12. Nuclear arms control and non-proliferation

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I. Introduction

Developments in 2004 gave urgency to calls for new measures to strengthen the nuclear non-proliferation regime and to reinforce its principal legal foundation, the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT). Evidence emerged confirming the existence of a clandestine transnational network of middlemen and companies, centred around Pakistan's leading nuclear scientist, that supplied sensitive nuclear technology and expertise to Iran, Libya and possibly other states. This raised concern about the diffusion of nuclear weapon capabilities to non-state as well as state actors, and it spurred new initiatives aimed at preventing the illicit transfer of nuclear technologies and materials. There continued to be controversy over the scope and nature of Iran's nuclear programme, as the International Atomic Energy Agency (IAEA) provided further detail about Iran's repeated failures over many years to declare important nuclear activities, in contravention of its NPT-mandated nuclear safeguards agreement with the IAEA. In addition, little progress was made in the international talks on the future of the nuclear programme of the Democratic People's Republic of Korea (DPRK, or North Korea).

This chapter reviews the principal developments in nuclear arms control and non-proliferation in 2004. Section II describes the discovery of a global black market in nuclear weapon-related technologies and assesses its implications for the non-proliferation regime. Section III summarizes the IAEA's findings about Iran's past and current nuclear activities and describes developments in the country's nuclear programme. Section IV summarizes efforts to resolve the diplomatic impasse over North Korea's nuclear programme and related developments. Section V summarizes the latest findings of the US inspection team that searched for evidence of Iraq's nuclear weapon programme. Section VI describes the IAEA's investigation following the disclosure by the Republic of Korea (South Korea) that it has conducted undeclared nuclear activities in contravention of its safeguards agreement with the IAEA. Section VII reports on the results of the 2004 Preparatory Committee meeting for the 2005 NPT Review Conference. Section VIII discusses the proposals for multilateral arrangements to manage the nuclear fuel cycle and the appointment of an IAEA-sponsored Expert Group to survey the most promising approaches, while section IX examines the opposition in the US Congress to the proposals of the Administration of President George W. Bush to develop new types of nuclear weapons. Section X presents the conclusions.

Appendix 12A provides tables of data on world nuclear forces and on the forces of the United States, Russia, the United Kingdom, France, China, India, Pakistan and Israel.

II. The Khan nuclear network

A series of revelations in 2004 confirmed long-circulating rumours that Pakistan's most prominent nuclear scientist, Abdul Qadeer Khan, was behind an illicit nuclear trafficking network.[1] Khan, who has been called 'the father of Pakistan's bomb', is widely seen as a national hero in Pakistan. As the head of the Khan Research Laboratory for two decades he had considerable autonomy in running the country's nuclear programme.

Although Khan had long been suspected of involvement in the illicit transfer of nuclear technology, evidence of his network's activities began to emerge publicly in October 2003, when Iran admitted to the IAEA that it had secretly imported centrifuge components from Pakistan. Libya's decision in December 2003 to abandon its weapons of mass destruction (WMD) and missile programmes resulted in the disclosure of detailed information about the network's activities and about individual suppliers.[2] Investigators identified foreign intermediaries—based in Germany, Malaysia, South Africa, Switzerland, Turkey, the UK and the United Arab Emirates—who had helped Khan deliver nuclear technology to client states. Among them was Buhary Syed Abu Tahir, a Sri Lankan businessman and Khan confidante based in Dubai, who reportedly oversaw the network's financial operations. Tahir gave Malaysian police detailed information about how the network had arranged for the manufacture and shipment of nuclear-related components to Iran and Libya.[3]

Khan initially denied allegations about his involvement but later confessed to Pakistan's Inter-Services Intelligence agency that he was behind the illicit transfers of nuclear technology.[4] On 5 February 2004 Pakistani President Pervez Musharraf pardoned Khan following Khan's nationally televised confession the previous day. In pardoning Khan, Musharraf insisted that the scientist had acted on his own, without the knowledge or support of the Pakistani Government.[5] This claim was disputed by opposition parties in Pakistan as well as by many outside observers, who doubted that Khan could have cir-

[1] For an overview of the Khan network's activities see Powell, B. and McGirk, T., 'The man who sold the bomb', *Time*, 14 Feb. 2005, pp. 38–42.

[2] On the Libyan decision see chapter 14 in this volume.

[3] Royal Malaysia Police, 'Press release by Inspector General of Police in relation to investigation on the alleged production of components for Libya's uranium enrichment programme', 20 Feb. 2004, URL <http://www.rmp.gov.my/rmp03/040220scomi_eng.htm>.

[4] Khan, K., 'Pakistani exploited nuclear network', *Washington Post* (Internet edn), 28 Jan. 2004, URL <http://www.washingtonpost.com/ac2/wp-dyn/A54334-2004Jan 27>; and Iqbal, N., 'Dr Khan "admits" he transferred N-technology: action to be decided by NCA', *Dawn* (Internet edn), 2 Feb. 2004, URL <http://www.dawn.com/2004/02/02/top2.htm>.

[5] Ziauddin, M., 'Dr A. Q. Khan pardoned: other scientists' fate hangs in the balance', *Dawn* (Internet edn), 6 Feb. 2004, URL <http://www.dawn.com/2004/02/06/top1.htm>; and Akhtar, H., 'Dr Khan not given blanket pardon: investigations continuing—FO', *Dawn* (Internet edn), 10 Feb. 2004, URL <http://www.dawn.com/2004/02/10/top2.htm>.

cumvented security measures for more than a decade without the tacit approval of the government or the military high command.[6] Islamabad pledged that Pakistan would cooperate with the international bodies that were investigating the network, such as the IAEA, but stated repeatedly that these bodies would not be granted direct access to Khan or to other scientists suspected of involvement in the network.[7]

The Khan network's activities

The network's origins are believed to date from the time after Khan quit his job at the European uranium enrichment consortium, Urenco, in the Netherlands. According to Dutch court documents, Khan fled to Pakistan in 1976 with stolen Urenco blueprints for G-1 and G-2 centrifuges; Pakistan's uranium enrichment programme was based on modifications of these designs, called the P-1 and P-2 centrifuges. Khan used his experience and contacts from working at Urenco to build up a clandestine network of suppliers which procured the components needed for Pakistan's centrifuge programme.[8]

As the network's activities expanded, Khan began to sell nuclear technology. This reportedly occurred in the late 1980s, when Khan ordered more centrifuge components from the foreign suppliers than Pakistan's nuclear programme needed and then secretly sold the excess items to other countries.[9] This enabled Khan to sell P-1 centrifuge components to Iran. He later sold complete P-1 assemblies as Pakistan's enrichment programme phased out the P-1 in favour of the more sophisticated P-2 centrifuge. He also eventually provided Iran with P-2 design information.

Khan began to sell technology to Libya in the mid-1990s and continued to do so until 2003. This included centrifuge components and assemblies for Libya's undeclared uranium enrichment programme.[10] According to the IAEA, Libya also received from 'a foreign source' detailed engineering drawings for nuclear weapon components.[11] It has not been publicly con-

[6] See, e.g., Masood, S. and Rhode, D., 'Pakistan opposition charges atomic cover-up', *New York Times* (Internet edn), 17 Feb. 2004, URL <http://www.nytimes.com/2004/02/17/international/asia/17STAN.html>; and Fidler, S. and Burnett, V., 'Pakistan's "rogue nuclear scientist": what did Khan's government know about his deals?', *Financial Times*, 6 Apr. 2004, p. 11.

[7] Ziauddin (note 5); Efron, S., 'Musharraf scorns nuclear probe', *Los Angeles Times*, 6 Dec. 2004, p. A4; and 'Foreigners access to Dr Khan ruled out', *Dawn* (Internet edn), 10 Dec. 2004, URL <http://www.dawn.com/2004/12/11/top1.htm>.

[8] For the history of Pakistan's nuclear weapons programme see Ahmed, S., 'Pakistan's nuclear weapons program: turning points and nuclear choices', *International Security*, vol. 23, no. 4 (spring 1999), pp. 178–204; Albright, D. and Hibbs, M., 'Pakistan's bomb: out of the closet', *Bulletin of the Atomic Scientists*, vol. 48, no. 6 (July/Aug. 1992), pp. 38–43, URL <http://www.thebulletin.org/article.php?art_ ofn=ja92albright>; and Burrows, W. and Windrem, R., *Critical Mass* (Simon & Schuster: New York, 1994), pp. 60–90.

[9] Broad, W., Sanger, D. and Bonner, R., 'A tale of nuclear proliferation: how Pakistani built his network', *New York Times* (Internet edn), 12 Feb. 2004, URL <http://www.nytimes.com/2004/02/12/international/asia/12NUKE.html>.

[10] IAEA, 'Implementation of the NPT safeguards agreement in the Socialist People's Libyan Arab Jamahiriya', Report by the Director General to the IAEA Board of Governors, GOV/2004/12, Vienna, 20 Feb. 2004, p. 5, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-12.pdf>.

[11] IAEA (note 10), pp. 6–7.

firmed that the drawings came from Pakistan, but US officials have indicated that the design was for a uranium implosion weapon that was developed by China in the 1960s and was rumoured to have been transferred to Pakistan.[12] The US Government estimates that Khan's network may have earned as much as $100 million from sales to Libya alone.[13]

The extent to which Khan may have transferred sensitive nuclear technology and expertise to North Korea is unclear from publicly available information. US intelligence officials believe that in 1997–2001 Khan provided North Korea with centrifuge components and design information as well as uranium hexafluoride gas.[14] There have been numerous reports alleging that Pakistan gave North Korea uranium enrichment technology in exchange for missile technology. The Pakistani Government has denied that it made any barter deals with North Korea to obtain missile technology, and both governments have denied reports about the transfer of centrifuge designs and components.[15] In addition to these questions, US officials have indicated that Khan may have shared documentation with North Korea on how to make nuclear warheads that were compact enough to be delivered by ballistic missiles.[16]

The Khan network and proliferation concerns

The revelations during 2004 about Khan's activities heightened concern about the proliferation risks posed by knowledgeable individuals or non-state purveyors of nuclear and missile-related materials and technology, either acting independently or in complicity with government officials. There was particular concern about the nature and scope of the black market activities of the network. IAEA Director General Mohamed ElBaradei described it as a 'Nuclear Wal-Mart'—a reference to the USA's largest retailer.[17] As a source for 'one-stop shopping', Khan's network effectively circumvented many of the legal and regulatory arrangements put into place to prevent state actors from spreading nuclear weapon-relevant technology. These concerns gave impetus to new initiatives, most notably UN Security Council Resolution 1540, aimed at reinforcing the non-proliferation regime by requiring states to

[12] Broad, W. and Sanger, D., 'Warhead blueprints link Libya project to Pakistan figure', *New York Times* (Internet edn), 4 Feb. 2004, URL <http://www.nytimes.com/2004/02/04/politics/04NUKE.html>.

