

CRS Report for Congress

Iran's Nuclear Program: Status

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Summary

Although Iran claims that its nuclear programs are exclusively for peaceful purposes, they have generated considerable concern that Tehran is pursuing a nuclear weapons program. Indeed, the UN Security Council has responded to Iran's refusal to suspend work on its uranium enrichment and heavy-water nuclear reactor programs by adopting several resolutions which imposed sanctions on Tehran.

Despite this pressure, Iran continues at its Natanz centrifuge facility to enrich uranium, expand the number of operating centrifuges, and conduct research on new types of centrifuges. Tehran has also continued to produce centrifuge feedstock, as well as work on its heavy-water reactor and associated facilities.

Whether Iran is pursuing a nuclear weapons program is, however, unknown. A National Intelligence Estimate made public in December 2007 assessed that Tehran "halted its nuclear weapons program," defined as "Iran's nuclear weapon design and weaponization work and covert uranium conversion-related and uranium enrichment-related work," in 2003. The estimate, however, also assessed that Tehran is "keeping open the option to develop nuclear weapons" and that any decision to end a nuclear weapons program is "inherently reversible."

Although Iran has cooperated with the International Atomic Energy Agency (IAEA) to an extent, the agency says that Tehran has not gone far enough to alleviate all of the agency's concerns about Iran's enrichment and heavy-water reactor programs. The IAEA continues to investigate the program, particularly evidence that Tehran may have conducted procurement activities and research directly applicable to nuclear weapons development.

This report expands and replaces RS21592, *Iran's Nuclear Program: Recent Developments*, by Sharon Squassoni, and will be updated as necessary.

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Iran's Nuclear Program: Status

Background

Iran has had a nuclear program for close to 50 years, beginning with a research reactor purchased from the United States in 1959. U.S. concerns that Iran could pursue a nuclear weapons program date back to at least the mid-1970s, as evidenced by U.S. intelligence reports from that decade.¹ During the 1970s, Tehran planned to build nuclear power reactors and actually began constructing a light-water moderated nuclear power reactor near the city of Bushehr. Iran also considered obtaining uranium enrichment and reprocessing technology.²

Iran cancelled the nuclear program after the 1979 revolution, but “reinstated” the program in 1982, according to a 1988 CIA report.³ But a 1985 National Intelligence Council report, which cited Iran as a potential “proliferation threat,” stated that Tehran was “interested in developing facilities that ... could eventually produce fissile material that could be used in a [nuclear] weapon.” The report, however, added that it “would take at least a decade” for Iran to do so.⁴

The Iranian government says that it plans to expand its reliance on nuclear power in order to generate electricity. This program will, Tehran says, substitute for oil and gas consumption and allow Iran to export its fossil fuels. Currently, a Russian contractor is completing the Bushehr reactor, and Iran says it intends to build additional reactors.⁵ Iranian officials say that Tehran has begun design work on its first indigenously produced light-water reactor, which is to be constructed at

¹ *Prospects for Further Proliferation of Nuclear Weapons*, Special National Intelligence Estimate, August 23, 1974.

² For example, the United States was willing to supply Iran with reprocessing technology, according to 1975 and 1976 National Security Council documents. Tehran also had a 1976 contract for a pilot uranium enrichment facility using lasers (see *Iran*, Report by the Director General, GOV/2007/58, November 15, 2007).

³ *Middle East-South Asia: Nuclear Handbook*, Central Intelligence Agency, May 1988.

⁴ *The Dynamics of Nuclear Proliferation: Balance of Power and Constraints*, National Intelligence Council, September 1985.

⁵ See statement by Iran's former Foreign Minister Kamal Kharrazi, at [http://www.pbs.org/newshour/bb/middle_east/july-dec04/iran_9-27.html].

Darkhovin.⁶ Iran anticipates that “foreign experts” will be involved in the project, an official associated with the project said.⁷

Iranian officials have repeatedly asserted that the country’s nuclear program is exclusively for peaceful purposes. For example, Supreme Leader Ayatollah Ali Khamene’i, declared during a June 3, 2008, speech that Iran is opposed to nuclear weapons “based on religious and Islamic beliefs as well as based on logic and wisdom.” He added, “Nuclear weapons have no benefit but high costs to manufacture and keep them. Nuclear weapons do not bring power to a nation because they are not applicable. Nuclear weapons cannot be used.” Similarly, Iranian Foreign Ministry spokesperson Hassan Qashqavi stated November 10, 2008 that “pursuance of nuclear weapons has no place in the country’s defense doctrine.”⁸

However, the United States and other governments have argued that Iran may be pursuing, at a minimum, the capability to produce nuclear weapons. Discerning a peaceful nuclear program from a nuclear weapons program can be difficult because of the dual-use nature of much of the technology. In addition, military nuclear programs may co-exist with civilian programs, even without an explicit decision to produce nuclear weapons. Jose Goldemberg, Brazil’s former secretary of state for science and technology, observed that a country developing the capability to produce nuclear fuel

does not have to make an explicit early [political] decision to acquire nuclear weapons. In some countries, such a path is supported equally by those who genuinely want to explore an energy alternative and by government officials who either want nuclear weapons or just want to keep the option open.⁹

The main source of proliferation concern is Tehran’s construction of a gas-centrifuge-based uranium enrichment facility. Tehran claims that it wants to produce low-enriched uranium (LEU) for its current and future reactors. Although Iranian officials have expressed interest in purchasing nuclear fuel from other countries, they assert that Tehran should have an indigenous enrichment capability as a hedge against possible fuel supply disruptions.¹⁰

⁶ “Iran Nuclear Spokesman Interviewed on Situation,” *E'temad*, November 9, 2008. Iran has stated that construction on the 360 MW reactor is to start in 2013. The reactor is to be completed in 2016. See “Foreign Firms Interested to Build Darkhovin Nuclear Plant - Iran Official,” *Mehr News Agency*, October 19, 2008, and “Bushehr Plant To Be Inaugurated By Mid October 2008 - Iranian Official,” *Islamic Republic of Iran News Network*, January 30, 2008.

⁷ *Mehr News Agency*, October 19, 2008.

⁸ “Weekly Briefing of the Foreign Ministry Spokesman,” November 10, 2008.

