

10. Chemical and biological weapons: developments and destruction

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I. Introduction

The prospects for ratification of the 1993 Chemical Weapons Convention (CWC) were significantly affected by the events of 1994.¹ The community interested in chemical disarmament focused on implementation of the CWC, and there were fewer allegations of the possession and use of chemical weapons (CW) and biological weapons (BW) in 1994 (see section II). Section III addresses the threat of CW and BW proliferation, which is expected to be of major concern for the rest of the 1990s. Section IV focuses on concerns about the slow pace of the destruction of the declared CW stockpiles, particularly as regards Russia and the USA, the two major CW possessor states. There is growing evidence that destruction of the Russian and US chemical weapon stockpiles will require the investment of substantial economic resources.

New information became available in 1994 about former Soviet dumping operations, and the scientific and technical problems related to old CW dumped at sea or buried are outlined in section V.

Section VI discusses the debate on the source of the so-called Gulf War Syndrome in soldiers who served in the Coalition forces in the 1991 Persian Gulf War and reports on the studies which have been conducted.

II. Allegations of use or possession of CW and BW

In 1994 there were few allegations of chemical weapon use. The most important allegations concentrated on the former Yugoslavia and Angola.

The allegations of CW use in the former Yugoslavia in 1994, like those in 1993, were made by all of the parties involved in the war. In January 1994 Croats accused Bosnian Croats of using poison gas, although no specific gas was named and there was no independent confirmation of such use.² In April 1994 Bosnian Croats accused Serbs of having used chemical weapons against Gorazde.³ This allegation was dismissed by the United Nations as Bosnian

¹ For further discussion, see chapter 19 in this volume.

² 'Croats accuse Muslims of using poison gas', Radio Free Europe/Radio Liberty (hereafter RFE/RL) *RFE/RL News Briefs*, vol. 3, no. 4 (10–21 Jan. 1994), supplements, p. 16.

³ 'Ganic: many killed in "gas attack"', in Foreign Broadcast Information Service, *Daily Report—East Europe (FBIS-EEU)*, FBIS-EEU-94-069, 11 Apr. 1994, p. 17.

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Croat propaganda⁴ and was also denied by the Serbs, who countered with accusations that the Bosnian Croats had used chemical weapons.⁵ Serbs were again accused of using CW in Glamoc in April 1994,⁶ and in Teslic in northern Bosnia in June 1994.⁷ In addition, there were claims that the Serbs used CW against Bosnian Croats in June 1994 in Zavidovici.⁸ None of these allegations has been proved or confirmed. The accusations against the various parties to the conflict have appeared in conjunction with each other and are most likely propaganda.

In Angola, another area of internal conflict, allegations of CW use continued. In May 1994 the União Nacional Para a Independência Total de Angola (National Union for the Total Independence of Angola, UNITA) accused the Popular Movement for the Liberation of Angola (MPLA) of dropping bombs containing phosphine, napalm and phosphorus on the city of N'dalatando.⁹ In June 1994 allegations were made that the MPLA had bombed a hospital in Bie with eight bombs charged with toxic chemicals.¹⁰ This accusation was allegedly confirmed by the UNITA health services, which stated that 53 civilians who had had contact with toxic gases had been examined.¹¹ The alleged use has not been confirmed by independent sources and may be propaganda.

There were reports alleging that Laos had used CW along the Thai–Laotian border; these were immediately denied by Laos.¹²

In 1994 there were also accusations of the possession and development of CW. In 1993 there were reports that Russia was not complying with international agreements to disclose its total CW stockpile and that it was in fact developing advanced CW. These allegations continued in 1994 as Clinton Administration officials accused Russia of concealing its efforts to develop such weapons.¹³ The charges were denied by senior Russian officials as groundless. A spokesman for the Russian Defence Ministry stated that 'no binary chemical weapons had been produced'.¹⁴ The accusations were based on statements made by Vil Mirzayanov about a new chemical agent called

⁴ Reuters, "Chemical" attack dismissed', *The Independent*, 11 Apr. 1994, p. 10. The United Nations claimed that the chemical weapons referred to by the Muslims were in fact smoke mortars 'intended to create a pall of smoke on the battlefield to obscure the enemy's vision and sow confusion'. These mortars, a UN spokesperson said, were 'not chemical weapons, were not banned under the Geneva Convention and were in the arsenals of most armies in the world'.

⁵ 'Serbs: Muslims using chemical agents', in FBIS-EEU-94-069, 11 Apr. 1994, p. 23.

⁶ 'Serbs say army used poison gas in Glamoc', in FBIS-EEU-94-077, 21 April, 1994, p. 33.

⁷ 'Serbs says Muslims using poison gas in Teslic', in FBIS-EEU-94-106, 2 June. 1994, p. 28.

⁸ 'Serbs employ tanks, chemicals in Zavidovici', in FBIS-EEU-94-124, 28 June, 1994, p. 33.

⁹ 'UNITA says MPLA using toxic weapons in N'dalatando', in Foreign Broadcast Information Service, *Daily Report–Sub-Saharan Africa (FBIS-AFR)*, FBIS-AFR-94-092, 12 May 1994, p. 7.

¹⁰ 'MPLA allegedly bombs hospital with chemical weapons', in FBIS-AFR-94-106, 2 June 1994, p. 8.

¹¹ 'UNITA confirms government use of chemical weapons', in FBIS-AFR-94-115, 15 June 1994, p. 26.

¹² 'Staff deputy chief rebuffs Thai allegation', in Foreign Broadcast Information Service, *Daily Report–East Asia (FBIS-EAS)*, FBIS-EAS-94-117, 17 June, 1994, p. 50; and 'Government denies Thai charge on chemicals', in FBIS-EAS-94-108, 6 June 1994, p. 32.

¹³ Gordon, M., 'Russia hides efforts to develop deadly poison gas, U.S. says', *New York Times*, 23 June 1994, p. 3; and Walder, M., 'Suspicions over Moscow's chemical weapons plans', *The Guardian*, 24 June 1994. The new weapons alleged to be under production are binary weapons.

¹⁴ 'Russia denies hiding chemical arms data', *New York Times*, 30 June 1994, p. 4.

Novichok. Mirzayanov was arrested in 1992 for disclosing state secrets about the Russian CW programme.¹⁵ He was tried in February 1994 and released.¹⁶ In a *Moscow News* article Mirzayanov accused Russia of continuing research and development (R&D) on binary CW.¹⁷ All charges against him were dropped in March 1994.¹⁸ In May 1994 Mirzayanov repeated his allegations in a *Wall Street Journal* article and named Substance A232, a substance which allegedly could be used in a binary weapon.¹⁹ These accusations have not been confirmed.

In March and April 1994 the British *Sunday Times* and the *Washington Post* published allegations of Russian production of BW agents,²⁰ based in part on reports from US and British inspections of major Russian biological research centres that demonstrated “substantial [biological] infrastructure with no commercial purpose” and [that] links to the Russian military remain largely intact’.²¹ Russian Government officials denied the allegations.²²

In 1994 allegations were again made that Iran and North Korea possess CW. Reports continued to list North Korea as having eight CW factories and six CW storage sites.²³ In March 1994 a North Korean soldier trained in chemical warfare defected to South Korea and made allegations of North Korean CW possession. He stated that ‘North Korea has enough chemical weapons to destroy the southern part of the peninsula without using nuclear weapons’.²⁴

Iran is regarded by the West as a nation with a CW capability, an accusation which has been repeatedly denied by Iran. In 1994 there were no new reports, although articles on CW capability listed Iran as a nation of concern.²⁵

¹⁵ See Stock, T., ‘Chemical and biological weapons: developments and proliferation’, SIPRI, *SIPRI Yearbook 1993: World Armaments and Disarmament* (Oxford University Press: Oxford, 1993), chapter 7, p. 266; and Stock, T. and De Geer, A., ‘Chemical weapon developments’, SIPRI, *SIPRI Yearbook 1994* (Oxford University Press: Oxford, 1994), chapter 9, pp. 327–28.

