Some historical, legal and technical aspects of disposal of old and abandoned chemical weapons

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Introduction

The Chemical Weapons Convention (CWC) contains time-based destruction provisions which are dependent on the Convention's entry into force, while other time limitations are based on when the treaty enters into force for the State Party. Given the imminence of entry into force of the Chemical Weapons Convention, it is appropriate to review some of the relevant factors affecting destruction of old and/or abandoned chemical weapons (OACW).

There is a general concern, which is reflected in the text of the Convention, that parties which are responsible for the existence of chemical weapons should also be responsible for their destruction. In practice, however, responsibility for the destruction of old and/or abandoned chemical weapons may not be so clear-cut. In the case of 'abandoned chemical weapons', for example, both the State Party which owns or possesses chemical weapons 'in any place under its jurisdiction or control' and a State Party which has abandoned chemical weapons on the territory of another State Party have an obligation to destroy such weapons.[1] (See discussion below.) Political sensibilities, differing interpretations of past events or a lack of sufficient historical information may also complicate the destruction process.

Chemical Weapon Convention OACW–related requirements

The Convention requires each State Party to destroy all chemical weapons it 'owns or possesses, or that are located in any place under its jurisdiction or control'.[2] Declaration and destruction requirements for chemical weapons are located in Articles III (Declarations) and IV (Chemical Weapons) and Part IV(A) of the Verification Annex (Destruction of Chemical Weapons and its Verification Pursuant to Article IV). The Convention requires that chemical weapons be destroyed in 'an essentially irreversible way to a form unsuitable for production of chemical weapons'.[3] A State Party may not destroy chemical weapons by dumping in any body of water, land burial or open–pit burning.[4] State Parties are also required to 'assign the highest priority' to ensuring the protection of people and the environment during transportation, sampling storage and destruction of chemical weapons.[5]

During the course of negotiations in the Preparatory Commission for the Organisation for the Prohibition of Chemical Weapons (PrepCom), the term

[1]Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and on their destruction (corrected version, 8 Aug. 1994), hereafter referred to as the 'CWC' or 'Convention'; CWC, par. 2–3, Article I.

[2] CWC, par. 2, Article I. There is one exception to the general obligation to destroy chemical weapons. Chemical weapons which were buried before 1 Jan. 1977 and which remain buried or chemical weapons dumped at sea before 1 Jan. 1985 are not, at the discretion of the State Party, subject to the CWC's declaration and destruction provisions. CWC, par. 2, Article III; and par. 17, Article IV.

[3] CWC, par. 12 of Part IV(A) of the Verification Annex.

[4] CWC, par. 13 of Part IV(A) fo the Verification Annex.

[5] CWC, par. 10, Article IV.

'chemical weapon' has been frequently understood to mean either *(a)* a chemical weapon produced between 1925 and 1946 which has been determined to be usable, or *(b)* a chemical weapon produced after 1 January 1946. The Convention defines a 'chemical weapon'—in the broader sense of the term—as consisting of one or more of the following: *(a)* toxic chemicals and their precursors which are in a type or quantity not consistent with the object and purpose of the Convention; *(b)* munitions and devices which are specifically designed to cause harm or death through the use of toxic chemicals and their precursors; or *(c)* any equipment which is specifically designed to be used directly in connection with the munitions and devices as defined in *(a)* or *(b)*.[6] An 'old chemical weapon' is defined as a chemical weapon which was produced before 1925 or one which was produced between 1925 and 1946 which has been determined to be 'unusable'.[7] The level of verification will correspond to the level of risk the weapon poses to the Convention. Thus chemical weapons produced *(a)* after 1 January 1946 or *(b)* produced between 1925 and 1946 which have been determined to be usable are subject to full and systematic verification. Chemical weapons which the Technical Secretariat has confirmed as having been produced before 1925, however, are to be destroyed as 'toxic waste'.[8]

The regime for old and/or abandoned chemical weapons is located in Part IV(B) of the Verification Annex (Old Chemical Weapons and Abandoned Chemical Weapons). Relevant provisions of Article III (Declarations), Article IV (Chemical Weapons) and Part IV(A) of the Verification Annex (Destruction of Chemical Weapons and its Verification Pursuant to Article IV) are also applicable to old and/or abandoned chemical weapon destruction requirements.[9]

Old chemical weapon (OCW)–related requirements

Each State Party is required to submit a declaration to the Technical Secretariat no later than 30 days after the Convention enters into force for it. Information in the declaration must include *inter alia* a declaration of whether the State Party has old chemical weapons on its territory and, to the extent possible, the location, type, quantity and present condition of these weapons.[10] State Parties which discover an old chemical weapon after the Convention has entered into force for them, are required to provide, within 180 days of the discovery, information including, to the extent possible, the weapon's location, type, quantity and current condition.[11]

[6] CWC, par. 1, Article II.
[7] CWC, par. 5, Article II.
[8] CWC, par. 6, Part IV(B) of the Verification Annex.
[9] CWC, par. 17, Part IV(B) of the Verification Annex.
[10] CWC, par. 1(b)(i), Article III; and par. 3, Part IV(B) of the Verification Annex.
[11] CWC, par. 3–4, Part IV(B) of the Verification Annex.