⁹ Jose Goldemberg, “Looking Back: Lessons From the Denuclearization of Brazil and Argentina,” *Arms Control Today*, April 2006.

¹⁰ “Soltaniyeh: Iran Has No Alternative But To Enrich Uranium,” *Islamic Republic News Agency*, October 2, 2008; Paul Kerr, “U.S. Offers Iran Direct Talks,” *Arms Control Today*, June 2006.

Gas centrifuges enrich uranium by spinning uranium hexafluoride gas at high speeds to increase the concentration of the uranium-235 isotope. Such centrifuges can produce both LEU, which can be used in nuclear power reactors, and highly enriched uranium (HEU), which is one of the two types of fissile material used in nuclear weapons. HEU can also be used as fuel in certain types of nuclear reactors.¹¹ Iran also has a uranium-conversion facility, which converts uranium oxide into several compounds, including uranium hexafluoride.

A heavy-water reactor, which Iran is constructing at Arak, has also been a source of concern. Although Tehran says that the reactor is intended for the production of medical isotopes, it is a proliferation concern because its spent fuel will contain plutonium well-suited for use in nuclear weapons.

Spent nuclear fuel from nuclear reactors contains plutonium, the other type of fissile material used in nuclear weapons. In order to be used in nuclear weapons, however, plutonium must be separated from the spent fuel — a procedure called “reprocessing.” Iran has said that it will not engage in reprocessing.

In addition to the dual-use nature of the nuclear programs described above, Tehran’s interactions with the International Atomic Energy Agency (IAEA) have contributed to suspicions that Tehran has a nuclear weapons program. In the past, Iran has taken several actions that interfered with the agency’s investigation of its nuclear program, including concealing nuclear activities and providing misleading statements. Although the IAEA has gotten a more complete picture of Iran’s nuclear program since its investigation began in 2002, the agency still wants Tehran to provide more information. IAEA Director-General Mohamed ElBaradei explained in a June 2008 interview that

they [the Iranians] have concealed things from us in the past, but that doesn’t prove that they are building a bomb today. They continue to insist that they are interested solely in using nuclear power for civilian purposes. We have yet to find a smoking gun that would prove them wrong. But there are suspicious circumstances and unsettling questions. The Iranians’ willingness to cooperate leaves a lot to be desired. Iran must do more to provide us with access to certain individuals and documents. It must make a stronger contribution to clarifying the last unanswered set of questions — those relating to a possible military dimension of the Iranian nuclear program.¹²

Recent Nuclear Controversy

The recent public controversy over Iran’s nuclear program began in August 2002, when the National Council of Resistance on Iran (NCRI), an Iranian exile group, revealed information during a press conference (some of which later proved to be accurate) that Iran had built nuclear-related facilities at Natanz and Arak that

¹¹ Highly enriched uranium typically contains over 90% uranium-235, whereas low-enriched uranium used in nuclear reactors typically contains less than 5% uranium-235.

¹² “Interview With IAEA Boss Mohamed ElBaradei,” *Der Spiegel*, June 11, 2008.

it had not revealed to the IAEA. The United States had been aware of at least some of these activities, according to knowledgeable former officials.¹³

States-parties to the nuclear Nonproliferation Treaty (NPT) are obligated to conclude a safeguards agreement with the IAEA. In the case of non-nuclear-weapon states-parties to the treaty (of which Iran is one), such agreements allow the agency to monitor nuclear facilities and materials to ensure that they are not diverted for military purposes. However, the agency's inspections and monitoring authority is limited to facilities that have been declared by the government.¹⁴ Additional protocols to IAEA safeguards agreements augment the agency's authority to investigate clandestine nuclear facilities and activities by increasing the agency's authority to inspect certain facilities and demand additional information from states-parties.¹⁵ The IAEA's statute requires its Board of Governors to refer cases of non-compliance with safeguards agreements to the UN Security Council. Prior to the NCRI's revelations, the IAEA had expressed concerns that Iran had not been providing the agency with all relevant information about its nuclear programs, but had never found Iran in violation of its safeguards agreement.

In fall 2002, the IAEA began to investigate Iran's nuclear activities at Natanz and Arak, and inspectors visited the sites the following February. The IAEA board adopted its first resolution, which called on Tehran to increase its cooperation with the agency's investigation and to suspend its uranium enrichment activities, in September 2003. The next month, Iran concluded an agreement with France, Germany, and the United Kingdom, collectively known as the "E3," to suspend its enrichment activities, sign and implement an additional protocol to its 1974 IAEA safeguards agreement, and comply fully with the IAEA's investigation.¹⁶ As a result, the IAEA board decided to refrain from referring the matter to the UN Security Council.

Ultimately, the IAEA's investigation, as well as information Tehran provided after the October 2003 agreement, revealed that Iran had engaged in a variety of clandestine nuclear-related activities, some of which violated Iran's safeguards agreement. These included plutonium separation experiments, uranium enrichment and conversion experiments, and importing various uranium compounds.

¹³ Gary Samore, Former Senior Director for Nonproliferation and Export Controls on the National Security Council, personal communication June 5, 2008; Director of Central Intelligence George J. Tenet, "DCI Remarks on Iraq's WMD Programs," February 5, 2004, available at [https://www.cia.gov/news-information/speeches-testimony/2004/tenet_georgetownspeech_02052004.html].

¹⁴ The IAEA does have other investigative tools, such as monitoring scientific publications from member-states.

¹⁵ NPT states are not required to conclude additional protocols. However, applicable UN Security Council resolutions require Iran to conclude such a protocol.

¹⁶ The text of the agreement is available at [http://www.iaea.org/NewsCenter/Focus/IaeaIran/statement_iran21102003.shtml]. Iran signed its additional protocol in December 2003, but has not ratified it.

After October 2003, Iran continued some of its enrichment-related activities, but Tehran and the E3 agreed in November 2004 to a more detailed suspension agreement. However, Iran resumed uranium conversion in August 2005 under the leadership of President Mahmoud Ahmadinejad, who had been elected two months earlier. Iran announced in January 2006 that it would resume research and development on its centrifuges at Natanz. In response, the IAEA board adopted a resolution February 4, 2006, that referred the matter to the Security Council. Two days later, Tehran announced that it would stop implementing its additional protocol.

