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Appendix D - The Material Balance of Iraq's Weapons of Mass Destruction

The consolidated results – the Material Balance, for all of UNSCOM's inspection activities during the period 1991 to December 1998 are contained in its final report to the United Nations Security Council – UNSCOM Report No S/1999/94 dated 25 January 1999. The tables and figures relating to Iraq's Biological and Chemical Warfare and Ballistic Missile programmes contained in the UNSCOM report were considered to be too extensive to be included in this report. However, a series of summary tables based on the UNSCOM Material Balance for Iraq's BW, CW and Ballistic Missile programmes have been prepared and are included as Parts 1 to 3 of this appendix.

A summary of the Material Balance for Iraq's nuclear programme has been prepared from the data contained in the International Atomic Energy Agency Report No S/1997/779 dated 8 October 1997, and is included as Part 4 of this appendix.

Where appropriate, revised figures that have been derived as a result of the more recent UMOVIC inspections have also been included.

Part 1: Material Balance - Ballistic Missiles Programme

Al Hussein (SCUD) Missiles

	Missiles		Launchers		Warheads	
Initial Holdings:		**Initial Holdings:**		**Initial Holdings:**		
Missiles	819	Imported Cbt Launchers	10	Imported warheads	819	
		Indigenous Cbt Launchers	4	Indigenous warheads	121	
		Indigenous Trailer Launchers	10			
Indigenous unaccounted for missiles	*7*	Fixed Operational Launchers	28			
		Fixed Stand-by Launchers*	28			
Total	**826**	**Total**	**80**	**Total**	**940**	
Used by Iraq		**Destroyed by Iraq**		**Used by Iraq**		
Training etc	8	Imported Cbt Launchers	5	Used pre 1980	8	
Iran/Iraq War	516	Indigenous Cbt Launchers	2	Iran/Iraq War	515	
Iraqi R&D	69	Indigenous Trailer Launchers	4	Iraq R&D	64	52imported/12indigenous
1991 Gulf War	93			1991 Gulf War	93	87imported/6indigenous
Destroyed by UNSCOM	48	**Destroyed by UNSCOM**	5	**Destroyed by UNSCOM**	50	37imported/13indigenous
		Imported Cbt Launchers	5			
Declared destroyed by Iraq*	85	Indigenous Cbt Launchers	2	**Destroyed by Iraq***	160	120imported/90indigenous
Accepted by UNSCOM	83	Fixed Launchers	56			
		Imported Training Launchers	1			
Total	**817**	**Total**	**80**	**Total**	**890**	
Unaccounted For	***9***			***Unaccounted For***	***50***	

Trailers released

Trailers released

Trailers released

Note: Figures qualified by an * indicate possible discrepancy between the number of warheads declared by Iraq, and which it (Iraq) destroyed, and the number of warheads accepted as being accounted for by UNSCOM.

The principal difference relates to 25 imported and 25 Iraqi manufactured warheads which according to UNSCOM, remain unaccounted for.

Part 2: Material Balance - Chemical Weapons Programme

Iraqi CW weapons Holdings as at January 1991

Declared by Iraq (Filled and unfilled Munitions)	**127941**	
Declared as destroyed by Iraq*		
Filled and unfilled	13660	
Unfilled	15900	
	100	*BW unaccounted for*
Sub-total	**29660**	
Destroyed in Gulf War		
Filled and unfilled	34000	
	550	*CW unaccounted for*
	2000	Uncertain
Sub-total	**36550**	
After Gulf War		
Destroyed by UNSCOM		
Filled	21825	
Unfilled	18223	
Sub-total	**40048**	
Converted to conventional	15616	
Accidental loss (fire)	438	
Sub-total	**56102**	
Total	**122312**	
Overall Shortfall	***5629***	*Includes CW and BW unaccounted for*

