



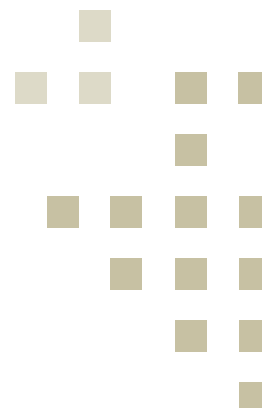
[644] Paper

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Nuclear Dimensions of the Iraqi Crisis

Morten Bremer Mærli

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Nuclear Dimensions of the Iraqi Crisis¹

In accordance with Resolution 1441,² unanimously passed by the UN Security Council, Iraq on November 7th, 2002, submitted a declaration of its activities concerning weapons of mass destruction (WMD).³ Copies of the declaration were forwarded to the International Atomic Energy Agency (IAEA) and later to the permanent members of the Security Council. The declaration described the various methods used by Iraq in trying to produce nuclear material suitable for weapons, as well as the many sites involved in the nuclear program.⁴ In the nearly 12,000-page document Iraq claimed that it had no current WMD programs. However, intelligence analysts from the United States and other nations immediately began to scrutinize the document, and senior US officials quickly rejected the claims made by Iraq.⁵

January 27, 2003, the UN inspectors currently working inside Iraq reported back to the Security Council about their preliminary findings. UN weapons inspection chief Hans Blix then said Iraq had not genuinely accepted the UN resolution demanding that it disarm.⁶ During the same brief, Mohamed ElBaradei, Director-General of the IAEA, said his inspectors had found no prohibited nuclear activity at new sites visited in Iraq, but that his teams needed an additional «few months» to complete the search. He added that the infrastructure for effective inspections was now in place. However, US ambassador to the United Nations John Negroponte immediately reacted to the report by claiming that Iraq was failing to comply with UN disarmament demands.⁷

If Iraq fails to disclose its weapons of mass destruction program and disarm fully, the United States stands ready to lead a coalition to disarm Iraqi President Saddam Hussein through military force – even alone if its divided European allies would not join the fight.⁸ Only weeks after it had been submitted, US Secretary of State Colin Powell said the Iraqi declaration was in «material breach» of UN Security Council resolutions and that it totally «fails to move us in the direction of a peaceful solution.»⁹ February 5, 2003, Powell

1 Henrik Thune and Brikt Harr Vaage contributed inputs and comments during the preparation of this research note. Paul Rogers provided useful background information. Any mistakes or inaccuracies, however, are of course the full responsibility of the author.

2 The text can be found at <http://www.cnn.com/2002/US/11/08/resolution.text/index.html>

3 The Iraqi dossier included more than 11,800 pages and 12 CD-ROMs containing 529 megabytes of information.

4 According to the table of contents of the dossier, 443 pages are devoted to the Iraqi nuclear program; see <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd16.pdf> .

5 Jeffrey Richelson, «Iraq and Weapons of Mass Destruction», *National Security Archive Electronic Briefing Book* no. 80, December 20, 2002, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/>

6 Statement by Hans Blix to the UN Security Council, January 27, 2003.

7 CNN, «U.S. urges U.N. to get tougher on Iraq», January 27, 2003, <http://www.cnn.com/2003/US/01/27/sprj.irq.wrap/index.html>

8 Mark Landler and Alan Cowell, «Powell, in Europe, Nearly Dismisses U.N.'s Iraq report», *New York Times*, January 23, 2003, <http://www.nytimes.com/2003/01/27/international/middleeast/27IRAQ.html?todaysh headlines>

9 CNN, «Powell Lays Out Path in Iraq Dispute», December 19, 2002, <http://www.cnn.com/2002/US/12/19/sproject.irq.us.iraq.war/index.html>

used images, audiotapes and anecdotal points during his presentation to the UN Security Council to describe what he said is Iraq's deception of the UN weapons inspection program.

This situation opens up for an array of scenarios, some of which *could* involve the use of nuclear weapons. Through a set of questions and answers, this research note will assess the likelihood of nuclear weapons being used in the conjunction with the Iraqi crisis. The conclusion is that, although the risk for now is limited, it is still not negligible. If anything, the most immediate nuclear threat emanates not from Saddam Hussein's own nuclear capabilities, but in fact from US – and possibly British – forces in a response to Iraqi biological or chemical weapons.

Does Iraq possess nuclear weapons?

After UNSCOM and the International Atomic Energy Agency were forced to leave Iraq in 1998, confusion has remained within the international community about the country's nuclear capabilities. Former key Iraqi nuclear scientists now in exile portray the Iraqi nuclear program as well advanced,¹⁰ although questions have been raised about their credibility and possible hidden agendas.¹¹ Reportedly, IAEA officials – and even US intelligence experts – privately put scant faith in the claims of various Iraqi defectors that Iraq retains the ability to make fissile material, has extensive covert fissile material production facilities, and has workable bomb designs small enough to be used in missile warheads.¹²

According to ElBaradei in December 1998, when the inspections came to an abrupt halt, the IAEA had neutralized the Iraqi nuclear program.¹³ Damage from Operation Desert Storm had virtually incapacitated the country's nuclear weapons infrastructure, but UNSCOM and IAEA proved even more effective in destroying Iraq's nuclear program than the coalition bombers.¹⁴ At that time the agency was thus confident it had not missed any significant component of Iraq's nuclear program. On November 27, 2002, the IAEA was

10 Khidhir Hamza is the source of many headlines claiming that Iraq is on the verge of (or already has) nuclear weapon capability. He has been portrayed as a key Iraqi bombmaker. See e.g. Khidhir Hamza with Jeff Stein, *Saddam's Bombmaker: The Daring Escape of the Man Who Built Iraq's Secret Weapon*, Touchstone, October 2001.

11 See e.g. Norman Dombey, «What Has He Got?», *The London Review of Books*, October 17, 2002, p. 27.

12 Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 10, <http://www.csis.org/hill/ts020731cord.pdf>

13 Remarks by Director General Mohamed ElBaradei, International Atomic Energy Agency, at the *Carnegie International Non-Proliferation Conference*, Washington D.C., November 14-15, 2002, <http://www.ceip.org/files/projects/npp/pdf/conference/speeches/Elbaradei.pdf> .

14 Anthony H. Cordesman, *Iraq and the War of Sanctions: Conventional Threats and Weapons of Mass Destruction*, Praeger, Westport, CT, 1999, p. 647.

able to resume its inspection activities.¹⁵ As of the end of January 2003, the IAEA has found no evidence that Iraq has revived its nuclear program since the elimination of the program in the 1990s.¹⁶

In any case, Iraq's nuclear *ambitions* remain unquestionable and probably quite comprehensive. What stands between Saddam Hussein and nuclear capabilities are rather technical capacities and competence than lack of motivation. Past inspections have revealed clandestine uranium enrichment programs and «repeated and willful non-compliance with past Security Council Resolutions (SCR 687 and 707) and violation of UN/IAEA privileges and immunities».¹⁷ After the last round of inspections, remaining questions and concerns regarding Iraq's nuclear program relate to:¹⁸ uncertainty about the progress made in weapons design and centrifuge development due to the lack of relevant documentation; the extent of external assistance from which Iraq had benefited; and the lack of evidence that Iraq had abandoned definitively its nuclear program.

Key questions for consideration now are thus:

- if and to what extent Iraq has been able to reinstall pre-1991 nuclear capacities (i.e. from the time before the inspections started),
- the potentials for a nuclear crash-program,
- whether Iraq managed to hide vital parts of its nuclear weapon program from the inspections in the 1990s,
- Additionally, the prospects for Iraq developing and deploying so-called radiological dispersal devices are a special case that needs to be considered.