In June 2006, China, France, Germany, Russia, the United Kingdom, and the United States, collectively known as the “P5+1,” presented a proposal to Iran that offered a variety of incentives in return for Tehran taking several steps to assuage international concerns about its enrichment and heavy-water programs.¹⁷ The proposal called on the government to address the IAEA’s “outstanding concerns ... through full cooperation” with the agency’s ongoing investigation of Tehran’s nuclear programs, “suspend all enrichment-related and reprocessing activities,” and resume implementing its additional protocol.

European Union High Representative for Common Foreign and Security Policy Javier Solana presented a revised version of the 2006 offer to Iran in June 2008.¹⁸ Representatives from the P5+1 discussed the new proposal with Iranian officials in July 2008. Iran provided a follow-up response the next month, but the six countries deemed it unsatisfactory.¹⁹ Tehran has told the IAEA that it would implement its additional protocol “if the nuclear file is returned from the Security Council” to the agency.²⁰ It is, however, unclear how the council could meet this condition.

The 2006 offer’s requirements have also been included in several UN Security Council resolutions, the most recent of which, Resolution 1835, was adopted September 27, 2008.²¹ However, a November 19, 2008 report from ElBaradei to the Security Council and the IAEA board indicated that Tehran has continued to defy the council’s demands by continuing work on its uranium enrichment program and

¹⁷ The proposal text is available at [http://armscontrol.org/pdf/20060606_Iran_P5+1_Proposal.pdf]. Prior to late May 2006, the United States refused to participate in direct talks with Iran about its nuclear program. In March 2005, Washington had offered some limited incentives for Iran to cooperate with the E3. (See Kerr, *Arms Control Today*, June 2006). For more information about the state of international diplomacy with Iran, see CRS Report RL32048, *Iran: U.S. Concerns and Policy Responses*, by Kenneth Katzman.

¹⁸ The revised proposal text is available at [<http://www.auswaertiges-amt.de/diplo/de/Aussenpolitik/Themen/Abruestung/IranNukes/Angebot-e33-080614.pdf>].

¹⁹ Iran had also presented a proposal to the P5+1 in May 2008. See Peter Crail, “Proposals Offered on Iranian Nuclear Program,” *Arms Control Today*, May 2008. The proposal text is available at [<http://www.iaea.org/Publications/Documents/Infcircs/2008/infcirc729.pdf>].

²⁰ *Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions 1737 (2006), 1747 (2007) and 1803 (2008) in the Islamic Republic of Iran*, Report by the Director General, GOV/2008/4, February 22, 2008.

²¹ The resolution text is available at [<http://un.org/News/Press/docs/2008/sc9459.doc.htm>]. The resolutions also require Iran to suspend work on its heavy water-related projects.

heavy-water reactor program.²² Iranian officials maintain that Iran will not suspend its enrichment program.

Iran's Cooperation with the IAEA

Iran and the IAEA agreed in August 2007 on a work plan to clarify the outstanding questions regarding Tehran's nuclear program.²³ Most of these issues,²⁴ which had contributed to suspicions that Iran had been pursuing a nuclear weapons program, have essentially been resolved, but ElBaradei told the IAEA board June 2, 2008, that there is "one remaining major [unresolved] issue," which concerns questions regarding "possible military dimensions to Iran's nuclear programme." Iran maintains that it has not conducted any work on nuclear weapons.

Iran and the IAEA have had a series of discussions regarding these issues; the last meeting was held August 18-20, according to ElBaradei's September report. The agency has provided Iran with documents or (in some cases) descriptions of documents, which themselves were provided to the IAEA by several governments, indicating that Iranian entities may have conducted studies related to nuclear weapons development. The subjects of these studies included missile re-entry vehicles for delivering nuclear warheads, uranium conversion, and conventional explosives used in nuclear weapons.²⁵ ElBaradei told the IAEA Board of Governors September 22, 2008 that, according to Iranian officials, the documents are not authentic.²⁶ He added that these officials acknowledged that some of the information in the documents is accurate, but the activities described were, the Iranians said, exclusively for peaceful purposes. Tehran has provided some relevant information about these matters to the IAEA, but ElBaradei reported that the government still should provide all of the "information, access to documents and access to individuals necessary to support Iran's statements." Indeed, the agency believes that "Iran may

²² *Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions 1737 (2006), 1747 (2007), 1803 (2008) and 1835 (2008) in the Islamic Republic of Iran*, Report by the Director General, GOV/2008/59, November 19, 2008.

²³ The text of the work plan is available at [<http://www.iaea.org/Publications/Documents/Infcircs/2007/infcirc711.pdf>].

²⁴ These issues included plutonium experiments, research and procurement efforts associated with two types of centrifuges, operations of a uranium mine, and experiments with polonium-210, which (in conjunction with beryllium) is used as a neutron initiator in certain types of nuclear weapons.

²⁵ For more information about Iran's ballistic missile program, see CRS Report RS22758, *Iran's Ballistic Missile Programs: An Overview*, by Steven A. Hildreth.

²⁶ Iran has complained that the IAEA has not provided Tehran with original versions of some documentation related to the alleged "military dimensions" of Iran's nuclear program. ElBaradei's February, May, and September reports have all stated that the agency has not had permission to provide this documentation from the governments which provided it. On September 22, ElBaradei called on such governments "to authorize the Agency to share it with Iran."

have additional information ... which could shed more light on the nature of these alleged studies and which Iran should share with the Agency.”²⁷

In a September 28, 2008 letter to the IAEA, Iran described some characteristics of the documents discussed above.²⁸ The letter stated that some of the information from the United States was shown to Iranian officials as PowerPoint presentations. Additionally, some of the documents are “in contradiction with typical standard Iranian documentation” and lack “classification seals,” the letter said.

The IAEA has asked Tehran about other information suggesting that the country may have pursued nuclear weapons, such as

- “information about a high level meeting in 1984 on reviving Iran’s pre-revolution nuclear programme”;
- “the scope of a visit by officials” associated with Iran’s Atomic Energy Organization “to a nuclear installation in Pakistan in 1987”;
- information on 1993 meetings between Iranian officials and members of a clandestine procurement network run by former Pakistani nuclear official Abdul Qadeer Khan; and
- information about work done in 2000 which apparently related to reprocessing.²⁹

The agency also wants Iran to provide more information on nuclear-related procurement, production, and research activity by entities linked to Iran’s military and defense establishments. These included attempts to obtain items, such as spark gaps, shock wave software, and neutron sources, which could be useful for developing nuclear weapons.³⁰ In addition, ElBaradei’s May report notes that “substantial parts” of Iran’s centrifuge components “were manufactured in the workshops of the Defence Industries Organization.”