[13] Sanger, D. and Broad, W., 'Pakistani's nuclear earnings: $100 million', *New York Times* (Internet edn), 16 Mar. 2004, URL <http://www.nytimes.com/2004/03/16/international/asia/16NUKE.html>.

[14] Sanger, D., 'US sees more arms ties between Pakistan and Korea', *New York Times* (Internet edn), 14 Mar. 2004, URL <http://www.nytimes.com/2004/03/14/international/asia/14KORE.html>.

[15] Takeishi, E., 'Bhutto: we bought missile technology', Asahi.com, 19 July 2004, URL <http://www.asahi.com/english/world/TKY200407190155.html>.

[16] Squassoni, S., Congressional Research Service (CRS), *Weapons of Mass Destruction: Trade Between North Korea and Pakistan*, CRS Report for Congress RS 31900, updated 11 Mar. 2004, p. 9, URL <http://fpc.state.gov/documents/organization/30781.pdf>.

[17] Landler, M., 'UN official sees a "Wal-Mart" in nuclear trafficking', *New York Times* (Internet edn), 23 Jan. 2004, URL <http://www.nytimes.com/2004/01/23/international/23CND-NUKE.html>.

criminalize black market activities by private actors, enact strict export controls and secure all sensitive materials within their borders.[18]

III. Iran and nuclear proliferation concerns

In 2004 the controversy over the scope and nature of Iran's nuclear programme intensified, as Iran reaffirmed its plans to develop a uranium enrichment capability and to construct a heavy-water research reactor.[19] The controversy arose after evidence began to emerge in 2002 that the Atomic Energy Organization of Iran had engaged in sensitive nuclear fuel cycle activities, including uranium enrichment and plutonium separation, without declaring them in a timely manner to the IAEA, as it was required to do under the terms of its full-scope safeguards agreement.[20] This gave rise to concern in Europe and the USA that Iran was attempting to put into place, under the cover of a civil nuclear energy programme, the fuel cycle facilities needed to produce fissile material—plutonium and enriched uranium—for a clandestine nuclear weapon programme. Iranian officials insisted that the country's ambitious nuclear programme was aimed solely at producing electricity and that any violations of its safeguards agreement were inadvertent and minor in nature and did not constitute non-compliance with that agreement.[21] They also emphasized that Iran was entitled, as a non-nuclear weapon state (NNWS) party to the NPT, to develop nuclear energy for peaceful purposes.[22]

Cooperation between Iran and the IAEA

On 21 May 2004 Iran submitted to the IAEA its initial expanded declaration under the NPT Additional Safeguards Protocol.[23] Iranian officials stressed that

[18] On UN Security Council Resolution 1540 see chapters 11 and 18 in this volume; and for the text of the resolution see appendix 11A.

[19] For a description of the Iranian nuclear controversy see Kile, S. N., 'Nuclear arms control and non-proliferation', *SIPRI Yearbook 2004: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2004), pp. 604–12.

[20] For the agreement see IAEA, The text of the agreement between Iran and the agency for the application of safeguards in connection with the Treaty on the Non-proliferation of Nuclear Weapons, INFCIRC/214, 13 Dec. 1974, URL <http://www.iaea.org/Publications/Documents/Infcircs/Others/infcirc214.pdf>.

[21] In 2002 Iran announced plans to construct, over the next 20 years, nuclear power plants with a total capacity of 6000 MW as part of a long-term energy policy to make up for the expected depletion of Iran's extensive fossil fuel reserves. Statement by H.E. Reza Aghazadeh, President of the Atomic Energy Organization of Iran, at the 46th General Conference of the International Atomic Energy Agency, Vienna, 16 Sep. 2002, URL <http://www.iaea.org/About/Policy/GC/GC46/iran.pdf>.

[22] According to Art. IV of the NPT, all parties have an 'inalienable right' to research, produce and use nuclear energy 'for peaceful purposes without discrimination'. Art. IV also mandates that 'Parties to the Treaty in a position to do so' shall cooperate in contributing to the development of nuclear energy for peaceful purposes. For the full text of the NPT see URL <http://www.iaea.org/Publications/Documents/Treaties/npt.html>.

[23] See IAEA, 'Iran signs Additional Protocol on nuclear safeguards', IAEA News Centre, 18 Dec. 2003, URL <http://www.iaea.org/NewsCenter/News/2003/ iranap20031218.html>. For a discussion of the domestic debate surrounding the Iranian Government's decision to sign the Additional Protocol see Balouji, H., 'The process of national security decision making in Iran: the signature of the Additional

the submission of the expanded declaration was a 'voluntary confidence-building measure', since the Majlis (parliament) had not yet ratified the Additional Protocol.[24] They also insisted that all of the IAEA's remaining safeguards compliance questions were being satisfactorily answered and that the IAEA Board of Governors therefore should vote to close the Iranian nuclear file at its next meeting.

In a report sent to the IAEA Board of Governors on 1 June 2004, Director General ElBaradei criticized Iran's cooperation with the agency as having 'fallen far short of what was required' to resolve the agency's safeguards concerns.[25] The report stated that serious questions remained about nearly all aspects of Iran's past and current nuclear fuel cycle activities, especially its uranium enrichment programme. On 18 June the Board adopted a resolution 'deploring' Iran's failure to provide the agency with 'full, timely and proactive co-operation'.[26] Among other measures, the Board's resolution urged Iran to take additional steps to answer questions about its advanced gas centrifuge programme and about the source of enriched uranium particles found in environmental samples taken at three nuclear-related sites. It also urged Iran to fully implement its October 2003 pledge to suspend its uranium enrichment programme by halting all manufacturing and testing of centrifuge components and not proceeding with the planned production of uranium hexafluoride (UF_6) at its conversion facility at Esfahan.[27] At its next meeting, on 18 September, the Board of Governors reiterated its call for Iran to immediately suspend all uranium enrichment activities.[28] Iran promptly rejected this call as a capitulation to pressure from the US Administration, which had been urging the Board to take a tougher approach to the nuclear controversy, including bringing the matter before the UN Security Council.[29] The Board also urged Iran to 'proactively assist the Agency to understand the full extent and nature' of its uranium enrichment programme before the meeting scheduled for the end of November 2004.[30]

Protocol', ed. S. N. Kile, *Europe and Iran: Perspectives on Non-proliferation*, SIPRI Research Report no. 21 (Oxford University Press: Oxford, forthcoming 2005).

[24] 'Iran submits full report on nuclear program to UN nuclear agency', *Tehran Times*, 23 May 2004, pp. 1, 15.

[25] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Report by the Director General to the IAEA Board of Governors, GOV/2004/34, Vienna, 1 June 2004, p. 1, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-34.pdf>.

[26] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Resolution adopted by the IAEA Board of Governors, GOV/2004/49, Vienna, 18 June 2004, p. 2, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-49.pdf>.

[27] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Report by the Director General, GOV/2004/60, Vienna, 1 Sep. 2004, p. 2, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-60.pdf>. UF_6, either alone or in combination with hydrogen or helium, is the feedstock used in most uranium enrichment processes, including gas centrifuges.

[28] IAEA (note 27), p. 2.

[29] Mehr News Agency, 'Tehran will not forgo civilian nuclear program at any cost', *Tehran Times* (Internet edn), 21 Sep. 2004, URL <http://www.tehrantimes.com/archives/description.asp?DA=9/21/2004&Cat=2&Num=009>.

[30] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Resolution adopted by the IAEA Board of Governors, GOV/2004/79, Vienna, 18 Sep. 2004, p. 2, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-79.pdf>.

The IAEA Director General's assessment of Iran's nuclear programme

On 15 November 2004 Director General ElBaradei sent to the IAEA Board of Governors the sixth in a series of written reports on the progress made by the agency in verifying Iran's implementation of its safeguards agreement with the agency.[31] The report came against the background of mounting pressure from Iran and the USA for the Board to make its upcoming meeting a decisive one in terms of either closing the nuclear file, as demanded by Iran, or referring it to the UN Security Council for further action, as urged by the USA. It offered an overall assessment of the IAEA's efforts since the beginning of 2003 to clarify the scope and nature of Iran's nuclear activities and to resolve safeguards-related questions arising from these activities.

According to ElBaradei, prior to October 2003 Iran had pursued a 'policy of concealment' which resulted in many aspects of its nuclear activities and experiments, particularly in the areas of uranium enrichment, uranium conversion and plutonium separation, not being declared to the IAEA.[32] The agency had discovered a number of instances, occurring over an extended period of time, in which Iran had failed to comply with its safeguards obligations with respect to the reporting of the processing, use and storage of nuclear material and the facilities where this took place. The report stated that since October 2003, when Iran issued a revised declaration of its past and current nuclear activities and pledged to cooperate fully with the agency, 'good progress' had been made in correcting these failures.[33] As a result, the IAEA was able to verify that none of the declared nuclear material inside Iran had been diverted to prohibited activities and to confirm certain aspects of Iran's current declarations. ElBaradei's report noted that verifying all aspects of Iran's declaration would probably be a time-consuming process, even with the implementation of the Additional Protocol, in the light of Iran's past pattern of concealment and its failure to declare significant aspects of its nuclear programme.[34] At the same time, it cautioned that the focus of safeguards agreements and Additional Protocols is on nuclear material: in the absence of some connection to nuclear material, the agency's legal authority to pursue the verification of possible nuclear weapons-related activity was limited.

ElBaradei's report included detailed summaries of the agency's findings that Iran had failed to report or declare to the IAEA eight different nuclear activities, including uranium conversion and enrichment experiments, as required under its safeguards agreement. It also included six instances in which Iran had failed to provide in a timely manner design information, or updated information, about nuclear fuel processing, storage and waste handling facilities.[35] In addition, it noted that the agency had not been able to come to a

[31] See IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Report by the Director General to the IAEA Board of Governors, GOV/2004/83, 15 Nov. 2004, p. 23, URL <http://www.iaea.org/Publications/Documents/Board/2003/gov2003-75.pdf>.

