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Iran Nuclear Brief
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Iran's Nuclear and Missile Programs as P5+1 Talks Resume

As negotiations are poised to resume between Iran and the six powers seeking to rein in Iran's nuclear program, it is difficult to avoid a sense of déjà vu. For years now, the UN Security Council has demanded Iran suspend uranium enrichment. Tehran continues to expand its nuclear program and insists it will never compromise its right to enrich, the United States continues to tighten sanctions on Iranian trade and finances, and alarms are raised about Iran being able to sprint to a nuclear bomb with little warning. Yet, with a new Iranian president and negotiating team, there are grounds for cautious optimism that talks this time can be different. Although Iran continues to enrich uranium and add to its nuclear complex, time remains to negotiate an agreement that adequately guards against Iran building nuclear weapons.

HIGHLIGHTS

- Iran continues to expand its ability to produce low-enriched uranium (LEU).
    - o Current stockpiles contain sufficient quantities of LEU that, if further enriched to weapons-grade level, could provide fissile material for four weapons.
- Iran's 186 kilograms of 20 percent-enriched uranium gas could be rapidly enriched further to weapons grade, but another 60 kilograms would be required to enrich the amount necessary to construct the core of a single bomb.
- Iran is converting most of its newly produced 20 percent-enriched uranium gas into the solid (powder) form needed to fabricate research reactor fuel plates.
    - o The 20 percent-enriched gas converted to solid form is no longer readily available for further enrichment to weapons grade, although until it is actually made into fuel plates, it can be converted back into gaseous form, with some delay and wastage.
- 1,000 of Iran's 19,000 installed centrifuges are the more-advanced IR-2M. When this more efficient version comes online, it will provide Iran with a faster breakout capability.
- Work is continuing on the Arak heavy-water reactor, which would provide Iran a plausible pathway to developing a nuclear bomb by using plutonium, but the schedule for a start date has been slipping.
    - o Moreover, once operational, the Arak facility would require at least one year to produce sufficient plutonium for a bomb, and Iran would have to build a reprocessing facility to extract it from the spent fuel.
- If Iran were to decide soon to build nuclear explosives, they would likely be designed for delivery by currently operational liquid-fueled medium-range ballistic missiles, capable of targeting U.S. bases in the region and urban areas in countries such as Israel and Turkey.
- Iranian development of longer-range and more-capable ballistic missiles is proceeding at a slower pace than previously forecast.
    - o No Iranian intermediate-range ballistic missiles, intercontinental ballistic missiles, or large space launch vehicles have been seen or flight-tested.

Background

Nuclear talks between Iran and the group of six world powers known as the P5+1—China, France, Germany, Russia, the United Kingdom, and the United States—are expected to resume soon. These negotiations over the future of Iran's nuclear program will be the first major diplomatic undertaking of the new Iranian president, Hassan Rouhani, and an opportunity to test the sincerity of his stated desire to reconcile with the international community and reduce Iran's isolation.

However congenial the style and rhetoric of Iranian negotiators and unpalatable for both sides the prospect of failure, the obstacles to success loom large. The ultimate "decider" in Tehran is Supreme Leader Ayatollah Ali Khamenei, who not only does not trust the United States but also helped build an identity for the Islamic Republic of Iran in contradistinction to the U.S. "Great Satan."

Although the outcomes that the sides declare they desire are not very far apart, mutual suspicions about actual intentions run deep. The six powers tend to believe that Iran either wants to use its nuclear infrastructure to develop, build, and deploy nuclear weapons or that, at a minimum, it wishes to acquire an ability to quickly break out of its obligations under the nuclear Nonproliferation Treaty (NPT). Tehran tends to believe that the motive of the United States and its European allies is to use the nuclear dispute to weaken Iran and contribute to the regime's demise.

Both sides are now feeling more acute pressure from the ticking clock. In the case of Tehran, economic pressure is building as a result of four UN Security Council sanctions, culminating with Resolution 1929, passed in June 2010, and ever more comprehensive unilateral sanctions on banking, insurance, and the petroleum trade by the United States and the European Union.

