

Iraq

Nuclear Weapon Capability

By mid-1997 the International Atomic Energy Agency believed that its dismantlement efforts, regular monitoring and verification efforts, and the damage from Operation Desert Storm had virtually incapacitated Iraq's nuclear weapons infrastructure.¹ United States and British air strikes in Operation Desert Fox during December 1998 inflicted additional damage on Iraq's missile production capabilities. Iraq's ambitions and accumulated nuclear technical expertise remain, however, and with them the capability to restart the program covertly. Without on-site inspectors it is difficult to ascertain the precise extent to which Saddam Hussein has been able to rebuild his nuclear weapon program. According to a U.S. Defense Department 2001 report, "Iraq would need five or more years and key foreign assistance" to rebuild its nuclear facilities to enrich sufficient uranium for a nuclear weapon.² Significantly, this time frame has not changed from the five to seven years estimated in the department's 1996 assessment.³ The time will be considerably shortened if Baghdad acquires fissile material from foreign suppliers. Iraq's greatest asset is the two dozen nuclear scientists and engineers still in Iraq.⁴ This expertise, combined with the absence of ground monitors and decreasing support for the U.N. sanctions regime, has led to heightened anxiety about Iraq's program. Iraq may have a workable design for a nuclear weapon, and thus the major obstacle is its acquiring fissile material. If Iraq were to acquire material from another country, it is possible that it could assemble a nuclear weapon in months.⁵

Missile Capability

Under the terms of U.N Security Council Resolution 687, Iraq is not allowed to possess missiles with a range that is beyond 150 kilometers. By the end of 1997, 817 of the 819 prohibited ballistic missiles had been accounted for.⁶ Iraq continues to work on the liquid-propelled Al Samoud and the solid-propelled Ababil short-range ballistic missiles, both permitted under U.N. Resolution 687. In July 2000 Iraq successfully tested the Al Samoud, which has a range of 140 kilometers and carries a payload of 300 kilograms. These programs could allow Baghdad to develop technological improvements and an infrastructure that could be applied to a longer-range missile program. The Al Samoud could achieve a low-level operational capability in the near term, and Iraq's solid-propellant program may now be receiving a higher priority.⁷ The December 1998

bombing damaged Iraq's ballistic missile infrastructure, but the country retains domestic expertise and sufficient infrastructure to support most missile component production. According to Scott Ritter, who headed the U.N. Special Commission on Iraq Concealment Unit, Iraq probably has between 5 and 25 missile assemblies and missile components for up to 25 missiles salvaged from destroyed stockpiles.⁸ The CIA believes that Iraq probably retains a small, covert force of Scud-type missiles.⁹ There are no U.N. restrictions on Iraq's development of cruise missiles.

Biological and Chemical Weapon Capability

The absence of U.N. monitoring since 1998 has aroused concerns that Iraq may again have produced some biological warfare agents.¹⁰ Iraq currently maintains numerous science and medical facilities furnished with dual-use equipment where potential biological warfare-related work could easily take place. According to U.N. estimates, Iraq possesses the technology and expertise to reconstitute an offensive biological weapon program within a few weeks or months.¹¹ Iraq's continual refusal to disclose any details about its biological weapon program has led U.S. officials to conclude that Baghdad maintains an active program, in spite of Iraq's ratification of the Biological Weapons Convention in 1991.¹² In the absence of further monitoring, the current status of the Iraqi chemical weapon program is also unknown. Iraq maintains the expertise to resume chemical agent production within a few weeks or months. However, to attain former levels of production, Iraq would need significant amounts of foreign assistance.

Strategic Context

Saddam Hussein wants Iraq to be the predominant power in the Middle East, and he sees weapons of mass destruction and a ballistic missile program as necessary to achieve that goal. In his strategic calculus, a nuclear bomb would provide him with the ultimate symbol of military power. He believes that it would have been a deterrent against the Coalition forces as the confrontation over Kuwait evolved in 1991.

Iraq's interest in preserving as many of its WMD-related capabilities as possible, in spite of U.N. resolutions, was reflected in its strategy of frustrating and hindering the U.N. inspection process throughout the 1990s, forgoing more than \$120 billion in oil revenues, which is an indication of the price Iraq has been prepared to pay to keep as much of its weapon infrastructure as possible.¹³

Troubled relations with Iran have also contributed to the quest for weapons of mass destruction. During the Iran-Iraq War, Saddam Hussein increased pressure on his nuclear scientists to accelerate and expand the nuclear program. He wanted to draw the nuclear weapon program into the framework of the war, including the possibility of using radiation weapons along the border with Iran.¹⁴ Relations with Iran continue to remain problematic. In April 2001, for example, Iran reportedly fired anywhere between 44 and 77 Scud-B missiles

against the Mujaihaideen Khalk Organization, which is based in southern and eastern Iraq. Iraq characterized the “aggression” as a coordinated effort by Iran and Saudi Arabia.¹⁵

For Saddam, the nuclear bomb is a means to prevail in the long term against Iraq’s rivals in the region, including Iran, Israel, and Turkey.¹⁶ Israel’s destruction of the Osiraq reactor only made Saddam more determined to acquire a nuclear capability. After the Osiraq attack, former Iraqi nuclear scientist Khidhir Hamza says, “We went from 500 people to 7,000 in a timeframe of five years. All done in secret.”¹⁷

In the fall of 1998 Saddam Hussein grew in defiance, having succeeded in gaining sympathy in the Arab world and taking advantage of the sanction rift in the Security Council. By December 15, UNSCOM chief Richard Butler reported that “Iraq’s conduct ensured that no progress was able to be made in the fields of disarmament.”¹⁸ Saddam Hussein refused to allow inspectors unfettered access inside Iraq without a firm commitment to lift all remaining sanctions. As a result, the standoff led to the withdrawal of all U.N. inspection-related personnel on December 16, 1998, followed by military action that night by the United States and the United Kingdom. U.N. Security Council Resolution 1284, adopted in December 1999, established a follow-up inspection regime in the form of the Monitoring, Verification, and Inspection Commission (UNMOVIC) to continue UNSCOM’s work. It has not been able to begin its inspections because of Iraq’s refusal to permit them until sanctions are lifted.

Without inspectors on the ground, it is difficult for the United Nations or United States to determine the current state of Iraq’s WMD program.¹⁹ The end of inspections has meant not only that there are no inspectors on the ground, but also that the automated video monitoring system that the United Nations installed at known and suspected WMD facilities is no longer operating.²⁰ The absence of any on-site monitoring in Iraq has raised concerns, therefore, that Saddam Hussein may have begun to reconstitute Iraq’s WMD programs, including the nuclear weapon program.