[32] IAEA (note 31), p. 23.

[33] IAEA (note 31), p. 23.

[34] IAEA (note 31), p. 24.

[35] IAEA (note 31), pp. 22–23.

judgement about explanations provided by Iran for several other nuclear-related activities.[36]

Unresolved safeguards compliance issues

The November 2004 report by ElBaradei identified three outstanding issues which the IAEA was working with Iran to clarify.

1. *The origins of enriched uranium contamination.* In February 2003, in response to IAEA enquiries, Iran acknowledged that two centrifuge enrichment plants were under construction at Natanz: a research-scale facility designed to house 1000 centrifuges; and a commercial-scale plant designed to house 50 000 centrifuges.[37] Iran also admitted that a facility at the Kalaye Electric Company workshop in Tehran had been used for the production of centrifuge components. It initially stated that there had been no testing of centrifuges assembled from these components involving the use of nuclear material, either at that workshop or at any other location in the country. However, in October 2003 Iran acknowledged that in 1999–2002 it had conducted 'a limited number' of tests at the Kalaye workshop using small amounts of imported UF_6, without informing the IAEA.[38] Iran also acknowledged that in 1994–95 it had received engineering plans and components for the centrifuges, based on the Pakistani P-1 design, through a foreign intermediary. This contradicted Iran's previous claim that the centrifuge programme was entirely indigenous.[39]

In verifying Iran's declarations concerning its enrichment activities, the IAEA conducted extensive environmental sampling at locations where Iran had declared that centrifuge components were manufactured and stored. The results of samples taken at the pilot centrifuge plant in Natanz and at the Kalaye workshop and a subsidiary company revealed particles of low enriched uranium (LEU) and highly enriched uranium (HEU).[40] These particles were 'indicative of types of nuclear material' that were not included in Iran's inventory of declared nuclear material.[41] This raised doubts about the correct-

[36] The IAEA discovered that in 1989–93 Iran had conducted experiments to produce polonium-210 (Po-210), a short-lived unstable element which has very few commercial applications but which has been used in the past as a neutron initiator for nuclear weapons. Iran told the IAEA that its experiments with Po-210 were for nuclear batteries for satellites to be used in future Iranian space programmes.

[37] IAEA, 'Introductory Statement by IAEA Director General Mohamed ElBaradei to the Board of Governors', Vienna, 17 Mar. 2003, URL <http://www.iaea.org/NewsCenter/Statements/2003/ebsp2003n008.shtml>.

[38] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Report by the Director General to the IAEA Board of Governors, GOV/2003/75, 10 Nov. 2003, p. 9, URL <http://www.iaea.org/Publications/Documents/Board/2003/gov2003-75.pdf>.

[39] Albright, D., and Hinderstein, C., 'The centrifuge connection', *Bulletin of the Atomic Scientists*, vol. 60, no. 2 (Mar./Apr. 2004), pp. 62–63. A report from the Malaysian Inspector-General of Police stated that centrifuges were shipped from Pakistan to Iran, through a company based in the United Arab Emirates, in the mid-1990s. Royal Malaysia Police (note 3).

[40] HEU is uranium enriched to 20% or above in the isotope uranium-235 (U-235); LEU is uranium enriched to 0.72–20% U-235. Weapons-grade uranium is uranium enriched to more than 90% U-235.

[41] The environmental samples revealed that domestically manufactured components were contaminated mainly with LEU, while imported components showed both LEU and HEU contamination; some

ness and completeness of Iran's declarations to the agency and suggested that Iran might have conducted other undeclared activities or might be concealing nuclear material. Iran attributed the presence of the particles of enriched uranium to contamination from centrifuge components imported through the foreign intermediary and continued to insist that it had not enriched uranium beyond 1.2 per cent in the isotope uranium-235 (U-235).[42]

According to ElBaradei, the IAEA's overall assessment was that the environmental sampling data tended, 'on balance, to support Iran's statement about the origin of much of the contamination'.[43] The agency believed that it was 'plausible' that the HEU contamination found at the Kalaye workshop and at Natanz may not have resulted from the enrichment of uranium there. However, the report added that, while contamination resulting from imported components and equipment was one possible explanation, the agency continued to investigate other explanations, including the possibility that the contamination resulted from undeclared enrichment activities, from undeclared imported enriched uranium or from contaminated equipment imported from an undisclosed supplier. It also noted that, in order for the IAEA inspectors to be able to confirm the actual source of contamination and the correctness of statements made by Iran, they needed to take samples from the centrifuges and centrifuge components 'at relevant locations in the State from which most of the imported components originated'.[44] The report stated that the IAEA was discussing with this state—widely reported to be Pakistan—the modalities for taking the samples.[45]

2. *The design and manufacture of an advanced centrifuge*. The IAEA has questioned Iran's claims about its research and development (R&D) work on the P-2 centrifuge. Iranian officials acknowledged in January 2004 that they had previously failed to report the acquisition of design plans for this more advanced centrifuge. Iran told the IAEA that it received the P-2 plans through a foreign intermediary in 1995; however, because of a 'shortage of professional resources', it did not begin manufacturing work and mechanical testing of the centrifuge's composite rotors until 2002.[46] IAEA investigators questioned this account, citing the investment made by Iran in obtaining the design drawings and the technical capabilities that existed inside the country. They also expressed doubt about the feasibility of carrying out centrifuge tests based on the P-2 design—which required the procurement of magnets, bearings and other parts from abroad as well as the manufacture of casings and centrifuge components—within the stated period of less than a year. According to ElBaradei's report, the IAEA is continuing to investigate Iran's claim that it did not pursue any work on the P-2 centrifuge design in 1995–2002 in

of the imported components, along with associated assembly equipment and work areas, were contaminated with particles of *c*. 36% U-235 and others with *c*. 54% U-235. IAEA (note 31), p. 9.

[42] IAEA (note 31), p. 9.

[43] IAEA (note 31), p. 10.

[44] IAEA (note 31), p. 10.

[45] IAEA (note 31), p. 23.

[46] IAEA (note 31), pp. 10–11.

order to be able to give 'sufficient assurances that there were no related activities carried out during that period'.[47]

3. *Plutonium reprocessing.* The IAEA has been unable to verify Iran's account of the dates of experiments conducted at the Tehran Nuclear Research Center (TNRC) involving the irradiation of uranium dioxide targets and the subsequent separation of a small amount of plutonium. According to Iran, the experiments took place in the period 1988–93; it did not declare the experiment or the plutonium separation to the IAEA.[48] On the basis of samples taken in November 2003, the IAEA concluded that Iran had underestimated the quantities of plutonium that had been separated, and it discovered that the age of the plutonium solution appeared to be less than the declared 12–16 years. Iran subsequently corrected the declared amount of separated plutonium, from microgram to milligram quantities. However, it reiterated previous statements that it had not conducted any plutonium separation experiments after 1993, but the results from samples taken by the IAEA in September 2004 again indicated that the plutonium could have been separated more recently. The IAEA has requested additional clarifications to determine whether Iran might have conducted other undeclared separation experiments.[49]

Other safeguards-related issues

In 2004 the IAEA investigated two Iranian Ministry of Defence (MOD) facilities where undeclared nuclear experiments may have been carried out. The first site, called the Lavizan-Shian Technical Research Center, came to public attention in May 2003 and then in November 2004 following allegations from an Iranian opposition group, the National Council of Resistance of Iran, that it was associated with nuclear weapon research.[50] Iran denied this allegation, saying that a Physics Research Center was established there in 1989 to prepare emergency responses to nuclear attacks or accidents and to provide scientific advice and services to the MOD. The site was razed following its return to the Municipality of Tehran. The results of soil samples taken by the IAEA in June 2004 showed no sign of nuclear activity.[51]

The second site was the Parchin complex, located outside Tehran. This large military complex is dedicated to the R&D and production of ammunition, rockets and high explosives. Within the complex there is an isolated, separately secured site for the testing of high explosives. Some reports have suggested that this could be part of a programme to develop conventional explosives for a nuclear warhead. [52] Although Iran stated that it was under no legal

[47] IAEA (note 31), p. 23.

[48] IAEA (note 38), p. 5.

[49] IAEA (note 31), p. 17.

[50] National Council of Resistance of Iran, 'Disclosing a nuclear site under Ministry of Defence', 17 Nov. 2004, at URL <http://www.globalsecurity.org/wmd/library/report/2004/new-nuke-info.htm>.

[51] IAEA (note 31), p. 22.

[52] E.g., Albright, D. and Hinderstein, C., 'Parchin: possible nuclear weapons-related site in Iran', Institute for Science and International Security (ISIS), *ISIS Issue Brief*, 17 June 2004, URL <http://www.isis-online.org/publications/iran/parchin.html>.

obligation to do so, it nevertheless agreed in early January 2005 to grant IAEA inspectors partial access to the Parchin complex.[53]

The new E3–Iranian suspension agreement

In the autumn of 2004 intense negotiations were held between Iran and France, Germany and the UK (the so-called E3), supported by the High Representative for the European Union Common Foreign and Security Policy, Javier Solana. The main issue was the E3's demand that Iran completely suspend its uranium enrichment programme.

On 21 October 2003 the foreign ministers of Iran and the E3 states had issued a joint declaration in Tehran announcing that Iran agreed to suspend its enrichment programme in exchange for access to advanced European technology.[54] However, in the ensuing months the deal became mired in disputes over the length and scope of application of the moratorium amid allegations of bad faith from both sides. Following the June 2004 IAEA Board of Governors resolution, which strongly criticized Iran, Iran announced that it would resume its production of centrifuges.[55] In August 2004 Iran announced plans to convert 37 tonnes of uranium oxide ('yellowcake') into UF_6 at its Esfahan facility.[56] This led to renewed calls from the US Administration for the E3 to take a tougher approach to resolving the nuclear controversy, including referral of the issue to the UN Security Council.