¹⁶ ‘Program views Mirzayanov case, chemical weapons’, in Foreign Broadcast Information Service, *Daily Report—Central Eurasia (FBIS-SOV)*, FBIS-SOV-94-037, 24 Feb. 1994, p. 30; and Perera, J., ‘Russians release chemist after international protest’, *New Scientist*, vol. 141, no. 1916 (12 Mar. 1994), p. 10. Mirzayanov was released following protests from the international scientific community.

¹⁷ Mirzayanov, V. and Fyodorov, L., ‘A poisoned policy’, *Moscow News*, no. 39 (27 Sep.–4 Oct. 1992), p. 9.

¹⁸ Loshak, V., ‘All charges against Vil Mirzayanov are dropped’, *Moscow News*, 18–24 Mar. 1994, p. 3. In June 1994 Mirzayanov was awarded 30 million roubles in compensation by a Russian court for having been unjustly accused. See Hiatt, F., ‘Scientist wins case in a Russian court and against state’, *International Herald Tribune*, 9 June 1994, p. 6.

¹⁹ Mirzayanov, V., ‘Poisons the treaty left out’, *Wall Street Journal*, 25 May 1994.

²⁰ Adams, J., ‘Russia’s secret biological weapons’, *Sunday Times*, 27 Mar., 1994; and Smith, J., ‘U.S. wary of Russian germ arms, despite assurances from Yeltsin, effort may be continuing’, *Washington Post*, 8 Apr. 1994, pp. 1, 28.

²¹ Smith, J., ‘U.S. wary of Russian germ arms, despite assurances from Yeltsin, effort may be continuing’, *Washington Post*, 8 Apr. 1994, pp. 1, 28.

²² ‘Commentary on biological weapons charges’, in FBIS-SOV-94-072, 14 Apr., 1994, p. 24.

²³ Jane’s Intelligence Review: Special Report, ‘Chemical and biological warfare programme’, no. 2, p. 8–10; and ‘North Korea has 8 chemical weapons factories: white paper’, *Seoul Monthly Magazine of Korea*, May 1994, p. 35. See also *SIPRI Yearbook 1994* (note 15), p. 326.

²⁴ ‘A defector warns South of chemical destruction’, *International Herald Tribune*, 23 Mar. 1994, p. 5; and *Asia Pacific Defence Reporter*, vol. 20, no. 21 (June/July, 1994), p. 23.

²⁵ See, for example, Rathmell, A., ‘Iran’s rearmament: how great a threat?’, *Jane’s Intelligence Review*, vol. 6, no. 7 (July 1994), pp. 317–22; and Reuters, ‘Iran denies it developing chemical weapons’, *Reuters North America*, 16 Aug. 1994.

Allegations about two other past programmes surfaced in 1994. In the spring of 1994 there were reports that the former Czechoslovakia had possessed CW and BW and that stockpiles of both might remain.²⁶ According to Czech newspapers, 'chemical weapons were stored in several locations throughout the Czech Republic'.²⁷ After the initial allegation of CW and BW possession, the debate focused solely on allegations that BW stockpiles had been left by the former Czech Government. These reports were not categorically denied, instead statements were made that the stocks were only bacteriological and virological materials and not weapons. The Czech military denied that its Immunology and Bacteriology Research Institute had 'produced, developed or stored military bacteriological weapons'.²⁸

In June 1994 the Romanian Defence Minister announced that former Romanian President Nicolae Ceaucescu had launched a CW programme, but that the programme had been scrapped in 1990.²⁹ To verify these claims of non-possession the USA sent an investigative team to Romania.³⁰ The findings of the investigation were not disclosed in 1994.

III. Proliferation

The US Congressional Research Service produced a study on the proliferation of CW and BW, including a table of states possessing chemical and biological weapons.³¹ It listed Iran, Iraq, Russia and the USA as the only confirmed states which possess chemical weapons. Afghanistan, Burma, China, Egypt, Ethiopia, Israel, Kazakhstan, North Korea, Syria, Taiwan, Ukraine and Viet Nam were categorized as probable possessor states. Chile, Cuba, France, South Korea, Libya, Pakistan, Somalia, South Africa and Thailand were classified as suspected of having CW programmes. For BW the list was shorter. Only Russia was registered as a confirmed possessor state while China, India, Iran, North Korea, Pakistan, Syria and Taiwan were listed as probable possessors. Egypt and Libya were suspected of having BW programmes, and Iraq was said to have shown a 'clear intent'.³²

In January 1994 there was an incident involving the German ship *Asian Senator*, which was inspected on its way to the Middle East following accusations that it was transporting illicit chemicals. Chemicals 'used for making dangerous weapons' were found.³³ It was later stated that the cargo was on its

²⁶ Garrett, B., 'Czech biological weapons?', *ASA Newsletter*, no. 41 (7 Apr. 1994), p. 7; and Garrett, B., 'Czech BW/CW stocks?', *Chemical Warfare/Chemical and Biological Defense Information Analysis Center, CBIAC Newsletter*, vol. 8, nos 1 and 2 (winter/spring 1994), pp. 1, 9.

²⁷ See Garrett, 'Czech BW/CW stocks?' (note 26).

²⁸ 'Military denies developing bacteriological arms', in FBIS-EEU-94-110, 8 June, 1994, p. 9.

²⁹ 'On Romania's stance as to chemical weapons', Statement made by Gheorghe Tinca, Romanian Minister of National Defence, 30 June 1994 (Romanian Embassy, Stockholm).

³⁰ Balkan News International, 'Romania denies chemical weapons, US military experts check the situation', 4-10 Sep. 1994, p. 16.

³¹ '28 June', *Chemical Weapons Convention Bulletin*, no. 25 (Sep. 1994), p. 25.

³² See note 31.

³³ Mann, J., 'Illegal chemical cargo was bound from China to Mideast', *Washington Post*, 23 Jan. 1994, p. 22. The exact chemicals exported were not specified.

way to Iraq, a violation of the UN embargo, and that the chemicals were to be used as fuel ingredients for the Iraqi missile programme.³⁴

Debate continued on the Iraqi arsenal of weapons of mass destruction and on the sources of these weapons. In 1994 the focus was on the USA and the Reagan Administration. Allegations were made that during the 1980s the Commerce Department approved the export of lethal viruses to Iraq.³⁵ According to US Senator Donald W. Riegle, Jr, these viruses and bacteria 'were shipped to Iraqi government agencies by American Type Culture Collection', an organization that exports biological specimens world-wide.³⁶ The viruses could have been used in building up an Iraqi biological warfare programme.

There were reports in a German newspaper that North Korea had transferred CW and BW technology to the Middle East,³⁷ but these reports were not confirmed.

Libya and its alleged CW production plant at Tarhuna remained a proliferation concern. It was apparently confirmed that Belgium, Germany and the UK were the main Western suppliers of dual-use technology to the Tarhuna plant.³⁸ It was also reported that the plant, scheduled to become operational in 1995, will be capable of producing 1000 tonnes (t) of mustard gas, 90 t of sarin and 1300 t of soman annually.³⁹

IV. CW destruction

The US–Russian Agreement on the Destruction of Chemical Weapons

In 1994 there was concern about how the two major possessors of chemical weapons, Russia and the USA, will meet their pledges to achieve chemical disarmament and to destroy their CW stockpiles. During a January 1994 summit meeting President Bill Clinton and President Boris Yeltsin reaffirmed their commitment to promote the implementation of a comprehensive ban on CW and agreed to conclude work as rapidly as possible on implementing the necessary documents for the 1990 bilateral Agreement on the Destruction of

³⁴ 'Bonn discovers, halts chemicals bound for Iraq', in Foreign Broadcast Information Service, *Daily Report–West Europe (FBIS-WEU)*, FBIS-WEU-94-016, 25 Jan., 1994, p. 17. A similar incident took place in the summer of 1993 when the Chinese cargo vessel *Yin He* created an international incident. The *Yin He* was bound for Iran and accused by US Intelligence of carrying illegal chemicals used in the production of CW. China protested and claimed the cargo did not contain such chemicals. After three weeks the ship was finally examined and no prescribed chemicals were found. See *SIPRI Yearbook 1994* (note 15), p. 318. Additional information on Iraq is presented in chapter 19 in this volume.