Nuclear Analysis

Iraq ratified the Non-Proliferation Treaty on October 29, 1969, pledging not to manufacture nuclear weapons and agreeing to place all its nuclear materials and facilities under IAEA safeguards. Iraq violated its NPT obligations, however, by secretly pursuing a multi-billion-dollar nuclear weapon program. Iraq’s near-term potential to develop nuclear weapons has been curtailed by the implementation of U.N. Security Council Resolution 687, adopted in April 1991, following Iraq’s defeat in the 1991 Persian Gulf War. Operation Desert Storm and the inspection and dismantling efforts of the International Atomic Energy Agency, assisted by the U.N. Special Commission on Iraq, are believed to have left no weapons-capable fissile materials and no nuclear-weapons-related production facilities in Iraq. (Note that there is both natural uranium and LEU in Iraq under IAEA safeguards and that Iraq has allowed

the IAEA to inspect these materials annually in accordance with its NPT safeguard obligations.)

Iraq's efforts to produce weapons-grade uranium used virtually every feasible uranium-enrichment process, including electromagnetic isotope separation, the use of gas centrifuges, chemical enrichment, gaseous diffusion, and laser isotope separation. The program was initiated in 1982, when the Iraqi authorities decided to abandon Iraq's nuclear reactor program after Israel's June 7, 1981, bombing of the Osiraq research reactor.²¹ Until the Israeli attack, Iraq had chosen plutonium over highly enriched uranium as the preferred fissile material for its nuclear weapon program. The Osiraq research reactor, purchased from France in 1976, was unusually large and was therefore capable of irradiating uranium specimens to produce significant quantities of plutonium.²²

Iraq's EMIS program went undetected because it did not rely on state-of-the-art, imported equipment whose acquisition might have given the effort away.²³ Indeed, the EMIS program might have remained hidden from the IAEA inspection teams but for the fact that it was revealed by an Iraqi nuclear engineer who had defected to U.S. forces after the war.²⁴ Iraq started its gas-centrifuge program for uranium enrichment later than its EMIS program. It relied heavily on foreign contractors who were willing to circumvent export controls and to sell classified design information on early Western-type centrifuges and high-tensile "maraging" steel for the manufacture of centrifuges.²⁵

Iraqi scientists also organized secret attempts to produce and separate small quantities of plutonium in IAEA-safeguarded facilities at Tuwaitha. By 1991 they had acquired a rudimentary ability to separate plutonium, producing approximately 6 grams. Without any changes to the configuration of their radiochemical laboratory, the Iraqis would have been unable to separate more than 60 grams of plutonium a year, a quantity insufficient to produce the 5–8 kilograms needed for a first nuclear device.²⁶

Weaponization

The Iraqis focused their efforts on developing an implosion-type weapon,²⁷ whose basic design involves surrounding a subcritical mass, or core, of fissile material (in this case, highly enriched uranium) with conventional high-explosive charges. The charges are uniformly detonated to compress the nuclear material into a supercritical configuration. Iraq's weaponization program was in its early stages at the time of the Gulf War. In spite of making progress in the high-explosive testing program, Iraqi scientists were still struggling to master the high-explosive charges that must be precisely fabricated in order to produce homogeneous shock waves against the core after ignition.²⁸

Disclosures made by Lt. Gen. Hussein Kamel (former Iraqi minister of industry and military industrialization) after his defection to Jordan on August 8, 1995, prompted the Iraqi government to invite then-UNSCOM chair Rolf Ekeus and an IAEA delegation to Baghdad so that it could make new information available about Iraq's former nonconventional weapon activities that had allegedly been withheld by General Kamel. The discussions and subsequent

inspections revealed that following the invasion of Kuwait in August 1990, Iraq had embarked on a stepped-up program to develop a nuclear device by extracting weapons-grade material from safeguarded research reactor fuel.²⁹

Launched in September 1990, this program provided for such measures as the accelerated design and fabrication of the implosion package, the selection and construction of a test site, and development of a delivery vehicle. The deadline for producing a weapon under this program apparently was April 1991.³⁰ The program was cut short, however, by the 1991 Gulf War.

The IAEA concluded that the original plan of the Iraqi nuclear weapon program, as set out in 1988, was to produce a small arsenal of weapons, with the first one to be ready in 1991. While the weaponization team made significant progress in designing a workable device, the original deadline could not have been met because progress in the production of HEU—using the EMIS and gas-centrifuge processes—had lagged far behind. The fact that domestically produced HEU would not have been available for some time led Iraq to modify the objective of the original plan and to undertake the accelerated program.

In its October 1996 assessment the IAEA stated that the “industrial infrastructure which Iraq had set up to produce and weaponize special nuclear material has been destroyed.” However, the agency was aware “that the know-how and expertise acquired by Iraqi scientists and engineers could provide an adequate base for reconstituting a nuclear-weapons-oriented program.”³¹

Sanctions

U.N. Resolution 1284, adopted in December 1999, calls for the streamlining of economic sanctions and for their eventual suspension once UNMOVIC has reported that Iraq is cooperating with U.N. resolutions on dismantling its WMD.³² This resolution remains the legal basis for continuing to control Iraq’s assets, but Iraq has refused to allow UNMOVIC on the ground, insisting that the sanctions should be lifted since it has disarmed to the extent called for by U.N. resolutions.³³ U.N. Resolution 1284 places no limits on the volume of petroleum that Iraq can export for humanitarian needs.³⁴

While the sanctions against Iraq have not unraveled altogether, support in the Arab world and from European allies for them has eroded, and China and Russia are eager to resume economic ties with Iraq. An Anglo-American effort in the summer of 2001 to restructure the oil-for-food program failed to receive the support of the Security Council. While lifting most restrictions on Iraq’s imports of civilian goods, the proposed resolution sought to diminish Saddam Hussein’s ability to circumvent the U.N. escrow account; to tighten the embargo on dual-use technology that could aid Iraq’s WMD program; and to continue the blockade on the sale of conventional arms.³⁵ With Russia set to veto the resolution, the Security Council voted, instead, to continue the existing oil-for-food program.³⁶

Disturbing images of the effects of ten years of sanctions against Iraq, combined with escalating violence in Israel and the West Bank, have decisively shift-

ed the sympathies of the “Arab street” to the once-pariah regime of Saddam Hussein. With the backdrop of a collapsing Middle East peace process, sympathy for the Palestinian and Iraqi people has worked in Saddam Hussein’s favor, even after September 11. Arab governments have found that their publics are in no mood to continue isolating Saddam Hussein. The United States has recognized that its political success in pursuing its policy toward Iraq is, at least in part, connected to the success of its policy in the Levant.³⁷

In public, at least, these governments, including U.S. allies in the region, have begun to be circumspect in their support of the policy of sanctions and no-fly zones. Among the conservative Arab Gulf states, all except Saudi Arabia and Kuwait have flouted the sanctions and shown an interest in resuming ties with Saddam Hussein’s regime. Diplomatic and economic relations between even Iraq and Syria have been restored for the first time since the 1990 Gulf War, opening an oil pipeline that adds to Baghdad revenues from illegal oil sales.³⁸ Iraq also has an oil exchange program with Jordan and Turkey. The United States hopes to reverse this trend with a new hard-line policy to remove Saddam Hussein from power. By early 2002, it appeared that military action was all but certain, hampered only by the continuing conflict in Afghanistan and near-war in Israel.

