Testimony of David Albright
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on
Reversing Iran's Nuclear Program:
Understanding Iran's Nuclear Program and
Technically Assessing Negotiating Positions

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Iran has invested heavily in nuclear industries in the last thirty years. However, its investments, often made in secret and dominated by black market purchases, have not been consistent with a strictly peaceful nuclear program.

Despite many setbacks over the last three decades, Iran has found suppliers to provide the wherewithal to build many nuclear facilities. One of the most important suppliers was A.Q. Khan and his network of business associates in Europe, Asia, and Africa. They provided Iran in the 1980s and 1990s with many key requirements necessary to build and operate gas centrifuge plants. Without their assistance, Iran would have likely been unable to develop a successful gas centrifuge program. Since then, Iran has depended extensively on illicit foreign procurement of a wide range of nuclear-related dual-use goods to outfit many of its nuclear efforts. Those efforts continue today.

Iran's current nuclear infrastructure is large. It has two gas centrifuge sites, the underground Natanz plants and the deeply buried Fordow enrichment plant. It has stated plans to build a total of ten enrichment plants and suspicions are growing that it is building another one in secret. It is operating a large power reactor at Bushehr and maintains relatively large uranium conversion and fuel fabrication facilities near Esfahan. It is nearing completion of a heavy water reactor at Arak that appears better suited to make plutonium for nuclear weapons than to produce medical isotopes for civilian use.

If Iran decided to produce nuclear explosive materials today, it could use its gas centrifuge program to produce weapon-grade uranium (WGU). However, Iran's fear of military strikes likely deters it at this time from producing WGU or nuclear weapons. However, if its centrifuge plants expand as currently planned, by the middle of 2014 these plants could have enough centrifuges to allow Iran to break out so quickly, namely rapidly produce WGU from its stocks of low enriched uranium, that the International Atomic Energy Agency (IAEA) would likely not detect this breakout until after Iran had produced enough WGU for one or two nuclear weapons. ISIS calls this a "critical capability."

If the Arak reactor operates, Iran could also create a plutonium pathway to nuclear weapons. This reactor can produce enough plutonium each year for one or two nuclear

weapons, heightening concerns that Iran aims to build nuclear weapons. Its operation would needlessly complicate negotiations and increase the risk of military strikes.

Current Enrichment Status and Low Enriched Uranium (LEU) Stocks

Iran began enriching uranium in its main enrichment facility, the Fuel Enrichment Plant (FEP), near Natanz in February 2007. Over the past six years, Tehran has increased the number of enriching centrifuges at Natanz to more than 9,000 IR-1 centrifuges, added a set of tandem IR-1 centrifuge cascades in the Pilot Fuel Enrichment Plant (PFEP) at Natanz, and commenced enrichment at the fortified, underground Fordow Fuel Enrichment Plant (FFEP) in two sets of tandem IR-1 cascades. Additionally, Iran has worked to improve its cascade design and greatly increased its skill in operating centrifuge cascades. While the IR-1 is not an advanced centrifuge, and while its performance in Iran has been subpar, Iran's IR-1 cascades still could be employed effectively to make WGU.

Iran has in the last two years installed many thousands of additional centrifuges at its facilities. Although it has not begun enriching in these machines, the vast majority are fully installed and under vacuum, meaning that Iran could quickly begin feeding natural uranium into these cascades and more than double its enrichment capacity.

As of the August 2013 IAEA safeguards report on Iran, Iran had installed an additional 6,250 IR-1 centrifuges for a total of 15,416 IR-1 centrifuges at the Natanz FEP. Iran has also begun installing its advanced centrifuge, the IR-2m, a centrifuge with a capacity three to five times greater than the IR-1 centrifuge, at the FEP. As of August, Iran had fully installed 1,008 IR-2m centrifuges there and was preparing to fully install over 3,000 of these machines at the FEP. Even if Iran installs no additional IR-2m centrifuges, these installed IR-2ms are equivalent to 3,000 – 5,000 IR-1 centrifuges.

Iran has nearly fully outfitted the Fordow facility with IR-1 centrifuges, although it continues to enrich in only 696 centrifuges. Another 2,014 IR-1 centrifuges are installed, for a total of 2,710 IR-1 centrifuges. If all these centrifuges are devoted to making near 20 percent LEU, Iran could nearly quadruple its output of this material to over 40 kilograms (kg) per month.

