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Iran's Nuclear Program: Recent Developments

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Summary

Iran may be poised to clear one of the biggest technical hurdles in a nuclear weapons program – production of fissile material (enriched uranium in this case). In June, International Atomic Energy Agency (IAEA) Director General ElBaradei issued a report stating that Iran did not meet all of its obligations under its nuclear safeguards agreement pursuant to the Nuclear Nonproliferation Treaty (NPT), but stopped short of reporting non-compliance. This report, which will be updated as needed, analyzes the findings of the IAEA report and their significance for a possible 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 fifty years, beginning with a research reactor purchased from the United States in 1959 and branching out to nuclear power in the 1970s. U.S. concerns about Iran's intentions to develop nuclear weapons are long-standing, but have escalated in the last two years. First, the program has clearly advanced.¹ Much concern in the last decade focused on the provision of expertise via the Bushehr nuclear reactor project with Russia and possible cooperation in laser uranium enrichment technology. Despite U.S. attempts to impose an international embargo on nuclear cooperation with Iran since the 1980s, Iran may now be poised to clear the biggest technical hurdle in developing nuclear weapons – the production of fissile material (enriched uranium or plutonium). Despite Iran's assertions that its nuclear program is strictly peaceful, few observers believe that enriching uranium is necessary or economic for a civilian nuclear fuel cycle like Iran's. A key question is whether Iran has crossed the threshold of enrichment. Despite media reports that samples taken at the Natanz

¹ Leonard S. Spector, "Iran's Secret Quest for the Bomb." *YaleGlobal*, May 16, 2003.

centrifuge facility show evidence of enrichment, the International Atomic Energy Agency (IAEA) has not yet fully analyzed the samples.²

A second reason that concern about Iran's program has grown is that the Bush administration's emphasis on three "axis of evil" states – Iraq, Iran, and North Korea – has refocused attention on weapons of mass destruction (WMD) programs. Some observers have argued that the WMD capabilities of Iran and North Korea were more worrisome than those of Iraq, particularly in the nuclear area. It is fairly evident that Iran's uranium centrifuge enrichment capability – a key technology that is difficult to detect and quite efficient for producing highly enriched uranium for simple gun-type assembly nuclear weapons – is more advanced than Iraq's and, possibly, North Korea's.³

Third, the National Council of Resistance of Iran (NCR) has been more active in exposing nuclear facilities in Iran.⁴ The NCR, which has been on the State Department's list of foreign terrorist organizations since 1997, held three press conferences in the last year to reveal alleged covert nuclear weapons-related sites. On August 14, 2002, the NCR unveiled satellite photographs of nuclear sites at Natanz and Arak. On May 27, 2003, the NCR revealed sites that might be used for uranium enrichment to complement Natanz: the Lashkar-Abad site near Hashtgerd and a site near Ramandeh village. On July 8, 2003, the NCR revealed two more sites, including the Kolehdoz Complex (related to centrifuge enrichment) and Ardekan Nuclear Fuel Site.

The NCR and other exiled groups have a mixed record of providing accurate information, but revelations have been useful in giving the IAEA leverage to investigate claims.⁵ Following the August 2002 NCR press conference, Iran's Vice President Reza Aghazadeh informed the IAEA about its activities in the nuclear fuel cycle; according to the IAEA, DG ElBaradei asked Aghazadeh to confirm media reports of the facilities at Natanz and Arak at the September General Conference.⁶ IAEA inspectors have made multiple visits to Iranian facilities in 2003.

² See "Iran Samples Show Enriched Uranium - Diplomats," *Reuters*, July 18, 2003, and "Iran probe time line lengthens as IAEA mulls Natanz sample data," *Nucleonics Week*, July 31, 2003. The issue is not quantity of uranium enriched, but whether any enrichment may have occurred.

³ In November 2002, the CIA gave Congressional staffers a white paper on North Korea's enrichment capabilities, which said North Korea had recently begun constructing a centrifuge facility and began seeking in 2001 large quantities of centrifuge-related equipment. Iran, according to the IAEA's report, is constructing a commercial scale plant (built for 50,000 centrifuges) and has an operational pilot plant. See CRS Report RL31900, *Weapons of Mass Destruction: Trade Between North Korea and Pakistan*.

⁴ The NCR, according to its web site, was established in 1981 and is based in Paris. It has been described as the political arm or umbrella for other Iranian resistance groups, including the People's Mujahedin of Iran and the Muhahedin-e Khalq organization (MEK or MKO).

⁵ In February 1992, the People's Mujahedin of Iran revealed two "secret Iranian" nuclear sites – Darkhouin and Gurgan – which had been sites for terminated French and Russian power reactor projects. See Mark Hibbs, "IAEA Explores Iran's Intentions, Minus Evidence of Weapons Drive," *Nucleonics Week*, February 13, 1992.

