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Digital Globe - ISIS

PREVENTING IRAN FROM GETTING NUCLEAR WEAPONS: CONSTRAINING ITS FUTURE NUCLEAR OPTIONS

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SUMMARY

Without past negotiated outcomes, international pressure, sanctions, and intelligence operations, Iran would likely have nuclear weapons by now. Iran has proven vulnerable to international pressure. It now faces several inhibitions against building nuclear weapons, not least of which is fear of a military strike by Israel and perhaps others if it "breaks out" by egregiously violating its commitments under the Nuclear Non-Proliferation Treaty (NPT) and moves to produce highly enriched uranium (HEU) for nuclear weapons.

However, threats of pre-emptive military strikes alone have been unproductive in extending this inhibition against building nuclear weapons. Instead, these threats have led Iran to better protect its nuclear facilities and activities and allowed it to make false comparisons to the case of Iraq, undermining support in much of the world for increasing pressure internationally out of fear that pressure would lead to a preventive attack.

Iran is already capable of making weapon-grade uranium and a crude nuclear explosive device. Nonetheless, Iran is unlikely to break out in 2012, in large part because it will remain deterred from doing so and limited in its options for quickly making enough weapon-grade uranium. Iran continues to be subject to a complex set of international actions that constrain its nuclear options.

Faced with the difficulties and risks of military options and the marginal benefits of negotiations during the last several years, an alternative third option, born out of frustration and slow, patient work, has developed. It builds on United Nations Security Council (UNSC) resolutions that delegitimize certain aspects of Iran's nuclear programs. However, it goes beyond these efforts by increasing the chance of detecting secret nuclear activities and heightening barriers against Iran achieving its nuclear objectives. Its goal is to create and implement

measures to delay, thwart, and deter Iran's acquisition of nuclear capabilities. This strategy is having some significant successes, including delaying Iran's ability to make nuclear weapons and creating significant deterrence against it building nuclear weapons today. Absent a meaningful negotiated settlement, which remains the best way to resolve the nuclear crisis with Iran, its longer-term prognosis is difficult to predict without broader application.

These methods help explain Iran's delayed progress in developing its nuclear weapons capabilities. However, they have not completely stopped Iran from making progress toward that goal. Iran continues to make both 3.5 and 19.75 percent low enriched uranium (LEU) and it has tripled its rate of 19.75 percent LEU production with the installation of IR-1 centrifuges at the subterranean Fordow enrichment site. Enrichment at this site started in late 2011.

This project has examined a wide range of future options that Iran may use during the next several years to build nuclear weapons (see table 2). The four that emerged as showing the highest probability of occurring in the period from now through 2015 are:

- Dash at a Declared Enrichment Site
- Dash at a Covert Enrichment Site
- Cheating in Plain Sight
- A Parallel Program

In all cases ISIS evaluated, each potential nuclear future is not inevitable. International actions may delay or prevent them. Iran may decide that the potential costs are too high and may choose not to pursue any of them. Despite the existing constraints, however, Iran may decide that at some point obtaining nuclear weapons is worth the risks.

In 2012, the probability of any of the scenarios occurring is judged to be low. This can be interpreted to mean that Iran is currently in a poor position to build nuclear weapons covertly and is thus unlikely to attempt to do so this year. In 2013 and onward, the probabilities of the four futures mentioned above occurring begin to increase toward a medium likelihood (see table 3).

Iran is unlikely to break out in 2012, in large part because it will remain deterred from doing so and limited in its options for quickly making enough weapon-grade uranium.

None of the probabilities of the nuclear futures evaluated by ISIS is judged as being high; many remain low. These judgments reflect technical challenges Iran will face, international actions that will continue to constrain particular nuclear futures, and the extent of pressure on Iran today and that is expected to be applied in the future to deter Iran from building nuclear weapons.

However, low-probability events should not be interpreted in the context of this study as not meriting concern. The assigned probabilities during the next several years provide no reason for complacency. Given the consequences of a nuclear armed Iran, even options with low probabilities of occurring require action designed to keep them low. Similarly, since an Iran with nuclear weapons would be a high impact event, futures with a low probability, or those that are unlikely to occur, are still highly important and could have a severe impact. Thus, working to lower their probability of occurrence is important, as is developing contingency plans in case they do occur. In this report, the medium probability futures are the top priorities, and they require extra effort to reduce their likelihood of occurring.

According to this analysis, the options that Iran would tend to favor involve developing and deploying advanced centrifuges, making IR-1 centrifuges in lieu of advanced ones, continuing to find ways to produce higher enriched uranium in greater quantities under a civilian cover, building

confidence in an ability to build covert sites, evading answering the IAEA's questions about past nuclear weaponization activities, and better protecting nuclear sites against military strikes. The task is to prevent Iran from succeeding by lowering the probabilities that Iran could achieve any of these nuclear futures while keeping it within the constraints of the NPT.

This report shows that Iran's capability to build nuclear weapons is constrained. However, this capability nevertheless increases with time, and Iran could develop more options to acquire nuclear weapons in the coming years unless it is further constrained or the probabilities of these futures occurring are lowered further. Additional constraints can emerge through negotiations, but these are more likely if a range of methods are utilized along the way to slow Iran's progress.

Any pragmatic future strategy must inhibit Iran's nuclear progress and pressure it into changing course while offering it an alternative, more prosperous pathway forward. But as we seek and engage in negotiations for a long-term solution, the key goal must be, at the same time, to implement additional measures to delay, thwart, and deter Iran's acquisition of nuclear capabilities and inhibit its ability to break out. In particular, such a strategy should focus on several key priorities:

- More effective legal mechanisms to stop Iran from acquiring key goods for its nuclear programs. A priority is China's domestic enforcement of sanctions and trade controls; Better detection of Iran's illicit procurement efforts and broader enforcement of legal mechanisms worldwide;
- Increased efforts in countries of transit concern to prevent Iran from transshipping banned goods; Stepped up operations to detect clandestine Iranian nuclear activities, including heightened intelligence operations inside Iran aimed at detecting secret nuclear sites and activities and encouraging defections of nuclear program "insiders";
- Covert action to slow Iran's nuclear program, particularly if the conflict transforms into a protracted Cold War style stand-off between Iran and several members of the international community; and,
- Increased economic and financial sanctions aimed at augmenting pressure, combined with an effort to displace Iranian oil exports.
- A parallel strategy alongside pressure is to seek interim negotiated constraints on Iran's nuclear program that serve to reduce concerns about an Iranian breakout or dash to the bomb. Iran can receive tangible benefits in return for reducing its options to build nuclear weapons quickly and in secret. All sides could build valuable trust, something currently in short supply.

Table 4 evaluates a set of interim measures. The measures are ranked on their ability on an interim basis to inhibit breakout to weapons, improve detection of secret nuclear activities and sites, and prevent further development, diffusion, and protection of centrifuge assets. The table shows that none of the measures are effective at accomplishing all three goals. As these are interim measures, the negotiators should focus on the strategies that impact Iran's ability to break out in the short term, deploy advanced centrifuges, and to diffuse and better protect its centrifuge assets. The priority measures based on the ranking in Table 4 are:

- Cap all enrichment at the level of five percent;
- Freeze centrifuge installation at Qom (limit of four IR-1 centrifuge cascades);

- Limit the number of advanced centrifuges enriching uranium to fewer than 500 and limit deployment exclusively to the Natanz Pilot Fuel Enrichment Plant (PFEP); and
- Deposit all 19.75 percent LEU overseas.

Based on the public discussion, the following summarizes the most commonly discussed incentives in the context of an interim agreement:

- Provision of 19.75 percent LEU fuel for the Tehran Research Reactor (TRR), starting within one year of date of agreement;
- Provision of LEU targets for medical isotope production;
- Provision of medical isotopes of the type that the TRR would produce; and
- Commitment by P5+1 not to seek new U.N. Security Council sanctions for a defined period of time, contingent on implementation of agreement.

At the same time, the United States and its allies should reject any Iranian effort to trade interim measures for a reduction in sanctions or commitments not to add national or regional sanctions. In addition, Iran sought in an agreement negotiated by Turkey, Brazil, and Iran to establish an essentially unbridled right to uranium enrichment. But the P5+1 is unlikely to acknowledge Iran's right to uranium enrichment under the Nuclear Non- Proliferation Treaty without a verified assurance that it is in compliance with this treaty, something lacking today. Iran needs to first satisfy the many concerns raised on an on- going basis by the IAEA about Iran's nuclear efforts.

Significant sanctions relief and how to ensure Iran is in compliance with the NPT are the proper subject of long-term negotiations.

The best remedy is a negotiated long-term resolution of the nuclear issues. Although Iran remains difficult to engage in a comprehensive negotiated solution, the shape of a future solution to the Iranian nuclear crisis is important to consider now. Several earlier attempts to engage Iran in a long-term solution have laid the basis for an acceptable outcome including illuminating creative diplomatic methods of achieving a compromise. The first was the "freeze for freeze" proposal, whereby Iran would have agreed to a suspension of its enrichment program in return for a freeze in additional U.N. sanctions. More recently, Russia proposed a step-wise resolution to the issue, although it did not release its proposal publicly.

These earlier efforts have created a sound foundation to b
uild on. One lesson is that because the situation is so complicated, the negotiating goal should be a framework agreement that can incorporate a series of stages where each step includes concessions by Iran matched with incentives or concessions by the P5+1. (The P5+1 is the main negotiating partner of Iran composed of the five permanent members of the Security Council plus Germany.)

This report discusses the essential elements of such an agreement. Table 5 in the report lists ISIS's rough proposal for a five-stage framework agreement with Iran. The five stages in brief are:

1. Updated, verified "freeze for freeze" agreement.
2. Iran coming clean in a verifiable manner about its past and possible ongoing nuclear weaponization activities and accomplishments and receiving significant sanctions relief.

3. Intensive International Atomic Energy Agency (IAEA) verification, temporary suspension of sensitive Iranian nuclear programs, and provisional suspension of U.N. Security Council sanctions.
4. IAEA certification of absence of undeclared nuclear activities, resumption of Iran's nuclear program, provision of major incentives package, and end of U.S. sanctions.
5. Growth of Iran's civil nuclear program and end of all remaining sanctions.

Absent a negotiated outcome, the international community must be prepared to signal for years if necessary that an Iran that seeks nuclear weapons will never be integrated. It must not acquiesce to Iran's current trajectory or give up on sanctions and other measures while accepting the current level of ambiguity over Iran's nuclear weapons aspirations. Ultimately, a negotiated solution remains the best way to resolve the nuclear crisis with Iran, and increased pressure offers the best hope of convincing Iran to undertake successful negotiations.

This report builds on a series of ISIS reports, research, and workshops during the last year. Background information and reports are available on the ISIS web site at http://www.isis-online.org.

INTRODUCTION

One of the most difficult and politically divisive issues facing the United States is how to prevent Iran from getting nuclear weapons. A nuclear-armed Iran would spur proliferation in the region, increase regional instability, and increase the chance of nuclear war.

With presidential elections and domestic issues increasingly dominating both Iran and the United States, resolving this issue peacefully is complicated yet imperative to international security. President Barack Obama has said, "There should be no doubt, the United States and the international community are determined to prevent Iran from acquiring nuclear weapons."[1] The United States and its allies are dramatically increasing pressure on Iran through sanctions and economic isolation with the aim of encouraging Iran to negotiate in a meaningful way. New negotiations could start in 2012, although their chance of success is difficult to predict. Meanwhile, extraordinary efforts to constrain Iran's nuclear efforts are occurring and could expand.

An increase in pressure on Iran followed a recent International Atomic Energy Agency (IAEA) action. For the first time publicly, the IAEA laid out in its November 2011 safeguards report on Iran a strong case for past and possibly on-going Iranian work on nuclear weaponization, the part of nuclear weapons development focused on building a deliverable device.[2] The IAEA's data indicates that Iran has carried out activities that are "relevant to the development of a nuclear explosive device." The report additionally states "that prior to the end of 2003, these activities took place under a structured program, and that some activities may still be ongoing."

An internal 2009 IAEA report, released by ISIS, contains conclusions about the information in the November report.[3] In this 2009 report, the IAEA stated that it "assesses that Iran has sufficient information to be able to design and produce a workable implosion nuclear device based upon [highly enriched uranium] HEU as the fission fuel." However, it also concluded that Iran had not yet achieved the "means of integrating a nuclear payload into the Shahab 3 missile with any confidence that it would work," adding that, with "further effort it is likely that Iran will overcome problems and confidence will be built up."

The IAEA findings have served to highlight what many chose to ignore, namely that Iran is far along in its pursuit of a strategy of "nuclear hedging," or developing the capability to rapidly build nuclear weapons under the cover of a civilian nuclear program. The intent of such hedging is very different than the latent nuclear weapons capabilities possessed by states such as Japan or Germany and is inimical to the objectives of the Nuclear Non-Proliferation Treaty (NPT).[4] The IAEA report has shown that even in the short run, the seriousness of Iranian nuclear situation should not be downplayed. The problem could grow graver if Iran's ability to quickly build nuclear weapons increases during the next few years. Pre-emptive or preventive military options to end Iran's nuclear program are often offered as the best alternative to negotiations but appear unlikely to succeed. Despite the current political dialogue in Israel and the United States about a growing urgency to strike Iran, short of full-scale war or occupation,

[1] "Barack Obama Signs New Sanctions against Iran into Law," BBC News. July 1, 2010.
[2] IAEA Director General, *Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions in the Islamic Republic of Iran*, GOV/2011/65, November 8, 2011. Weaponization is a technical process focused on building the components of the nuclear weapon itself. Another key part, which is the most difficult stage to achieve in any Iranian nuclear weapons effort, aims at making nuclear explosive material, such as highly enriched uranium or separated plutonium. Another fundamental part of acquiring a nuclear weapons arsenal is developing delivery systems such as ballistic missiles.
[3] "Excerpts from Internal IAEA Document on Alleged Iranian Nuclear Weaponization" (Washington, D.C.: Institute for Science and International Security, October 2, 2009). Available at: http://isis-online.org/uploads/isis-reports/documents/IAEA_info_30October2009.pdf.
[4] John Carlson, "Iran Nuclear Issue—Considerations for a Negotiated Outcome" (Washington, D.C.: Institute for Science and International Security, November 4, 2011.)

most military options are oversold as to their ability to end or even significantly delay Iran's nuclear program. Few Western publics would support another war of a larger scale with a front still open in Afghanistan and the fraught U.S. occupation of Iraq just ending, and especially given the urgency of domestic economic priorities. Military means also remain highly risky and could even be counterproductive. Limited bombing campaigns are unlikely to destroy Iran's main capability to produce weapon-grade uranium for nuclear weapons using its gas centrifuge program. Iran has dispersed its centrifuge program across many facilities, several whose locations remain secret. More importantly, Iran has mastered the construction of centrifuges and has likely even secretly stockpiled an unknown number of centrifuges, despite problems in their operation and limits to Iran's supply of raw materials. An ineffective bombing campaign that does not eliminate these capabilities would leave Iran able to quickly rebuild its program and would motivate it to launch its own Manhattan Project, resulting in a Middle East region that is far more dangerous and unstable.

