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Iran's Nuclear Program: Recent Developments

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Summary

Since 2003, International Atomic Energy Agency (IAEA) inspections of Iran's nuclear program have revealed significant undeclared activities with potential application for nuclear weapons, including uranium enrichment facilities and plutonium separation efforts. Also since 2003, Iran has been negotiating with Germany, France, and the UK (EU-3) for a wide range of assistance in exchange for a halt to such activities. Yet, most evidence indicates that Iran has never completely suspended its enrichment activities, raising the question of whether Iran is buying time to build nuclear weapons. Although the EU-3 are seeking a permanent suspension, Iran insists its suspension is temporary. Ever on the brink of being declared in violation of the Nonproliferation Treaty (NPT), Iran has allowed IAEA inspectors access only when pressed. This report, which is updated as needed, analyzes the significance of the IAEA's findings for a possible Iranian nuclear weapons program.

Background

Iran has had a nuclear program for close to 50 years, beginning with a research reactor purchased from the United States in 1959. The Shah's plan to build 23 nuclear power reactors by the 1990s was regarded as grandiose, but not necessarily viewed as a "back door" to a nuclear weapons program, possibly because Iran did not then seek the technologies to enrich or reprocess its own fuel.¹ There were a few suspicions of a nuclear weapons program, but these abated in the decade between the Iranian 1979 revolution and the end of Iran-Iraq war, both of which brought a halt to nuclear activities. Iran's current plans — to construct seven nuclear power plants (1000 MW each) by 2025

¹ However, there were reports that Iran's AEOI sought laser enrichment technology in the United States in the late 1970s, and that reprocessing-related experiments were conducted. In addition, there were intelligence reports that the Shah had a secret group to work on nuclear weapons. See Leonard S. Spector, *Nuclear Ambitions* (Colorado: Westview Press, 1990), p. 204.

— are still ambitious, particularly for a state with considerable oil and gas reserves.² Iran argues, as it did in the 1970s, that nuclear power is necessary for rising domestic energy consumption, while oil and gas are needed to generate foreign currency.

Iran has asserted repeatedly that its nuclear program is strictly peaceful, but few observers believe that such an ambitious program is necessary or economic for Iran. In May 2003, Iranian officials stated that “we consider the acquiring, development and use of nuclear weapons inhuman, immoral, illegal and against our basic principles. They have no place in Iran’s defense doctrine.”³ On August 6, 2003, President Khatami stated that Iran “cannot use such weapons based on our Islamic and moral teachings.”⁴

The United States has long been concerned about Iran’s intentions to develop nuclear weapons. U.S. attempts to impose an international embargo on nuclear cooperation with Iran since the 1980s were mostly successful, but an overwhelming focus on restricting Russian cooperation on the Bushehr nuclear power reactor project may have caused the United States to overlook help that Iran apparently was acquiring from Pakistan in uranium enrichment technologies, according to some observers.

What Inspections Revealed

In 2002, the National Council of Resistance of Iran (NCR) helped expose Iran’s undeclared nuclear activities by providing information about nuclear sites at Natanz (uranium enrichment) and Arak (heavy water production). In two years of intensive inspections, the IAEA has revealed significant undeclared Iranian efforts in uranium enrichment (including centrifuge, atomic vapor laser isotope separation and molecular laser isotope separation techniques), as well as significant foreign suppliers of technology, undeclared separation of plutonium, and undeclared imported material. Iranian officials have delayed inspections, changed explanations for discrepancies, cleaned up facilities and in one case, Lavizan-Shian, razed a site.⁵ According to IAEA Director General Mohamed ElBaradei, “Iran tried to cover up many of their activities, and they learned the hard way.”⁶ Only in January 2005 did Iranian officials share a copy of Pakistani scientist A.Q. Khan’s 1987 offer of a centrifuge enrichment “starter kit.”⁷

Inspections through June 2003 revealed various reporting failures by Iran (including failure to report uranium imported from China in 1991) and raised serious questions, particularly about how Iran was able to advance to a production stage of centrifuge enrichment without having introduced nuclear material into the process (a step required

² See statement by Iran’s Foreign Minister Kamal Kharrazi at [http://www.pbs.org/newshour/bb/middle_east/july-dec04/iran_9-27.html].