⁶ "Iran's Nuclear Policy (Peaceful, transparent, Independent)," H.E. Mr. Reza Aghazadeh, May 6, 2003.

What Inspections Revealed

The IAEA released a somewhat atypical report at the June 2003 Board of Governors meeting: *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran, Report by the Director General, GOV/2003/40*.⁷ While the DG often reports generally on the status of safeguards agreements, and reports in detail for countries like Iraq or North Korea which are in noncompliance, the 8-page report revealed significant details of Iran's program that might in the past have been considered to be safeguards-confidential information. (Iran's rebuttal to the Board of Governors on June 18, 2003 pointed out the unusual nature of this). However, DG ElBaradei stated that issues needed to be resolved as soon as possible, that Iran should cooperate and demonstrate full transparency, and that safeguards need to be more robustly implemented, even failures of reporting that previously might have been overlooked.⁸

The IAEA report identified three major areas of concern for implementing nuclear safeguards: Iran's failure to report uranium imported from China in 1991; questions about the centrifuge enrichment program; and questions about the heavy water program. Although the kinds and amounts of uranium imported without any declarations are insignificant for use in a nuclear weapon, Iran was technically incorrect in assuming that because the quantities did not exceed one effective kilogram that it did not have to place it under safeguards.⁹ The real problem is that such material was used to experiment with processes that are relevant for nuclear weapons development.

The 1800 kilograms of natural uranium consisted of: uranium hexafluoride (UF₆), which is used in centrifuge enrichment; uranium tetrafluoride (UF₄); and uranium oxide (UO₂). The containers of UF₆ reportedly were lighter than declared, leading to a concern that some of the UF₆ was used to perform tests of the centrifuge equipment. Iran converted the UF₄ into uranium metal (see below), and used the UO₂ in various processing experiments, including isotope production and purification and conversion processes. Some of these processes are also used in plutonium reprocessing (e.g., dissolution in nitric acid and separation in a pulse column). In short, the use of undeclared material allowed Iran to experiment with processes that, had they been under safeguards, would have come under serious scrutiny.

The most serious questions about the centrifuge enrichment program relate to whether Iran would have proceeded with the production of centrifuge equipment and construction of facilities, particularly the commercial-scale plant, without fully testing the centrifuge equipment with UF₆ process gas. Some observers believe that centrifuge

⁷ "Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran, Report by the Director General, GOV/2003/40," June 6, 2003 (released June 19, 2003).

⁸ See [www.iaea.org/worldatom/Press/Statements/2003/ebsp2003n016.shtml#technical] for the text of ElBaradei's intervention.

⁹ Natural uranium is a source material, not special fissionable material. It is not used in a nuclear explosive because in its natural state it is not fissile. The IAEA acknowledges that large quantities of source material have the potential to be significant for weapons if they are processed (enriched) and therefore has developed the concept of "effective kilogram." 1800 kg of natural uranium is the equivalent of 0.18 effective kilogram.

assemblies can be tested adequately with other gases; others believe that the enormous investment in equipment would require testing with nuclear material.

The heavy water program poses a large question mark about Iranian intentions. The NCR indicated that Iran had a production plant for heavy water at Arak. Iran reportedly told the IAEA initially that it planned to produce heavy water at Arak for export, but in May 2003, it told the Agency it planned to build a research reactor for research and development, radioisotope production, and training that would use heavy water as a coolant and moderator. The heavy water production plant is not subject to safeguards.

As a result of the inspections, 5 additional facilities will be put under safeguards. a fuel manufacturing plant at Esfahan and the IR-40 research reactor at Arak, both in the planning stages; the two centrifuge enrichment plants at Natanz; and the Jabr Ibn Hayan Multipurpose Laboratories (JHL). This last facility is not new, but previously had not been under safeguards. However, since JHL had been used to convert UF₄ into uranium metal in 2000 and store the undeclared uranium imported from China, it is required to be under safeguards. According to the June report, Iran was obligated to identify JHL by providing design information as soon as possible before the nuclear material was introduced into the facility and to negotiate with the Agency on how to verify holdings at the facility (an agreement called a facility attachment).

The two enrichment plants detected by satellite imagery have drawn the most attention.¹⁰ The pilot fuel enrichment plant began to operate in June (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. The commercial-scale plant is planned to have 50,000 centrifuges but is not scheduled to introduce nuclear material in the near future. These plants are built partly underground, raising concerns about the transparency of Iran's program.

Significance for a nuclear weapons program

The IAEA did not report Iran as violating its safeguards agreement, which would have required the DG to inform the Board and for the Board to inform the UN Security Council and General Assembly. Rather, the June 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." Since nuclear safeguards rely on accounting procedures, failures to report material can be significant, but some failures are more significant than others. A discrepancy in accounting for weapons-grade plutonium or highly enriched uranium would certainly have more significance for a nuclear weapons program than a discrepancy for natural uranium. Nonetheless, some argue that a pattern of deceptions is significant, and in part, a principle underlying strengthened safeguards is the evolution from a strict accounting approach to be able to see the "forest" as well as the "trees."