15 For an assessment and a summary of the inspection activities since then, see David Cortright, Alistair Millar, George A. Lopez, and Linda Gerber, «UN Weapon Inspections in Iraq: A Progress Report, published by the Forth Freedom Forum and Joan B. Koch Institute for International Peace Studies at the University of Notre Dame, January 23, 2003, p. 10, David Cortright, Alistair Millar, George A. Lopez, and Linda Gerber, «UN Weapon Inspections in Iraq: A Progress Report, published by the Forth Freedom Forum and Joan B. Koch Institute for International Peace Studies at the University of Notre Dame, January 23, 2003, www.fourthfreedom.org/pdf/inspections_report.pdf

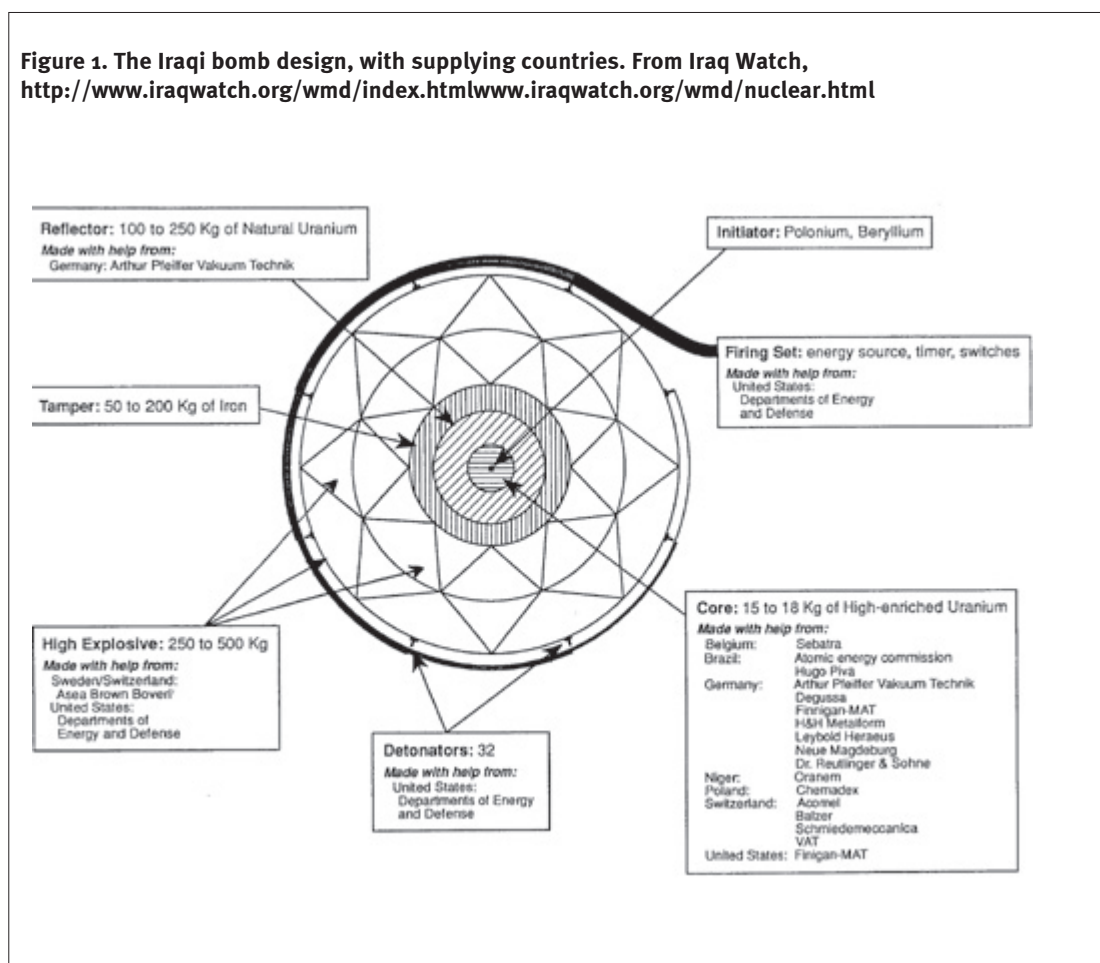
16 Statement given by IAEA Director ElBaradei to the UN Security Council, January 27, 2003.

17 From a letter dated 6 October 1997 from the Director General of the International Atomic Energy Agency to the Secretary General. The complete document, with attachments, is available at <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd06.pdf> Part one of the report attached to the letter describes the work done by the IAEA during the period April 1 to October 1, 1997, in monitoring and verifying Iraqi compliance with the nuclear disarmament provisions of UN Resolution 687 (1991). It includes an extensive summary of the technical discussions between IAEA and Iraq. The second part of the report provides an overview of IAEA activities since 1991 related to on-site inspection of Iraqi's nuclear capabilities and the destruction, removal, or neutralization of Iraqi nuclear weapons or nuclear weapons related material or facilities.

18 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

Question: Could the nuclear capacities of Iraq possibly have been reinstalled?

Since the end of the 1990s, Saddam Hussein has tried covertly to acquire technology and materials that could be used in the production of nuclear material; moreover, he is reported to have recalled scientists to work on Iraq's nuclear weapon program.¹⁹ Allegedly, Saddam Hussein has repeatedly met with his nuclear scientists over the past two years, signaling his continued interest in developing the nuclear program.²⁰ This does not, however, mean he has succeeded. The potential for Iraq's reinstalling its nuclear weapon



¹⁹ Based on «Iraq's Weapons of Mass Destruction», *The Assessment of the British Government, Stationary Office*, September 24, 2002, p. 19, http://www.mod.uk/linked_files/iraq/wmd.pdf

²⁰ U.S. State Department, *A Decade of Deception and Defiance*, September 12, 2002, p.10, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd10.pdf>

capacity can best be understood by looking at the state and magnitude of the country's earlier nuclear weapon ambitions, and at challenges to its production of nuclear weapons in the past.²¹

Iraq has been pursuing an implosion weapon (see figure 1, page 8). This is a first-generation nuclear weapon design, used in 1945 in Nagasaki. However, while the USA then used plutonium, the Iraqi design is based on highly enriched uranium (HEU). The design is fairly crude, but more complicated and less reliable than gun-type weapons. Space constraints, where a gun-type weapon easily becomes too large to fit into a missile, led Iraq to focus on the more advanced implosion design. Moreover, the Israeli bombing of the Osiraq research reactor in 1981 represented a severe blow to the plutonium path, and may very well have contributed to Iraq's decision to focus on HEU.

The fission weapon consists of HEU for the weapon core, explosives to compress the core rapidly, and sophisticated electronics to fire the explosives simultaneously.²² The reflector returns neutrons that otherwise would have escaped back to the core, and the tamper suppresses the expansion of the system after the chain reaction has been initiated. Iraq has also admitted to studying several approaches to building a neutron initiator, which is what supplies the neutrons necessary to set off a nuclear chain reaction. To boost weapons efficiency, Iraq produced and recovered tritium by irradiating lithium, and produced and recovered polonium by irradiating bismuth.²³

On *paper*, Iraq may thus have a workable nuclear design.²⁴ In practice, however, things probably look different. Prior to the Gulf War the Iraqis had successfully overcome some, but certainly not all, of the obstacles to a workable device. Iraq still had significant hurdles to overcome before being able to complete the fabrication of a first nuclear implosion device.²⁵ Despite having made progress in the high-explosive testing program, the Iraqi scientists were struggling to master conventional charges that must be precisely fabricated in order to produce simultaneous and homogenous shock-waves towards the core after ignition.²⁶ Using HEU, a completed weapon based on the latest Iraqi design might, moreover, have weighed about one ton – clearly a device that it would have been hard to deliver with a missile.²⁷

21 For a comprehensive summary of Iraqi nuclear ambitions and program see. Chapter 19 in Anthony Cordesman, *Iraq and the War of Sanctions: Conventional Threats and Weapons of Mass Destruction*, Praeger, Westport, CT, 1999.

22 Based on «Iraq's Weapons of Mass Destruction», *The Assessment of the British Government*, Stationary Office, September 24, 2002, p. 24, http://www.mod.uk/linked_files/iraq/wmd.pdf

23 The Iraq Watch, <http://www.iraqwatch.org/wmd/nuclear.html>

24 Joseph Cirincione, John Wolfsthal and Miriam Rajkumar, *Deadly Arsenals. Tracking Weapons of Mass Destruction*, Carnegie Endowment for International Peace, Washington DC, 2002, p. 271.

25 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

26 *Ibid.*, p. 275.

