Part I - The Military Threat from Iran

The Threat from Nuclear Weapons

What Is Happening to the Iranian Nuclear Program?
(February 2012)

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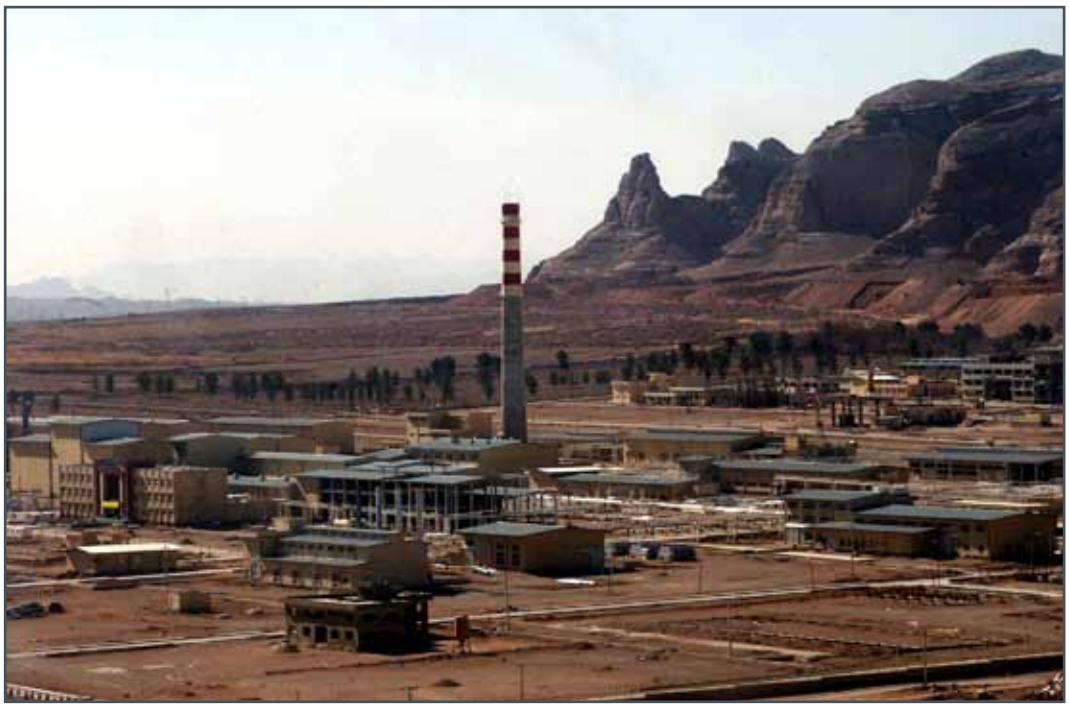
Over the last decade, a clear international consensus has slowly emerged that Iran was not just pursuing a civilian nuclear program, as Tehran argued, but rather was seeking nuclear weapons. True, the Nuclear Non-Proliferation Treaty guarantees the right of signatories, like Iran, to use nuclear energy for peaceful purposes, but that did not include a right to enrich uranium in order to produce indigenous nuclear fuels that could be employed for nuclear weapons. Many countries with nuclear power infrastructures, like South Korea, Finland, Spain, and Sweden, actually received their nuclear fuels from abroad.(1) Even in the U.S., 92 percent of the uranium used in 2010 by nuclear power plants was of foreign origin.(2) But unlike these other cases, Iran chose to establish its own uranium enrichment infrastructure at Natanz and suspiciously kept it totally secret from the world until 2002, when it was revealed by the Iranian opposition. A second secret enrichment facility, near Qom, buried deep inside a mountain, was disclosed in 2009.



Iran's Uranium Conversion Facility outside of Isfahan in 2005. (AP Photo/Vahid Salemi)

Because of the way Iran proceeded with its nuclear program, international suspicions of its purpose only increased. The official Iranian line that its nuclear infrastructure was for the production of electricity lost all credibility over time, especially in light of its enormous oil and gas reserves which were a far more economical source of energy. In February 2006, French Foreign Minister Philippe Douste-Blazy bluntly stated that "it is a clandestine military program."(3) Even the Russians could no longer protect what Iran was doing by saying that it was for purely civilian purposes. Thus, Russian President Dmitry Medvedev frankly admitted in July 2010, "We are not indifferent to how the military components of the corresponding [nuclear] program look."(4) More recently, U.S. Secretary of Defense Leon Panetta was interviewed by CBS News on December 19, 2011, at which time he stated that Iran could have a nuclear weapon in "about a year...perhaps a little less." For Washington, it was no longer a question of whether Iran wanted a nuclear bomb, but rather when it would obtain one.