In the case of the P5+1, there is growing concern about Iran's accumulation of low-enriched uranium (LEU) stockpiles that could put Iran on a fast track to breaking out of the NPT. Advanced centrifuges are being installed at its Natanz enrichment plant; centrifuges at the Fordow Fuel Enrichment Plant are enriching uranium hexafluoride gas to near 20 percent of the fissile isotope U-235 inside a relatively invulnerable mountain facility; and progress continues toward completion of a heavy-water reactor that could produce plutonium for weapons.

There is a parallel concern in the U.S. government that Israel will feel compelled to launch a preventive strike to set back Iran's nuclear development timetable and that the United States will find itself joined in that effort, willingly or otherwise.

Casus Belli

An active political debate is underway in the U.S. Congress over the proper meaning of denying Iran a "nuclear capability" and the nature of any "redline" Iran's nuclear program would have to cross to warrant a preventive military attack. Some have argued that the redline has already been crossed, considering Iran's ever shortening potential timeline for breaking out of the NPT to build a bomb. Others are particularly concerned by Iran's completion of centrifuge installation at the mountain-based Fordow plant, because Iran can further enhance to weapons grade the 20 percent-enriched uranium currently being produced there, creating what then-Israeli Defense Minister Yehud Barak called a "zone of immunity."[1]

A number of other security experts argue that, however undesirable, an Iranian nuclear weapons capability could be contained and deterred, presenting less of a threat to U.S. security than the consequences of a preventive attack.[2] They argue that a nuclear-armed Iran would balance a nuclear-armed Israel, creating more caution on the part of each and more stability in the region.

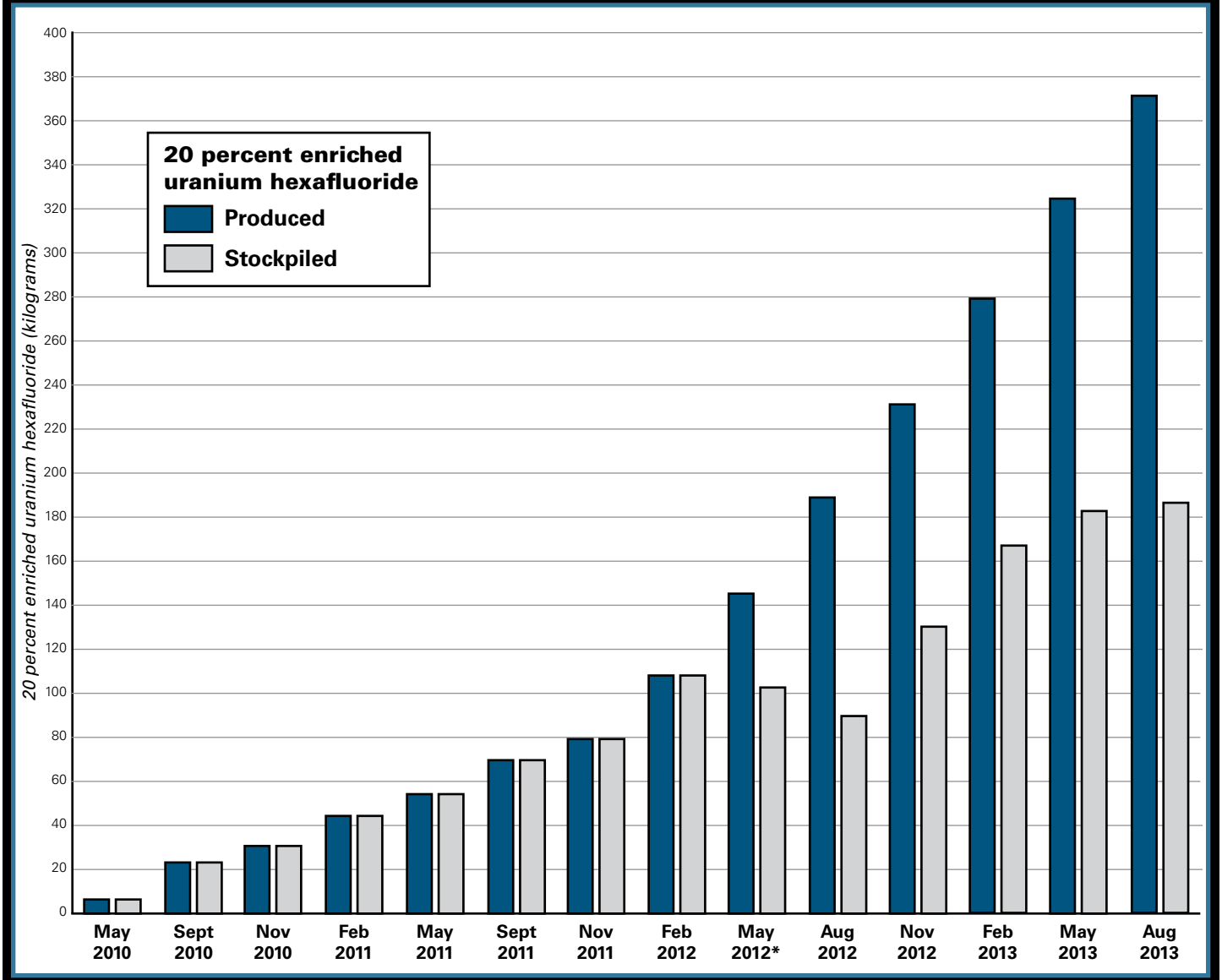
Despite the range of views within the U.S. government and Washington think tanks, there is an emerging political consensus that an unambiguous Iranian move to develop, test, and deploy nuclear weapons would trigger a military response. Considering the extremely dire consequences of exercising the military option and the alternative of allowing Iran to acquire nuclear weapons, which President Barack Obama labels "unacceptable," the negotiating path would appear to be the only viable option for satisfactorily resolving Iranian nuclear program issues.