27 The Federation of American Scientists, «Iraqi Nuclear Weapons», <http://www.fas.org/nuke/guide/iraq/nuke/program.htm>

However, the major challenge facing Iraq in its pursuit of nuclear weapons is to acquire fissile material in sufficient qualities and quantities. Fissile material is the essential component of any nuclear device. Fundamental to nuclear weapon production is thus the plutonium separation of spent fuel or enrichment of uranium. These are substantial steps, and the primary reason why nuclear weapons are hard to produce – for Iraq and for any other actors.

Iraq's design called for 93% enriched uranium, which required multiple stages of enrichment. Iraq had extensive programs to produce weapons-usable material along a range of different, and virtually all available, paths.²⁸ *Efforts included Electromagnetic Isotope Separation (EMIS), centrifuges, Laser Isotopic Separation (LIS), chemical and ion-exchange separation, gaseous diffusion, and diversion of reactor fuel and plutonium separation.*²⁹ *None of these efforts seem to have been sufficiently successful to produce fissionable materials for a workable nuclear device.*

Electromagnetic Isotope Separation (EMIS)

EMIS enrichment technology was abandoned by the United States in the 1950s because of its high consumption of electricity, but was adopted by the Iraqis because of its relative simplicity and their ability to procure the magnet material without encountering technology transfer obstacles.³⁰ For a long while, the EMIS program went undetected as it did not rely on state-of-the-art, imported equipment that could have revealed the efforts. According to the IAEA, however, calutron designs fell far short of meeting specifications.³¹ Expert estimates of Iraq's ability to enrich uranium with the calutrons were greatly reduced, from an initial high of 40 kilograms of highly enriched uranium down to only milligrams.³²

Centrifuges

Iraq started its gas-centrifuge for uranium enrichment later than its EMIS program.³³

Both gaseous diffusion and EMIS require enormous amounts of electricity,

28 An overview of Iraqi nuclear sites can be found at <http://www.ceip.org/files/Iraq/index.htm>

29 Plutonium may as well be applied in implosion designs, and this may explain why Iraq has diverged from the uranium path. The use of plutonium, however, introduces even higher construction challenges.

30 The Federation of American Scientists, «Uranium Production», <http://www.fas.org/nuke/intro/nuke/uranium.htm>

31 Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 10, <http://www.csis.org/hill/ts020731cord.pdf>

32 David Albright and Mark Hibbs, «Iraq: News the Front Page Missed», *The Bulletin of the Atomic Scientists*, Vol. 47, no. 8, October 1991, <http://www.thebulletin.org/issues/1991/o91/o91reports.html>

33 Centrifuge separation works by passing uranium molecules in gaseous form (UF₆) through

and Iraq's centrifuge designs proved far less efficient during laboratory review than initially estimated.³⁴ As with other enrichment techniques, centrifuges require several repetitions with the enriched product to reach a concentration high enough to serve as weapons-grade material.

For the centrifuge program, Iraq relied heavily on foreign contractors who were willing to circumvent export controls and to sell classified design information and technology and equipment parts on early Western-type centrifuges.³⁵ The willingness to seize such business opportunities has now probably been drastically reduced, not least due to the revelations of key international suppliers in Iraq's dossier provided to the Security Council. Concerns raised by US and British officials about Iraqi attempts to acquire high-strength aluminum tubes for uranium enrichment using gas centrifuges were refuted by the IAEA. According to IAEA Director ElBaradei, the tubes are not directly suitable for the manufacture of uranium centrifuges.³⁶ The claims were, however, maintained by US Secretary of State Colin Powell during his February 7, 2003 presentation to the UN Security Council. The case is now being further investigated.³⁷

Laser Isotopic Separation

In May 1994 the IAEA received information indicating that Iraq had pursued laser uranium enrichment through both molecular and atomic vapor isotope separation. But the IAEA did not believe that Iraq had made substantial progress in either.³⁸ Iraq later admitted to having had an exploratory laser

high-speed rotational machines called centrifuges. The different weights of the uranium isotopes cause them to separate, with the heavier U-238 being thrown to the outside of the centrifuge and the lighter U-235 staying nearer the inside. From The Iraq Watch, <http://www.iraqwatch.org/wmd/nuclear.html>

34 Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 10, <http://www.csis.org/hill/ts020731cord.pdf>

35 Joseph Cirincione, John Wolfsthal and Miriam Rajkumar, *Deadly Arsenals. Tracking Weapons of Mass Destruction*, Carnegie Endowment for International Peace, Washington D.C., 2002, p. 274.

36 David Cortright, Alistair Millar, George A. Lopez, and Linda Gerber, «UN Weapon Inspections in Iraq: A Progress Report, published by the Fourth Freedom Forum and Joan B. Koch Institute for International Peace Studies at the University of Notre Dame, January 23, 2003, p. 10, David Cortright, Alistair Millar, George A. Lopez, and Linda Gerber, «UN Weapon Inspections in Iraq: A Progress Report, published by the Fourth Freedom Forum and the Joan B. Koch Institute for International Peace Studies at the University of Notre Dame, January 23, 2003, p. 10, www.fourthfreedom.org/pdf/inspections_report.pdf

37 Statement given by IAEA Director ElBaradei to the UN Security Council, January 27, 2003.

38 Because isotopes of different masses absorb different wavelengths of light, uranium isotopes can be separated by lasers precisely tuned to excite or ionize only the U-235 atoms in a stream of atomic vapor (atomic vapor laser isotope separation, or AVLIS). The U-235 is then separated out using a chemical reaction or magnetic forces that attract the excited atoms and leave behind the neutral ones. From the Iraq Watch, <http://www.iraqwatch.org/wmd/index.html>

program, a program that had continued up to 1987 without success. On January 16, 2003, UN weapons inspectors discovered at the Baghdad home of nuclear physicist Faleh Hassan some 2,000 pages of documents related to uranium enrichment through laser technology. However, although atomic and molecular laser isotope separation appears promising, the technology has proven extremely difficult to master and may be beyond the reach of even technically advanced states. A preliminary analysis of the documents suggests that they are not of particular significance in terms of providing new information concerning Iraq's past nuclear program.³⁹

Chemical and Ion-Exchange Separation

On a laboratory scale, Iraq made some progress in chemical (solvent extraction) and ion-exchange methods of uranium enrichment before the Gulf War.⁴⁰ The reason for chemical enrichment was to provide feedstock for the EMIS separators, so they could begin with low enriched uranium instead of natural uranium, thereby boosting efficiency. Without a well-functioning EMIS program, however, this program would have only limited value.

Plutonium Separation

Attempts by Iraqi weapon scientists to produce and separate small quantities of plutonium at IAEA-safeguarded plants (at Tuwaitha) were rudimentary and not very successful. The quantities extracted by 1991 (6 gr.) are far below what is needed for a workable nuclear device. Since then, Iraq may have been able to separate some 60 gr. a year – again a quantity insufficient to produce the five to eight kilos needed for a first nuclear device.⁴¹

Domestic Uranium Stocks

In January 1991, at the beginning of the war, Iraq possessed somewhat more than 10 kg. of unirradiated uranium enriched to 90% and somewhat more uranium enriched to perhaps 80%, irradiated in a reactor.⁴² By 1998, all nuclear material of significance to Iraq's nuclear weapons program was verified and fully accounted for, and all nuclear-weapons-usable nuclear material (plutonium and HEU) was removed from Iraq.⁴³ Today, both natural uranium

39 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

40 The Iraq Watch, <http://www.iraqwatch.org/wmd/index.html>

41 Joseph Cirincione, John Wolfsthal and Miriam Rajkumar, *Deadly Arsenals. Tracking Weapons of Mass Destruction*, Carnegie Endowment for International Peace, Washington DC, 2002, p. 274.

42 Richard L. Garwin and Georges Charpak, *Megawatts and Megatons. A Turning Point in the Nuclear Age?*, Alfred A. Knopf, New York, 2001, p. 351.