In total, at the Natanz pilot plant, the Natanz FEP, and the Fordow site, Iran has installed 18,454 IR-1 centrifuges in production-scale cascade. To this must be added the 1,008 IR-2m centrifuges installed at the FEP. These results are summarized in table 1.

During this time, Iran has also enriched and stockpiled a significant amount of uranium. According to the August 2013 IAEA safeguards report, it has produced in total 9,704 kilograms of uranium hexafluoride enriched to 3.5 percent, some 2,877 kg of which has been further enriched at the Natanz pilot plant and the Fordow enrichment plant to produce 373 kg of near 20 percent LEU hexafluoride. As of August, Iran held a net 6,774 kg of 3.5 percent LEU hexafluoride and 186 kg of near 20 percent LEU hexafluoride, having converted a portion of its near 20 percent fuel to uranium oxide

suitable for fuel assemblies for the Tehran Research Reactor (TRR). These stockpiles are monitored by the IAEA, but if Iran chose to break out from its obligations under the Nuclear Nonproliferation Treaty (NPT), the stored LEU in both hexafluoride and oxide form would be available for the production of WGU. Table 2 summarizes these inventories.

Based on the IAEA August 2013 safeguards report on Iran, Iran had converted no more than 30 kilograms of near 20 percent LEU, or 45 kilograms of near 20 percent LEU hexafluoride, into fuel assemblies for the TRR. This represents approximately 12 percent of Iran's total stock of near 20 percent enriched uranium, or only about 25 percent of the amount of LEU Iran has sent to Esfahan for conversion.

Unless the near 20 percent LEU oxide is converted to fuel assemblies and irradiated, it can relatively easily be reconverted to uranium hexafluoride suitable for further enrichment. Even if Iran began rapidly producing fuel assemblies for the TRR, due to the small size of the research reactor, Iran cannot realistically irradiate this fuel.

As such, conversion into an oxide form cannot be seen as a significant confidence building measure on its own. Even so, Iran should be commended for taking measures to convert its uranium to uranium oxide at the Esfahan facility. Although conversion of uranium hexafluoride into uranium oxide and fabrication into fuel elements does limit Iran's ability to quickly use this material in a breakout scenario, the only iron-clad way to prevent its further enrichment is for an outside country to hold this material in escrow prior to irradiation.

Iran has been careful to convert sufficient near 20 percent LEU hexafluoride to keep its total stockpile of this material under the redline established by Israel of about 240-250 kilograms of near 20 percent LEU hexafluoride. These values are a rough measure of the amount of this LEU needed for further enrichment to produce about 25 kilograms of WGU, widely recognized as enough for a nuclear weapon.

These data show that Iran has produced far more LEU than it needs, whether the LEU is near 20 percent enriched or 3.5 percent enriched. Thus, a halt to enrichment would still leave Iran with a sizeable stock of LEU that is far in excess of its current needs.

Iran's Shortening Breakout Times

A central consideration in assessing the threat of Iran building nuclear weapons is the timeline for Iran to acquire them following a decision to do so. 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. It would take Iran longer to build a deliverable warhead for its Shahab 3 or Sajiil 2 ballistic missiles because Iran is believed to require more time to master the construction of a reliable, miniaturized warhead for these missiles.

Overall, Iran would likely need anywhere from a few months to about a year to build a crude nuclear explosive device and longer to build a warhead for a ballistic missile. The "long pole in the tent" of such an effort is Iran's lack of sufficient WGU. It is assessed as not possessing WGU, and thus its priority would be the production of enough for a nuclear weapon, or more likely several nuclear weapons.

In that light, Iran may seek to divert its existing stocks of LEU, enriching this material further up to weapon-grade as fast as it can. Iran's goal would be to accumulate enough weapon-grade uranium before it was detected and the United States and other nations responded, likely militarily destroying the facilities doing the enrichment.