³⁵ Bradsher, K., 'Senator says U.S. let Iraq get lethal viruses', *New York Times*, 10 Feb. 1994, p. 9.

³⁶ Merida, K. and Mintz, J., 'Rockville firm shipped germ agents to Iraq, Riegle says', *Washington Post*, 10 Feb. 1994, p. 8.

³⁷ DPRK, "'Transferring" weapons technology to Mideast', in FBIS-EAS-94-110, 8 June, 1994, p. 39.

³⁸ 'Germans in Libya weapons link', *Financial Times*, 4 Mar. 1994, p. 2; and Aloisi, S., 'Tarhunah chemical weapons plant described', *Milan Panorama*, 16 Apr. 1994, pp. 107–9, in FBIS-NES-94-078, 22 Apr. 1994, p. 14.

³⁹ Aloisi (note 38); and 'Commentary: close the dual-use door', *Defence News*, vol. 9, no. 9 (7–13 Mar. 1994), p. 14.

Chemical Weapons.⁴⁰ A 'plan-of-work' was agreed for 1994, including a timetable for a CW inventory at all Russian storage sites.⁴¹ In February 1994 Russia and the USA submitted an official document to the Organisation for the Prohibition of Chemical Weapons Preparatory Commission (OPCW PrepCom) which contained the major points of the agreed understanding on measures for the preparation and implementation of the second phase of the 1989 Wyoming Memorandum of Understanding (MOU),⁴² and which was signed at a January 1994 summit meeting.⁴³ The signing of this document inaugurates phase II. Under the plan, an exchange of detailed data on a chemical weapon production facility, a CW storage facility and a CW development facility or establishment was to be facilitated not later than 90 days after the signing of the January 1994 document. In addition, data on all CW stockpile and production facilities were to be provided not later than mid-May 1994. All 5 inspections (2 routine inspections, 1 trial challenge inspection and 2 challenge inspections) were to be conducted on the territory of the other country, beginning by mid-June 1994 and finishing by mid-November 1994. Trial inspections are designed to develop procedures for conducting the challenge inspections which would be carried out at suspected CW development, production or storage sites. In April the first information exchange took place.⁴⁴ By the end of May 1994 both sides had exchanged data on three CW sites and on all CW facilities.⁴⁵ However, the data provided were still disputed,⁴⁶ as was the interpretation of the declaration requirements and definitions under the MOU.⁴⁷

In August 1994 the USA conducted the first trial challenge inspection, as agreed under Phase II of the MOU, at the Russian CW storage site at Pochep (Bryansk oblast).⁴⁸ A month later Russia held its first inspection at Pine Bluff Arsenal at Pine Bluff, Arkansas.⁴⁹ In October both sides met in Moscow to discuss the ongoing data dispute.⁵⁰ Among other matters, disagreement about

⁴⁰ The text of the Agreement is reproduced in SIPRI, *SIPRI Yearbook 1991: World Armaments and Disarmament* (Oxford University Press: Oxford, 1991), appendix 14A, pp. 536–39.

⁴¹ 'U.S., Russia sign plan to help Russia destroy chemical arms', *Chemical & Engineering News*, vol. 72, no. 3 (17 Jan. 1994), p. 12.

⁴² Lundin, S. J., 'Multilateral and bilateral talks on chemical and biological weapons', SIPRI, *SIPRI Yearbook 1990: World Armaments and Disarmament* (Oxford University Press: Oxford, 1990), chapter 14, pp. 531–32.

⁴³ 'Letter from the Alternate Representative of the United States of America and the Deputy Head of the Delegation of the Russian Federation addressed to the Executive Secretary of the Preparatory Commission for the OPCW transmitting the text of understanding on measures for the preparation and implementation of the second phase of the Wyoming Memorandum of Understanding dated September 23, 1989'. PC-VI/4, 15 Feb. 1994.

⁴⁴ Office of Technology Assessment (OTA), *Proliferation and the Former Soviet Union*, US Congress, OTA-ISS-605 (US Government Printing Office: Washington, DC, Sep. 1994), p. 16; and Institute for Defense and Disarmament Studies, '28 May', *Arms Control Reporter* (IDDS: Brookline, Mass.), sheet 704.B.577, Oct. 1994.

⁴⁵ See *Arms Control Reporter* (note 44).

⁴⁶ 'Moscow opposes public argument with U.S. on chemical arms', in FBIS-SOV-94-123, 27 June 1994, pp. 9–10.

⁴⁷ '30 June', *Arms Control Reporter*, sheet 704.B.583, Oct. 1994.

⁴⁸ '24-27 August', *Arms Control Reporter*, sheet 704.B.584, Oct. 1994.

⁴⁹ '24-27 September', *Arms Control Reporter*, sheet 704.B.584, Oct. 1994.

⁵⁰ '10-14 October', *Arms Control Reporter*, sheet 704.B.585, Oct. 1994.

the interpretation of the requirement to declare CW development facilities or establishments was discussed. The bilateral Destruction Agreement was also discussed, but no progress was made on the Russian desire to convert a larger quantity of its CW agents⁵¹ instead of destroying them.

In October 1994 Russia conducted its second inspection at the Tooele Army Depot storage facility at Tooele, Utah,⁵² and the USA held its second and third inspections at the Shuchye facility (Kurgan oblast)⁵³ and at Maradikovskiy (Kirov oblast). Both countries concluded their remaining inspections by mid-December.

In March 1994 the US General Accounting Office (GAO) submitted a report on the status of the MOU and the bilateral Destruction Agreement.⁵⁴ The report noted that both countries had failed to implement all of the key aspects of the two agreements and have not yet begun to verify each other's declared CW stockpiles and facilities under the 1989 MOU. Ratification and implementation of the bilateral Destruction Agreement are still pending. The main issue of disagreement relates to the conversion of former CW production facilities and to the Russian proposal to convert chemicals that are components of chemical weapons to civilian use.⁵⁵

The US CW destruction programme

The debate about CW destruction in the USA in 1994 was much influenced by the fact that US Army finalized its review of alternative destruction technologies in 1994. In February 1994 the National Research Council (NRC) presented its recommendations⁵⁶ on chemical destruction technologies based on the June 1993 report of its Committee on Review and Evaluation of the Army Chemical Disposal Program.⁵⁷ The report presented findings and 21 recommendations in seven categories: expeditious progress, risk analyses, public concerns, current systems, alternatives, stockpile safety and staffing needs. In evaluating stockpile safety it was noted that the M55-rockets with propellant stabilization were at greatest risk to deteriorate and become increasingly hazardous; however, these rockets should be safe until 2007 or later. The most important recommendation of the NRC report was that there should be continued implementation of baseline incineration technology at the Johnston

⁵¹ See *Arms Control Reporter* (note 50).

⁵² '24 October', *Arms Control Reporter*, sheet 704.B.585, Oct. 1994.

⁵³ 'The bilateral track of chemical weapons disarmament', *CWC Chronicle*, vol. 1, issue 7 (Nov. 1994), pp. 1–2.

⁵⁴ US General Accounting Office (GAO), *Arms Control: Status of U.S.–Russian Agreements and the Chemical Weapons Convention*, Report to the Chairman, Committee on Foreign Relations, US Senate, GAO/NSIAD-94-136, 15 Mar. 1994.

⁵⁵ '22–29 November [1993]', *Arms Control Reporter*, sheet 704.B.560-1, Jan. 1994.

⁵⁶ Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program, Board on Army Science and Technology, Commission on Engineering and Technical Systems, *Recommendations for the Disposal of Chemical Agents and Munitions* (National Research Council: Washington, DC, 1994).

⁵⁷ Committee on Alternative Chemical Demilitarization Technologies, Board on Army Science and Technology, Commission on Engineering and Technical Systems, *Alternative Technologies for the Destruction of Chemical Agents and Munitions* (National Research Council: Washington, DC, 1993).