³ Statement by H.E. Mr. G. Ali Khoshroo, Deputy Foreign Minister for Legal and International Affairs, Second Session of the Prepcom for the 2005 NPT Review Conference, Apr. 29, 2003.

⁴ “Iran Denies It’s Building Nuclear Bomb,” *Associated Press*, Aug. 7, 2003.

⁵ David Albright and Corey Hinderstein, “Iran: Countdown to showdown,” *Bulletin of Atomic Scientists*, Nov./Dec. 2004, vol. 60, no. 6.

⁶ “Iran Was Offered Nuclear Parts,” *Washington Post*, Feb. 27, 2005.

⁷ *Ibid.*

to be declared to the IAEA).⁸ Overall, undeclared uranium raises a red flag since it could allow Iran to experiment with processes relevant to nuclear weapons development.⁹ Iran did experiment, converting some uranium into metal and using other uranium in isotope production, purification and conversion processes, some of which are relevant to plutonium reprocessing (e.g., dissolution in nitric acid and separation in a pulse column).¹⁰ In mid-2003, Iran admitted it conducted “bench scale” uranium conversion experiments a decade ago (required to be reported to the IAEA) and later, admitted that it used for those experiments some safeguarded material that had been declared lost in other processes (a safeguards violation). In February 2004, the IAEA concluded that, “given the size and capacity of the equipment used, the possibility cannot be excluded that larger quantities of nuclear material could have been involved than those declared.”¹¹ The IAEA has deemed credible Iran’s explanation that it needed to convert uranium into metal for its laser uranium enrichment program (revealed only in October 2003).

Iran’s two centrifuge enrichment plants at Natanz have generated significant concern.¹² The pilot fuel enrichment plant (planned to have 1000 centrifuges) started up in June 2003 but shut down again after Iran suspended enrichment activities in December 2003. Construction on the commercial-scale plant (planned to have 50,000 centrifuges) has also been suspended. The plants are built partly underground, raising concerns about transparency. For safeguards purposes, a key question has been whether Iran had introduced uranium gas (process gas, or UF₆) into its pilot-scale plant because the slight enrichment of uranium that would have resulted would be a safeguards violation if undeclared. Iranian officials first told the IAEA that it was too difficult to use process gas and that highly enriched uranium (HEU) particles found at the Natanz pilot plant in 2003 came from contamination from foreign-origin centrifuge assemblies. Analyses of the samples showed different levels of high enrichment at different locations: 36% enrichment on domestically manufactured components; 54% on imported components; and 70% at the Kalaye Electric Company workshop. Iran had admitted just to 1.2% domestic enrichment. In October 2003, Iranian officials admitted they tested centrifuges at the Kalaye Electric Company using UF₆ between 1998 and 2002. The IAEA did not rule out the possibility that Iran’s own enrichment activities could be the source of the HEU in samples.

Iran has been particularly slow in revealing two other developments related to enrichment — the existence of more sophisticated centrifuge designs (using maraging steel or composite rotors) and the laser enrichment program. Although Iran provided

⁸ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director General, GOV/2003/40, June 6, 2003.

⁹ Iran imported, but did not declare, 1800 kilograms of natural uranium in different forms: uranium hexafluoride (UF₆), which is used in centrifuge enrichment; uranium tetrafluoride (UF₄); and uranium oxide (UO₂).

¹⁰ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director General, GOV/2003/75, Nov. 10, 2003.

¹¹ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director General, GOV/2004/11, Feb. 24, 2004.

¹² See website [http://www.isis-online.org/images/main_satellite_index.html] for satellite photos of various Iranian sites.

significant detail about the P-1 centrifuges in its October 2003 declaration, it did not admit until asked by the IAEA in January 2004 that it possessed more advanced centrifuge designs (P-2). In light of Libya's admission that Pakistan supplied it with P-2 centrifuge designs, Iran's possession of P-2 designs is not surprising. Iran also did not admit until October 2003 that it also pursued a laser enrichment program beginning in the 1970s, focusing on two techniques — atomic vapor laser isotope separation (AVLIS) and molecular laser isotope separation (MLIS). Press reports about Iran's AVLIS and MLIS programs began appearing in 1998.¹³ At that time, it was anticipated that Iran would sign the Additional Protocol, providing more information about its nuclear fuel cycle, but this did not occur until 2003 (and even then, the additional protocol is not yet ratified).

