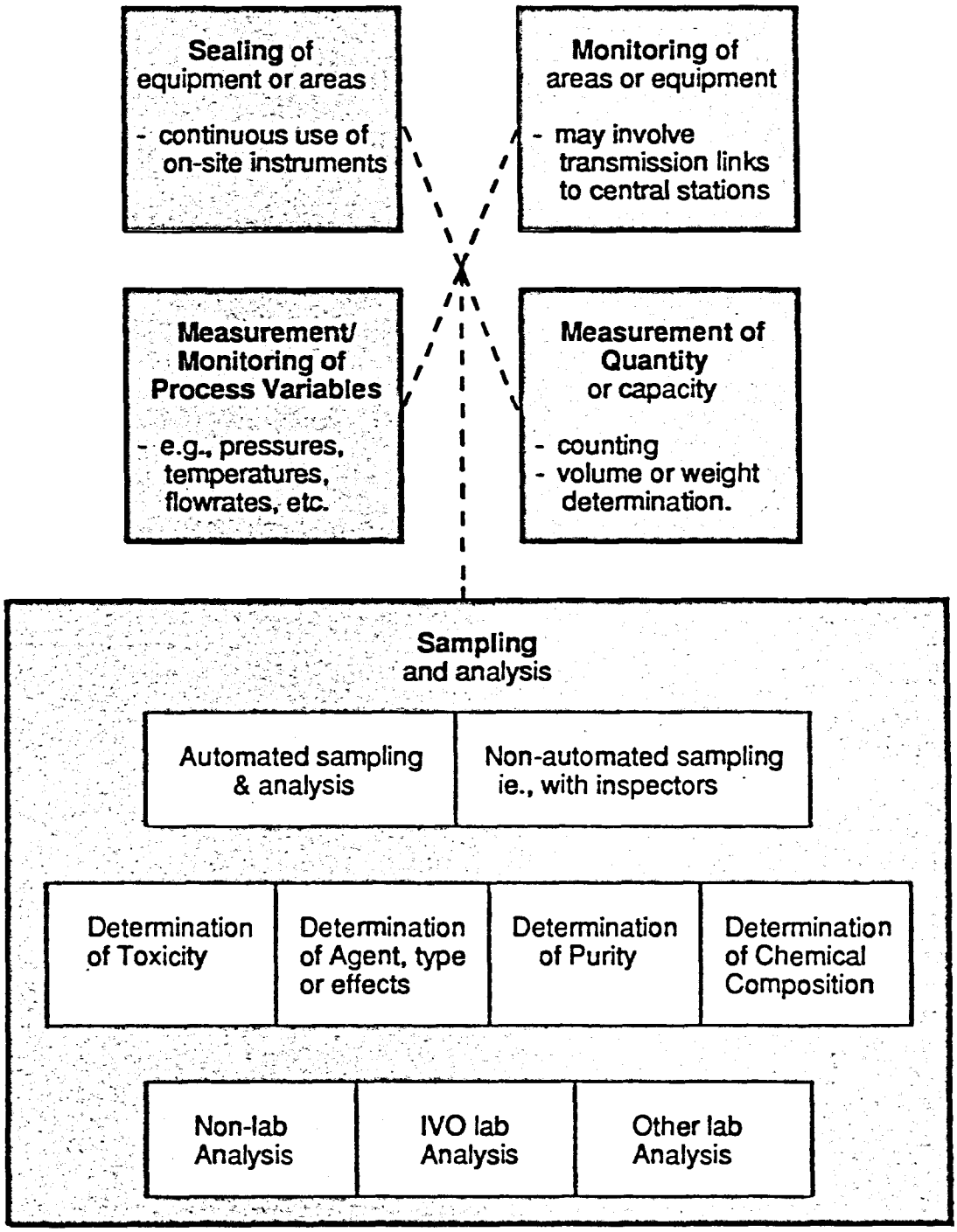
4. Verification with Use of Instruments

Note that the degree of inspectors' involvement in the options **highlighted** - i.e., in the activities of sealing, monitoring, measurement/monitoring of process variables, measurement of quantity, and sampling - is dependent upon the choices made in 3. "Verification by Inspection".



(Cont'd ....)

Chart: Methodological Options - continued



5. Literature Analysis (to compile and update chemical lists, or to verify non-compliance by exposing clandestine activities)

CHECKLIST: Verification Methods

This checklist is to be applied to a specific facility or operation or to one typifying a specific category or type of facility or operation. In the latter case, if the resulting verification scheme involves inspectors, then it will be implemented according to the appropriate selection, random or otherwise, of which and how many facilities or operations are to be inspected. Either one, a fixed percentage, or all facilities or operations of a given type may be inspected within a given time period.

1. National Technical Means = Nn — Yes ☐ = N1 No ☐ = N0*

*N0 is N zero, not N "oh"

2. Data Reporting = Rn — Yes ☐ = Rn No ☐ = R0 (go to 3)

2.1 Subject Matter = Rn (reports) — fill each box with one of F1, F2, F3 from 2.2 below (or insert F0 for "not required")

2.1.1	Plant Records = R1 (production, safety)	☐
2.1.2	Status of Facility = R2 (type, purpose, location)	☐
2.1.3	Description of Process = R3 (units, equipment, control, safety features, measurements, production specifications)	☐
2.1.4	Chemicals = R4 (types, quantities, imports, exports, transfers, research & development)	☐
2.1.5	Plans = R5 (verification, storage, transfer, production, destruction, modification, reconstruction)	☐
2.1.6	Utilities Statement = R6	☐
2.1.7	Financial Statement = R7	☐

2.2 Frequency of Reporting = Fn

2.2.1	One-time	= F1
2.2.2	Irregular	= F2
2.2.3	Periodic	= F3

(Cont'd...)

Checklist: Verification Methods - continued

3. Verification by Inspection = In Yes ☐ = I1 No ☐ = I0 (go to 4)

3.1 Composition of Inspectorate, Type of Inspection = Jn (jurisdiction)

3.1.1	IVO Inspectors = J1	*	**
3.1.2	State Inspectors = J2	*	**

* fill with one of F1 to F4 or place an F0 (for "not required") in **both** * and **
** fill with one of A1 to A3

3.2 Site of Access for Inspection

3.2.1	Remote	= A1
3.2.2	Near-site	= A2
3.2.3	On-site	= A3

3.3 Frequency of Inspection

3.3.1	One-time	= F1
3.3.2	Random or Irregular	= F2
3.3.3	Periodic	= F3
3.3.4	Continuous	= F4

4. Verification With Use of Instrumentation = Qn (equipment) Yes ☐ = Q1 No ☐ = Q0

Note that the degree of inspectors' involvement in the following options - i.e., in the activities of sealing, monitoring, measurement/monitoring of process variables, measurement of quantity, and sampling - is dependent upon the choices made in 3. "Verification by Inspection."

4.1 Instrumentation (and Inspectors' Activities) Options = Pn (procedures)

4.1.1 Sealing of Equipment or Areas = P1 (continuous use of on-site instrumentation) Yes ☐ = P1.1 No ☐ = P1.0

(Cont'd...)

Checklist: Verification Methods - continued

4.1.2 Monitoring of Areas for Equipment = P2 (may involve communication links to central stations)

Automated Sampling? Yes ☐ (go to 4.1.3A) No ☐ = P2.0 (go to 4.1.3)

Non-selective ☐ = P2.1 Selective ☐ = P2.2

Non-automated Sampling (i.e., sampling during inspection) = M2

☐** ☐* ☐* ☐** ☐***

4.1.3 Measurement/Monitoring of Process Variables = P3 (e.g. temperatures, pressures, flowrates)

Yes ☐ = P3.0 (go to 4.1.4)

No ☐ = P3.0 (go to 4.1.4)

Non-selective ☐ = P3.1 Selective ☐ = P3.2

Type of Analysis/Determination = Tn

4.1.5A Method of Sampling (and Analysis) = Mn

4.1.5B Type of Analysis/Determination = Tn

☐* ☐* ☐***

= T1 4.1.5B(i) Toxicity

= T2 4.1.5B(ii) Agent, Agent Category, or Agent Effects

= T3 4.1.5B(iii) Purity of Agent

= T4 4.1.5B(iv) Chemical Composition (Quantitative)

4.1.4 Measurement of Quantity or Capacity = P4 (e.g. counting, volume or weight determination)

Lab Analysis or Instrumentation? Yes ☐ = P4.0 (go to 4.1.5) No ☐ = P4.0 (go to 4.1.5)

= D1 4.1.5C(i) Non-lab Analysis, State Lab Analysis

= D2 4.1.5C(ii) IVO Laboratories, IVO Laboratories

= D3 4.1.5C(iii) Lab Analysis, State Laboratories

Non-selective ☐ Selective ☐ = P4.2

4.2 Type of Instrumentation = Jn (jurisdiction)

☐* ☐* ☐*

= J1 4.2.1 IVO Instruments

= J2 4.2.2 State or Facility Instruments

4.1.5 Sampling = P5

Use of Instrumentation? Yes ☐ = P5.0 (go to 5) No ☐ = P5.0 (go to 5)

Non-selective ☐ Selective ☐ = P5.2

4.3 Site of Access or Use of Instrumentation

☐* ☐* ☐*

= A1 4.3.1 Remote

= A2 4.3.2 Near-site

= A3 4.3.3 On-site

4.4 Frequency of Use of Instrumentation

☐* ☐* ☐*

4.4.1 One-time = F1

4.4.2 Random or Irregular = F2

4.4.3 Periodic = F3 (or 'Regular' as a sampling option)

4.4.4 Continuous = F4 (or 'Total' as a sampling option)

* fill with one of F1 to F4 or place an F0 (for "not required") in each box

** fill with one of A1 to A3

*** fill with one of J1 to J2

(Cont'd...)

4.1.5A Method of Sampling (and Analysis) = Mn

4.1.5A(i) Automated Sampling and Analysis = M1

4.1.5A(ii) Non-automated Sampling
(i.e., sampling during inspection) = M2

4.1.5B Type of Analysis/Determination = Tn

4.1.5B(i)	Toxicity = T1
4.1.5B(ii)	Agent, Agent Category, or Agent Effects = T2
4.1.5B(iii)	Purity of Agent = T3
4.1.5B(iv)	Chemical Composition (Quantitative) = T4

4.1.5C Laboratory or Instruments for Analysis/Determination = Dn

4.1.5C(i)	Non-lab Analysis, State Instruments = D1
4.1.5C(ii)	Lab Analysis, IVO Laboratory = D2
4.1.5C(iii)	Lab Analysis, State Laboratory = D3

4.2 Type of Instrumentation = Jn (jurisdiction)

4.2.1	IVO Instruments = J1
4.2.2	State or Facility Instruments = J2

4.3 Site of Access for Use of Instrumentation

4.3.1	Remote = A1
4.3.2	Near-site = A2
4.3.3	On-site = A3

4.4 Frequency of Use of Instrumentation

4.4.1	One-time = F1
4.4.2	Random or Irregular = F2
4.4.3	Periodic = F3 (or 'Regular' as a sampling option)
4.4.4	Continuous = F4 (or 'Total' as a sampling option)

(Cont'd...)

5. Analysis of Relevant Literature = Ln

5.1 Purpose of Analysis

5.1.1	Compiling and Updating Lists of Chemicals = L1	Yes ☐ = L1.1	No ☐ = L1.0
5.1.2	Verifying Non-compliance by Exposing Clandestine Activities (e.g., by analysis of trade records or reports) = L2	Yes ☐ = L2.1	No ☐ = L2.0

3.4 IVO Functions and Skills

The following sections, 3.4.1 and 3.4.2, list, in summary, the IVO functions and skills (with comments on personnel as well) required to implement a CW Convention. Each is relevant to at least one, but not necessarily all of the projects. The functions list was drawn up simultaneously with the compilation of alternative verification schemes, during the initial application of systems analysis. It was found that this list held general applicability to all projects, with specific functions relating moreover to specific methodological options. The skills list was in turn created to amplify the overall picture of an IVO. It closely parallels the functions list. For example, the skills under number eight in the skills list are those relating directly to the IVO functions under number eight in the functions list.