Faced with the difficulties and risks of military options and the marginal benefits of negotiations during the last several years, an alternative third option, born out of frustration and slow, patient work, has developed. It builds on United Nations Security Council (UNSC) resolutions that delegitimize certain aspects of Iran's nuclear programs. However, it goes beyond these efforts by increasing the chance of detecting Iran's secret nuclear activities and heightening barriers against Iran achieving its nuclear objectives. Its goal is to create and implement measures to delay, thwart, and deter Iran's acquisition of nuclear capabilities. This strategy is having some significant successes, including delaying Iran's ability to make nuclear weapons and creating significant deterrence against Iran building nuclear weapons today. Absent a meaningful negotiated settlement, its longer-term prognosis is difficult to predict without its broader application.

These methods complement in large part the extensive and growing international economic and financial sanctions on Iran. A recent focus is on a growing multilateral effort to target Iran's central bank and its oil exports. According to Ambassador Susan E. Rice, U.S. Permanent Representative to the United Nations, "Sanctions are only a means to an end. Our ultimate goal is to ensure that Iran enters into full compliance with all its international nuclear obligations and takes the steps necessary to resolve outstanding questions."[5] The recent sharp increase in sanctions aims to convince Iran to make concessions in negotiations. If negotiations occur, there are many useful proposals to create an effective long-term solution and implement interim negotiated constraints on Iran's nuclear program that would limit its ability to break out and build nuclear weapons. But political will and willingness to compromise remain necessary on both sides. A negotiated solution remains the best way to resolve the nuclear crisis with Iran, and increased sanctions offer the best hope of convincing Iran to undertake successful negotiations.

Avoiding the use of military options requires more effort, since negotiations may take time to produce a meaningful result. In the absence of progress in negotiations, the November 2011 IAEA report on Iran confirms that time is of the essence in slowing Iran's nuclear programs. The international community should therefore not wait to implement innovative methods and measures that build upon existing efforts to delay, thwart, and deter Iran's nuclear capabilities. Moreover, these methods, including sanctions, should not be sacrificed for anything but a long-term, mutually acceptable solution to the Iranian nuclear issue. As Ambassador Rice iterated, "In the face of Iran's deception and intransigence, the international community must speak with one voice, making clear that Iranian actions jeopardize international peace and security and will only further isolate the regime."[6]

[5] Remarks by Ambassador Susan E. Rice, U.S. Permanent Representative to the United Nations, at a Security Council Briefing on Iran and Resolution 1737, USUN PRESS RELEASE #320, December 21, 2011.

[6] Ibid.

Current Iranian Nuclear Weapons Capabilities

Although Iran is engaged in nuclear hedging, no evidence has emerged that the regime has decided to take the final step and build nuclear weapons. Such a decision may be unlikely to occur until Iran is first able to augment its enrichment capability to a point where it would have the ability to make weapon-grade uranium quickly and secretly. Its efforts to master uranium enrichment have gone slower than it likely expected, and international pressure that delayed its progress has been greater than anticipated.

If Iran wanted to build nuclear weapons today, it could build a nuclear device suitable for underground detonation or crude delivery in about one year. The weapon-grade uranium it requires would be derived from its gas centrifuge program, which is Iran's most advanced nuclear program capable of making nuclear explosive materials.

As mentioned above, the IAEA has concluded that Iran has the know-how to build a crude nuclear explosive device that it could detonate underground or deliver by aircraft or ship.[7] It would take Iran longer to build a deliverable warhead for its Shahab 3 or Sajiil 2 ballistic missiles because Iran is believed to still require more time to master the construction of a reliable, miniaturized warhead for these missiles.[8]

Breakout in 2012 Unlikely

Even as such, Iran is unlikely to break out in 2012, in great part because it is deterred from doing so. Iran is subject to a complex set of international pressures that constrain its nuclear options, particularly its ability to make weapon-grade uranium. Despite the November 2011 IAEA safeguard report's evidence that Iran has accomplished significant progress on nuclear weaponization, Iran's essential challenge remains developing a secure capability to make enough weapon-grade uranium, likely for at least several nuclear weapons.

Presently, Iran's most significant capability to produce sufficient weapon-grade uranium for a bomb resides at the Natanz underground Fuel Enrichment Plant (FEP), which, as of the last IAEA report, contains almost 9,000 enriching gas centrifuge machines. Iran is now capable of using the FEP to conduct a "dash" to the bomb using safeguarded low enriched uranium (LEU) to produce weapon-grade uranium. Iran is producing 3.5 percent LEU hexafluoride at a rate of about 150-170 kilograms per month and has produced about 5.5 tonnes of 3.5 percent LEU hexafluoride, enough to make over four nuclear weapons if further enriched to weapon-grade. Iran continues to produce 19.75 percent LEU at the Pilot Fuel Enrichment Plant (PFEP) at Natanz. It has recently started making 19.75 percent LEU at the Fordow plant, at a rate of more than double the rate of production at the PFEP. As of February 2012, it has produced about 110 kilograms of 19.75 percent LEU hexafluoride (see figures 1, 2, and 3). Iran has used a very small portion of this stockpile to make test fuel elements for the Tehran Research Reactor (TRR). The net amount of 19.75 percent LEU hexafluoride is still far short of enough for a nuclear weapon, if further enriched to weapon-grade, but the existing 19.75 percent LEU would allow for a quicker dash. Its efforts to test two production-scale cascades at the PFEP have gone slower than expected.

Because of several constraints, Iran is unlikely to undertake a dash to the bomb using safeguarded LEU located at the Natanz facilities. In order to conduct a dash using LEU at Natanz, Iran would need to

[7] "Excerpts from Internal IAEA Document on Alleged Iranian Nuclear Weaponization," op.cit. Available at: http://www.isis-online.org/uploads/isis-reports/documents/IAEA_info_30october2009.pdf.
[8] Ibid.

Figure 1: Cumulative 3.5 percent Low-Enriched Uranium (LEU) Production at the Natanz Fuel Enrichment Plant (FEP)

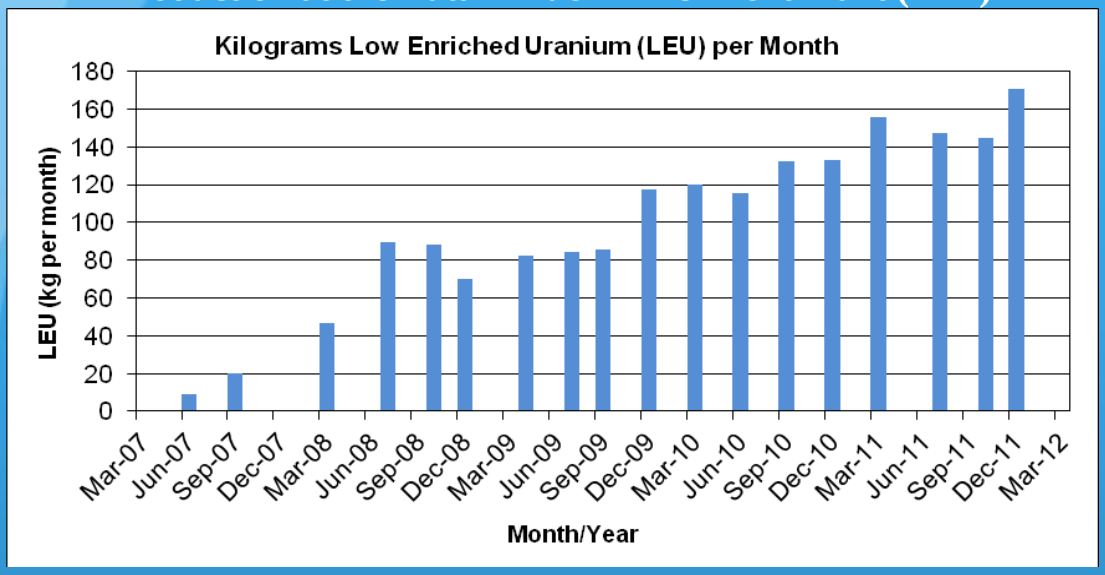


Figure 2: Snapshot of Iranian 3.5 and 19.75 Percent Enrichment Efforts

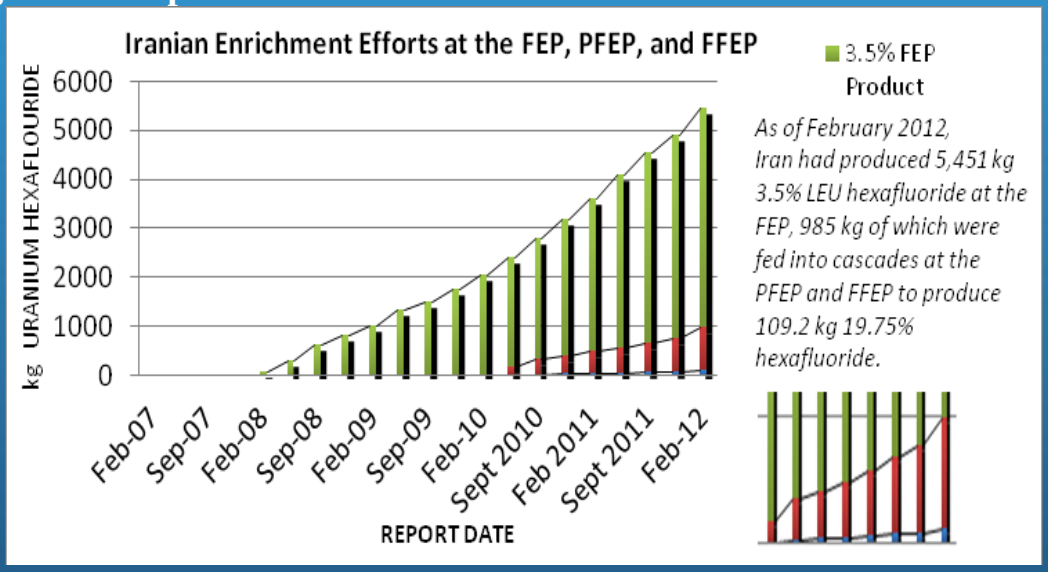
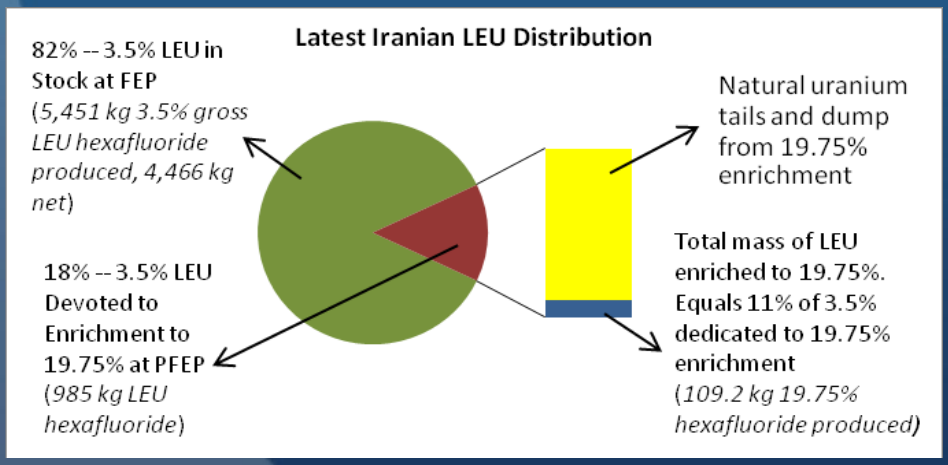


Figure 3: Allocation of Iranian 3.5 Percent LEU and 19.75 Percent Product



brazenly and visibly violate its commitments under the NPT, including diverting the LEU from IAEA safeguards and likely ejecting IAEA inspectors from the country. Although only minor modifications are necessary in the Natanz FEP infrastructure before Iran could start to enrich to weapon-grade levels, any dash using the FEP would not proceed quickly. Based on ISIS's most recent calculations, reflecting reduced performance of the centrifuges in the FEP over the last year, but more enriching centrifuges, Iran would need about four months to produce enough weapon-grade uranium for just one bomb. And in undertaking such a risky effort in which its facilities could be destroyed by military strikes, Iran would likely want to be able to produce enough weapon-grade uranium to make several weapons.[9]

Four months would provide more than enough time for the international community to impose draconian international sanctions on Iran. Despite the FEP being located underground, Iran would likely fear that one or more countries would conduct military strikes to destroy this facility, long before it could produce enough weapon-grade uranium for even a single bomb. It goes without saying that Iran takes seriously Israeli threats of military strikes. Although military options suffer from serious weaknesses, Iran may pause before inviting them by dashing to weapon-grade uranium at Natanz in blatant violation of the NPT.

Iran would also need to worry that the international community's willingness to support military strikes in response to a breakout to nuclear weapons could be far different than the lack of support for pre-emptive or preventive military strikes against its nuclear facilities. Although Iran could likely reconstitute its centrifuge program within a few years, it would undoubtedly continue to face a more hostile international environment if it decided to do so in continued violation of the NPT. These factors likely deter Iran from breaking out today. Other factors have slowed its progress on increasing its nuclear weapons capabilities.

Current Constraints on Iran's Nuclear Progress

Iran could have developed its centrifuge and other nuclear capabilities much further than it has by now. Given the status of its nuclear program in 2002, when the then-secret Natanz centrifuge enrichment site was publicly revealed, Iran could have already produced nuclear weapons by now. Of course, its nuclear programs' technical shortcomings are well documented in IAEA safeguards reports and ISIS analyses. The suspension in Iran's program from 2003-2006 negotiated by Britain, France, and Germany also contributed importantly to the delay in Iran's nuclear programs. But these self-inflicted problems and the suspension do not fully explain why despite enormous expenditures and decades of effort, Iran's centrifuge program continues to face significant delays. Ten years after construction started at Natanz, Iran has installed fewer than 20 percent of the 50,000 centrifuges planned for this facility, and the bulk of these machines continue to operate poorly (see figure 4).