There Is Time, but Not Too Much

Iran has not made a strategic decision to pursue nuclear weapons, according to senior U.S. intelligence and defense officials, and does not have the necessary ingredients for breaking out quickly to build an effective nuclear arsenal. But its uranium-enrichment capabilities are steadily improving, and progress on construction

Figure 1: Iran's Production of Uranium Enriched to 20 Percent

Iran began enriching uranium to 20 percent in February 2010. In May 2012, Iran began converting some of its 20 percent enriched uranium hexafluoride gas to uranium oxide, a solid to make fuel plates for the Tehran Research Reactor. Using quarterly reports from the IAEA, this graph shows Iran's total production of uranium enriched to 20 percent and how much uranium enriched to this level remains stockpiled as uranium hexafluoride gas.



*In February 2012, Iran began enriching uranium to 20 percent at its Fordow Fuel Enrichment Plant. Prior to this point, all enrichment to 20 percent occurred at the Natanz Pilot Fuel Enrichment Plant. Beginning with the May 2012 report, the quantity of uranium enriched to 20 percent reflects the combined total of both sites.

of a heavy-water reactor at Arak could soon open up a second route to producing fissile material for nuclear weapons.

Iran's stockpile of 20 percent-enriched uranium is one of the most proliferation-sensitive aspects of its nuclear program. Iran's claim that the 20 percent-enriched material is necessary to provide fuel for its Tehran Research Reactor (TRR) is dubious, as the size of the stockpile far exceeds any realistic estimation of Iran's needs.

According to an August 28 International Atomic Energy Agency (IAEA) report, Iran has produced 372 kilograms of 20 percent-enriched material, of which 185.8 kilograms are available for further enrichment (see Figure 1). This is still below the approximately 240-250 kilograms that is enough for one bomb, once further enriched to weapons grade (over 90 percent-enriched U-235).

Iran has kept its stockpile below the 240-250 kilogram threshold, which is Israeli Prime Minister Benjamin Netanyahu's redline, by converting approximately 185 kilograms of the 20 percent-enriched material from uranium hexafluoride gas to uranium oxide, a form suitable for making fuel plates for the TRR.