3.4.1 Functions

1. Data Collecting and Reporting
2. Performing Data Checks/Analyses
3. Conducting General Examinations of Facilities or Operations
4. Conducting Employee Interviews
5. Developing and Transmitting Questionnaires
6. Performing Material (/Energy) Balances
7. Advising
8. Planning/Designing
9. Counting Items
10. Weighing Items
11. Obtaining Samples
12. Analyzing Samples
13. Installing/Removing Instruments
14. Calibrating Instruments
15. Checking/Testing Instruments
16. Recording Readings
17. Monitoring Camera or Instrument Signals
18. Servicing Instruments
19. Supervising (State or Facility Personnel)
20. Inspecting at States Parties' Invitation
21. Analyzing Relevant Literature

3.4.2 Required Skills

This section of the report relates the required skills of an IVO to the specific functions listed in section 3.4.1. Each function is listed in turn, as in section 3.4.1, and each is followed by a description of the relevant skills required. In some cases, where a function entails different skills for different aspects of the function, the functions are elaborated, e.g., see point 2. "Performing Data Checks/Analyses".

1. Data Collecting and Reporting: Organizational and report-writing skills.

2. Performing Data Checks/Analyses (there are several aspects of this function, each with the skills noted):

   - To Check Reports Against Plant Records: familiarity with the processes carried out in the plant; awareness of possibilities of diversion; ability to check safety records; knowledge of instruments and equipment.

   - To Verify Facility Status: ability to conduct a check against previous records for anomalies.

   - To Verify a Process Description: familiarity with process equipment, control and safety features in industry; awareness of possibilities of diversion within the process.

   - To Verify Chemicals (i.e., to verify reported movement and/or status):

     - With Respect to Transfers/Imports/Exports: mathematician for material balance; see also "Plans" below.

     - With Respect to Destruction/Production Facilities: ability to compare chemicals and quantities with the process and the purpose of the facility.

   - To Approve Plans:

     - For Verification Systems: awareness of possible methods of diversion; familiarity with the processes in the case of destruction or production facilities; knowledge of instrumentation and equipment.

     - For Storage Facilities: familiarity with the problems of storage of hazardous substances.

     - For Destruction and Production Facilities: see "Process Description" above.

     - For Transfers: awareness of restrictions to transfers; familiarity with the handling and transport of hazardous substances.

   - To Verify Utilities Requirements: knowledge of utilities requirements for various industries and processes.

   - To Verify Financial Reports: knowledge of costs of raw materials, production and products.

3. Conducting General Examinations of the Facilities or Operations: either a technical background as in 2 (see "Process Description") for on-site activities or technical and/or security background for monitoring duties; familiarity with safety precautions in dealing with hazardous chemicals.

4. Conducting Employee Interviews: knowledge of the state language and interpersonal skills.

5. Developing and Transmitting Questionnaires: see 4.

6. Performing Material (/Energy) Balances: engineer or mathematician.

7. Advising: understanding of technical matters, e.g., process or instrumental design; knowledge of existing plans; awareness of possible methods of diversion and verification requirements.

8. Planning and Designing:

   - Facilities: skills as in 2 (see "Process Description") with a knowledge of optimization and cost engineering; experience in design of relevant facilities. e.g., production, destruction, or storage facilities.

   - Verification Systems: as in 2 (see "Process Description"); familiarity with computer design engineering and with instrumentation.

9 & 10. Counting/Weighing: analytical and mathematical skills.

11 & 12. Sampling: need appropriate sampling (and analytical) techniques for chemical, toxicological and medical sampling; knowledge of the hazards and necessary safety precautions involved with each class of chemicals.

13, 14 & 15. Installing, Calibrating, and Checking/Testing Instruments: skills of an electronics or computers technician.

16 & 17. Recording Readings from and Monitoring with Instruments: general knowledge of instrumentation and signal processing; familiarity with the system or process being monitored; knowledge of possible methods of diversion.

18. Servicing Instruments: technician with instrument or computer skills.

19. Supervising: good management skills; knowledge of all aspects of verification technology, inspection techniques and problems related to diversion.

20. Inspecting at States Parties' Invitation: any of those skills listed above depending upon the precise situation.

21. Analyzing Relevant Literature:

   - To Aid in Compiling and Updating Chemical Lists: organizational skills and knowledge of chemistry and toxicology.

   - To Aid in Verifying Non-compliance Resulting from Clandestine Activities (e.g., by analyzing trade records or reports): organizational skills and knowledge of CW chemicals, processes and equipment.

3.5 Correlating Projects, Methodological Options and Functions

Lists correlating projects, methodological options and specific IVO functions and skills have been compiled in the first three appendices of this report. A detailed example, explaining and expanding on the lists, is found in Appendix 4. The lists show essentially all[4] of the possible verification schemes which may be applied to those projects within the first three programs of this study. General methodological options, distinguished by capital letters, were derived from the checklist on pages 32 to 36. No attempt is made at this stage to evaluate the applicability of any particular method. Rather, all options are listed to promote comprehensive discussion.

With respect to any of Appendices 1, 2 or 3, a quick glance at the functions column for each project reveals that the general IVO functions which may need to be performed are similar from project to project, dependent more on the methodological option chosen to achieve a specified verification goal than on the project itself. This is not to say that the specific activities of the Inspectorate may not differ significantly from project to project. It is, however, indicative of the fact that, for any project with well-defined verification goals, the number of viable inspectorate activities is finite. As a result of this fact, a preliminary list describing overall personnel for an IVO can be drawn up (see also section 6.1).

Again with reference to any of the aforementioned appendices, the frequent use of round brackets (round brackets implying that the specific function(s) numbered within may or may not apply) suggests that a high degree of flexibility is available in

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4 Some schemes which are physically unrealizeable or obviously of little value to the Convention are not listed. Deliberate omissions are indicated in every case. For example, near-site verification is not considered to be an adequate methodological option in the case of Project 3.2 "Verification of Research and Development", since it would be of little value in assuring compliance with the Convention.

defining the specific IVO functions, even within the framework of having chosen a single methodological option. In view of this point, it is evident that a number of areas in the Convention still necessitate international agreement. The choices of which general methodological options are to ultimately apply to each project remain the central issues in negotiations. Agreement on these choices will provide the catalyst for ratification of a Convention. To make the decision-makers' task easier, Appendices 1 to 3 indicate that the number of options to choose from is finite for each project. A rational examination of the lists will force the reader to reject those verification methods which cannot satisfy the needs of the Convention and will reveal those methods best suited to achieving the verification goals inherent in each project.

3.6 Restrictions

The text which follows gives an indication of some of the possible restrictions, considerations and arguments which may be applied to eliminate unsuitable alternatives from the listing of methodological options for each of the projects. There are two basic types of restrictions applicable to the verification schemes for a Chemical Weapons Convention. Physical restrictions are usually objective and readily identifiable, e.g., cost and technological factors. State-imposed restrictions are largely subjective and often revolve around confidence-building measures. Verification measures will be agreed to only if they instill confidence among the signatories. Subjective constraints are not easily defined and are typically formulated and imposed in a selective fashion. Such restrictions are described in working papers, but are difficult to unify for international purposes.

3.6.1 Some physical restrictions

- Appropriate instrumentation must be available when the Convention comes into force. It should be tamper-proof, easy to check and service as well as relatively maintenance-free.

- Costs associated with verification schemes must be reasonable.
- Safety and environmental standards must be met. These would impose restrictions upon sampling and inspection of hazardous areas. Automation would circumvent some of these problems.

3.6.2 Some State or IVO-imposed restrictions

- Verification should be non-intrusive.
- IVO personnel should maintain their equipment. There should be back-up equipment on-site to minimize false alarms.
- The timing of inspections should be unpredictable to prevent diversion.
- Inspectors cannot ask staff other than the operator to carry out any operation, nor can they use any facility equipment except with the permission of the management.
- Uniform verification measures should be in place for all like facilities.
- Adequate provisions must be made to allow signatories to independently judge data obtained through verification schemes.
- The validity of data reported must be able to be confirmed.
- Verification schemes chosen must be optimal in terms of a balance between cost and effectiveness.

3.6.3 The Applicability of Near-site and Remote Verification Schemes

The following points examine near-site and remote verification as methodological options and illustrate some of the restrictions inherent in the methods.

- CW Storage:

  In the case of storage, we are considering methods of containment monitoring. With continuous monitoring of facilities, inspectors would be able to ensure that no unreported transfers took place. They could not, however, ascertain what (types and) quantities of chemicals were being stored. Because verification of CW would be of immediate concern to all Convention signatories, and since sampling and quantity measurement will be required at some point in the storage - transfer - destruction sequence anyway, on-site inspection and sampling of stockpiles is recommended.

- CW Destruction:

  Near-site or remote verification would have severe drawbacks. Neither plans, blueprints, nor the destruction process could be verified. A material balance would not be possible. Clandestine storage could not be refuted. Containment monitoring would be necessary 24 hours a day. Again only on-site inspection and sampling could be recommended.

- CWPF -Cessation of Production/Closure:

  Remote verification would be a useful way of monitoring activity at a site as would be near-site. These procedures would reduce the need for on-site inspection. On-site activity would allow for more careful inspection and a check on closure. This would be particularly significant if there was any delay between closure and destruction.

- CWPF- Destruction/Dismantling:

  Near-site and remote methods both afford adequate verification of destruction. If dismantling is involved, then on-site procedures would be necessary before equipment could be moved to another location.

- Permitted (Small-scale) Production:

  On-site verification is required to determine facility capacity and to check actual production rates.

- Non-production (Civilian Industry):

  Remote methods would be inadequate for the verification of non-production. Containment monitoring of such a facility would be impracticable. Some type of random on-site inspection would be required. Near-site sampling of waste water and/or stack emissions could be part of an initial inspection.

- Transfers:

  Remote verification may be of some use during a transfer, but on-site methods would be required at either or both ends of the operations, i.e., at departure and/or destination sites.

As far as remote verification is concerned, it should be relatively clear from the above that remote (satellite) methodology is unlikely to be of great utility in a CW Convention; its utility may not justify the costs of setting up such a verification

method. Also, it would be of little use in the area of non-production, which will be the sole area of activity after the first 10 years of the Convention. As an additional consideration, ambiguous data emanating from remote signals would trigger inspections anyway. Remote verification should only be considered further if a satellite is available for other purposes. Even then, it would only serve to supplement existing verification schemes.

With respect to near-site verification, it might be possible to obtain roughly equivalent information from near-site and on-site verification with the installation of appropriate (on-site) equipment. However, near-site inspection plus on-site equipment combinations would not build confidence to the same degree as on-site inspection. A near-site verification scheme would demand a high degree of co-operation between and trust among all parties concerned and again could not deal with the problems of ambiguous information.

3.6.4 Inherent Restrictions in the Use of Instrumentation

The on-site use of instrumentation/equipment will not eliminate the need for inspections; nor will it necessarily decrease the level of intrusiveness at the site of access. In most, if not all, cases, personnel from the Technical Secretariat will be required to install and maintain IVO equipment on the site; requirements of servicing and checking such equipment may necessitate frequent visits and may even, in a few cases, result in a greater level of intrusiveness than that involved with inspections. At best then, the use of instrumentation can decrease the resource requirements of an inspectorate, but only at the expense of increased technical support and capital costs.

3.6.5 The Applicability of One-time On-site Inspection

If on-site access is permitted on one occasion, then there is likely no reason why such permission should not be given again. Denial would only generate suspicion.

3.7 Verification Schemes Remaining After Application of Restrictions

The following verification schemes are those remaining after application of the restrictions to the lists in Appendices 1 to 3. In attempting to shorten the lists of suitable options, it was necessary to impose additional logical arguments to eliminate less-promising alternatives. Specifically, those options which were judged to be of little potential value to the Convention were removed from consideration.

Program 1 CW Stockpiles

Project 1.1 Verification of Declarations:

- on CW Storage Facilities (Storage locations, CW types and quantities, inventory arrangements):

One-time On-site Inspection with irregular (or random) on-site sampling (further options as in 4.1.5 from checklist, pages 32-36) and with quantity measurement and possibly with one-time use of on-site monitoring equipment.

- on CW Destruction Facilities (Locations of existing facilities, processes, control safety features, instrumentation):

One-time On-site Inspection with one-time use of on-site monitoring equipment, and possibly with measurement of quantity.

Project 1.2 Verification of CW Storage:

Random On-site Inspection with irregular on-site sampling (further options as in 4.1.5 from checklist, pages 32-36), with measurement of quantity (volume and counting), with sealing of equipment or areas, and with continuous, random, or periodic use of on-site monitoring instruments. May include periodic or irregular data reporting related to transfers or leakages.