The Technical Secretariat will conduct an initial inspection to *inter alia* confirm whether chemical weapons produced between 1925 and 1946 and declared to be 'unusable' meet the definition of 'old chemical weapons'.[12]

Abandoned chemical weapons (ACW)–related requirements

The Convention defines a State Party upon whose territory chemical weapons have been abandoned as the 'Territorial State Party' (TSP).[13] Each TSP is required to submit a declaration to the Technical Secretariat no later than 30 days after the Convention enters into force for it. The declaration includes, to the extent possible, information on the abandonment and the location, type, quantity, and current condition of the ACW.[14]

A TSP which discover an abandoned chemical weapon after the Convention has entered into force for it must provide, within 180 days of the discovery, all available relevant information including, to the extent possible, information on the CW's abandonment as well as its location, type, quantity and current condition.[15]

An Abandoning State Party (ASP)[16] is required to submit a declaration on chemical weapons it abandoned no later than 30 days after the Convention enters into force for it.[17] Information in the declaration must include, to the extent possible, information on the abandonment, the condition of the abandoned chemical weapons as well as their location, type and quantity.[18]

The Technical Secretariat will conduct an initial inspection to *inter alia (a)* verify whether all available, relevant information has been provided in accordance with the provisions of the Convention, and *(b)* verify the identity of the ASP.[19] The Technical Secretariat will then submit a report containing its findings to the Executive Secretary. Copies of the report will also be provided to the TSP and to the ASP or to the party identified by the TSP as the ASP.[20]

Upon the request of the TSP, the Executive Council may reduce the level of verification for ACW if provisions of other agreements or arrangements are determined to be complimentary to those of the Convention.[21]

[12] Paragraph 12(n) of the 'Resolution Establishing the Preparatory Commission for the Organisation for the Prohibition of Chemical Weapons' (also known as 'The Paris Resolution') and paragraph 5 of Part IV(B) of the Verification Annex (CWC) require the PrepCom to develop guidelines for 'usability' of chemical weapons produced between 1925 and 1946. These guidelines are to be used by the Technical Secretariat when it makes its assessment on 'usability'.

[13] 'Territorial State Party' is the State Party on whose territory abandoned chemical weapons are located.

[14] CWC, par. 8, Part IV(B) of the Verification Annex.

[15] CWC, par. 9, Part IV(B) of the Verification Annex.

[16] An 'Abandoning State Party' is the State Party which has abandoned chemical weapons at any time after 1 Jan. 1925 on the territory of another State Party without the consent of the latter.

[17] CWC, par. 10, Part IV(B) of the Verification Annex.

[18] CWC, par. 10, Part IV(B) of the Verification Annex.

[19] CWC, par. 11, Part IV(B) of the Verification Annex.

[20] CWC, par. 12, Part IV(B) of the Verification Annex.

[21] CWC, par. 18, Part IV(B) of the Verification Annex.

Obligations of the ASP and the TSP

Both the ASP and the TSP have an obligation to destroy abandoned chemical weapons. Thus, each State Party is required to destroy chemical weapons which are located in any place under its jurisdiction and control in accordance with the provisions of the Convention.[22] Also, State Parties which abandoned chemical weapons on the territory of another State Party are required to destroy such weapons in accordance with the provisions of the Convention.[23]

If there is disagreement over the identity of the ASP, the matter will be considered by the Executive Council.[24] The Convention stipulates that involved State Parties expeditiously pursue resolution of the matter with any assistance from the Technical Secretariat which may be required.

A TSP has the right to request the ASP to enter into negotiations to establish a mutually agreed plan for destruction. Negotiations must begin no later than 30 days after notification of the Technical Secretariat by the TSP requesting such negotiations.[25] A mutually agreed plan for destruction must be provided to the Technical Secretariat within 180 days after the start of these negotiations.[26] The Executive Council may extend this deadline upon receiving a joint request for extension by both the ASP and TSP.[27]

Burial or dumping of CW

The Convention allows the State Party the option of declaring and/or destroying chemical weapons buried on its territory before 1 January 1977 and which remain buried or chemical weapons 'dumped at sea' before 1 January 1985.[28]

(a) 'The provisons of this Article and the relevant provisions of Part IV of the Verification Annex shall not, at the discretion of a State Party, apply to chemical weapons buried on its territory before 1 January 1977 and which remain buried, or which had been dumped at sea before 1 January 1985.' (par. 2, Article III(Declarations));

(b) 'The provisions of this Article and the relevant provisions of Part IV of the Verification Annex shall not, at the discretion of a State Party, apply to chemical weapons buried on its territory before 1 January 1977 and which remain buried, or which had been dumped at sea before 1 January 1985.' (par. 17, Article IV(Chemical Weapons)).