Iran has the capability to convert the uranium oxide back to uranium hexafluoride in as little as one to two weeks, but some of the material would be lost in the process. Experts assess that the loss could be as much as 60 percent. It is also unlikely that Iran would be able to do this without alerting IAEA inspectors.

In any event, even a gradual accumulation of surplus uranium hexafluoride enriched to 20 percent, particularly from production at the Fordow facility where the Iranians may believe they are shielded from attack, is worrisome. Getting a handle on the stockpile of 20 percent-enriched uranium is thus the most urgent priority by far in managing the Iranian nuclear crisis. To reduce the risk of a nuclear-armed Iran, it is essential to reach a deal soon to prevent that 20 percent-enriched uranium stockpile from continuing to grow.

Given Iran's increasing centrifuge capabilities, it is likely that, should Tehran decide to pursue nuclear weapons, it would use highly-enriched uranium as the fuel for its arsenal. Using its 6,774 kilograms of 3.5 percent-enriched uranium hexafluoride and its 185 kilograms of 20 percent-enriched uranium hexafluoride for enrichment to weapons grade, Iran could have sufficient fissile material for approximately four nuclear weapons.

Iran's installation of advanced centrifuges, the IR-2Ms, in addition to the more than 18,000 IR-1s already installed, underscores the need to reinvigorate diplomatic efforts (See Figure 2). As indicated in the August 28 IAEA report, Iran had 1,008 IR-2Ms installed at its enrichment plant at Natanz. It has also announced plans to install more than 2,000 additional centrifuges in the coming months. Six cascades of IR-2Ms have been vacuum-tested. Iran said that the performance of the IR-2M will be tested using these six cascades, but did not give a date as to when testing would begin.

Iran has said that when running, the IR-2Ms will produce reactor-grade (3.5 percent-enriched) uranium. although it is difficult to assess the increase in efficiency afforded by the IR-2Ms before they are operational, experts assess that a tripling or quadrupling in efficiency over the older IR-1 centrifuges might be realistic. Once operational, use of the IR-2M could significantly decrease Iran's breakout time if these estimates prove correct and should Iran decide to further enrich its stocks of LEU to weapons grade.

Concerns About Arak

Iran's progress on construction of a heavy-water reactor at its Arak nuclear facility raises an additional concern. In the future, Iran could use the Arak site to pursue the plutonium route to nuclear weapons, as plutonium can be separated from the spent fuel produced by the reactor and then used as fissile material in weapons. Although Tehran declared to the IAEA that the reactor will not become operational in early 2014 as intended, the agency noted that the reactor vessel is in place and Iran is working on fuel assemblies for the reactor core.

Iran claims that the reactor will be used to produce medical isotopes, but it is ill suited to that purpose and better suited for a nuclear weapons program. Independent experts assess that if the Arak facility functions at optimal capacity, it could be used to produce sufficient plutonium to yield nine kilograms of fissile material annually, after separation, enough for approximately 1.5 nuclear weapons. Yet, Iran does not have a reprocessing facility for separating the plutonium to produce weapons-usable material, having revised its declaration to the IAEA regarding the Arak site in 2004 and eliminated plans for a reprocessing facility at the site. Tehran maintains that it does not intend to build a plant to separate plutonium from the irradiated fuel that the reactor will produce.

A historical dynamic that hangs over Iran's heavy-water reactor plans is Israel's propensity for bombing such facilities in the region before they begin operations. In 2007, Israel bombed the heavy-water reactor that Syria was constructing with help from the North Koreans and destroyed the Osirak reactor in Iraq in 1981.