Project 1.3 Verification of Destruction of CW Stocks:

- for facilities destroying significantly large amounts of CW and facilities which are suitable for readily installed verification instrumentation:

Continuous or Random On-site Inspection with continuous or random (automated) on-site sampling (further options as in 4.1.5 from checklist, pages 32-36), with measurement of quantity (by instruments), with sealing of equipment or areas, and with continuous or random use of on-site monitoring equipment and equipment to measure/monitor process variables. Periodic or irregular data reporting related to amounts destroyed and to transfers.

- for facilities destroying small amounts of CW in a relatively short period of time or for facilities which are unsuitable for readily installed verification instrumentation:

Continuous On-site Inspection with continuous or random on-site sampling (further options as in 4.1.5 from checklist, pages 32-36), with measurement of quantity, with random measurement/monitoring of process variables, and possibly with sealing of equipment or areas, and continuous or random use of on-site monitoring instruments. Periodic or irregular data reporting related to amounts destroyed and to transfers.

Project 1.4 Verification of Transfers of CW (and Key Precursors):

One-time On-site Inspection at both departure point and destination point of transfer, with measurement of quantity, with sealing of containers and/or with continuous observation or use of satellite or on-site monitoring instrumentation, and possibly with irregular or regular on-site sampling at one point in the transfer (further options as in 4.1.5 from checklist, pages 32-36). Irregular Data Reporting (i.e., declarations both before beginning and after completing each transfer operation).

Project 1.5 Verification of Diversion of CW:

When diversion means transfer of CW to storage for permitted (small-scale production) purposes, verification is carried out in the same method as for transfers (see Project 1.4 and 3.5). Storage for permitted purposes is verified as in Project 1.2.

Diversion also means an irreversible transformation of CW agents to other purposes.

When diversion is carried out in a single-purpose diversion facility, the same method of verification as is required in the destruction of CW is applicable in this case (see Project 1.3)

When diversion is carried out in civilian industry, the same method of verification as is required in non-production is required in this case (see Project 3.4)

Program 2 Chemical Weapons Production Facilities

Project 2.1 Verification of Declarations Concerning CWPF (Locations, processes, chemicals, equipment inventories):

One-time On-site Inspection.

Project 2.2 Verification of Cessation of Production and Closure of CWPF:

One-time, Random, or Continuous On-site Inspection with sealing of equipment/areas and with continuous or random use of monitoring equipment,

or for Cessation of Production:
Continuous or Random Near-Site Inspection with continuous or random satellite or camera monitoring and possibly with periodic or random sampling of waste streams (further options as in 4.1.5 from checklist, pages 32-36).

Project 2.3 Verification of Destruction or Dismantling of CWPF:

Random or Continuous On-site Inspection (or Near-Site Inspection for destruction) with continuous or random use of monitoring instrumentation.

Project 2.4 Verification of Temporary Conversion:

Follows the verification programs contained in Project 2.2, Project 2.3 and Project 1.3.

Project 2.5 Verification of Transfers of Equipment:

One-time On-site Inspection with sealing of equipment and with continuous use of satellite or on-site monitoring instrumentation.

Project 2.6 Verification of Reconstruction:

Follows the verification programs contained in Project 2.2, Project 2.3 and Project 3.4.

Program 3 Activities not Prohibited

Project 3.1 Verification of Declarations:

- Permitted (Small-scale) Production (Locations of existing facilities, processes, chemicals, capacities, equipment, control, safety features):

One-time On-site Inspection with one-time use of on-site instrumentation (measurement/monitoring of process variables and monitoring of areas or equipment), with one-time sampling (further options as in 4.1.5 from checklist, pages 32-36) and with measurement of quantity or capacity.

- Non-production (Facility locations, processes, chemicals, capacities, equipment, control, safety features):

One-time On-site Inspection (ie., familiarization visits), with one-time use of instrumentation for monitoring of areas or equipment and monitoring of process variables and with one-time sampling (further options as in 4.1.5 from checklist, pages 32-36.

Project 3.2 Verification of (toxic chemicals) Research and Development:

Periodic or Irregular Data Reporting. Analysis of Relevant Literature.

Project 3.3 Verification of Permitted (Small-scale) Production:

Random or Periodic On-site Inspection with one-time or random sampling (options as in 4.1.5 from checklist, pages 32-36), with measurement of quantity, with continuous or random use of on-site monitoring equipment and/or equipment to measure/monitor process variables. Periodic or irregular data reporting.

Project 3.4 Verification of Non-Production (Civilian Production):

Periodic or Irregular Data Reporting. Random On-site Inspection with sampling (options as in 4.1.5 from checklist, pages 32-36), and random use of monitoring instrumentation to monitor areas or equipment and to monitor process variables.

Project 3.5 Verification of Transfers, Imports, and Exports of Commercial-Use Chemicals:

Periodic or Irregular Data Reporting

Program 4 Challenge Inspection

This program is dealt with in section 5.0 of this report.

4.0 POTENTIAL SOLUTIONS, RESULTING FROM THE SYSTEMS STUDY

A number of important findings have resulted from the step by step analysis undertaken in this systems study. Among these are the identification of suitable methodological options and corresponding IVO functions and skills for each project examined. The results are interpreted in the following pages, wherein the inspection requirements of the Technical Secretariat are detailed, project by project. Although these "potential solutions" are based on the consideration of all material presented thus far and include the assimilation of numerous international papers, they still leave much room for discussion.

A change in the form of the presentation occurs in this section. Projects involving verification of declarations now will be subsumed under other projects within the relevant programs. This is done because declarations in fact relate to each project in a program, e.g., there are declarations for the projects of "CW Storage" and "CW Destruction" within the program "CW Stockpiles." The initial separation of declarations from other projects was made to emphasize the importance of declarations in initiating verification activities. In the narrative treatment which follows, however, verification of declarations is seen to be integrally connected with the verification activities of other projects under the first three programs.

4.1 Chemical Weapons

At the time when initial declarations are made, all activities involving CW (and key precursors), including destruction of stockpiles, must cease until verification procedures have been initiated or are completed. Verification procedures for the projects involving CW storage, transfer, and destruction are described below.

4.1.1 Storage

There are three aspects to the verification of the storage of chemical weapons: receipt of declarations; on-site validation of destruction; and checks on storage conditions, with documentation of any changes in storage.

- Declarations:

  Declarations must specify CW types and quantities, storage locations, and inventory arrangements.

- Verification of Declarations:

  Personnel from the Technical Secretariat are to conduct on-site inspections of storage facilities to check declarations (e.g., inspectors will count containers and weigh or otherwise measure the quantity of representative containers; they will sample or supervise sampling on a random or representative basis). Samples may be analyzed either using portable equipment or in a laboratory.

- Verification of Storage:

  Any changes in stockpiles must be reported (e.g., transfers, rearrangements, etc.) and the reporting should occur before the changes take place. Reports are to be examined to ensure that stocks are being moved according to submitted plans and in accordance with the Convention.

  Inspectors will have to set up verification schemes which ensure non-diversion. Personnel from the Technical Secretariat are to install and check tamper-resistant seals and monitoring equipment at the time of verification of the declaration. Camera and instrument signals are to be monitored either on-site or near-site by inspectors; alternatively, the signals are to be sent to an IVO centre. This latter procedure would require other staff to monitor the signals, but would enable simultaneous control over several storage and other operations at any time.

  To maintain an updated check on storage conditions, sampling and quantity measurements, will likely have to be repeated at regular intervals. This is particularly important in cases where changes in stockpiles are frequent or storage periods are long. Checks on the status of any equipment set in place for verification purposes will be performed whenever inspections are conducted.

  Inspectors also will have to be available to respond to alarms involving faulty equipment or ambiguous signals and to service or replace faulty equipment.

  If plans indicate immediate transfer and destruction of CW, then sampling and monitoring at the site of storage may not be necessary, provided continuous on-site inspection of transfer and destruction is a feasible alternative. Sampling at the site of destruction will be required.

  After a storage centre is declared to be empty, the site may require irregular inspection to preclude further use of the facility.

4.1.2 Destruction

There are three aspects to the verification of destruction of chemical weapons: receipt of declarations and plans; review and on-site validation of facilities and processes; and proof of destruction.

- Declarations:

  Existing facilities must be declared, including their locations, processes, control, safety features, instrumentation, and blueprints. Plans and timetables for elimination of CW must be included.

  Plans for proposed facilities must be submitted. These are to include the submission of plans for a verification system for each facility, as well as all the details as specified above for existing facilities.

  States are to report on the status of destruction facilities prior to beginning operations and again immediately after ending operations. A final declaration is to state that all destruction operations at a facility are completed.

- Verification of Declarations:

  Plans must be carefully checked to ensure compliance with the Convention. Ideally, there should be the possibility of input from an Inspectorate before a destruction facility is built. The Inspectorate would consult with State or facility officials and be able to suggest design modifications to improve verification. Frequent or continuous on-site inspection during construction would build confidence and possibly reduce the verification burden once operations began.

  There is to be an (on-site) engineering review conducted before CW destruction commences to check upon the actual operation of the facility and its ability to eliminate CW according to plans.

  A material balance check between destruction and storage of CW is to be performed whenever new data become available.

- Verification of Destruction:

  Periodic data reporting by the State may be required to check on the progress of operations and, in particular, to compare destruction rates with reports involving the storage and transfer of CW.

  As mentioned above, personnel from the Technical Secretariat will conduct engineering reviews of the facilities and their processes. During these reviews, they will also set in place verification schemes or approve those provided by the State authority. Verification will likely include automated equipment for continuous, random or periodic sampling, analysis, and quantity measurement prior to destruction. Instruments would be linked to on-site, near-site, or remote receiving stations. Periodic instrument

checks and/or calibrations will be required. Inspectors and/or instruments will also sample, analyze, and measure quantities of product materials (on a less frequent basis). Inspectors will monitor process variables to ensure that no CW are being diverted. It may be necessary to seal and monitor (by camera) areas between sampling and destruction.

Material balances over the facility are to be performed on a regular basis and all variables should be compared with expected values. Frequent measurements will be needed to preclude diversion. An overall material balance from storage to destruction must be maintained. Interim storage and transfers on-site are to be verified as in sections 4.1.1 and 4.1.3.

Personnel from the Technical Secretariat are to be present on-site during maintenance or construction periods. Inspectors should be present between destruction phases to ensure that instrumentation is not tampered with; alternatively, seals would be put in place for this purpose.

Inspectors are to report to their headquarters at the end of each destruction period to confirm reports submitted by the State.

4.1.3 Transfers of CW (or Key Precursors)

Transfers can be for interim storage, to permitted purposes, or to destruction sites. In each case, the essential aspects are the declared plans, their assessment for verifiability, and proof that transfers are carried out as planned and agreed.

- Declarations:

Plans for transfers must be submitted to the Inspectorate before they take place; they are to include endpoint locations, mode and route of transportation, chemicals, and reasons for transfer. In addition, completed transfers must be declared.

- Verification of Declarations:

Plans for transfers will be checked by the IVO to ensure that planned operations are verifiable and within the constraints of the Convention.

- Verification of Transfers:

Transfers must be inspected on-site at the start and at the end of the operation, i.e., leaving storage and arriving at the final destination. Continuous or periodic camera signals (cameras set up by the IVO) may be sent to a remote or on-site base to monitor the transfer. Satellite monitoring would also be useful.

Any seals originally set in place for verification of storage are to be left on to prevent tampering during transfer. Otherwise sealing devices are to be installed. Seals are to be removed only immediately prior to destruction.

If the point of departure and the point of destination are very close - i.e., in the case where facilities are adjacent and within view of one another - then seals may not be necessary. An example of this is where storage and destruction facilities are at the same site and continuous on-site inspection is feasible because immediate transfer and destruction of stockpiles is planned.

4.2 CW Production Facilities

Proposals to deactivate, close, destroy, dismantle, convert, or redeploy the equipment of a CW production facility require verification. There are well-defined classes of such alterations of CWPF, each with its own steps for implementation.

4.2.1 Cessation of Production/Closure

Verification of cessation of production, or of closure involves the receipt of declarations, the assessment of plans and validation of means of verification, and then the actual process of verifying the changes to the CWPF.

- Declarations:

  The State must declare all of its CWPF including these details: locations, process descriptions, blueprints, chemicals produced, and equipment inventories.

  The State must declare that production has ceased, and is to define the method employed to close the facility such that production is not possible without detection.

- Verification of Declarations:

  On-site inspections are to be carried out to verify that production has ceased and to check the equipment inventory (key equipment).