Atoll Chemical Agent Disposal System (JACADS), which is located on Johnston Atoll in the Pacific south-west of Hawaii.⁵⁸

The NRC Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program advised the Army to improve its system for monitoring emissions from destruction facilities before starting work at continental US destruction sites owing to the high rate of false alarms at JACADS.⁵⁹

After delivery of the NRC report the Army had 60 days to submit its own assessments to Congress under the 1993 Defense Authorization Act.⁶⁰ In addition, the Army was required to consider the recommendations of the Citizen Advisory Commission for each stockpile location. A pertinent February 1994 GAO report noted the delay of the Chemical Stockpile Emergency Preparedness Program, established in 1988, which is now scheduled to be completed in 2003 instead of 1994.⁶¹

In March 1994 a GAO report outlined the status of alternative chemical destruction technologies and drew the conclusion that none of the eight technologies under consideration could be used on a sufficient scale to meet the 31 December 2004 US deadline for finalization of destruction. At least 3 more years (i.e., a maximum of 7 years) will be needed, and by that time the 10-year destruction deadline under the CWC may have been exceeded.⁶²

On 11 April 1994 the US Army submitted its long-awaited report on alternative chemical destruction technologies to Congress.⁶³ The report contained an evaluation of the NRC recommendations and comments by the Citizen Advisory Commissions.⁶⁴ The report stated that 'No other alternative technologies are sufficiently mature to merit meaningful comparison with the baseline incineration technology'. It was also noted that no alternative technology would be able to meet the 2004 deadline for destruction of the US CW stockpile. The report pointed to findings that continuous storage of the munitions would be more risky than using incineration to destroy them. The Army agreed to investigate and test neutralization as a potential alternative, as recommended by the NRC, and will ask Congress for funding to do so. If successfully developed, neutralization technology could be used for the destruction of the low-volume bulk sites (e.g., those at the Newport Army

⁵⁸ Program Manager for Chemical Demilitarization, Department of the Army, *U.S. Army's Alternative Demilitarization Technology Report for Congress: Executive Summary*, 11 Apr. 1994.

⁵⁹ Ember, L., 'Army plans to continue burning chemical arms', *Chemical & Engineering News*, vol. 72, no. 16 (18 Apr. 1994), p. 7.

⁶⁰ See *SIPRI Yearbook 1993* (note 15), p. 286.

⁶¹ US GAO, *Chemical Weapon Stockpile: Army's Emergency Preparedness Program Has Been Slow to Achieve Results*, Report to the Chairman, Subcommittee on Environment, Energy, and Natural Resources, Committee on Governmental Operations, US House of Representatives, GAO/NSIAD-94-91, Feb. 1994.

⁶² US GAO, *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration*, Report to the Chairman, Subcommittee on Environment, Energy, and Natural Resources, Committee on Governmental Operations, US House of Representatives, GAO/NSIAD-94-123, Mar. 1994.

⁶³ The Army was required by Public Law 102-484 of 23 Oct. 1992, to submit this report by 31 Dec. 1993. The deadline was later extended to 60 days after the Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program had delivered its final report.

⁶⁴ See Program Manager for Chemical Demilitarization, *Alternative Technologies Report and Technical Appendixes* (note 58); and Ember (note 59).

Ammunition Plant at Newport, Indiana, and at Aberdeen Proving Ground at Edgewood, Maryland).⁶⁵ Following an NRC recommendation, the Army agreed to add carbon filters to the baseline process. In addition, the Army agreed to conduct new risk assessments for each CW storage site and to launch an extensive public outreach programme to provide information to and receive input from the communities where the destruction facilities are located. The risk-perception report for all eight storage sites was to be finalized by November 1994.⁶⁶

If Congress approves funding, a study will be conducted on the two most promising alternative technologies: (a) neutralization, which is especially useful for GB (sarin), followed by incineration; and (b) neutralization in combination with biological degradation. These two technologies might be used for agent in bulk storage containers which is not in munitions.

At an April 1994 US Senate hearing before the Armed Services Subcommittee on Nuclear Deterrence, Arms Control and Defence Intelligence, it was stated that it might be imprudent to delay the US destruction schedule because opponents of incineration might then achieve a prohibition on the future use of incineration. It was first estimated that destruction costs would exceed the 1993 estimate of \$8.6 billion;⁶⁷ the figure was later increased to \$10 billion.⁶⁸ (Table 10.1 presents an estimate of the life-cycle costs for the US destruction programme.⁶⁹)

For fiscal year (FY) 1995 President Clinton requested a total of \$851 million for the Chemical Stockpile Disposal Program and the Non-Stockpile Chemical Material Programme, including the costs for construction of new facilities.⁷⁰ The request allocated \$575 million for CW agent destruction for FY 1995.⁷¹ After the bill had passed both the House and Senate, the total amount was \$599.5 million, including \$24 million for construction of facilities, \$355.8 million for operations and maintenance, \$199 million for procurement of equipment and \$20.7 million for R&D, particularly on alternative technologies.⁷²

⁶⁵ 'Army releases report on alternative technologies', *Chemical Demilitarization Update*, special edn, Apr. 1994, p. 1.

⁶⁶ *Chemical Demilitarization Update*, vol. 3, issue 2 (Oct. 1994), p. 6.

⁶⁷ '26 April', *Chemical Weapons Convention Bulletin*, no. 24 (June 1994), p. 26.

⁶⁸ '1 October', *Chemical Weapons Convention Bulletin*, no. 26 (Dec. 1994), p. 24.

⁶⁹ US GAO (note 62), p. 17.

⁷⁰ '7 February', *Chemical Weapons Convention Bulletin*, no. 24 (June 1994), p. 14. In the budget request for FY 1995, \$276 million was earmarked for construction activities at two new disposal sites: Umatilla Army Depot at Hermiston, Oregon (\$179 million) and Pine Bluff Arsenal (\$97 million). See *Military Construction Appropriations for 1995*, Hearings before a Subcommittee of the Committee on Appropriations House of Representatives, part 5, 2 Mar. 1994, 79-381 O (US Government Printing Office: Washington, DC, 1994), p. 74. In May 1994 the House of Representatives allocated \$51.2 million for FY 1995 for both facilities and recommended that the remainder be provided in FY 1996. The bill passed the Senate and was signed in August 1994. See 'Military construction bill wins final approval', *Congressional Quarterly*, vol. 52, no. 32 (13 Aug. 1994), p. 2370.

⁷¹ 'Defense spending', *Congressional Quarterly*, vol. 52, no. 32 (13 Aug. 1994), p. 2366.

⁷² '12 August', *Arms Control Reporter*, sheet 704.E-1.34; and *Chemical Demilitarization Update*, vol. 3, issue 2 (Oct. 1994), p. 3.

Table 10.1. Cost of the US CW destruction programme, 1985–94

Figures are in US \$. Figures in italics are percentages.

Year	Cost	Increase	Cumulative increase
1985	1.7	–	–
1986	2.0	<i>18</i>	<i>18</i>
1987 ^a	–	–	–
1988	3.4	<i>70</i>	<i>100</i>
1989 ^a	–	–	–
1990 ^a	–	–	–
1991	6.5	<i>91</i>	<i>282</i>
1992	7.9	<i>22</i>	<i>365</i>
1993	8.6	<i>9</i>	<i>406</i>
1994	10.0	<i>16</i>	<i>488</i>

^a For the years 1987, 1989 and 1990 no official figures are available. Figures for 1994 are estimates.

Sources: United States General Accounting Office (GAO), *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration*, Report to the Chairman, Subcommittee on Environment, Energy, and Natural Resources, Committee on Governmental Operations, House of Representatives, GAO/NSIAD-94-123, Mar. 1994; and ‘1 October’, *Chemical Weapons Convention Bulletin*, no. 26 (Dec. 1994), p. 24.

The systemization process at the Tooele Chemical Disposal Facility (TOCDF) continued in 1994 and is planned to be completed by February 1995. In October 1994 it was announced that the beginning of destruction operations will be delayed by approximately six months owing to the additional time needed for review and approval of a large number of modification requests to the Resource Conservation and Recovery Act (RCRA)⁷³ permit.⁷⁴

In March 1994 the NRC Stockpile Committee issued part II of its evaluation of the JACADS Operational Verification Test (OVT). This report recommended changes and improvements at the TOCDF before actual (full-scale) agent destruction starts.⁷⁵ In autumn 1994 Hurricane John led to the evacuation and temporary closing of JACADS. However, no significant damage was reported, and CW destruction operations were to restart by mid-November.⁷⁶

The Russian CW destruction programme

Russia does not have a final approved programme for destruction of its CW stockpile and may not have the appropriate technology.⁷⁷ However, Russian

⁷³ The RCRA regulates the treatment, storage and disposal of hazardous waste. The 1976 RCRA was amended in 1984 and 1986.

