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Iran's Nuclear Program: Recent Developments

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Summary

Inspections in 2003 of Iran's nuclear program revealed significant undeclared activities with potential application for nuclear weapons. The most recent report by the International Atomic Energy Agency (IAEA) details two uranium enrichment programs (centrifuges and lasers) and the separation of plutonium, another fissile material, in small quantities. Although the IAEA has stated previously that Iran has not met all of its NPT obligations, it has not yet declared Iran in violation of the NPT. Iran declared in November 2003 that it would halt all enrichment and reprocessing-related activities and would sign an Additional Protocol, which contains provisions for enhanced inspection. Although it signed an additional protocol on December 18, 2003, Iran continued to assemble centrifuge components. In late February 2004, it halted this activity also. The IAEA Board of Governors meets again in March to consider Iran's compliance. This report, which will be updated as needed, analyzes the significance of the IAEA's findings for a possible Iranian nuclear weapons program. See also CRS Report RL30551, *Iran: Arms and Weapons of Mass Destruction Suppliers*.

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 may have been regarded as grandiose, but was not necessarily viewed as a "back door" to a nuclear weapons program, possibly because Iran then did not seek the technologies to enrich its own fuel or reprocess its own spent 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

¹ However, there were reports that Iran's AEOL 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.

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nuclear activities. Iran's current plans — to construct nuclear power plants with a total capacity of 6000MW within two decades — are still ambitious, and some question the need for nuclear power in a state with considerable oil and gas reserves. Iran, however, is using the same argument it used in the 1970s: that nuclear power is necessary in the context of rising domestic energy consumption rates and a desire to preserve oil and gas to generate foreign currency. Recently, however, Iran's stated intention to explore fuel cycle, safety, and waste management technology, which include sensitive fissile material production capabilities, has elevated concern about possible nuclear weapons production.

In May 2003, the Iranian officials told other NPT Prepcom delegates 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.”² Iranian officials call the speculations over the secrecy of facilities at Natanz and Arak “quite unfounded and irrational,” that it is not obligated under its current safeguards agreement to declare the heavy water production plant; and that it made no attempt to hide construction. On August 6, 2003 President Khatami stated that Iran “cannot use such weapons based on our Islamic and moral teachings,” but that Iran would not give up nuclear technology for power generation.³ Iran has asserted that its nuclear program is strictly peaceful, but few observers believe that such an ambitious program is necessary or economic for a civilian nuclear fuel cycle like Iran's. In mid-February 2004, Iran announced it planned to sell nuclear fuel abroad.⁴

The United States has had longstanding concerns about Iran's intentions to develop nuclear weapons, focusing in the last decade primarily on what Iranians might learn through Russian help on the Bushehr nuclear reactor project. Despite U.S. attempts to impose an international embargo on nuclear cooperation with Iran since the 1980s, Iran acquired significant help in uranium enrichment technologies, including from Pakistan. 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 and Arak. Iran was forced to inform the IAEA about its nuclear fuel cycle activities, and then permit inspections. A year's worth of inspections have revealed significant undeclared Iranian efforts in uranium enrichment (including centrifuge, atomic vapor laser isotope separation and molecular laser isotope separation techniques), significant foreign suppliers of technology (including Pakistan), separation of plutonium, and undeclared imported material. Under Iran's full-scope safeguards agreement, many of these activities were not required to be declared. An Additional Protocol agreement (which Iran signed on December 18, 2003) would require such to be declared.

² 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, April 29, 2003.

³ “Iran Denies It's Building Nuclear Bomb,” *Associated Press*, August 7, 2003.

⁴ This may have been an attempt to justify its uranium enrichment capability; it is not clear how profitable such a plan might be. See “Iran Announces Plans to Sell Nuclear Fuel,” *Washington Post*, February 16, 2004.