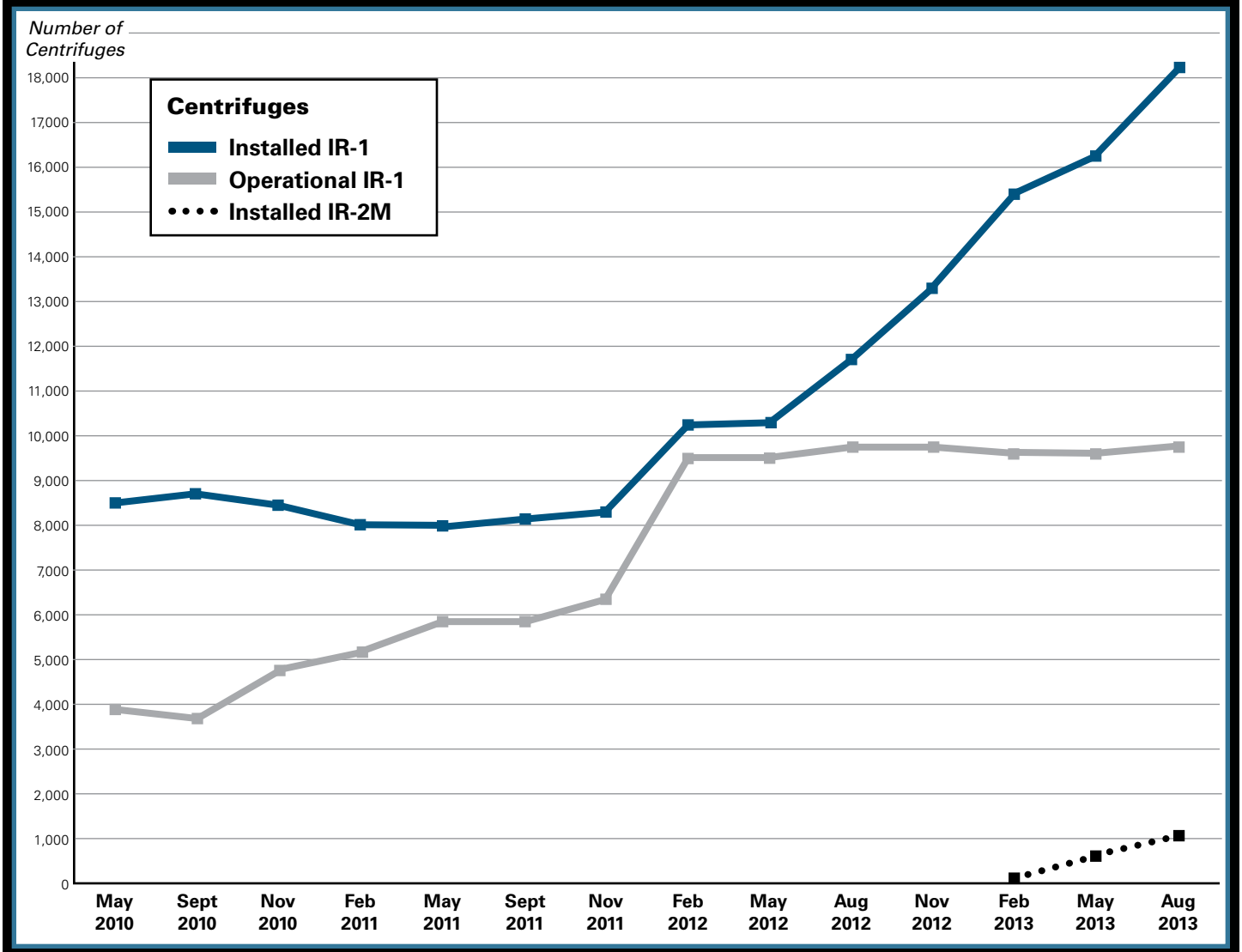
Unlike the Fordow facility, the Arak site is relatively vulnerable, and Israel has the capability to strike it without assistance from the United States. Bombing a nuclear reactor after it becomes operational, however, risks a catastrophic radiation release of Chernobyl-like proportions.