⁷⁴ ‘*Chemical Demilitarization Update*, vol. 3, issue 2 (Oct. 1994), p. 5.

⁷⁵ Peterson, C. R., ‘Disposing of chemical warfare agents and munitions stockpiles’, *Arms Control Today*, vol. 24, no. 5 (June 1994), pp. 8–13.

⁷⁶ *Chemical Demilitarization Update* (note 74).

⁷⁷ US GAO (note 54), p. 17.

authorities have stressed their willingness to keep their commitment to early ratification of the CWC, which includes a 10-year destruction schedule (with a possible extension of up to 15 years).

In an interview in February 1994 the head of the public relations department of the President's Committee on CBW Convention Problems confirmed the earlier estimates regarding the composition of the Russian CW stockpile, which consists of 32 300 t of organophosphorus compounds (stored in aviation, missile and artillery charges) and 7700 t of vesicants (mustard gas, lewisite and mixtures of both). The storage sites are located at: Shuchye (Kurgan oblast), Kizner (Udmurtia Republic), Maradikovskiy (Kirov oblast), Leonidovka (Penza oblast) and Pochev (Bryansk oblast).⁷⁸ Lewisite is stored in Kambarka (Udmurtia Republic), and smaller amounts of mustard gas, lewisite and mixtures of them are stored in Gorny (Saratov oblast).⁷⁹ Table 10.2 presents an overview of the storage sites and the agents present at them. Information is also now available about the distribution of the CW agents in munitions or bulk form (see table 10.3).

In 1994 discussion continued about the accuracy of the official total figure of 40 000 t for the Russian CW stockpile. Allegations were made that in the summer and autumn of 1993 quantities of CW had been destroyed in order to reduce the total amount to 40 000 t.⁸⁰ Former Head of the Russian Federation President's Committee on Matters Pertaining to Chemical and Biological Weapons Problems Academician Anatoliy Kuntsevich agreed in March 1994 that the actual figure exceeds 40 000 t.⁸¹ It is worth noting that one of the two Russian whistle blowers, Vil Mirzayanov, in a March 1994 State Duma Committee on International Affairs hearing on the CWC, pointed to the discrepancy between the declared size of the stockpile and the quantity actually produced, which according to him was more than 400 000 t.⁸²

Local opposition is growing in the regions where storage sites are located and where future destruction plants are planned. Such is the case, for example, in Pochev, where 7000 t of aircraft CW bombs are stored.⁸³

The destruction or conversion of former CW production facilities, long-debated in Russia, began in 1994. A former production plant for sarin and soman near Volgograd,⁸⁴ which had been mothballed after the cessation of production activities, will be destroyed.⁸⁵ In May 1994 the Government of the Republic of Chuvashia decided to destroy a former nerve gas factory at

⁷⁸ The storage site is located 5 km from Pochev; 7000 t of aircraft CW bombs are stored there. FBIS-SOV-94-128, 5 July 1994, pp. 26–27.

⁷⁹ '1 February', *Chemical Weapons Convention Bulletin*, no. 24 (June, 1994), p. 12.

⁸⁰ 'Chemical weapons exceeded estimates', *RFE/RL News Briefs*, vol. 3, no. 13 (21–25 Mar. 1994), p. 1; and FBIS-SOV-94-048, 11 Mar. 1994, p. 28.

⁸¹ 'Program reviews chemical weapons development', in FBIS-SOV-94-129, 6 July 1994, pp. 27–28.

⁸² 'Report on destruction of chemical weapons arsenal', in FBIS-SOV-94-058, 25 Mar. 1994, pp. 26–27.

⁸³ 'Planned Bryansk CW destruction plant opposed', in FBIS-SOV-94-063, 1 Apr. 1994, p. 33.

⁸⁴ *SIPRI Yearbook 1993* (note 15), p. 279.

⁸⁵ 'Russia "unilaterally" converting chemical production', in FBIS-SOV-94-078, 22 Apr. 1994, p. 38.

Table 10.2. Chemical weapon distribution at the Russian storage sites

Storage site	Percentage of CW stock	VX	Sarin	Soman
Pochep, Bryansk oblast	18.8	+	+	+
Maradikovsky, Kirov oblast	17.4	+	+	+
Leonidovka, Penza oblast	17.2	+	+	+
Shuchye, Kurgan oblast	13.6	+	+	+
Kizner, Udmurtia Republic	14.2	+	+	+
Kambarka, Udmurtia Republic	15.9	-	-	-
Gorny, Saratov oblast	2.9	-	-	-

Table 10.2. Continued. Chemical weapon distribution at the Russian storage sites

Storage site	Yperite	Yperite/lewisite		Phosgene
		Lewisite	mixture	
Pochep, Bryansk oblast	-	-	-	-
Maradikovsky, Kirov oblast	-	-	+	-
Leonidovka, Penza oblast	-	-	-	-
Shuchye, Kurgan oblast	-	-	-	+
Kizner, Udmurtia Republic	-	+	-	-
Kambarka, Udmurtia Republic	-	+	-	-
Gorny, Saratov oblast	+	+	+	-

Source: Russian Federation, *Conception: Destruction of Chemical Armament* (draft), 1994,p.5.

Table 10.3. Russian CW agents by method of storage

CW agent	Percentage stored in munitions and devices	Percentage CW agent stored in bulk (tanks)
V agent (viscous V agent)	100	–
Sarin	100	–
Soman (viscous soman)	100	–
Mustard gas	–	100
Lewisite and Mixture mustard gas/lewisite	10	90
Lewisite	2	98
Phosgene	100	–

Source: Russian Federation, *Conception: Destruction of Chemical Armament* (draft), 1994, p. 4.

Novocheboksarsk, which is now owned by the Khimprom Production Association. It has been kept in reserve mode since 1987, when production ceased.⁸⁶

In March a Deputy Chief of Radiation, Chemical and Biological Protection Troops stated in an interview that Russia has ‘completed work on elaborating the concept of destruction of toxic chemical agents’.⁸⁷ It was expected that the draft destruction plan would be presented to the State Duma in mid-April 1994. In March the Deputy Chairman of the State Duma Committee on International Affairs pointed out that ‘the sites where the destruction of the chemical weapons is to take place have yet to be chosen. As you can see . . . the settling of these matters with local authorities and, moreover, with local inhabitants is running into considerable difficulties’.⁸⁸ To speed up the process of finalizing the Russian CW destruction programme a government commission was established under the Deputy Prime Minister.⁸⁹

In a message to the 6th plenary meeting of the OPCW Preparatory Commission in April 1994 the Russian Foreign Minister reaffirmed Russia’s willingness to ratify the CWC and announced that the plan for the destruction of the Russian CW stockpile was being completed.⁹⁰

The figures presented in 1994 for the cost of the Russia CW destruction programme have increased dramatically from those presented in the past. In March 1994 during the State Duma hearings on CW destruction a figure of

⁸⁶ ‘Destruction of chemical weapon equipment begins’, in FBIS-SOV-94-098, 20 May 1994, p. 33; and Smithson, A. E., ‘Russia wants plastics, too’, *Bulletin of the Atomic Scientists*, vol. 50, no. 3 (May/June 1994), pp. 14–15.

⁸⁷ ‘Concept for chemical weapons destruction finalized’, in FBIS-SOV-94-044, 7 Mar. 1994, p. 27.

⁸⁸ ‘Report on destruction of chemical weapons arsenal’ (note 82).

⁸⁹ ‘Military guarantees safety of chemical arms depots’, in FBIS-SOV-94-128, 5 July 1994, pp. 26–27.

⁹⁰ ‘Message from the Minister of Foreign Affairs of the Russian Federation to Participants in the sixth session of the Preparatory Commission for the Organisation for the Prohibition of Chemical Weapons’, PC-VI/15, 8 Apr. 1994.