  Inspectors will inform States if measures taken for closure are adequate or require modifications. Alternate or additional measures may be designed or suggested.

- Verification of Cessation of Production and Closure:

  During verification of declarations, inspectors may install on-site or near-site instrumentation to monitor (on a continuous or random basis) cessation of production and/or closure. To close the facility, key equipment or areas will be sealed. Subsequent inspections, on a random basis, to check seals and instrumentation would be desirable.

  If the time between closure and destruction of the CWPF is short, continuous on-site or near-site inspection might be appropriate in place of

seals and/or monitoring equipment. On-site verification of the declaration would not be required.

4.2.2 Destruction/Dismantling

Verification of destruction or dismantling of a CWPF is initiated with the declaration, developed through the validation of plans, and realized in the actual process of proving that the agreed-upon plans are being implemented.

- Declarations:

  In terms of declarations concerning CWPF destruction or dismantling, the State first must submit plans for destruction or dismantling of CWPF. Later, the State is to declare that destruction or dismantling operations have been completed.

- Verification of Declarations:

  Any plans submitted are to be checked carefully to ensure that destruction or dismantling operations serve the purposes of the Convention. Equipment constructed specifically for CW production must be destroyed and verification procedures must be feasible. The IVO would suggest modifications or design alternative plans, as may be appropriate or necessary.

  On-site verification of the completion of destruction or dismantling operations is mandatory.

- Verification of Destruction/Dismantling

  Any instrumentation installed for purposes of verification of closure should be removed prior to destruction or dismantling, except that seals on key equipment need not be removed if such equipment is to be transferred out of the facility.

  On-site inspection will be required to re-confirm the inventory. Inspectors will remain on-site or near-site until destruction or dismantling of key equipment or areas is completed. They will oversee dismantling operations. Details of dismantling operations, including equipment destinations and purposes are to be recorded and/or checked against plans.

4.2.3 Temporary Conversion of CWPF to CW Destruction Facilities

As is usual, the verification process is step-wise, and proceeds in three phases: receipt of declarations on initial states and planned operations; review of plans for verifiability and congruity with the provisions of the Convention; and actual proof that the operations agreed to are executed accordingly.

- Declarations:

  Plans for conversion of the facility must be submitted by the State. Plans are to include details of equipment being transferred out of the existing facility (dismantling), equipment being brought in, process descriptions and blueprints for the destruction facility. Reasons for conversion, the chemicals involved, and the destruction timetables must be submitted.

  Declarations for destruction operations must be submitted in accordance with the Convention's articles covering declarations for the destruction of CW.

  Plans for destruction of the converted facility at the end of its usefulness to the Convention are to be submitted; and a final declaration will state that destruction of the converted facility has been completed.

- Verification of Declarations:

  Plans for conversion of the facility are to be carefully checked to ensure that the operations of dismantling and destruction will be conducted according to Convention guidelines. The IVO may wish to suggest modifications to plans.

  The final declaration, stating that the facility has been destroyed, is to be verified by on-site inspection.

- Verification of Temporary Conversion:

  This project involves the verification of the destruction/dismantling of CWPF, followed by verification of destruction of CW. A final stage, verification of destruction of the converted facility, involves the same tasks as for destruction of unconverted CWPF.

4.2.4 Transfers of Equipment

Verification of the transfer of equipment from CWPF proceeds in three phases: receipt of declarations, assessment of declared plans, and proof that the agreed-upon plans are being followed.

- Declarations:

  Plans for transfers must be submitted, including details on equipment, destinations, and reasons for transfers. A detailed description of the process in which the equipment is to be placed is mandatory. Measures for verification of the transfer may also be included.

  Completed transfers must be declared.

- Verification of Declarations:

  Inspectors are to check plans for transfers to ensure that the transfers are verifiable and according to Convention guidelines. Equipment specifically designed for CW production must be destroyed. The IVO may suggest modifications to plans for transfers.

- Verification of Transfers of Equipment:

  Transfers are to be inspected on-site at both the point of departure and the point of destination. A transfer operation may be monitored by continuous or periodic camera signals (camera set up by the IVO). Satellite monitoring is also possible. Equipment destinations and associated process schemes are to be inspected on-site. Any sealing devices originally in place on the equipment for closure purposes should serve also in sealing equipment for transfer purposes.

4.3 Activities Not Prohibited

There are three projects included in this program: Verification of R & D, of permitted (small-scale) production, and of non-production.

4.3.1 Research and Development

This project involves the receipt of declarations on R & D, and the verification of R & D activities.

- Declarations:

  Facility location, type, purpose, equipment, types of toxic chemicals worked with, and their toxicities - all these details will be essential in the R & D declaration.

- Verification of Research and Development:

  The facility or institute dedicated to chemical research will be required to report on its status and to report any related information on a regular basis. A pilot-plant facility is to report modifications to the facility and/or equipment inventory and include process measurements in sufficient detail to enable a material balance to be performed over the process. Additional information may be routinely required by inspectors and questionnaires may be presented to facility management accordingly.

  If feasible, the IVO should conduct an extensive literature search on new chemicals, and the corresponding toxicities. (It should be remembered that toxicity and usefulness for purposes of war are not strictly related).

In this respect, States will be required to report any new developments in terms of toxic chemicals and protective measures against CW.

4.3.2 Permitted Production - Small-scale Facilities

Verification of permitted (small-scale) production involves the receipt of plans for production, the validation of plans, and the ongoing checking of adherence to the agreed-upon plans.

- Declarations:

There are two types of declarative acts here. The first is the required submission of plans for the production of relevant chemicals in new or existing facilities. The locations, chemicals, capacities, equipment, blueprints, descriptions of processes, production timetables, control, and safety features must all be documented. Secondly, there is required a declaration stating that the facility is ready for operation.

- Verification of Declarations:

Inspectors are to check plans to ensure that a facility's capacity is within Convention guidelines and that it cannot be significantly increased with only minor modifications to the process.

After the plant has been declared ready for operation, an on-site inspection is conducted. An engineering review of the facility serves to check key aspects of the process against any plans to ensure that capacity is as stated.

- Verification of Permitted (Small-scale) Production:

During construction of a new facility or upon completion of an engineering review, a verification scheme is designed and set in place. Such a scheme is to involve on-site monitoring instrumentation (to monitor key areas or equipment) and/or measurement/monitoring of process variables, for the purpose of maintaining a check on capacity.

The facility will be required to report information (including process measurements in sufficient detail to enable a material balance to be performed over the facility) on a regular basis and also to submit plans for modification in design or production. Additional information may be routinely required by inspectors and questionnaires may be presented to facility management accordingly.

Some form of random on-site inspection must be conducted on small-scale facilities, to ensure that States are adhering to any limits on production set in the Convention. The inspection is to focus on one or two key aspects or areas of operation. Inspectors will check facility records

against the data they have received from facility management. Interviews with employees at the plant may or may not be conducted.

If the need for agents could be reduced to a few kg/yr, only lab scale production (less than 100 g/batch) would be needed. Because of no possibility of production capacity being exceeded in this case, a simple reporting procedure would be sufficient rather than using on-site verification.[1]

Verification of related storage and transfer operations is critical to the verification of permitted (small-scale) production. Storage and transfer operations are to be verified as described in sections 4.1.1 and 4.1.3.

4.3.3 Non-production

Without verification, States could not be confident that civilian industrial facilities were not producing CW. Declarations coupled with reporting and monitoring are required.

- Declarations:

  Civilian industries with CW-relevant capabilities and processes will be required to declare their facility locations, chemicals, capacities, equipment, blueprints, descriptions of processes, control, and safety features).

- Verification of Non-production:

  The facility will be required to report information (including process measurements in sufficient detail to enable a material balance to be performed over the facility) on a regular basis. The facility will also be required to submit plans for modifications in design or production. Additional information may be routinely required by inspectors and questionnaires may be presented to facility management accordingly.

  Some form of random inspection will have to be conducted on civilian industry, to ensure that facilities are not diverting materials to CW production (i.e., to ensure, in particular, that data reporting is accurate and complete). Inspectors are to check facility records against the data they have received from facility management. Interviews with employees at the plant may or may not be conducted. Instrumentation or monitoring equipment may be set up to record process variables, to sample, and/or to monitor an area if this would permit assurance of non-diversion (and if facility managers approve).

  Inspections may be conducted in stages of increasing intrusiveness (e.g., from sampling near-site waste materials, and subsequent analysis of

[1] CD/CW/WP.92 - Finland - Jan., 1985.

samples using portable equipment or a laboratory analysis, to observation of safety features, to observation of process equipment and facilities, to agreed observation and check on aspects of the control systems and on key process variables, to on-site sampling at agreed points). Inspections may focus on one or two key aspects or areas of operation.

The verification scheme preferably is to be designed by, and certainly is to be approved by, the IVO, taking into account suggestions from facility managers.

State-conducted inspections and/or data collected by the State would serve to supplement IVO data collection on relevant facilities. The State's contributions to inspections may or may not lessen the verification burden on the IVO.

5.0 CHALLENGE INSPECTION

The following discussion focuses on the inspection requirements of an IVO in relation to challenge inspection. In the cases of alleged CW storage or production, much of the detail involving inspectors' functions and skills can be found in section 3.4; the narrative descriptions under appropriate sub-sections in section 4.0 may also apply to some extent. Where allegations of use are involved, a separate systems study conducted by the Canadian government led to the publication of a Handbook for the Investigation of Allegations of the Use of Chemical or Biological Weapons. The study was based on actual inspection and, as a result, much more detail can be discerned regarding both verification duties and personnel descriptions.

5.1 CW Storage and Production

In the event that a challenge inspection is judged necessary to refute allegations of CW storage or production, then Convention guidelines will dictate the need for immediate one-time on-site inspection. Challenge inspections are to be given top priority in the activities of the Executive Council. Qualified personnel from the Technical Secretariat must be granted full access to all areas within the facility, unless it has previously been agreed that certain areas need not be inspected. Inspectors will initially carry out those activities, including sampling, which are most likely to refute the challenge. These functions will be dependent on the details involved in the formal allegation. Inspections will end when inspectors are convinced that allegations are not founded; in the event that this is not the case, verification will require complete, detailed inspection.

5.2 Allegations of Use

The use of CW would constitute a breach of the Geneva Protocol of 1925 and would have to be considered a very serious matter. Unfortunately, there is no verification mechanism within the Protocol, and so there is considerable confusion as to how to deal with allegations of use. It is agreed that the Chemical Weapons Convention will deal with this under "Challenge Inspection." Several investigative teams have been sent out by the Secretary-General of the United Nations over the last few years, and also by the Government of Canada, to enquire into the validity of charges made in the area of chemical weapons. This means that there is quite a lot of information available on the skills, personnel and resources required to investigate such allegations. In November 1985, the Canadian government provided the United Nations with a Handbook for the Investigation of Allegations of the Use of Chemical or Biological Weapons, which can be used to determine the requirements of an investigatory team. The needs will be independent of the political decision-making process which leads to the investigation. The actual resources ought to be relatively small since there should not be a great need for such inspections.

The most effective method of handling allegations of use would be prompt on-site inspection by a team of experts. A Technical Secretariat would have experts and technicians available in various disciplines and ought to have equipment and supplies stockpiled for such challenge situations.

Upon receipt of a request for inspection of an allegation of use, an investigative team should be put on standby and dispatched to an appropriate holding point. The IVO would have to arrange for secure passage to the site of the alleged incident and act as liaison between the team and the national authorities involved. The team

would have to be briefed on the situation, informed of the operating procedures and put in contact with the appropriate authorities. The investigators should be on site as soon as practical, but there will be several delays inherent in the system. If the team is denied access to the site, then backup arrangements must be made. The team should be able to investigate at least two sites and be equipped to operate for at least a week in the field. The team should interview victims (observers) and conduct medical examinations before setting up their site investigation; this would help to decide on the best place to carry out sampling. Base camp analysis would have the following objectives: (a) provide early information to assess the nature of the alleged event; (b) assist the sampling team in its efforts to determine if CW agents had been used; (c) preparation of samples for more extensive analysis.

The samples should be sent to designated laboratories under escort. These laboratories should then transmit their results to the IVO who would then relay them to the investigating team. The team could then weigh all the evidence and present their report to the international authority.

5.2.1 Inspection Activities

A point-form summary of the activities involved in investigating alleged use of CW follows. Further details can be found in the aforementioned handbook.