[22] CWC, par. 2, Article I.
[23] CWC, par. 3, Article I.
[24] CWC, par. 12, Part IV(B) of the Verification Annex.
[25] CWC, par. 14, Part IV(B) of the Verification Annex.
[26] CWC, par. 14, Part IV(B) of the Verification Annex.
[27] CWC, par. 14, Part IV(B) of the Verification Annex.
[28] CWC, par. 2, Article III; and par. 17, Article IV.

The Expert Group 1 on Chemical Weapons Issues recently recommended that Working Group B submit to the 16th Plenary of the PrepCom for adoption the following understanding of the declaration and destruction requirements for chemical weapons 'buried by a State Party on its territory' and 'dumped at sea':[29]

'*(a)* the term 'buried by a State Party on its territory' in Article III, paragraph 2 and Article IV, paragraph 17, shall be understood to cover chemical weapons buried on the land territory of a State Party or in its internal waters;

(b) the term 'dumped at sea' in the same paragraphs shall be understood to cover chemical weapons dumped at all parts of sea, including territorial sea of a State Party.'

The recommendation also states that chemical weapons dumped in archipelagic waters should be considered as having been 'dumped at sea' and that borders between territorial sea, land territory and internal waters should be determined in accordance with relevant international law.

For chemical weapons buried on the territory of a State Party after 1 January 1977 and for chemical weapons dumped at sea after 1 Janaury 1985, 'Article III subparagraph 1(a) and the relevant provisions of Part IV(A) of the Verification Annex should be the basis for declarations'.[30] Additional information which could be provided in such declarations includes:

'*(a)* the exact date when the chemical weapons were buried or dumped;
(b) how the chemical weapons were buried or dumped, e.g. inside crates, individual items, etc.;
(c) the present condition of the buried and dumped chemical weapons; and
(d) possible environmental risks posed'.[31]

It is unclear to what extent the provisions of paragraph 1(a) of Article III apply to *(a)* chemical weapons buried on the territory of a State Party after 1 January 1977 and which remain buried, and *(b)* for chemical weapons dumped at sea after 1 January 1985. However, it appears that the PrepCom is moving towards an understanding that State Parties which have carried out such dumping or burial will be obliged to destroy such weapons where feasible. The concept of 'territory' includes a State Party's internal waters. If the weapons become exposed, then the destruction provisions of the Convention apply.

[29] 'Expert Group 1 on Chemical Weapons Issues, First Report', PrepCom document, PC-XVI/B/WP.4, 13 Feb. 1997, pp. 3–4.

[30] Part IV(A) of the Verification Annex contains detailed destruction provisions for chemical weapons. Paragraph 1(a) of Article III is reproduced in Annex 1.

[31] Expert Group 1 on Chemical Weapons Issues, First Report', PrepCom document, PC-XVI/B/WP.4, 13 Feb. 1997, p. 4.

Tasks of the Expert Group on Old and Abandoned Chemical Weapons

The Expert Group on Old and Abandoned Chemical Weapons is currently tasked to:[32]

(a) Develop guidelines to determine the 'usability' of chemical weapons produced between 1925 and 1946, in accordance with Part IV(B), paragraph 5, of the Verification Annex (subparagraph 12(n) of the Paris Resolution);
(b) Resolve the issue of verification and destruction requirements for old chemical weapons produced between 1925 and 1946;
(c) Finalize the declaration requirements for old chemical weapons produced between 1925 and 1956;
(d) Develop destruction and verification requirements for abandoned chemical weapons, including a possible challenge inspection;
(e) Resolve the issue of the cost of verification of old chemical weapons and their destruction as referred to in paragraph 8 of the Annex to the Second Report of the Expert Group (PC–VI/B/WP.5);
(f) Finalize the Draft of Section E of the Declaration Handbook entitled 'Old Chemical Weapons Produced Before 1925', reflecting the different views expressed by delegations;
(g) Finalize the Draft of Section G of the Declaration Handbook entitled 'Abandoned Chemical Weapons'.

Given the confidential nature of the negotations in the PrepCom, it is difficult to ascertain exactly how the views of the various delegations diverge. It should also be noted that all official reports contain language agreed to by consensus. One of the reasons for the differences is the fact that the detailed verification and destruction provisions for chemical weapons, located in Part IV(A) of the Verification Annex, are more developed than the verification and destruction provisions for old and/or abandoned chemical weapons, located in Part IV(B) of the Verification Annex. Sections of Part IV(A) are expressly applicable to old and/or abandoned chemical weapons, rather than repeated in Part IV(B). Interpretation of the precise application of provisions of Part IV(A) to old and/or abandoned CW has naturally varied. Another factor hindering final consensus on outstanding OACW issues is achieving a proper balance between fulfilling declaration requirements to the level necessary to ensure confidence in the verification regime and final destruction of the old and/or abandoned CW on the one hand, and not burdening State Parties with excessive and, perhaps, more costly, informational requirement which are difficult to fulfill on the other.