Summary by Munition Type remaining after the 1991 Gulf War	Nos - UNSCOM	Comments	Shortfall (δ)
250 Gauge Aerial Bombs - Mustard filled	1233	1243 declared by Iraq	10
250 Gauge Aerial Bombs - unfilled*	7627	8122 declared by Iraq	495
500 Gauge Aerial Bombs - Mustard filled	1418	1426 declared by Iraq	8
500 Gauge Aerial Bombs - unfilled*	331	422 declared by Iraq	109
R-400 Aerial Bombs - Sarin (Binary)	337	337 declared by Iraq	
R-400 Aerial Bombs - unfilled	58	58 declared by Iraq	
DB-2 Aerial Bombs - unfilled	1203	1203 declared by Iraq	
122mm Rockets - Sarin	6454	6610 declared by Iraq	156
122mm Rockets - unfilled	7305	6880 declared by Iraq	
155mm Artillery Shells - Mustard	12792	13000 declared by Iraq	208
155mm Artillery Shells - unfilled	17316	16950 declared by Iraq	
Missile Warheads - Sarin/Binary	30	30 declared by Iraq	
Sub-total	**56104**	**Sub-total (Short-fall)**	**986**

Chemical Weapons Programme - continued

Summary by Munition Type declared as destroyed during 1991 Gulf War	Nos - UNSCOM	Comments	Shortfall (ð)
500 Gauge Aerial Bombs - CS	116		
R-400 Aerial Bombs - Sarin (Binary)	160		
DB-2 Aerial Bombs - Sarin	50	12 declared by Iraq	48
122mm Rockets - Sarin	4000	4660 declared by Iraq	660
122mm Rockets - Unfilled	36500		
155mm Artillery Shells - Mustard		550 declared by Iraq	550
Sub-total	**40826**	**Sub-total**	**1258**

Summary by Munition Type declared by Iraq as unilaterally destroyed	Nos	Comments	Shortfall (ð)
250 Gauge Aerial Bombs - CS	125		
251 Gauge Aerial Bombs - Unfilled	2000		
R-400 Aerial Bombs - Sarin (Binary)	527		
R-400 Aerial Bombs - Unfilled		308 declared by Iraq	308
122mm Rockets - Unfilled	26500	26500 declared by Iraq	
Missile Warheads - Sarin/Binary	45		
Sub-total	**29197**	**Sub-total**	**308**

Total	**126127**	**Total** **2552**

Grand Total Accounted & Unaccounted	**128679**	Note: This is greater than the total declared by Iraq.
Declared by Iraq (Filled and unfilled Munitions)	**127941**	
Shortfall	***2552***	

Chemical Weapons Programme - continued

Summary of Bulk CW Agents (tonnes) declared by Iraq	Tonnes	Comments
Total Production of CW Agents	**3859**	
Weaponised CW Agents	3315	
CW Agent used during Iran/Iraq War	*2652*	*Estimate at 80% of weaponised agents*
Bulk CW Agents discarded	130	During 1980s
Bulk CW Agents remaining end of 1991Gulf War	412.5	
Sub-total	**3857.5**	

Detailed Summary of Bulk CW Agents remaining after 1991 Gulf War	Tonnes - UNSCOM	Comments	Shortfall (δ)
Mustard	295	Destroyed UNSCOM	
Tabun	76	Destroyed UNSCOM	
Sarin	40	Destroyed UNSCOM	
VX	1.5	Unaccounted for	1.5
Sub-total	**412.5**	**Sub-total**	**1.5**

Shortfall (Tonnes)	***1.5***

Chemical Weapons Programme - continued

Summary of Bulk CW Precursor Agents	Tonnes	Comments	δ Tonnes
Overall quantity of Precursor Chemicals produced and/or imported by Iraq	**20150**		
Precursor Chemicals used for the production of CW agents	14500	To be accounted for	5650
Declared Precursor Chemical holdings Jan 1991	**3915**		
D4 - Tabun	166	Destroyed - UNSCOM	
POCl3 - Tabun	477	576 tonnes destroyed - UNSCOM	
Dimethylaminohydrochloride - Tabun	295	272 tonnes destroyed - UNSCOM, and 30 tonnes during 1991 Gulf War	
Sodium Cyanide - Tabun	371	180 tonnes destroyed - UNSCOM	191
Thiodiglycol - Mustard	377	188 tonnes destroyed - UNSCOM, and 120 tonnes during 1991 Gulf War	69
Thionylchloride - Mustard, GB, GF and VX		282 tonnes destroyed - UNSCOM, and 100 tonnes during 1991 Gulf War	
PCl3 - Mustard, GB, GF and VX	2422	650 tonnes destroyed - UNSCOM	1772
MFP - GB and GF	67	20 tonnes destroyed - UNSCOM, 9 tonnes during 1991 Gulf War and 30 tonnes by Iraq	8