Over the last several years, ISIS in collaboration with U.S. centrifuge specialists at the University of Virginia have estimated Iranian breakout times under a variety of circumstances. These estimates seek to determine a minimum time for Iran to accumulate enough weapon-grade uranium for a nuclear weapon. In practice, breakout times may be even longer than predicted. For example, Iran may know in theory how to enrich to weapon-grade but in practice may encounter difficulties and unexpected inefficiencies. Iran has found enrichment very difficult and far more time consuming than expected. Nonetheless, one central trend in these calculations is that as Iran has further developed its gas centrifuge capabilities and increased its inventories of LEU, breakout times have shortened significantly.

How quickly could Iran break out today at the Natanz and Fordow enrichment plants?

The two main enrichment sites at Natanz and Fordow contain a total of 18,454 IR-1 centrifuges (see table 1). In order to conduct a dash using safeguarded LEU at Natanz and Fordow, Iran would need to violate its commitments under the NPT, including diverting the LEU from IAEA safeguards. In that effort, however, Iran would need to make only minor modifications in the enrichment plants before starting to enrich to weapon-grade levels. We assess that these modifications today would take at least two weeks to accomplish.

Recent estimates by the University of Virginia experts and ISIS incorporate the data from the August 2013 IAEA report on Iran. According to this estimate, if Iran used some of its existing stock of 3.5 percent LEU, all of its near 20 percent LEU hexafluoride, and all of its installed IR-1 centrifuges, it could dash to produce one significant quantity (SQ) of WGU needed for a nuclear weapon, or 25 kilograms of WGU, in 1.0 – 1.6 months. If it used in addition the installed IR-2m centrifuges at Natanz and Fordow, it could reduce this breakout time to 0.9 – 1.4 months.

If Iran chose to dash at these plants to WGU without using its near 20 percent LEU stockpile, it could produce 25 kg of WGU in 1.9 – 2.2 months with its IR-1 centrifuges, or in somewhat less time if it also used its installed IR-2m centrifuges at the FEP. Iran currently has enough 3.5 percent inventory to produce approximately 100 kg of WGU, according to this estimate.

These estimated breakout times today are sufficiently long enough to allow for detection by IAEA inspectors and a military response that could end further production. However, breakout times are growing dangerously short as Iran builds up its stock of near 20 percent LEU hexafluoride and installs more centrifuges.

Critical Capability

Although Iran is engaged in nuclear hedging, no evidence has emerged that the regime has decided to 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 sufficient WGU quickly and secretly.

ISIS measures Iran's progress through an indicator called critical capability, shorthand for an Iranian capability to produce one or two weapons worth of WGU using a stock of sufficient near 20 percent LEU while avoiding detection by the IAEA and time for action to be taken to stop it. Iran would achieve this capability principally by implementing its existing, firm plans to install thousands more IR-1 centrifuges, and perhaps a few thousand IR-2m centrifuges, at its declared Natanz and Fordow centrifuge sites and to learn to start up WGU production faster than it is judged capable of doing today. ISIS currently assesses that Iran will reach critical capability in mid-2014 if it continues on its current trajectory.

Iran's critical capability date could be achieved a few months earlier. For example, it could happen earlier if Iran successfully deployed and operated several thousand IR-2m centrifuges while continuing to install and operate more IR-1 centrifuges.

To delay this critical capability date, the most important condition that could be placed on Iran is achieving a halt to the installation of more centrifuges of any type. Any future nuclear agreement must include a limit on the number and type of centrifuges Iran can install. A numerical limit would need to be well below the number of centrifuges currently installed at Natanz and Fordow and below the number of centrifuges actually enriching in the summer of 2013, when the level was around 9,000 IR-1 centrifuges. In determining this limit, each IR-2m should be treated as equivalent to 3-5 IR-1 centrifuges. Once data are available on the ability of IR-2m cascades to enrich uranium, this equivalence can be better defined.

Nuclear Weapons Program

During the last several weeks, Iranian officials, including President Hassan Rouhani and Foreign Minister Mohammad Javad Zarif have emphasized that Iran has never pursued or sought a nuclear bomb. Unfortunately, the available evidence provides little reason to believe them. If Iran wants the world to believe it will not build nuclear weapons in the future, the Iranian government should reconsider its blanket denials of ever seeking nuclear weapons in the past.