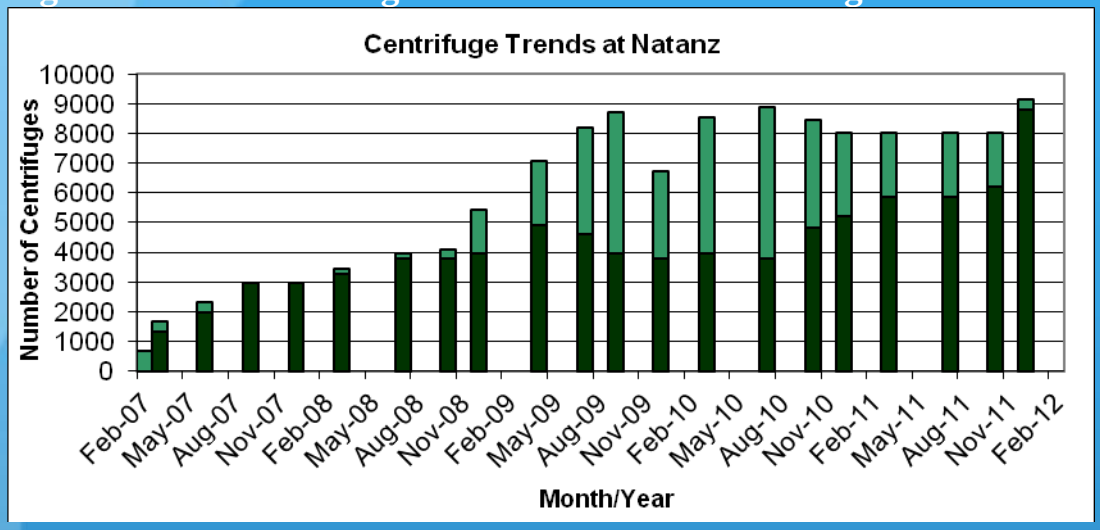
As mentioned earlier, one of the remarkable successes of the effort to prevent Iran from getting nuclear weapons is the collection of measures to delay, thwart, and deter Iran's acquisition of a nuclear weapons capability that are in line with United Nations Security Council resolutions calling on Iran to suspend its uranium enrichment program and agree to more international transparency of its nuclear activities. Granted, these measures have not led Iran to submit to the Security Council's requests, but for several years they essentially achieved a freeze in the total number of centrifuges Iran installed and complicated its efforts to build and deploy more advanced centrifuges. As a result, Iran's future nuclear options are more limited now than just a few years ago. Its programs are better understood by the international community and are more vulnerable to disruption and delay.

These sets of actions build upon the fact that Iran has faced serious domestic technical hurdles in its

[9] This estimate is a shorter breakout time than the one in an earlier draft of this report. It reflects the 9,000 IR-1 centrifuges now enriching at the FEP. Theoretically, this estimate could be shorter, but the on-going performance problems in FEP cascades and limitations imposed by the design of the facility lead to a longer breakout time than theoretically possible.

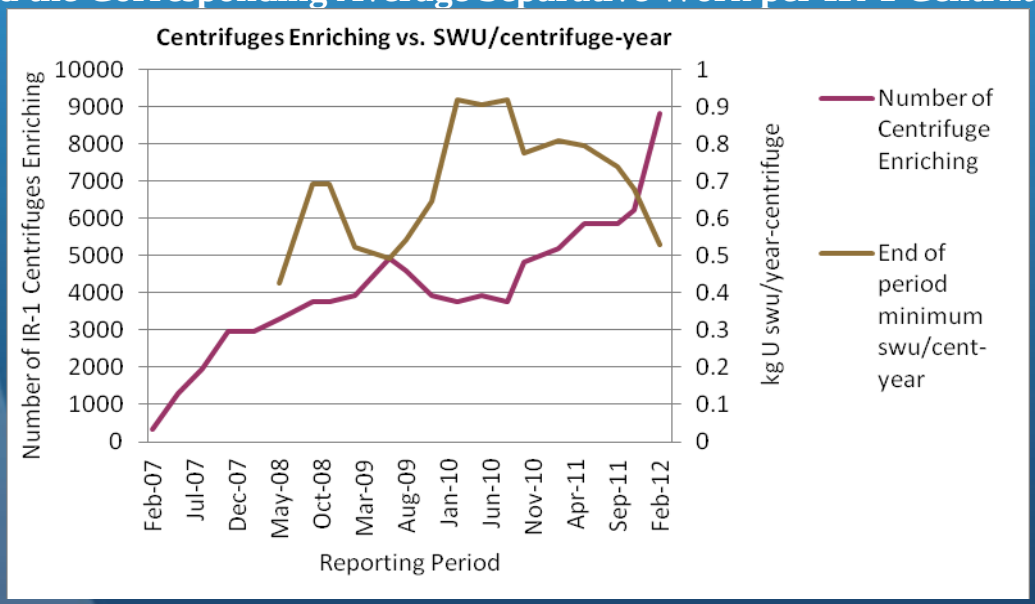
efforts to create a capability to quickly make nuclear explosive materials and a deliverable nuclear weapon. A major challenge for Iran is its difficulty in finding outside assistance in overcoming bottlenecks in its efforts. It is by no means self-sufficient in making all the goods it needs for its nuclear programs nor is it able to solve problems encountered in its deployment of nuclear technologies. In 2011, its centrifuges at the FEP performed worse than during the previous year. While Iran managed to increase its monthly output of low-enriched uranium during this time, the number of centrifuges needed to produce this product increased disproportionately compared to the previous year. Figure 5 shows how the average enrichment capability of the IR-1 centrifuges in the FEP has decreased in 2011.

Figure 4: IR-1 Centrifuges Installed and/or Enriching at the Natanz FEP



The height of the bar represents the total number of installed centrifuges and the dark green portion represents those centrifuges enriching uranium.

Figure 5: Number of Centrifuges Installed at the Natanz Fuel Enrichment Plant and the Corresponding Average Separative Work per IR-1 Centrifuge



The separative work of an IR-1 centrifuge is measured in separative work units (swu) per year. The IR-1's average separative work at the Fuel Enrichment Plant, tabulated from IAEA data and explained in ISIS reports, shows that while the number of enriching centrifuges increased (red line, its vertical scale is on the left side of the graph), the enrichment output per centrifuge in terms swu/cent-year (green line; right vertical scale) decreased during 2011. So, although Iran's production of 3.5 percent LEU has stayed roughly the same, Iran needed more IR-1 centrifuges to produce this LEU.

Iran is currently facing many obstacles as it seeks vital goods abroad for its nuclear programs. U.N. Security Council sanctions along with domestic and regional sanctions have complicated its smuggling operations. Sanctions laws are now more standard and universal; they are being better implemented and enforced. Countries are having more success at interdicting illegal shipments to Iran. Supplier companies and governments also cooperate more effectively in thwarting Iran's illegal smuggling efforts. The United States is effectively using sting operations against Iran's smuggling networks and many countries have on-going intelligence operations to detect and disrupt its illicit procurement attempts.

There remain significant gaps, notably, the weak implementation of U.N. Security Council sanctions by China. China remains vulnerable to Iran's smuggling of vital goods for its nuclear program. Smugglers use front companies to buy from Chinese suppliers or Western high technology subsidiaries located within its borders. There remain many concerns about Iran's continued ability to transship goods through countries with weak implementation of sanctions or trade controls, commonly called countries of "transit concern."

Nonetheless, many countries that make the goods Iran needs to build and expand its nuclear facilities are now far more united in implementing U.N. Security Council bans on supplying Iran's nuclear programs.[10] Iran's centrifuge program depends on high-tech imports, including high quality maraging steel (grade 300 or 350), high quality carbon fiber, vacuum pumps, and vacuum measuring equipment. But these goods are no longer easy for Iran's smuggling networks to obtain.

As a result, Iran has faced a shortage of the raw materials it needs to build significantly more of its current generation of IR-1 centrifuges at its enrichment sites. The IAEA reported in its February 2012 Iran safeguards report that Iran had recently placed 6,177 empty IR-1 outer casings at the FEP and 2,088 empty IR-1 outer casings at the Fordow enrichment site. Outer casings are relatively easy to manufacture and installation is just a matter of bolting them to the floor, explaining how Iran could have installed such a quantity within a few weeks. But their installation normally would imply that Iran is getting ready to install the sensitive and difficult to make rotor assemblies. One of the key raw materials in short supply for the IR-1 centrifuge is maraging steel (grade 300). It is used to make the sensitive, thin-walled bellows, three of which are used in each rotor assembly. The current question is whether Iran can actually build over 8,000 more rotor assemblies. Did Iran obtain more maraging steel through smuggling or did it create its own indigenous capability to make high quality maraging steel? Or is Iran bluffing, unable to build this many centrifuge rotor assemblies? Is it asserting a new threshold under which it will not go?

Iran is also focusing its efforts on building advanced centrifuges that are expected to perform far better than the IR-1 centrifuges currently deployed at the Natanz FEP. But Iran's efforts to manufacture these advanced centrifuges likewise face shortages of vital raw materials. In the case of the bellows of one advanced centrifuge design, Iran has sought to substitute carbon fiber for maraging steel, a raw material found in current Iranian centrifuges but one that has become difficult to acquire internationally. Iran likely believes it has a better chance of obtaining adequate carbon fiber abroad. But carbon fiber is also increasingly more difficult for Iran to acquire internationally due to trade controls and sanctions; its recently announced domestic efforts to make carbon fiber are not likely to yield a fiber adequate for use in centrifuges any time soon. Moreover, Iran's attempt to use different materials for components of its advanced centrifuges, for example, carbon fiber bellows and high strength aluminum instead of maraging steel end caps, could be risky and have unintended consequences, such as increased rates of machine failure. Sanctions are forcing Iran to make less than desirable design choices and these choices further slow its progress and increase the technological risks that complicate any Iranian decision to dash to the bomb.

[10] The U.N. Security Council resolutions on Iran exempt the Bushehr nuclear power reactor from this ban.

Iran's efforts to build covert nuclear sites, which it could operate out of sight of IAEA inspectors, have time and again failed either through good IAEA detective work or Western intelligence agency discoveries. The most recent case is the confirmation by Western intelligence in mid-2009 that Iran was building a clandestine centrifuge plant near the city of Qom. Senior officials close to the IAEA suspect that this enrichment site was intended to be part of a parallel, secret program to produce weapon-grade uranium under the control of the Iranian military. That facility, now called the Fordow Fuel Enrichment Plant (FFEP), is currently under IAEA safeguards, and Iran declared that it is dedicated to the production of 3.5 percent and 19.75 percent uranium. The November 2011 IAEA safeguards report on Iran contains numerous other examples of secret military related nuclear activities and facilities in Iran discovered by about ten IAEA member states, including the United States, Britain, France, Germany, and Israel.

In order to deter Iran from constructing covert nuclear sites, intelligence options aimed at their detection remain vitally important. Known methods used by intelligence agencies include human spying, cyber snooping, aerial surveillance, and bugging of equipment procured by Iran overseas. Intelligence agencies are also encouraging more defectors from the nuclear program with some notable successes.

As a result, Iran must be increasingly anxious that its nuclear program is highly penetrated by foreign intelligence agencies. It may hesitate in making decisions to construct parallel, clandestine facilities to make weapon-grade uranium; currently, there is no evidence of a secret enrichment site able to produce weapon-grade uranium. The 2009/2010 cyber attack by the Stuxnet malware on the Natanz enrichment plant likely worsened Iran's paranoia. Whichever nation launched that attack had a surprising amount of confidential detail about operations at the facility - far more inside information than could be acquired from IAEA reporting. Intelligence agencies needed to penetrate both the inner workings of that plant and a collection of Iranian companies, which illicitly obtained Siemens computer control equipment and software and prepared it for delivery to the centrifuge program, leading to the Stuxnet attack. Moreover, Stuxnet also functioned to gather information about operations at Iran's centrifuge sites and broadcast them through the Internet to command and control servers located outside Iran.

Stuxnet is an example of a covert effort that seeks to actively damage Iranian nuclear equipment subject to U.N. Security Council resolutions. It destroyed at least 1,000 IR-1 centrifuges at the Natanz Fuel Enrichment Plant and set the program back by about a year. It may have caused lingering effects that contribute to centrifuge problems at the Natanz plant today. Despite their controversy, more cyber attacks may yet occur. A Stuxnet 2.0 or 3.0 may sorely test Iran's claim that it improved its cyber security and its ability to significantly mitigate the effects of another cyber attack on the centrifuges at Natanz.

The discovery in the fall of 2011 of the "Duqu" malware heightened expectations of additional attacks. This malware, according to the computer security firm Symantec, which analyzed the code, has nearly identical components to the original Stuxnet malware and appears to be the precursor to a future Stuxnet-like attack. Symantec found that "Duqu's purpose is to gather intelligence data and assets from entities, such as industrial control system manufacturers, in order to more easily conduct a future attack against another third party. The attackers are looking for information such as design documents that could help them mount a future attack on an industrial control facility."[11] Despite the downsides and risks associated with cyber attacks against Iranian nuclear facilities, the tactic is becoming more widely accepted as a means to slow down Iran's nuclear progress and stymie programs which violate UNSC resolutions, particularly the uranium enrichment program.

[11] Symantec, *W32. Duqu: The Precursor to the Next Stuxnet*, Version 1.4, November 23, 2011. Available at: http://www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/w32_duqu_the_precursor_to_the_next_stuxnet_research.pdf

Broader sabotage of Iran's imported equipment is another well-known tactic of Western intelligence agencies. Intelligence agencies first infiltrate an Iranian smuggling network and provide the goods the network seeks, but not before they first modify the goods so they will not work, perhaps in a way that will damage adjacent equipment. Sometimes bugging devices are placed in the equipment and send information about operations after the equipment is installed at a site. This technique has likely revealed at least one of Iran's secret nuclear sites and, according to official Iranian statements, to have caused centrifuges to break. Undoubtedly, the tactic is being pursued more diligently today by a range of countries.

There are several riskier strategies that are being pursued against Iran that have serious downsides and implications. Assassinations of Iranian nuclear scientists and engineers have occurred with greater frequency but should be stopped because they carry too high a risk of retaliation and involve terrorism against civilians. Moreover, assassinations are unlikely to be effective in setting back the nuclear program, which involves thousands of specialists and ingrained know-how. Furthermore, Iran could argue that assassinations are equivalent to a military attack and use this as justification for further provocations. An under-siege mentality created by use of such tactics could motivate Iran to further degrade its cooperation with the IAEA and resist offers of negotiation.