Lack of final consensus on outstanding old and/or abandoned CW issues—and on other issues discussed within the PrepCom—also stems in part from political considerations and a tendency towards discussing implementation

[32] 'Report of the Commission', PrepCom document, PC–XV/25, 21 Dec. 1996, p. 25.

procedures in perhaps too great of detail. Guidelines on usability, for example, should not and cannot act as a rigid framework with which a final determination on the level of verification can be made. Such a determination cannot be made without the expert evaluation of technical experts on a-case-by case basis. PrepCom negotiations have demonstrated the limits of trying to establish precise procedures for theoretical scenarios. On the whole, the utility of this exercise cannot be understated. Guidelines and procedures have been established where none existed previously. All parties concerned now have a much clearer understanding of the kinds of situations which may arise during implementation of the Convention. Nevertheless, planning for theoretical scenarios has limitations. The general level of understanding can only increase once implementation has begun. After entry into force, a significant number of differences in views between delegations will disappear. Remaining concerns can still be addressed through the Executive Council and Conferences of State Parties.

Planning assumptions for entry into force

Operating assumptions have been developed in order to plan for entry into force. It is estimated that 40 old and/or abandoned sites will be initially declared and or inspected, 12 of which will be inspected during 1997.[33] The estimated average size of an OACW inspection team is six.[34] The estimated average time on-site is three days.[35]

Past disposal activities[36]

After World War II, the Allies dumped approximately 250 000 tons (munition plus agent weight) of German CW, principally in the Baltic Sea.[37] Dumping in the Baltic Sea occurred principally in areas near *(a)* the Danish island of Bornholm, *(b)* south of the Swedish island of Gotland, and *(c)* the Skagerrak channel between Denmark and Norway. Chemical weapons were also dumped off the coast of Japan following the end of World War II.[38] From 1968 to 1970, the United States Navy conducted four sea-dumpings off the east coast

[33] 'Expert Group on Programme of Work and Budget, Revised Draft OPCW as of 18 March 1997', PrepCom document, 18 March 1997, p. 65.

[34] As opposed to 4 for inspections to Schedule 1 plants engaged in non-prohibited activites and 14 for inspcetions of chemical weapon destruction facilites. 'Expert Group on Programme of Work and Budget, Revised Draft OPCW as of 18 March 1997', PrepCom document, 18 March 1997, p. 66.

[35] 'Expert Group on Programme of Work and Budget, Revised Draft OPCW as of 18 March 1997', PrepCom document, 18 March 1997, p. 66.

[36] For more information, see Kaffka, A. (ed.), *Sea–Dumped Chemical Weapons: Aspects, Problems and Solutions* (Kluwer Academic Publishers: Dordrecht, 1996); and Haug, M., 'Historical chemical weapons sites in the Asia–Pacific region', 28 May 1996, URL: <http://bicc.uni-bonn.de/weapons/chemweap/asiapac/content.htm>.

[37] Program Manager for Non-Stockpile Chemical Materiel, *Survey and Analysis Report*, US Army, Nov. 1993, p. 2–4.

[38] Kurata, H., 'Lessons learned from the destruction of the chemical weapons of the Japanese Imperial Forces', *Chemical Weapons: Destruction and Conversion* (Taylor & Francis: London, 1980), pp. 77–93.

of the United States as part of 'Operation CHASE'.[39] An unknown quantity of chemical weapons have been dumped off the coast of Crimea.[40]

Shortly before the end of World War II, the German government dumped 69 000 GA-filled artillery shells at a depth of between 20–30 metres in an area called 'Little Belt' between the Danish islands of Als and Fys. In 1959–1960, the German Government raised two ships containing the GA shells and repackaged the munitions before redisposing of them in the Bay of Biscay at a depth of 2 km.[41] As far as the author is aware, this is the only operation in which a large quantity of dumped chemical weapons was recovered for redisposal.

Destruction

Countries which have experience in destroying chemical weapons include: Austria, Belgium, Canada, France, Germany, Great Britain, Italy, as well as the Netherlands, Russian Federation, and the United States. Past experience has shown that there are numerous uncertainties connected with the retrieval and destruction of OCW. Many OCW are in a dangerously deteriorated state, making their identification and destruction difficult. Each country with old chemical weapons is faced with a unique set of circumstances which must be taken into consideration when developing and implementing a destruction programme. Some relevant factors are listed below.

Identification of suspected chemical weapons

Munitions retrieved from old battlefields or test ranges may contain either a chemical or conventional explosive. During World War II, up to 60–70 types of chemical mixtures were weaponized.[42] Some chemical munitions may also be filled with water.[43] Alternatively, the chemical fill may have since hydrolysed.[44] Chemical munitions can usually be distinguished from conventional munitions through the use of an X–ray. More precise information on the composition of the chemical agent may be obtained by

[39] 'CHASE' stands for 'Cut Holes and Sink 'Em'. Material which was disposed of included containers of mustard, sarin, VX, as well as M–55 rockets filled with sarin and VX.

[40] At least some are said to have been dumped by Soviet troops during World War II.