The U.S. intelligence community in a 2007 National Intelligence Estimate (NIE) stated: "We assess with high confidence that until fall 2003, Iranian military entities were working under government direction to develop nuclear weapons." It added: "We assess with moderate confidence Tehran had not restarted its nuclear weapons program as of mid-2007, but we do not know whether it currently intends to develop nuclear weapons." Our European allies, Britain, France, and Germany, agreed that Iran had a sizeable nuclear weapons program into 2003. However, they differed with the NIE's post-2003 conclusion. They assessed that Iran's nuclear weaponization program continued after 2003, albeit in a smaller and less structured manner.

A March 31, 2012 New York Times story by James Risen reported that the 2010 National Intelligence Estimate assessed that "while Iran had conducted some basic weapons-related research, it was not believed to have restarted the actual weapons program halted in 2003." In an earlier article on March 17, 2012, Risen wrote: "Iran says its nuclear program is for peaceful civilian purposes, but American intelligence agencies and the International Atomic Energy Agency have picked up evidence in recent years that some Iranian research activities that may be weapons-related have continued since 2003, officials said. That information has not been significant enough for the spy agencies to alter their view that the weapons program has not been restarted." But Risen reporting shows that U.S. intelligence found evidence that research on nuclear weapons may have continued after 2003.

These assessments are in-line with the IAEA's findings. In its November 2011 safeguards report, the IAEA provided evidence of Iran's pre- and post-2003 nuclear weaponization efforts. The IAEA found, "The information indicates that prior to the end of 2003 [the activities] took place under a structured programme. There are also indications that some activities relevant to the development of a nuclear explosive device continued after 2003, and that some may still be ongoing." Several years of efforts by the IAEA to resolve these concerns have proven fruitless. The IAEA is scheduled to meet Iran in late October to discuss these issues again, where Iran has indicated it wants to make substantive progress.

Thus, these intelligence and IAEA assessments differ markedly with Iranian blanket denials about seeking nuclear weapons. Moreover, they share a view that Iran may have continued researching nuclear weapons in more recent times.

These intelligence agencies also share an assessment that Iran has not made a decision to build nuclear weapons. So, President Rouhani's pledge that Iran will not build nuclear weapons can still be realistic. And his apparent willingness to seek meaningful negotiations offers the first hope in several years that an agreement solving this nuclear crisis is possible. However, if Iran is unwilling to detail its past efforts to build nuclear weapons, or at the very least acknowledge the existence of a program, it undermines the credibility of statements about its present-day nuclear intentions.

If Iran truly does not intend to pursue nuclear weapons in the future, it should heed the experience of states that abandoned nuclear weapons. Brazil and South Africa described

their past nuclear weapons efforts as part of their successful process to convince the international community that they had turned their back on nuclear weapons and would not seek them in the future. Brazil admitted its past nuclear weapons work at the start of its renunciations of all nuclear explosives. South Africa mistakenly chose the path of trying to deny that it ever had nuclear weapons as it limited its nuclear programs to civil activities and greatly increased transparency over its remaining nuclear programs. But South Africa's approach did not work; too many governments knew that it had had a nuclear weapons program and wondered if the deception meant that it was hiding on-going nuclear weapons efforts. The IAEA, which was intensely investigating South Africa's nuclear activities, shared this skepticism. South Africa's deception poisoned the well.

In March 1993, President F.W. de Klerk announced to the world that indeed South Africa did have nuclear weapons but had destroyed them several years earlier. He invited the IAEA to verify his statements. The IAEA did so in a half year because of South Africa's remarkable cooperation with the inspectors. South Africa's pledge that it would never seek nuclear weapons again suddenly became much more credible. These transparency measures quickly convinced the world of South Africa's sincerity.

Iran may fear that it will be treated differently. The Iranian government may reason that if it comes clean about its past activities, it will be punished by the international community. But other cases argue against such a response. The key is admitting these past activities should be part of a process of placing strategic limitations on its nuclear programs, instituting far greater transparency, and adhering to frankness about its past. The IAEA and governments can then develop confidence that Iran is not seeking nuclear weapons. But if Iran seeks to continue to hide its past military nuclear efforts, it may find that no amount of limitations and transparency on its current programs is enough to reassure the international community. Significant questions about its motives would likely remain, and thus it would be less likely to gain the major relief from sanctions it so desperately seeks.