2.5 trillion roubles was given for the total cost.⁹¹ For 1994, 10.4 billion roubles were allocated.⁹² The first phase of the destruction operations at Kambarka and Gorny is expected to cost 500 billion roubles.⁹³ A US publication estimated the total cost of the Russian destruction programme at \$5–6 billion, with at least \$1 billion in foreign assistance required.⁹⁴

By the end of June 1994 the two houses of the Russian Parliament approved the 1994 federal budget legislation, including 115.96 billion roubles for the elimination of CW to meet Russia's international commitments.⁹⁵

In April a two-day international symposium on CW destruction was held in Moscow.⁹⁶ The symposium was opened by Kuntsevich, who had been dismissed by President Yeltsin from his position as Head of the Russian Federation President's Committee on Matters Pertaining to Chemical and Biological Weapons Problems two weeks earlier.⁹⁷ The official statement on Kuntsevich's dismissal read: 'The committee for conventions on chemical and biological weapons under the Russian president agreed to the transportation and storage of poisonous substances in a major populated area. That is why its chief Anatoliy Kuntsevich was dismissed by presidential decree'.⁹⁸ He was replaced in June by Pavel Syutkin, who previously served as deputy chairman.⁹⁹ The agenda of the Moscow symposium was broad and focused on CW destruction issues. However, compared to the first conference in May 1993, there was little progress and no clear indication of what the final decision would be on the sites chosen for CW destruction in Russia. Russian experts again presented their proposal to convert lewisite into pure arsenic to be used in civilian production.

In autumn 1994 two draft Russian Council of Minister decrees on the creation of facilities for CW destruction in Kambarka and Gorny were reviewed and the Law on the Destruction of Chemical Weapons in Russia was submitted to the Government and the State Duma.¹⁰⁰ A plant is scheduled to be constructed in Kambarka by the end of 1997, and destruction of lewisite will start in 1998. Destruction will be based on neutralization and subsequent electrolysis to process the pure arsenic.

⁹¹ 'CBW official informs Parliament on weapons' in FBIS-SOV-94-058, 25 Mar. 1994, p. 27; and 'Company seeks to recycle chemical weapon poisons' in FBIS-SOV-94-170, 1 Sep. 1994, p. 26.

⁹² 'Official views cost of CW destruction program' in FBIS-SOV-94-060, 29 Mar. 1994, pp. 22–23.

⁹³ 'Report on destruction of chemical weapons arsenal' (note 82); and '24 March', *Chemical Weapons Convention Bulletin*, no. 24 (June 1994), p. 20.

⁹⁴ US GAO (note 54), p. 17.

⁹⁵ '24 June', *Chemical Weapons Convention Bulletin*, no. 25 (Sep. 1994), p. 24.

⁹⁶ 'Convention on chemical disarmament to be ratified', in FBIS-SOV-94-077, 21 Apr. 1994, p. 29.

⁹⁷ 'Yeltsin dismisses biological, chemical weapons aide', in FBIS-SOV-94-067, 7 Apr. 1994, p. 25; and 'Kostikov explains CW chief's dismissal', in FBIS-SOV-94-068, 8 Apr. 1994, p. 32.

⁹⁸ Kuntsevich was also alleged to have violated labour regulations. See 'Yeltsin dismisses biological, chemical weapons aide' (note 97). In addition it was noted that Kuntsevich had spent many years developing CW, and 'it is difficult for a person to part from his child even if the child is dangerous one'. See also 'Kostikov explains CW Chief's dismissal' (note 97).

⁹⁹ '22 June', *Arms Control Reporter*, sheet 704.E-2.116.

¹⁰⁰ 'Chemical Weapons destruction concept urged', in FBIS-SOV-94-189, 29 Sep. 1994, pp. 38–40.

International support for Russian CW destruction

Russia and the USA signed an agreement in July 1992¹⁰¹ under which the USA will provide up to \$25 million in assistance to Russia for CW destruction.¹⁰² Most of the money will be used to develop a comprehensive destruction plan.¹⁰³ In addition, \$30 million has been allocated to assist Russia to develop and set up an analytical CW destruction laboratory.¹⁰⁴ This laboratory is to develop quality control measures, conduct environmental studies and train scientists and technicians.¹⁰⁵ The Vernadskiy Institute of Geochemistry and Analytical Chemistry in Moscow is to be the central CW destruction analytical laboratory.¹⁰⁶ A US contractor was hired to develop a comprehensive plan for the Russian destruction programme under the January 1994 agreed work plan. A programme management system will also be developed to: (a) estimate costs, (b) set up a comprehensive public outreach and education programme, and (c) develop criteria for destruction facilities. The Chemical Weapons Destruction Support Office in Moscow,¹⁰⁷ established in 1993, continued its work and will be the coordination office for US support to Russia.

In May 1994 the US Defense Nuclear Agency awarded a \$7.4 million contract to Bechtel National Inc. of San Francisco for 'Russian chemical weapons destruction support'.¹⁰⁸ In 1994 Russian and US representatives met to work out the best way to administer the US financial support.¹⁰⁹ The USA has insisted that before it provides most of the funds to Russia a specific plan must be established for exchanging information on the Russian CW stockpile.

In May 1994 the US Assistant Defense Secretary for Atomic Energy announced that President Clinton would ask Congress for an additional \$500 million to construct a CW destruction facility in Russia, on the condition that Russia made progress in compliance with the CWC.¹¹⁰ This plant would be a pilot project, which might be followed by a second destruction facility, also funded by the USA.

In FY 1993 Germany provided \$2.9 million to support the Russian CW destruction programme.¹¹¹ At the end of 1993 a mobile laboratory was handed over to the Russian Ministry of Defence; it can be used for effective monitor-

¹⁰¹ *SIPRI Yearbook 1993* (note 15), p. 280.

¹⁰² This is a part of the funding under the legislation sponsored by Senators Sam Nunn and Richard Lugar. Since 1992 the US Congress has approved \$1.2 billion for this programme which is to help Russia and other former Soviet republics destroy their weapons of mass destruction.

¹⁰³ US GAO (note 54), p. 17.

¹⁰⁴ *SIPRI Yearbook 1994* (note 15), p. 336.

¹⁰⁵ 'Chemical arms to be destroyed', *Signal*, vol. 48, no. 7 (Mar. 1994), p. 8.

¹⁰⁶ US GAO (note 54), p. 18; and 'U.S. to supply "nearly \$30 million" for CW destruction', in FBIS-SOV-94-022, 2 Feb. 1994, p. 2.

¹⁰⁷ *SIPRI Yearbook 1994* (note 15), p. 336.

¹⁰⁸ *ASA Newsletter*, no. 42 (16 June 1994), p. 23.

¹⁰⁹ Hitchens, T. and St LeSueur, S., 'Critics fear misuse of U.S. aid to destroy Russian arms', *Defense News*, vol. 9, no. 25 (27 June–3 July 1994), p. 14.

¹¹⁰ Hitchens, T., 'U.S. eyes Russian chemical aid: Congress may increase funding for deconstruction site', *Defense News*, vol. 9, no. 20 (23–29 May 1994), p. 34.

¹¹¹ The support focused on helping to finance the destruction of mustard gas and lewisite and exploring the feasibility of extracting arsenic from lewisite for commercial purposes.

ing of CW destruction. The laboratory, valued at 1.3 million Deutschmark, is to be deployed in the Saratov oblast.¹¹²

A German–US consortium—controlled by the US companies Lurgi Environmental Participating Organization Ltd (LUB) and Raytheon,¹¹³ and the German companies Uhde GmbH (a branch of Hoechst AG) and EST (a subsidiary of DASA)—was created to set up enterprises in Russia.¹¹⁴

Sweden continues its support to Russia.¹¹⁵ The Swedish National Defence Research Establishment (FOA) conducted risk assessment analysis for the storage site at Kambarka where 6000 t of lewisite are stored.¹¹⁶

CW destruction technologies

In the USA discussion of alternative destruction technologies continued in 1994. Following the NRC recommendations¹¹⁷ on CW destruction technologies and the US Army report to Congress on alternative chemical destruction technologies, \$20.7 million were allocated in the FY 1995 budget for R&D, primarily on alternative technologies. Research will focus on two technologies: stand-alone neutralization, and neutralization followed by biodegradation. The intent is not to replace the incineration technology, but rather to find a back-up system for the two storage sites where only bulk agents are stockpiled (Aberdeen Proving Ground and the Newport Army Ammunition Plant). Neutralization alone, however, will not meet the CWC ‘irreversibility’ requirement. This means that a combination with another process such as secondary oxidation would be required.¹¹⁸ Table 10.4 presents an overview of the alternative destruction technologies and their capabilities and availability.