Iran's Nuclear Delivery Vehicles

The U.S. intelligence community has judged repeatedly, most recently in March 2013, that "Iran would likely

Figure 2: Iran's Deployment of Centrifuges

Iran continues to install centrifuges at its Natanz and Fordow uranium enrichment plants. This graph shows the number of centrifuges that Iran has installed and is operating at the two facilities using data from the quarterly IAEA reports on Iran. The numbers do not include advanced centrifuges being tested in the research and development area at Natanz.



choose a ballistic missile as its preferred method of delivering a nuclear weapon, if one is ever fielded."[3]

The most likely present candidate for that delivery vehicle is the single-stage, liquid-fueled Shahab-3 medium-range ballistic missile. A longer-range variant of the Shahab, the Ghadar-1, would also be a candidate carrier, although it would require a more compact warhead because of size and weight constraints. Either system would have the ability to deliver a nuclear-weapon-sized payload from Iran to Israel or other countries in the Middle East. The Shahab-3 is currently deployed in both fixed-site and mobile basing mode. The silo-based missiles would be vulnerable to attack by sophisticated militaries; the Shahab-3 and Ghadar-1 road-mobile missiles would be more difficult to attack pre-emptively, but they are still more vulnerable to attack than solid-fueled, road-mobile missiles would be because of the larger logistic trains and the longer launch preparation time required by liquid fuel systems.

Iran has been developing a two-stage, solid-fueled medium-range ballistic missile, the Sejjil-2, which would be more survivable and have a longer range than the Shahab-3 or Ghader-1. The absence of any flight testing of a Sejjil model since 2011 suggests that Iran has encountered developmental problems with the system, had difficulty obtaining the requisite material, or both.

In order to pose a threat to most NATO European

members or the United States, Iran would have to develop and deploy even longer-range systems. In the 1999 National Intelligence Estimate on foreign ballistic missile threats, all U.S. intelligence agencies but one predicted that Iran would flight-test an intercontinental ballistic missile (ICBM) by 2015; some analysts judged this step was likely before 2010.[4]

As the years have passed, there has been a gradual retreat from that "probable" prediction. In 2009, when the Obama administration decided to deploy the Aegis Standard Missile-3 (SM-3) missile defense system to Europe rather than implement the "third site" Ground-Based Midcourse Defense-based plan of the previous administration, senior officials explained that Iran's long-range ballistic missile capabilities were evolving more slowly than originally anticipated and that Tehran was concentrating instead on improving its medium-range ballistic missile capabilities.

The intelligence community has nonetheless continued to highlight 2015 as the year that an Iranian ICBM could be flight-tested. In April 2010, the Pentagon provided heavily qualified language to the U.S. Congress: "With sufficient foreign assistance, Iran could probably develop and test an intercontinental ballistic missile capable of reaching the United States by 2015." In April 2012, the Department of Defense stated that "Iran may be technically capable of flight-testing an intercontinental ballistic missile by 2015."[5]

In a July 2013 report, the National Air and Space Intelligence Center was still assessing that Iran "could develop and test an ICBM capable of reaching the United States by 2015."[6] Contrary to most of the predictions about milestones leading to the first flight of an Iranian ICBM, there have been no medium- or intermediate-range ballistic missile flight tests by Iran for more than two years and no large space rocket launches ever.

Despite Iran's evident emphasis on developing short- and medium-range weapons, some analysts point to Iran's ambitious space program as a cloaked means of developing ICBMs. They note repeated successful satellite launches by Iran's Safir space launch vehicle and the announcements that multiple additional launches are planned in successive years. Most relevant to Iran's potential for building an ICBM was the appearance of the Samorgh space launch vehicle mockup in February 2010, larger than the Safir and potentially the kind of system that could be converted into a long-range ballistic missile capable of nuclear weapons delivery. Based on the predictions made when the mockup was first displayed, however, the appearance of a working rocket is three years overdue. Recent indications that Iran is building a second space launch or ballistic missile launch site at Shahrud may rejuvenate the case for 2015 as the earliest possible glimpse of an ICBM threat. Yet, it would not erase the consistent historical patterns established by the five states that deploy ICBMs. Space rockets have been made out of ballistic missiles, but ballistic missiles have not been made out of space rockets. Moreover, in every case, ICBMs have become operational only after years of flight testing.