Recent major accidents at Iranian facilities have led to speculation that countries are conducting sabotage against significant Iranian missile and nuclear-related sites. An explosion late last year at a major missile production facility outside Tehran is being called sabotage by some.[12] In December 2012, there was an explosion at the newly opened Ghadir steelworks in Yazd that reportedly could have been making maraging steel. Despite Iranian denials of sabotage and a lack of clear evidence of sabotage, these cases have ignited a debate into the risks, feasibility, and desirability of sabotaging major facilities via covert operations that go beyond cyber attacks.

Slowed but not Stopped

The methods described above help explain Iran's delayed progress in developing its nuclear weapons capabilities. However, they have not completely stopped Iran's nuclear programs from making progress toward that goal. Iran continues to make both 3.5 and 19.75 percent LEU, and it has recently tripled its rate of 19.75 percent LEU production with the installation of IR-1 centrifuges at the Fordow enrichment site. Enrichment at this site started in late 2011. Iran has recently brought the total number of enriching centrifuges at the Natanz Fuel Enrichment Plant to about 9,000 IR-1 centrifuges, which is the number it had installed by 2009, when so many troubles started. As mentioned above, it has also installed over 8,000 empty IR-1 centrifuge casings at Natanz and Fordow, perhaps to be loaded with rotor assemblies, although many doubt that Iran can make so many rotors.

Increasingly, Iran's enrichment program appears to be geared toward making 19.75 percent LEU as opposed to just stockpiling 3.5 percent LEU. If this is the case, most of its total monthly 3.5 percent LEU production at the Natanz Fuel Enrichment Plant would be turned into 19.75 percent LEU, producing about 15 kilograms of 19.75 percent LEU hexafluoride per month.

An on-hand stockpile in Iran of 19.75 percent LEU would greatly reduce the time necessary for making one bomb's worth of weapon-grade uranium. At a three-fold rate of production, Iran could produce enough 19.75 percent LEU for a nuclear weapon by late 2012 but more likely by early 2013.[13] With

[12] Paul Brannan, "Satellite Image Showing Damage from November 12, 2011 Blast at Military Base in Iran (Washington, D.C.: Institute for Science and International Security, November 28, 2011).

[13] David Albright and Christina Walrond, "Determining the Purpose of Iran's Growing Stock of 19.75 Percent Enriched Uranium: Production Should be Capped" (Washington, D.C.: Institute for Science and International Security, September 21, 2011); and Albright and Walrond, "Iranian Production of 19.75 Percent Low Enriched Uranium and Possibly of 60 percent Highly Enriched Uranium: Beyond Its Realistic Needs" (Washington, D.C.: Institute for Science and International Security, forthcoming).

2,000 more IR-1 centrifuges at Fordow, it could boost several-fold 19.75 percent LEU production. However, using about 2,700 IR-1 centrifuges and starting with 19.75 percent LEU, breakout times to produce weapon-grade uranium in IR-1 centrifuges would be about three months.

Iran may start deployment of advanced centrifuges at the Fordow enrichment plant as soon as this year. Its advanced centrifuges, namely the IR-2m and the IR-4 models, are expected to achieve about 3-4 times the enrichment output of the IR-1 centrifuges. Iran is currently testing them in production-scale cascades at the Natanz Pilot Fuel Enrichment Plant, but making progress slower than expected. After completing this testing, Iran has indicated it would deploy the advanced centrifuges at the Fordow site, although it has not stated the scale at which it plans to deploy at the site or other planned enrichment sites. With advanced centrifuges, Iran could increase by several-fold the amount of 19.75 percent LEU it can produce by late 2013, producing several nuclear weapons-worth of the material by the end of 2013.[14]

Iran continues to better protect its nuclear sites against military strikes. The centrifuge plant at Fordow is located in a deeply buried facility under 90 meters of rock in a mountainous region, and

the facility is considered significantly less vulnerable to an airstrike than the underground FEP at Natanz.

Over the next several years, Iran will broaden its nuclear weapons capability. In about three years, it will bring on-line a heavy water reactor well-suited to make plutonium for nuclear weapons. It may also further diversify its enrichment capabilities by developing laser enrichment of uranium later this decade.

As a result, the probability that the regime will opt for nuclear weapons is bound to increase, perhaps substantially, unless the nuclear conflict is resolved or Iran's programs are further delayed or disrupted. The regime will undoubtedly continue to further develop its nuclear capability to permit a faster and less exposed dash to nuclear weapons. Although slowed, Iran's momentum toward nuclear weapons is already substantial and is increasing.

Centrifuges at the PFEP: IR-1 machines on the left, advanced centrifuges on the right.

[14] "Iranian Production of 19.75 Percent Low Enriched Uranium and Possibly of 60 Percent Highly Enriched Uranium" op. cit.

Iran's Nuclear Futures

Given existing constraints, what are Iran's realistic options to get nuclear weapons over the next several years? Iran has essentially two broad sets of options to acquire nuclear weapons in the current period through 2015. The first involves a set of cheating scenarios, where Iran remains in the NPT as long as possible while further developing nuclear weapons capabilities. Hedging is a critical part of this strategy. The second is that Iran formally withdraws from the NPT and then dedicates nuclear facilities to making nuclear weapons outside of the non-proliferation regime.

Table 1 describes a timeline of Iran's potential future capabilities to make weapon-grade uranium, where a modest growth projection is assumed. For the next two to three years, Iran will likely be limited to the Natanz and Fordow enrichment sites. There is currently no evidence of a covert gas centrifuge site able to make weapon-grade uranium. Iran is expected to build a third centrifuge plant and may try in addition to build a covert, parallel centrifuge plant and associated uranium conversion facility. It announced in the summer of 2011 that it will not build the third centrifuge plant for two years, although site preparation may have started. It may currently be deterred from building a parallel site due to fears of it being discovered.

ISIS identified four main options that Iran may use during the next several years to build nuclear weapons, which are discussed individually below:

- Dash at a Declared Enrichment Site
- Dash at a Covert Enrichment Site
- Cheating in Plain Sight
- A Parallel Program

Table 2 summarizes these and several other nuclear futures that Iran may pursue. In all cases, these potential nuclear futures are not inevitable. International actions may delay or prevent them. Iran may decide that the potential costs are too high and may choose not to pursue any of them. Despite the existing constraints, however, Iran may decide that at some point obtaining nuclear weapons is worth the risk.

Drawing on a series of discussions at ISIS workshops and expert judgments, each option is assigned a probability of occurrence—low, medium, or high. Each probability is an assessment that involves evaluating current conditions and projecting future expectations. The assigned probabilities are necessarily uncertain, but they provide a relative comparison that helps identify which Iranian nuclear futures require greater scrutiny and more effective countermeasures aimed at reducing the probability of this option developing. Table 3 summarizes these findings.

It is important to keep in mind the meaning of low, medium, and high probabilities. A low probability assigned to a future option means that it is not likely to happen. Medium probability means that this option could occur. High probability means there is a very significant chance of the scenario happening.[15]

[15] One can also assign standard numerical values to these qualitative terms, where low is greater than zero but less than 0.33, medium is between above 0.33 to 0.66, and high is from 0.66 to 1.0.

Table 1. A Timeline of Potential Future Capabilities to Make Weapon-Grade Uranium: Modest Growth Projection

	2012	2013	2014	2015
Natanz FEP (3.5% and 19.75% LEU)	6,000 – 9,000 IR-1s enriching	6,000-12,000 IR-1s enriching	4,000-15,000 centrifuges enriching	4,000-15,000 centrifuges enriching
Fordow (19.75% LEU; 3.5% LEU; HEU?)	2-4 IR-1 tandem cascades (with 696-1044 IR-1 centrifuges); another 1,000 IR-1 centrifuges (advanced centrifuges?)	2-4 IR-1 tandem cascades; another 2,000 IR-1 centrifuges; (or 500-1,000 advanced centrifuges)	3,000 IR-1 or 1,000-2,000 advanced centrifuges	2,000 -3,000 advanced centrifuges
Third enrichment site	Under construction	500-1000 centrifuges	1000 centrifuges	1,000-2,000 centrifuges
Covert, parallel site (3,000 centrifuges maximum)	Under construction?	Under construction?	Under construction?	1,000 centrifuges?
Covert uranium supply and conversion facility	Under construction?	Under construction?	Operational?	Operational?
Covert laser separation facility	Under Development?	Under Development?	Under construction?	Operational?

Comment: In 2014 and 2015, Iran may deploy advanced centrifuges at the Natanz Fuel Enrichment Plant (FEP). The values of IR-1 centrifuges in the table are highly sensitive to the stocks and replenishment of critical raw materials, such as maraging steel for the bellows. At issue is whether Iran will learn to make adquate maraging steel domestically or smuggle sufficient stocks from abroad in spite of sanctions. At the Fordow Fuel Enrichment Plant (FFEP), Iran has installed about 2,100 IR-1 outer casings, but without the critical rotor assembly. The FFEP is slated to hold about 3,000 centrifuges. Faced with apparent delays in developing advanced centrifuges, Iran seems to be shifting its plans back to the deployment of about 3,000 IR-1 centrifuges at the FFEP in the near term. Whether these plans will change again over the next year is unclear.

Table 2. Iranian Paths to Nuclear Explosive Materials

I. Cheating Scenarios

Method	Advantages to Iran	Disadvantages to Iran	Prerequisites to Success for Iran
Dash at declared centrifuge sites to HEU using safeguarded LEU	Minimal start times; current infrastructure needs minor modifications; could implement now	Diversion from safeguards required; vulnerable during HEU production to military strikes, especially Natanz	Minimize time to produce HEU; better operation of centrifuges; legitimize enrichment
Dash at undeclared centrifuge site using safeguarded LEU stockpile	Dedicated, secret site; optimal cascade design possible	LEU diversion required; risk of detection; high cost, if detected; probably site not yet in place (two years away)	More efficient, powerful centrifuges; more effective security; weakened sanctions; weak IAEA inspections
HEU production under safeguards	Civilian cover; can do it now; requires minor modifications to Natanz/Qom	Takes several years to produce enough; progress known; risk of military strikes even with civilian cover	Establish rationale for 45 or 90%; Produce 90 percent HEU; legitimize enrichment
Parallel covert program	Independent undeclared fuel cycle No diversion necessary	Keeping all sites secret	More experience and skill; weakened sanctions and inspections; indigenous manufacturing capabilities
Secret production of HEU at declared site	Use existing facility	IAEA safeguards; risk of getting caught	Weaken IAEA safeguards; Much larger number of centrifuges that work better

Method	Advantages to Iran	Disadvantages to Iran	Prerequisites to Success for Iran
Arak reactor and reprocessing plant	Small-scale Pu separation plant is low tech; Pu separation in few months	Diversion of spent fuel required; must build a secret plutonium separation plant; risk of military strike of reactor	Getting Arak reactor operating, building secret separation plant
Laser enrichment	Small facility; Unexpected; has Experience and able to produce most of the equipment	Difficult to do	Acquire remaining goods; successfully enrich uranium
Illicitly acquireShortcut fissile material overseas		Not easy to acquire; high cost if detected	Secret overseas network; knowing where stocks vulnerable or of a secret seller
II. NPT Withdrawal (assuming no military strikes)			
Legal withdrawal from NPT and then weapons production	Dedicate range of facilities to weapon production; move quickly	Risk of isolation; credibility problem; risk of military strikes heightened	Weak NPT regime

Table 3. Probabilities of Iranian Paths to Nuclear Explosive Materials

(Each probability reflects the likelihood that Iran would pursue each method, based on a judgment of its technical capabilities to do so and a range of factors that deter its pursuit of this method)

I. Cheating Scenarios

Method	Probability 2012	2013	2014-15
Dash at declared centrifuge sites to highly enriched uranium (HEU) using safeguarded LEU			
Natanz FEP	low	low	low
Fordow FEP	low	low-medium	low-medium
Dash at undeclared, covert centrifuge site using the safeguarded LEU stockpile	low	low-medium	medium
HEU production under safeguards at declared centrifuge plants	low	low	medium
Parallel covert centrifuge program	low	low	medium
Secret production of HEU at declared Safeguarded sites	low	low	low
Arak reactor and secret, undeclared reprocessing plant (reactor to be operational in 2014)	--	--	low
Laser enrichment to produce HEU	low	low	low
Illicitly acquire fissile material overseas for use in nuclear weapons	low	low	low

II. NPT Withdrawal

Legal withdrawal from NPT and then weapons production	low	low	low-medium

1.) Dash at Declared Enrichment Site

The most widely discussed option for Iran, as detailed earlier, is conducting a dash to weapon-grade uranium at a declared centrifuge site, starting with its stockpile of safeguarded LEU. This option has a minimal start time, since the existing infrastructure would need only minor modifications before it could be used to enrich to weapon-grade. Diversion of the safeguarded LEU would be required, and the IAEA would detect this diversion. Therefore, Iran would want to minimize the time it would need to produce weapon-grade uranium before making the dash, likely by increasing the number of operational centrifuges and deploying more advanced centrifuges with improved performance. It may also want to seek ways to legitimize its production of higher enriched uranium by claiming it will be devoted to civilian nuclear energy programs.

But as discussed, an unlikely candidate for such a dash is the Natanz FEP because of its vulnerability to military strikes. On balance, the chance that Iran would pursue a dash to weapon-grade uranium at the Natanz facility today or in the next several years is low.

Iran could wait and prepare the Fordow enrichment site for use in a dash to weapon-grade uranium. In the 2012-2013 timeframe, this facility is expected to contain an increasing number of centrifuges. Roughly 1,000 IR-2m or IR-4 centrifuges, 3000-4000 IR-1 centrifuges, would be enough to allow Iran to dash to a bomb in six to twelve months using 3.5 percent LEU as the starting material, a timeframe that would decrease to about 2-3 months if 19.75 percent LEU were used. With 2,000-3,000 advanced centrifuges, dash times would be correspondingly shortened, but Iran is unlikely to have that number of advanced centrifuges at Fordow until after 2013 (see table 1). This site is deeply buried and less vulnerable to military strikes, but the IAEA would relatively quickly detect any diversion of LEU here, leading to draconian sanctions and possibly military strikes against a range of nuclear facilities. In addition, although aerial strikes would be hard pressed to destroy the centrifuges underground at the Fordow plant, they are likely to destroy critical supporting facilities on the surface, including power plants and tunnel entrances that could cause a temporary halt of centrifuge operations. Moreover, an attack by the United States could likely cause substantial destruction to tunnel passageways leading to the chamber containing the centrifuge cascades. On balance, the probability of Iran pursuing this option is assessed as low in 2012 and low to medium in 2013. Afterwards, the probability could increase to medium once more advanced centrifuges are deployed and Iran has greater stocks of 19.75 percent LEU.