The heavy water program also has raised questions about Iran's intentions. Reportedly, Iran first told the IAEA that it planned to produce heavy water for export, then told the Agency that the heavy water would be used as a coolant and moderator for a planned IR-40 reactor for research and development, radioisotope production, and training. Subsequently, Iran's design information for the facility omitted necessary hot cell equipment for producing radioisotopes, which the Agency asked Iran to clarify, given reports of Iranian efforts to import hot cell equipment. Construction of the heavy water reactor has continued into 2005, despite the Board's call for a halt in 2004. The foundation of the reactor has been poured, and the heavy water production plant may soon produce heavy water.¹⁴

In October 2003 Iran revealed that it had conducted plutonium reprocessing experiments in a hot cell at the Tehran Nuclear Research Center and estimated the amount separated as 200 micrograms. The IAEA calculated that more plutonium would have been produced (about 100g) and Iran admitted in May 2004 that it understated the amount. Inspections also revealed that Iran experimented in irradiating bismuth, which can be used to produce Polonium-210 for civilian purposes (for nuclear batteries) or in conjunction with beryllium to create a neutron initiator for a nuclear weapon. These experiments were conducted between 1989 and 1993. Polonium, according to many observers, is not ideal for nuclear weapons purposes.

IAEA Board of Governors Actions

The IAEA has resisted pressure to call Iran in violation of its NPT obligations. According to the IAEA Statute, if inspectors find a state in noncompliance with its safeguards agreement, they report that to the Director General, who informs the Board of Governors. The Board informs all IAEA member states, the UN Security Council, and the General Assembly.¹⁵ Reportedly, the EU-3 agreed with the United States to call for UN Security Council action if their negotiations with Iran fail.¹⁶

¹³ "Iran Said To Be Stepping Up Effort to Support Laser Enrichment Program, *Nuclear Fuel*, Oct. 5, 1998.

¹⁴ For analysis, see [<http://www.isis-online.org/publications/iran/arakconstruction.html>].

¹⁵ For text of the Statute, see [http://www.iaea.org/About/statute_text.html#A1.12].

¹⁶ "Europeans Agree To Meeting With Iran On Nuclear Program," *Washington Post*, May 17, 2005.

In September 2003, the Board called on Iran to suspend all further uranium enrichment and reprocessing activities, resolve all outstanding issues, be transparent and cooperative with the IAEA, and sign, ratify and implement the Additional Protocol, and set an October 31 compliance deadline. EU foreign ministers (the EU-3: Germany, France, UK) attempted to help resolve the issue, traveling to Tehran and agreeing that once international concerns were fully resolved, Iran “could expect easier access to modern technology and supplies in a range of areas.”¹⁷ Iran said it would sign the NPT Additional Protocol and suspend all uranium enrichment and “processing activities.” Specifically, Iran told the Agency that it would suspend: operation and/or testing of centrifuges at the pilot plant, further introduction of any nuclear material into any centrifuges, and installation of new centrifuges at the pilot plant and at Natanz. Iran also said it would withdraw nuclear material from any centrifuge facility to the extent practicable.¹⁸ During the period of suspension, Iran said it did not “intend to make new contracts for the manufacture of centrifuge machines and their components;” that the Agency could supervise the storage of machines assembled during that period; that it had dismantled its laser enrichment projects and that it was not constructing or operating any plutonium separation facility. However, Iran reportedly continued to assemble centrifuges, and many observers felt Iran had not lived up to its part of the bargain. On February 24, 2004, Iran stated it would “suspend the assembly and testing of centrifuges and suspend the domestic manufacture of centrifuge components, including those related to existing contracts.”¹⁹

Although the Director General’s March 2004 report to the Board noted that Iran had been actively cooperating with the Agency, including providing access to workshops at military sites, Iran failed to mention advanced centrifuge designs (P-2) in its October 2003 declaration and the Agency was not able to resolve the major outstanding issue of LEU and HEU contamination at Kalaye and Natanz. Between February and June 2004, the IAEA attempted to verify Iran’s pledges to suspend activities. Its June 2004 report (GOV/2004/34) assessed that Iran had delayed inspections at the Natanz pilot scale enrichment plant; Iran had not suspended UF₆ production or domestic production of centrifuge components; and Iran had not previously declared the procurement of 4000 magnets (and orders for more) for P-2 centrifuges.