[41] Ministry of the Environment, Environmental Protection Agency (Denmark), 'Update of Report Dated 7 May 1985 Concerning Environemtnal, Health and Safety Aspects Connected with the Dumping of War Gas Amunition in the Waters Around Denmark', Paper presented at the 14th meeting of the Baltic Marine Environment Protection Commission (Helsinki Commission), HELCOM 14/10/1, 14 Jan. 1993, p. 10; and Chemische Kampfstoffmunition in der südlichen und westlichen Ostsee: Bestandsaufnahme, Bewertung und Empfehlungen, Bericht der Bund/Länder-Arbeitsgruppe Chemische Kampfstoffe in der Ostsee [Chemical munitions in the southern and western Baltic Sea: compilation, assessment and recommendations, Report by the Federal/Länder Government Working Group 'Chemical Munitions in the Baltic Sea'] (Federal Maritime and Hydrographic Agency: Hamburg, May 1993), p. 1.

[42] For more detailed information, see 'chapter 1. The developing technology of CBW', *The Problem of Chemical and Biological Warfare* (Almqvist & Wiksell: Stockholm, 1971), vol. 1, pp. 25–58.

[43] In the past, some practice rounds were filled with water. See Bunnett, J., 'Some Problems in the Destruction of Chemical Munitions, and Recommendations Toward Their Amelioration', *Pure & Applied Chemistry*, vol. 67, no. 5, 1995, p. 844.

[44] See Annex 4.

bombarding the munition body with a radiation source and measuring the energy levels of the radiation produced by the interaction between the initial radiation source and the chemical agent. One such system, Portable Isotopic Neutron Spectroscopy (PINS), uses a neutron emitter as a radiation source and measures the resulting gamma rays. It should be noted that acquiring the expertise to identify and handle old munitions is a developed skill which exists in comparatively few places around the world.

On-site destruction versus destruction at a centralized destruction facility

Some countries have numerous sites containing chemical material, making it unfeasible to construction a separate destruction facility for each site. The United States Non–stockpile Chemical Materiel Program,[45] for example, has identified approximately 65 sites which require some sort of destruction or remediation activity. The Program Manager for Chemical Demilitarization is therefore developing a 'Munition Management Device–1' consisting of two mobile trailers which will be operated in tandem. One trailer will house neutralization–based destruction equipment, while the other will house control and analysis equipment. If Munition Management Device–1 (MMD) is successfully tested, the US Army plans to construct two more MMDs.[46]

Disassembly

Although research continues to be conducted on methods of dissolving entire chemical weapons, such work is essentially experimental. Munition bodies have, in practice, been separated from the chemical fill. This can be done by *(a)* reverse dissassmbly of the munition; *(b)* punching, drilling and draining the chemical fill; or *(c)* shearing the munition body. After disassembly, the agent fill, munition body, and explosive components can then be treated separately. Reverse dissambly of old chemical weapons is not applicable to OCW given their generally poor condition. Shearing of chemical shells must be done below the burster charge whose precise location can be determined with the use of an X–ray.

United States

Most of the United States OCW will be disposed of under the US Army's Non–stockpile Chemical Materiel Program. It is estimated that this programme will cost approximately $15.2 billion to implement over a 40-year

[45] For further information see Program Manager for Non-Stockpile Chemical Materiel, *Survey and Analysis Report*, US Army, Nov. 1993.

[46] US General Accounting Office (GAO), Chemical Weapons and Materiel, Key Factors Affecting Disposal Costs and Schedule, GOA/NSIAD-97-18, Feb. 1997, pp. 50–1. The Soviet Union also initiated development of a mobile destruction facility (KUASI) for non-explosively configured munitions containing sarin, soman or Russian V–gas. Russian V–gas and US 'VX' are isomers. For information on KUASI, see Union of Soviet Socialist Republics, 'Complex for the Destruction of Faulty Chemical Munitions (KUASI)', Conference on Disarmament document, CD/CW/WP.369, 8 Oct. 1991.

period.[47] Material for which the Non–stockpile Chemical Materiel Program is responsible for destroying include: *(a)* chemical warfare material recovered from test ranges or burial sites, *(b)* chemical agent detector sets, and *(c)* former chemical weapon production facilities. The US Army is planning to destroy chemical material with mobile destruction units operating in pairs and using a yet to be determined chemical neutralization technology.