On 15 November 2004 the E3 reached an agreement with Iran on a new deal, which envisioned several steps.[57] Iran undertook, as a 'voluntary confidence-building measure', to continue to extend the previous suspension of its enrichment programme to include all enrichment-related and reprocessing activities.[58] The suspension would be sustained, under IAEA verification and monitoring, while negotiations proceeded 'on a mutually acceptable agreement on long-term arrangements'. The aim of the long-term agreement was to provide 'objective guarantees' that Iran's nuclear programme was exclusively for peaceful purposes as well as guarantees regarding nuclear, technological and economic cooperation between the EU and Iran and 'firm

[53] Bernstein, R., 'US accuses Iran of deceiving UN inspectors', *New York Times* (Internet edn), 2 Mar. 2005, URL <http://www.nytimes.com/2005/03/02/international/europe/02cnd-nuke.html>.

[54] 'Statement by the Iranian Government and visiting EU foreign ministers', Tehran, 21 Oct. 2003, URL <http://www.iaea.org/NewsCenter/Focus/IaeaIran/statement_iran21102003.shtml>.

[55] Mehr News Agency, 'Nation backs bid by government to resume construction of centrifuges: legislators', *Tehran Times* (Internet edn), 27 June 2004, URL <http://www.tehrantimes.com/archives/description.asp?DA=6/27/2004&Cat=2&Num=031>.

[56] Two non-governmental experts calculated that theoretically this could produce *c*. 100 kg of weapons-grade HEU, or enough for 5 crude nuclear weapons. Albright, D. and Hinderstein, C., 'Iran: countdown to showdown', *Bulletin of the Atomic Scientists*, vol. 60, no. 6 (Nov./Dec. 2004), p. 67.

[57] IAEA, The text of the agreement between Britain, France, Germany and Iran, signed in Paris on 15 Nov. 2004, INFCIRC/637, 26 Nov. 2004, URL <http://www.iaea.org/Publications/Documents/Infcircs/2004/infcirc637.pdf>.

[58] These activities were specified in the agreement as: the manufacture and import of gas centrifuges and their components; the assembly, installation testing or operation of gas centrifuges; work to undertake any plutonium separation, or to construct or operate any plutonium separation installation; and all tests or production at any uranium conversion installation. IAEA (note 57).

commitments on security issues'.[59] On 29 November ElBaradei reported that the IAEA had completed its verification of Iran's suspension of its uranium enrichment-related and plutonium reprocessing activities. This included the application of IAEA containment and surveillance measures at the Esfahan conversion facility and at declared centrifuge component production locations.[60]

The agreement on suspension called for negotiations to be launched by an E3–Iranian steering committee, which was also responsible for setting up working groups on political and security issues, technology and economic cooperation, and nuclear issues. The first meeting of the steering committee, which was attended by Solana, the British, French and German foreign ministers and the head of Iran's Supreme National Security Council, Hassan Rowhani, was held on 13 December 2004.[61] The first meetings of the working groups were held five days later. On 12 January 2005 the EU resumed talks with Iran, suspended for 18 months, on a Trade and Cooperation Agreement (TCA).[62]

Criticism of the suspension agreement

The 2004 E3–Iran suspension agreement has come under criticism, particularly in Israel and the USA.[63] The main complaint is that the deal did not go far enough: Iran's moratorium on enrichment activities was a voluntary measure rather than a legal obligation; and its duration was directly linked to the duration of the negotiations between Iran and the E3 on the broader sets of issues. Iran has repeatedly stated that it will restart its uranium enrichment programme, with appropriate assurances about its peaceful purpose, once the concerns raised by the IAEA have been resolved.[64] The deal has also been criticized for not requiring Iran to halt construction of a heavy water-moderated reactor near the town of Arak.[65] This type of reactor is well suited for producing weapons-grade plutonium. There has been speculation that Israel or the USA might launch pre-emptive military strikes against Iranian

[59] IAEA (note 57).

[60] IAEA, 'Introductory Statement by IAEA Director General Dr. Mohamed ElBaradei', IAEA Board of Governors, DG 25112004, 25 Nov. 2004, URL <http://www.iaea.org/NewsCenter/Statements/2004/ebsp 2004n016.html>. Iran requested an exemption from the suspension, stating that it wanted to 'use up to 20 sets of [centrifuge] components for R&D purposes and provide the Agency with access when requested'. Iran subsequently withdrew this request because of opposition from the E3.

[61] 'European restart talks with Iran', *International Herald Tribune*, 14 Dec. 2004, p. 5.

[62] Hafezi, P., 'Iran says EU nuclear talks going well', Reuters, 16 Jan. 2005, URL <http://uk.news yahoo.com/051116/325/fadpn.html>. The Nov. 2004 agreement stipulated that, once a suspension of Iran's enrichment programme had been verified, the negotiations on the TCA would resume.

[63] Asculai, E. and Kam, E., 'Iran's slippery nuclear slope', *Tel Aviv Notes* (Jaffee Center for Strategic Studies, Tel Aviv University), no. 117 (22 Dec. 2004), pp. 2–3; Reuters, 'EU defends Iran diplomacy after Bush remarks', 18 Jan. 2005, URL <http://www.alernet.org/thenews/newsdesk/L18331811.htm>.

[64] Mehr News Agency, 'Iran's nuclear activities will never be halted–Leader', *Tehran Times* (Internet edn), 30 Nov. 2004, URL <http://www.tehrantimes.com/archives/description.asp?DA=11/30/2004 &Cat=2&Num=008>.

[65] Broad, W. and Sciolino, E., 'Iranians retain plutonium plan in nuclear deal', *New York Times* (Internet edn), 25 Nov. 2004, URL <http://www.nytimes.com/2004/11/25/international/middleeast/25NUKE.html>.

nuclear facilities in order to prevent, or at least slow down, Iran's development of a nuclear weapon capability.[66] Neither Israel nor the USA has ruled out the possibility of taking military action against Iran.[67]

The IAEA Board of Governors resolution

On 29 November 2004 the IAEA Board of Governors adopted a much-anticipated resolution on the implementation of safeguards in Iran which noted that 'Iran's practices before October 2003 had resulted in many breaches of its obligations to comply with its safeguards agreement'.[68] It also noted that the 'Agency is not yet in a position to conclude that there are no undeclared nuclear materials or activities in Iran'.[69] At the same time, the resolution acknowledged Iran's corrective measures, as described in ElBaradei's report, and welcomed Iran's decision to continue and extend the suspension of all of its uranium enrichment-related and plutonium reprocessing activities.

While acknowledging Iran's breaches of its NPT safeguards agreement, the Board of Governors did not declare Iran to be in non-compliance with that agreement or with its commitments under the NPT and did not refer the issue to the UN Security Council.[70] Prior to the Board's meeting, the US Administration had pushed for the issue to be moved to the Security Council, over Iran's strong opposition. Many EU member states resisted the US demand to incorporate in the IAEA resolution a 'trigger mechanism' that would automatically require the Board to report Iran to the Security Council if it did not fully resolve outstanding concerns about its nuclear activities.[71] They argued that Iran's recent steps warranted a more conciliatory approach. They also argued that a referral would be premature and possibly counterproductive in that it might spur Iran to disengage altogether from its cooperation with the IAEA or withdraw from the NPT, following the North Korean precedent.

The disagreement between the E3 and the US Administration over a referral to the UN Security Council highlighted fundamental differences over means and modalities in their respective strategies for addressing WMD proliferation

[66] See Hersh, S., 'The coming wars', *New Yorker*, 24–31 Jan. 2005, URL <http://www.newyorker.com/fact/content/?050124fa_fact>.

[67] Reuters, 'Bush won't rule out action against Iran over nukes', ABC News (Internet edn), 17 Jan. 2005, URL <http://abcnews.go.com/International/wireStory?id=420027>; and Penketh, A., 'Israel refuses to rule out attack on Iran', *The Independent*, 27 Jan. 2005, URL <http://news.independent.co.uk/world/middle_east/story.jsp?story=604945>.

[68] IAEA, 'Implementation of the NPT safeguards agreement in the Islamic Republic of Iran', Resolution adopted by the IAEA Board of Governors, GOV/2004/90, Vienna, 29 Nov. 2004, p. 1, URL <http:// www.iaea.org/Publications/Documents/Board/2004/gov2004-90.pdf>.

[69] IAEA (note 68).

[70] According to Article XII.C of the IAEA Statute, the 'Board shall call upon the recipient State or States to remedy forthwith any [safeguards] non-compliance which it finds to have occurred. The Board shall report the non-compliance to all members and to the Security Council and General Assembly of the United Nations.' The full text of the IAEA Statute is available at URL <http://www.iaea.org/About/statute_text.html>.

[71] Reuters, 'US, Iran face off over EU nuclear draft-diplomats', ABC News (Internet edn), 23 Nov. 2004, URL <http://abcnews.go.com/International/print?id=276168>.

risks and challenges.[72] Some analysts have portrayed the issue as posing a crucial test of the credibility of the EU's multifunctional strategy of 'conditional engagement': specifically, whether that strategy—which includes the prospect of improved political and economic ties, but also, if necessary, the imposition of sanctions—can deliver real and sustainable results in addressing concerns about Iran's nuclear activities.[73]

IV. The Six-Party Talks on North Korea's nuclear programme

During 2004 two new rounds were held in the Six-Party Talks between China, Japan, North Korea, South Korea, Russia and the USA aimed at resolving the crisis over North Korea's nuclear programme.[74] The first round had been held on 27–29 August 2003 and ended inconclusively. The next round, held on 25–28 February 2004, resulted in an agreement to establish a working group to prepare for further talks. However, neither North Korea nor the USA showed signs of moving away from their initial negotiating positions.

The principal reason for the impasse was a fundamental difference between the two main protagonists over the timing, or sequencing, of a possible deal. North Korean officials insisted on a multiphase agreement, consisting of step-by-step 'simultaneous actions', under which it would 'clear up all US security concerns' in exchange for the USA's abandoning its 'hostile policy' towards North Korea.[75] Their proposals envisioned a deal similar to the one worked out under the 1994 Agreed Framework between North Korea and the USA.[76] This would involve, in the first phase, the normalization of bilateral relations, including the lifting of US sanctions against North Korea. The USA would resume shipments of heavy fuel oil, which were suspended in November 2003, and pledge not to hinder North Korea's economic cooperation with other countries. In return, North Korea would refreeze activity at its nuclear facilities at Yongbyon. In the next phase, the two sides would conclude a non-aggression treaty; following this, North Korea would begin to dismantle the Yongbyon facilities. This would be completed once the two light-water power reactors promised to North Korea under the 1994 Agreed Framework were

[72] For a discussion of the progress in implementing the Action Plan accompanying the EU's Strategy Against Proliferation of Weapons of Mass Destruction see chapter 11 in this volume.