What Inspections Revealed

By most accounts, Iranian officials have not been forthcoming about the extent of their nuclear program (especially in comparison to Libya's cooperation with the IAEA on its undeclared nuclear program since December 2003). Iran has revealed information in piecemeal fashion. Inspections through June 2003 revealed various reporting failures on Iran's part (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 (which would need to be declared to the IAEA).⁵ Overall, the existence of undeclared uranium was a red flag, since it could allow Iran to experiment with processes relevant to a nuclear weapons program.⁶ In fact, Iran converted some uranium into metal, and used other uranium in various processing experiments, including isotope production and purification and conversion processes. Some of these processes are relevant to plutonium reprocessing (e.g., dissolution in nitric acid and separation in a pulse column).⁷ Prior to the September IAEA Board meeting, Iran admitted it had conducted "bench scale" uranium conversion experiments a decade ago, which should have been declared under its safeguards agreement. In October 2003, Iran admitted that it used, for those experiments, some safeguarded material that it had declared had been lost in other processes (a safeguards violation). After inspections in January 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 by Iran."⁸ The IAEA also has investigated Iran's explanations for why it converted uranium into metal. In October 2003 Iranian officials said it was produced for shielding material; Iranian officials later admitted it was used in a laser enrichment project.

Much concern has focused on the two centrifuge enrichment plants at Natanz.⁹ The pilot fuel enrichment plant began to operate in June 2003 (although not all centrifuges have been installed), despite requests by the IAEA to delay operations, and the commercial-scale plant is still under construction. The pilot facility eventually will have about 1000 centrifuges installed, while the commercial-scale plant is planned to have 50,000 centrifuges. These plants are built partly underground, raising concerns about the transparency of Iran's program.

Many observers doubted that Iran could consider building a commercial-scale plant without having performed tests using process gas (UF₆). However, even the slight

⁵ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran, Report by the Director General*, GOV/2003/40, June 6, 2003.

⁶ Iran imported, but did not declare, 1800 kilograms of natural uranium in different forms: uranium hexafluoride (UF₆), which is used in centrifuge enrichment; uranium tetra fluoride (UF₄); and uranium oxide (UO₂).

⁷ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran, Report by the Director General*, GOV/2003/75, November 10, 2003.

⁸ IAEA Director General's Report, *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director General, GOV/2004/11, February 24, 2004.

⁹ See website, [<http://www.isis-online.org>] for satellite photos of the enrichment plant.

enrichment of uranium that would have resulted would be considered a safeguards violation if not declared. Iranian officials first told the IAEA that their program experienced so many difficulties that they did not conduct experiments with inert or process gas. Moreover, when inspectors detected highly enriched uranium (HEU) particles at the Natanz pilot plant in the summer of 2003, Iranian officials attributed the particles to contamination from foreign-origin centrifuge assemblies. However, this explanation became technically less credible when analysis of the sample showed different levels of enrichment at different locations, and that domestically manufactured components showed 36% low-enriched uranium (LEU) contamination, when Iran had admitted just to 1.2% enrichment. In addition, other sampling revealed UF₆ contamination at the Tehran research reactor. In October 2003, Iranian officials admitted they tested centrifuges at the Kalaye Electric Company using UF₆ between 1998 and 2002. The IAEA has not yet fully resolved the issue of the varied levels of enrichment at Natanz.

Iran has also been 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 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 offered several explanations for why it did not reveal this information in October, although the IAEA has cast doubt on the credibility of those explanations. 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). The IAEA will continue to study this development.

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, but then told the Agency in May that the heavy water would be used as a coolant and moderator for a planned research 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. The Agency has asked Iran to clarify this issue, given reports of efforts by Iran to import hot cell equipment.

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 has calculated that more plutonium should have been produced in 3 kg of depleted uranium targets, but is assessing this discrepancy. Inspections also revealed that Iran experimented in irradiating bismuth, which can be used to produce Polonium-210 for civilian purposes (for radioisotope thermoelectric generators, or 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, it should be noted, is not ideal for nuclear weapons purposes, according to many observers.