Missile Analysis

Before the 1991 Gulf War, Iraq had extensive short-range ballistic missile capabilities, including a stockpile of Soviet-supplied, single-stage liquid-fueled Scud-Bs (having a 300-kilometer-range and a 1,000-kilogram payload) and three indigenously produced variants of the Scud-B (the Al Hussein, the Al Hussein Short, and the Al Hijarah) all with an approximate range of 600–650 kilometers. Iraq was developing a domestic manufacturing capability for these modified Scuds, which included a sophisticated missile technology base to reverse-engineer the systems. According to Ambassador Rolf Ekeus, Iraq had the capability to produce Scud-type engines, airframes, and warheads.³⁹ It had also undertaken a joint venture with Argentina and Egypt to develop a two-stage solid-fueled missile with an intended range of 750–1,000 kilometers, the Badr 2000.⁴⁰ UNSCOM concluded that no complete Badr 2000 missile was ever produced in Iraq. (The Argentine version was called Condor.) Baghdad also had plans for a 2,000-kilometer-range missile, called the Tammouz I,⁴¹ which was to have a Scud-derivative first stage and an SA-2 sustainer as the second stage.

Until the Gulf War, Iraq had focused on ballistic missiles as the only truly practicable delivery system for its nuclear weapons. Iraq was apparently pursuing three options. The first option was tailored to the longer-term plan, initiated in 1988, of producing the first of a number of nuclear weapons in 1991. The delivery vehicle would have been based on a modification of the Al Abid satellite launcher and would have had the capability to deliver a 1-metric-ton warhead to a distance of almost 1,200 kilometers.⁴² However, since work on the engines for the system did not begin until April 1989, it would not have been ready until 1993. The second option, a fallback position, would have been to

put the nuclear warhead on an unmodified Al Hussein missile, which would have limited the range to 300 kilometers. The third option, initiated in August or September 1990 under the accelerated program, was to produce “a derivative of the Al Hussein/Al Abbas short-range missile designed to deliver a warhead of one metric ton to 650 kilometers and to accommodate a nuclear package (80 centimeters in diameter).”⁴³ The estimated timeframe for completing the third option was six months.

Under the terms of U.N. Security Council Resolution 687, Iraq was obliged to eliminate ballistic missiles with ranges exceeding 150 kilometers. Significantly, Resolution 687 places no limits on Iraqi missile payloads, and range-payload tradeoffs allow missiles with lighter warheads to travel to greater ranges, as Iraq demonstrated in its doubling of the range of the Soviet-supplied Scud missile type.⁴⁴

In early July 1991 UNSCOM destroyed Iraq’s known 48 ballistic missiles that had a range capability greater than 150 kilometers and dismantled a large part of the related infrastructure. However, in March 1992 Iraq admitted that it had withheld 85 missiles from UNSCOM’s controlled destruction. Iraq had destroyed those missiles in mid-July and October 1991 in a secret operation (after the official destruction of the 48 missiles). UNSCOM inspectors have confirmed that most of Iraq’s remaining Scud-based missile force was eliminated, although the clandestine character of Iraq’s destruction of the 85 missiles showed that it was desperately trying to preserve missiles and missile components.⁴⁵ Furthermore, after Lt. Gen. Hussein Kamel’s defection, Iraqi officials admitted that Iraq had carried out research and development work on advanced rocket engines and that it had manufactured rocket engines “made of indigenously produced or imported parts and without the cannibalization of the imported Soviet-made Scud engines.”⁴⁶

By early 1995 UNSCOM believed that it had a fairly complete overview of the facilities, equipment, and materials used in Iraq’s former missile program. However, because Iraq repeatedly withheld and falsified information, UNSCOM had unresolved issues, partly regarding past research and development activities and partly regarding the numerical accounting of missiles, warheads, and supporting and auxiliary equipment.⁴⁷ UNSCOM also found itself in disagreement with the United States over whether all of Iraq’s illegal missiles had been accounted for. The U.S. intelligence community believed that Iraq may have successfully hidden up to a hundred such missiles.⁴⁸

In December 1995 UNSCOM reported that some elements of Iraq’s final missile declaration were still unaccounted for, including ten missile engine systems that Iraq claimed it had destroyed.⁴⁹ Neither was UNSCOM satisfied that it had accounted for the indigenously produced warheads and of “such major components for operational missiles as guidance and control systems, liquid propellant fuels and ground support equipment.”⁵⁰

UNSCOM was also concerned that Iraq had resumed the foreign procurement of banned missile technologies and components.⁵¹ Iraq defended those procurement activities as being intended for the legal Ababil-100 missile program. Yet Iraq was ordering the import of equipment and materials without

making the required notifications to UNSCOM; that importation would violate the U.N. sanctions in place.⁵²

In October 1997 UNSCOM finally reported that it had made significant progress in the missile area, accounting for 817 of the 819 missiles that Iraq had imported from the Soviet Union before the end of 1988. UNSCOM analyzed the remnants of those missiles that Iraq unilaterally destroyed in July and October 1991 and was able to verify that 83 engines of the 85 declared missiles had in fact been destroyed.⁵³

Biological and Chemical Weapon Analysis

The United Nations Special Commission in Iraq was created to supervise the destruction of Iraq's biological and chemical weapon and production facilities, pursuant to U.N. Security Council Resolution 687, and to monitor long-term related activities to prevent their reconstruction. In 1991 the Iraqi government declared that it did "not possess any biological weapons or related items."⁵⁴ UNSCOM's findings, strengthened by information obtained in 1995 as a result of the Kamel defection, eventually revealed that Iraq's BW program was well developed and highly managed, encompassing all aspects of biological weapon development from research to weaponization.