Furthermore, the IAEA has asked Tehran to provide additional information about the manner in which it acquired a document “describing the procedures” for reducing uranium hexafluoride to uranium metal, as well as “machining ... enriched uranium metal into hemispheres,” which are “components of nuclear weapons.”³¹ Tehran has previously told the agency that it was offered equipment for casting uranium but never actually received it. According to Iran, its nuclear suppliers, many

²⁷ GOV/2008/4.

²⁸ Permanent Mission of the Islamic Republic of Iran, *Explanatory Comments by the Islamic Republic of Iran on the Report of the IAEA Director General to the September 2008 Board of Governors (GOV/2008/38)*, September 28, 2008. INFCIRC/737.

²⁹ For a detailed discussion of this information, as well as the documents concerning Iran’s nuclear weapons related studies, see GOV/2008/15.

³⁰ GOV/2008/4.

³¹ GOV/2008/15.

of whom were affiliated with the Khan network, provided the document in 1987 at their own initiative, rather than at Tehran's request. Islamabad has confirmed to the IAEA that "an identical document exists" in Pakistan.³²

ElBaradei's November report points out that the IAEA, with the exception of the document related to uranium metal, has "no information ... on the actual design or manufacture by Iran" of components (nuclear or otherwise) for nuclear weapons.

The report also suggests that Iran and the IAEA are at a serious impasse; Tehran has not cooperated with the agency on these matters since ElBaradei's September report. Iranian officials have indicated that Tehran will not provide any further information to the agency.³³ Nevertheless, Iran has been cooperating with the agency in other respects, albeit with varying consistency. The IAEA has been able to verify that Iran's declared nuclear facilities and materials have not been diverted for military purposes. And Tehran has provided the agency with "information similar to that which Iran had previously provided pursuant to the Additional Protocol," ElBaradei reported in February, adding that this information clarified the agency's "knowledge about Iran's current declared nuclear programme." Iran, however, provided this information "on an ad hoc basis and not in a consistent and complete manner," the report said.³⁴ Indeed, the IAEA requested in April 2008 that Iran provide "as a transparency measure, access to additional locations related ... to the manufacturing of centrifuges, R&D on uranium enrichment, and uranium mining." But Tehran has not yet agreed to do so.

ElBaradei's February 2008 report underscored the importance of full Iranian cooperation with the agency's investigation, as well as Tehran's implementation of its additional protocol:

Confidence in the exclusively peaceful nature of Iran's nuclear programme requires that the Agency be able to provide assurances not only regarding declared nuclear material, but, equally importantly, regarding the absence of undeclared nuclear material and activities in Iran ... Although Iran has provided some additional detailed information about its current activities on an ad hoc basis, the Agency will not be in a position to make progress towards providing credible assurances about the absence of undeclared nuclear material and activities in Iran before reaching some clarity about the nature of the alleged studies, and without implementation of the Additional Protocol.

The IAEA has also asked Iran to "reconsider" its March 2007 decision to stop complying with a portion of the subsidiary arrangements for its IAEA safeguards agreement. That provision, to which Iran agreed in 2003, requires Tehran to provide design information for new nuclear facilities "as soon as the decision to construct, or to authorize construction, of such a facility has been taken, whichever is earlier."

³² GOV/2008/15.

³³ "Iran not to Answer Calls Beyond NPT," *Fars News Agency*, November 20, 2008; "Tehran Will Have Comprehensive Interaction with IAEA: Official," *Islamic Republic News Agency*, November 19, 2008; INFCIRC/737.

³⁴ GOV/2008/4.

Previously, Iran was required to provide design information for a new facility only 180 days before introducing nuclear material into it. If Tehran does not alter this decision, the agency will receive considerably later notice about the construction of future Iranian nuclear facilities. Indeed, Iran, invoking its March 2007 decision, refused to allow IAEA inspectors to conduct an inspection of the Arak reactor, according to ElBaradei's November 2008 report.

Status of Iran's Nuclear Programs

Some non-governmental experts and U.S. officials have argued that, rather than producing fissile material indigenously, Iran could obtain such material from foreign sources.³⁵ A National Intelligence Estimate (NIE) made public December 3, 2007, states that the intelligence community "cannot rule out that Iran has acquired from abroad — or will acquire in the future — a nuclear weapon or enough fissile material for a weapon." Similarly, during a press briefing that same day, a senior intelligence official characterized such acquisition as "an inherent option" for Iran. However, Tehran's potential ability to produce its own HEU or plutonium is a greater cause of concern; the official explained that "getting bits and pieces of fissile material from overseas is not going to be sufficient" to produce a nuclear arsenal.

Uranium Enrichment

Iran has a pilot centrifuge facility and a larger commercial facility, both located at Natanz. The latter is eventually to hold over 47,000 centrifuges.³⁶ Vice President Gholamreza Aghazadeh, who also heads Iran's Atomic Energy Organization, said in April 2007 that it will take up to four years to install all of them.³⁷ Iran began enriching uranium in the facility after mid-April 2007, producing a total of 630 kilograms of LEU containing a maximum of 4.9% uranium-235.³⁸ Some experts have reportedly concluded that this quantity of LEU, if enriched, would produce enough HEU for a nuclear weapon. However, an Iranian attempt to enrich this LEU

³⁵ See, for example, then-Undersecretary of State for U.S. Arms Control And International Security Robert Joseph's testimony before the Senate Committee on Foreign Relations, February 9, 2006; and then-Director of Research Institute for National Strategic Studies National Defense University Stephen Cambone's testimony before the Senate Committee on Governmental Affairs, September 21, 2000.

³⁶ GOV/2008/15. According to this report, Iran is planning to install 16 cascade units, each containing 18 164-centrifuge cascades. Tehran has previously told the agency that it intends to install over 50,000 centrifuges; see *Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran*, Report by the Director-General, GOV/2004/83.