2.) Dash at a Covert Enrichment Site

A modification of the above approach involving a dash to weapon-grade uranium at a declared enrichment site is a dash at an undeclared centrifuge site using Iran's safeguarded LEU to produce several nuclear weapons by 2014 or 2015. This scenario involves significant risk of being caught, offering some deterrence. Its probability of occurring in 2012 is assessed as low, but its likelihood of occurring is assessed as growing, reaching a low to medium probability in 2013, barring the deployment of additional countermeasures. The increase to low to medium reflects new information suggesting that Iran may have a capability to build greater numbers of IR-1 centrifuges than previously assessed. This capability, namely the manufacture of centrifuges, lies largely outside the purview of the IAEA under current, weakened inspections.

To carry out this scenario, Iran would need to have built or have plans to build a secret centrifuge site against a background of Western intelligence agencies working overtime to discover one. Given Western success in discovering the Fordow plant and developing the Stuxnet virus, Iran may currently feel deterred from pursuing this option, and no evidence of such a secret site has emerged. However, deterring Iran from this option could become less tenable as it learns to build and operate advanced centrifuges.

The advanced centrifuges give Iran the option of building a smaller covert enrichment facility with fewer machines necessary for making highly enriched uranium from LEU diverted from safeguards. The smaller the covert enrichment facility, the less likely intelligence agencies are to discover it. Iran could covertly design this site explicitly to make weapon-grade uranium, increasing cascade efficiency significantly compared to that achievable in its cascades designed to make 3.5 percent LEU, decreasing the time needed to produce enough of this material for a weapon and increasing the chance the enrichment plant could survive long enough to make enough weapon-grade uranium for several nuclear weapons. Since the IAEA would detect the diversion and warn the international community that Iran had diverted LEU, Iran would expect draconian sanctions and military strikes, although its enrichment site could be safe from strikes as long as it remained undiscovered by foreign intelligence agencies or was sufficiently fortified and protected.

Iran could also seek to deploy in a covert plant its less capable IR-1 centrifuges instead of advanced centrifuges if it is not able to develop or build enough advanced centrifuges in time. But a disadvantage of this choice is that Iran would need several times more IR-1 centrifuges to achieve the same breakout times as with advanced centrifuges. Building and outfitting a plant with 3,000-4,000 centrifuges increases the chances of detection by intelligence agencies that likely have a window into the centrifuge manufacturing and deployment chain. Nonetheless, this option remains realistic and should not be discounted or ignored.

Another possible way of achieving this scenario would involve Iran opting to build a third centrifuge plant under the guise of its announced plan to eventually build ten civilian centrifuge plants. If Iran happened to avoid having this site discovered, it could be used as a covert breakout option designed to make weapon-grade uranium. If discovered, Iran could modify the plant's design to make LEU, declare that it is one of its ten planned civilian plants, and allow IAEA inspections. The discovery of the Fordow plant by Western intelligence agencies strengthens suspicion that Iran has already seen the value in pursuing this strategy.

Fewer than 1,000 advanced centrifuges would suffice to produce weapon-grade uranium in 6-12 months at a covert plant, starting with 3.5% LEU. That time would decrese to 2-3 months with 19.75% LEU feed. The probability of Iran pursuing this option is assessed as low in 2012, low to medium in 2013, and medium in 2014 or 2015.

3.) Cheating in Plain Sight

Iran could choose to play out a problematic scenario of "cheating in plain sight" as a way to shorten its timeline to producing weapon-grade uranium and nuclear weapons. This scenario is slow moving and would take until 2014 or 2015 to reach full fruition but the relative slowness of this scenario should not lead to understating its potential threat. It is judged as having a probability of medium.

This option would involve the sequential enrichment of uranium at the Natanz and Fordow sites under safeguards to progressively higher levels, for example, from 3.5% → 19.75% → 60% → 90%, by offering a civilian justification and later diverting the material for weaponization. Iran has already successfully justified producing near 20 percent LEU as fuel for the Tehran Research Reactor, a possibility that most analysts just a few years ago dismissed as something Iran could not "get away" with. This scenario would make sense for Iran to use as a response to the constraints on its nuclear program and the international community's difficulty in dealing with Iran's incremental movement towards a nuclear weapons capability.

To achieve levels higher than 20 percent enrichment, Iran could attempt to justify a civilian need for highly-enriched uranium in targets, which it would claim it needs to specially preparefor irradiation in the Tehran Research Reactor to produce medical isotopes. Several countries now use targets

composed of 45 percent HEU or even weapon-grade uranium to produce the fission product Molybdenum-99, which decays to very short-lived Technetium-99m, a widely used medical isotope in modern diagnostic procedures. Using higher enriched uranium is a simple way to increase the yield of the Molybdenum-99.

At any step in this process, Iran could also divert this safeguarded enriched uranium and dash to nuclear weapons under one of the above scenarios. At its most extreme, and if nothing were done to prevent Iran from moving forward, this path could allow Iran to make weapon-grade uranium under safeguards for a claimed use in targets to increase the yield of medical isotopes or as fuel in one of its research reactors. Were it to divert the HEU, which the IAEA would detect, Iran would move directly to manufacturing HEU components for nuclear weapons. A disadvantage to Iran is that only relatively low rates of weapon-grade uranium production can be justified under a civilian cover, making the production of HEU in this scenario quite slow.

In this case, Iran would likely delay its move to make HEU under safeguards as long as feasible. First, it would likely focus on building up its stock of 19.75 percent LEU. In doing so, Iran would produce enough 19.75 percent LEU for several nuclear weapons by 2014 at the earliest and could start producing medium-level highly enriched uranium (up to 60 percent) in late 2013 or early 2014 at the Fordow site under a civilian guise. Weapon-grade uranium production could follow within a year, since adequate amounts of the medium-level enriched uranium would be accumulated more quickly than 19.75 percent LEU. Iran would need to worry that its production of highly-enriched uranium could invite a military strike by nations that simply cannot accept the possibility of Iran producing HEU, regardless of the supposed justification. Draconian U.N. Security Council sanctions may be difficult to achieve, given the civilian intent Iran would declare, but additional unilateral or regional sanctions would be likely. On balance, the probability of Iran pursuing this option is assessed as low until 2014, when it becomes medium.

4.) A Parallel Program

Iran may have or may seek to build nuclear weapons through the creation of an independent, undeclared fuel cycle starting with natural uranium and enriching to weapon-grade uranium. A major benefit of this option is that Iran would not need to divert its declared nuclear material. The current probability of this scenario is assessed as low, but the likelihood is assessed to grow to medium during the next several years.

The IAEA has suspected that Iran planned originally to pursue this path, based on the discoveries of its once covert Gchine uranium mine and mill - the so-called “Green Salt” project that was designed to make uranium tetrafluoride - and the undeclared Fordow enrichment plant. An example of this path would involve Iran using uranium mined at Gchine or imported secretly, converting the uranium at a covert site to uranium hexafluoride, and enriching it in a clandestine enrichment site using advanced centrifuges. If its clandestine enrichment site (or for that matter, a secret uranium hexafluoride production plant) is discovered before enrichment starts, Iran could claim the site is one of the ten centrifuge sites it announced it would build (or that the hexafluoride production plant is necessary for such an ambitious enrichment program).

To exercise this option in the next several years, Iran would need to keep all these sites secret, which would not be easy, given international scrutiny by intelligence agencies. Iran would have an incentive under this route to weaken IAEA safeguards further, but it would still need to worry about multiple exposures of its secret nuclear activities and sites, especially considering the record of past discoveries. Therefore, the probability that Iran would pursue this path is judged to be low currently, but the probability is assessed as medium during 2014-2015.

Review of the Probabilities

In 2012, the probability of all of the scenarios occurring is judged as low. This can be interpreted to mean that Iran is currently in a poor position to build nuclear weapons covertly and is thus unlikely to attempt to do so this year. In 2013 and onward, the probabilities of the four futures discussed above occurring begin to increase toward a medium likelihood.

None of the probabilities of the nuclear futures discussed in table 3 is judged as being high; many remain low. These judgments reflect technical challenges Iran will face, international actions that will continue to constrain particular nuclear futures, and the extent of pressure on Iran today and that is expected to be applied in the future to deter Iran from building nuclear weapons.

At the same time, the assigned probabilities during the next several years provide no reason for complacency. Given the consequences of a nuclear armed Iran, even options with low probabilities of occurring require action designed to keep them low. Similarly, since an Iran with nuclear weapons would be a high impact event, futures with a low probability, or those that are unlikely to occur, are still highly important and have a severe impact. Thus, working to lower their probability of occurrence is important, as is developing contingency plans in case they do occur. In this case, the medium probability futures are the top priorities, given their higher impact, and they require extra effort to reduce their likelihood of occurring.

According to this analysis, the options that Iran would tend to favor involve developing and deploying advanced centrifuges, making IR-1 centrifuges in lieu of advanced ones, continuing to find ways to produce higher enriched uranium in greater quantities under a civilian cover, building confidence in an ability to build covert sites, evading answering the IAEA's questions about past nuclear weaponization activities, and better protecting nuclear sites against military strikes. The task is to prevent Iran from succeeding by lowering the probabilities that it could achieve any of these nuclear futures while keeping it within the constraints of the NPT.

Given the consequences of a nuclear-armed Iran, even options with low probabilities of occurring require action designed to keep them low.

Policy Measures to Further Constrain Iran's Future Nuclear Breakout Options

An analysis of Iran's nuclear futures shows that Iran's capability to build nuclear weapons is constrained. However, this capability nevertheless increases with time, and Iran could have more options to acquire nuclear weapons in the coming years unless it is further constrained or the probabilities of these futures occurring are lowered further. These constraints can emerge through negotiations, which are discussed further below, or by using a range of alternative methods to slow Iran's progress, which are discussed in this section.

Any pragmatic future strategy must inhibit Iran's nuclear progress and pressure it into changing course while offering it an alternative, more prosperous pathway forward. But as we seek and engage in negotiations for a long-term solution, the key goal must be, at the same time, to implement additional measures to delay, thwart, and deter Iran's acquisition of nuclear capabilities and inhibit its ability to break out.

An underlying priority is increasing international political will to stop Iran from getting nuclear weapons. Mustering this international will for action is even more urgent if military options are seen as too dangerous or unlikely to succeed. Those who seek to downplay the threat posed by Iran's growing nuclear weapons capabilities should be convinced of its gravity.

In particular, such a strategy should focus on several key priorities:

- More effective legal mechanisms to stop Iran from acquiring key goods for its nuclear programs. A priority is domestic enforcement of sanctions and trade controls in China;
- Better detection of Iran's illicit procurement efforts and broader enforcement of legal mechanisms worldwide;
- Increased efforts in countries of transit concern to prevent Iran from transshipping banned goods;

- Stepped up operations to detect clandestine Iranian nuclear activities, including heightened intelligence operations inside Iran aimed at detecting secret nuclear sites and activities and encouraging defections of nuclear program "insiders";
- Covert action to slow Iran's nuclear program, particularly if the conflict transforms into a protracted Cold War style stand-off between Iran and several members of the international community; and,
- Increased economic and financial sanctions aimed at augmenting pressure, combined with an effort to displace Iranian oil exports.

These options should be implemented as quickly as possible, since many of them could take time to have an effect on further slowing or constraining Iran's ability to use its nuclear capabilities to produce nuclear weapons.

Improved Implementation of National and International Judicial Mechanisms Against Iran's Illicit Procurements

Better implementation of existing U.N. Security Council sanctions, including in China. Better enforcement of existing U.N. Security Council resolutions on Iran would prevent it from obtaining the goods it seeks for its nuclear programs, especially via key countries Iran now uses for its procurement needs that are lacking in enforcement.

As previously discussed, sanctions, when enforced, have successfully prevented Iran from purchasing goods for its centrifuges, inhibited domestic production of centrifuges, and forced it to make undesirable design changes in its centrifuges. Iran faces problems in acquiring a wide range of vital nuclear dual-use goods, such as high precision maraging steel, high quality carbon fiber, vacuum pumps, and pressure transducers. Although Iran has tried to domestically produce some advanced equipment, it has found that procurement abroad is still required to acquire the varied types of quality equipment that is necessary to operate a gas centrifuge plant.

Despite many successes, several countries need to commit greater political will to implementing the mandates of U.N. Security Council resolutions on Iran. A stronger mandate of the Iran Resolution 1737 Sanctions Committee, which oversees Iran's compliance with and the international community's implementation of UNSC resolutions on Iran, and stronger reporting requirements for this committee, as well as broad publicity over egregious lapses would help identify and close gaps in implementation. The committee should also reinvigorate its efforts to assist member states meet their obligations under these resolutions.

The 1737 Committee should also designate sanctions violators for targeted sanctions. New designations of such individuals and entities would send a powerful signal of this Committee's commitment to enforcing U.N. Security Council resolutions.

Improved implementation in China. China in particular needs to improve its implementation of Security Council sanctions and its own trade controls. It remains a key procurement and transshipment point used by Iranian smugglers. Better enforcement in China would prevent Iran from buying from Chinese suppliers or using private Chinese companies to purchase high-technology goods from subsidiaries of foreign companies located in China. Chinese companies can now with little risk provide banned goods to an Iranian trading company located in China or can send goods directly to Iran. Chinese government officials have signaled that the government is now more open to improving compliance by private Chinese companies, which are long overdue for targeting.

Broader requirements on countries of "transit concern." Countries of transit concern serve as transshipment points for goods destined for Iran and mask the goods' true destination from suppliers. Currently, Turkey has emerged as a country of major concern. In the past, the United Arab Emirates (UAE) and Malaysia have been major transit countries willing to turn a blind eye to Iran's smuggling operations. Iranian smugglers depend on these types of countries because they can rarely ship goods directly to Iran from Europe, Japan, or the United States.

To address the problems posed by these countries, a coalition of willing nations can increase licensing requirements on major countries of transit concern, which would require these transit countries to ensure that imported, controlled or dual-use goods are not being sent to Iran. Countries of transit concern would need to show extra documentation substantiating that an end-user of a sensitive good is not Iran's nuclear program. This approach would stimulate countries of transit concern to pass more effective laws and regulations against Iran's illicit nuclear trade. Avoiding the threat of extra requirements has already motivated some countries, such as the UAE and Malaysia, to put more emphasis on stopping Iran's illegal activities on their territories.