43 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)»,

and low-enriched uranium exist in the country. These materials are under IAEA safeguards and are thus controlled by the international community. In accordance with its safeguards obligations, Iraq has allowed the IAEA to inspect these stocks annually.⁴⁴

Several states, among them Brazil, have exported uranium to Iraq in the past. UK allegations that the Iraqis have purchased significant quantities of uranium from Africa,⁴⁵ have, however, been repudiated by independent analysts.⁴⁶ Still, according to the USA, the hiding of uranium procurement from Niger is one of several «*illustrative examples of omissions from the Iraqi declaration to the United Nations Security Council*».⁴⁷ Without more specific information, it has not been possible for the IAEA to draw any conclusions with respect to this issue.⁴⁸

An attempt made by Iraq to divert HEU from its safeguarded research reactor fuel (see below) was probably a clear indication that the uranium enrichment program was still far from production in January 1991.⁴⁹ According to a 2001 US Defense Department report, «Iraq would need five or more years and key foreign assistance» to rebuild its nuclear facilities to enrich sufficient amounts for a nuclear weapon. This time estimate has remained more or less constant, compared with similar US assessments performed during the mid-1990s. This conclusion is, moreover, supported by the September 2002 assessment of the International Institute of Strategic Studies in London, as long as Iraq is not able to acquire externally supplied fissile material (see below).⁵⁰

Answer: Could the nuclear capacities of Iraq possibly have been reinstalled?

Prior to the 1990–91 Gulf War, the Iraqi nuclear weaponization program was comprehensive in nature, though not very successful and still in its early stages. Since 1998, Iraq has had a better chance of reconstituting parts of its nuclear

January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/iaeaIraq/unscreport_290103.html

44 An inspection of a location just outside the Tuwaitha complex was undertaken in December 2002. The inspection confirmed that the IAEA seals, and the inventory of nuclear material, remained intact since the last safeguards inspection in January 2002. From IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/iaeaIraq/unscreport_290103.html

45 «Iraq's Weapons of Mass Destruction», *The Assessment of the British Government*, Stationery Office, September 24, 2002, http://www.mod.uk/linked_files/iraq/wmd.pdf

46 Francois Misser, «Uranium Fantasies», *New African*, November 2002, p. 21.

47 U.S. Department of State, *Fact Sheet*, «*Illustrative Examples of Omissions From the Iraqi Declaration to the United Nations Security Council*», Washington, DC, December 19, 2002, <http://www.state.gov/r/pa/prs/ps/2002/16118pf.htm>

48 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/iaeaIraq/unscreport_290103.html

49 The Federation of American Scientists, «Iraqi Nuclear Weapons», <http://www.fas.org/nuke/guide/iraq/nuke/program.htm>

50 The International Institute of Strategic Studies, «Iraq's Weapons of Mass Destruction. A Net Assessment», *IISS Strategic Dossier*, September 9, 2002.

weapon program, as no international inspectors have been present. Parts of possible nuclear weaponization attempts, in particular theoretical and preparatory (non-nuclear) elements, could thus have been performed clandestinely.

However, while Iraq's nuclear weapon ambitions have been, and probably are, extensive, it is unlikely that the country has managed to reinstall any significant parts of its nuclear weapons program. Given the production difficulties the Iraqis were facing and the massive setbacks represented by the Gulf War and the IAEA inspections, it is unlikely that Iraq possesses any real nuclear weapon capability today. Access to highly enriched uranium or plutonium has long been the most formidable barrier to acquiring nuclear weapon capabilities. Construction and use of new production facilities for fissile material would probably have been detected, and most experts do not believe that Iraq could have completed a facility for producing nuclear weapons-usable material in only a few years.⁵¹

Question: Is there potential for an Iraqi nuclear crash-program?

During the course of the inspections in the 1990s, 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 ones being ready in 1991.⁵² However, this deadline could not have been met, as production of highly enriched uranium had lagged far behind. Following the invasion of Kuwait in August 1990, the lack of fissile material led Iraq to modify the objective of the original plan and to undertake an accelerated program. Weapons-grade material was then extracted from safeguarded research reactor fuel, the design and fabrication of the implosion device were accelerated, a construction site was selected, and a delivery vehicle was developed.⁵³ According to IAEA sources, Iraq was then only a few months away from a bomb.⁵⁴

Now, according to US intelligence, Iraq has stepped up its quest for nuclear weapons and has embarked on a worldwide hunt for materials.⁵⁵ However, as noted, the major obstacle to Iraqi nuclear capabilities remains access to fissile material. Since the 1991 crash-program attempts, the highly enriched uranium has been removed from the country.⁵⁶ Iraq is thus probably further

51 Ibid., p. 26.

52 Joseph Cirincione, John Wolfsthal and Miriam Rajkumar, *Deadly Arsenals. Tracking Weapons of Mass Destruction*, Carnegie Endowment for International Peace, Washington DC, 2002, p. 275.

53 Ibid., loc.cit.

54 Quoted by Norman Dombey, «What Has He Got?», *The London Review of Books*, October 17, 2002, p. 29.

55 Iraq's attempt to buy thousands of specially designed aluminum tubes is often quoted as an indication. See e.g. U.S. State Department, *A Decade of Deception and Defiance*, September 12, 2002, p. 9, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd10.pdf>

56 Norman Dombey, «What Has He Got?», *The London Review of Books*, October 17, 2002, p. 29.

away than ever from making a nuclear weapon from indigenously produced material.⁵⁷

However, if the country is able to acquire externally supplied fissile material, this could significantly reduce the time needed to produce and deploy nuclear weapons. US President Bush claims that «if the Iraqi regime is able to produce, buy, or steal an amount of highly enriched uranium a little larger than a single softball, it could have a nuclear weapon in less than a year.»⁵⁸ If so, the International Institute of Strategic Studies (IISS) has estimated this time range to perhaps «a matter of months».⁵⁹

But even such short-cuts do not circumvent the need for weaponization of the material and the construction of reliable delivery systems. These steps represent particular challenges in themselves, not at least if the size and weight of the designed weapon indicated above is correct. Based on externally supplied material, the number of weapons possible to produce may, moreover, be limited. According to IAEA assessments, Iraq is probably looking for a minimum nuclear force of more than a set of single nuclear weapons – both for deterrence and for possible uses.

A final nuclear crash-program scenario might conceivably involve the commissioning of an intact nuclear device. Illicit transfers of nuclear warheads from former Soviet republics have been reported in the past. None of these news reports, however, ever seems to have been properly substantiated. Moreover, acquisition of a complete warhead may still not circumvent the mentioned challenges with regard to delivery and control of the nuclear device. Locks and codes against unauthorized use of such warheads could also limit usability.

Answer: Is there potential for an Iraqi nuclear crash-program?

Past evidence clearly indicates Iraqi interest in nuclear weapon crash-programs. However, it is unclear how such rapid and swift programs could (suddenly) manage to solve many of the significant and long-term problems Iraq has faced in its earlier nuclear weaponization attempts. The components previously attempted to be rushed into place were all essential elements of a nuclear program. These attempts, which not only were abrogated by the Gulf War, probably also reveal the limitations in any ongoing work. If these pieces could not be put together before, the prospects of a successful crash-program (and a particularly stressful one) would seem low.

57 The International Institute of Strategic Studies, «Iraq's Weapons of Mass Destruction. A Net Assessment», *IISS Strategic Dossier*, September 9, 2002, p. 26.

58 President Bush Outlines Iraqi Threat, «Remarks by the President on Iraq», Cincinnati Museum Center – Cincinnati Union Terminal, Cincinnati, Ohio, October 7, 2002. www.whitehouse.gov/news/releases/2002/10/print/20021007-8.html

59 *Ibid.*, loc.cit.

Clearly, the most formidable barrier – access to highly enriched uranium or plutonium – could be avoided with material supplied from abroad. Estimates then indicate an active deployment period of «months» before Iraq is in possession of nuclear capabilities. President Bush has forcefully embraced this finding. These disturbing estimates, however, may be too «optimistic». Even with the nuclear material in hand, the Iraqis would have to deal with nuclear weapons optimalization and delivery challenges. Moreover, as far as is known, neither Iraq nor any other country has been able to obtain an intact nuclear device or sufficient fissile material from any «black markets» for a nuclear device.⁶⁰

Question: Has Iraq been able to hide parts of its nuclear weapon program?