Preliminary activities:

- Notify and assemble the experts and support staff
- Prepare and check the equipment and supplies
- Dispatch the team and equipment to the "holding point"
- Instruct team and individuals on their responsibilities and tasks
- Obtain clearances, etc., for the team and its supplies
- Make arrangements with local authorities, e.g., cease-fire, communications, etc.

Regional activities:

- Send team to the site of the alleged incident(s)
- Arrange local briefings
- Arrange local security and administration
- Arrange for local interviews with witnesses, etc., through the competent authorities
- Proceed to a location for a secure base camp in a "clean" environment
- Establish a base camp
- Establish communication links with local authorities and others

Sample collection activities:

- Sample team proceeds to the site of the alleged incident
- Identifies the site and determines if there is any continuing hazard
- Lays out a grid re sample collecting
- Collects and documents samples and returns them to base camp

Base camp activities:

- Conduct preliminary analyses
- Prepare multiple samples for onward transmission
- Provide guidance for further sampling

Interviews and other activities:

- Interview victims and observers
- Carry out medical examinations
- Collect organ and body fluid samples
- Collect control samples

Transmission of samples:

- Deliver escorted samples to designated laboratories
- Arrange for the IVO to document receipt and condition of samples

Preparation of reports:

- On-site reports
- Designated laboratory reports
- Final/interim reports

5.2.2 Team Personnel

The following point-form text indicates the minimum staff requirements for the verification of alleged use of CW.

verification of alleged use of CW.

Sample collection staff:

- Chemist
- Military expert
- Medical doctor
- Interpreter
- Radio operator
- Driver

Analytical staff:

- Chemist
- Medical technician
- Electronics technician
- Driver

Interviewing staff:

- Interviewers
- Interpreters
- Driver

It is to be noted that each member of the team would be expected to carry out a number of these tasks and so this would have to be agreed upon before departure. The actual size of the international team would be as small as consistent with the nature of the investigation. The national authorities would be expected to provide the local support. This would consist of interpreters, drivers, officials, and soldiers to carry out general duties and provide security.

In the event that evidence is obtained indicating the presence of an unknown agent, arrangements would have to be made for the addition of several scientific/medical experts to develop an in-depth scientific investigation.

If the investigating team is set up on an ad hoc basis from lists of experts maintained for that purpose, then it is imperative that training schemes be set up under the IVO so that procedures can be standardized and so that all their work be

6.0 SKILLS, PERSONNEL AND RESOURCES REQUIRED

The systems study has led to a number of important findings; among these are: (1) the distinction between functional programs and projects, likened to departments within an IVO, and the articles of a Convention treaty, (2) the compilation of a list of functions and skills for the Technical Secretariat, and (3) the realization that a limited number of verification schemes, for each project, serve the purposes of the Convention. It is hoped then, that some clarity has been added to the picture of an IVO in terms of its inspection requirements, although there still remain a number of points which necessitate decision-making and therefore, international discussion and agreement.

Having elaborated on the operational aspects of a Technical Secretariat, it is appropriate to re-state that the skills, personnel and resources required for this sub-organ of the Consultative Committee will be a function of its delegated responsibilities, and its size will be related to the extent of its duties.

6.1 Skills and Personnel

The skills required by an Inspectorate have been considered throughout this systems study (section 3.4.2, in particular). Personnel requirements for an IVO can, therefore, be derived from any detailed listing of skills. The various descriptions given would suggest that, in the first place, engineers of various kinds, including chemical engineers, industrial engineers, and process engineers, will be needed in the organization to advise on technical matters, to design verification schemes, to check technical plans or reports, to inspect facilities or operations, and to train inspectors.

Secondly, to advise on technical matters, to aid in designing/supervising sampling systems and other verification schemes, to conduct interviews, to compile and update chemical lists, and to check trade records or reports, the IVO will need analytical and other chemists, toxicologists, industrial hygienists, and materials accounting specialists.

A technical support staff will need to include interpreters, data specialists, computer and data communications engineers and technicians, electronics technicians, other instrumentation specialists, and lab technicians. An administrative group will include lawyers, accountants and secretaries.

The first group (engineers), and the analytical chemists, toxicologists and industrial hygienists must either have extensive experience with the chemical industry, or undergo training in the specialty area in which they are to work.

An additional group that will have to be set up within the IVO has to be a Quality Assurance Unit (QAU) of much larger size than the QAU's required in those countries that use "Good Laboratory Practice Regulations" (GLP's). That QAU could serve as an examination/certification board, and as an internal quality control monitor. Standard Operating Procedures (SOP's) will have to be written, and tailored and approved by the QAU, for each and every job.

It may be advisable to create also a Scientific Advisory Board to the IVO, which would review, regularly, the scientific criteria and methods employed by departments within the IVO. This would provide yet another dimension of quality assurance, including maintenance of all activities at the current state-of-the-art.

The initial volume of work for the QAU is probably more readily underestimated than estimated, and serious thought will have to be given to three aspects:

(1) Where will the initial cadre of experts, inspectors and members of the QAU come from?

(2) What are the attractions for a highly qualified, well established person, to enter into a career with the IVO, and to continue to be interested in doing what may amount to rather repetitive, boring, and frustrating work?

(3) How does one ensure that the IVO, and its key personnel, maintains a high level of scientific credibility and integrity?

These questions are examined in turn in the following three sections.

6.1.1 Source of Highly Skilled Personnel

As pointed out, both the group of team-leading inspectors and the QAU will require highly skilled and experienced personnel. Such persons are likely to be found in the leading positions of the chemical industry or in "leading-edge" research establishments. Ways and means have to be found to attract such persons to the IVO. This will probably and most likely occur under mutually satisfying agreements between the IVO, the primary employer, and the employee, via temporary leave of absence with compensation. Industry and research institutions would profit from enhanced reputation and visibility, and from the considerable knowledge gained by the specialists, once they return to the home institution. For training of young, aspiring, and eager prospective employees, the IVO could obtain the cooperation of universities and research institutions by providing training and fellowship positions.

6.1.2 Career Aspects

If one follows, in principle, the idea of temporary employment by the IVO (see above), one can surmise that young engineers, scientists, etc., might be attracted to serving in the IVO (never mind the appealing thought that "one can do something important for mankind"), with the prospect of obtaining, eventually, a leading position in industry, government or academia. This is because the leadership qualities which must develop during employment with the IVO (otherwise, the "inspectors," or whatever the role is, would not serve the intended purposes of the IVO) will be of considerable interest to prospective employers.

6.1.3 Maintenance of Scientific Credibility and Professional Status

Many of the key professionals required by the IVO will have to maintain their research careers, for instance by publication of scientific papers. The regular work of the IVO may provide for opportunities for such activities so necessary to retain able specialists.

While it is recognized that the IVO's primary purpose and function would be to take care of the tasks described in considerable detail in this paper, the IVO could assume secondary functions that should and would not interfere with its primary role, but could advance and exploit skills similar to those needed for the primary tasks of the IVO. These secondary functions would achieve several, seemingly unrelated goals. For instance, the organization might investigate sudden and unexplained epidemics or subtle general health problems localized in various places of the world, or assist in determining the cause and effects (short-term and long-term) of major industrial accidents (like the Bhopal incident in 1984) or natural, environmental disasters. One could describe this function as being the task of a "UN Environmental Emergency

Organization." By performing such (secondary) functions[1], the IVO would not only remain visible (a rather important aspect when it comes to convincing States Parties to foot the annual, high-volume expenditures), but would also be kept in a constant state of alert; would have the chance to continually test the functional/organizational ability of all the IVO-associated laboratories, scientists, and supporting structures; would justify the enormous annual expenditures, by serving all nations of the world in a general way; and would produce international respect for the organization.

6.2 Resources

CD/387 and, to a greater extent, CD/445, present some estimates of the resources required by an IVO, in terms of manpower for inspections. Determining the resource requirements in any greater detail is not possible at this stage. The reasons for this are expounded in the presentation below, detailing those parameters which determine the size an Inspectorate, the size of a technical support staff, and the costs associated with an IVO.

6.2.1 Size of an Inspectorate

The number of inspectors required by the IVO is a function of:

- the number of facilities and operations to be inspected.

  For any given project, the greater the number of facilities to be inspected, the greater is the need for proportionately higher numbers of inspectors. The same holds true for transfer operations.

- the size and detail of the facility or area requiring inspection.

  'Size' refers to the physical size of an area and not to the process load of a facility. The greater the size or the more the detail, the greater will be the need for higher numbers of inspectors.

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[1] Such a secondary function, in principle, was first suggested by P.G. Cassell in an article entitled "Establishing Violations of International Law: 'Yellow Rain' and the Treaties Regulating Chemical and Biological Warfare," Stanford Law Review 35, 259-295, 1983.

- the proximity of areas requiring inspection.

  If such areas are close together and can be inspected jointly or in a single visit, then the burden on the IVO in terms of numbers of inspectors is reduced.

- the duration of operations.

  In the case of destruction operations, longer time-frames for operations generally necessitate more frequent inspections where inspections are random or periodic and necessitate more inspectors in any event. For transfer operations, longer time-frames for operations typically indicate that points of transfer are distant, that the transfer route is a slow one, or that the load to be transferred is large. Only in the last case are inspector numbers noticeably affected.

- the frequency of inspection.

  If the frequency is made to be higher, then resource requirements become larger as well.

  The choice of frequency of inspection is dependent in turn on:

  - the duration of an operation;
  - decisions to conduct familiarization visits;
  - the type of facility or operation, i.e., classification according to chemicals;
  - the level of risk of diversion within a facility or operation;
  - the State's CW capability.

- the type of inspection or verification, i.e., the IVO functions to be carried out.

  The greater the number of duties assigned to an Inspectorate or the more complicated or time-consuming those activities are, the greater will be the required number of inspectors.

  The choice of inspection type is dependent in turn on:

  - the type of facility or operation, i.e., classification according to chemicals;
  - the level of risk of diversion within a facility or operation;
  - the applicability of employing instrumentation. Note that instruments may not be feasible where operations are of short duration;
  - obtaining a balance between the degree of effectiveness of the verification method and the degree of intrusiveness which results;
  - decisions to conduct inspections in stages of increasing intrusiveness and the likelihood that an inspection will be necessitated beyond a given stage for a given facility;
  - co-operation between the State and the IVO at the levels of planning, advising, designing equipment, inspecting, and compiling lists.

- the percentage of time spent travelling, report-writing, etc.

  The greater the relative percentage of time devoted to inspecting, the smaller will be the size of the Inspectorate.

- training requirements.

  A sub-organ within the IVO will be responsible for training new personnel. (Personnel in charge of training programs will be qualified inspectors). The size of this sub-organ will be dependent on the details of training programs, including their durations and frequencies. If training programs are long, "back-up inspectors" may be incorporated into the Inspectorate in anticipation of future turnovers.

- requirements for challenge inspections.

  These requirements cannot be readily determined before a Convention is in force. The expectations are that the effect of challenge inspections on the resources required by an IVO will be relatively small. Certainly, if a decision is made to set up a permanent sub-organ within the IVO for the purposes of challenge inspections, then the impact on resources can be estimated. It is not likely, however, that such a sub-organ will be required; in any event, one or more persons must be responsible for organizing activities in case it is found that a challenge warrants inspection.

- cost considerations.

  An optimum balance between the size of an Inspectorate and the costs it incurs may be required.

6.2.2 Size of a Technical Support Staff

The size of a technical support staff is a function of:

- the form of data management chosen.

  Data management may be of a very simple nature, involving a large amount of paper work; or it may be of a highly technical nature, involving electrical, optical, or satellite communication links from various sites to one or more designated centers; or it may be of an intermediate nature, e.g., involving data storage at various sites and subsequent transfer of data by IVO personnel. An appropriate balance between the numbers of highly-skilled technicians and the numbers of less-skilled members of the technical support staff will be dependent on the form of data management chosen.

- the types and amounts of instrumentation or equipment employed in the verification schemes.

  Any IVO equipment or instrumentation should be installed, calibrated, checked, serviced, and removed by competent IVO personnel. The technical support staff may also be required to assist in checking important facility equipment. The resource requirements of this sub-organ will increase with increased complexity and use of instrumentation or equipment.

- the frequencies of challenge inspections and false alarms.

  False alarms may occur with power failures or general equipment failure. Frequent challenge inspections and false alarms will necessitate frequent checks on equipment. The frequency of false alarms may be reduced by utilizing back-up power generators and equipment or instrumentation.