IAEA Board of Governors Actions

The IAEA Board of Governors adopted a resolution on September 12, 2003 which called on Iran, among other things, to suspend all further uranium enrichment and reprocessing activities and set an October 31 deadline for Iran's compliance. The IAEA requested that Iran provide details about its contaminated centrifuge equipment, including the origin and date of receipt of the equipment, and where it has been used or stored in Iran, as well as further information about its uranium conversion experiments.¹⁰

Ten days before the October 31 deadline Iran invited the foreign ministers of Britain, France, and Germany to visit Tehran. Iran issued a statement declaring that it would sign the IAEA Additional Protocol and suspend all uranium enrichment and "processing activities." The EU ministers agreed that once international concerns are fully resolved, that Iran "could expect easier access to modern technology and supplies in a range of areas."¹¹ On December 29, 2003, Iran informed the Agency that it would take the following actions:

- suspend operation and/or testing of centrifuges at the pilot plant;
- suspend the further introduction of any nuclear material into any centrifuges;
- suspend installation of new centrifuges at the pilot plant and at Natanz;
- withdraw nuclear material from any centrifuge facility if and to the extent practicable.¹²

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, reports surfaced that Iran was continuing to assemble centrifuges, and many observers felt Iran had not lived up to its part of the bargain. On February 24, 2004, Iran further stated it will "suspend the assembly and testing of centrifuges and suspend the domestic manufacture of centrifuge components, including those related to existing contracts."¹³

DG ElBaradei thus far has not reported Iran as violating its safeguards agreement, which requires the Board to inform the UN Security Council and General Assembly. The June 2003 report stated that "Iran failed to meet its obligations under its Safeguards Agreement with respect to reporting of nuclear material, the subsequent processing and use of that material and the declaration of facilities where the material was stored and processed." The United States stated in September 2003 that "the facts already established would fully justify an immediate finding of noncompliance by Iran with its safeguards

¹⁰ Dr. Mohammed ElBaradei, Statement to Board of Governors, September 8, 2003 at [<http://www.iaea.org/worldatom/Press/Statements/2003/ebsp2003n019.shtml#Anchor-Iran>]

¹¹ "Statement by the Iranian Government and visiting EU Foreign Ministers," *Reuters*, October 21, 2003.

¹² GOV/2004/11, February DG's report on Iran, p. 10.

¹³ *Ibid.*

obligations.”¹⁴ The Board of Governors adopted a resolution on November 26, 2003 which stated that “should any further serious Iranian failures come to light, the Board of Governors would meet immediately to consider, in light of the circumstances and of advice from the Director General, all options at its disposal, in accordance with the IAEA Statute and Iran’s Safeguards Agreement.”¹⁵

The February 24, 2004 report, which will be considered by the IAEA Board of Governors at the March 8 Board meeting, noted that Iran has been actively cooperating with the Agency, including providing access to workshops at military sites. However, Iran omitted any mention of advanced centrifuge designs (P-2) in its October 2003 declaration, and that the Agency still has to resolve the major outstanding issue of LEU and HEU contamination at Kalaye and Natanz. Until this is resolved, the Agency will be unable to confirm the absence of undeclared nuclear material or activities. Moreover, apparently Iran still has not provided detailed information on centrifuge procurement.

Significance for a Nuclear Weapons Program

Nuclear safeguards are fundamentally accounting procedures to ensure that material is not diverted to weapons uses. Therefore, failures to report material can be significant, but some failures are more significant than others. Iran has stated that “The failures...are minor, and are only on the order of the gram or milligram.”¹⁶ A discrepancy in accounting for large quantities of weapons-grade plutonium or highly enriched uranium would certainly be more significant for a nuclear weapons program than a discrepancy for smaller quantities or for other materials like natural uranium. However, some argue that a pattern of deception is significant. In part, a principle underlying strengthened safeguards is the evolution from a strict accounting approach (seeing the “trees”) to evaluating the program in its entirety (seeing the “forest”).

The latest IAEA report seems to indicate that Iran has pursued two different methods for uranium enrichment and that it experimented with separating plutonium. Although Iran is years away from producing quantities of fissile material (highly enriched uranium or plutonium) that it could use in nuclear weapons, the steady accrual of expertise in weapons-relevant areas is viewed with concern by many. In the run-up to the next Board decision on whether or not Iran has violated its safeguards agreement, a key factor may be whether Board members feel that the enhanced inspections under the Additional Protocol will be enough to keep any potential nuclear weapons ambitions by Iran in check.

¹⁴ Statement of Ambassador Kenneth Brill at September 2003 IAEA Board of Governors Meeting.

¹⁵ *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Resolution adopted by the Board on November 26, 2003, GOV/2003/81.

¹⁶ “After Report, Iran Acknowledges ‘Minor’ Breach of Nuclear Pact,” *Washington Post*, November 12, 2003.