A major question today is whether Iraq managed to hide away significant parts of its weapon programs during the Gulf War and the subsequent inspections. The preliminary findings of the UN inspectors challenge such assumptions. After the previous round of inspections, there were no indications that there remained in Iraq any physical capability for the production of amounts of nuclear-weapons-usable nuclear material of any practical significance.⁶¹ During this latest round of inspections, the Iraqi authorities have provided access to all facilities visited – including presidential compounds and private residences.⁶²

However, given the magnitude of Iraq's prewar nuclear program, the size of the country, the presence of civilian nuclear programs and domestic nuclear know-how, and the radical control exercised by Saddam Hussein, the prospect of clandestine nuclear weapons activity can certainly not be ruled out. Baghdad has tried to remove nuclear-related equipment like uranium enrichment equipment from clandestine sites before UN inspectors were able to tag and destroy it.⁶³ As mentioned, documents of relevance to uranium enrichment have been found at private homes, suggesting deliberate evasions.⁶⁴

60 The International Institute of Strategic Studies, «Iraq's Weapons of Mass Destruction. A Net Assessment», *IISS Strategic Dossier*, September 9, 2002, p. 26.

61 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

62 This access was granted without conditions and without delay, despite some complaints about the inconvenience or intrusive nature of the inspection activities. IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

63 Tim Trevan, «UNSOCM Faces Entirely New Verification Challenges», *Arms Control Today*, April 1993.

64 Iraq has therefore been urged to implement measures to locate any other documents which may have been retained by individuals and which contain information relevant to Iraq's nuclear and nuclear-related activities and to provide promptly to the IAEA any documents so located documents so located. IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/IaeaIraq/unscreport_290103.html

Moreover, during earlier inspections, there were reports of trucks full of equipment driving away from the back-gates of plants and facilities as the inspectors entered at the front. There have also been reports of mobile systems, of trucks full of advanced laboratory equipment, constantly moving around in the country.⁶⁵

However, by the time the inspectors were withdrawn in 1998, the IAEA had been able to draw a comprehensive and coherent picture of Iraq's past nuclear weapons program (and to dismantle this program).⁶⁶ It should thus be assumed that the IAEA should have a fairly comprehensive picture of where Iraq's nuclear facilities could be located today – particularly if provided with (US) intelligence data. In the first eight weeks of inspections, the IAEA has visited all sites identified by it or by member states as significant. No evidence of ongoing prohibited nuclear or nuclear-related activities at those locations has been detected. Nor have the inspections thus far revealed signs of new nuclear facilities or direct support to any nuclear activity.⁶⁷ For example, in a speech October 7, 2003, President Bush claimed that satellite photos of construction activity at Iraqi nuclear facilities indicated that Iraq was developing nuclear weapons. IAEA inspectors later visited these sites but detected no evidence of prohibited nuclear weapon activity.⁶⁸

As opposed to biological or chemical weaponization attempts, a nuclear weapon program is relatively hard to conceal. Both enrichment and reprocessing plants are large industrial complexes that could be detected using satellite and possibly thermal imagery. Cascades of centrifuges could of course be concealed in multi-story buildings, but Iraq is highly dependent on imports to create such a facility and would probably need outside technical support.⁶⁹ Underground facilities could be spotted by extensive activities on the surface (e.g. people, shipments) and by tracking electricity consumption and transfers to specific regions.

Recent developments in North Korea may be indicative. In October 2002, after being confronted with intelligence evidence from US officials, the country conceded that it had been pursuing the development of nuclear weapons. A clandestine program to produce HEU had been installed, despite promises to the contrary. In 1994, the USA and North Korea found themselves on the verge of war, after a hidden reprocessing facility was discovered. Moreover,

65 Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 11, <http://www.csis.org/hill/ts020731cord.pdf>

66 IAEA, «Update Report for the Security Council Pursuant to Resolution 1441 (2002)», January 27, 2003, http://www.iaea.org/worldatom/Press/Focus/iaeaIraq/unscreport_290103.html

67 Ibid.

68 David Cortright, Alistair Millar, George A. Lopez, and Linda Gerber, «UN Weapon Inspections in Iraq: A Progress Report», published by the Forth Freedom Forum and Joan B. Koch Institute for International Peace Studies at the University of Notre Dame, January 23, 2003, p. 10, www.forthfreedom.org/pdf/inspections_report.pdf

69 Ibid., p. 10.

the transfer of sensitive reprocessing chemicals from China to North Korea was recently exposed. Thus, heavily monitored countries pursuing clandestine production and illicit nuclear transfers would seem to face distinct risks of being detected.

The monitoring and detection abilities of the IAEA have improved steadily over the past decade. Inspectors are now able to use an array of devices including hand-held sensors and high-speed communications technologies, enabling them to analyze data and receive encrypted intelligence in a fraction of the time required only five years ago.⁷⁰ In addition to visual inspections, UN inspectors are thus gathering air, water, soil and dust samples to test Saddam Hussein's claims that his country poses no nuclear threat. Environmental sampling could detect both ongoing and earlier nuclear activities: The inspectors are able to detect minuscule quantities of different radioactive isotopes, from which any earlier nuclear enrichment or reprocessing activities at the facilities can be determined.⁷¹

Finally, Resolution 1441 opens the way for questioning key scientists in the weapons program. To ensure their security and cooperation, such persons can, together with their families, be taken outside the country. To meet international criticism, on January 20, 2003, Iraq struck a deal with the UN, allowing its scientists and officials to be questioned without the presence of government minders.⁷² Under another clause of the deal, the Iraqis agreed to send out their own teams to look for armaments that may have been omitted from the inventory submitted to the UN in December 2002.

Answer: Has Iraq been able to hide parts of its nuclear weapon program?

International inspectors and the intelligence community are likely to possess a fairly comprehensive picture of Iraq's nuclear infrastructure. Clandestine and hidden nuclear weapon production in Iraq cannot, of course, be ruled out. However, attempts at earlier weaponization efforts – in Iraq and elsewhere – have been identified. Moreover, new and intrusive equipment for detection for verification and control could challenge any clandestine Iraqi nuclear activities.

While any remaining (and isolated) parts of the Iraqi program that may have avoided public scrutiny could provide a useful stepping-stone for future nuclear weaponization, its current usability, e.g. for comprehensive nuclear crash-programs, would seem limited. Finally, the country might have been able to hide away small quantities of fissile material. However, these limited quanti-

⁷⁰ Ibid., p. 9.

⁷¹ CNN, «U.N. Lab to Determine Iraq Nuke Status», December 11, 2002 <http://www.cnn.com/2002/TECH/science/12/11/science.saddam.ap/index.html>

⁷² Julian Borger and Helena Smith, «Iraq and UN Reach Deal on Cooperation», *The Guardian*, January 21, 2003, p. 4.

ties, if available, may not suffice for a nuclear weapon, and Iraq would still face the challenges of weaponizing the fissile material.

Question: Does Iraq possess Radiological Dispersal Devices (RDDs)? Like any other state, Iraq would find it easier to acquire radioactive materials for a radiological weapon – or a so-called dirty radioactive bomb – than to assemble a workable nuclear device. Radioactive sources are widely distributed with no international control, and are thus probably fairly accessible. It may be that Iraq has access to radioactive material in sufficient quantities to inflict damage and substantial disruption.

In the past, Iraq has indeed attempted to build RDDs. Iraqi defectors claim to have had taken part in both radioactive material procurement and the development of devices, but such information has not been officially confirmed.⁷³ In 1995, the IAEA and UNSCOM discovered earlier Iraqi efforts aimed at developing a device to scatter lethal radioactive debris. These weapons used irradiated zirconium oxide and were designed to produce an «area denial» weapon for the Iran–Iraq War.⁷⁴ Three prototypes, one ground-level device and two bomb-types, were developed. According to the Iraqis, however, the program did not meet expectations and was later abandoned. Reportedly, the design was inefficient, as well as being far too large to be delivered by missiles available in the Iraqi inventory.⁷⁵

Radioactive material could also be used to create disruption and economic losses without the use of specially designed RDDs. A scenario involving radioactive materials could be the sabotaging of Iraqi oil fields. To sky-rocket oil prices, oil wells could again be set on fire and possibly simultaneously contaminated with chemical or radiological material.⁷⁶

Answer: Does Iraq possess Radiological Dispersal Devices (RDDs)? Iraq is likely to be capable of building a crude radiological weapon. The presence and possible use of such weapons is thus a question not of availability, but of usability. As military devices RRDs have obvious limitations, with a restricted ability inflict acute damages or casualties. Radioactive material may, however, play a role during acts of sabotage, possibly of oil wells, or in denying troops access to/ through limited areas. However, to be effective this requires a certain level of pre-planning on the Iraqi side.