Until August 1990 the Iraqi BW capability had been expanding and diversifying at a steady pace. The biological weapon program included a broad range of agents and delivery systems. Pathogens produced by the Iraqi program included both lethal agents (e.g., anthrax, botulinum toxin, and ricin) and incapacitating agents (e.g., aflatoxin, mycotoxins, hemorrhagic conjunctivitis virus, and rotavirus). Documents discovered by UNSCOM indicated that Iraq had produced 8,500 liters of anthrax, 20,000 liters of botulinum toxin, 2,200 liters of aflatoxin, and the biological agent ricin.⁵⁵ Iraq conducted research to examine the effects of combining biological and chemical agents and also pursued anti-plant agents, such as wheat cover smut.⁵⁶

Biological Weapons

The Iraqi BW program explored and developed a broad range of weapon delivery systems, including aerial bombs, rockets, missiles, and spray tanks. In December 1990 Iraq began the large-scale weaponization of biological agents. More than 160 R-400 aerial bombs and 25 600-kilometer-range Al Hussein missiles were filled with aflatoxin, anthrax, and botulinum toxin. The missiles were deployed in January 1991 to four sites for the duration of the Gulf War.⁵⁷

UNSCOM repeatedly claimed that Iraq had failed to provide a full and correct account of its biological weapon program. Despite its monitoring activities, UNSCOM remained concerned that Iraq may have retained a stock of biological weapons and related manufacturing capabilities as late as 1997. Iraq repeatedly blocked or hindered a number of UNSCOM inspections, culminating in a standoff with the United Nations in late October 1997. Iraq unilaterally

ended UNSCOM weapon inspections and monitoring in December 1998; UNSCOM was disbanded shortly thereafter.

Chemical Weapons

In March 1986 U.N. Secretary General Javier Perez de Cuellar formally accused Iraq of using chemical weapons against Iran. Iraq allegedly had used chemical weapons, including mustard and nerve gases, during the Iran–Iraq War, resulting in approximately 50,000 Iranian casualties.⁵⁸ Iraq had also used chemical weapons—on its own Kurdish populations in northern Iraq. The CW attack on the city of Halabja on March 16, 1988, has been described as “the largest-scale chemical weapon attack against a civilian population in modern times.”⁵⁹ During the attack, multiple chemical agents—mustard gas, tabun, sarin, and VX—were delivered by aerial bombs. The exact number of Kurdish casualties is unknown but it is speculated to be high.

Inspections by the United Nations revealed that before the Gulf War, Iraq maintained one of the most extensive chemical weapon capabilities in the developing world. The Iraqi production of chemical weapons began in the early 1980s and continued until December 1990. Iraq had produced sufficient quantities of chemical precursors for almost 500 metric tons of the nerve agent VX. Hundreds of metric tons of tabun, sarin, and the blister agent mustard gas were also produced.⁶⁰ Iraq weaponized mortar shells, artillery shells, grenades, aerial bombs, and rockets for chemical use. It also deployed 50 Al Hussein missiles equipped with potent chemical warheads as part of its active forces.

Reportedly, Saddam Hussein fully intended to use chemical weapons and gave local commanders the authority to use them at their discretion. Various explanations have been offered as to why Iraq did not launch a chemical or biological weapon during the war. One is that just before the outbreak of the war, President George Bush vowed that “the American people would demand the strongest possible response . . . and [Iraq] will pay a terrible price” for the use of chemical or biological weapons against the Coalition forces.⁶¹ Another interpretation holds that the U.S. decision to halt the ground war after only four days was influenced by concerns that Iraq might use chemical or biological weapons if Coalition forces closed in on Baghdad. In 1996 Iraqi officials indicated to UNSCOM that they considered their missile-based biological and chemical weapons to be “strategic” capabilities, for potential use against cities in nearby countries. After the Gulf War, allegations of exposure to chemical and biological agents surfaced. Ultimately, nearly 60,000 veterans reported medical problems, prompting an investigation into the so-called Gulf War Syndrome.⁶² Research by the U.S. Department of Defense failed to diagnose the problems as symptoms of biological or chemical exposure.

After the Gulf War, UNSCOM, as the U.N.–mandated inspection team, began the detection and destruction of Iraq’s chemical weapon stockpiles and production facilities. United Nations specialists destroyed more than 480,000 liters of chemical agents and 1.8 million liters of chemical precursors in the Iraqi arsenal.⁶³ Because of the size of the Iraqi program, however, it is widely

believed that significant quantities of chemical agents and precursors remain stored in secret depots. United Nations officials have publicly expressed their doubts that the entire Iraqi stockpile of chemical weapons was found. Iraq's interest in preserving as many of its biological and chemical weapon capabilities as possible, in spite of U.N. resolutions, was reflected in its strategy of frustrating and hindering the U.N. inspection process. Iraq also repeatedly attempted to import proscribed equipment and tried to hide chemical agents, munitions, and hardware. As a result, UNSCOM reported to the Security Council that "the Commission has serious concerns that a full accounting and disposal of Iraq's holding of prohibited items has not been made."⁶⁴ Rough estimates conclude that Iraq may have retained up to 600 metric tons of agents, including mustard gas, VX, and sarin. Approximately 25,000 rockets and 15,000 artillery shells with chemical agents also remain unaccounted for.⁶⁵ Iraq is not a state party to the Chemical Weapons Convention.

NOTES

1. Barbara Crossette, "Iraqis Still Defying Arms Ban, Departing U.N. Official Says," *New York Times*, June 25, 1997. Also see Evelyn Leopold, "France Says IAEA Should Close Nuclear File on Iraq," *Reuters*, October 17, 1997.
2. U.S. Department of Defense (DOD), *Proliferation Threat and Response*, January 2001, p. 40.
3. U.S. DOD, *Proliferation Threat and Response*, January 1996.
4. Khidhir Hamza with Jeff Stein, *Saddam's Bombmaker: The Terrifying Inside Story of The Iraqi Nuclear and Biological Weapons Agenda* (New York: Scribner, 2000). Hamza made these comments at a Carnegie Non-Proliferation Roundtable, November 2, 2000.
5. ISIS (Institute for Science and International Security), "Military Strikes in Iraq: Inspections, Sanctions Must Stay in Place To Prevent Nuclear Weapons Program Reconstitution," press release, December 17, 1998, quoted in "Inspecting Iraq," in Joseph Cirincione, ed., *Repairing the Regime: Preventing the Spread of Weapons of Mass Destruction* (New York: Routledge, 2000), p. 183.
6. "Inspecting Iraq," in Cirincione, *Repairing the Regime*, p. 181.
7. Central Intelligence Agency, *Unclassified Report to Congress on the Acquisition of Technology relating to Weapons of Mass Destruction and Advanced Conventional Munitions, January 1 through June 30, 2001*. Released January 2002. Available at www.cia.gov/cia/publications/bian/bian_jan_2002.htm.
8. Scott Ritter, *Endgame* (New York: Simon and Schuster, 1999), p. 217, quoted in "Inspecting Iraq," in Cirincione, *Repairing the Regime*, p. 181.
9. CIA, *Unclassified Report to Congress*.
10. U.S. DOD, *Proliferation Threat and Response*, January 2001, p. 40.
11. *Ibid.*
12. John Bolton, Under Secretary for Arms Control and International Security, "Remarks to the Fifth Biological Weapons Convention RevCon Meeting," Geneva, Switzerland, November 19, 2001.
13. Rick Marshall, "Ekeus: Weapons of Mass Destruction of Higher Value to Iraq Than Oil," *USIS Washington File*, June 10, 1997.
14. Hamza, Carnegie Proliferation Roundtable, November 2, 2000. Available at www.ceip.org/npp.
15. Amin Tarzi and Darby Parliament, "Missile Messages: Iran Strikes MKO Bases in Iraq," *Nonproliferation Review*, summer 2001, pp. 125-133.
16. Hamza, Carnegie.