Disposal of ACW

A possible ACW–scenario would be one involving a former colonial power. In 1979 approximately 45 tons of mustard which had been manufactured in Batujajar, West Java in 1940–41 by the Dutch colonial government was destroyed by incineration in a cooperative effort between the governments of Indonesia and the Netherlands ('Project Obong').[48]

Two of the most interested nations in the issue of ACW are China and Japan.[49] In February 1992, the Chinese delegation introduced a paper in the Conference on Disarmament estimating that approximately 2 million chemical weapons had been abandoned on its territory.[50] In June of the previous year, the first joint Chinese–Japanese investigation of a site containing chemical weapons was conducted. These investigations have been carried out to identify or confirm the source and location of the abandoned chemical weapons, as well as to determine the scope of the problem generally. To date, a total of six joint investigations have been conducted,[51] revealing evidence for the presence of approximately 770 000 munitions—90 per cent of which are apparently located in Harbaling district.[52] A series of bilateral discussions between both governments have been conducted in parallel with the joint investigations.[53] Japan is reportedly prepared to construct one or more destruction facilities in a multi-year, multi-billion dollar project which will require an estimated 10–15 years.[54] Concern has also been expressed by

[47] US General Accounting Office (GAO), *Chemical Weapons and Materiel, Key Factors Affecting Disposal Costs and Schedule*, GAO/NSIAD-97-18, Feb. 1997, p. 4.

[48] 'Letter dated 31 March 1982 from the heads of the delegations of Indonesia and the Netherlands transmitting a document entitled 'Indonesia and the Netherlands–working document–destruction of about 45 tons of mustard agent at Batujajar, West–Java, Indonesia'', Conference on Disarmament document, CD/270, 31 Mar. 1982.

[49] Japan has signed and ratified the Convention. It has been reported that on 30 Dec. 1996, the Chinese parliament ratified the Convention. ('Decisions of the 23d session of NPC Standing Committee cited', *Xinghua*, in Foreign Broadcast Information Service, *Daily Report (FBIS-CHI)*, FBIS-CHI-96-251, 31 Dec. 1996.) It has not, however, deposited its instruments of ratification. Both delegations play an active role in the PrepCom negotiations.

[50] 'Some information on discovered chemical weapons abandoned in China by a foreign state', Conference on Disarmament document CD/1127, CD/CW/WP.384, 18 Feb. 1992.

[51] 'Japan sets chemical-arms hunt', *International Herald Tribune*, 9 May 1996, p. 4.

[52] 'China arms dump is surveyed', *International Herald Tribune*, 4 June 1996, p. 4; and Karniol, R., 'Japan set to clean up its chemical hangover', (*Jane's Defence Weekly*) vol. 26, no. 9, p. 17.

[53] The most recent discussion were held in March.

[54] Yaponiya izbavit Kitai ot svoero chimoruzhiya' (Japan will free China of chemical weapons), *Krasnaya Zvezda*, 4 Jan. 1996, p. 3; and Karniol, R., 'Japan set to clean up its chemical hangover', (*Jane's Defence Weekly*) vol. 26, no. 9, p. 17.

Russia about possible plans to construct one or more chemical weapon destruction facilities close to the Russian border.[55]

Dumped chemical weapons

Mustard and all arsenical–based CW agents such as lewisite,[56] present an unquestioned threat to human health and the environment. As a rule, arsenic-containing compounds are always toxic. Concern has been expressed that Baltic Sea sediment contains elevated levels of arsenic and that this may be due at least in part to widescale dumping of chemical weapons.[57] Whereas nerve and other CW agents generally hydrolyse quite readily, mustard does so only very slowly. Instead, a hardened, protective gel forms around its exterior. The mustard in the interior can remain active for decades. Baltic Sea fisherman are sometimes injured by World War II-era munitions containing mustard which they have caught in their nets.

Destruction of arsenic-based chemical agents presents an additional challenge in that the Chemical Weapons Convention requires that the destruction process be 'essentially irreversible'. In other words, the final destruction product should be in a form from which a chemical warfare agent cannot be readily reconstituted. In addition, the verification regime must confirm that the final destruction products will not be diverted for purposes prohibited by the Convention. Paragraph 10 of Article IV also requires that States Parties 'assign the highest priority' to the protection of the environment and of human health. One possible solution could be methods which have been employed in Italy and Canada in which the arsenical-based destruction products have been mixed with cement.[58]

Conclusion

The above discussion is incomplete and is only meant to provide a brief overview of certain basic issues concerning the destruction of OACW. Although it is difficult to estimate the total amount of CW which has been dumped with any degree of precision, the cumulative large-scale nature of the dumping alone and the consequent potential cost for recovery and destruction is very clear. A paper presented to a Helsinki Commission Ad Hoc Group on

[55] Pavlov, E., 'Kitaitzy budut unitchtozhat smertonosny gaz u granitz Rossii' (The Chinese will destroy lethal gas on the border of Russia), *Komsomolskaya Pravda*, 15 Jan. 1997.

[56] Mustard was sometimes mixed with an arsenical–based agent such as lewisite or diphenylchloroarsine in order to extend the effect of the weapon and to lower the freezing temperature below that of mustard alone. Distilled mustard has a freezing point of about 24.5°C. Mustard-lewisite mixture have a freezing point, depending on purity and production method, of about minus 25°C.

[57] Ministry of the Environment, Environmental Protection Agency (Denmark), 'Update of Report Dated 7 May 1985 Concerning Environemtnal, Health and Safety Aspects Connected with the Dumping of War Gas Amunition in the Waters Around Denmark', Paper presented at the 14th meeting of the Baltic Marine Environment Protection Commission (Helsinki Commission), HELCOM 14/10/1, 14 Jan. 1993, p. 6.