Chemical Weapons Programme - continued

Hydrogen Fluoride - GB and GF	181	11 tonnes destroyed - UNSCOM, 200 tonnes released for civilian use	
Isopropanol - GB	465	445 tonnes destroyed - UNSCOM	20
Cyclohexanol - GF	120	105 tonnes destroyed during 1991 Gulf War, and 20 tonnes released for civilian use	
P2S5 - VX	242	153 tonnes destroyed by Iraq - verified by UNSCOM, 85 tonnes destroyed during 1991 Gulf War	4
Chloroethanol - VX	202	2 tonnes destroyed - UNSCOM, 200 tonnes destroyed during 1991 Gulf War	
Choline - VX	55 litres	55 litres destroyed by Iraq	
Sub-total	**5385**	**Sub-total**	**2064**

Summary of CW Accounting and Shortfalls (UNSCOM)

	High Degree of Confidence	Moderate Degree of Confidence	Lesser Degree of Confidence	Totals	Declared	***Shortfall***
Special Munitions	56104	34000	13660	103764	127941	***24177***
Bulk CW Agents (Tonnes)	411	0	0	411	412.5	***1.5***
Key Precursors (Tonnes)	2810	823	200	3833	3915	***82***

Part 3: Material Balance - Biological Weapons Programme

BW Systems

AL Hussein Missiles			
Produced	**25**	**Total Destroyed (Iraq)**	**25**
Filled - Botulinum*	16		
Filled - Anthrax*	5		
Filled - Aflatoxin	4		
Sub-total	**25**		
R-400 Aerial Bombs			
Produced	**200**	Destroyed UNSCOM	37
		Destroyed Iraq**	128
Filled - Botulinum*	100	*Declared destroyed Iraq****	*29*
Filled - Anthrax*	50	Defective - not filled	6
Filled - Aflatoxin*	7	**Total**	**200**
Unfilled	43	** Verified by UNMOVIC 2003	
Sub-total	**200**	*** Unaccounted for	
F-1 Drop Tanks			
Produced	**4**	Destroyed - 1991 Gulf War	1
		Inspected UNSCOM	3
Sub-total	**4**	**Total**	**4**
Pilotless MiG 21	**1**	Unclear whether for BW or CW	carriage
		Not completed - unconfirmed	
Aerosol Generators (Heli-born)	**12**	*Unaccounted for by UNSCOM*	
Mobile Transfer Tanks (1m3)	47	24 accounted for by UNSCOM, *20+ NOT accounted for*	

Bulk BW Agents (Litres)

Botulinum Toxin (total)	**19180**		
Munition filling	10820		
Field Trials	569		
Wastage/Loss	118		
Botulinum remaining	7673	Destroyed Iraq (1991)	**7665 - 7735**
Bacillus Anthrax (total)	**8445**		
Munition filling	4975		
Field Trials	0		
Wastage/Loss	52.5		
Anthrax remaining	3417.5	Destroyed Iraq (1991)	**3412**
Aflatoxin (total)	**2200**		
Munition filling	1120		
Field Trials	231		
Wastage/Loss	30.5		
Aflatoxin remaining	818.5	Destroyed Iraq (1991)	**900 - 970**
Clostridium perfringens	**340**		
Munition filling	0		
Field Trials	0		
Wastage/Loss	0		
Perfringens remaining	340	Destroyed Iraq (1991)	**338**
Ricin (total)	**10**		
Field Trials	10		
Ricin remaining	0	Destroyed Iraq (1991)	**0**
Wheat Cover Smut (total)	Not quantifiable	Destroyed Iraq (1991)	**0**