The DG’s November 2004 report (GOV/2004/83) noted that Iranian cooperation had improved since October 2003. At the March 2005 Board meeting, however, IAEA Deputy Director for Safeguards Goldschmidt gave a detailed list of Iranian actions from November 2004 to March 2005. Some observers believe the lack of a formal report by ElBaradei was a tactical move to allow EU-Iranian negotiations to proceed; others believe that it was a further indication of the Board’s inability to call Iran in noncompliance. Despite the suspension agreement, Iran continued the production of UF₄, as well as quality control testing on centrifuge components. In March, 2005, Iran proposed running its pilot-scale enrichment facility to EU negotiators, which they rejected. In April 2005, Iran announced it would start-up its UF₆ production (uranium conversion) unless

¹⁷ “Statement by the Iranian Government and visiting EU Foreign Ministers,” *Reuters*, Oct. 21, 2003.

¹⁸ GOV/2004/11, February DG’s report on Iran, p. 10.

¹⁹ *Ibid.*

negotiations with the EU progressed. The next, perhaps final negotiations are scheduled for the last week in May 2005.

Since September 2003, U.S. officials have maintained that “the facts already established would fully justify an immediate finding of noncompliance by Iran with its safeguards obligations.”²⁰ In November 2003 (GOV/2003/81), the Board resolved that “should any further serious Iranian failures come to light, the Board of Governors would meet immediately to consider...all options at its disposal, in accordance with the IAEA Statute and Iran’s Safeguards Agreement.” In June 2004 the Board noted (GOV/2004/49) with concern continuing discrepancies about HEU contamination and the nature of the P-2 centrifuge program and called upon Iran to halt UF₆ production and planned construction of the research reactor designed to use heavy water, but did not call these serious Iranian failures. The resolution noted the Board would remain seized of the matter. The Board’s November 2004 resolution (GOV/2004/90) was very mild, and the March 2005 Board did not issue a resolution. In the interim, negotiations by the EU seem to be failing to obtain Iran’s agreement on a key objective — a permanent halt to uranium enrichment activities. Iran repeatedly has asserted its moratorium is temporary and that it has a right to pursue peaceful uses of nuclear energy.

Significance for a Nuclear Weapons Program

Nuclear safeguards are fundamentally accounting procedures to detect if material is diverted for weapons. Failures to report material can be significant or trivial, depending on the circumstances. Discrepancies involving large quantities of weapons-grade plutonium or highly enriched uranium are certainly more significant for a nuclear weapons program than those involving smaller quantities or non-weapons grade materials like natural uranium. Nonetheless, many hold that discrepancies often establish a pattern of deception that is significant.

By many accounts, Iran is years away from producing weapons-grade plutonium or highly enriched uranium. That said, Iran has pursued at least three different methods for uranium enrichment and has experimented with separating plutonium. Uranium conversion activities contribute to what looks like a steady accrual of expertise in weapons-relevant areas. The conversion of 37 tons of raw uranium into UF₄ before last November’s suspension also raises questions. Most important, if Iran received the same nuclear weapon design that Libya received from A.Q. Khan, the remaining technical hurdle would be fissile material production — one reason why the EU’s efforts to persuade Iran to give up uranium enrichment and plutonium reprocessing are so crucial. President Khatami stated in March 2005 that ending Iran’s uranium enrichment program is “completely unacceptable,” but that Iran would provide “objective guarantees” of the peaceful uses of enrichment.²¹ Although some NPT members may feel that enhanced inspections under the Additional Protocol will be enough to verify Iran’s enrichment, others feel that access to enrichment and reprocessing technologies must be restricted. This debate likely will be played out in the NPT Review Conference taking place in New York throughout May 2005 and beyond.

²⁰ Statement of Ambassador Kenneth Brill at September 2003 IAEA Board of Governors Meeting.

²¹ “Iran Offers Europe ‘Guarantees’ On Its Nuclear Program,” *New York Times*, Mar. 17, 2005.