73 The International Institute of Strategic Studies, «Iraq's Weapons of Mass Destruction. A Net Assessment», *IISS Strategic Dossier*, September 9, 2002, p. 26.

74 Anthony H. Cordesman, *Iraq and the War of Sanctions: Conventional Threats and Weapons of Mass Destruction*, Praeger, Westport, CT, 1999, p. 647.

75 The International Institute of Strategic Studies, «Iraq's Weapons of Mass Destruction. A Net Assessment», *IISS Strategic Dossier*, September 9, 2002, p. 26.

76 Paul Rogers raises this possibility in his report *Iraq: Consequences of a War*, Briefing Paper, Oxford Research Group, October 2002, p. 10.

Could allied coalition forces possibly use nuclear weapons?

The possible use of nuclear weapons by any allied coalition forces may seem particularly remote, given the conventional weapon superiority of such forces, coupled with the long-standing threshold against using nuclear weapons, and the fact that the primary role of nuclear weapons has long been to deter others from using such weapons. However, both technical developments in nuclear weapons and recent statements by key allied officials make it necessary to consider this option and associated scenarios.

Question: Could the USA resort to the nuclear option?

On December 11, 2002, the Bush Administration issued a reminder and clarification of its policy that warns any nation contemplating the use of weapons of mass destruction against the United States or its allies that it will face massive retaliation, possibly including nuclear weapons.⁷⁷ In the US dossier, the conventional and nuclear response and defense capabilities of the USA were stressed as an important part of the posture against weapons of mass destruction threats – also in the context of «pre-emptive» strikes.⁷⁸ The same document underlined, however, that «a strong declaratory policy» is an essential element of the contemporary US deterrent posture, along with the full range of political tools to persuade potential adversaries not to seek or use WMD. The threats may thus primarily be of a political nature, meant to deter any stockpiling or use of chemical or biological weapons – thus the strong language. For example, according to Andrew H. Card Jr., the White House Chief of Staff, the United States is prepared to use nuclear weapons if need be against Iraq: «Should Saddam Hussein have any thought that he would use a weapon of mass destruction, he should anticipate that the United States will use whatever means necessary to protect us and the world from a holocaust.»⁷⁹

However, intelligence data indeed show that Saddam Hussein attaches great importance to possessing the weapons of mass destruction which he regards

77 U.S. «National Strategy to Combat Weapons of Mass Destruction», December 2002, <http://www.whitehouse.gov/news/releases/2002/12/WMDStrategy.pdf>. See also CNN, «U.S. Warns Potential Enemies: Retaliation Could Include Nukes», December 11, 2002, <http://www.cnn.com/2002/US/12/11/bush.weapons.security/index.html>

78 The strategy document is an unclassified extract of Top Secret National Security Presidential Directive 17. The unclassified version asserts that «We will not permit the world's most dangerous regimes and terrorists to threaten us with the world's most destructive weapons.» It also notes that «because deterrence may not succeed ... U.S. military forces and appropriate civilian agencies must have the capability to defend against WMD-armed adversaries, including in appropriate cases through pre-emptive measures.» From the *National Security Archive Electronic Briefing Book* No. 80, edited by Jeffrey Richelson, December 20, 2002, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80>

79 Mark Landler and Alan Cowell, «Powell, in Europe, Nearly Dismisses U.N.'s Iraq report», *New York Times*, January 23, 2003, <http://www.nytimes.com/2003/01/27/international/middleeast/27IRAQ.html?todayshdlines>

as the basis for Iraq's regional power – and, according to allied assessments, he is ready to use them.⁸⁰ Declassified information has shown, for instance, that in the fall of 1990, the Iraqi president ordered that plans be drawn up for the airborne delivery of an unspecified biological agent. The probable target was Israel.⁸¹

Even before the USA abandoned its «calculated ambiguity» doctrine, in which the US government in the past was deliberately unclear about its responses,⁸² strong calls were made about the dangers of using nuclear threats to deter biological and chemical weapons attacks. This could easily create a «commitment trap» in which US leaders would «feel compelled to use nuclear weapons after a biological or chemical attack because they believed that adversaries and allies perceive that the US reputation for honoring its commitments was at stake».⁸³ Thus, in an extreme case, Iraqi use of chemical or biological weapons could result in nuclear retaliation by the USA.

The results of a war game conducted in July 1995 may be illustrative. The Global 95 exercise was based on two simultaneous crises, one in Korea and the other in the Persian Gulf, strikingly similar to today's conflict pattern.⁸⁴ The Korea crisis was terminated, but the other escalated to the point where Iraq used biological weapons, with devastating effect against military forces and civilians in the region. In this simulation, the United States retaliated with nuclear weapons to end the war. The escalation was unexpected and, within the rules of the exercise, apparently not subject to control.⁸⁵

The voice of the people may push the USA further in the direction of resorting to nuclear weapons. Today most Americans favor using nuclear weapons against Iraq, should Saddam Hussein attack US military forces with chemical or biological weapons. A December 2002 survey found that 6 in 10 Americans favored a nuclear response if Hussein ordered the use of chemical or biological weapons on US troops.⁸⁶ Moreover, active use of nuclear

80 «Iraq's Weapons of Mass Destruction», *The Assessment of the British Government*, Stationary Office, September 24, 2002, p. 18, http://www.mod.uk/linked_files/iraq/wmd.pdf

81 The first mission was, however, shot down over the Persian Gulf and according to CIA «no efforts were made to find another method to deliver the BW agent». The plan envisioned a conventional air raid employing three MiG-21s, to be followed by another raid involving three MiGs and a SU-22 aircraft that would disperse the biological agent. From CIA, *Iraqi BW Mission Planning*, 1992, a secret document declassified through the Freedom of Information Act and published by the *National Security Archive Electronic Briefing Book* No. 80, edited by Jeffrey Richelson, December 20, 2002, Document 5, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd05.pdf>

82 This doctrine basically left open the US response to biological or chemical attacks, to make any potential adversary unsure of the response.

83 Scott Sagan, «The Commitment Trap», *International Security*, vol. 24, no.4, Spring 2000, p. 113.

84 The exercise is described by Theresa Hitchens, «Wargame Finds U.S. Short in Biowar», *Defense News*, August 28, 1995, and discussed in Paul Rogers, *Iraq: Consequences of a War*, Briefing Paper, Oxford Research Group, October 2002, pp. 11-12

85 Paul Rogers, *Iraq: Consequences of a War*, Briefing Paper, Oxford Research Group, October 2002, p. 12.

86 Richard Morin, «Most Favor Nuclear Option Against Iraq», *Washington Post*, December 18,

weapons was advocated for retaliation after the attacks of September 11, 2001.⁸⁷

Disturbingly, the US nuclear option may not purely be for declaratory or retaliatory purposes. According to the US Nuclear Posture Review, released in December 2001, «new capabilities must be developed to defeat emerging threats such as hard and deeply buried targets (HDBT), to find and attack mobile and relocatable targets, to defeat chemical or biological agents, and to improve accuracy and limit collateral damage».⁸⁸ The range of new capabilities mentioned here includes nuclear weapons, and the attacks could be performed against any state. Options of a nuclear first-strike war may thus be more than a relic of the Cold War years.⁸⁹ To the Bush Administration a low-yield nuclear weapon would, moreover, have greater deterrence value, because of its possible usability. Voices close to the White House have argued that having only high-yield weapons could in fact self-deter the United States, as such weapons are too large to be used in practice.⁹⁰

Thus the USA is developing small, precision-guided and nuclear-tipped missiles to destroy deep underground targets such as command bunkers, and storages with chemical and biological weapons. Reportedly, potential adversaries of the USA have responded to its global striking capabilities by burying key command and control installations and storages deeper and deeper underground and inside mountains.⁹¹ The US Defense Department is certain that Iraq is hiding chemical and biological weapons underneath its vast deserts.⁹² No open-source information, however, seems available to support this. According to intelligence estimates, there are more than 10,000 such «havens» in dozens of countries around the world.⁹³ About one thousand of these caves, tunnels and labyrinths are considered to be of high strategic value because they are suspected of harboring chemical, biological and nuclear weapons, long-range missiles, or control centers.