Biological Weapons Programme - continued

Bacterial Growth Media (kg)			
Casein acquired	**17554**		
Used - Botulinum	7074		
Wastage/Lost	145		
Remaining 1991	10335	Destroyed UNSCOM (1996)	**10335**
Thioglycollate Broth acquired	**6036**		
Used - Botulinum	4130		
Wastage/Lost	58		
Remaining 1991	1848	Destroyed UNSCOM (1996)	**1848**
Yeast Extract acquired	**7070**		
Used - Botulinum	1768		
Used - Anthrax	185		
Used - Perfringens	11		
Wastage/Lost	15		
Remaining 1991	5091	Destroyed UNSCOM (1996)	**4942**
		Discrepancy	***149***
Peptone acquired	**1500**		
Used - Perfringens	45		
Wastage/Lost	705		
Remaining 1991	750	Destroyed UNSCOM (1996)	**625**
		Discrepancy	***125***

UNSCOM Estimate of UNACCOUNTED for Media (kg)		**Comment**
Casine	**460**	Sufficient for **1200 ltrs Botulinum** (concentrate)
Thioglycollate Broth	**80**	
Yeast Extract	**520**	Sufficient for **26000 ltrs Anthrax**
Peptone	**1100**	Sufficient for **5500 ltrs Perfringens** (concentrate)
Total	**2160**	
Destroyed 2003	**244.6**	**Under UNMOVIC supervision**
Remaining Shortfall	***1915.4***	

Summary of BW Accounting and Shortfalls (UNSCOM)

	High Degree of Confidence	Moderate Degree of Confidence	Lesser Degree of Confidence	Little or No Degree of Confidence	Totals	Declared	***Shortfall***
BW Munitions/Systems	0	0	4	253	257	288	***31***
Bulk BW Agents (Litres)	0	0	0	30175	30175	30175	***0***
Growth Media (Kg)	244.6	30000	0	0	30244.6	32160	***1915.4***

Note: While the above Summary Table attempts to quantify the state of Iraq's BW program, the range of uncertainties involved, as evidenced by only one entry against elements with high or moderate confidence, makes these figures all but meaningless. However, greater value can be obtained from the following qualitative extract from the UNSCOM Report dated 25 January 1999:

In its accounting for various BW weapons-program-related elements, the Commission has achieved various levels of confidence, depending on the quality of information; documentary, physical, and personal testimony provided by Iraq; and the correlation of this information with other information derived from Iraq, information provided by its former suppliers, or otherwise obtained by the Commission.

The Commission has a degree of confidence in the accounting for some proscribed items which were presented by Iraq for verification and disposal. This includes, for example: the destruction of buildings, and equipment at Al-Hakam, the destruction of large quantities of growth media acquired for the program; and evidence that R-400 aerial bombs and Al-Hussein warheads contained BW agents and consequently that Bacillus anthracis spores and botulinum toxin were indeed weaponised.

The Commission has less confidence in the accounting for proscribed items declared by Iraq as having been unilaterally destroyed. These include, for example: the number and fill of R-400 aerial bombs destroyed at Al-Azzizziyah; the number and fill of BW Al-Hussein warheads destroyed; and the fate of the agent to be used with drop tanks.

The Commission has little or no confidence in the accounting for proscribed items for which physical evidence is lacking or inconclusive, documentation is sparse or nonexistent, and coherence and consistency is lacking. These include, for example: quantities and types of munitions available for BW filling; quantities and types of munitions filled with BW agents; quantities and type of bulk agents produced; quantities of bulk agents used in filling; quantities of bulk agents destroyed; quantities of growth media acquired for the program; quantities of growth media used/consumed; and when or whether the program ended. In addition the Commission has no confidence that all bulk agents have been destroyed; that no BW munitions or weapons remain in Iraq; and that a BW capability does not exist in Iraq.

United Nations Security Council Report S/1999/94, 25 January 1999, p. 148

Part 4: Material Balance – Nuclear Weapons Program

The results of the International Atomic Energy Agency's (IAEA's) inspection regime of Iraq's nuclear capabilities produced a detailed picture of a well-funded programme aimed at the indigenous development and production of weapons-grade nuclear materials and the subsequent production of nuclear weapons themselves. The intended target date for the first nuclear weapon was 1991.