Is Iran building a secret gas centrifuge plant?

The question of whether Iran is building a third enrichment plant in secret has been an open one since then Iranian nuclear chief Ali Akbar Salehi claimed on August 16, 2010 that "studies for the location of 10 other uranium enrichment facilities" had ended, and that "the construction of one of these facilities will begin by the end of the (current Iranian) year (March 2011) or start of the next year." Succeeding nuclear head Fereydoun Abbasi-Davani said in mid-2011 that construction on additional enrichment plants was delayed by two years. Now, over two years later, is Iran building a new centrifuge plant in addition to the Natanz and Fordow centrifuge plants? Or is the plant deferred for another year? Iran in the past secretly constructed the Natanz centrifuge site, the Kalaye Electric centrifuge research and development plant, and the deeply buried Fordow centrifuge facility.

Since March 2007, Iran has taken the position that it does not have to notify the IAEA if it begins construction of a nuclear facility, but the IAEA says that Iran has a legal obligation to do so under its current safeguards agreement. Iran's provision of information about the construction of any new enrichment sites is pertinent to instilling confidence about the peaceful nature of its nuclear activities and that it will not make weapon-grade uranium in secret.

It remains for Iran to abide by the simple provision of its IAEA safeguards agreement, modified Code 3.1, to provide the IAEA with advance information about its construction of additional enrichment facilities and to explain any current construction of a third enrichment site. In avoiding its responsibility under its safeguards agreement, Iran risks that any site subsequently discovered being built in secret will be viewed as a threat, increasing the risks of military confrontation and undermining the credibility of President Rouhani and the regime.

But an important question is how quickly could a secret site outfitted with IR-2m centrifuges produce WGU? Little is known about Iran's manufacture of these centrifuges or the total number manufactured to date or planned to be made in the next year. The IAEA is currently unable to monitor centrifuge manufacturing.

To understand this case better, ISIS and its University of Virginia collaborators performed two estimates. Each assumes that the covert plant contains 3,000 IR-2m centrifuges, a size consistent with the Fordow plant, and the plant design has other similarities to that of the Fordow plant (in particular that the covert plant is not optimized for weapon-grade uranium production). The output of each centrifuge is considered slightly more than about 3-5 times that of the IR-1 centrifuges.[1]

The first case considers that Iran would divert safeguarded stocks of LEU to this plant. The IAEA would detect the diversion of the LEU within a few weeks; however, the centrifuge site would be unknown and immune from military strikes, complicating enormously any U.S. or international response. In this case, Iran would use both of its 3.5 percent and near 20 percent LEU stocks, which are assumed to be at current levels. In this case, Iran could produce 25 kg of WGU in 1.3 – 2.3 months before using up its current stock of near 20 percent LEU stockpile. Without using its 20 percent stockpile, and using only its 3.5 percent LEU stock, Iran could produce 25 kg of WGU in 2.2 – 4.5 months with enough 3.5 percent inventory for approximately 100 WGU. If Iran had sufficient near 20 percent LEU for one nuclear weapon, it could reduce breakout times to about one month.

The second case is that Iran would not use its safeguarded LEU but a secret stock of natural uranium hexafluoride that it produced at a secret production plant.
In this case, Iran would need 6.4 to 11 months to produce 25 kg of WGU.

[1] Each IR-2m centrifuge is assumed to have an output of 3-5 separative work units per year.

Identifying and Assessing Necessary Concessions by Iran in Negotiations

As part of understanding the proposed negotiating process, it is useful to discuss the range of concessions that Iran could make in order to gain confidence that it is not seeking nuclear weapons. Incentives involving sanctions relief are equally important and are not considered here but an ISIS report prepared for the U.S. Institute of Peace includes this analysis. The following list includes a wide range of Iranian concessions. The final list would of course be decided in a negotiation and Iran may or may not agree to all of the following:

Resolving outstanding issues with the IAEA over the military dimension

- Address cooperatively the IAEA's concerns over its past and possibly on-going military nuclear activities. "Coming clean", or detailing past work on nuclear weapons, remains critical.