2002; Page A18, <http://www.washingtonpost.com/wp-dyn/articles/A4014-2002Dec17.html>

87 To retaliate after September 11, 2000, and to raise the bar against future such acts from occurring, a call was made after the attacks to use «at a bare minimum, tactical nuclear capabilities» against bin Laden camps in the deserts of Afghanistan. See Thomas Woodrow, «Time to Use the Nuclear Option», *The Washington Times*, op-ed, September 14, 2001, p. A23. The author was a 22-year veteran intelligence officer, recently resigned from the US Defense Intelligence Agency. At that point, however, the views of author clearly did not represent mainstream US thinking.

88 From the Nuclear Posture Review [Excerpts], Submitted to Congress on December 31, 2001, <http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm>

89 Steven Miller, «The Utility of Nuclear Weapons and the Strategy of No-First-Use», Paper presented at the Pugwash Meeting No. 279, «No First Use of Nuclear Weapons», London, November 15–17, 2002, www.pugwash.org/reports/nw/miller.htm

90 Steven Younger, Head of the Defense Threat Reduction Agency, to Andrew Koch, «The Bunker Nightmare Goes Nuclear», *Popular Science*, December 12, 2002, <http://www.popsci.com/popsci/science/article/0,12543,351094,00.html>

91 «Tiny Nukes», Cover story in *Popular Mechanics*, October 2002, p. 67.

92 Andrew Koch, «The Bunker Nightmare Goes Nuclear», *Popular Science*, December 12, 2002, <http://www.popsci.com/popsci/science/article/0,12543,351094,00.html>

93 Ibid.

Ideally, after burrowing into the buried bunker or weapon storage, the low-yield nuclear device would detonate and melt the surrounding rock into a sealed compartment. In theory, no radioactive releases would thus escape, and the target would be thoroughly destroyed. In practice, however, things probably look different. Robert Nelson, a physicist at Princeton University, has calculated the effects of the so-called «Robust Earth-Penetrator». While it is true that most material would remain within the blast area, a plume of radioactive gases would result. Even if an earth-penetrating missile were somehow able to drill hundreds of feet into the ground and then detonate, the explosion would be likely to shower the surrounding region with highly radioactive dust and gas.⁹⁴ To fully contain the explosion of a 0.1 kiloton weapon (about one-hundredth of the energy of the weapon dropped on Hiroshima), the device would have to penetrate to approximately 70 m.⁹⁵ But for the current bunker-busters, reaching a depth of only 50 feet (slightly more than 15 m.) is still a challenge.⁹⁶

The radioactive fall-out and collateral damage would thus probably be significant. For a 1 kiloton (approximately one-tenth of the yield of the Hiroshima weapon) earth-penetrator detonated in a dense urban area, deaths could number in the tens of thousands.⁹⁷ Detonations outside a city area would lessen the collateral damage. While the explosion itself could destroy facilities buried under nearly 30 m. of granite, such a bunker-busting fission bomb detonated 5 m. underground in a wind of 16 km/hour could result in lethal radiation doses to residents as far as 3 km downwind.⁹⁸

Answer: Could the USA resort to the nuclear option?

Iraq has had strong incentives to improve the efficiency of its chemical and biological weapons over the last decade.⁹⁹ From what is known from earlier Iraqi chemical and biological warfare, scenarios involving such weapons during a military intervention cannot be ruled out. In accordance with current US

94 Robert W. Nelson Low-Yield Earth-Penetrating Nuclear Weapons, *Public Interest Report, The Journal of the Federation of American Scientists*, Volume 54, Number 1, January/February 2001, <http://www.fas.org/faspir/2001/v54n1/weapons.htm> .

95 «Tiny Nukes», Cover story, *Popular Mechanics*, October 2002, p. 67.

96 Sidney Drell, Stanford physicist and long-term advisor to the US government on nuclear weapon issues, quoted by Andrew Koch, «The Bunker Nightmare Goes Nuclear», *Popular Science*, December 12, 2002, <http://www.popsci.com/popsci/science/article/0,12543,351094,00.html>

97 Michael Levi, *Fire in the Hole. Nuclear and Non-Nuclear Options for Counterproliferation*, Working Paper no. 31, Carnegie Endowment for International Peace, November 2002.

98 Ibid.

99 According to Anthony H. Cordesman «there is a broad agreement among experts that Iraq has probably developed effective sprayer and line source-delivery technology since the Gulf war. This is the most lethal way to deliver chemical and biological weapons, and is far more effective than using even advanced missile warheads», from Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 9, <http://www.csis.org/hill/ts020731cord.pdf>

military doctrines, Iraqi use of chemical or biological weapons could – in an extreme case – result in nuclear retaliation by the USA. In the absence of own biological and chemical weapon capabilities, the USA has now resorted to the «big stick» of nuclear weapons to deter the use of biological and chemical weapons. The way from words to action is a long one, but it is an open question how long nuclear threats against biological and chemical attacks could sustain credibility. Deterrence rests upon credible threats. The dilemma of the «commitment trap»– leading up to «compulsory» nuclear use by US forces in response to chemical and biological attacks – could thus eventually push the USA in the nuclear direction.

US nuclear weapons could also be used to take out hardened and buried installations, including possible commando bunkers or storage facilities for biological chemical weapons. The notion of limited and confined nuclear warfare associated with the small, precision-guided nuclear warheads could serve to lower the nuclear threshold. The use of nuclear weapons against underground facilities would, however, probably result in substantial radioactive fallout. This would not only cause severe collateral damage, but could also impede own military forces.

Question: Could other members of allied coalition forces resort to the nuclear option?

The number of participating states in a possible Iraqi military intervention will probably depend on the outcome of the ongoing inspections and the appurtenant process in the UN Security Council. Amongst the most prominent candidates to join in with the USA is the United Kingdom, itself a nuclear weapon state.

Initially, the British contribution will, like that of the USA, involve solely conventional armed force. However, as with the USA, there could be circumstances when Britain would consider using nuclear weapons to respond to or even deter attacks involving chemical or biological weapons.¹⁰⁰ In March 2002, UK Secretary of State for Defence, Geoffrey Hoon, said: «they can be absolutely confident that in the right conditions we would be willing to use our nuclear weapons». «They» specifically referred to the Iraqis, and the statement was confirmed and repeated in a later television interview.¹⁰¹

100 Paul Rogers, *Iraq: Consequences of a War*, Briefing Paper, Oxford Research Group, October 2002, p. 14.

101 Quoted in Paul Rogers, *loc.cit.*.

Answer: *Could other members of allied coalition forces resort to the nuclear option?*

Like the USA, Britain could find itself in a situation where nuclear weapons could have to be contemplated, e.g. after or during a biological attack by Iraq. Statements by key UK officials confirm such a possibility. The UK has not, however, taken the same steps as the United States to remilitarize its nuclear weapons in the form of small tactical nuclear-tipped bunker-busters.

Could other actors involved resort to nuclear weapons?

Finally, the possibility of nuclear inducement by other actors in the region should be discussed. A prime candidate could be Israel, a country with longstanding – albeit undeclared – nuclear capabilities, and possibly terrorists pursuing nuclear weapons.

Question: Could Israel, if attacked, resort to nuclear weapons?

Iraq has openly threatened to escalate the war if attacked by the USA.¹⁰² During the first Gulf War, 39 conventionally armed SCUD missiles were launched by the Iraqis at Israel, probably intended to erode Arab and Islamic coalition support, incite Arab publics, and possibly transform the conflict into one pitting Israel and the United States against some coalition of Arab regimes.¹⁰³ None of these missiles contained biological or chemical material. Iraq did not succeed in escalating the war by attacking Israel in 1991, but there is no guarantee that it will not try again, possibly – depending on current delivery capabilities – with biological or chemical weapons. The current number of operational Iraqi SCUDs could be anywhere between 20 and 80.¹⁰⁴

More elaborate scenarios could involve violent acts by terrorists within Israel, where Iraq might provide suicide-bombers with biological material.¹⁰⁵ Nor can one rule out biological or chemical terrorist acts of other terrorist groups without any formal or practical linkages with Iraq – groups simply seeking to add significant fuel to the fire.