17. Ibid.
18. "Inspecting Iraq," in Cirincione, *Repairing the Regime*, p. 181.
19. CIA, *Unclassified Report to Congress*.
20. Ibid.
21. IAEA, *Report on the Fourth IAEA On-site Inspection in Iraq under Security Council Resolution 687*, S/22986, August 28, 1991, p. 5.
22. Rodney Jones and Mark McDonough, with Toby Dalton and Gregory Koblentz, *Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1998* (Washington, D.C.: Carnegie Endowment for International Peace, 1998), pp. 187–194.
23. IAEA, *Report on the Fourth IAEA On-site Inspection*, p. 6; and IAEA, *Report on the Seventh IAEA On-site Inspection*, S/23215, November 14, 1991, annex 4, p. 4.
24. "Iraqi Defector," *Associated Press*, June 14, 1991; R. Jeffrey Smith, "Iraqi Nuclear Program Due Further Inspections," *Washington Post*, June 14, 1991.
25. For descriptions of the Iraqi gas centrifuge program, see IAEA, *Report on the Fourth On-site Inspection*, pp. 3, 9–13; IAEA, *Report on the Seventh On-site Inspection*, pp. 17, 19, and 21, annex 4, pp. 5–10; David Albright and Mark Hibbs, "Iraq's Bomb: Blueprints and Artifacts," *Bulletin of the Atomic Scientists, January/February 1993*, pp. 39–40; Albright and Hibbs, "Iraq's Shop-till-You-Drop Nuclear Program," *Bulletin of the Atomic Scientists, January/February 1993*, pp. 27–37; Albright and Hibbs, "Iraq: Supplier-Spotting," *Bulletin of the Atomic Scientists, January/February 1993*, pp. 8–9.
26. IAEA, *Report on the Fourth On-site Inspection*, pp. 17–19; also see *Report on the Seventh On-site Inspection*, pp. 23 and 27; IAEA, *IAEA Inspections and Iraq's Nuclear Capabilities*, IAEA/PI/A35E, April 1992.
27. See IAEA, *Report on the Eighth On-site Inspection*, p. 15; and IAEA, *Report on the Eleventh IAEA*, S/23947, May 22, 1992, p. 20.
28. IAEA, *First Report on the Sixth IAEA On-site Inspection in Iraq under Security Council Resolution 687 (1991)*, S/23122, October 8, 1991, p. 4; IAEA, *Report on the Seventh On-site Inspection*, pp. 8, 9, 13.
29. IAEA, *Eighth Report of the Director General of the International Atomic Energy Agency on the Implementation of the Agency's Plan for Future Ongoing Monitoring and Verification of Iraq's Compliance with Paragraph 12 of Resolution 687 (1991)*, S/1995/844, October 6, 1995; IAEA, *Report on the Twenty-Eighth IAEA On-site Inspection in Iraq*; IAEA, *Report on the Twenty-Ninth IAEA On-site Inspection in Iraq Under Security Council Resolution 687 (1991)*, S/1996/14, January 10, 1996.
30. Mark Hibbs, "Experts Say Iraq Could Not Meet Bomb Deadline Even with Diversion"; IAEA, *Report on the Twenty-Eighth On-site Inspection*, p. 14; and briefing by Ambassador Rolf Ekeus, Hearings on Global Proliferation, p. 99.
31. IAEA, *Second Consolidated Report of the Director General of the International Atomic Energy Agency under Paragraph 16 of Resolution 1051 (1996)*, S/1996/833, p. 11.
32. Morton Halperin and Geoffrey Kemp, *A Report on U.S. Policy Options toward Iraq* (Washington, D.C.: Nixon Center, June 2001). Available at www.nixoncenter.org/publications/iraqpolicy.htm.
33. "Iraq Resumes WMD Activities, New York Times Reports," Carnegie Analysis, January 22, 2001. Available at www.ceip.org/npp.
34. U.S. DOD, *Proliferation: Threat and Response*, January 2001, p. 39.
35. Halperin and Kemp, *U.S. Policy Options toward Iraq*; and Robert Windrem and Linda Fasulo, "Sanctions Fail To Check Iraqi Military," *MSNBC.com*, August 14, 2001.
36. Colum Lynch, "Russia Threatens Veto of U.N. Iraq Resolution," *Washington Post*, June 26, 2001.
37. Janine Zacharia, "U.S. Pressing Israel To Begin Counting," *Jerusalem Post*, July, 27, 2001.
38. "Iraq and Syria Sign Economic Accords," *Reuters* report in *International Herald Tribune*, August 14, 2001; and Robert Einhorn, "The Emerging Bush Administration Approach to Addressing Iraq's WMD and Missile Programs," keynote address to the Institute for Science and International Security, June 14–15, 2001.
39. Briefing by Ambassador Rolf Ekeus, Hearings on Global Proliferation, p. 93.
40. U.S. DOD, *Proliferation: Threat and Response*, January 1996, p. 21; and UNSCOM, *Report of the Secretary-General on the Status of the Implementation of the Special Commission's Plan for the Ongoing Monitoring and Verification of Iraq's Compliance with Relevant Parts of Section C of Security Council Resolution 687 (1991)*, S/1995/284, April 10, 1995, p. 6.