While Iran's continuing enrichment of uranium that began in 2007 has defied no less than six UN Security Council resolutions, unfortunately there has been a tendency, at times, over the last five years to play down the immediacy of the Iranian nuclear threat.(5) This new conventional wisdom helped remove the urgency many in the West felt with respect to the Iranian nuclear program. For example, on August 19, 2011, the *New York Times* published a major article entitled: "US Assures Israel that Iran Threat Is Not Imminent."(6) The authors claimed that because Iran had been facing increasing problems with its nuclear program, the Obama administration concluded that it would take a year or more for Iran to make the final sprint to a nuclear weapon. According to the article, the critical question was how long it would take the Iranians to convert their supplies of low-enriched uranium to weapons-grade uranium to make a bomb: what has been called by experts, "nuclear breakout."

These optimistic assumptions about the Iranian nuclear program continued to appear. For example, the *Washington Post* ran a dramatic headline at the top of its front page on October 18, 2011, which read "Iran 'Setback' on Nuclear Program." In its opening paragraph, the article explained that beyond the reported cyber-attack that afflicted Iran's nuclear facilities last year, the equipment in its main uranium fuel plant was performing poorly; specifically, its centrifuges for enriching uranium were old and they had a shortage of spare parts. Because of its prominence, the report in the *Washington Post* set the news agenda for the days that followed. *Time* magazine featured the story. So did CNN. Even Fox News reported that Iran was having "major problems" with its nuclear program. One of its lead commentators, Charles Krauthammer, spoke about the Iranian nuclear program being "devastated" and suggested that the West had been able to "disarm and retard the program."(7) Hearing all this commentary in the U.S., it might be possible for some to conclude that the international community can relax a bit and not be so worried about an imminent Iranian atomic bomb.

As background to the debate over the Iranian nuclear program, it is important to know some basic essentials. Uranium is normally found in two forms or isotopes: U-238 (with a nucleus made up of 92 protons and 146 neutrons) and the lighter isotope, U-235 (whose nucleus is made up of 92 protons and 143 neutrons). It is only the lighter isotope, U-235, that can undergo nuclear fission and release the energy needed for a nuclear reactor or an atomic bomb. But natural uranium is only 0.7% U-235 and 99.3% U-238. Iran has converted its uranium ore into a gas, at a facility in Isfahan, and then injected the uranium gas into centrifuges that spin at high speeds

to increase the amount of U-235, at its Natanz enrichment plant. A civilian reactor needs only 3.5% U-235, which is called low-enriched uranium (LEU), while for nuclear weapons, high-enriched uranium (HEU), which is based on 90% U-235, is required.

Most international concern was directed toward Iran's uranium enrichment efforts under the assumption that Tehran had decided that its nuclear weapons would be based on weapons-grade uranium. In comparison, North Korea's first nuclear test was based on a plutonium bomb. Iran had an active plutonium effort underway. It was building a heavy-water reactor at Arak and a heavy-water production plant. Iran told the IAEA that the heavy-water reactor would only be ready at the end of 2013. While UN resolutions called on Iran to suspend all heavy-water projects and Iran nonetheless persisted with this work, the more near-term threat to international security clearly came from its uranium projects.