102 Steven E. Miller, «Force, Order, and the Implications of War with Iraq», Working paper presented at Pugwash Meeting No. 276, Pugwash Workshop on Terrorism: Terrorism with WMD, Como Italy, 26–28 September 2002, p. 10.

103 Ibid.

104 Anthony H. Cordesman, «Iraqi War Fighting Capabilities: A Dynamic Net Assessment», *Testimony to the Senate Committee of Foreign Relations*, July 31, 2002, p. 8, <http://www.csis.org/hill/ts020731cord.pdf>

105 As contemplated by Steven E. Miller, «Force, Order, and the Implications of War with Iraq», Working paper presented at Pugwash Meeting No. 276, Pugwash Workshop on Terrorism: Terrorism with WMD, Como, Italy, 26–28 September 2002, p. 10.

Answer: Could Israel, if attacked, resort to nuclear weapons?

Israel is vulnerable to chemical and biological attacks, delivered by both conventional (military) and non-conventional (terrorist) means. Any successful large-scale attack in or on Israel with ties to Iraq during a military crisis would have severe ramifications.

However, it remains an open issue whether Iraq again will attack Israel, and, moreover, if it will do so with biological or chemical weapons. Even in the event of a biological or chemical attack, Israel might respond solely with conventional weaponry. Israel has never officially confirmed its nuclear weapon program, and the country enjoys its current nuclear ambiguity. Revealing its nuclear capabilities would likely cause uproar amongst Arab neighbors, and could thus back-fire on Israel itself.

Question: Is there a nuclear linkage to terrorists?

The greatest fear of President Bush is «that terrorists will find a shortcut to their mad ambitions when an outlaw regime supplies them with the technologies to kill on a massive scale.»¹⁰⁶ According to John Bolton, US *Under Secretary for Arms Control and International Security*, «terrorist groups now seek to acquire chemical, biological, or nuclear weapons any way they can. In parallel, state sponsors of terrorism are actively working to acquire weapons of mass destruction and their missile delivery systems.»¹⁰⁷

Iraq has denied any connection to terrorism. But the Bush Administration has persistently tried to link Al Qaeda and Saddam Hussein, and to reveal a «weapons of mass destruction conspiracy». Speaking at the World Economic Forum on January 26, 2003, US Secretary of State Powell's repeated his assertion that Saddam Hussein has «clear ties» to Al Qaeda and other terrorist groups. The longer he goes without being disarmed of nuclear, chemical and biological weapons, Powell said, the more likely he is «to pass a weapon, share a technology or use these weapons again».¹⁰⁸ News of a «credible report that Islamic extremists affiliated with al Qaeda took possession of a chemical weapon in Iraq last month or late in October» surfaced in mid-December 2002.¹⁰⁹ However, as is often the case with intelligence data, the reported chemical weapon transfer is not backed by open-source evidence.

106 George W. Bush as quoted by John R. Bolton, *US Under Secretary for Arms Control and International Security*, «*The International Aspects of Terrorism and Weapons of Mass Destruction*», Remarks to the Second Global Conference on Nuclear, Bio/Chem Terrorism: Mitigation and Response, The Hudson Institute, Washington, D.C., November 1, 2002 <http://www.state.gov/t/us/rm/14848pf.htm>

107 John R. Bolton, *op.cit.*

108 CNN, « U.S. drafting use-of-force resolution », January 27, 2003, <http://www.cnn.com/2003/US/01/27/sprj.irq.wrap/index.html>

Answer: Is there a nuclear linkage to terrorists?

While Saddam Hussein has a record of sponsoring terrorists, no hard facts have so far been provided to support alleged linkages between him and groups pursuing biological, chemical or nuclear weapon capabilities. This may be due to lack of evidence – or because biological and chemical weapons may extend beyond what states are willing to provide to support sub-national groups. Traditionally, state sponsoring of terrorists has involved safe havens and immunity, conventional weapons training, equipment, and logistics, and financial support.

Iraq's lack of nuclear weapon capabilities renders, of course, any assistance in this field particularly difficult, so the nuclear terrorist threat would seem limited.

Conclusions

The overall risk of a nuclear outcome to the Iraqi crisis may be limited, but it is not negligible.

Iraq's nuclear ambitions have been ambitious – nearly all technical options available have been pursued in the country's efforts to acquire fissile material. And yet, Iraq now seems farther than ever from nuclear weapon capabilities. Of possible weapons – biological, chemical or nuclear – the latter seem the furthest from the Iraqi grasp. Iraq's pre-Gulf War nuclear infrastructure and material assets were effectively disarmed by 1998, when the UN inspectors had to leave the country. Subsequent sanctions and close international monitoring have rendered any substantial rebuilding of the program difficult. It thus appears unlikely that Iraq today has an operational nuclear weapon infrastructure, or a clandestine nuclear weapon capability. To date, the IAEA has found no evidence that Iraq has revived its nuclear program since the elimination of the program in the 1990s.¹¹⁰

For any other state actors who might become involved in the conflict, several constraining factors mitigate against the use of nuclear weapons. First of all, the vast majority of states still perceive nuclear weapons as weapons of last resort, and as a tool to deter others from using such weapons, through the prospects of massive retaliation. Strong «nuclear taboos» prevail, and any state resorting to first-use of such weapons would be likely to face heavy stigmatization and enormous political costs. For Israel, special considerations may be particularly important, as the country most probably would be reluctant to forswear its long-standing nuclear-weapon ambiguity. Secondly, from what is known about past (and limited) effects of biological and chemical attacks, the

109 Barton Gellman, « U.S. Suspects Al Qaeda Got Nerve Agent From Iraqis », *Washington Post*, December 12,

110 Statement given by IAEA Director ElBaradei to the UN Security Council, January 27, 2003.

use of such weaponry may not be sufficient to justify the extensive damage that nuclear weapons could inflict. Finally, given the conventional superiority of the coalition forces, nuclear weapons may simply not be needed in a military conflict.

However, one cannot completely discount scenarios involving the active use of nuclear weapons, escalating from conventional war in the event of biological or chemical attacks. Both the USA and the UK have officially announced that they could respond with nuclear force in such a case. Clearly, the way from words to action is a long one, but, in order to maintain trustworthiness, these declaratory commitments might eventually have to be fulfilled. Deterrence rests upon credible threats.

Moreover, to maintain a full range of nuclear capabilities – and to maintain its «deterrence value» – the Bush Administration has developed small, precision-guided nuclear missiles to destroy hardened targets. As states could protect and hide vital commando centers and biological and chemical weapons and material underground, the USA has come to regard new offensive nuclear capacities as a necessary part of a wide range of response options. Such remilitarization of nuclear weapons can only blur the boundaries between conventional and non-conventional weaponry, and might well increase the risk of nuclear war. Indeed, the notion of limited and confined nuclear warfare associated with the small, precision-guided nuclear warheads under development could serve to weaken the «nuclear taboo».

The Bush Administration's interest in nuclear contingency plans stems from its deeply held conviction that the United States must act against Iraq because of new and more dangerous threats involving biological, chemical or nuclear weapons.¹¹¹ Recently declassified CIA information, however, suggests that an undisturbed Iraq poses a «low» threat to US security interests, and that the only plausible scenario in which Saddam Hussein would actually deploy chemical or biological weapons would be one where he was attacked, and felt he had nothing to lose.¹¹²

111 William M. Arkin, «The Nuclear Option in Iraq», *Los Angeles Times*, January 26, 2003, <http://www.latimes.com/news/nationworld/nation/wire/la-op-arkin26jan26.story>

112 CIA Letter to Senate on Baghdad's intentions, October 7, 2002, <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/wmd13.pdf>. See also, «Iraq Unlikely to Initiate Attack on US: CIA», *The Dawn*, October 9, 2002, <http://www.dawn.com/2002/10/10/int1.htm>