³⁷ "Installation of Centrifuges Continues in Natanz - Iran Nuclear Official," *Iranian Students News Agency*, April 17, 2007.

³⁸ GOV/2008/59; Iranian operating records show that the plant has produced LEU containing 4.9% uranium-235. IAEA samples have indicated that it has produced LEU containing 4% uranium-235.

would likely be detected by the IAEA.³⁹ (This point is discussed in greater detail below).

Individual centrifuges are linked together in cascades; each cascade in the commercial facility contains 164 centrifuges. Currently, Iran has 18 cascades (2,952 centrifuges) of first generation (IR-1) centrifuges installed in the facility. Iran is feeding uranium hexafluoride into five additional 164-centrifuge cascades and is installing and testing thirteen more cascades.⁴⁰ Tehran has not fed uranium hexafluoride into any additional centrifuges since ElBaradei's September report.

A senior U.S. intelligence official said December 3, 2007, that a country needs to be able to "operate large numbers of centrifuges for long periods of time with very small failure rates" in order to be able to "make industrial quantities of enriched uranium." The NIE stated that Iran still "faces significant technical problems operating" its centrifuges.⁴¹

Iran's ability to operate its centrifuges appears to have improved in recent months, however. ElBaradei's February report indicated that the Natanz commercial facility had been operating "well below its declared design capacity" — language that does not appear in subsequent reports. In addition, a September 15, 2008 report from the Institute for Science and International Security (ISIS) says that Tehran's centrifuges "appear to be running at approximately 85 percent of their stated target capacity, a significant increase over previous rates."⁴² A senior UN official reportedly offered a similar assessment in September 2008.⁴³ Moreover, a November 19, 2008, ISIS report points out⁴⁴ that, based on data from ElBaradei's November report, Iran's daily LEU production rate has remained the same since early May 2008.

Iran is also working on several other centrifuge designs. Tehran has given the IAEA information on four different centrifuge designs and has been testing small numbers of more advanced centrifuges, known as the IR-2 and IR-3, which could

³⁹ William J. Broad and David E. Sanger "Iran Said to Have Nuclear Fuel for One Weapon," *New York Times*, November 20, 2008; Jonathan Tirone, "Iran Has Enough Low-Level Uranium for Work on Bomb," *Bloomberg News*, November 20, 2008.

⁴⁰ GOV/2008/59.

⁴¹ Available at [http://odni.gov/press_releases/20071203_release.pdf].

⁴² David Albright, Jacqueline Shire, and Paul Brannan, *IAEA Report on Iran: Centrifuge Operation Significantly Improving; Gridlock on Alleged Weaponization Issues*, September 15, 2008, available at [http://www.isis-online.org/publications/iran/ISIS_Report_Iran_15September2008.pdf]. The report compares data from the previous IAEA reports about the amount of uranium hexafluoride fed into Iran's centrifuges.

⁴³ Peter Crail, "ElBaradei Says Iran Stalls IAEA Inquiry," *Arms Control Today*, October 2008.

⁴⁴ Albright, Shire, and Brannan, *IAEA Report on Iran: Enriched Uranium Output Steady; Centrifuge Numbers Expected to Increase Dramatically; Arak Reactor Verification Blocked*, November 19, 2008. Available at [http://www.isis-online.org/publications/iran/ISIS_analysis_Nov-IAEA-Report.pdf].

increase Iran's enrichment capacity.⁴⁵ Iran may also be conducting work on another advanced centrifuge in its pilot enrichment facility.⁴⁶

In addition to its centrifuge work, Tehran is continuing to produce uranium hexafluoride; as of November 3, Iran had produced approximately 519 metric tons since March 2004. Tehran also appears to have improved its ability to produce centrifuge feedstock of sufficient purity.⁴⁷

Stating that “centrifuge enrichment is how Iran probably could first produce enough fissile material for a weapon,” the 2007 NIE adds that “the earliest possible date Iran would be technically capable of producing enough HEU for a weapon is late 2009.”⁴⁸ This date, however, “is very unlikely,” the estimate says, adding that “Iran probably would be technically capable of producing enough HEU for a weapon sometime during the 2010-2015 time frame.” But the State Department Bureau for Intelligence and Research, the estimate says, judges that Tehran “is unlikely to achieve this capability before 2013” and all intelligence agencies “recognize the possibility that this capability may not be attained until *after* 2015.”⁴⁹ A senior intelligence official explained during the December press briefing that the “acquisition of fissile material ... remains the governing element in any timelines in which they'd have a nuclear device.”

The above time frame assesses Tehran's capability to produce HEU from its Natanz facility. However, the 2007 NIE states that Iran would “probably would use covert facilities — rather than its declared nuclear sites — for the production of highly enriched uranium for a weapon.” Indeed, it is very difficult to divert without detection significant amounts of nuclear material from centrifuge facilities under IAEA safeguards. A 2004 CIA report concluded that “inspections and safeguards will most likely prevent Tehran from using facilities declared to the IAEA directly for its weapons program as long as Iran remains a party to the NPT.”⁵⁰ Moreover, the cascades in the Natanz facility are not configured to produce HEU and reconfiguring

⁴⁵ GOV/2008/59; GOV/2008/38; GOV/2008/15; GOV/2008/4.

⁴⁶ David Albright, Jacqueline Shire, and Paul Brannan, *May 26, 2008 IAEA Safeguards Report on Iran: Centrifuge Operation Improving and Cooperation Lacking on Weaponization Issues*, May 29, 2008, available at [http://www.isis-online.org/publications/iran/ISIS_Iran_IAEA_Report_29May2008.pdf]. The report's argument is based on an analysis of recent photographs taken at Iran's pilot centrifuge facility.

⁴⁷ IISS Strategic Comments, “Nuclear Iran: How Close Is It?,” September 2007, available at [<http://www.iiss.org/publications/strategic-comments/past-issues/volume-13---2007/volume-13--issue-7/nuclear-iran/>]. Paul Kerr, “Iran Continues Security Council Defiance,” *Arms Control Today*, June 2007. Interview with State Department official October 28, 2008.

⁴⁸ This time frame describes the point at which Iran could have enough HEU for a weapon, rather than when Iran could start producing HEU.