The Growing Stockpile of Low-Enriched Uranium

Iran's known nuclear facilities are monitored by the International Atomic Energy Agency (IAEA) which uses cameras and makes regular onsite visits to learn what is going on. According to the May 2009 report of the IAEA, Iran had 4,920 operational centrifuges in Natanz enriching uranium. But in the May 2010 report that number dropped to 3,936 – a thousand fewer operational centrifuges than in 2009. This change was one of the main factors that led some analysts to conclude that the Iranian nuclear program was in trouble; the stories on the problems that the Iranians faced were based on the view that some of their centrifuges were breaking down or were not as efficient as previously thought and had to be repaired or replaced. It would be reasonable to ask how Iran could make a final dash to weapons-grade uranium with faulty centrifuge machines. For example, Gary Samore, President Obama's advisor on nuclear issues, has been quoted as questioning the "technical competence" of the Iranians.(8)

Yet there were important counter-trends that contradict the conventional wisdom that was being heard in 2011 about a contracting Iranian nuclear program. First, the overall quantities of low-enriched uranium in Iranian stockpiles are steadily growing. If Iran had 839 kg. of low-enriched uranium, according to the June 2009 IAEA report, it had 2,427 kg. by the May 2010 IAEA report. In November 2011 the IAEA report stated that Iran had 4,922 kg. of low-enriched uranium. If all Iran requires is 914 kg. of low-enriched uranium to produce sufficient weapons-grade uranium for a single bomb, then Iran already has enough uranium on hand for at least four or five nuclear bombs, should it decide to further enrich its stock of low-enriched uranium.(9)

The rate of uranium enrichment, according to these reports, has also been accelerating. According to data developed by the Institute for Science and Technology, in May 2009, the Iranians were producing a little over 80 kg. of low-enriched uranium every month. A year later in May 2010, the rate of production increased to 120 kg. per month. By May 2011, the monthly rate of production was nearly 160 kg. per month – almost double the rate in 2009.(10) In short, Iran was managing to produce low-enriched uranium despite all the reported problems it was having with its aging centrifuges.

Another area of concern about the Iranian uranium enrichment program was connected with the Fordow facility near Qom. Iran had kept this facility a secret, until it informed the IAEA in September 2009. At the time, the Iranians informed the IAEA

that they planned to install 3,000 centrifuges there. But what made Fordow a special concern was the fact that it was built deep inside a mountain, that is roughly 200 feet in height, and hence far better protected than the Natanz facility (which is estimated to be only 25-30 feet underground). The November 2011 IAEA report revealed that Iran had already transferred "one large cylinder" containing an unspecified amount of low-enriched uranium from Natanz to Fordow. Presumably, the Iranians hoped to produce either 20-percent-enriched uranium or even weapons-grade uranium, without the fear of a Western air attack.

Producing 20%-Enriched Uranium

The second counter-trend that showed Iran's nuclear program was not regressing involves its decision to enrich uranium beyond the 3.5% U-235 level up to 20% U-235. When the West refused to supply 20%-enriched uranium for the small Tehran Research Reactor, where the Iranians produce medical isotopes, Iranian nuclear experts went ahead in June 2010 and fed their 3.5%-enriched uranium into the centrifuges to produce 20%-enriched uranium, by themselves. With a stockpile of 20%-enriched uranium, the Iranians would cut by more than half the time they needed to take the next enrichment step to weapons-grade uranium.(11)

This demonstration of Iran's enrichment capabilities certainly undermined assessments in the West that doubt Tehran's technical competence. On July 11, 2011 Britain's foreign secretary William Hague wrote an op-ed in *The Guardian* entitled, "Iran's Nuclear Threat Is Escalating." He estimated that it would only take two to three months of additional enrichment of the 20%-enriched stockpile to make weapons-grade material. Moreover, he added that Iran was planning to shift the production of 20%-enriched uranium from an above-ground facility in Natanz to the new Fordow facility near Qom that is deep underground and had been kept secret until September 2009.

President Mahmoud Ahmadinejad appointed Fereydoun Abbassi-Divani on February 13, 2011, to head Iran's atomic energy program. His promotion to this sensitive position should have raised eyebrows in the West. The UN Security Council designated him in 2007 as one of a list of Iranians suspected of involvement in "Iran's nuclear or ballistic missile activities." He is thought to have been involved in the Iranian weaponization program.(12) Before this appointment he headed the physics department at Imam Hossein University, which is linked to Iran's Islamic Revolutionary Guard Corps (IRGC).