The *Silver II* process,¹¹⁹ which was developed by the British Atomic Energy Authority and Scotland-based company SubSea Offshore Ltd, has been successfully tested in experiments with VX, tabun, sarin and mustard gas in pure, weaponized and thickened forms.¹²⁰ Based on the reduction of silver II ions, which have been oxidized from the normal silver I ion state in an electrochemical cell, to normal silver I ions the chemical warfare agent is oxidized to carbon dioxide, carbon monoxide, mineral acids and protons. This process has been demonstrated to be a viable alternative technology for the destruction of CW agents and munitions containing CW agents, especially the M55-rockets.

¹¹² ‘Germany provides chemical weapons monitoring equipment’, in FBIS-SOV-93-246, 27 Dec. 1993, p. 29.

¹¹³ The Raytheon Company installed and operates equipment at JACADS.

¹¹⁴ ‘International Consortium to clean Russian CWs’, *Military Technology, MILTECH*, vol. 18, no. 3 (1994), p. 101.

¹¹⁵ *SIPRI Yearbook 1994* (note 15), p. 337.

¹¹⁶ Blomgren, J., ‘Kemvapen förstörs: Ryssland får svensk experthjälp i avvecklingsprojekt’ [‘Chemical weapons are destroyed: Russia receives Swedish expert help in destruction project’], *Svenska Dagbladet*, 16 Sep. 1994, p. 7.

¹¹⁷ See *Recommendations for the Disposal of Chemical Agents and Munitions* (note 56).

¹¹⁸ Peterson, C. R., ‘Disposing of chemical warfare agents and munitions stockpiles’, *Arms Control Today*, vol. 24, no. 5 (June 1994), pp. 8–13.

¹¹⁹ *SIPRI Yearbook 1994* (note 15), p. 338.

¹²⁰ ‘Cleaning up CW disposal’, *Jane’s Defence Weekly*, vol. 22, , no. 12 (24 Sep. 1994), pp. 20–21.

Table 10.4. Destruction and decontamination capabilities and availability of alternative technologies and whether they can or cannot destroy/decontaminate

Technology	Chemical agent	Explosive propellants	Metal parts	Dunnage	Estimated year of full-scale operation
Baseline incineration	Yes	Yes	Yes	Yes	Currently
Molten salt oxidation	Yes	Yes	No	No	2007–2008
Fluidized bed oxidation	Yes	Yes	No	No	2007–2008
Molten metal pyrolysis	Yes	Yes	Yes	No	2007–2008
Plasma arc pyrolysis	Yes	No	No	No	2007–2011
Steam gasification	Yes	No	No	No	2007–2011
Wet air oxidation	Yes	Yes	No	No	2007–2008
Supercritical water oxidation	Yes	Yes	No	No	2007–2008
Chemical neutralization	Yes	No	No	No	2007–2008

Source: *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration* (General Accounting Office: Washington, DC, Mar. 1994), tables 1 and 3, pp. 5, 8; and Smithson, A. E., *The US Chemical Weapons Destruction Program: Views, Analysis, and Recommendations*, Report no. 13 (Henry L. Stimson Center: Washington, DC, 1994).

V. Old CW ammunition

Sea-dumped chemical weapons

In January 1994 the third meeting of the *Ad Hoc* Working Group on Dumped Chemical Munition of the Baltic Marine Environment Protection Commission of the Helsinki Commission (HELCOM CHEMU) was held in Copenhagen.¹²¹ At the meeting the Russian delegation stated that ‘the data submitted to the Ministry of Environment Protection does not contain any reference to dumping of chemical weapons in the Baltic Sea after 1947’. However, there is scepticism about this statement, especially in light of the many allegations of later dumping operations by the former Soviet Union, including dumping in the Baltic Sea.¹²² The Working Group presented its final report, which included conclusions and recommendations for further action,¹²³ to the March 1994 Helsinki Commission ministerial meeting. The report contained a recommendation ‘not to recover chemical munitions from the Helsinki Convention Area’, owing to the risks associated with such recovery.

¹²¹ Helsinki Commission, *Press Release*, Baltic Marine Environment Protection Commission, Copenhagen, 21 Jan. 1994; see also *SIPRI Yearbook 1994* (note 15), pp. 339–40.

¹²² *SIPRI Yearbook 1993* (note 15), pp. 282–83; and Lundin, S. J., Stock, T. and Geissler, E., ‘Chemical and biological warfare and arms control developments in 1991’, *SIPRI, SIPRI Yearbook 1992: World Armaments and Disarmament* (Oxford University Press: Oxford, 1992), chapter 6, p. 172.

¹²³ *Ad Hoc* Working Group on Dumped Chemical Munition (HELCOM CHEMU), ‘Report on Chemical Munitions Dumped in the Baltic Sea’, Report to the 16th Meeting of the Helsinki Commission, 8–11 Mar. 1994.

The ministerial meeting decided to prolong the mandate of the Working Group for an additional year.¹²⁴ Denmark will continue to lead the work of the group. Two more meetings were held in June¹²⁵ and September 1994.¹²⁶ The discussion focused on: (a) the chemical processes of warfare agents and the ecological effects of such processes; (b) the state of corrosion of dumped chemical munitions; (c) the Baltic Guidelines for fishermen on how to deal with dumped chemical munitions; and (d) the Baltic Guidelines on how the appropriate authorities should deal with incidents where such munitions are 'caught' by fishermen. Draft guidelines were developed for c and d.

An earlier report submitted by Latvia stated that Latvia had not dumped chemical munitions after re-establishment of its independence and that no further information on the issue had been obtained from Russia.¹²⁷ Poland stated that it had not dumped chemical munitions.¹²⁸

Germany hosted the third meeting of the Working Group in December 1994. All participating states were to provide information on dumping activities, especially those conducted after 1947.

In 1994 it also became known that the former Soviet Union had dumped large amounts of CW into the northern seas in the 1950s and 1960s.¹²⁹ It was reported that near the town of Petschenga,¹³⁰ close to the Norwegian border, rail cars arrived with bombs and artillery shells filled with mustard gas, which were then shipped to the Polar Sea. It was also claimed that other areas in the Barents Sea, Kara Sea, White Sea, Sea of Okhotsk and Sea of Japan were used by the former Soviet Union for dumping.¹³¹ An account of a 1961 ocean dumping operation in the Arctic Ocean of mustard gas bombs and other chemical munitions by the former Soviet Union was presented by a man who had participated.¹³²

Old chemical weapons in Russia

According to press accounts, large amounts of adamsite are buried near Shikhany, the former Soviet CW test site.¹³³ The first reported figures ranged

¹²⁴ Baltic Marine Environment Protection Commission, Helsinki Commission, Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1974 (Helsinki Convention), Report of the 15th Meeting, Helsinki, Finland, 8–11 Mar. 1994, HELCOM CHEMU 15/18.

¹²⁵ 'Ad Hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU), Report of the 4th Meeting, Copenhagen, Denmark, 16–17 June 1994, HELCOM CHEMU 4/5.

¹²⁶ 'Ad Hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU), Report of the 5th Meeting, Copenhagen, Denmark, 22 Sep. 1994, HELCOM CHEMU 5/4.

¹²⁷ 'Ad Hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU) (note 125), p. 4.

¹²⁸ 'Ad Hoc Working Group on Dumped Chemical Munition (HELCOM CHEMU) (note 126), p. 4.

¹²⁹ 'Bericht über russische Chemiewaffen im Eismeer' [Report of Russian chemical weapons in Polar Sea], *Neue Zürcher Zeitung*, 13–14 Feb. 1994, p. 8; and 'Sowjetische Chemiewaffen im Eismeer versenkt' [Soviet chemical weapons sunk in the Polar Sea], *Süddeutsche Zeitung*, 12–13 Feb. 1994, p. 6.