41. U.S. DOD, *Proliferation: Threat and Response*, January 1996.
42. Ibid.
43. IAEA, *First Consolidated Report of the Director General of the International Atomic Energy Agency under Paragraph 16 of Resolution 1051 (1996)*, S/1996/261, April 11, 1996, p. 7. Also see IAEA, *Report on the Twenty-Eighth On-site Inspection in Iraq*, p. 15, and *Report on the Twenty-Ninth On-site Inspection*, p. 10.
44. R. Jeffrey Smith, "U.N. Finds New Evidence of Iraqi Long-Range Missile Research," *Washington Post*, February 5, 1997.
45. Interview with Rolf Ekeus, spring 1997; UNSCOM, *Report of the Secretary-General on the Activities of the Special Commission Established by the Secretary-General pursuant to Paragraph 9 (b)(i) of Resolution 687 (1991)*, S/1997/774, October 6, 1997, p. 6.
46. UNSCOM, *Report of the Secretary-General on Iraq's Compliance*, October 11, 1995, p. 14.
47. UNSCOM, *Report of the Secretary-General on Iraq's Compliance*, April 10, 1995, p. 6; UNSCOM, *Report of the Secretary-General on Iraq's Compliance*, October 11, 1995, p. 14.
48. David Isby, "Iraq's Residual Scud Force," *Jane's Intelligence Review*, March 1995; Sid Balman, Jr., "CIA: Saddam Building and Hiding Weapons," *United Press International*, September 26, 1994; and Patrick Worsnip, "CIA Chief Attacks Iran, Iraq Weapons Programs," *Reuters*, September 26, 1994.
49. Evelyn Leopold, "U.N. Official Unsatisfied with Iraqi Missile Data," *Reuters*, December 5, 1995.
50. UNSCOM, *Tenth Report of the Executive Chairman*.
51. UNSCOM, *Report of the Secretary-General on Iraq's Compliance*, October 11, 1995, p. 13. Also see UNSCOM, *Tenth Report of the Executive Chairman*; and Barbara Crossette, "U.N. Panel Says Iraq May Still Be Trying To Produce Missiles," *New York Times*, December 22, 1996.
52. UNSCOM, *Report of the Secretary-General on Iraq's Compliance*, October 11, 1995, p. 12.
53. UNSCOM, *Report of the Secretary-General on the Activities of the Special Commission Established by the Secretary-General Pursuant to Paragraph 9 (b)(i) of Resolution 687 (1991)*, S/1997/774, October 6, 1997, pp. 6–8.
54. Ambassador Amir Al-Anabari of Iraq, Letter to U.N. Secretary General, April 18, 1991, as quoted in Michael Crowley, *Disease by Design: De-Mystifying the Biological Weapons Debate*, BASIC (British-American Security Information Council), November 2001.
55. White House Fact Sheet, "Iraq's Program of Mass Destruction: Threatening Security of the International Community," November 14, 1997.
56. *Report of the Secretary-General on the Status of the Implementation of the Special Commission's Plan for the Ongoing Monitoring and Verification of Iraq's Compliance with Relevant Parts of Section C Of Security Council Resolution 687 (1991) October 11, 1995*.
57. Ibid.
58. Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks*, August 1993, p. 10.
59. Christine M. Gosden, "Chemical and Biological Weapons Threats to America: Are We Prepared?" Testimony before the Senate Select Committee on Intelligence, April 22, 1998.
60. UNSCOM, Seventh Report under Resolution 715, October 4, 1995.
61. Public Papers of George Bush: Book 1, January 1 to June 30, 1991, "Statement by Press Secretary Fitzwater on President Bush's Letter to President Saddam Hussein of Iraq," January 12, 1991. As cited in Michael R. Gordon and Gen. Bernard E. Trainor, *The General's War: The Inside Story of the Conflict in the Gulf* (New York: Little Brown, 1995), p. 493.
62. Jeffery Smart, "History of Chemical and Biological Warfare: An American Perspective," chap. 2, *Medical Aspects of Chemical and Biological Warfare, Part I: The Textbook of Military Medicine* (Washington, D.C.: Office of the Surgeon General, Borden Institute, 1997), p. 73.
63. E. J. Hogendoorn, "A Chemical Weapons Atlas," *Bulletin of the Atomic Scientists*, September/October 1997, p. 37.
64. UNSCOM, *First Consolidated Report of the Secretary-General Pursuant to Paragraph 9*, April 11, 1996, pp. 6–8.
65. Center for Defense Information, "Iraq," Chemical and Biological Weapons web site, www.cdi.org/issues/cbw/Iraq.html.

Table 16.1: Iraqi Biological Warfare, Chemical Warfare, and Ballistic Missile Programs

A. Iraqi Biological Warfare Program	
BW AGENT PRODUCTION AMOUNTS ¹	
BW AGENT (ORGANISM)	Anthrax (<i>Bacillus anthracis</i>)
DECLARED CONCENTRATED AMOUNT	8,500 liters (2,245 gallons)
DECLARED TOTAL AMOUNT	85,000 liters (22,457 gallons)
COMMENTS	UNSCOM estimated production amounts were actually three to four times more than the declared amounts, but is unable to confirm.
BW AGENT (ORGANISM)	Botulinum toxin (<i>Clostridium botulinum</i>)
DECLARED CONCENTRATED AMOUNT	19,400 liters (10x and 20x concentrated) (5,125 gallons)
DECLARED TOTAL AMOUNT	380,000 liters (100,396 gallons)
COMMENTS	UNSCOM estimated production amounts were actually two times more than the declared amounts, but is unable to confirm.
BW AGENT (ORGANISM)	Gas gangrene (<i>Clostridium perfringens</i>)
DECLARED CONCENTRATED AMOUNT	340 liters (90 gallons)
DECLARED TOTAL AMOUNT	3,400 liters (900 gallons)
COMMENTS	Production amounts could be higher, but UNSCOM was unable to confirm.
BW AGENT (ORGANISM)	Aflatoxin (<i>Aspergillus flavus</i> and <i>Aspergillus parasiticus</i>)
DECLARED CONCENTRATED AMOUNT	N/A
DECLARED TOTAL AMOUNT	2,200 liters (581 gallons)
COMMENTS	Production amounts and timeframe of production claimed by Iraq do not correlate.
BW AGENT (ORGANISM)	Ricin (Castor bean plant)
DECLARED CONCENTRATED AMOUNT	N/A
DECLARED TOTAL AMOUNT	10 liters (2.7 gallons)
COMMENTS	Production amounts could be higher, but UNSCOM was unable to confirm.

(Table continues on the following page.)

Table 16.1 (continued)

BW-FILLED AND DEPLOYED DELIVERY SYSTEMS	
DELIVERY SYSTEM	Missile warheads—Al Hussein (modified Scud—B) <i>Anthrax: 5</i> <i>Botulinum Toxin: 16</i> <i>Aflatoxin: 4</i>
COMMENTS	UNSCOM could not confirm the unilateral destruction of these 25 warheads because of conflicting accounts provided by Iraq.
DELIVERY SYSTEM	R-400 aerial bombs <i>Anthrax: 50</i> <i>Botulinum Toxin: 100</i> <i>Aflatoxin: 7</i>
COMMENTS	Iraq claimed unilateral destruction of 157 bombs, but UNSCOM was unable to confirm that number. UNSCOM has found the remains of at least 23.
DELIVERY SYSTEM	Aircraft aerosol spray tanks (F-1 Mirage modified fuel drop tank) <i>Anthrax: 4</i>
COMMENTS	Iraq claims to have produced four but may have manufactured others.
BW AGENT GROWTH MEDIA	
QUANTITY IMPORTED	31,000 kg (68,200 lbs)
UNACCOUNTED FOR AMOUNTS	3,500 kg (7,700 lbs)
B. Iraqi Chemical Warfare Program	
CW AGENT STOCKPILES	
CHEMICAL AGENT	VX <i>Declared by Iraq: at least 4 metric tons</i> <i>Potential based on unaccounted precursors: 200 metric tons</i>
COMMENTS	Iraq denied producing VX until Hussein Kamil's defection in 1995.
CHEMICAL AGENT	G agents (sarin) <i>Declared by Iraq: 100–150 metric tons</i> <i>Potential based on unaccounted precursors: 200 metric tons</i>
COMMENTS	Figures include both weaponized and bulk agents.