[73] Everts, S., 'Engaging Iran: a test case for EU foreign policy', Centre for European Reform, Working Paper 513 (Mar. 2004), URL <http://www.cer.org.uk/publications/513.html>; and Eizenstat, S., 'Iran: a test for the European approach', *International Herald Tribune*, 14 Dec. 2004, p. 9.

[74] For a description of the controversy over North Korea's nuclear programme see Kile (note 19), pp. 612–17; and Kile, S. N., 'Nuclear arms control, non-proliferation and ballistic missile defence', *SIPRI Yearbook 2003: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2003), pp. 578–92.

[75] See, e.g., KCNA, 'KCNA slams US talk about "early inspection"', 20 Aug. 2003, URL <http://www.kcna.co.jp/item/2003/200308/news08/21.htm>.

[76] The Agreed Framework between the United States of America and the Democratic People's Republic of Korea was signed in Geneva on 21 Oct. 1994. It is reproduced at URL <http://www.kedo.org/pdfs/AgreedFramework.pdf>.

operating, or when the USA provided compensation in the form of 'heavy oil and electricity, etc.' equal to the 2000-MW capacity of the reactors.[77]

The USA insisted that a 'complete, verifiable and irreversible' end to all of North Korea's nuclear activities, including a suspected uranium enrichment programme, was a precondition for beginning serious negotiations. This meant that North Korea first had to declare all its nuclear facilities, including the alleged enrichment facility, and then dismantle them under international supervision. On the issue of non-aggression, the USA indicated that it would be willing to offer written security assurances; however, it continued to rule out concluding a formal treaty.

In the third round of talks, held on 23–26 June 2004, the USA adopted a more flexible approach.[78] This was motivated in part by the concerns of the USA's allies that the US focus on rolling back North Korea's nuclear programme threatened to undermine regional stability. Some analysts have also charged that the US Administration is not interested, for ideological reasons, in holding serious negotiations with North Korea.[79] The new US proposal called for the complete and verified dismantlement of North Korea's nuclear programme, to take place in two stages. During the first, three-month 'preparatory' phase, North Korea would freeze its nuclear programme in return for receiving fuel oil from China, South Korea and Russia. It would also prepare a comprehensive declaration of all the nuclear material, facilities and equipment in the country. In the second phase, North Korea would agree to eliminate these with international verification. US officials presented their North Korean counterparts with a document providing, for the first time, detailed information about what economic and political benefits North Korea might receive in exchange for verifiably dismantling its nuclear programme.[80] Among other benefits, these included a gradual lifting of US sanctions and the normalization of political relations. In addition, the proposal called for the USA and the other parties to conclude a new regional security agreement.

A North Korean foreign ministry spokesman condemned the US proposal for moving away from the 'principle of simultaneous action' by requiring that North Korea complete the unilateral dismantlement of its nuclear programme as a first step.[81] North Korea insisted that the first step should consist of a 'reward for freeze' in which North Korea's agreement to freeze its nuclear programme at Yongbyon would be accompanied by tangible 'rewards' from the USA, the nature of which would determine the duration of the freeze.[82] On

[77] KCNA, 'Keynote speeches made at six-way talks', 30 Aug. 2003, URL <http://www.kcna.co.jp/item/2003/200308/news08/30.htm>; and KCNA, 'Spokesman for DPRK FM on prospect of resumption of Six-Party Talks', 13 Nov. 2004, URL <http://www.kcna.co.jp/item/2004/200411/news11/15.htm>.

[78] Kerr, P., 'US unveils offer at North Korea talks', *Arms Control Today*, vol. 34, no. 6 (July/Aug. 2004), pp. 35–37.

[79] Eckert, P., 'US should renew focus on N. Korea talks—analysts', Reuters, 25 Jan. 2005, URL <http://www.reuters.ch/newsArticle.jhtml?type=reutersEdge&storyID=7429557>.

[80] 'Dealing with North Korea's nuclear programs', Statement of James A. Kelly, Assistant Secretary of State for East Asian and Pacific Affairs, to the Senate Foreign Relations Committee, Washington, DC, 15 July 2004, URL <http://www.senate.gov/~foreign/testimony/2004/KellyTestimony040715.pdf>.

[81] KCNA, 'Spokesman for DPRK FM on prospect of resumption of Six-Party Talks' (note 77).

[82] KCNA, 'Spokesman for DPRK FM on prospect of resumption of Six-Party Talks' (note 77).

16 August North Korea announced that it would not participate in the working group meetings to prepare for the next round of talks, scheduled for September 2004, arguing that the USA's 'hostile attitude' made such meetings pointless.[83] North Korea also cited South Korea's disclosure of several undeclared nuclear experiments in justifying its withdrawal from the talks[84] (see section VI). Throughout the autumn, the state-run media accused the USA of plotting to overthrow the North Korean Government, including making preparations for the use of military force.[85]

International concern about the impasse was heightened when IAEA Director General ElBaradei stated, in November 2004, that he believed that North Korea had separated plutonium from the spent fuel rods which the IAEA had monitored before being expelled from the country in December 2003 and had used it to manufacture four to six nuclear weapons.[86] There has been considerable debate over the question of whether or not North Korea has produced operational nuclear weapons.[87] Although official statements on the subject from Pyongyang are ambiguous, the emerging consensus among governmental and independent experts is that North Korea has probably managed to develop a small number of nuclear weapons.

V. Post-war findings about Iraq's nuclear programme

Iraq's suspected WMD programme remained a focus of international attention during 2004, as inspection teams from the coalition Iraq Survey Group (ISG) failed to discover stockpiles of nuclear, chemical or biological weapons or evidence of recent programmes to manufacture them. This fuelled the controversy over the validity of the rationale given by the British and US governments for the decision to invade Iraq in March 2003. With regard to nuclear weapons, the main question was whether Iraq had engaged in proscribed nuclear weapon-related activities, as alleged in British and US intelligence reports prior to the invasion of the country. The accuracy of these reports—and the process by which they had been put together—came under the scrutiny of parliamentary commissions of inquiry in a number of countries taking part in the occupation of Iraq, including an investigation launched by the US Senate.[88]

[83] KCNA, 'Spokesman for DPRK Foreign Ministry on prospect of Six-Party Talks', 17 Aug. 2004, URL <http://www.kcna.co.jp/item/2004/200408/news08/17.htm>. Many observers believed that North Korea refused to participate because it was awaiting the outcome of the US presidential election.

[84] KCNA, 'US double standards assailed', 20 Sep. 2004, URL <http://www.kcna.co.jp/item/2004/200409/news09/21.htm>.

[85] KCNA, 'Spokesman for DPRK FM on prospect of resumption of Six-Party Talks', 13 Nov. 2004, URL <http://www.kcna.co.jp/item/2004/200411/news11/15.htm>. North Korea cited the Proliferation Security Initiative (PSI) interdiction exercise, which Japan hosted in late Oct. 2004, as evidence of this strategy. On the PSI see chapter 18 in this volume.

[86] Sanger, D. and Broad, W., 'UN atom chief certain North Korea has made fuel for 4 to 6 bombs', *International Herald Tribune*, 7 Dec. 2004, p. 5.

[87] See Kile (note 19), pp. 615–17.

[88] See chapter 13 in this volume.

On 30 September 2004 Charles Duelfer, the head of the ISG, published a new interim report on the inspectors' findings.[89] The report confirmed the main findings of an October 2003 interim report by then ISG head David Kay.[90] It stated that Iraq's WMD capability had been 'essentially destroyed in 1991' and was never reconstituted.[91] Duelfer told the US Congress that he did not 'expect that militarily significant WMD stocks are cached in Iraq'.[92]

With regard to nuclear weapons, the new report confirmed the ISG's previous finding that former Iraqi Presisdent Saddam Hussein had ended the country's nuclear weapon programme in 1991, after the Persian Gulf War, and had not made any 'concerted efforts to restart the program'.[93] It also stated that 'Saddam aspired to develop a nuclear capability in an incremental fashion, irrespective of international pressure' and assigned a 'high value' to retaining the 'nuclear progress and talent that had been developed'.[94] Towards this end, Iraq had taken steps to preserve some technological capability from the pre-1991 programme. These included, for example, hiding in scientists' homes documents and equipment that would have been useful for resuming a uranium enrichment programme. Iraq also transferred many nuclear scientists to related jobs in the Military Industrial Commission (MIC) in order to help them maintain their weapons knowledge. Despite these efforts, the report concluded that, after the nuclear programme was ended in 1991, Iraq's accumulated 'intellectual capital decayed in the succeeding years'.[95] It also concluded that Saddam eventually would have sought to reconstitute the country's WMD programmes but probably intended to give higher priority to ballistic missile and chemical warfare capabilities than to nuclear weapons.[96]

The ISG ended its search for Iraqi non-conventional weapons in December 2004. According to US officials, the group's operations were brought to a close because there was little expectation of finding any substantial new evidence and the hunt could no longer be justified in view of the rising danger to the investigators.[97]

[89] [US Central Intelligence Agency (CIA)], Director of Central Intelligence, *Comprehensive Report of the Special Advisor to the Director of Central Intelligence on Iraq's WMD*, 3 vols, 30 Sep. 2004, URL <http://www.odci.gov/cia/reports/iraq_wmd_2004/index.html>.

[90] See Kile (note 19), pp. 620–21. On the work of the ISG see also chapter 13 in this volume.

[91] CIA, (note 89), vol. 1, 'Key findings', p. 1.

[92] Testimony of Charles Duelfer, Special Advisor to the Director of Central Intelligence for Iraqi Weapons of Mass Destruction, to the Armed Services Committee, US Senate, Washington, DC, 6 Oct. 2004, URL <http://armed-services.senate.gov/statemnt/2004/October/Duelfer%2010-06-04.pdf>.

[93] CIA (note 89), vol. 1, 'Key findings'.

[94] CIA (note 89), vol. 1, 'Key findings', and vol. 2, 'Nuclear', p. 1.

[95] CIA (note 89), vol. 2, 'Nuclear'.

[96] CIA (note 89), vol. 1, 'Key findings'.

[97] Borger, J. and Steele, J., 'US gives up search for Saddam's WMD', *The Guardian*, 13 Jan. 2005, URL <http://www.guardian.co.uk/Iraq/Story/0,2763,1389370,00.html>; and Linzer, D., 'Search for banned arms in Iraq ended last year', *Washington Post*, 12 Jan. 2005, URL <http://www.washingtonpost.com/ac2/wp-dyn/A2129-2005Jan11>.