¹³⁰ Umnov, V., 'Will the Baltic Sea be saturated with mustard gas?', *Moscow News*, no. 23 (10–16 June 1994), p. 13.

¹³¹ '100 000 Tonnen C-Waffen in russischen Meeren' [100 000 tonnes of chemical weapons in Russian Sea], *Neue Zürcher Zeitung*, 22 Jan. 1994, p. 9.

¹³² 'Chemical weapons dumping after WWII reported', in FBIS-SOV-94-030, 14 Feb. 1994, p. 31.

¹³³ 'Program reviews chemical weapons development' (note 81).

from more than 4000 t to 8000 t.¹³⁴ Later a lower figure was presented by the former deputy chief of Shikhany, who stated that in 1962, 3200 t of adamsite were abandoned in an open trench at the base.¹³⁵ There is currently no plan to dig up this enormous amount of adamsite, as it is not now technically possible for Russia to destroy it.

In Moscow during restoration work near All Hallow's Church, several buried containers of mustard gas were unearthed.¹³⁶

VI. The Gulf War Syndrome

The Gulf War Syndrome continued to be debated in 1994 and was still not satisfactorily explained.¹³⁷ In January 1994 the US Department of Defense (DOD) and the Department of Health and Human Services formed a task force together with the Veterans Administration to investigate the possible causes of the syndrome.¹³⁸ Senator Riegle continued his investigation of possible explanations for the symptoms experienced by the Persian Gulf War veterans. In February 1994 a Senate report was released which listed a cocktail 'of biological and chemical warfare agents'¹³⁹ as the prime suspect for the Gulf War Syndrome. According to Senator Riegle there could be no other logical explanation of the symptoms 'than that they were caused by exposure to biological and/or chemical agents'.¹⁴⁰ In May 1994 a congressional report was released stating that there was indeed 'strong evidence that Iraq attacked U.S. troops with chemical weapons during the Gulf War'.¹⁴¹ This view is partly supported by the investigation carried out on behalf of the Senate Armed Services Committee. According to that investigation 'chemical agents were present in the theater of operations during the Persian Gulf War', although the report did not mean that Iraq had used CW.¹⁴² The Under Secretary of Defense for Personnel and Readiness stated that 'We have concluded that Iraq did not use chemical or biological weapons during the war'.¹⁴³ Instead several scenarios were offered including an accident in the Coalition forces involving CW

¹³⁴ 'Chemical weapons dumping after WWII reported' (note 132).

¹³⁵ '5 June', *Chemical Weapons Convention Bulletin*, no. 25 (Sep. 1994), p. 19.

¹³⁶ 'Moscow workmen find containers of suspected mustard gas', in FBIS-SOV-94-180, 16 Sep. 1994, pp. 31–32.

¹³⁷ Unexplained illnesses suffered by veterans of the 1991 Persian Gulf War have been labelled 'Gulf War Syndrome'. See also *SIPRI Yearbook 1994* (note 15), pp. 328–30.

¹³⁸ 'Panel formed to probe source of Persian Gulf War illnesses', *Chemical & Engineering News*, vol. 72, no. 5 (31 Jan. 1994), p. 15.

¹³⁹ Tisdall, S., 'Iraq "used US biotoxins in Gulf War"', *The Guardian*, 11 Feb. 1994, p. 5.

¹⁴⁰ Tisdall (note 139).

¹⁴¹ Associated Press, 'Iraq used toxic arms in war, report says', *International Herald Tribune*, 26 May 1994, pp. 1, 5.

¹⁴² 'Senator says chemical agents were released in Gulf War', *Congressional Quarterly*, 19 Mar. 1994, p. 682.

¹⁴³ Ember, L., 'Gulf troop exposure to chemical arms charged', *Chemical & Engineering News*, vol. 72, no. 22 (30 May 1994), p. 6.

agents or a chemical cloud resulting from Coalition bombing of Iraqi CW facilities.¹⁴⁴

Another panel investigating the cause of the symptoms rejected the idea that they constituted a single medical syndrome but did recommend that extensive research be carried out on the almost 700 000 troops that served in the Persian Gulf.¹⁴⁵ This was in line with the view of the Under Secretary of Defense for Personnel and Readiness, who said that the 'Pentagon had concluded that Iraq did not use chemical or biological weapons during the war and that there were no conclusive reports of troops having symptoms caused by exposure to chemical or biological warfare agents'.¹⁴⁶

There was much debate in Congress about the Gulf War Syndrome, and in October 1994 a bill was passed authorizing the Department of Veterans Affairs to provide compensation for those veterans suffering from it.¹⁴⁷

Both British and US troops experienced the Gulf War Syndrome. In the UK there were suggestions that the syndrome might stem from the large stocks of insecticides which the British forces maintained in the war zone. However, the British Ministry of Defence claims that there is no medical link between the insecticides and the illnesses.¹⁴⁸ In the USA it was claimed that the drug given to troops to protect them from nerve gas attacks, in combination with insecticides, could have caused some of the symptoms.¹⁴⁹

Claims that Iraq had used CW in the Persian Gulf War were denied by Iraq.¹⁵⁰ Kuwait has declared that 'in the aftermath of the Kuwait liberation war, [Kuwait] is free of any abnormal diseases'.¹⁵¹

VII. Conclusions

Although the number of reports of alleged use of CW decreased in 1994 they continued to occur especially as regards the former Yugoslavia and Angola. Greater attention was focused on accusations of current or past possession and development of CW or BW. The countries named in 1994 included the former Czechoslovakia, Libya, North Korea, Romania and Russia.

Reports of proliferation of BW or CW continued in 1994, and the number of countries accused of involvement in proliferation activities was of the same magnitude as in past years.

¹⁴⁴ Senator says chemical agents were released in Gulf War', *Congressional Quarterly*, 19 Mar. 1994, p. 682.

¹⁴⁵ Gavaghan, H., 'NIH panel rejects Persian Gulf Syndrome', *Nature*, vol. 369, no. 6475 (5 May 1994), p. 8.

¹⁴⁶ Associated Press (note 141).

¹⁴⁷ Ember, L., 'Sick Gulf vets get aid: chemical arms link probed', *Chemical & Engineering News*, vol. 72, no. 43 (24 Oct. 1994), p. 22.

¹⁴⁸ Fairhall, D., 'MOD denies chemicals link with Gulf "fever"', *The Guardian*, 9 Aug. 1994, p. 8.

¹⁴⁹ Katz, I., 'US Gulf troops "not warned about toxins"', *Guardian Weekly*, vol. 151, no. 7 (14 Aug. 1994), p. 5. See also *SIPRI Yearbook 1994* (note 15), p. 328.

¹⁵⁰ Reuters, 'Iraq denies weapons allegations', *The Independent*, 27 May 1994, p. 11.

¹⁵¹ 'Officials deny "abnormal diseases" surfaced after war', in FBIS-NES-94-050, 15 Mar. 1994, p. 12.

Implementation of the Destruction Agreement between Russia and the USA progressed. The second phase of the 1989 Wyoming Memorandum of Understanding was completed in mid-December 1994.

CW destruction is of major concern for the entry into force of the CWC. Both the primary possessor states, Russia and the USA, face problems. In the USA construction of CW destruction facilities is delayed. The overall cost of the US destruction programme is growing. In the final evaluation of alternative destruction technologies submitted by the US Army it was noted that there is no alternative to the currently used baseline incineration technique. However, additional funding has been provided for research on alternative technologies. Russia has not yet approved a final CW destruction programme, and estimates of its total cost approach those of the US programme. No destruction facility is functional, and debate about the accuracy of the declared total amount of the Russian CW stockpile continues. International support for Russia's CW destruction is essential, and the contribution that will be needed continues to grow.

The issue of CW dumped at sea in the past is being debated and is of particular concern to the countries around the Baltic Sea.

The origin of the so-called Gulf War Syndrome remains unknown, and new theories about its origin were advanced. The US Senate has indirectly acknowledged that the syndrome exists by approving a bill to compensate veterans suffering from illnesses acquired during the Persian Gulf War.