CW AGENT STOCKPILES (CONTINUED)	
CHEMICAL AGENT	Mustard <i>Declared by Iraq: 500–600 metric tons</i> <i>Potential based on unaccounted precursors: 200 metric tons</i>
COMMENTS	Figures include both weaponized and bulk agents.
CW DELIVERY SYSTEMS	
DELIVERY SYSTEM	Missile warheads—Al Hussein (modified Scud—B) <i>Estimated number before the Gulf War: 75–100</i> <i>Munitions unaccounted for:² 45–70</i>
COMMENTS	UNSCOM supervised the destruction of 30 warheads
DELIVERY SYSTEM	Rockets <i>Estimated number before the Gulf War: 100,000</i> <i>Munitions unaccounted for:² 15,000–25,000</i>
COMMENTS	UNSCOM supervised the destruction of nearly 40,000 chemical munitions (including rockets, artillery, and aerial bombs), 28,000 of which were filled.
DELIVERY SYSTEM	Aerial bombs <i>Estimated number before the Gulf War: 16,000</i> <i>Munitions unaccounted for:² 2,000</i>
DELIVERY SYSTEM	Artillery shells <i>Estimated number before the Gulf War: 30,000</i> <i>Munitions unaccounted for:² 15,000</i>
DELIVERY SYSTEMS	Aerial spray tanks <i>Estimated numbers before the Gulf War: Unknown</i> <i>Munitions unaccounted for:² Unknown</i>
C. Iraqi Ballistic Missile Program	
ITEM	Soviet-supplied Scud missiles (includes Iraqi modifications of the Scud: the Al Hussein, with a range of 650 km, and the Al-Abbas, with a range of 950 km)
INITIAL INVENTORY	819
COMMENTS	UNSCOM accepted Iraqi accounting for all but two of the original 819 Scud missiles acquired

(Table continues on the following page.)

Table 16.1 (continued)

C. Iraqi Ballistic Missile Program (continued)	
	from the Soviet Union. Iraq has not explained the disposition of major components that it may have stripped from operational missiles before their destruction, and some Iraqi claims—such as of the use of 14 Scuds in ATBM tests—are not believable. Gaps in Iraqi declarations and Baghdad's failure to account fully for indigenous missile programs strongly suggest that Iraq retains a small missile force.
ITEM	Iraqi-produced Scud missiles
INITIAL INVENTORY	Unknown
COMMENTS	Iraq denied producing a completed Scud missile, but it produced or procured and tested all major subcomponents.
ITEM	Iraq-produced Scud warheads
INITIAL INVENTORY	120
COMMENTS	Iraq claims all 120 were used or destroyed. UNSCOM supervised the destruction of 15. UNSCOM inspections found additional CW and BW warheads beyond those currently admitted.
ITEM	Iraqi-produced Scud airframes
INITIAL INVENTORY	2
COMMENTS	Iraq claims testing two indigenous airframes in 1990. It is unlikely that Iraq produced only two Scud airframes.
ITEM	Iraqi-produced Scud engines
INITIAL INVENTORY	80
COMMENTS	Iraq's claim that it melted 63 engines following acceptance tests—53 of which failed quality controls—are unverifiable and not believable. The United Nations is holding this as an open issue.
ITEM	Soviet-supplied missile launchers
INITIAL INVENTORY	11
COMMENTS	UNSCOM doubted Iraq's claim that it unilaterally destroyed five launchers. The Soviet Union may have sold more than the declared 11 launchers.

C. Iraqi Ballistic Missile Program (continued)

ITEM	Iraqi-produced missile launchers
INITIAL INVENTORY	8
COMMENTS	Iraq has the capability to produce additional launchers.

NOTES

1. "Total" refers to the amount of material obtained from the production process, while "concentrated" refers to the amount of concentrated agent obtained after final filtration and purification. The concentrated number is the amount used to fill munitions.
2. All these munitions could be used to deliver CW or BW agents. The numbers for missile warheads include 25 that Iraq claims to have unilaterally destroyed after having filled them with biological agents during the Gulf War. UNSCOM was unable to verify the destruction of these warheads.

Table 16.2: **Iraq: Nuclear Infrastructure**

NAME/LOCATION OF FACILITY	TYPE/STATUS	IAEA SAFEGUARDS ¹
NUCLEAR WEAPONS COMPLEX		
Al Atheer	Prime development and testing complex for nuclear weaponization program; large-scale uranium metallurgy that could produce reflectors, tampers, and other weapons components; location of two isostatic presses (hot and cold) suitable for making shaped charges, plus other remote-controlled machining equipment suitable for production of explosive structures. Operational until damaged by Coalition air attacks (1991); subsequently destroyed by IAEA inspectors.	NPT violation
Al Tuwaitha	Nuclear physics and uranium metallurgy laboratories; research and development (R&D) in triggering system capacitors; possible site for experimental work on neutronic initiators. Operational until damaged by Coalition air attacks (1991); under IAEA monitoring.	NPT violation
Al Qa Qaa	Military R&D facility; development and fabrication of exploding bridge wire detonators and high-explosive lenses (plane and spherical); site of shock-wave and high-explosive experiments; storage of large quantities of HMX high explosive; under IAEA monitoring.	NPT violation
Al Musaiyib (Al Hateen establishment)	High-explosive testing site; facility for hydrodynamic studies; facilities and equipment destroyed by the IAEA	NPT violation
Al Hadre	Open firing range for fuel-air bombs and fragmentation testing, suitable for experimentation with entire non-nuclear explosive structure of an implosion-type nuclear device; damaged by Coalition (1991) air attacks; under IAEA monitoring.	NPT violation
RESEARCH REACTORS		
Osiraq/Tammuz I	Light-water, HEU, 40-MWt; destroyed by Israeli air attack (1981).	Yes
Isis/Tammuz II	Light-water, HEU, 800-KWt; operational until destroyed by Coalition air attack (1991)	Yes
IRT-5000	Light-water, HEU, 5-MWt; operational until destroyed by Coalition air attack (1991)	Yes