In June 2011, Abbas-Davani announced that Tehran was planning to triple its capacity to produce 20%-enriched uranium. Yet in an August 2011 interview published by the Iran News Agency, he admitted that Iran had produced 20%-enriched uranium in quantities that "already exceeded the required amount for the Tehran Research Reactor." Indeed, the November 2011 IAEA report indicates that Iran has already produced 73.7 kg. of 20%-enriched uranium. Given that Iran needs only 6 to 10 kg. per year to fuel the Tehran Research Reactor,(13) Iran has already produced more than seven years of fuel.(14) Moreover, that 20% stockpile could grow much larger if the Iranians install faster centrifuges for uranium enrichment. What will Iran do with all the excess of 20%-enriched uranium that it accumulates? Abbas-Davani's proposal to massively increase Iran's production of 20%-enriched uranium has clear military implications.

How is Iran going to triple the production of 20%-enriched uranium? It could devote more centrifuges to 20% enrichment, or it could employ more advanced centrifuges that operated much faster. The standard centrifuge that Iran used was known as the IR-1. The new generation of Iranian centrifuges, known by professionals as the IR-2m and IR-4, by some estimates would be able to increase the output of each machine by 600%.(15) A more conservative estimate is that the output of the new centrifuges is 4 to 5 times greater than the older machines.(16) By August 2011, Iran had installed 136 IR-2m centrifuges and 27 IR-4 centrifuges at the Pilot Fuel Enrichment Plant (PFEP) at Natanz.

It appeared that at this stage the Iranians wanted to test the performance of the new centrifuges before replacing the older centrifuge machines on a wide scale. Abbas-Davani made clear in June 2011 that Iran ultimately planned to install the advanced centrifuges at the Fordow plant where production of 20%-enriched uranium would be located in the future. The main, unanswered question is how many enrichment sites Iran presently has. In August 2010, Iran announced that it was building ten new enrichment sites that were to be built inside of mountains.(17) Construction of these new plants was to begin in early 2011. But where are these sites? The IAEA admitted in its May 2011 report: "The Agency's knowledge about Iran's enrichment activities continues to diminish."

So where does Iran stand with respect to an atomic bomb, given both of its paths to weapons-grade uranium: converting low-enriched uranium to weapons-grade fuel and the fast track they are developing with 20%-enriched uranium? Olli Heinonen, the former deputy director-general of IAEA and one of its chief inspectors, told the U.S. House Foreign Affairs Committee on June 23, 2011, that he expects Iran to have the ability to produce up to 250 kg. of 20%-enriched uranium, which would be sufficient for two atomic bombs, by the end of 2012. The entire stockpile of 3.5%-enriched uranium, according to Heinonen's estimate, could reach 7-8,000 kg., which could be converted with further enrichment to enough weapons-grade uranium for several more atomic bombs. He concludes that both paths of enrichment could yield together between 125 and 150 kg. of weapons-grade uranium by the end of 2012.(18) Between 20 and 25 kg. of weapons-grade uranium is needed for a single bomb.

Nuclear Warhead Design

There are, of course, three dimensions to any nuclear weapons program: enriched uranium, ballistic missiles, and nuclear warheads. The latter issue also grew in importance for the IAEA. This began to become evident in February 2008 when, Heinonen, then IAEA deputy director-general, gave a highly classified briefing to representatives of more than 100 states. According to a description of the meeting reported by David Sanger of *The New York Times*, Heinonen displayed original Iranian documents that he stressed came from several member states of the IAEA, and not just from the U.S.(19) In June 2010, the German newspaper *Der Spiegel* reported that the material came from a joint operation by German and American intelligence agencies. The IAEA had the international standing to authenticate U.S. intelligence reports for those who doubted their veracity. When the IAEA said they were true, many more states were willing to accept them.

The Iranian documents detailed how to design a warhead for the Shahab-3 missile, which has been operational in the Iranian armed forces since 2003. While the Iranian documents made no reference to a nuclear warhead, they did show the arc of a missile's flight and that the warhead of the missile had to be detonated at an altitude of 600 meters. To the IAEA experts, a conventional explosion at that altitude would have no effect on the ground below. But 600 meters was the ideal altitude for a nuclear explosion over a city. As Sanger points out, it was in fact the height of the Hiroshima explosion. Despite the substance of his presentation, Heinonen did not yet say that the Iranians were producing nuclear weapons, but he left his audience in Vienna with many questions they had not asked before.