- the use of labs for analysis of samples.

  Lab technicians may be required if it is decided to set up one or more central labs for samples analyses.

- the degree of IVO involvement in planning and designing facilities and/or verification schemes.

  Details of equipment and instrumentation design, as well as details on their incorporation into plans, would require the involvement of technical support personnel.

6.2.3 Costs Associated with an IVO

The costs associated with an IVO are a function of:

- the number of IVO inspectors employed (see 6.2.1).

  This number will be in a state of general flux, dependent inter alia on the numbers of personnel in training at any given time. More importantly, it is generally expected to be at its highest value at the time of the Convention's coming into force; as destruction operations are completed, the number should drop and eventually (after ten years) level off.

- the types of inspectors employed.

  For example, if inspections are on a non-continuous basis, then personnel with broad expertise in the chemical industry will be needed; this would increase average salary levels within the Inspectorate, although it would probably decrease training costs.

- the size of the technical support staff (see 6.2.2).

  Again, the size of this sub-organ will be greatest at the time of the Convention's coming into force, when the design of verification schemes and the installation of new equipment are expected to be key activities of the IVO. As destruction operations are completed, staff numbers will decrease.

- the amounts and types of IVO instrumentation and equipment required for verification purposes.

  Instrumentation not under continuous control by the IVO should be tamper-proof, reliable and long-lived. To decrease the chances of false alarms, back-up generators and back-up equipment and instrumentation may be installed. Equipment for the purposes of investigation of allegations of use would also be needed, e.g., perhaps a portable 'package' consisting of some vehicle loaded with appropriate equipment.

- the form of data management utilized.

  The most efficient forms of data management are also the most costly, both in terms of capital costs and equipment upkeep, since they generally involve sophisticated computer equipment and communication links. The operating advantages of modern systems, which are capable of processing large amounts of information both rapidly and securely, may offset cost disadvantages.

- the size of the administrative organization.

  The size of the administrative organization is expected to be proportionately related to the size of the Inspectorate.

- the locations of (an) IVO headquarters.

  Headquarters should be located centrally in relation to the sites of inspection and preferably in neutral countries. Locations in both Europe and North America would be desirable. Other offices may be set up near areas where allegations of use are frequent or have been confirmed.

- travel requirements.

  Travel expenses may be minimized by an appropriate choice of locations of headquarters. The choice of inspection frequency obviously affects travel requirements.

- challenge inspection costs.

  These costs may include the hiring of special personnel and/or laboratories in cases of allegations of use. Hopefully, the added resource requirements necessitated by the inspection of allegations of use will be relatively small.

APPENDIX 1

COMPLETE LISTINGS WHICH CORRELATE PROJECTS, METHODOLOGICAL OPTIONS AND FUNCTIONS, FOR PROGRAM ONE, "CHEMICAL WEAPONS"

The following lists correlate projects, methodological options and specific IVO functions and skills for each project in Program One, "Chemical Weapons." The lists show essentially all[1] of the possible verification schemes which may be applied to those projects within the first three programs of this study. General methodological options, distinguished by capital letters, were derived from the checklist on pages 32 to 36. No attempt is made at this stage to evaluate the applicability of any particular method. Rather, all options are listed to promote comprehensive discussion.

Under "Functions of IVO", IVO functions and skills are indicated by numbers, matching the numbered functions and skills described in section 3.4. Where IVO instruments are to be used instead of or in addition to States' or facilities' instruments, [square] brackets indicate the extra functions of the IVO that may apply. Where States' or facilities' inspectors are to be used in addition to IVO inspectors, <triangular> brackets indicate the extra functions of the IVO that may apply. (Round) brackets under "Functions of IVO" indicate that the specific IVO function(s) numbered within may or may not apply.

Numbers under "Methodological Options" refer to the checklist on pages 32-36. IVO inspectors and State's or facilities' instruments are assumed to be the methods employed in the cases below which involve both inspectors and instruments.

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[1] Some schemes which are physically unrealizeable or obviously of little value to the Convention are not listed. Deliberate omissions are indicated in every case. For example, near-site verification is not considered to be an adequate methodological option in the case of Project 3.2 "Verification of Research and Development," since it would be of little value in assuring compliance with the Convention.

Project 1.1 - Verification of a Declaration on CW Storage Facilities
(Storage locations, CW types and quantities, inventory arrangements)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Near-site Inspection with	- 1,2,3,(4,5,6,7)<19>
One-time on-site monitoring of areas or equipment - options as in (4.1.2) and/or with	- add (15,16,17) [13,14,18]
One-time measurement of quantity - options as in (4.1.4) and/or with	- add (7,8,9,10,15,17) [13,14,18]
Irregular, regular, or total sampling - options as in (4.1.5)	- add (7,8,11,12,15,16) [13,14,18]
C. One-time On-site Inspection with... - same as B	

- Verification of a Declaration on CW Destruction Facilities
(Locations of existing facilities, processes, control, safety features, instrumentation)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Near-site Inspection with	- 1,2,3,(4,5,6,7,8) <19>
One-time on-site monitoring of areas or equipment - options as in (4.1.2)	- add (15,16,17) [13,14,18]
C. One-time On-site Inspection with... - same as B	

Project 1.2 Verification of CW Storage

Methodological Options	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Data Reporting (Declarations)	- 1,2,20,(5,6)
C. Irregular Data Reporting	- same as B

(Cont'd...)

Appendix 1 - continued

D. Periodic Data Reporting	- same as B
E. One-time Near-site Inspection with Sealing of equipment or areas - options as in (4.1.1) and/or with Monitoring of areas or equipment - options as in (4.1.2) and/or with Measurement of quantity - options as in (4.1.4) and/or with Irregular, regular, or total sampling - options as in (4.1.5)	- 1,2,3,(4,5,6,7,8) <19> - add (8,15,16,17) [13,14,18] - add (7,8,15,16,17) [13,14,18] - add (7,8,9,10,15,16) [13,14,18] - add (7,8,11,12,15,16) [13,14,18]
F. Random Near-site Inspection with... - same as E	
G. Periodic Near-site Inspection with... - same as	
H. Continuous Near-site Inspection with... - same as E	
I. One-time On-site Inspection with... - same as E (except add the stipulation of 'on-site' monitoring)	
J. Random On-site Inspection with (sealing, measurement of quantity, sampling) and/or with Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2)	- same as E
K. Periodic On-site Inspection with... - same as J	
L. Continuous On-site Inspection with... - same as J	
M. Remote (IVO Satellite) Instrumentation with Random, periodic or continuous monitoring of areas or equipment and/or sampling	- 1,2,3,20,(6,15,17,18) [13,14,18]
N. Any combination of one of E to L and/or one of B to D and/or M	- add functions

(Cont'd...)

Appendix 1 - continued

Project 1.3 Verification of Destruction of CW

	Methodological Options	Functions of IVO
A.	National Technical Means	- 1,20
B.	One-time Data Reporting (Declarations)	- 1,2,20,(5,6,7)
C.	Irregular Data Reporting	- same as B
D.	Periodic Data Reporting	- same as B
E.	One-time Near-site Inspection with Sealing of equipment or areas - options as in (4.1.1) and/or with Monitoring of areas or equipment - options as in (4.1.2) and/or with Measurement/monitoring of process variables - options as in (4.1.3) and/or with Measurement of quantity - options as in (4.1.4) and/or with Sampling - options as in (4.1.5)	- 1,2,3,(4,5,6) <19> - add (8,15,16,17) [13,14,18] - add (7,8,15,16,17) [13,14,18] - add (7,8,15,16,17) [13,14,18] - add (7,8,9,10,15,16) [13,14,18] - add (7,8,11,12,15,16) [13,14,18]
F.	Random Near-site Inspection - same as E	
G.	Periodic Near-site Inspection with... - same as E	
H.	Continuous Near-site Inspection with... - same as E	
I.	One-time On-site Inspection with... - same as E (except add the stipulation of 'on-site' monitoring)	
J.	Random On-site Inspection with (sealing, measurement of quantity, sampling) and/or with Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2) and/or with Random, periodic, or continuous on-site measurement/monitoring of process variables - options as in (4.1.3)	- same as E

(Cont'd...)

Appendix 1 - continued

K. Periodic On-site Inspection with...
- same as J

L. Continuous On-site Inspection with...
- same as J

M. Remote (IVO Satellite) Instrumentation with Random, periodic or continuous monitoring of areas or equipment and/or measurement of process variables (e.g. temperature sensor) and/or measurement of quantity and/or sampling - 1,2,3,20,(6,9,10,15,16,17) [13,14,18]

N. Any combination of one of E to L and/or one of B to D and/or M - add functions

Project 1.4 Verification of Transfers of CW (and Key Precursors)

See Project 3.5

Project 1.5 Verification of Diversion of CW

Diversion meaning the transfer of CW to storage for permitted (small-scale) purposes is covered under Transfers.

Diversion meaning an irreversible transformation of CW Agents to other (useful civilian) purposes involves the same alternative verification methods and IVO functions as for Destruction of CW if the diversion is carried out in a single-purpose diversion facility. Diversion involves the same alternative verification methods and IVO functions as for Non-production if diversion is carried out in civilian industry.

APPENDIX 2

COMPLETE LISTINGS WHICH CORRELATE PROJECTS, METHODOLOGICAL OPTIONS AND FUNCTIONS, FOR PROGRAM TWO, "CHEMICAL WEAPONS PRODUCTION FACILITIES"

The following lists correlate projects, methodological options and specific IVO functions and skills for each project in Program Two, "Chemical Weapons Production Facilities." The lists show essentially all[1] of the possible verification schemes which may be applied to those projects within the first three programs of this study. General methodological options, distinguished by capital letters, were derived from the checklist on pages 32 to 36. No attempt is made at this stage to evaluate the applicability of any particular method. Rather, all options are listed to promote comprehensive discussion.

Under "Functions of IVO", IVO functions and skills are indicated by numbers, matching the numbered functions and skills described in section 3.4. Where IVO instruments are to be used instead of or in addition to States' or facilities' instruments, [square] brackets indicate the extra functions of the IVO that may apply. Where States' or facilities' inspectors are to be used in addition to IVO inspectors, <triangular> brackets indicate the extra functions of the IVO that may apply. (Round) brackets under "Functions of IVO" indicate that the specific IVO function(s) numbered within may or may not apply.

Numbers under "Methodological Options" refer to the checklist on pages 32-36. IVO inspectors and State's or facilities' instruments are assumed to be the methods employed in the cases below which involve both inspectors and instruments.

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[1] Some schemes which are physically unrealizeable or obviously of little value to the Convention are not listed. Deliberate omissions are indicated in every case. For example, near-site verification is not considered to be an adequate methodological option in the case of Project 3.2 "Verification of research and Development," since it would be of little value in assuring compliance with the Convention.

Project 2.1 **Verification of a Declaration on CW Production Facilities**
(Locations, processes, chemicals, equipment inventories)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Near-site Inspection with One-time on-site monitoring of areas or equipment - options as in (4.1.2)	- 1,2,3,(4,5,6) <19> - add (15,16,17) [13,14,18]
C. One-time On-site Inspection with... - same as B	

Project 2.2 **Verification of Cessation of Production/Closure in CWPF**

Methodological Options	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Data Reporting (Declarations)	- 1,2,20,(5)
C. Irregular Data Reporting	- same as B
D. Periodic Data Reporting	- same as B
E. One-time Near-site Inspection with	- 1,2,3,(4,5),<19>
Sealing of equipment or areas - options as in (4.1.1) and/or with	- add (8,15,16,17) [13,14,18]
Monitoring of areas or equipment - options as in (4.1.2) and/or with	- add (7,8,15,16,17) [13,14,18]
Measurement/monitoring of process variables - options as in (4.1.3) and/or with	- add (7,8,15,16,17) [13,14,18]
Sampling - options as in (4.1.5)	- add (7,8,11,12,15,16) [13,14,18]
F. Random Near-site Inspection with... - same as E	
G. Periodic Near-site Inspection with... - same as E	
H. Continuous Near-site Inspection with... - same as E	
I. One-time On-site Inspection with... - same as E (except add the stipulation of 'on-site' monitoring)	

(Cont'd...)