URANIUM ENRICHMENT		
Al Tuwaitha	Prototype-scale, electromagnetic isotope separation (EMIS) method; operational until damaged by Coalition air attack (1991)	IAEA violation
Al Tuwaitha	Prototype-scale, gas-centrifuge method; operations relocated to Rashdiya in 1987	IAEA violation
Rashdiya	Prototype-scale, gas-centrifuge method; operations terminated at the outbreak of the 1991 Gulf War; under IAEA monitoring	IAEA violation
Al Tuwaitha	Laboratory-scale, chemical exchange isotope separation method; operational until damaged by Coalition air attack (1991)	IAEA violation
Al Tarmiya	Industrial-scale, EMIS method; ² partially operational until damaged by Coalition air attack (1991); EMIS-related installations and equipment subsequently destroyed by IAEA	IAEA violation
Ash Sharqat	Industrial-scale, EMIS method; under construction until damaged by Coalition air attack (1991); EMIS-related installations and equipment subsequently destroyed by IAEA	IAEA violation?
Al Furat	Large manufacturing and testing facility for centrifuge production; under construction until it came under IAEA monitoring.	IAEA violation?
REPROCESSING (PLUTONIUM EXTRACTION)		
Al Tuwaitha	Laboratory-scale; three hot cells used for separating plutonium from irradiated uranium; operations terminated as a result of Gulf War (1991); equipment largely escaped damage; destroyed or rendered inoperable subsequently by IAEA inspectors	IAEA violation ³
URANIUM PROCESSING		
Akashat	Uranium mine; operational until damaged by Coalition air attack (1991)	N/A
Al Qaim	Phosphate plant that produced uranium concentrate (U ₃ O ₈); operational until damaged by Coalition air attack (1991); recovered material under IAEA monitoring	N/A

(Table continues on the following page.)

Table 16.2 (continued)

NAME/LOCATION OF FACILITY	TYPE/STATUS	IAEA SAFEGUARDS ¹
URANIUM PROCESSING (CONTINUED)		
Al Tuwaitha	Laboratory-scale uranium purification facility (UO ₂); operational until heavily damaged by Coalition air attack (1991); recovered equipment under IAEA monitoring	IAEA violation
Al Tuwaitha	Laboratory-scale, uranium tetrachloride facility (UCL ₄); operational until heavily damaged by Coalition air attack (1991); recovered equipment under IAEA monitoring	IAEA violation
Al Tuwaitha	Laboratory-scale production of uranium hexafluoride (UF ₆); operational until damaged by Coalition air attack (1991)	IAEA violation
Al Tuwaitha	Fuel-fabrication laboratory; operational until destroyed by Coalition air attack (1991); recovered nuclear material under IAEA monitoring	IAEA violation
Mosul (Al Jesira)	Industrial-scale, uranium tetrachloride facility (UCL ₄); operational until damaged by Coalition air attack (1991)	IAEA violation
Mosul (Al Jesira)	Production-scale uranium purification facility (UO ₂); operational until heavily damaged by Coalition air attack (1991); production area sustained greatest damage by subsequent Iraqi deception activities.	IAEA violation

Abbreviations

HEU	highly enriched uranium	MWt	millions of watts of thermal output
LEU	low-enriched uranium	kWt	thousands of watts of thermal output
MWe	millions of watts of electrical output	N/A	not applicable

NOTES

1. For the purposes of this table, the designations “Yes” and “N/A” (“not applicable”) are used to describe the safeguards in place before the 1991 Gulf War at facilities processing or using nuclear materials that were declared by Iraq to the IAEA under Iraq’s safeguard agreement with the IAEA (INFCIRC/172). “IAEA violation” denotes clandestine facilities involved in processing or using nuclear materials that were discovered in the course of the postwar IAEA inspections and found by the IAEA to be violations of the IAEA–Iraq safeguard agreement. “NPT violation” denotes clandestine facilities that were discovered in the course of the postwar IAEA inspections and were involved in nuclear weapons-related activities inconsistent with Iraq’s NPT pledge not to manufacture nuclear arms.

2. Component manufacturing facilities for the Iraqi EMIS program were located at: Al Ameen (prototype components); Al Radwan and Al Amir (magnet cores, return irons, ion sources, collector parts); Sehee at Daura (vacuum chamber parts); Salladine (electrical control panel assembly); and Tuwaittha (coil manufacturing).
3. One of the fuel elements processed was from the IRT-5000 reactor and was exempt from safeguards under article 37 of INFCIRC/172, Iraq's safeguard agreement with the IAEA. The other three were fabricated indigenously from undeclared nuclear material, in violation of the safeguard agreement. A total of 6 grams of plutonium was recovered.



1 Al Tuwaitha Nuclear Research Center Tammuz I (Osiraq), Tammuz II (Isis), and IRT-5000 research reactors (the first destroyed by Israel in 1981); subject to IAEA inspection prior to Gulf War.

Site of research and development (R&D) programs in uranium enrichment, including gas centrifuges, electromagnetic isotope separation (EMIS), chemical separation, and gaseous diffusion.*

Location of “hot cells” used for separation of grams of plutonium.*
Experimental program for the production of lithium-6 which, if irradiated in a reactor, yields tritium for use in advanced nuclear weapons. Weapons-related R&D activities in nuclear physics, uranium metallurgy, and triggering system capacitors.**

2 Al Atheer Prime development and testing site for nuclear weaponization program, including facilities and equipment for large-scale uranium metallurgy and production of weapons components; computer simulations of nuclear weapon detonations; and experiments for the development of an implosion-type explosive structure in nearby “bunker” at Al-Hateen. Possible testing of explosive structures at Al Hadre.**

3 Al Qa Qaa High Explosives and Propellant Facility Military and nuclear weapons R&D facility; development of exploding bridge wire detonators (EBW) used in the firing system of nuclear weapons; high-explosive experiments; storage of large quantities of HMX high explosive used in nuclear weapons.**

4 Rashdiya Central site of Iraq’s centrifuge research and development efforts.

5 Al Tarmiya Industrial-scale complex for EMIS designed for the installation of 70 1,200-millimeter separators plus 20 600-millimeter separators. Eight units were operational prior to Desert Storm bombings; if all separators had been installed, plant could have yielded 15 kg of HEU annually, possibly enough for one nuclear weapon. Replica facilities were under construction at Ash Sharqat.*

6 Al Furat Project Large-scale manufacturing and testing facility, designed for the production of centrifuges for uranium enrichment. Site of a planned 100-centrifuge experimental cascade, with an initial operational capability by mid-1993. A 1000-centrifuge cascade was to be built at Taji.*

7 Al Jesira Large-scale facility for the production of uranium dioxide (UO₂) and uranium tetrachloride (UC₄), feed materials for EMIS. Intended site for the production of uranium hexafluoride (UF₆) to feed the centrifuge enrichment program.*

* Activities found by IAEA to be in violation of Iraq’s safeguard agreement with the IAEA.

** Activities found by the United States to be in violation of Iraq’s obligations under Article II of the Nuclear Non-Proliferation Treaty (NPT) prohibiting the “manufacture” of nuclear weapons.

Italicized names on map represent nuclear-related sites either declared by Iraq or discovered by IAEA inspectors during implementation of U.N. Security Council Resolution 687 adopted at the end of the 1991 Gulf War. The facilities and equipment at these sites that escaped damage during the war were subsequently dismantled or destroyed by the IAEA or came under IAEA monitoring; sensitive nuclear materials have been removed. See table 16.2