VAHI REZA ALAEE/AFP/Getty Images

This picture, obtained from the Iranian ISNA news agency on December 16, 2009, shows the test-firing at an undisclosed location in Iran of an improved version of the Sejil 2 medium-range missile.

There has been no change in the assertions of Iranian political and military leaders, who deny any intention of or political-military requirement for developing nuclear weapons or long-range missiles. The clerical leadership in Tehran continues to challenge the rationale and morality of nuclear weapons. Although such policy statements are hardly determinative of actual intentions, they stand in stark contrast to the declaratory policies of other governments of proliferation concern, such as North Korea and Pakistan.

Moreover, even as Iran exaggerates or fraudulently represents its capabilities with regard to short- and medium-range missiles, it disavows the need for longer-range systems.

The absence of discernable Iranian activity in pursuing long-range ballistic missiles suggests either that Tehran is not especially interested in fielding an ICBM or that problems with the solid-fueled medium-range ballistic missile program it would use as a stepping-stone has delayed its efforts. It is possible that this pause is a consequence of the November 12, 2011, "accident" at a major missile-testing site near Tehran. The Iranian government acknowledged that the head of Iran's missile program, Gen. Hassan Tehrani Moghaddam, was killed in an explosion at the site. Western sources report that the blast leveled much of the facility.

Whatever the explanation for Iran's quietude on the long-range missile front, the timeline forecast by U.S. security experts for Iran's long-range missile development is clearly slipping. A December 2012 Congressional Research Service report judged it "increasingly uncertain whether Iran will be able to achieve an ICBM capability by 2015," as previously forecast by the intelligence community.[7] Michael Elleman, a missile proliferation expert with the International Institute for Strategic Studies has expressed doubts about whether an operational Iranian ICBM is even likely within the current decade. Elleman does not rule out a flight test of such a system before 2020, but notes that such a test would provide a three- to five-year warning of Iran developing a military capacity to field an ICBM.[8]

Conclusion

Iran has achieved the status of a nuclear weapons-capable country at high cost to its economic health and military prowess. Unless it can convince the international community that it does not intend to build nuclear weapons and could not do so quickly, it can anticipate increasingly serious economic problems, political isolation, and possibly war.

In spite of its achievements and potential, Iran is still far from having a credible nuclear arsenal. Although Tehran is unlikely to accept dismantlement of its nuclear program and facilities, it may be willing to accept enhancements to the IAEA inspection regime such as adoption of the Additional Protocol to the underlying safeguards agreement, as well as agreements to tie the production of power reactor fuel to the country's needs for that fuel. The Rouhani government appears to be sending signals that it will be receptive to this pragmatic approach. If the P5+1 does not let the perfect become the enemy of the good when negotiations resume, the parties may finally find the path to resolving the Iranian nuclear crisis.

ENDNOTES

1. "Iran 'Zone of Immunity' Resonating With World," The Jerusalem Post, March 19, 2012.

2. For example, see Paul Pillar, "We Can Live With a Nuclear Iran," Washington Monthly, March/April 2012.

3. James R. Clapper, "Statement for the Record: Worldwide Threat Assessment of the U.S. Intelligence Community," March 12, 2013, http://intelligence.senate.gov/130312/clapper.pdf (before the Senate Select Committee on Intelligence).

4. Senate Committee on Foreign Relations, Ballistic Missiles: Threat and Response, 106th Cong., 1st sess., 1999 (statement of Robert D. Walpole).

5. Department of Defense, "Annual Report on Military Power of Iran," April 2012.

6. National Air and Space Intelligence Center, "Ballistic & Cruise Missile Threat," July 2013.

7. Steven A. Hildreth, "Iran's Ballistic Missile and Space Launch Programs," Congressional Research Service Report for Congress, December 6, 2012.

8. Michael Elleman, e-mail communication with author, January 22, 2013.

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