By May 2011, the IAEA became far more explicit in its report on Iran than Heinonen had been in 2008. Its report raised concerns about the "possible existence" of seven areas of military research in the Iranian nuclear program, the last of which was the most alarming: "the removal of the conventional high explosive payload from the warhead of the Shahab-3 missile and replacing it with a spherical nuclear payload."

Yet, the IAEA was not ready to say it had reached any conclusions. It only sought "clarifications" about its suspicions.

The most important of the IAEA reports on Iran was released in November 2011 and proved to be significant in a number of ways. First, it showed that the IAEA no longer had "suspicions" about the Iranian weaponization program – it had what it called "credible" intelligence. The appendix of the report, moreover, devoted a whole section to the "credibility of information." It was not relying on the Iranian laptop that was at the heart of Heinonen's 2008 presentation, but also on a much larger volume of documentation. The report states that the agency has more than 1,000 pages of material to substantiate its claims. In case there were suspicions that this material came from U.S. intelligence agencies alone, the report makes sure to clarify that the sources involved "more than 10 member states."

Second, the material that the IAEA presented pointed clearly to the fact that Iran wanted to develop a deliverable nuclear weapon. The Iranians had sought to obtain uranium for a secret enrichment program that would not be under IAEA safeguards. The uranium that would come out of this clandestine program would be further processed to produce the uranium metal required for a nuclear warhead. The planned warhead design also underwent studies that investigated how it would operate if it was part of a missile re-entry vehicle and had to stand up to the stress of a missile launch and flying in a ballistic trajectory to its target. The IAEA concluded that "work on the development of an indigenous design of a nuclear weapon including the testing of components" had been executed by the Iranians. That "indigenous design," however, required external help. The IAEA report discloses that aspects of Iran's nuclear weapons "design concept" came from a foreign country, presumably from a state that possesses nuclear weapons.

The November 2011 report also contained references to documentation in Farsi detailing the safety arrangements that would have to be put in place for conducting an actual nuclear test. There were also public statements in 2011 that provide additional evidence that the Iranians were moving in the direction of an atomic bomb. For example, on June 23, 2011, Agence France-Presse quoted Mahmoud Ahmadinejad boasting on Iranian state television: "If we want to make a bomb, we are not afraid of anyone and we are not afraid to announce it; no one can do a damn thing." He then

added for the record, "we do not want to," but his initial statement demonstrated how confidant the Iranians have now become as their nuclear program progressed.

Timeline to Nuclear Weapons

The public data published by the International Atomic Energy Agency clearly points to the fact that the Iranian nuclear program is advancing. But, as noted earlier, there are conflicting assessments about the urgency of the problem. There is a mistaken impression in the West that Iran's ability to enrich uranium has been severely set back. The numbers do not indicate that such a conclusion is warranted. Hague's warning in June about the Iranian nuclear program at least indicates that one of the main Western powers sitting in the UN Security Council is aware of the severity of the situation.

There are elements of the Iranian nuclear program that are known to the international community. But there is also a great deal about the program that is not known that makes the calculation of a timeline for Iran's acquisition of nuclear weapons capability very difficult. Are there more secret enrichment plants like the Fordow facility that was only disclosed in 2009? Even Secretary of Defense Leon Panetta inserted this caveat into his assessment during a December 19, 2011 interview on CBS in which he said that Iran could have a bomb by the end of 2012:

> One proviso, Scott, is if they have a hidden facility somewhere in Iran that may be enriching fuel.
> *Pelley*: So that they can develop a weapon even more quickly...
> *Panetta*: On a faster track...
> *Pelley*: Than we believe...
> *Panetta*: That's correct.

There are other factors that can affect the timeline for the Iranians. How quickly are the Iranians intending to install their latest-generation centrifuges that can enrich uranium at a much higher rate than the older IR-1 centrifuges that they have been using until recently? All of these calculations are relevant should the Iranians decide on a strategy of "nuclear breakout" – expelling all IAEA inspectors, shutting down their monitoring equipment, and making a final dash for a bomb. When North Korea undertook this approach in 2002, the West did not respond with any effective steps. Why can't Iran adopt this approach as well?