VI. South Korean safeguards violations

Another safeguards-related controversy arose in September 2004 when South Korea acknowledged that it had conducted uranium enrichment and plutonium separation experiments without reporting them in a timely manner to the IAEA, as required by its full-scope safeguards agreement. Since these activities have direct applications in the development of nuclear weapons, the revelations raised international concern that there was renewed interest in weapon research in South Korea.[98] However, the IAEA's subsequent investigations did not find evidence that South Korea was attempting to reconstitute the nuclear weapon R&D programme which it had abandoned in the 1970s, under strong US pressure.[99] ElBaradei stated in an interview that there were no signs that South Korea had 'any intentions to develop nuclear weapons'.[100]

The uranium enrichment experiments came to light in connection with South Korea's submission to the IAEA Secretariat, on 23 August 2004, of its initial expanded declaration under the NPT Additional Safeguards Protocol.[101] South Korea's Ministry of Science and Technology reported to the IAEA that it had discovered, in June 2004, that scientists at the Korea Atomic Energy Research Institute (KAERI) had conducted laboratory-scale uranium enrichment experiments using the atomic vapour laser isotope separation (AVLIS) method.[102] The experiments had been conducted in 2000 along with unrelated isotope separation experiments.[103] A senior South Korean scientist said that the experiments had not been reported to the IAEA because they were a one-time 'academic test' that had produced a 'miniscule' amount of uranium.[104]

South Korea's failure to report the experiments violated its safeguards agreement, which obliges it to declare to the IAEA the use of nuclear material in enrichment experiments and to provide the agency with information about

[98] Some experts have warned that the protracted crisis over North Korea's nuclear programme might eventually lead South Korea and Japan to re-evaluate their status as NNWSs. Pollack, J. and Reiss, M., 'South Korea: the tyranny of geography and the vexations of history', eds K. Campbell *et al*., *The Nuclear Tipping Point: Why States Reconsider Their Nuclear Choices* (Brookings Institution Press: Washington, DC, 2004).

[99] For an overview of South Korea's nuclear policies see Feldman, Y. and Boureston, J., 'Country profile 2: South Korea', SIPRI–FirstWatch International Internet site on Countries of Nuclear Strategic Concern, URL <http://projects.sipri.se/nuclear/cnscindex.htm>.

[100] Quoted by Faiola, A., 'IAEA chief doubts S. Korea arms plans', *Washington Post* (Internet edn), 9 Oct. 2004, URL <http://www.washingtonpost.com/wp-dyn/articles/A18674-2004Oct8.html>.

[101] South Korea signed an Additional Protocol on 21 June 1999, which entered into force on 18 June 2004; see IAEA INFCIRC236.Add1, 18 June 2004, URL <http://www.iaea.org/Publications/Documents/Infcircs/2004/infcirc236a1.pdf>.

[102] IAEA, 'Implementation of the NPT safeguards agreement in the Republic of Korea', Report by the Director General to the IAEA Board of Governors, GOV/2004/84, Vienna, 11 Nov. 2004, p. 1, URL <http://www.iaea.org/Publications/Documents/Board/2004/gov2004-84.pdf>.

[103] The experiments used 3.5 kg of natural uranium metal to produce 200 mg of uranium enriched to an average of 10.2% in U-235. The peak level of enrichment produced by the experiments was 77% U-235, which was close to weapons-grade level (90%). Hibbs, M.,'77% U-235 was peak enrichment reported to IAEA by South Korea', *Nuclear Fuel*, vol. 29, no. 30 (27 Sep. 2004), pp. 7–8.

[104] Chang In Soon, President of the Korea Atomic Energy Research Institute, quoted by Brooke, J., 'South Korean scientist calls uranium test "academic"', *New York Times* (Internet edn), 7 Sep. 2004, URL <http://www.nytimes.com/2004/09/07/international/asia/07korea.html>.

the facilities and equipment involved.[105] In the course of verifying South Korea's account of the enrichment experiments, IAEA inspectors learned that KAERI had failed to declare all of its uranium conversion activities. These included the production, in 1982–84, of 154 kg of natural uranium metal—a sample from which was used in the AVLIS laser enrichment experiments.[106]

One week after disclosing the uranium enrichment experiments, South Korean officials acknowledged, in response to press inquiries, that scientists at KAERI had conducted an undeclared plutonium separation experiment.[107] This experiment was already the subject of discussions between South Korea and the IAEA. In 1997 IAEA inspectors had taken environmental samples at a hot cell facility at the TRIGA III research reactor that revealed the presence of slightly irradiated depleted uranium with associated plutonium that was not consistent with any reported activities.[108] In March 2004 South Korea informed the IAEA that its scientists had conducted an undeclared laboratory-scale plutonium separation experiment in 1981–82. The experiment yielded a small amount of plutonium, estimated to be less than 40 mg.[109]

The reaction to the disclosures

The disclosures impeded efforts to restart the Six-Party Talks on North Korea's nuclear weapon programme and complicated South Korea's efforts to engage North Korea in improving inter-Korean relations.[110] According to a North Korean foreign ministry spokesman, the key issue was not the level of uranium enrichment or the amount of separated plutonium; rather, it was that 'South Korea had pursued in secrecy a nuclear weapons program with the connivance of the US' and now had 'full access' to technology for developing a nuclear weapons capability.[111]

The South Korean Government played down the undeclared nuclear activities, describing them as 'isolated laboratory-scale research activities' which a few scientists had conducted on their own initiative without the knowledge of their supervisors or the government.[112] Some observers doubted the plausibility of this explanation, at least with respect to the plutonium separation

[105] In addition, the 1992 Joint Declaration of the Denuclearization of the Korean Peninsula, signed by North Korea and South Korea on 20 Jan. 1992, prohibits the 2 parties from possessing or developing uranium enrichment capabilities. The text of the Joint Declaration is available at URL <http://www.ceip.org/files/projects/npp/resources/koreadenuclearization.htm>.

[106] IAEA (note 102), pp. 4–5.

[107] Faiola, A. and Linzer, D., 'S. Korea admits extracting plutonium', *Washington Post* (Internet edn), 10 Sep. 2004, p. 1, URL <http://www.washingtonpost.com/wp-dyn/articles/A9761-2004Sep9.html>.

[108] IAEA (note 102), p. 5.

[109] IAEA (note 102), p. 5.

[110] 'Seo, H., 'Pyongyang seizes on Seoul's nuclear dabbling', *Asia Times* (Internet edn), 14 Sep. 2004, URL <http://www.atimes.com/atimes/Korea/FI14Dg05.html>.

[111] KCNA, 'Foreign Ministry spokesman demands clarification of S. Korea's nuclear issue', 6 Oct. 2004, URL <http://www.kcna.co.jp/item/2004/200410/news10/07.htm>.

[112] Statement by H.E. Mr Ban Ki-moon, Minister of Foreign Affairs and Trade, Republic of Korea, at the 59th Session of the United Nations General Assembly, New York, 24 Sep. 2004, URL <http://www.un.org/webcast/ga/59/statements/koreng040924.pdf>.

experiment, saying that it was widely known among nuclear specialists and within US intelligence agencies; they also pointed out that the scientists involved should have been aware that the activities had to be reported to the IAEA.[113] The revelations raised concerns about the South Korean Government's regulatory and supervisory capacities with respect to the country's nuclear establishment.[114] On 25 October 2004 the Ministry of Science and Technology announced the creation of a National Nuclear Management and Control Agency to 'monitor nuclear energy-related activities' and assist with national safeguards implementation.[115]

The IAEA Board of Governors took up the issue of South Korea's undeclared nuclear activities at its November 2004 meeting, which concluded that South Korea's failure to declare the experiments was a 'matter of serious concern'.[116] However, the Board noted that the quantities of nuclear material involved had not been significant and that there was no indication that the experiments had continued. It also noted the corrective action taken by South Korea and welcomed the active cooperation it had provided to the agency. The Board requested that the Director General 'report as appropriate' on the safeguards issue but did not discuss whether to refer it to the UN Security Council.[117] Prior to the meeting, there had been speculation that the US Administration intended to push for a referral of the issue to the UN Security Council in order to create a precedent for dealing with what the White House considered to be Iran's more serious safeguards violations.[118]

VII. The NPT Review Conference Preparatory Committee

The third meeting of the Preparatory Committee (PrepCom) for the 2005 NPT Review Conference was held at UN Headquarters in New York on 26 April–7 May 2004.[119] Delegations from 123 states parties to the NPT par-

[113] Kang, J. *et al*., 'South Korea's nuclear surprise', *Bulletin of the Atomic Scientists*, vol. 61, no. 1 (Jan./Feb. 2005), pp. 40–49.

[114] Pinkston, D., 'South Korea's nuclear experiments', *CNS Research Story*, Center for Nonproliferation Studies, Monterey Institute of International Studies, 9 Nov. 2004, URL <http://cns.miis.edu/pubs/week/041109.htm>; and Kang, *et al*. (note 113).

[115] Fifield, A., 'S. Korea establishes its own nuclear watchdog', *Financial Times* (Internet edn), 25 Oct. 2004, URL <http://www.ransac.org/printerfriendly.asp?doc=1025200493619AM.html>.

[116] IAEA, 'Implementation of the NPT safeguards agreement in the Republic of Korea', Chairman's conclusion on item 4(c): nuclear verification, IAEA Board of Governors, Vienna, 26 Nov. 2004, URL <http://www.iaea.org/NewsCenter/News/2004/south_korea.html>.

[117] IAEA (note 116).

[118] Linzer, D., and Faiola, A., 'US won't report South Korea to UN for nuclear tests', *Washington Post* (Internet edn), 25 Nov. 2004, URL <http://www.washingtonpost.com/wp-dyn/articles/A11256-2004Nov24.html>; and Fifield, A., 'Seoul hopes to escape UN referral over nuclear plans', *Financial Times*, 13–14 Nov. 2004, p. 5.