¹⁰ See website, [www.isis-online.org] for satellite photos of the enrichment plant.

The IAEA posed several questions in its June 2003 report, which indicate some areas of concern. First, the Agency would like more information on Iran's centrifuge enrichment program and also its laser enrichment program, which was acknowledged for the first time this year. A detailed chronology and description of research and development efforts could help the Agency verify whether it is plausible that Iran would construct centrifuge plants without testing centrifuge assemblies with UF₆. A related question is the involvement of other facilities such as the Kalaye Electric Company in undeclared enrichment. Many believe that Iran's refusal to allow environmental sampling at Kalaye masked potentially undeclared enrichment. If Iran did enrich small quantities of nuclear material, such a violation of safeguards would be more significant than mere reporting omissions. The ability to take environmental samples at Kalaye will be key to establishing whether undeclared enrichment has taken place.

Additionally, the Agency questioned the uses of uranium metal in Iran's nuclear program, since Iran admitted to converting UF₄ into metal at the JHL facility and the role of heavy water in the fuel cycle. While none of Iran's proposed reactors would use uranium fuel in metal form, the production of radioisotopes for medical purposes, like Molybdenum-99, can use highly enriched uranium metal fuel plates. It is possible to use low-enriched uranium in these fuel plates, although some experts have claimed that it is not as efficient. With respect to heavy water, a key concern is the potential for heavy water reactors to produce weapons-grade plutonium, and as a byproduct, tritium, which is a key ingredient in boosted fission weapons.¹¹ Iran's experiments at the JHL facility indicate an interest in reprocessing technologies, but it is difficult to tell from this what commitment Iran might make to plutonium production. A key feature of the Russian-Iranian Bushehr project is Russia's commitment to take back the spent fuel from Bushehr, eliminating an excuse for Iran to reprocess. Iran has agreed to this requirement, although it has not yet signed the required protocol.

Iran's Response

In the 1970s, the Shah's plan to build 23 nuclear power reactors may have been regarded as grandiose, but was not necessarily viewed as a "back door" to a nuclear weapons program, possibly because Iran did not seek the technologies to enrich its own fuel or reprocess its own spent fuel.¹² 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 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. It should be noted, however, that Iran 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. Iran's now publicly stated intention to explore fuel cycle, safety, and waste management technology – particularly – has raised concerns.

¹¹ Natural uranium produces more plutonium when irradiated than low- or high-enriched uranium.

¹² Iran's AEOI sought laser enrichment technology in the United States in the late 1970s, and the former head of the AEOI stated 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.

Iranian officials call the speculations over the secrecy of 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 (although it did argue similarly for the enrichment plant). 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.”¹³ On August 6, 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.¹⁴

Next Steps

The IAEA in June 2003 called upon Iran to:

- rectify all safeguards problems identified in the report and resolve open questions;
- not introduce nuclear material into the Natanz enrichment plant;
- sign the Additional Protocol without any conditions.¹⁵

Since June, Iran has taken some steps to rectify safeguards problems, but it has introduced nuclear material into the Natanz plant and appears to be negotiating with the IAEA on the additional protocol. Iran’s signing the Additional Protocol (INFCIRC/540), which was developed in response to the failure of nuclear safeguards in Iraq and is designed to strengthen the IAEA’s ability to detect undeclared nuclear activities, will be a key step towards greater transparency. In July, AEIOI’s Mr. Aghazadeh said Iran was considering signing the additional protocol.¹⁶ In August, IAEA experts met with Iranian officials to discuss the additional protocol and a team of inspectors planned to conduct additional verification activities, possibly including more environmental sampling.

The IAEA will issue another report at the September Board of Governors meeting. The United States expects that “further information will point to only one conclusion: that Iran is aggressively pursuing a nuclear weapons program.”¹⁷ A finding of noncompliance may rest on more definitive results of environmental sampling which, by some accounts, may not yet be ready. Barring the possibility of contaminated samples, if further analysis shows evidence of indigenous enrichment, then Iran’s violations of its safeguards agreement would appear to be more serious than technical reporting failures and could begin a chain of events leading to UN Security Council resolutions.

¹³ 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.

¹⁴ “Iran Denies It’s Building Nuclear Bomb,” *Associated Press*, August 7, 2003.

¹⁵ See [www.iaea.org/worldatom/Press/P_release/2003/med-advise_072.shtml] for text.

¹⁶ “U.N.’s Nuclear Watchdog Presses Iran for More Cooperation,” *Los Angeles Times*, July 10, 2003

¹⁷ Statement of the U.S. at June 2003 IAEA Board of Governors Meeting; Agenda Item 6 (B).