J.	Random On-site Inspection with (sealing, measurement of quantity, sampling) and/or with Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2) and/or with Random, periodic, or continuous on-site measurement/monitoring of process variables - options as in (4.1.3)	- same as E
K.	Periodic On-site Inspection with... - same as E	
L.	Continuous On-site Inspection with... - same as E	
M.	Remote (IVO Satellite) Instrumentation with Random, periodic or continuous monitoring of areas or equipment and/or measurement of process variables (e.g., temperature sensor) and/or sampling	- 1,2,3,20,(15,16,17) [13,14,18]
N.	Any combination of one of E to L and/or one of B to D and/or M	- add functions

Project 2.3 Verification of Destruction/Dismantling of CWPF

Note: Dismantling may be connected with Project 2.5 Transfers (of equipment) and with Project 2.6 Reconstruction as well.

	Methodological Options	Functions of IVO
A.	National Technical Means	- 1,20
B.	One-time Data Reporting (Declarations)	- 1,2,20,(5)
C.	Irregular Data Reporting	- same as B
D.	Periodic Data Reporting	- same as B
E.	One-time Near-site Inspection with Random, periodic, or continuous monitoring of areas or equipment - options as in (4.1.2)	- 1,2,3,(4,5) <19> - add (7,8,15,16,17) [13,14,18]

(Cont'd...)

F. Random Near-site Inspection with...
   - same as E

G. Periodic Near-site Inspection with...
   - same as E

H. Continuous Near-site Inspection with...
   - same as E

I. One-time On-site Inspection with...
   - same as E (except add the stipulation of 'on-site' monitoring)

J. Random On-site Inspection with...
   - same as I

K. Periodic On-site Inspection with...
   - same as I

L. Continuous On-site Inspection with...
   - same as I

M. Remote (IVO Satellite) Instrumentation with Random, periodic or continuous monitoring of areas or equipment - 1,2,3,20,(15,16,17) [13,14,18]

N. Any combination of one of E to L and/or one of B to D and/or M - add functions

Project 2.4 Verification of Temporary Conversion of CWPF (Conversion to Destruction Facilities)

Three stages of this program will need to be considered:

Stage 1: Cessation of Production
Stage 2: Selective Destruction/Dismantling
Stage 3: Destruction of CW

Project 2.5 Verification of Transfers of Equipment

See Project 3.5

Project 2.6 Verification of Reconstruction of CWPF (for Peaceful Purposes)

Three stages of this program will need to be considered:

Stage 1: Cessation of Production
Stage 2: Selective Destruction/Dismantling
Stage 3: Non-Production or Permitted (Small-scale) Production

APPENDIX 3

COMPLETE LISTINGS WHICH CORRELATE PROJECTS, METHODOLOGICAL OPTIONS AND FUNCTIONS, FOR PROGRAM THREE, "ACTIVITIES NOT PROHIBITED"

The following lists correlate projects, methodological options and specific IVO functions and skills for each project in Program Three, "Activities Not Prohibited." The lists show essentially all[1] of the possible verification schemes which may be applied to those projects within the first three programs of this study. General methodological options, distinguished by capital letters, were derived from the checklist on pages 32 to 36. No attempt is made at this stage to evaluate the applicability of any particular method. Rather, all options are listed to promote comprehensive discussion.

Under "Functions of IVO", IVO functions and skills are indicated by numbers, matching the numbered functions and skills described in section 3.4. Where IVO instruments are to be used instead of or in addition to States' or facilities' instruments, [square] brackets indicate the extra functions of the IVO that may apply. Where States' or facilities' inspectors are to be used in addition to IVO inspectors, <triangular> brackets indicate the extra functions of the IVO that may apply. (Round) brackets under "Functions of IVO" indicate that the specific IVO function(s) numbered within may or may not apply.

Numbers under "Methodological Options" refer to the checklist on pages 32-36. IVO inspectors and State's or facilities' instruments are assumed to be the methods employed in the cases below which involve both inspectors and instruments.

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[1] Some schemes which are physically unrealizeable or obviously of little value to the Convention are not listed. Deliberate omissions are indicated in every case. For example, near-site verification is not considered to be an adequate methodological option in the case of Project 3.2 "Verification of research and Development," since it would be of little value in assuring compliance with the Convention.

Project 3.1 - **Verification of a Declaration on Permitted (Small-scale) Production**
(Locations of existing facilities, processes, chemicals, capacities, equipment, control, safety features)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Near-site Inspection with	- 1,2,3,(4,5,6) <19>
One-time on-site monitoring of areas or equipment - options as in (4.1.2) and/or with	- add (15,16,17) [13,14,18]
One-time measurement/monitoring of process variables - options as in (4.1.3) and/or with	- add (15,16,17) [13,14,18]
Measurement of quantity - options as in (4.1.4) and/or with	- add 10,(15,16) [13,14,18]
One-time sampling - options as in (4.1.5)	- add (7,8,11,12,15,16) [13,14,18]
C. One-time On-site Inspection with... - same as B	

- **Verification of a Declaration on Civilian Facilities**
(Facility locations, processes, chemicals, capacities, equipment, control, safety features)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Near-site Inspection with	- 1,2,3,(4,5,6) <19>
One-time on-site monitoring of areas or equipment - options as in (4.1.2) and/or with	- add (15,16,17) [13,14,18]
One-time measurement/monitoring of process variables - options as in (4.1.3) and/or with	- add (15,16,17) [13,14,18]
Measurement of quantity - options as in (4.1.4) and/or with	- add 10,(15,16) [13,14,18]
One-time sampling - options as in (4.1.5)	- add (7,8,11,12,15,16) [13,14,18]
C. One-time On-site Inspection with... - same as B	

(Cont'd...)

Project 3.2 Verification of (Toxic-chemicals) Research and Development

Methodological Options (Near-site verification not considered) (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. Irregular Data Reporting	- 1,2,20,(5)
C. Periodic Data Reporting	- same as B
D. Literature Search	- 1,20
E. Random or Irregular On-site Inspection with	- 1,2,3,(4,5),<19>
Measurement of quantity - options as in (4.1.4) and/or with	- add (10,15,16) [14,18]
Irregular or total sampling - options as in (4.1.5)	- add (11,12,15,17) [14,18]
F. Periodic On-site Inspection with... - same as E	
G. Continuous On-site Inspection with... - same as E	
H. Any combination of one of E to G and/or one of B to C and/or D	- add functions

Project 3.3 Verification of Permitted (Small-scale) Production

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Data Reporting (Declarations)	- 1,2,20,(5,6,7)
C. Irregular Data Reporting	- same as B
D. Periodic Data Reporting	- same as B
E. One-time Near-site Inspection with	- 1,2,3,(4,5,6),<19>
Monitoring of areas or equipment - options as in (4.1.2) and/or with	- add (7,8,15,16,17) [13,14,18]

(Cont'd...)

Measurement/monitoring of process variables - options as in (4.1.3) and/or with Measurement of quantity - options as in (4.1.4) and/or with Sampling - options as in (4.1.5)	- add (7,8,15,16,17) [13,14,18] - add 10,(8,15,16) [13,14,18] - add (7,8,11,12,15,16) [13,14,18]
F. Random Near-site Inspection with... - same as E	
G. Periodic Near-site Inspection with... - same as E	
H. Continuous Near-site Inspection with... - same as E	
I. One-time On-site Inspection with... - same as E (except with the stipulation of 'on-site' monitoring)	
J. Random On-site Inspection with (measurement of quantity, sampling) and/or with Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2) and/or with Random, periodic, or continuous on-site measurement/monitoring of process variables - options as in (4.1.3)	- same as E
K. Periodic On-site Inspection with... - same as J	
L. Continuous On-site Inspection with... - same as J	
M. Any combination of one of E to L and/or one of B to D	- add functions

Project 3.4 Verification of Non-production (Civilian Production)

Methodological Options (Remote verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Data Reporting (Declarations)	- 1,2,20,(5,6)
C. Irregular Data Reporting	- same as B

(Cont'd...)

Appendix 3 - continued

D. Periodic Data Reporting - same as B

E. One-time Near-site Inspection with - 1,2,3,(4,5,6) <19>
Monitoring of areas or equipment
- options as in (4.1.2) - add (7,8,15,16,17) [13,14,18]
and/or with
Sampling - options as in (4.1.5) - add (7,8,11,12,15,16) [13,14,18]

F. Random Near-site Inspection with...
- same as E

G. Periodic Near-site Inspection with...
- same as E

H. Continuous Near-site Inspection with...
- same as E

I. One-time On-site Inspection with...
- same as E (except with the stipulation of on-site monitoring)

J. Random On-site Inspection with (sealing, measurement of quantity, sampling) and/or with - same as E
Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2)
and/or with
Random, periodic, or continuous on-site measurement/monitoring of process variables - options as in (4.1.3)

K. Periodic On-site Inspection with...
- same as J

L. Continuous On-site Inspection with...
- same as J

M. Any combination of one of E to L and/or one of B to D - add functions

Projects 1.4, 2.5 and 3.5 **Verification of Transfers of Chemicals or Equipment** (Imports and exports included)

Methodological Options (Near-site verification not considered)	Functions of IVO
A. National Technical Means	- 1,20
B. One-time Data Reporting (Declarations)	- 1,2,20,(5,6)

(Cont'd...)

Appendix 3 - continued

C.	Irregular Data Reporting	- same as B
D.	Periodic Data Reporting	- same as B
E.	One-time On-site Inspection with Sealing of equipment or areas - options as in (4.1.1) and/or with Random, periodic, or continuous on-site monitoring of areas or equipment - options as in (4.1.2) and/or with Measurement of quantity - options as in (4.1.4) and/or with Irregular, regular, or total sampling - options as in (4.1.5)	- 1,2,3,(4,5,6) <19> - add (8,15,16,17) [13,14,18] - add (7,8,15,16,17) [13,14,18] - add (7,8,9,10,15,16) [13,14,18] - add (7,8,11,12,15,16) [13,14,18]
F.	Random On-site Inspection with... - same as E	
G.	Periodic On-site Inspection with... - same as E	
H.	Continuous On-site Inspection with... - same as E	
I.	Remote (IVO Satellite) Instrumentation with Random, periodic or continuous monitoring of the transfer and/or measurement of quantity and/or sampling	- 1,2,3,20,(6,9,10,15,16,17) [13,14,18]
J.	Any combination of one of E to H and/or one of B to D and/or I	- add functions

APPENDIX 4

METHODOLOGICAL OPTION EXAMPLE

The following example details one of the methodological options (namely, one-time, near-site inspection with ..., etc.) for the project involving the Destruction of CW Stockpiles. This example was chosen to demonstrate the detail that arises when one closely examines one general methodological option for a given project. Data exchange is assumed to be included in the verification scheme.

An important consideration here is that, in spite of the restriction on inspection frequency and site (i.e., one-time near-site inspection), all possible combinations of instrumentation frequency and site exist and might prove useful.

Referring to the example which follows under "Functions of IVO", IVO functions and skills are indicated by numbers, matching the numbered functions and skills described in section 3.4. Where IVO instruments are to be used instead of or in addition to State's or facilities' instruments, [square] brackets indicate the extra functions of the IVO that may apply. Where State's or facilities' inspectors are to be used in addition to IVO inspectors, <triangular> brackets indicate the extra functions of the IVO that may apply. (Round) brackets under "Functions of IVO" indicate that the specific IVO function(s) numbered within may or may not apply.

Numbers under "Methodological Options" refer to the checklist on pages 32-36.
IVO inspectors and State's or facilities' instruments are assumed to be the methods employed in the cases below which involve both inspectors and instruments.

Example: Verification of Destruction of CW (Project 1.3), Methodological Option E. One-time Near-site Inspection with sealing of equipment or areas, monitoring of areas or equipment, measurement/monitoring of process variables, measurement of quantity, and sampling.

Methodological Options	Functions of IVO
E. One-time Near-site Inspection	- 1,2,3,(4,5,6) <19>
with Sealing of equipment or areas - options as in (4.1.1)	- add (8,15,16,17) [13,14,18]
and/or with Monitoring of areas or equipment - options as in (4.1.2)	- add (7,8,15,16,17) [13,14,18]
and/or with Measurement/monitoring of process variables - options as in (4.1.3)	- add (7,8,15,16,17) [13,14,18]
and/or with Measurement of quantity - options as in (4.1.4)	- add (7,8,9,10,15,16) [13,14,18]
and/or with Sampling - options as in (4.1.5)	- add (7,8,11,12,15,16) [13,14,18]

Explanations:

Inspectors set up camp near-site; they are not allowed on-site.