Better Detection of Iran's Smuggling Efforts and Greater Commitment to Enforcement of Sanctions

Better government/industry cooperation. Improved cooperation between governments and the private sector to detect Iranian proliferation attempts would better prevent Iran from illicitly outfitting its nuclear programs. Government/industry cooperation programs are already successful in Germany and Britain and have proven valuable in strengthening national export control and sanctions efforts.

Governments inform companies about the latest procurement schemes used by Iran in order to help these firms avoid making accidental bad sales. Governments receive information about Iranian procurement attempts from companies, which is useful in informing intelligence assessments about Iran's requirements, activities and smuggling techniques. The United States, perhaps surprisingly given its focus on stopping Iran's smuggling, has found it difficult to implement such a system because of regulatory and classification issues over this type of information sharing with companies. However, it should continue attempting to implement such a system.

More focus on interdictions under UNSC resolutions and Proliferation Security Initiative (PSI). Increased efforts to interdict goods heading to Iran would render it less able to obtain the goods it requires and provide intelligence-usable information about its needs and activities. National governments must increase and improve border operations and interagency government coordination for conducting national operations. They should work to expand the use of transnational operations, necessitating better government-government coordination and sharing of intelligence information that can catch illicit Iranian shipments. Countries that have made progress in this area must offer training and cooperation programs to other nations. The PSI, through which participating states agree to stop proliferation cargos crossing their air, terrain, or maritime boundaries, should be expanded as part of these efforts. The PSI has proven effective on numerous occasions and expanded participation would lead to more interdictions.

Increased arrests and prosecutions of Iran's smugglers. Increased arrests and prosecutions of nuclear smugglers would work to delay or interrupt procurement operations and actively shut down Iran's procurement networks. The United States has spearheaded arrests and indictments against Iranian smugglers caught operating or passing through U.S. territory. Other countries should model these efforts. Stronger sentences against smugglers would also better deter and disrupt procurement operations.

Increased use of sting operations against Iran's illicit smuggling networks. Sting operations have proven effective at catching and stopping both major and minor Iranian smugglers and should be expanded. The United States is the only country currently known to sting Iran over procurements of controlled goods. Other countries should start using sting operations to prevent Iran from obtaining the goods it requires, eliminate more Iranian smugglers from the scene, and send a stronger message about the willingness of states to tolerate violations of their export laws.

Increased international cooperation to augment chances of successfully prosecuting Iranian smugglers and sanctions violators. Increased cooperation between countries to overcome legal impediments to prosecuting smugglers and sanctions violators would better deter and prevent Iranian illicit trade. Many problems currently exist which impede successful prosecutions, such as barriers to the sharing of evidence and witnesses among countries, lack of bilateral extradition treaties or laws in both countries that cover the crime, lack of specific laws altogether against smuggling in some countries, and an absence of strong uniform penalties against the crime. Countries need to improve their laws against dual-use smuggling as a few recent extradition cases of the United States against smugglers arrested in Europe have shown. These cases fell through due to a lack of European recognition of U.S. dual-use export laws, underlining a need for more consensus and new regimes to handle this transnational issue.

More Detection of Secret Iranian Nuclear Activities

Intelligence operations aimed at data gathering in Iran through a variety of means, including spying, cyber infiltrations or snooping, aerial surveillance, and bugging of equipment procured by Iran. Intelligence operations aimed at data gathering may provide information and advanced warning about Iran's nuclear activities and plans. As previously discussed, these measures include operations to gather data through spying, use of cyber infiltrations, aerial surveillance to reveal new activities and nuclear sites, and bugging of equipment destined for the Iranian nuclear program in order to follow its path and use. Western governments routinely use intelligence operations to increase knowledge about Iran's activities and should actively expand them and cooperate closely with other governments.

Encouraging and seeking information from defectors from Iran's nuclear program and providing nuclear information to the IAEA. The use of spies or domestic informants to obtain data about Iran's nuclear activities and intentions should be expanded to inform intelligence assessments about Iran's plans to expand enrichment sites, build covert ones, move toward a dash for nuclear weapons, or experiment with or conduct nuclear weaponization activities. Informants working inside the program with access to the most restricted information and plans have already provided detailed information to Western governments about Iran's nuclear weaponization projects and other military nuclear efforts. These governments provided a significant amount of this information to the IAEA and should continue to do so. The IAEA plays an important role as a reviewer and synthesizer of such information for its safeguards reporting. It also remains in the best position to attempt to seek answers from Iran.

Nations should start programs, if their intelligence agencies do not already have them, to encourage and reward defections from Iranian nuclear programs that are in violation of U.N. Security Council resolutions. A whistleblower program should offer asylum for the person and his or her family and a monetary reward for key information about secret or banned activities.

Stronger mandate to IAEA to investigate Iran's illicit procurements. The IAEA could also serve a more useful role in investigating Iran's illicit procurement attempts and should receive a mandate to pursue this fruitful area. By centralizing available data on Iran's procurement schemes collected by member states, the IAEA could better understand Iran's nuclear program and make its analyses available to all member states and their domestic companies. Such an IAEA mandate would support government/industry cooperation programs. Issues of member states sharing confidential information on Iran's procurement schemes with an international organization would need to be overcome, in addition to some member states' concerns about the IAEA potentially communicating directly with private companies.

Covert Actions

Sabotage of procured goods through infiltration of smuggling networks. As discussed, sabotage of illicitly procured equipment through the infiltration of Iran's illicit supply lines reportedly has had some success.

Sabotage efforts can cause damage to enrichment or other nuclear operations. Such initiatives should be expanded. Iran's acquisition of these goods for its nuclear program is in clear violation of nations' laws and U.N. Security Council sanctions. Sabotaging the goods is not distinguishable legally from the practices carried out by police forces in enforcing their own national laws.

Surveillance and disruption of smuggling networks. Intelligence and law enforcement agencies can seek to survey and disrupt the operations of entire smuggling networks rather than singling out a few key actors. Effective operations require coordination across national boundaries in order to find out what major procurement networks are seeking, detect how they operate, and eventually shut them down through intelligence operations or arrests and prosecutions.

Cyber attacks meant to inflict physical damage to nuclear facilities. As discussed above, cyber attacks against Iran's nuclear infrastructure are a newer tool first put in use during the 2009/2010 Stuxnet cyber attack against Iran's Natanz enrichment plant. The attack, launched by unknown governments, resulted in the decommissioning of about 1,000 centrifuges. The malware infected computer systems that controlled centrifuge operations and abruptly spun the centrifuges up to very high and then low speeds in order to destroy their delicate internal machinery. The attack set back Iran's centrifuge program for about a year, after which it largely recovered. Additional cyber attacks could be considered for use against enrichment plants other than Natanz that pose a greater risk of breakout when they come into operation.

The next attack may be more difficult to accomplish, since Iran is likely to have taken precautions against this type of attack. These codes also take years to develop. Further, cyber attacks run the risk of being used against an attacker or being manipulated by non-state actors. Yet, the tool has the attractiveness of a lack of signature, psychological impact, and the potential for causing damage. Already a successor to the Stuxnet attack, the Duqu malware, has shown that cyber attacks are likely to continue against Iran as long as it remains in violation of Security Council resolutions.

Increased Sanctions

Additional unilateral, regional, and UNSC sanctions. Unilateral sanctions have proven effective in reinforcing multilateral measures, closing loopholes, and putting additional pressure on Iran to negotiate in a meaningful manner. Unilateral and regional sanctions imposed by the United States, European Union, and other Western countries have made it more difficult for Iran to obtain the goods it needs for its nuclear program, and increasingly restricted its ability to conduct routine economic business. These measures go further than U.N. sanctions by listing and prosecuting additional entities and individuals associated with illicit procurement, enforcing additional travel bans, targeting Iran with financial sanctions by making it illegal for domestic businesses and banks to transact with Iranian banks, implementing sanctions against Iran's energy sector and military sector, and sanctioning Iran's key shipping industries.

Additional U.N. Security Council sanctions against Iranian entities of proliferation concern and increased and better enforcement of financial sanctions against Iranian banks that facilitate proliferation financing would further prevent and deter Iran's nuclear expansion and present a unified message to Iran about the international community's unwillingness to tolerate its behavior. Although new U.N. Security Council sanctions are politically difficult and time consuming to achieve because they require consensus, while they usually result in only marginal improvements to existing sanctions, they are worthwhile to pursue.

Sanctions on Iran's central bank, Bank Markazi, and diminishing its oil exports. To increase pressure on Iran to negotiate in good faith, the United States and several of its allies have moved to reduce Iran's ability to export oil and sanction its central bank. The plan, led by the United States, is intended to

displace Iranian oil with oil from other suppliers, who would increase their output to make up for any shortage caused by not buying Iranian oil. The goal thus far is to reduce gradually purchases of Iranian oil by 20 percent or more by finding alternative suppliers for Greece, Italy, Spain, South Korea, and Japan. The likely suppliers who would fill the shortfall are Saudi Arabia, Libya, Iraq, and other Gulf states. A key challenge will be developing enough alternative supply and avoiding significant rises in oil prices.

All of these sanctions are inflicting substantially more pain on the Iranian government, its military, and the nuclear programs. A side effect of these broader economic and financial sanctions is that Iran will likely have an even harder time outfitting its industrial nuclear infrastructure. For a variety of reasons, these sanctions must be implemented cautiously. They must be implemented so as not to increase oil prices substantially, undercutting their value by allowing Iran to sell its oil for a higher price, and causing economic pain to the United States and its allies.

Oil Bans and Military Actions

Absent an egregious action by Iran to break out or significantly reduce cooperation with the IAEA, crippling economic sanctions, such as worldwide bans on Iran's oil exports, would likely lack support from much of the international community, particularly Iran's key trading partners, such as China and Russia. Human suffering and social unrest arising from these sanctions could cause harsh government crackdowns, amplifying social misery, or measures could instead backfire by creating a rally-around-the-flag effect.

However, if Iran does move to build nuclear weapons, such sanctions could find endorsement in the Security Council. Moreover military action may be viewed differently in this case.

So far, Iran appears to worry about the existing implied threat of military force against its nuclear sites, based on its efforts to dig deeper, more protected centrifuge sites, such as the Fordow site. If Iran is judged to be building nuclear weapons, the probability of multilaterally sanctioned military action will increase. Despite the risks, this threat of military action can be useful to keep the pressure on the regime and draw redlines about the international community's tolerance for major violations.

This implied threat aimed at creating deterrence is in no way an endorsement of a pre-emptive military strike. For this strategy to be effective, Iran must sincerely believe that the United States or Israel may execute a military strike if it moves to build nuclear weapons. However, this remains a risky strategy. If Iran believes an attack is inevitable, it may increase its efforts to develop a nuclear weapon in secret in an effort to deter an anticipated military strike. Thus, managing an implied military threat requires careful balance, attention, and consideration and an avoidance of any commitment to a pre-emptive strike.

Interim Negotiated Measures

In order to reduce the likelihood of Iran deciding to pursue a nuclear future, interim agreements can play a useful role. They could increase the time needed for Iran to breakout, cap the enrichment level of LEU production, broaden the transparency of Iran's sensitive nuclear activities, and limit progress on new enrichment plants and advanced centrifuges. Iran can receive tangible benefits in return for narrowing its options to pursue nuclear weapons quickly and in secret. All sides could build valuable trust, something currently in short supply.

However, the United States and its allies should reject any Iranian effort to trade an interim concession for major sanctions relief or commitments to stop permanently seeking more sanctions. Significant sanctions relief is the proper subject of long-term negotiations (see next section). The inability to pay such a price in an interim agreement, however, likely limits the types of concessions Iran would be willing to make.

A range of possible interim measures with wide international support has emerged during the last several years.

Background

Fuel swaps and production freezes. To date, the most developed interim measure involves a deal in which Iran would swap part or most of its 3.5 and 19.75 percent LEU stock in return for 19.75 percent LEU fuel for the Tehran Research Reactor (TRR). If enough LEU were removed from the country, this measure would delay Iran's capability to dash to produce weapon-grade uranium. To make the proposal more meaningful, however, Iran should remove far more than the 1,200 kilograms of 3.5 percent LEU discussed in two past offers. In addition, Iran should send out all of its 19.75 percent LEU. A May 2010 agreement negotiated among Brazil, Turkey, and Iran failed to account for a large enough quantity of LEU after a similar swap agreement was floated but ultimately failed between Iran and the United States. In addition, this more recent agreement contained articles that greatly diminished the deal's value to the United States and the European Union.[16] A new agreement should correct these problems. If an adequate amount of LEU were sent out of Iran, the regime would be left with insufficient LEU for one nuclear weapon. With modifications, this interim measure would decrease concern about Iranian breakout and build confidence among the parties. However, Iran would likely continue producing LEU and could eventually restore its stockpile. Thus, this interim measure provides at best only temporary confidence building and more time to negotiate.

An effective but more modest proposal could involve a country selling Iran 19.75 percent LEU fuel for the TRR in exchange for Iran halting altogether the production of LEU over 5 percent. This measure would not involve Iran swapping out any of its 3.5 percent LEU, but it would require Iran's commitment to not enrich to higher levels, preventing dangerously short breakout times in the next year or two. In media interviews in the fall of 2011, Iranian President Mahmoud Ahmadinejad indicated his willingness to negotiate such a deal.[17]

To increase interest in this or the fuel-swap proposal, Iran could be offered new LEU target technology that is used to make Molybdenum-99. With these newer targets, Iran could increase the TRR's yield of Molybdenum-99 without the need for HEU.

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[16] ISIS critique of this agreement: http://www.isisnucleariran.org/assets/pdf/Iran_LEU_deal_17May2010.pdf.

[17] "Iran In Brief: Ahmadinejad Reiterates Willingness to Halt 20 Percent Enrichment" (Washington, D.C.: Institute for Science and International Security, September 22, 2011). Available at: http://www.isisnucleariran.org/brief/detail/ahmadinejad-reiterates-willingness-to-halt-20-percent-enrichment/.

As such, sales and cap agreements should not be expected to lead to any reductions in sanctions on Iran or the type of transparency the IAEA says is required. Despite the limited nature of such an agreement, capping, even temporarily, Iran's stock of 19.75 percent LEU would reduce concern that Iran is producing weapon-grade uranium piecemeal. This agreement would also provide humanitarian assistance by increasing Iran's supply of medical isotopes.