Limiting breakout times

- End production of any more near 20 percent LEU and commit not to enrich uranium over five percent. Dismantle and decommission the tandem cascades at the Fordow site and the Natanz Pilot Fuel Enrichment plant

- Send out under IAEA custody stocks of near 20 percent LEU in excess of near-term needs of the Tehran Research Reactor.

- Decommission the Fordow enrichment site.

- Commit not to assemble a production line to reconvert enriched U_3O_8 to UF_6, whatever its enrichment level.

- Freeze the number and type of Iran's installed centrifuges to below an equivalent of 10,000 IR-1 centrifuges. Limit enrichment to the Natanz site only.

- Send out under IAEA custody excess stocks of LEU enriched below five percent. Stocks could be considered excess if over the next several years, they are unlikely to be used to fuel a nuclear reactor. The total stock should be less than the equivalent of 1 tonne of LEU hexafluoride.

- Convert all LEU remaining in Iran first into an oxide form and then into a solid fuel form

- Halt production of LEU enriched less than five percent, unless there is an economic need for domestically produced LEU fuel in a reactor.

- Halt the construction of centrifuge components and the assembly of centrifuges, except a limited number to replace broken centrifuges at existing enrichment sites.

Increasing transparency

- Enhance IAEA monitoring, including:
    - implementing early notification of the construction of nuclear plants (or more formally implement modified code 3.1. of the Subsidiary Arrangements to Iran's Comprehensive Safeguards Agreement),
    - ratifying the Additional Protocol,
    - increasing the monitoring of centrifuge production and assembly facilities, and
    - establishing remote monitoring at key nuclear sites.

Ending a plutonium pathway

- Halt the construction and operation of the Arak heavy water reactor. Initiate studies to determine the feasibility and cost of converting the reactor to a light water moderator and LEU fuel.

- Commit not to conduct any plutonium separation or reprocessing activities

Halting illicit nuclear trade and proliferation to other countries

- Commit not to engage in nuclear smuggling to obtain any goods for its nuclear or missile programs. Key nuclear- and missile-related sanctions would become verification mechanisms to ensure Iran's compliance with its agreements.

- Agree not to proliferate nuclear technologies to other countries.

Experts may differ over the relative importance of each concession, and negotiators may add or subtract concessions. However, most of these concessions would be expected to be needed in a final agreement that would establish confidence that Iran is not seeking nuclear weapons and that would provide confidence that an Iranian effort to do so would be detected in a timely manner, allowing adequate time for an international response to prevent Iran from successfully building nuclear weapons. As such, this list of concessions provides an indication of the difficult work needed to achieve an agreement that would lead to a significant reduction of sanctions.

Some would argue that all of these concessions are not possible to achieve in an agreement with Iran. In that case, it is important to consider trade-offs. Some can undoubtedly be weakened or avoided. Whether the agreement allows 5,000 or 10,000 IR-1 centrifuges may not matter that much if other conditions are in place. Likewise, the tonnage of 3.5 percent LEU in Iran is certainly adjustable. Perhaps no 3.5 percent LEU needs to leave Iran. Some may also be startled by a condition to make the enrichment of LEU dependent on an economic evaluation of the need for reactor fuel, but such a condition is what drives most civilian nuclear programs. And if there is a settlement, Iran would be able to buy reactor fuel abroad at a lower cost than required to make the fuel itself. The imported fuel would be safer and more reliable, given that it would come from venders with decades of experience. Thus, an economic constraint on the enrichment of uranium is reasonable and would certainly make verification of any agreement easier.