[119] The 1995 NPT Review and Extension Conference had sought to strengthen the review process by requiring that Preparatory Committee meetings be held in each of the 3 years leading up to the 5-yearly Review Conferences. The purpose of the Preparatory Committee meetings is to 'consider principles, objectives and ways in order to promote the full implementation of the Treaty, as well as its universality, and to make recommendations thereon to the Review Conference'. 'Strengthening the review process for the Treaty', New York, 11 May 1995, NPT/CONF.1995/32 (Part I), URL <http://disarmament2.un.org/wmd/npt/1995dec1.htm>.

ticipated, with Ambassador Sudjadnan Parnohadiningrat, of Indonesia, serving as chairman.[120] Under the 'enhanced', strengthened review process agreed at the 2000 Review Conference, the main purpose of the 2004 PrepCom meeting was to produce consensus recommendations to the upcoming Review Conference on a range of treaty-related issues, taking into account the deliberations and results of the two previous sessions.[121]

The meeting was marked by discord and deep division between the states parties. The PrepCom failed to produce a report containing any substantive recommendations for the conference on treaty implementation issues. It also failed to adopt an agenda for the conference. This was primarily because of opposition from the USA and other nuclear weapon states (NWSs) to a proposal, supported by many NNWSs, to frame the 2005 treaty review in terms of the 13-step programme of action on nuclear disarmament agreed at the 2000 Review Conference.[122] The Committee did manage to adopt the minimum organizational and procedural agreements needed for the Conference to be able to take place.[123]

The 2004 PrepCom meeting highlighted deep differences between the states parties over the issue of responding to suspected or clear-cut cases of non-compliance and the perceived lack of commitment of some parties to fulfilling their treaty obligations.[124] The main division was between the five NPT-defined NWSs—China, France, Russia, the UK and, especially, the USA—and the members of the Non-Aligned Movement (NAM)[125] and other NNWS parties. The former discussed treaty non-compliance primarily in terms of NNWS parties seeking to develop nuclear weapons, in contravention of Articles I and II of the NPT.[126] Many NNWS parties, led by NAM members such as Indonesia, Iran and Malaysia, focused on the obligation of the NWSs, codified in Article VI, to work 'in good faith' towards nuclear disarmament.

[120] 'Third session of Preparatory Committee for 2005 Review Conference of parties to NPT concludes in New York', United Nations Press Release DC/2923, 13 May 2004, URL <http://www.un.org/News/Press/docs/2004/dc2923.doc.htm>.

[121] 'Improving the effectiveness of the strengthened review process for the Treaty', New York, 19 May 2000, NPT/CONF.200/28 (Part I), URL <http://disarmament2.un.org/wmd/npt/finaldoc.html>.

[122] As part of the compromise paving the way for the consensus adoption of a final document at the 2000 Review Conference, the NWSs reaffirmed their commitment to nuclear disarmament, as mandated by Art. VI of the NPT, by agreeing to a specific programme of action to reduce the role of—and eventually eliminate—their nuclear arsenals. 'Review of the operation of the treaty, taking into account the decisions and the resolution adopted by the 1995 Review and Extension Conference', New York, 19 May 2000, NPT/CONF2000.28 (Part I), URL <http://disarmament2.un.org/wmd/npt/finaldoc.html>.

[123] These included decisions setting the conference date for 2–27 May 2005 and selecting Ambassador Sérgio de Queiroz Duarte of Brazil as its president. 'Third session of Preparatory Committee for 2005 Review Conference of parties to NPT concludes in New York' (note 120).

[124] Johnson, R., 'Report on the 2004 NPT PrepCom', *Disarmament Diplomacy*, no. 77 (May/June 2004), URL <http://www.acronym.org.uk/dd/dd77/77npt.htm>; and Boese, W., 'NPT meeting marked by discord', *Arms Control Today*, vol. 34, no. 5 (June 2004), pp. 28–29.

[125] For the members of the NAM see the glossary in this volume.

[126] A US official named 4 NNWS—Iraq, Iran, Libya and North Korea—as suspected or known to have proscribed military nuclear programmes and warned of a 'crisis of NPT noncompliance' that was eroding confidence in the regime. 'The NPT: a crisis of non-compliance', Statement by John R. Bolton, Under Secretary for Arms Control and International Security, to the Third Session of the Preparatory Committee for the 2005 Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons, New York, 27 Apr. 2004, URL <http://www.state.gov/t/us/rm/ 31848.htm>.

They argued that the failure of the NWSs to make sufficient progress towards complying with their nuclear disarmament obligation posed at least as serious a threat to the vitality of the NPT as 'horizontal' proliferation by NNWS, since disarmament and non-proliferation are interdependent and mutually reinforcing.[127] This view was supported by the seven members of the New Agenda Coalition (NAC), which expressed disappointment over the lack of progress made by the NWS in implementing the practical steps towards disarmament to which they had agreed at the 2000 Review Conference.[128] The NAC was particularly critical of the USA's retreat from its commitment, as part of the 13-step programme of action agreed at the 2000 Review Conference, to seek the early entry into force of the 1996 Comprehensive Nuclear Test-Ban Treaty.

A number of perennially controversial NPT issues surfaced during the third PrepCom meeting. The League of Arab States took the lead in calling for the establishment of a nuclear weapon-free zone in the Middle East.[129] There was considerable debate about proposals for a global treaty on negative security assurances—that is, legally binding promises by the NWSs not to use, or threaten to use, nuclear weapons against NNWS parties to the NPT.[130] There was also debate about proposals to make the Additional Protocol a mandatory condition for suppliers' transfer of nuclear technology and materials to recipient states.[131]

VIII. Internationalization of the nuclear fuel cycle

During 2004 there was new interest in the old idea of establishing multinational or international arrangements for controlling the nuclear fuel cycle activities of greatest proliferation concern—uranium enrichment and plutonium reprocessing; and spent fuel management and waste disposal.[132] This idea had been widely discussed in the late 1970s in connection with the Inter-

[127] See, e.g., 'Working paper submitted by Malaysia on behalf of the Group of Non-Aligned and Other States Parties to the Treaty on the Non-Proliferation of Nuclear Weapons', New York, 5 May 2004, NPT/ CONF.2005/PC.III/WP.24, URL <http://daccess-ods.un.org/TMP/3589686.html>.

[128] 'New Agenda Coalition substantive recommendations to the third session of the Preparatory Committee of the 2005 NPT Review Conference', New York, 26 Apr. 2004, NPT/CONF.2005/PC.III/11, URL <http://daccess-ods.un.org/TMP/7933799.html>. For the members of the NAC see the glossary in this volume.

[129] 'Paper presented on behalf of the States members of the League of Arab States at the third session of the Preparatory Committee for the 2005 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, New York, 28 Apr. 2004, NPT/CONF.2005/PC.III/WP.12, URL <http://daccess-ods.un.org/TMP/6450427.html>. For the members of the League of Arab States see the glossary in this volume.

[130] For more detail see du Preez, J., 'Security assurances against the use or threat of use of nuclear weapons: is progress possible at the NPT Prepcom?', Monterey Institute of International Studies, Centre for Nonproliferation Studies, 28 Apr. 2003, URL, <http://cns.miis.edu/research/npt/nptsec.htm>.

[131] Johnson (note 124).

[132] Rauf, T. and Simpson, F., 'The nuclear fuel cycle: is it time for a new approach?', *Arms Control Today*, vol. 34, no. 8 (Dec. 2004), URL <http://www.armscontrol.org/act/2004_12/Rauf.asp>.

national Nuclear Fuel Cycle Evaluation (INFCE) conference.[133] However, the discussions led to few concrete results because of opposition from the nuclear power industry and the unwillingness of some countries with advanced nuclear power programmes to foreclose fuel cycle options.

The resurgence of interest in proposals to internationalize the nuclear fuel cycle has been stimulated by the controversies over the scope and nature of nuclear programmes in Iran and North Korea. These controversies have led some observers to conclude that there is an inherent structural weakness in the NPT: namely, that NPT Article IV, which gives NNWS parties an 'inalienable right' to import and develop materials and technologies for use in civil nuclear energy programmes, opens the possibility that an NNWS can covertly develop a nuclear weapon capability by putting in place, under the cover of a civil nuclear energy programme, the fuel cycle facilities needed to produce weapon-usable nuclear material.[134] This concern has been reinforced by revelations about the existence of a global black market in nuclear technology and expertise. The perceived weaknesses in the NPT regime have led to recent calls for a permanent halt to the construction of new nationally controlled facilities for producing fissile material.[135] The main aim of proposals to internationalize the fuel cycle is to allow states to continue to develop nuclear energy for peaceful purposes, as guaranteed by Article IV, while preventing the diversion of nuclear technologies and material to clandestine weapon programmes.

A number of proposals are currently being discussed that envision new management or control arrangements for limiting the front end of the civilian nuclear fuel cycle.[136] These fall into four general categories: (*a*) the establishment of a more intrusive international inspection and regulatory regime for existing fuel processing and production facilities; (*b*) the creation of new multinational consortia involving the sharing of the ownership and operation of sensitive fuel cycle facilities among a number of nations (the 'Urenco model');[137] (*c*) the creation of multinational enterprises, hosted and operated by a single national authority, having other nations as shareholders (the

[133] The INFCE was an international study initiated by US President Jimmy Carter in Oct. 1977 to assess the comparative economic, technical and political advantages of various nuclear fuel cycles, with particular reference to the use of plutonium for recycling.

[134] See, e.g., ElBaradei, M., 'Towards a safer world', *The Economist*, 18 Oct. 2003, pp. 43–44; Cirincione, J. and Wolfsthal, J., 'North Korea and Iran: test cases for an improved non-proliferation regime?', *Arms Control Today*, vol. 33, no. 10 (Dec. 2003), pp. 11–14; and Levi, M., 'There is no absolute right to nuclear energy', *Financial Times*, 22 Sep. 2004, p. 15.

[135] Allison, G., 'How to stop nuclear terror', *Foreign Affairs*, vol. 83, no. 1 (Jan./Feb. 2004), pp. 64–74; and Campbell, K. and Einhorn, R., 'Avoiding the tipping point: concluding observations', eds Campbell *et al*. (note 98).

[136] The nuclear fuel cycle consists of front-end steps (milling and mining of uranium ore, uranium conversion and enrichment, fuel fabrication) that lead to the preparation of uranium for use as fuel for reactor operation and back-end steps that are necessary to safely manage, prepare and dispose of the highly radioactive spent nuclear fuel.

[137] Urenco is a multinational uranium enrichment enterprise, established by a 1970 treaty between Germany, the Netherlands and the UK, that operates gas centrifuge facilities to provide fuel for commercial nuclear power reactors.