Alternatively, Iran's purchase of medical isotopes internationally could be subsidized, alleviating the need for the TRR or other research reactors to make isotopes, or for that matter, for Iran to produce 19.75 percent uranium. This could also be offered as an initial step in the above proposals to alleviate any immediate shortages in the supply of medical isotopes in Iran.

Additional IAEA monitoring and notification. There are several transparency measures that Iran has thus far resisted but that nonetheless would be worthwhile to continue pursuing as interim measures. These measures would make it harder for Iran to hide any dash to nuclear weapons and build secret centrifuge facilities.

One measure involves establishing remote IAEA monitoring at declared enrichment plants, which would allow a more prompt detection of any diversion of LEU. Similarly, Iran could allow IAEA inspectors to remain at its enrichment sites continuously.

Iran could also implement an agreement to notify the IAEA immediately before it begins construction on a new nuclear facility rather than notifying it six months before nuclear material is introduced to such a facility.[18] This step would improve international confidence in Iran's intentions and make the building of secret enrichment sites a violation of Iran's agreements.

Iran has sporadically provided the IAEA access to one of its centrifuge research and development facilities. It could commit to providing the IAEA regular access to all its centrifuge research, development, and manufacturing facilities.

Other Measures. There are a range of other interim measures that have been discussed that could reduce tension, increase transparency, and build confidence with the international community. The regime could announce that it will not build any additional centrifuge plants or that it will limit the number of advanced centrifuges enriching uranium at its facilities to fewer than 500.

Incentives for Iran

In any interim negotiation, Iran would want to receive incentives. It could identify the benefits it would like to receive in return for its cooperation and the international community should weigh them, with the exception of major sanctions relief. As discussed above, that should be offered in the context of a long-term solution.

Based on the public discussion, the following summarizes the most commonly discussed incentives in the context of an interim agreement:

- Provision of equivalent [to LEU deposited abroad] amount of 19.75 percent LEU fuel for TRR, starting within one year of date of agreement;
- Provision of LEU targets for medical isotope production;
- Provision of medical isotopes of the type that the TRR would produce; and,
- Commitment by P5+1 not to seek new U.N. Security Council sanctions for a defined period of time, contingent on implementation of agreement.

At the same time, the unlikely types of incentives are a reduction in sanctions or commitments not to add national or regional sanctions. In addition, Iran sought in the Turkey/Brazil/Iran Declaration to establish its unbridled right to uranium enrichment. But the P5+1 is unlikely to acknowledge Iran's right to uranium enrichment without a verified assurance that it is in compliance with the NPT, something sorely lacking today.

[18] The IAEA refers to this condition as implementing modified Code 3.1.

An Interim Agreement

Although there are many possible elements that could be folded into an interim agreement, only a few are realistic and worthwhile to seek outside the negotiations of a major settlement. Neither the P5+1 nor the Iranian regime is currently in a position to make major concessions or pay a major price for an interim agreement. However, there are several measures that are worth pursuing that would allow more time for more substantial negotiations and help build confidence in the value of those negotiations.

Table 4 evaluates the interim measures discussed above. The measures are ranked on their ability on an interim basis to inhibit breakout to weapons, improve detection of secret nuclear activities and sites, and prevent further development, diffusion, and protection of centrifuge assets. The table involves a ranking on a scale of 1-3 with 1 having the highest effect. The table shows that none of the measures are effective at accomplishing all three goals. As these are interim measures, the P5+1 should focus on the measures that impact Iran's ability to break out in the short term, deploy advanced centrifuges, and to diffuse and better protect its centrifuge assets.

The priority measures based on the ranking in table 4 include:

- Cap all enrichment at the level of five percent;
- Freeze of centrifuge installation at Qom (limit of two IR-1 cascades);
- Limit the number of advanced centrifuges enriching uranium to fewer than 500 and limit deployment exclusively to the Natanz PFEP; and
- Deposit all 19.75 percent LEU overseas.

These priority measures limit Iran's capability to break out quickly and forestall its creation of a deeply buried enrichment capability at Fordow. An interim agreement cannot be focused on the 19.75 percent LEU without also focusing on the advanced centrifuges or the potential for large numbers of IR-1s being installed at Fordow.

This set does not include Iran depositing most of its 3.5 percent LEU overseas. This stock is so large now that convincing Iran to part with 4,000-5,000 kilograms of 3.5 percent LEU hexafluoride may be difficult. Seeking the removal of a quantity of only 1,000-2,000 kg of LEU hexafluoride is not worthwhile.

The measures to increase transparency over Iran's program, while very valuable, are difficult to achieve in the sense that Iran would likely want a larger incentive for this concession than the P5+1 is willing to give at this time. For example, a commitment by Iran to reveal and open up its centrifuge research, development, and manufacturing facilities would likely need a concession that includes a commitment not to strike Iran militarily.

Table 4 Ranking Interim Measures, based on a set of criteria, priority measures are highlighted in blue
(Rank of 1-3 with a rank of 1 having the greatest effect.

Measures	Limiting enrichment levels and quantities	Limiting progress on centrifuge development and diffusion	Broadening transparency
Cap all enrichment at the level of five percent	1	3	3
Freeze of centrifuge installation at Qom	1	1	3
Commit to maintain all LEU hexafluoride stockpile at Natanz or Uranium Conversion Facility	3	2	2
Deposit 1,200 kg 3.5 percent LEU hexafluoride in Turkey	2	3	3
Deposit 4,000- 5,000 kg 3.5 percent LEU hexafluoride in two lots of 2,500 kg, one initially and the other one year later in Turkey	1	3	3
Deposit all 19.75 percent LEU overseas	1	3	3
Limit the number of advanced centrifuges enriching uranium to fewer than 500 and limit deployment exclusively to the Natanz PFEP.	1	1	3
Announce that it will not build any additional centrifuge plants	2	2	2

Establish remote IAEA monitoring at declared enrichment plants. Similarly, Iran could allow IAEA inspectors to remain at its enrichment sites continuously.	3	2	1
Implement an agreement to notify the IAEA immediately before it begins construction on a new nuclear facility rather than notifying it six months before the introduction of nuclear material. The IAEA refers to this condition as implementing modified Code 3.1.	3	2	1
Allow IAEA regular access to all its centrifuge research, development, and manufacturing facilities, including where it tests centrifuges without uranium hexafluoride.	3	3	1

Finding a Negotiated Long-Term Settlement

All measures aimed at constraining Iran are intended to be a means to an end. They are aimed at convincing Iran to verifiably demonstrate a commitment not to build nuclear weapons, including making all its past and current nuclear or nuclear-related activities transparent to the international community, in particular the IAEA. Many of the constraints could be halted immediately if Iran agreed to meaningful concessions over its nuclear program. Although reviving P5+1 long-term, meaningful negotiations with Iran currently looks difficult, bringing Iran into such negotiations must remain a central pillar of any strategy to keep it from getting nuclear weapons.

Elements of a Solution

Although Iran remains difficult to engage in a comprehensive negotiated solution, the shape of a future solution to the Iranian nuclear crisis is important to consider now. Several earlier attempts to engage Iran in a long-term solution have laid the basis for an acceptable outcome including illuminating creative diplomatic methods of achieving a compromise. The first was the "freeze for freeze" proposal, whereby Iran would have agreed to a cap or freeze on its enrichment program in return for a freeze in additional U.N. sanctions. More recently, Russia proposed a step-wise resolution to the issue, although it did not release its proposal publicly.

These earlier efforts have created a sound foundation to build on. One lesson is that because the situation is so complicated, the negotiating goal should be a framework agreement that can incorporate a series of stages where each step includes concessions by Iran matched with incentives or concessions by Iran's main negotiating partners.

It is useful to consider the elements of such an agreement and their relative irreversibility to ensure that Iran is deterred from conducting a covert breakout or dash to nuclear weapons. The following elements should be considered essential components of a long-term negotiated solution to the Iran nuclear crisis. They are motivated by other successful cases and explicated further below this list and in a theoretical framework agreement involving the elements being implemented in sequential stages.

- Iran satisfies the IAEA's concerns, including answering questions about the military dimensions of its program, and implements the Additional Protocol.
- Iran comes clean about its nuclear weapons or weaponization related activities and verifiably dismantles and halts any associated facilities and activities.
- Iran would agree not to produce enriched uranium above five percent.
- Iran suspends its enrichment program as a part of any deal, although the duration of a suspension could be limited, as stipulated in the Russian proposal, which suggests limiting the suspension to 1-3 months.
- The negotiating parties agree on the near- and longer-term scale and parameters of Iran's nuclear program. For some predetermined period, its sensitive nuclear activities would not exceed existing levels. (These last terms are taken from the Russian proposal and would need to be defined in a negotiation. But this terminology may be easier to work with than the idea of a freeze.) In the longer-term, Iran would commit to match any planned increases in its nuclear program to actual civilian needs in a manner that is transparent to independent scrutiny.
- The IAEA issues a determination that it has confidence in the absence of undeclared materials and facilities in Iran.
- Incentives for Iran must be guaranteed and difficult to reverse. Iran and the European Union developed lists of projects in 2005, 2006, and 2008 that could be the basis of an incentive package received by Iran,[19] as suggested in the Russian proposal.

[19] See offers included in past diplomatic initiatives at: http://www.isisnucleariran.org/documents/initiatives/,

- Sanctions would be suspended gradually, or step-wise, with flexibility for reintroduction. The Russian proposal contains a proposal for an orderly removal of all sanctions in a stage-wise manner in exchange for specific Iranian nuclear concessions. The Russian proposal could be the starting point of negotiations for the removal of most of the U.N. Security Council, unilateral, and multilateral sanctions, followed by U.S. sanctions.
- Iran would agree not to proliferate its nuclear or nuclear-related technologies and capabilities to others.
- U.N. Security Council sanctions resolutions and national trade controls affecting goods for Iran's nuclear and missile programs would remain in place. Key nuclear and missile sanctions would become verification mechanisms to ensure Iran's compliance with its agreements.
- Iran would commit not to engage in nuclear smuggling to obtain any goods for its nuclear or missile programs. During this period, Iran would need to be self-sufficient in outfitting its nuclear programs. This phase would likely overlap the period where Iran's nuclear program does not exceed existing levels, as discussed above.
- At a defined point, sanctions affecting Iran's nuclear program would be removed, and Iran would join the Nuclear Suppliers Group (NSG).

More on Key Elements

Iran satisfies the IAEA's concerns, including answering questions about the military dimensions of its program, and implements the Additional Protocol. Iran must resolve to the satisfaction of the IAEA all outstanding questions about its military nuclear activities. It should implement the Additional Protocol and place all enrichment and other nuclear fuel cycle-related activities under full IAEA supervision. This would include Iran's centrifuge R&D programs, manufacturing sites, mills and mines, reactors and heavy water production facilities, and any enrichment or other nuclear sites under construction about which it has not informed the IAEA. The IAEA would have the authority to conduct snap inspections at sites over which it has suspicion of undeclared nuclear activities, which would help detect and deter potential safeguards violations and clandestine activities. The IAEA would determine that it has confidence in the absence of undeclared materials and facilities in Iran. This last condition may not be satisfied until later in the implementation phase of an agreement, and its accomplishment should be linked to the provision of major incentives and sanctions relief.

Iran comes clean about its nuclear weapons and weaponization activities and verifiably dismantles and halts any associated facilities and activities. Iran must disclose its past and any ongoing nuclear weapons and missile delivery related activities, research, and development in a verifiable manner. Given the strong evidence for the existence of such efforts, particularly in the past, for Iran not to disclose such activities early in the process would likely undermine any agreement. Iran would need to provide verification that it has dismantled any military nuclear sites or activities. The international community would need to assure Iran that it would not be sanctioned over its admissions or have such information used against it in any way.

The cases of Brazil, South Africa, Libya, and Taiwan, all of which came clean about and dismantled past nuclear weapons or explosive activities, provide important lessons. Libya and South Africa worked extensively with the IAEA to verify the dismantlement of its nuclear weapons programs; a senior Brazilian official reporting directly to the President led the investigation and revelation of Brazil's military nuclear programs; and Taiwan secretly revealed its nuclear weapons efforts during the late 1980s to the United States. Some of these countries endured a regime transformation or change in regime behavior that led to a shift in policies toward nuclear weapons development. Each improved its international political and economic standing, and South Africa and Libya received a reversal of international sanctions after the dismantlement of their nuclear weapons programs. International embarrassment was always a concern but never a factor preventing the regimes from coming clean.

These cases provide several lessons for Iran and for those who think Iran should not be pressed to do likewise.

Even if Iran does not soon experience a change from theocracy to more representative democracy, the lessons of Libya in particular offer a way forward. Although the Libyan regime did not move toward democracy, the regime committed in a diplomatic deal with Britain and the United States to change its behavior and end its covert nuclear weapons programs. Libya saw sanctions quickly removed as part of this bargain, and the regime enjoyed a dramatic improvement in international political and economic standing for several years following.

Iran would need long-term security assurances against attack or foreign assistance aimed at regime overthrow in the event that it came clean and negotiated a long-term agreement providing assurance that its nuclear program would remain peaceful. However, security assurances cannot be absolute. Colonel Muammar Qaddafi may have wanted security assurances against all challenges to his rule, but no government was willing to go that far. No regime can expect such a security assurance. For example, a government cannot expect immunity if it commits a major, internationally-recognized humanitarian crime against its own people, such as those Colonel Qaddafi committed in 2011 against Libyan citizens that led to re-imposition of sanctions and the NATO mission to overthrow his regime.

Iran would agree not to produce enriched uranium above five percent. Iran must commit to stop producing LEU above 5 percent in the acknowledgement that it lacks any civilian rationale for 19.75 percent LEU production. Its president and other leaders have admitted continued production is uneconomical, and importing fuel for the Tehran Research Reactor make more sense. Iran would also need to cap and send out its growing stockpile of 19.75 percent LEU in order to reduce its ability to quickly enrich to weapon-grade uranium. Foreign offers of a guaranteed supply of fuel for this reactor should be given to Iran to meet its future reactor needs.

Early suspension of Iran's enrichment program must be part of any deal, although its duration would be limited. Iran should agree in the early stages of an agreement to suspend enrichment activities for a limited duration while other parts of the agreement are implemented. Suspension is a necessary confidence building measure. If Iran continued for example producing 19.75 percent LEU, building additional enrichment sites and manufacturing and installing new centrifuges, its activities would hardly instill confidence that its nuclear intentions are peaceful. Iran could eventually resume enrichment under agreed parameters.