The following extract from the IAEA report to the United Nations Security Council, dated 8 October 1997, is a summary of the Iraqi nuclear programme. It sets out the major components of the programme and details the action(s) taken by the IAEA with respect to materials, equipment and processes which are defined as being proscribed under the term of Security Council resolution 687 (1991):

- Indigenous production and over and covert procurement of natural uranium compounds. In this regard:
  - ⇒ All known indigenous facilities capable of production of amounts of uranium useful to a reconstituted nuclear programme have been destroyed along with their principal equipments;
  - ⇒ All known procured uranium compounds are in the custody of the IAEA;
  - ⇒ All known practically recoverable amounts of indigenously produced uranium compounds are in the custody of the IAEA.
- Industrial-scale facilities for the production of pure uranium compounds suitable for fuel fabrication or isotopic enrichment. In this regard:
  - ⇒ All known facilities for the industrial-scale production of pure uranium compounds suitable for fuel fabrication or isotopic enrichment have been destroyed, along with their principal equipment.
- Research and development of the full range of enrichment technologies culminating in the industrial-scale exploitation of EMIS and substantial progress towards similar exploitation of gas centrifuge enrichment technology. In this regard:
  - ⇒ All known single-use equipment used in the research and development of enrichment technologies has been destroyed, removed or rendered harmless;
  - ⇒ All known dual-use equipment used in the research and development of enrichment technologies is subjected to ongoing monitoring and verification;

⇒ All known facilities and equipment for the enrichment of uranium through EMIS technologies have been destroyed along with their principal equipment.

- Design and feasibility studies for an indigenous plutonium production reactor. In this regard:
  ⇒ IAEA inspections have revealed no indications that Iraq's plans for an indigenous plutonium production reactor proceeded beyond a feasibility study.
- Research and development of irradiated fuel reprocessing technology. In this regard:
  ⇒ The facility used for research and development of irradiated fuel reprocessing technology was destroyed in the bombardment of Tuwaitha and the process-dedicated equipment has been destroyed or rendered harmless.
- Research and development of weaponisation capabilities for implosion-based nuclear weapons. In this regard:
  ⇒ The principal buildings of the Al Atheer nuclear weapons development and production plant have been destroyed and all known purpose-specific equipment has been destroyed, removed or rendered harmless.
- A "crash programme" aimed at diverting safeguarded research reactor fuel and recovering the HEU for use in a nuclear weapon. In this regard:
  ⇒ The entire inventory of research reactor fuel was verified and accounted for by the IAEA and maintained under IAEA custody until it was removed from Iraq.[1]

Following the resumption of inspection activities in late November 2002, the Director General of the IAEA concluded in his report on 7 March 2003 to the United Nations Security Council that:

> in the area of nuclear weapons - the most lethal weapons of mass destruction - inspections in Iraq are moving forward. Since the resumption of inspections a little over three months ago - and particularly during the three weeks since my last oral report to the Council - the IAEA has made important progress in identifying what nuclear-related capabilities remain in Iraq, and in its assessment of whether Iraq has made any efforts to revive

1 Director-General IAEA, International Atomic Energy Agency (IAEA) Report S/1997/779, 8 October 1997, p. 18

> its past nuclear programme during the intervening four years since inspections were brought to a halt. At this stage, the following can be stated:
>
> - There is no indication of resumed nuclear activities in those buildings that were identified through the use of satellite imagery as being reconstructed or newly erected since 1998, nor any indication of nuclear-related prohibited activities at any inspected sites.
> - There is no indication that Iraq has attempted to import uranium since 1990.
> - There is no indication that Iraq has attempted to import aluminium tubes for use in centrifuge enrichment. Moreover, even had Iraq pursued such a plan, it would have encountered practical difficulties in manufacturing centrifuges out of the aluminium tubes in question.
> - Although we are still reviewing issues related to magnets and magnet production, there is no indication to date that Iraq imported magnets for use in a centrifuge enrichment programme. [2]

In his closing remarks, the Director-General emphasised that the IAEA would continue to further scrutinize and investigate these and other related issues.

2 Director-General IAEA, *The Status of Inspections in Iraq: An Update*, 7 March 2003, p. 3