[58] 'Italian experience of the destruction of old and obsolete chemical weapons', Conference on Disarmament document, CD/CW/WP.375, 20 Nov. 1991.

dumped chemical weapons estimated that the cost of salvaging CW muntions dumped in the Baltic Sea and in the Skagerrak would cost ‘billions’ of Swedish crowns.[59] A private industry estimate puts the total cost of destruction of all chemical weapons in the world at over $50 billion.[60] The decision on whether to recover dumped CW should be made on technical merits. Although the Little Belt recovery operation was a success, it ocurred 14 years after the initial dumping in comparatively shallow water. In addition, detailed information on technical aspects of the operation and possible difficulties encountered have apparently not been made public.

It is generally believed that insufficient research into the behavior of chemical warfare agents exists and that only a fraction of that is readily available. Governments should also be encouraged to provide all relevant data in their possession on the behaviour of CW in sea-water as well as any other historical information, such as locations of dump sites, which may assist in destruction efforts.

Another factor which should be taken into consideration when planning and implementing destruction programmes is the role of the public. A Soviet chemical weapon destruction facility was not allowed to begin operation in 1989 because of local public opposition. In 1985, the official estimated cost of destroying the US stockpile was approximately $3.2 billion. This figure has since grown to about $12.4 billion. One of the principal reasons for the rising cost has been the establishment by the US Army of an alternative destruction technology programme and persistent delays in implementing destruction measures generally. Both have largely been the result of public opposition to the US Army’s choice of incineration as its ‘baseline’ destruction technology.

By definition, OCW is not usable for the purpose for which they were designed. The need for secrecy within military and political circles concerning OACW should be assessed within the context of at least two factors. One is that such weapons are always—in the case of OCW, and—in the case of ACW, not infrequently ‘unusable’. By their continued existence, such weapons represent more of an environmental, rather than a military, threat.

[59] Ministry of the Environment and Natural Resources, ‘Report on the Availability of Correct Information on Dumped Chemical Munition on the Swedish Continental Shelf’, Paper presented at the 1st meeting of the Ad Hoc Working Group on Dumped Chemical Weapons (Helsinki Commission), HELCOM CHEMU 1/3, 5 Apr. 1993, p. 19.

[60] M4 Limited Partnership, *M4’s Molten Metal Process selected by Japanese firm for chemical weapons cleanup* (25 Sep. 1996), URL: <http://m4web.m4lp.com:80/newsrls/MITSUBIS.html>.

Annex 1

Paragraph 1(a) of Article III

‘1. Each State Party shall submit to the Organization, not later than 30 days after this Convention enters into force for it, the following declarations, in which it shall:

(a) With respect to chemical weapons:

(i) Declare whether it owns or possesses any chemical weapons, or whether there are any chemical weapons located in any place under its jurisdiction or control;

(ii) Specify the precise location, aggregate quantity and detailed inventory of chemical weapons it owns or possesses, or that are located in any place under its jurisdiction or control, in accordance with Part IV(A), paragraphs 1 to 3, of the Verification Annex, except for those chemical weapons referred to in sub–paragraph (iii);

(iii) Report any chemical weapons on its territory that are owned and possessed by another State Party and located in any place under the jurisdiction or control of another State, in accordance with Part IV(A), paragraph 4, or the Verification Annex;

(iv) Declare whether it has transferred or received, directly or indirectly, any chemical weapons since 1 January 1946 and specify the transfer or receipt of such weapons, in accordance with Part IV(A), paragraph 5, of the Verification Annex;

(v) Provide its general plan for destruction of chemical weapons that it owns or possesses, or that are located in any place under its jurisdiction or control, in accordance with Part IV(A), paragraph 6, of the Verification Annex;’

Annex 2

Locations of United States non-stockpiled chemical warfare material[61]

State (location)	Site	Material
Alabama	Anniston Army Depot	Misc. chemical material
Alabama	Redstone Arsenal	Recovered CW
Alaska	Fort Richardson	Recovered CW[62]
Arkansas	Pine Bluff Arsenal	Binary CW, former CWPFs[63], misc. chemical material, recovered CW
Colorado	Pueblo Depot Activity	Misc. chemical material, recovered CW
Colorado	Rocky Mountain Arsenal	Former CWPF, recovered CW
Indiana	Newport Chemical Activity	Former CWPFs
Johnstan Atoll (Pacific Ocean)	Johnston Atoll	Recovered CW
Kentucky	Blue Grass Army Depot	Misc. chemical material
Maryland	Aberdeen Proving Ground	Binary CW, former CWPFs, misc. chemical material, recovered CW
Oregon	Umatilla Depot Activity	Binary CW, misc. chemical material
Texas	Camp Bullis[64]	Recovered CW
Utah	Dugway Proving Ground	Recovered CW, misc. chemical material
Utah	Tooele Army Depot	Binary chemical weapons, misc. chemical material, recovered CW

Source: US General Accounting Office (GAO), *Chemical Weapons and Materiel, Key Factors Affecting Disposal Costs and Schedule*, GAO/T-NSIAD-97-118, 11 Mar. 1997, p. 18.