'Eurodif model');[138] and (*d*) the establishment of international nuclear fuel bank, under an international nuclear fuel authority, into which producers would deposit their fuel output to be 'paid out' to end-users.[139] With regard to the back end of the fuel cycle, proposals have been put forward for establishing new multinational programmes for managing and disposing of spent fuel and radioactive waste.

At the June 2004 meeting of the IAEA Board of Governors, ElBaradei announced the appointment of an international Expert Group to consider possible multilateral approaches to sensitive nuclear fuel cycle activities.[140] The Group's mandate is to support decision making in government and industry by providing an initial survey of the most promising institutional and technical approaches, including consideration of relevant economic, legal and security issues.[141] The first meeting of the Group, consisting of 23 experts, took place on 10 September 2004.[142] It is scheduled to submit a report to ElBaradei by March 2005.

IX. New US nuclear weapons

There has been a long-running debate in the US Congress over the building of new types of nuclear weapons. The debate intensified in 2002, when officials of the Bush Administration called for the development of a robust nuclear earth-penetrating (RNEP) weapon. They argued that this nuclear 'bunker buster' was needed for the USA to be able to hold at risk the command-and-control and WMD production facilities that potential adversaries were building deep underground, beyond the reach of current US conventional munitions.[143] The administration also urged the development of new very-low-yield

[138] Eurodif is a uranium enrichment consortium established in 1973 by Belgium, France and Spain, and later joined by Italy, that operates a gaseous diffusion plant at a site in France, under the management of the French Atomic Energy Commission.

[139] See, e.g., 'Statement by Director General Mohamed ElBaradei, at the 47th Regular Session of the General Conference of the International Atomic Energy Agency', Vienna, 15 Sep. 2003, available at URL <http://www.acronym.org.uk/docs/0309/doc26.htm>; and McCombie, C. and Chapman, N., 'Nuclear fuel cycle centres—an old and new idea', Paper presented at World Nuclear Association annual symposium, London, 10 Sep. 2004, URL <http://www.world-nuclear.org/sym/2004/mccombie.htm>.

[140] IAEA, Introductory statement to the Board of Governors by IAEA Director General Dr Mohamed ElBaradei, DG/14062004, Vienna, 14 June 2004, URL <http://www.iaea.org/NewsCenter/Statements/2004/ebsp2004n003.html>.

[141] These include, *inter alia*, questions about ownership, management and control of facilities, financing arrangements, conditions for supplying fuel services, insurance and liability, safety and environmental protection, physical security, and international safeguards arrangements. IAEA Office of External Relations and Policy, 'Multilateral approaches to the nuclear fuel cycle: preliminary views of the IAEA Secretariat for the proposed study', Vienna, 2004, URL <http://www.iaea.org/NewsCenter/Focus/FuelCycle/preliminaryviews.pdf>.

[142] IAEA, 'Expert Group meeting on control of nuclear fuel cycle' IAEA News Centre, Vienna, 10 Sep. 2004, URL <http://www.iaea.org/NewsCenter/News/2004/bettercontrols.html>.

[143] See, e.g., Younger, S., 'Nuclear weapons in the twenty-first century', Los Alamos National Laboratory, Report LAUR-00-2850, 27 June 2000, URL <http://www.fas.org/nuke/guide/usa/doctrine/doe/younger.htm>. Critics have argued that even very-low-yield nuclear weapons detonated deep underground will produce considerable collateral blast damage as well as significant radioactive fallout. Nelson, R., 'Low-yield earth-penetrating nuclear weapons', *FAS Public Interest Report*, vol. 54, no. 1 (Jan./Feb. 2001), URL <http://www.fas.org/faspir/2001/v54n1/weapons.htm>.

nuclear weapons (so-called mini-nukes) to enhance US capabilities to deter 'rogue states' from using, or threatening to use, non-conventional weapons, and even to dissuade them from developing such weapons.[144] In 2003 Congress voted to repeal the 10-year-old Spratt–Furse ban (named after its two congressional sponsors) on research leading to development of nuclear weapons with yields of less than five kilotons.[145] It also approved funding, with some restrictions, for proposals to continue researching new types of nuclear 'bunker busters'.[146] However, it withheld authorization for work on designing, engineering and testing new or modified nuclear weapons.

The debate took a new turn when, on 22 November 2004, the Republican Party-controlled Congress passed an omnibus appropriation bill for financial year (FY) 2005 that eliminated or reduced funding requested by the administration for work on new types of nuclear weapons. The bill deleted the White House's request for $27 million to continue research on modifying two existing nuclear weapons (B-61 and B-83 gravity bombs) for the earth-penetrator role; spending on this programme had been set to rise sharply, to $485 million over five years.[147] The bill also rescinded $9 million that had been previously authorized for work on the Advanced Concepts Initiative, which included research into very-low-yield nuclear weapons. The money was redirected into the Reliable Replacement Warhead programme, which is aimed at improving the reliability and longevity of existing weapons and their components without nuclear explosive testing.[148] In addition, the bill cut funding requested for selecting a site for a $4 billion facility for making new plutonium triggers ('pits') for nuclear warheads.[149]

The vote revealed significant bipartisan opposition to the administration's funding requests for nuclear weapon research and a reinvigorated testing capacity. This opposition stemmed from two main concerns. First, some legislators were worried that new types of low-yield and earth-penetrating nuclear weapons were likely to be viewed as being more usable than existing

[144] The White House, 'National Strategy to Combat Weapons of Mass Destruction', Washington, DC, Dec. 2002, URL <http://www.whitehouse.gov/news/releases/2002/12/WMDStrategy.pdf>; and House Policy Committee, Subcommittee on National Security and Foreign Affairs, *Differentiation and Defense: An Agenda for the Nuclear Weapons Program* (House Policy Committee: Washington, DC, Feb. 2003), URL <http://cox.house.gov/files/nuclear_report.pdf>.

[145] 'US lawmakers agree to end ban on low-yield nuclear weapons research', *Global Security Newswire*, 7 Nov. 2003, URL <http://www.nti.org/d_newswire/issues/print.asp?story_id=B8DDB202-0889-427B-AD35-CDD79E709BB1>. For further detail about the 1994 Spratt–Furse ban (Section 3136 of Public Law 103-160) see Wright, D., 'The Spratt–Furse law on mini-nuke development', Backgrounder, Union of Concerned Scientists, 11 May 2003, URL <http://www.ucsusa.org/global_security/nuclear_weapons/page.cfm?pageID=1182>.

[146] In addition, Congress approved measures to shorten the time required to prepare for a full-scale nuclear test from 24 months to 18 months.

[147] Wald, M., 'Nuclear weapons money is cut from spending bill', *New York Times* (Internet edn), 23 Nov. 2004, URL <http://www.nytimes.com/2004/11/23/politics/23nuke.html>.

[148] Wald (note 147); and 'US nuclear security in the 21st century', Address by Rep. David Hobson to the Arms Control Association, 3 Feb. 2005, URL <http://www.armscontrol.org/events/20050203_hobson_text.asp>.

[149] Opponents of the Modern Pit Facility have argued that, with a planned 50% reduction of the US nuclear stockpile, a small facility currently operating at Los Alamos National Laboratory could produce enough pits for the US arsenal. Fetter, S. and von Hippel, F., 'Does the United States need a new plutonium-pit facility?', *Arms Control Today*, vol. 34, no. 4 (May 2004), pp. 10–14.

weapons, especially as part of the administration's strategy of pre-empting WMD threats, and hence would increase the risk of war.[150] Second, there was concern that the administration's interest in these weapons was undermining broader international efforts to devalue the role of nuclear weapons in military planning and to reduce the incentives for their acquisition.[151] Despite congressional opposition, administration officials indicated that they would make a new effort to secure funding in the FY 2006 and FY 2007 budgets to complete the RNEP study.[152]

X. Conclusions

In 2004 concern about the long-term vitality of the nuclear non-proliferation regime led to new initiatives aimed at strengthening the regime. Revelations about the activities of the clandestine black market network organized by Pakistani nuclear scientist A. Q. Khan highlighted the difficult problem posed by the willingness of some states, or of individual scientists, to sell sensitive nuclear technologies and expertise that can be used to develop nuclear weapons. The discovery of the Khan network gave impetus to new strategies aimed at curbing 'secondary proliferation', in which illegally acquired nuclear technologies and materials are re-exported to other would-be proliferators. It also led to a new legally binding initiative, UN Security Council Resolution 1540, which requires governments to tighten domestic legislation and to take action against private companies or individuals found to be operating outside the law.

During 2004 there continued to be concern about a perceived lacuna in Article IV of the NPT that potentially allowed NNWSs such as Iran to put in place the key fuel cycle facilities for manufacturing nuclear weapons under the cover of civil nuclear energy programmes. This led to growing interest in the idea of limiting civil uranium enrichment and plutonium reprocessing programmes to a handful of fully transparent nuclear fuel cycle facilities, operating under multinational or international control. It reflected a broader concern that the diffusion of sensitive nuclear technology and expertise is undermining the efficacy of traditional regime instruments, including export controls and international safeguards on nationally controlled fuel cycle facilities and nuclear material holdings, in reducing proliferation risks.

The serious weaknesses evident in the non-proliferation regime underscore the urgent need for the international community to work to revitalize and strengthen the regime. This will involve filling gaps in safeguards and export control arrangements as well as closing loopholes that have been exploited in the past by some states. This in turn will require new multifunctional

[150] Pincus, W., 'Funds for atomic bomb research cut from spending bill', *Washington Post* (Internet edn), 23 Nov. 2004, URL <http://www.washingtonpost.com/ac2/wp-dyn/A5554-2004Nov22>.

[151] Ruppe, D., 'Bush nuclear policies undermine nonproliferation, Republican Congressman says', *Global Security Newswire*, 12 Aug. 2004, URL <http://www.nti.org/d_newswire/issues/print.asp?story_id=49C0280E-D749-4916-81AB-1882EC615784>.

[152] Pincus, W., 'Rumsfeld seeks to revive burrowing nuclear bomb', *Washington Post* (Internet edn), 1 Feb. 2005, URL <http://www.washingtonpost.com/ac2/wp-dyn/A52564-2005Jan31>.

approaches to addressing proliferation challenges that make use of the full range of political and economic as well as military instruments that the international community has at its disposal. Above all, it will require a renewed commitment by all states to fully implement their arms control and disarmament commitments within the existing multilateral treaty framework.