⁴⁹ The time frame described in the 2007 NIE is the same as one described in a 2005 NIE.

⁵⁰ Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, January 1-December 31, 2004, available at [http://www.odni.gov/reports/2004_unclass_report_to_NIC_DO_16Nov04.pdf].

them would be extremely difficult to do without detection.⁵¹ Although Tehran could end its cooperation with the IAEA and use its declared centrifuge facilities to develop fissile material, such an action would be virtually unprecedented.⁵²

A senior intelligence official explained that Iran could use knowledge gained from its Natanz facilities at covert enrichment facilities. However, there is no public official evidence that Iran has covert centrifuge or conversion facilities. And according to the NIE, a “growing amount of intelligence indicates Iran was engaged in covert uranium conversion and uranium enrichment activity,” but Tehran probably stopped those efforts in 2003 and had not, as of mid-2007, restarted them.

Plutonium

Iran acknowledged to the IAEA in 2003 that it had conducted plutonium-separation experiments — an admission which aroused suspicions that Iran could have a program to produce plutonium for nuclear weapons. The IAEA, however, continued to investigate the matter, and ElBaradei reported in August 2007 that the agency has resolved its questions about Iran’s plutonium activities.⁵³

The 2007 NIE stated that “Iran will not be technically capable of producing and reprocessing enough plutonium for a weapon before about 2015.” But, as noted above, Iran says that it does not plan to engage in reprocessing and ElBaradei’s November 2008 report stated that “[t]here have been no indications of ongoing reprocessing related activities” at Iran’s declared nuclear facilities.

Arak Reactor. Iran says that its heavy-water reactor, which is being constructed at Arak, is intended for the production of medical isotopes. According to a May 5, 2008, presentation by Ambassador Ali Asghar Soltanieh, Iran’s Permanent Representative to the International Atomic Energy Agency, it is to substitute for an “outdated” HEU-fueled research reactor in Tehran that has been in operation since 1967.⁵⁴ However, the reactor is a proliferation concern because its spent fuel will contain plutonium better suited for nuclear weapons than the plutonium produced by light-water moderated reactors, such as the Bushehr reactor. In addition, Iran will be able to operate the reactor with natural uranium, which means that it will not be dependent on supplies of enriched uranium.

⁵¹ For more details about cascade configuration, see Houston G. Wood, Alexander Glaser, and R. Scott Kemp, “The Gas Centrifuge and Nuclear Weapons Proliferation,” *Physics Today*, September 2008, and International Institute for Strategic Studies, *Iran’s Strategic Weapons Programmes: A Net Assessment*, (UK: Routledge, 2005), pp. 53-54.

⁵² No state in good standing with the IAEA has ever used this tactic. North Korea restarted its nuclear weapons program after announcing its withdrawal from the NPT in 2003. But the IAEA has never completed an assessment of that country’s nuclear activities.

⁵³ *Iran*, Report by the Director General, GOV/2007/48, August 30, 2007.

⁵⁴ “Iran’s Exclusively Peaceful Nuclear Programs and Activities,” Briefing for NGOs, May 5, 2008, available at [http://www.reachingcriticalwill.org/legal/npt/prepcom08/WP/iran_briefing.pdf]

Iran also has a plant for producing heavy water. According to ElBaradei's November report, satellite imagery appears to indicate that the plant is "in operational condition." Moreover, Tehran is continuing work on a fuel manufacturing plant which, when complete, is to first produce fuel for the Arak reactor.⁵⁵

Bushehr Reactor. Iran is also constructing near the city of Bushehr a 1,000 megawatt nuclear power reactor moderated by light water. The original German contractor, which began constructing the reactor in 1975, abandoned the project following Iran's 1979 revolution. Russia agreed in 1995 to complete the reactor, but the project has since encountered repeated delays. In February 2005, Moscow and Tehran concluded an agreement stating that Russia would supply fuel for the reactor for 10 years. At the time, the director of the Russian Federal Agency for Atomic Energy said the reactor would begin operating in late 2006. More recently, spokespersons from Iran's Atomic Energy Organization and Atomstroyexport, the Russian contractor, have said that the reactor would begin operating sometime in 2009.⁵⁶ Russia has blamed financial and technical issues for delaying the project's completion. However, it had been widely believed that Moscow may have been delaying fuel shipments in order to increase political pressure on Iran to comply with the Security Council resolutions.

In any case, Atomstroyexport sent the first shipment of LEU fuel to Iran on December 16, 2007, and the reactor received the last shipment near the end of January. The fuel, which is under IAEA seal, will contain no more than 3.62% uranium-235, according to an Atomstroyexport spokesperson.⁵⁷

The United States had previously urged Moscow to end work on the project, citing concerns that it could aid an Iranian nuclear weapons program by providing the country with access to nuclear technology and expertise.⁵⁸ However, U.S. officials said in 2002 that Washington would drop these public objections if Russia took steps to mitigate the project's proliferation risks; the 2005 deal requires Iran to return the

⁵⁵ "Aqazadeh: Iran Heralds Peaceful Nuclear Program," *Islamic Republic News Agency*, April 8, 2008.

⁵⁶ "Russia Says Iran Nuclear Plant Nearing Completion," *Reuters*, September 9, 2008; "Iran Nuclear Spokesman Interviewed on Situation," *E'temad*, November 9, 2008.

⁵⁷ "Atomstroyexport Completes Latest Shipment of Fuel to Bushehr Nuclear Plant," *Interfax*, December 28, 2007.

⁵⁸ For example, then-Deputy Assistant Secretary of Defense Marshall Billingslea testified before the Senate July 29, 2002, that the United States was "concerned that the Bushehr nuclear power project is, in reality, a pretext for the creation of an infrastructure designed to help Tehran acquire atomic weapons." Then-Undersecretary of State for International Security and Arms Control John Bolton told the House International Relations Committee in June 2003 that Iran could build "over 80 nuclear weapons" if it had access to sufficient fuel, operated the reactor for five to six years, and chose to withdraw from the nuclear Nonproliferation Treaty (NPT). This estimate assumes that Iran possesses a reprocessing facility.

spent nuclear fuel to Russia.⁵⁹ This measure is designed to ensure that Iran will not separate plutonium from the spent fuel. Moscow also argues that the reactor will not pose a proliferation risk because it will operate under IAEA safeguards. It is worth noting that light-water reactors are generally regarded as more proliferation-resistant than other types of reactors.