[61] This list should not be considered as comprehensive.
[62] Chemical weapons.
[63] Chemical weapon production facility.
[64] Located outside of San Antonio.

Other United States sites which may contain non-stockpiled chemical warfare material

State (location)	No. of sites	State (location)	No. of sites
Alabama	3	Michigan	1
Alaska	5	Mississippi	2
Arizona	2	Missouri	1
Arkansas	3	Nevada	1
California	3	New Jersey	2
Colorado	2	New Mexico	1
Florida	3	New York	1
Georgia	2	North Carolina	2
Hawaii	1	Ohio	2
Illinois	2	Oregon	1
Indiana	3	South Carolina	1
Iowa	1	South Dakota	1
Kentucky	2	Tennessee	1
Louisiana	3	Texas	1
Maryland	2	Utah	3
Massachusetts	1	Virgin Islands	6

Source: US General Accounting Office (GAO), *Chemical Weapons and Materiel, Key Factors Affecting Disposal Costs and Schedule*, GAO/T-NSIAD-97-118, 11 Mar. 1997, p. 25.

Known or possible sites containing non–stockpiled United States chemical material

State (location)	Sites
Alabama	Camp Sibert, Fort McClellan, Redstone Arsenal
Alaska	Cape Yakak Radio Station, Chichagof Harbor, Fort Wainwright, Gerstle River Expansion Area, Gerstle River Test Site, Unalaska Island
Arizona	Camp Navajo, Yuma Proving Ground
Arkansas	Fort Chaffee, Pine Bluff Arsenal, Southwestern Proving Ground
California	Edwards Air Force Base, Fort Ord, Santa Rosa Army Air Field
Colorado	Pueblo Army Activity, Rocky Mountain Arsenal
Florida	Brooksville Army Air Field, MacDill Force Base, Withlacoochee
Georgia	Fort Benning, Fort Gillem
Hawaii	Kipapa Ammunition Storage, Schofield Army Barracks
Illinois	Fort Sheridan, Savanna Army Depot Activity
Indiana	Camp Atterbury, Naval Surface Warfare Center (Crane Division), Newport Chemical Activity
Iowa	Camp Dodge
Kentucky	Blue Grass Army Depot, Fort Knox
Louisiana	Camp Claiborne, England Air Force Base, Fort Polk
Maryland	Aberdeen Proving Ground, Fort Meade
Massachusetts	Fort Devens
Michigan	Chemical Warfare Development Division
Mississippi	Camp Van Dorn, Columbus Army Airfield
Missouri	Camp Crowder
Nevada	Hawthorne Army Depot
New Jersey	Fort Hancock, Naval Air Warfare Center (Lakehurst), Raritan Arsenal
New Mexico	Fort Wingate Depot Activity
New York	Camp Hero
North Carolina	Camp Lejeune, Laurinburg–Maxton Army Air Base
Ohio	Cleveland Plant, Ravenna Army Ammunition Plant
Oregon	Umatilla Depot Activity
South Carolina	Charleston Naval Weapons Station
South Dakota	Black Hills Ordnance Depot
Tennessee	Defense Depot Memphis
Texas	Camp Bullis, Camp Stanley Storage Activity
US Virgin Islands	Water Island
Utah	Dugway Proving Ground (two sites), Tooele Army Depot, Wendover Bombing and Gunnery Range

Source: US Army Non–Stockpile Chemical Materiel Program, *Programmatic Environmental Statement Information Paper*, URL: <http://www-pmcd.apgea.army.mil/nscmp/link4b.htm>.

Annex 4

A list of chemical warfare agents and some possible hydrolysis products[65]

Chemical agent (formula)	US code name	Hydrolysis products
Adamsite	DM	HCl, diphenylarsenious oxide
Chlorine	—	HCl, HOCl
Cyanogen chloride	CK	HCl, CNOH
Hydrogen cyanide	AC	NH3, NCOOH
Lewisite	L	HCl, Chlorovinylarsenious oxide
Mustard (sulfur)	H	HCl, (CH2CH2OH)2S
Mustard (distilled)	HD	HCl, (CH2CH2OH)2S
Mustard/lewisite mixuture	HL	HCl, (CH2CH2OH)2S, chlorovinylarsenious oxide
Phosgene	CG	HCl, CO2
Sarin	GB	HF, isopropyl alcohol
Soman	GD	HF
Tabun	GA	HCN
VX	VX	Diethyl methylphosphonate, 2-diisopropylaminoethyl mercaptan

Source: *Military Chemistry and Chemical Compounds, Field Manual FM 3–9*, Department of the Army, Oct. 1975.

[65] The list of hydrolysis products is not meant to be complete and is for general informational purposes only. The chemistry of hydrolysis of chemical warfare agents is more complex and is not fully understood.