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Iran's Nuclear Program: Recent Developments

Sharon Squassoni
Specialist in National Defense
Foreign Affairs, Defense, and Trade Division

Summary

Inspections in 2003 and 2004 of Iran's nuclear program revealed significant undeclared activities with potential application for nuclear weapons. The International Atomic Energy Agency (IAEA) uncovered two uranium enrichment programs (centrifuges and lasers) and plutonium separation efforts. Iran has been pressured to give up its enrichment and reprocessing activities and has declared twice (November 2003 and November 2004) that it would halt all such activities in exchange for technical cooperation with Germany, France, and the UK. It is not clear whether Iran is buying time for a clandestine program or effectively using its program as a bargaining chip for wider economic gain. Iran signed an Additional Protocol to its safeguards agreement in December 2003, but has not yet ratified it. Ever on the brink of being declared in violation of the NPT, Iran has allowed IAEA inspectors access only when pressed. After several months, Iran recently agreed to let inspectors visit a military site: Parchin. 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 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 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.

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 argues, as it did 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 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."[2] 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 (uranium enrichment) and Arak (heavy water production). Iran was forced to inform the IAEA about its nuclear fuel cycle activities, and then permit inspections. Subsequent 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, 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.

What inspections revealed

Iranian officials clearly have not been forthcoming about the extent of their nuclear program (especially compared to Libya's cooperation with the IAEA since December 2003). Iran has revealed information and allowed access in piecemeal fashion. Inspections through June 2003 revealed various reporting failures on Iran's part (including

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[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.

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 2003 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 had been declared 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 started up in June 2003 but shut down again after Iran decided to halt enrichment activities in December 2003. The commercial-scale plant was under construction, which presumably also has halted. 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.

A key question early on was whether Iran had introduced uranium gas (process gas, or UF6) into its pilot-scale plant; the slight enrichment of uranium that would have resulted would have been a safeguards violation if undeclared. Iranian officials first told the IAEA that their program experienced too many difficulties to conduct experiments with process gas and they attributed the presence of highly enriched uranium (HEU) particles at the Natanz pilot plant in the summer of 2003 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

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[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 (U02).

[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.

(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 also has 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 continues 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 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, 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 has resisted pressure to call Iran in violation of its NPT obligations. In light of discrepancies revealed in inspections through June 2003, the Board adopted the following resolutions in September 2003: calling on Iran to comply with its safeguards agreement; suspend all further uranium enrichment and reprocessing activities; resolve all outstanding issues; sign, ratify and implement the Additional Protocol; and be transparent and cooperative with the IAEA. The Board also set a deadline for compliance of October 31, which set in motion negotiations between Iran and EU foreign ministers (Germany, France, UK). Initially, the EU ministers agreed that once international concerns were fully resolved, Iran "could expect easier access to modern

technology and supplies in a range of areas."[10] Iran declared that it would sign the NPT Additional Protocol and suspend all uranium enrichment and "processing activities." Specifically, on December 29, 2003, Iran informed the Agency that it would:

- 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.[11]

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 stated it would "suspend the assembly and testing of centrifuges and suspend the domestic manufacture of centrifuge components, including those related to existing contracts."[12]

The IAEA issued a report on February 24, 2004, which was considered by the Board of Governors in March. It noted that Iran had 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 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 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.[13]

The Board's most recent report, GOV/2004/83 dated November 15, 2004, notes that Iranian cooperation has improved since October 2003. The Board thus far has not reported Iran as violating its safeguards agreement, which requires reporting to the UN Security Council and General Assembly. 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."[14] In November 2003, the Board

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

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

[12] ibid.

[13] IAEA Director General's Report, *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director General, GOV/2004/34, June 1, 2004.

[14] Statement of Ambassador Kenneth Brill at September 2003 IAEA Board of Governors (continued...)

adopted a resolution 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 June 18, 2004, Board of Governors resolution (GOV/2004/49) noted 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.

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").

IAEA reports 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. Iran's recent agreement to allow inspectors to visit Parchin, a military site, may provide a glimpse of whether expanded inspections under the Additional Protocol are useful. Thus far, it appears that more rigorous IAEA inspections with wider access have provided a wealth of data about Iran's efforts. A broader question is whether Iran is pursuing delaying tactics to buy time for a nuclear weapons program, given its on-and-off suspension of activities, or whether it is pursuing a strategy to elicit the greatest advantage for truly giving up sensitive nuclear capabilities.

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[14] (...continued)
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.