Although the UN Security Council resolutions restrict the supply of nuclear-related goods to Iran, they do permit the export of nuclear equipment related to light water reactors.

Does Iran Have a Nuclear Weapons Program?

In addition to the possible nuclear-weapons related activities discussed above, Iran has continued to develop ballistic missiles, which could potentially be used to deliver nuclear weapons. But Tehran's nuclear program has raised concerns for various other reasons.

First, Iran has been secretive about its nuclear programs. For example, Tehran hindered the IAEA investigation by failing to disclose numerous nuclear activities, destroying evidence, and making false statements to the agency.⁶⁰ Moreover, although Iran's cooperation with the agency has improved, the IAEA has repeatedly criticized Tehran for failing to provide the agency with timely access to documents and personnel.

Second, many observers have questioned Iran's need for nuclear power, given the country's extensive oil and gas reserves. The fact that Tehran resumed its nuclear program during the Iran-Iraq war has also cast doubt on the energy rationale.

Furthermore, many countries with nuclear power reactors purchase nuclear fuel from foreign suppliers — a fact that calls into question Iran's need for an indigenous enrichment capability, especially since Russia has agreed to provide fuel for the Bushehr reactor. Moreover, although Tehran plans to develop a large nuclear power program, the country lacks sufficient uranium deposits — a fact acknowledged by Iranian officials.⁶¹

Iran's stated rationale for its Arak reactor has also been met with some skepticism. Tehran says it needs the reactor to produce medical isotopes, but the Tehran research reactor is capable of producing such isotopes and has unused

⁵⁹ Estimates for the length of time the spent fuel will have to stay in Iran to cool range from two to five years. See Paul Kerr, "Iran, Russia Reach Nuclear Agreement," *Arms Control Today*, April 2005.

⁶⁰ For example, Iran sanitized a facility where Iranian scientists had enriched uranium, falsely told the IAEA that it had not enriched uranium, and falsely claimed that it had not procured any foreign components for one of its centrifuge programs.

⁶¹ *Iranian Students News Agency*, April 17, 2007; Thomas W. Wood, Matthew D. Milazzo, Barbara A. Reichmuth, and Jeffrey Bedell, "The Economics Of Energy Independence For Iran," *Nonproliferation Review*, Vol. 14, No. 1, March 2007.

capacity. In addition, non-proliferation experts have argued that the reactor is unnecessary for producing such isotopes.⁶²

However, Iran maintains that its enrichment program has always been exclusively for peaceful purposes. Tehran argues that it cannot depend on foreign suppliers for reactor fuel because such suppliers have been unreliable in the past.⁶³ Iran also says that it has been forced to conceal its nuclear procurement efforts in order to counter Western efforts to deny it nuclear technology, a claim that appears to be supported by a 1997 CIA report.⁶⁴ Furthermore, as noted above, Iran has stated that it needs the Arak reactor to replace the Tehran research reactor.

Although few experts argue that there is no evidence that Iran has pursued a nuclear weapons program, some have documented Tehran's projected difficulty in exporting oil and natural gas without additional foreign investment in its energy infrastructure.⁶⁵ And at least one expert has described Iran's inability to obtain nuclear fuel from an international enrichment consortium called Eurodif. During the 1970s, Iran had reached an agreement with Eurodif that entitled Iran to enriched uranium from the consortium in exchange for a loan.⁶⁶

The 2007 National Intelligence Estimate

According to the 2007 NIE, "Iranian military entities were working under government direction to develop nuclear weapons" until fall 2003, but then halted its nuclear weapons program "primarily in response to international pressure." The NIE defines "nuclear weapons program" as "Iran's nuclear weapon design and weaponization work and covert uranium conversion-related and uranium enrichment-related work."⁶⁷

⁶² Robert J. Einhorn, "Iran's Heavy-Water Reactor: A Plutonium Bomb Factory," November 9, 2006, available at [http://www.armscontrol.org/pressroom/2006/20061109_Einhorn.asp?print].

⁶³ Paul Kerr, "News Analysis: Behind Iran's Diplomatic Behavior," *Arms Control Today*, June 2006.

⁶⁴ The report says that Iran had responded to "Western counterproliferation efforts by relying more on legitimate commercial firms as procurement fronts and by developing more convoluted procurement networks."

⁶⁵ See, for example, Roger Stern, "The Iranian Petroleum Crisis and United States National Security," *Proceedings of the National Academy of Sciences of America*, January 2007, and George Perkovich and Silvia Manzanero, "Plan B: Using Sanctions to End Iran's Nuclear Program," *Arms Control Today*, May 2004.

⁶⁶ Oliver Meier, "Iran and Foreign Enrichment: A Troubled Model," *Arms Control Today*, January/February 2006.

⁶⁷ The NIE does not incorporate intelligence reporting after October 31, 2007 — a time frame that includes EIBaradei's last three reports to the IAEA Board of Governors. Some documents described in his May 2008 report contain 2004 dates, but whether that fact would change the NIE's conclusion regarding the date when Iran ended its nuclear weapons program is unclear.

The estimate, however, added that the intelligence community also assesses “with moderate-to-high confidence that Tehran at a minimum is keeping open the option to develop nuclear weapons.”⁶⁸ The estimate adds that, because of “intelligence gaps,” the Department of Energy and the National Intelligence Council “assess with only moderate confidence that the halt to those activities represents a halt to Iran’s entire nuclear weapons program.”

The NIE also stated that “Tehran’s decision to halt its nuclear weapons program suggests it is less determined to develop nuclear weapons than we have been judging since 2005.”⁶⁹ The change in assessments, a senior intelligence official said December 3, 2007, was the result of “new information which caused us to challenge our assessments in their own right, and illuminated previous information for us to be able to see it perhaps differently than we saw before, or to make sense of other data points that didn’t seem to self-connect previously.”

According to press accounts, this information included various written and oral communications among Iranian officials which indicated that the program had been halted.⁷⁰ The United States may also have obtained information from Iranian officials who defected as part of a CIA program to induce them to do.⁷¹ The NIE also incorporated open-source information, such as photographs of the Natanz facility that became available after Iran allowed members of the press to tour the facility.