Although the inspection is of fixed duration and is not to be repeated, on-site or near-site instrumentation may be allowed to be set in place for continuous, random, or periodic use. Any such instrumentation would feed signals to a remote site. e.g., an IVO centre. The installation, calibration, checking, and servicing of IVO equipment may be carried out by IVO technicians given special access for such purposes. On the other hand, the stipulation of one-time near-site inspection may require that State or facility personnel be solely responsible for these activities.

Under this scheme, data management would be a major component to IVO requirements. Although data collection and reporting would be largely automatic, subsequent analysis of the data, ex. material balances, would involve personnel employed at an IVO centre.

In terms of the inspectors' responsibilities, the major goals of a one-time near-

site inspection would be 1) to check the process over carefully to ensure that the facility is designed for the destruction of relevant CW according to plans, and 2) to oversee the installation and operation of any equipment set up for the purposes of verification. Both of these goals are difficult to achieve from a position of near-site access. However, the use of on-site monitoring equipment, carried by State or facility personnel, makes the scheme possible and at this stage of the study, all possible methods of verification are listed. Discussion on confidence-building measures of near-site verification is reserved for a later step in the analysis.

Further detail on the various aspects of the verification scheme are discussed below.

Sealing of Equipment or Areas:

- might want to seal the area of the destruction process which immediately follows the measurement of quantity to ensure that nothing is being removed from the production line.
- IVO instrumentation should be sealed as well.

Monitoring of Areas or Equipment:

- cameras may be carried with the State or facility personnel to monitor, e.g., the sampling on-site, or any process area or instruments. These monitoring devices may be permanently set in place with the recorded data being sent back to an IVO centre (i.e., on a random, periodic, or continuous basis).

Measurement/Monitoring of Process Variables:

- camera monitoring of instrument readings on-site may be sufficient in place of IVO measuring devices. Alternatively, on-site measuring devices may be installed

by State of facility personnel and their signals or readings sent directly to an IVO centre.

Measurement of Quantity:

- could involve the instrumentation set up for monitoring on-site, e.g., a camera watches the feed line to the furnace of a destruction facility and allows for counting munitions or containers.
- in the same way, instrumentation might be set in place on-site by State or facility personnel to measure volume or weight of material entering the destruction site. This measurement might be one-time, random, periodic, or continuous.

Sampling:

- inspectors may sample waste streams or air near-site.
- they may or may not set up a random, periodic, or continuous sampling system that will operate automatically and send information back to an IVO centre.
- sampling may also be on-site, i.e., the inspectors ask someone from the inspected State or facility to collect the sample or set up an automatic sampling system connected to an IVO centre.
- samples may be analyzed on-site using facility equipment, or near-site using IVO equipment, or in a remote lab.

APPENDIX 5

GLOSSARY

Ad hoc On-site Inspection	An inspection requested by and submitted to the Consultative Committee, at any time, by a Party to clarify and resolve any matter which may cause doubts about compliance or give rise to concerns about a related matter which may be considered ambiguous, of any location or facility not subject to Special Inspection (CD/500).
Allegation	A charge of a violation of the Chemical Weapons Convention.
Allegation of Use	Arises when at least one State voices its concerns in international circles and charges a second State with using chemical weapons for the purposes of (chemical) warfare.
Cessation of Production	The ending of production of CW at a chemical weapons production facility prior to closure, destruction, or conversion of the facility.
Challenge Inspection	An inspection which results from a suspicion that there has been a violation of the Convention.
Challenge Procedures	Procedures for initiating an investigation which arises from an allegation; or guidelines for carrying out an inspection in the event of suspicion of a violation of the Convention.
Civilian Production	See Non-production.
Closure	The act of rendering a production facility inoperable.
Consultative Committee	Each State Party will have a representative on the Consultative Committee. It has overall authority with respect to the Convention. It is described in detail in CD/500 and CD/734.
CW	A commonly used abbreviation for Chemical Weapon(s). Used both for the chemical agent and for munitions.
CW Agent	Chemical Warfare Agent, an alternate nomenclature for CW instead of "chemical agent".

CW Capability	Refers to a State's or facility's technical capability with respect to the production of chemical weapons. A State which has produced and stockpiled CW clearly has such capability. A State which has not produced CW, but has the required technological ability, could also be said to possess CW capability, whereas a State which does not have the technical ability to initiate production does not have CW capability. May also be used to describe a facility which could readily be modified from a current process to one which could be used for CW production. Such a facility would be said to have a high CW capability.
Chemical Weapons Production Facility (CWPF)	A facility built specifically to produce chemical weapons or to fill such munitions. It could also be used to define a facility sometimes used to produce chemical weapons.
CW Stockpiles	A term used to describe the storage of chemical weapons. The word "stock" can also be used for a quantity of CW.
Data Check/Analysis	Checking/analyzing various collected data or plans for purposes of verification. Different types of data checks/analyses are described under "Required Skills (of an IVO)" (see 3.4.2).
Data Exchange	The exchange of data between two or more groups as required by the Convention. Usually this information is needed for verification purposes.
Data Management	Consists of the collecting, recording and checking/analyzing of information required for purposes of verification. Data management involves the transfer and processing of data between and at a verification site and an IVO headquarters.
Data Reporting	The transfer of information between the State (facility) and the IVO and between various levels in the IVO. It can also refer to reporting to the Executive Council, the Consultative Committee, or the States Parties.

Declarations		Statements, data, or plans submitted by a State to the IVO before beginning or after completing an operation necessitated by the Convention. Also refers to any data reported by a State Party at the time at which the Convention enters into force for that State.
Depositary		The body to whom the instruments of ratification and instruments of accession are deposited.
Destruction	- of CW	A process by which chemicals are converted in an essentially irreversible way to a form unsuitable for the production of CW and which renders munitions and other devices unusable as such.
	- of CWPF	The razing to the ground of a facility used to produce CW or the rendering of CW equipment unusable.
Dismantling		The disassembling of technological equipment that was used in a production facility.
Diversion		A process by which chemicals are converted in an essentially irreversible way into end products which may only be used for purposes other than those related to chemical weapons. Other meanings: taking supertoxic lethal chemicals from CW stocks for permitted purposes. : removal from stockpiles of certain precursors or toxic substances utilizable for industrial purposes.
Executive Council		That organ of the Convention which acts in the place of the Consultative Committee between sessions and which oversees the activities of the other sub-organs.
Fact-finding		The seeking of information to resolve an inquiry.
Fact-finding Panel		A panel set up by the Consultative Committee to carry out fact-finding activities.
Familiarization Visit		Initial visit to a facility by the Inspectorate to aid in planning a verification scheme for that facility or category of facility.
Inquiries		Requests by one State to the Executive Council to clarify an ambiguous situation concerning the Convention and the activities of another State.
Inspectorate		That part of an IVO which carries out inspections under the Convention.

Irregular	Data reporting, inspection, sampling, or use of instruments upon request of the IVO, at unannounced intervals. In the case of instruments, 'irregular' does not refer to availability for use.
IVO	An International Verification Organization (Technical Secretariat) which oversees the implementation of a Chemical Weapons Convention and carries out the inspection tasks. It is an organ of the Consultative Committee and reports to the Executive Council.
Key Precursor	A precursor which poses a significant risk to the objectives of the Convention by virtue of its importance in the production of a toxic chemical.
Materials Accountancy	Data management for the purposes of recording and checking the movement, within a facility, within a State, or across international boundaries, of certain chemicals.
Methodological Options	Alternative methods available to carry out projects/tasks, i.e., methods of verification.
National Technical Means	Equipment or technical systems employed by a State to monitor others' territory or activities, i.e., to monitor compliance with the Convention.
Near-site	In close proximity to a site.
Non-production	Refers to the purpose of a facility. Non-production facilities produce chemicals for civilian, peaceful use.
Non-selective	Without restriction on the area to be monitored, stream to be sampled, variable to be measured, etc.
One-time	Data reporting, inspection, sampling or use of instrumentation on a single occasion.
On-site	On the precise location. The term "on-site" may signify both on-site and/or near-site. For example, an inspector may be granted continuous on-site access to a facility, but may conduct a majority of his activities near-site.
Operation	Used mainly to refer to a destruction or transfer operation carried out by a State. May also refer to a storage operation.

Periodic	A constant interval between specified events such as data reporting, inspections, sampling, or use of instrumentation. In the case of instruments, 'periodic' does not refer to availability for use.
Permitted Production	The production of chemicals which fit the criteria for chemical weapons or key precursors but are being produced for purposes not prohibited by the Convention.
Precursor	A chemical reagent which may be used as part in the production of a toxic chemical.
Preparatory Commission	Representatives of all signatory States convened for the purpose of carrying out the preparations required before the entry into force of the provisions of the Convention. This includes the first meeting of the Consultative Committee.
Program(me)	A broad area of concern or required activity in the proposed articles of the Chemical Weapons Convention and based upon CD/500 or CD/734.
Project	A more closely defined area of concern or required activity within a specific program.
Protective Purposes	Directly related to protection against chemical weapons.
Quota	A (lower) limit upon the number of inspections to be carried out or facilities visited. It can be specified either as a number or as a percentage.
Random	Inspection, sampling, or use of instruments at unpredictable intervals. Randomly-timed activities may be conducted within the framework of a somewhat predictable schedule. For example, random inspections of a facility may be scheduled to occur on average once in every thirty-day period. To accomplish this, a random date for inspection would be chosen from a sixty-day time period. The sixty-day period would be reset to begin at the time of the previous inspection's completion. In the case of use of instruments, 'random' does not refer to availability for use. 'Random' inspection may also refer to the 'chance' selection of a facility for inspection.
Reconstruction	The construction of a new facility from dismantled components acquired from a decommissioned facility.

Regular Sampling	The sampling of every n-th container or munition.
Remote	Far from the site or facility or operation.
Representative	Sampling or measurement carried out once per group of like-samples or containers, with the expectation that the remaining samples or containers are virtually identical.
Research and Development	Referring to the synthesis of new chemicals which are potential CW agents.
Sealing	The use of opto-electronic or other devices to continuously monitor the status of equipment, areas, munitions, or containers.
Selective	Carrying out verification activities only at specified points in a facility or during an operation, where access is permitted by prior agreement. Also, a limitation on the numbers and/or types of activities, e.g., measurements.
Small-scale Production	See Permitted Production.
Special Inspection	An inspection requested by any member of the Fact-finding Panel at any time of any other Party to clarify and resolve any matter which may cause doubts about compliance or give rise to concerns about a related matter which may be considered to be ambiguous.
Specific Functions	Duties to be performed be the Technical Secretariat, to accomplish specific verification requirements within a project.
Supertoxic Lethal Chemical	Any toxic chemical with a median lethal dose (STLC) which is less than or equal to 0.5 mg/kg (subcutaneous administration) or 2000 m-min/m^3 (by inhalation) when measured by an agreed method.
Stocks/Stockpiles	See CW Stockpiles.
Systematic	Predictable; based on a fixed timetable.
Systems Analysis	A logical technique used in problem solving. It involves identifying, organizing and developing ideas.
Systems Study	A qualitative study of a system using the ideas of systems analysis and variations thereon.

Technical Secretariat		See "IVO."
Technical Support Staff		The staff concerned with the actualization of verification schemes, e.g., electronics experts who install monitoring devices, data-entry operators who process information.
Temporary Conversion		The conversion of a CWPF into a chemical weapons destruction facility for a period during which the destruction of CW occurs.
Total		Relates to sampling and counting - of each and every container and munition.
Toxic Chemical		Strictly speaking, a misnomer, because <u>all</u> chemicals can be toxic, depending on the dosis. However, the words are so widely used that this paper uses them also, sparingly, to avoid further confusion.
Toxicity		A measure of the extent to which a chemical is harmful to a living organism.
Transfer(s) -	relating to CW	The movement (usually within a State) of CW or key precursors 1) from a storage facility to an interim storage facility near to or within a destruction site, 2) from a storage area to a destruction facility, or 3) from a storage facility to another storage facility for purposes not prohibited by the Convention.
	- relating to CWPF	The transfer of key equipment for CWPF (for reconstruction for peaceful purposes, or for other purposes not prohibited by the Convention).
	- relating to activities not prohibited	The movement of civilian chemicals from one State facility to another, or the movement across international boundaries from one State to another. Where transfers of CW or key precursors are for purposes not prohibited by the Convention, discussion on verification measures is found under Project 1.4, "Transfers of CW (or Key Precursors)", i.e., they are transfers "relating to CW."
Verification		The establishment of factual or true conditions.


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