Professional assessments about the timeline of the Iranians to obtain an atomic bomb thus have varied. For example, Gregory Jones, an adjunct senior defense policy analyst at the RAND Corporation, suggested that Iran's breakout timeline at the Natanz Fuel Enrichment Plant was as follows: he asserted that Iran could produce 20 kg. of weapons-grade uranium – enough for one nuclear weapon – in two months. In contrast, the Institute for Science and International Security assessed that a breakout scenario would take at least six months. In either case, Iranian nuclear weapons were no longer years away. Both analyses believed that Tehran could cross the nuclear threshold in a matter of months.(20)

Despite the dramatic information disclosed in the November 2011 IAEA Report, the Russians and the Chinese appeared to prefer to drag their feet on initiating harsh sanctions against Iran in the UN Security Council. A 2011 UN report assessed that sanctions were only having a limited impact on the regime in Tehran. The report

concluded that the sanctions that had been imposed on Iran were "not yet having an impact on the decision calculus of its leadership with respect to enrichment and heavy water-related activities."(21) And while EU governments agreed in principle to impose an oil embargo on Iran in January 2012, it did not appear to be comprehensive, allowing for exceptions in implementation that take into account the special needs of Greece, Italy, and Spain and their economic conditions. At least six months were expected to pass before the European oil sanctions would be fully put into effect.

Similarly, while President Obama signed into law a defense authorization bill in early 2012 that imposed new sanctions on Iran's central bank, the harshest measures in the legislation will also not go into effect for at least six months. Yet by June 2012, the Iranian nuclear program will have advanced considerably further. The critical question that remained unanswered in the first part of 2012, was whether the most painful economic sanctions the West might institute, at this late date, would influence Iranian decision-making with regard to its nuclear-weapons program. It seemed doubtful that Iran would fully halt its drive to nuclear weapons and provide the transparency to the West to verify that its program had indeed been halted.

How far will the Iranians push their nuclear efforts in the year ahead? Writing in *Foreign Affairs* (Jan.-Feb. 2012), Matthew Kroenig, a former Special Advisor on Iran policy in the Office of the U.S. Secretary of Defense (during 2010 and 2011), outlined what should be the "red lines" of the U.S. as the Iranians progress:

1. Iran expels the IAEA inspectors from its nuclear facilities.

2. The Iranians enrich their uranium stockpiles to the weapons-grade level of 90%.

3. The Iranians install their advanced centrifuges at their underground Fordow facility near Qom.

In January 2012, the IAEA verified an Iranian announcement that Tehran had begun production of 20%-enriched uranium at the fortified Fordow facility, indicating that the Iranians were prepared to move close towards crossing at least the last of these red lines, though without advanced centrifuges at this stage. *Kayhan*, the Iranian daily that was close to Supreme Leader Ayatollah Ali Khameini, wrote in its editorial, in response, that as a result of the enrichment effort in Fordow, Iran was entering "the zone of immunity," a term the Iranians borrowed from the West.(22) Iran was not only prepared to engage in nuclear brinksmanship, but it was also positioning itself to shorten the time frame necessary for the final dash to nuclear weapons, when it takes that decision in the months ahead.

Appendix I

The Growing Iranian Stockpile of Low-Enriched Uranium

September 2008 - 480 kg.

November 2008 - 630 kg.

February 2009 - 839 kg.

February 2010 - 2,065 kg.

May 2010 - 2,427 kg.

Sept. 2010 - 2,803 kg.

Nov. 2010 - 3,183 kg.

May 2011 - 4,105 kg.

Nov. 2011 - 4,922 kg.

February 2012 - 5,451 kg. (of which 985 kg. used for further enrichment and other purposes)

Source: IAEA

Appendix II

Iran's Stockpile of 20% Enriched Uranium

May 2010 - 5.7 kg.

Sept. 2010 - 22 kg.

Nov. 2010 - 33 kg.

Feb. 2011 - 43.6 kg.

May 2011 - 56.7 kg.

Nov. 2011 - 73.7 kg.

February 2012 - 109.2 kg. (of which 8 kg. removed and used for other purposes)

Source: IAEA

Notes

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