According to the 2007 NIE, the intelligence community continues to assess “with moderate-to-high confidence that Iran does not have a nuclear weapon.” Although the community assesses “with low confidence that Iran probably has

⁶⁸ Prior to the NIE, some non-governmental experts had argued that Iran had stopped its nuclear weapons program. See, for example, Paul Kerr, “Divided From Within,” *Bulletin of the Atomic Scientists*, November/December 2006; Jeffrey Lewis, “Iran Roundup: Negotiations and Wonkporn,” July 27, 2005, available at [<http://www.armscontrolwonk.com/703/iran-roundup-negotiations-and-wonkporn>]; and George Perkovich, *Changing Iran’s Nuclear Interests, Policy Outlook, Carnegie Endowment for international Peace*, May 2005, available at [<http://www.carnegieendowment.org/files/PO16.perkovich.FINAL2.pdf>].

⁶⁹ Although the 2005 NIE stated that “Iran currently is determined to develop nuclear weapons despite its international obligations and international pressure,” that assessment was somewhat qualified. Titled “Iran’s Nuclear Program: At A Crossroads,” the estimate stated that Iran was not “immovable” on the question of pursuing a nuclear weapons program and also addressed the possibility that Tehran may not have had such a program. Moreover, the word “determined” was used in lieu of “pursuing” a nuclear weapon because the authors believed the latter to be a stronger term.

⁷⁰ Dafna Linzer and Joby Warrick, “U.S. Finds that Iran Halted Nuclear Arms Bid in 2003,” *Washington Post* December 4, 2007; Greg Miller, “Iran’s Nuclear Ambitions on Hold, U.S. Agencies Conclude,” *Los Angeles Times*, December 4, 2007; David E. Sanger and Steven Lee Myers, “Details in Military Notes Led to Shift on Iran, U.S. Says,” *New York Times*, December 6, 2007; Peter Baker and Dafna Linzer, “Diving Deep, Unearthing a Surprise; How a Search for Iran’s Nuclear Arms Program Turned Up an Unexpected Conclusion,” *Washington Post*, December 8, 2007.

⁷¹ Greg Miller, “CIA Has Recruited Iranians to Defect; The Secret Effort Aims to Undermine Tehran’s Nuclear Program,” *Los Angeles Times*, December 9, 2007.

imported at least some weapons-usable fissile material,” it still judges “with moderate-to-high confidence” that Tehran still lacks sufficient fissile material for a nuclear weapon.

In addition to the new intelligence, other factors suggest that Iran may not have an active nuclear weapons program. First, the IAEA has resolved several of the outstanding issues described in the August 2007 Iran-IAEA work plan and has apparently not found additional evidence of a nuclear weapons program. Indeed, the agency has not discovered significant undeclared Iranian nuclear activities for several years (although, as noted above, the IAEA’s ability to monitor Iran’s nuclear facilities has decreased). Furthermore, Tehran, beginning in 2003, has been willing to disclose previously undeclared nuclear activities to the IAEA (though, as previously discussed, Iran has not been fully cooperating with the agency). In addition, Iran made significant changes to the administration of its nuclear program in fall 2003 — changes that produced greater openness with the IAEA and may have indicated a decision to stop a nuclear weapons program.⁷² Finally, as noted above, Iranian officials have stated numerous times that Tehran is not seeking nuclear weapons, partly for religious reasons. A change in this stance could arguably damage religious leaders’ credibility.

Living with Risk. Other findings of the NIE indicate that the international community may, for the foreseeable future, have to accept some risk that Iran will develop nuclear weapons. According to the 2007 NIE, “only an Iranian political decision to abandon a nuclear weapons objective would plausibly keep Iran from eventually producing nuclear weapons — and such a decision is inherently reversible.” The estimate also asserted that “Iran has the scientific, technical and industrial capacity eventually to produce nuclear weapons if it decides to do so,” adding that, “since fall 2003, Iran has been conducting research and development projects with commercial and conventional military applications — some of which would also be of limited use for nuclear weapons.”

This is not to say that an Iranian nuclear weapons capability is inevitable; as noted above, Iran does not yet have such a capability. But Tehran would have to accept some constraints on its nuclear program in order to provide the international community with confidence that Iran is not pursuing a nuclear weapon.

Other Constraints on Nuclear Weapons Ambitions

Although the production of fissile material is widely considered to be the most difficult step in nuclear weapons development, Iran would, even with the ability to produce HEU, still face challenges in producing nuclear weapons, such as developing a workable physics package and effective delivery vehicles.⁷³

⁷² This argument is explained in more detail in Kerr, *Bulletin of the Atomic Scientists*, 2006. For an in-depth discussion of Iran’s nuclear decision-making process, see Abbas William Samii, “The Iranian Nuclear Issue and Informal Networks,” *Naval War College Review*, Winter 2006.

⁷³ For a more detailed discussion, see Office of Technology Assessment, *Technologies* (continued...)

Although developing and producing HEU-based nuclear weapons covertly would probably be Tehran's preferred option, such a path would present additional challenges. A 2005 report from the International Institute for Strategic Studies concluded that "an Iranian planner would have little basis for confidence that significant nuclear facilities could be kept hidden."⁷⁴ Tehran would need to hide a number of activities, including uranium conversion, the movement of uranium from mines, and the movement of centrifuge feedstock.⁷⁵ Alternatively, Tehran could import uranium ore or centrifuge feedstock, but would also need to do so covertly. Furthermore, Iran could produce only fairly simple nuclear weapons, which are not deliverable by longer-range missiles, without conducting explosive nuclear tests. However, many analysts argue that such tests would likely be detected.⁷⁶

⁷³ (...continued)

Underlying Weapons of Mass Destruction (OTA-BP-ISC-115), December 1993.

⁷⁴ International Institute for Strategic Studies, p. 57.

⁷⁵ The 2005 IISS report also explains that concealing a plutonium-based nuclear weapons program would be even more difficult (pp. 62-63).

⁷⁶ For a detailed discussion of this issue, see Steven A. Hildreth, statement before the House Committee on Oversight and Government Reform, Subcommittee on National Security and Foreign Affairs, March 5, 2008, available at [<http://nationalsecurity.oversight.house.gov/documents/20080305141600.pdf>].