The scale and parameters of Iran's nuclear program should be agreed upon. For a predetermined period, sensitive nuclear activities would not exceed existing levels. Subsequently, any planned increases would be both transparent and correlate to actual civilian needs. Negotiations must determine the fate of Iran's sensitive nuclear programs. But if Iran comes clean about and pledges to verifiably end its past and possibly on-going nuclear weapons efforts, the discussion about the future parameters of its nuclear programs can be eased considerably. At first, Iran should keep its nuclear activities consistent with past operations for some period. Afterwards, the parameters and scale of Iran's nuclear programs would need to be matched with a practical, evident civilian rationale.

Incentives for Iran must be guaranteed and difficult to reverse. Every effort should be made to ensure that incentives promised to Iran are followed through on quickly and are difficult to reverse. If Iran reneges on an agreement, the international community should, as a good faith effort, allow substantial time for re-negotiation before it reverses any incentives. The lack of a clause to make incentives irrevocable was one of Iran's stated concerns about incentives offered in previous years by the P5+1. This concern will need to be factored into any incentives package.

Sanctions would be suspended gradually, or step-wise, with flexibility for reintroduction. Sanctions on Iran would need to be suspended step-wise or gradually as Iran fulfills its commitments. The Security Council must agree at the outset that if Iran reneges on its commitments, sanctions will be put back in place with no objections. Since U.N. Security Council and some national sanctions are not flexibly lifted or reinstated, an agreement must leave in place the nuclear program sanctions until later stages after Iran has carried out measures to increase transparency and has established confidence in the absence of undeclared nuclear activities and materials, including nuclear weaponization activities. Non-nuclear sanctions could be separated from nuclear ones and lifted as incentives as Iran fulfills its agreements. Some countries could also flexibly lift national and regional sanctions earlier in the process, owing to simple administrative processes, such as the European Union or Japan. U.S. sanctions would require time and legislation to reverse.

Iran would agree not to proliferate its nuclear or nuclear-related technologies and capabilities to others. Iran should agree in early stages of an agreement not to proliferate sensitive nuclear technology to any potential or current proliferation partners. Intelligence assessments and law enforcement information about Iranian illicit procurement would be required to verify that Iran is not conducting prohibited nuclear trade.

UNSC sanctions resolutions and national trade controls affecting goods for Iran's nuclear and missile programs would remain in place; Iran would commit not to engage in nuclear smuggling to obtain any such goods for its nuclear or missile programs. Nuclear program sanctions and trade controls would remain in place until the final stages of an agreement since the parameters of what Iran will be allowed to import will first need to be worked out. The process would identify which nuclear and possibly missile sanctions will be needed as a core set of sanctions for future verification purposes and ultimately lift the others.

Key nuclear and missile sanctions would become verification mechanisms to ensure Iran's compliance. A core set of nuclear and missile sanctions would remain in place on Iran, requiring a verification regime to ensure the absence of military nuclear activities in Iran over the long term. This verification regime could build upon the mission of the current U.N. Sanctions Committee and the Panel of Experts on Iran, which now evaluates Iran's compliance with U.N. resolutions based on its illicit procurement efforts and could evaluate its compliance with its denuclearization agreements using the same information. This panel would continue reporting to the Security Council. This verification regime would complement the work of the IAEA and provide greater assurance of Iran's commitment not to seek or build nuclear weapons.

At some point, nuclear sanctions would be dropped, and Iran would join the Nuclear Suppliers Group (NSG). Iran would eventually join the Nuclear Suppliers Group and abide by its multinational export guidelines. Intelligence assessments and law enforcement information about Iranian illicit procurement would be required to verify that Iran is not conducting prohibited nuclear trade.

Structuring a Framework Agreement

The parties would need to agree upon an order and timing of addressing the issues, such as IAEA evidence of Iran's nuclear weapons work, a temporary halt to enrichment, parameters of continued enrichment, increased transparency and inspections, lifting of sanctions, and implementing incentives. The sooner Iran comes clean about its past and possibly on-going nuclear weapons activities, the more likely the negotiating process will succeed. Thus, Iran should fulfill this condition early in any framework agreement. Although Iran could always reduce its level of cooperation, the elements described here would provide more warning and earlier indications of its activities and intentions, giving the international community more time to act before Iran can produce a nuclear weapon.

A multi-stage framework would be the proper subject of negotiations. The Russian proposal provides one model for such a framework, although it suffers from too rapid of a decrease in sanctions to be acceptable. Under this plan, within two years, all sanctions would be dropped in exchange for major Iranian nuclear concessions. The Russian proposal also does not address directly the IAEA's concern about the military dimensions of Iran's nuclear program, particularly the historical dimensions of this concern. Iran claimed in late 2011 that it was still studying the Russian proposal. However, it is fairly simple in nature, and therefore Iran's claim is widely interpreted as a rejection of the proposed limitations on its nuclear program. For example, the first step in the Russian proposal would have Iran freeze the number of enriching centrifuges, concentrate all its enrichment activities within the Natanz plant, and not produce and install new generation centrifuges. In return, Iran would receive from the P5+1 a freeze on the imposition of additional national sanctions and a reduction in several sanctions included in Security Council Resolution 1929, such as travel restrictions on listed individuals.

Negotiators are the most competent to create a framework agreement and have the highest motivation to create a realistic one. But for purposes of discussion, a rough placement of the key elements identified above into stages is nonetheless useful for promoting discussion of the goals of a negotiation. Russia should also publicly release its proposal to add to that discussion.

Table 5 summarizes ISIS's rough proposal for a framework agreement with Iran in five stages. The five stages in brief are:

1. Updated "freeze for freeze"
2. Iran coming clean about its past and possible on-going nuclear weaponization activities and accomplishments and receiving significant sanctions relief
3. Intensive IAEA verification, temporary suspension of sensitive Iranian nuclear programs, and provisional suspension of U.N. Security Council sanctions
4. IAEA certification of absence of undeclared nuclear activities, resumption of Iran's nuclear program, provision of major incentives package, and end of U.S. sanctions
5. Growth of Iran's civil nuclear program and end of all remaining sanctions

Stages 1-4 could take a few years to accomplish because of the complexity of carrying out each step. Stage 5's implementation is more open ended.

Table 5. Creating A P5+1/Iran Framework Agreement: Preliminary Suggestions

Stage 1 (an updated "Freeze for Freeze" Proposal)

Iran

- Freezes the number of enriching centrifuges
- Caps the total number of installed centrifuges
- Concentrates all its enrichment activities within the Natanz and Qom plant
- Does not produce and install the new generation of centrifuges, except for a few test cascades already installed at the Natanz Pilot Fuel Enrichment Plant.
- Allows IAEA monitoring of all steps in this stage

P5+1

- Commits not to add any more U.N. Security Council or national sanctions.

Stage 2 (Iran "coming clean" in a verifiable manner about its past and possible on-going nuclear weaponization activities and accomplishments and receiving significant sanctions relief.)

Iran

- Comes clean in a verifiable manner about its nuclear weaponization activities
- Addresses the IAEA's concerns about the military dimensions of its nuclear program
- Produces only LEU enriched to below five percent in amounts consistent with its actual civilian needs
- Transports any uranium already enriched above five percent to Turkey; converts remaining stocks of LEU into uranium oxide or sells it abroad. The goal in this stage is to create a method to continuously reduce the inventory of LEU hexafluoride inside Iran below one or two tonnes at any one time.
- Agrees not to proliferate its nuclear or nuclear-related technologies and capabilities to others.

P5+1

- Sanctions provisions in U.N. Security Council resolutions are reduced, particularly bans on travel and asset freezes on certain listed individuals
- Some countries, such as the European Union, South Korea, and Japan, lift national and regional sanctions, including sanctions on Iran's central bank.
- The President of the United States waives U.S. sanctions on foreign entities that do business with Iran's central bank
- The P5+1 provides security assurances to Iran against military strikes. (Covert actions against Iran's nuclear program, including cyber attacks, by members of the P5+1 are suspended.)

- The nuclear weapon states of the P5+1 confirm to Iran their security assurances against the use of nuclear weapons against Iran as a non-nuclear-weapon state party to the Non-Proliferation Treaty under U.N. Security Council resolution 984 (1995). Although Israel is not explicitly involved in such a guarantee, its tacit acceptance could be sought.
- The implementation of a range of non-nuclear confidence building measures occurs, such as assistance on civil aviation, education, and scientific assistance
- If not already done earlier, the P5+1 ensures the sale of 19.75 percent LEU fuel and targets for the Tehran Research Reactor.

Stage 3 (Intensive IAEA verification, temporary suspension of sensitive Iranian nuclear programs, and provisional suspension of U.N. Security Council sanctions)

Iran

- Suspends enrichment-related and any reprocessing-related activities, including construction or operation of the heavy water reactor at Arak and any other heavy water-related projects
- IAEA gains regular access to entire centrifuge complex, including centrifuge R&D and component manufacturing locations
- Brings into force Additional Protocol
- Verifiably dismantles its nuclear weapons or weaponization-related facilities or activities. Ideally, the verification organization should be the IAEA, but the nuclear weapons states, or P5, may want to handle this step themselves.

P5+1

- Provisionally suspends U.N. Security Council sanctions, except those related to bans of importation of goods for Iran's nuclear and missile programs, and creates a U.N. Security Council verification regime monitoring those sanctions.

Stage 4 (IAEA certification of absence of undeclared nuclear activities, resumption of Iran's nuclear program, provision of major incentives package, and end of U.S. sanctions.)

Iran

- With full Iranian cooperation, IAEA arrives at a determination of the inspectors' confidence in the absence of undeclared nuclear materials or facilities in Iran
- In consultation with the P5+1, Iran agrees on the near- and longer-term scale and parameters of its nuclear program. For some predetermined period, its sensitive nuclear activities would not exceed existing levels. Iran would agree to discuss the replacement of the Arak heavy water reactor with other, more proliferation-resistant reactors (see below).
- Commits not to smuggle goods for its nuclear programs
- UNSC sanctions resolutions and national trade controls affecting goods for Iran's nuclear and missile programs would remain in place.

P5+1

- Starts the provision of a significant incentives package agreed upon by both sides, which would be built from earlier negotiations
- As part of the incentives package, the P5+1 provides Iran with nuclear reactors, including both power and research reactors. The provision of research reactors would serve to replace the Arak heavy water reactor.
- U.N. Security Council formally cancels all sanctions and requirements on Iran, except those related to the verification that Iran is not importing goods for its nuclear or missile programs
- Iran is removed from the agendas of the IAEA and the Security Council
- The United States lifts its national sanctions on Iran

Stage 5 (Growth of Iran's civil nuclear program and end of all remaining sanctions)

Iran

- Any expansion of Iran's nuclear programs is defined by civil needs and is fully transparent in its justification
- Commits to full cooperation with IAEA

P5+1

- Incentives package continues to be delivered
- At a defined point, sanctions affecting Iran's nuclear program are removed, and Iran is invited to join the Nuclear Suppliers Group.

CONCLUSION

The international community should not accept an Iran with nuclear weapons or Iran's continued hedging strategy. Towards that goal, it remains critical to delay, thwart, and deter Iran's improvement of its nuclear weapon capabilities and clearly signal that the costs of building nuclear weapons will be high. At the same time, opportunities to negotiate a way out of this crisis should be sought steadfastly.

The approach outlined above focuses on two alternatives forward for Iran: a future of potential economic prosperity and engagement or the status and limitations of an isolated pariah state. History has several examples, including the cases of South Africa, Brazil, Libya, and Taiwan, where regimes have renounced nuclear weapons or nuclear weapons programs in favor of transparency and improved international political and economic standing. None have done so without extensive external pressure or the threat of significant negative repercussions. In cases where pressure was applied ineffectively or haphazardly, as in the case of Pakistan, eventual nuclear weapons possession was ensured. At the same time, those that renounced nuclear weapons needed to see clear, positive incentives for taking such a monumental step. These cases also show that Iran should understand the terms of a settlement that would lead to international acceptance of its nuclear activities and that this agreement should clearly delineate what is unacceptable. Revealing its past and possibly on-going nuclear weapons activities must remain a key condition.

If Iran is unwilling to make concessions to negotiate a long-term solution, the strategy must remain the alternative path of complicating and constraining Iran's pursuit of nuclear weapons capabilities or the weapons themselves. Achieving interim negotiated measures, such as caps on enrichment levels and centrifuge deployments, would remain important. But the main effort would entail a strengthened effort to delay, thwart, and deter Iran's pursuit of nuclear capabilities. Such a strategy would make it less likely that the world would have to learn to live with Iranian nuclear weapons.

Iran has not broken out and made nuclear weapons even when able to do so on a timeline of six to twelve months. Iran is unlikely to decide to dash toward making nuclear weapons as long as its uranium enrichment capability remains as limited

as it is today. A range of factors today inhibits the regime from being able to quickly build nuclear weapons or deciding to do so. They include outside pressure and efforts, such as the threat of military action, a range of sanctions and the threat of more of them, international political pressure, the potential consequences of being caught again lying to the international community about its nuclear activities, sabotage of its illegally imported equipment and Security Council sanctioned facilities, and cyber attacks against its nuclear program. There are also domestic inhibiting considerations, such as loss of credibility if Iran builds nuclear weapons, concerns about the likelihood of starting a Middle East nuclear arms race, and worries about creating a far more dangerous region. By placing more constraints on its activities with strengthened and new policy measures which further deter, thwart, and delay its development of nuclear capabilities, Iran will likely be further inhibited from seeking nuclear weapons and find it increasingly difficult to expand its nuclear weapons capabilities.

An end to the Iranian nuclear threat requires a long-term strategy aimed at constraining, deterring, and ultimately changing decision making inside the Iranian regime. A prudent strategic endgame on Iran must acknowledge that demographic and economic shifts underway in Iran could to lead to an eventual turn from theocracy. A change in Supreme Leader could lead to a decision not to pursue nuclear weapons. The current environment in the Middle East makes this more likely to occur.

The international community must be prepared to signal for years if necessary that an Iran that seeks nuclear weapons will never be integrated. It must not acquiesce to Iran's current trajectory or give up on sanctions and other measures while accepting the current level of ambiguity over Iran's nuclear weapons aspirations. Instead, Iran must know it will endure the treatment of regimes like the South African apartheid government, which faced continuously improved sanctions for decades until it changed course. Instead of a failed effort to prevent the emergence of another nuclear weapons state, these strategies can make the case of Iran a historical lesson in deterring a country from building nuclear weapons.

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