In some cases, dropping a concession could be highly problematic for the success of an agreement. For example, it is instructive to consider that Iran is now sticking by its story that it never had a nuclear weapons program and this would not satisfy the IAEA in its investigation about past and possibly on-going nuclear weapons work. In this case, there would remain significant suspicions about whether Iran is maintaining a capability to build nuclear weapons. In response, an agreement would probably need to contain much more stringent limitations on Iran's enrichment capabilities and its centrifuge manufacturing facilities. Likely, many would demand that Iran agree to zero centrifuges or the dismantlement of its centrifuge program, a condition not included above, or a cap of far fewer centrifuges than the equivalent of 10,000 IR-1 centrifuges mentioned above. These concerns are driven by numerous verification uncertainties generated by an active, relatively large centrifuge program, and the IAEA currently having little hope of finding secret nuclear sites or verifying their absence. Iran's ratification of the Additional Protocol would help but even that may not be sufficient for the IAEA to determine with high enough confidence the absence of a secret centrifuge site to satisfy key IAEA member states, particularly when ambiguities arise, as is inevitable in such a complicated agreement. Moreover, under an Additional Protocol, or even the current Comprehensive Safeguards Agreement, the inspectors would be obligated to return over and over again to these alleged nuclear weapons issues as part of determining on an on-going basis the correctness and completeness of Iran's nuclear declaration and developing confidence that no nuclear material has been diverted to a nuclear weapons program. The main difference would be that the Additional Protocol would grant the IAEA more tools to pursue their completeness investigations, generating more opportunities for conflict between Iran and the IAEA. Instructing the IAEA not to determine the completeness of Iran's declaration could damage the IAEA's credibility and greatly undermine confidence in ability to verify an agreement.

Thus, some concessions may be obligatory if an agreement is to succeed. It is imperative to determine the critical concessions and the risks posed by omitting others as soon as possible.

Additional Measures to Limit Iran's Ability to Expand its Nuclear Programs

The Chairman has also asked for additional measures to pressure Iran and limit its ability to outfit its nuclear programs. ISIS just released a major report, the Future World of Illicit Nuclear Trade: Mitigating the Threat, written in part under a grant from the Project on Advanced Systems and Concepts for Countering Weapons of Mass Destruction (PASCC) at the Center on Contemporary Conflict, Naval Postgraduate School. This report is the result of a two-year original research effort and contains a characterization of future threats over the next five to ten years related to augmented nuclear trafficking worldwide and more than 100 recommendations aimed at preventing the emergence of these threats, including many related to better limiting Iran's nuclear progress.

I would like to mention two key recommendations detailed in our report that would increase the effectiveness of sanctions against Iran's nuclear programs. They are:

- The U.S. government would announce it will designate China and Hong Kong, key persistent trans-shippers of U.S. goods to Iran's nuclear program despite years of diplomatic overtures, as destinations of diversion concern under the Comprehensive Iran Sanctions, Accountability, and Divestment Act (CISADA) unless they make concrete changes within a given grace period. Just the threat of making this designation could inspire action on the parts of China and Hong Kong, as it did with the United Arab Emirates in 2007. If made official, such designations could reduce the supply to Iran of proliferation-sensitive goods, services, or technologies by: enhancing scrutiny by U.S. government licensing agencies of specific proliferation-sensitive exports from the United States to China and Hong Kong; increasing pressure on the Chinese and Hong Kong authorities to crack down on diversion through their territories to Iranian end-users and Iranian intermediaries; and helping secure support from other countries which likewise face challenges in ensuring that sales to China and Hong Kong do not end up in Iran, allowing it to expand its nuclear programs.

- The U.S. government should increase its use of sting operations and investigations aimed at stopping Iran's illicit nuclear procurement networks and launch a major effort to encourage other governments to initiate their own sting operations against trafficking in nuclear-related commodities. Few governments conduct this type of sting operation, and U.S. sting operations against Iranian smugglers have been particularly effective. Implementing this recommendation would help create an additional risk factor for Iran and those helping Iran outfit its nuclear programs. The United States should work with global partners to assist them and coordinate with them on conducting their own or joint sting operations.

Table 1 NUMBER OF CENTRIFUGES ENRICHING AND/OR INSTALLED IN IRAN

LOCATION	IR-1 Centrifuges Enriching	IR-1 Centrifuges Installed*	IR-2m Centrifuges Enriching	IR-2m Centrifuges Installed
FEP	9,166	15,416	0	1,008
PFEP**	328	328	0**	N/A
FFEP	696	2,710	0	0
TOTAL	10,190	**18,454**	0	**1,008**

*Number of centrifuges installed includes enriching centrifuges.

**Iran has installed a number of different types of centrifuge in different cascade configurations at the PFEP. This table disregards centrifuges from which Iran recombines product and tails.

Table 2 CUMULATIVE TOTALS OF NATURAL AND ENRICHED URANIUM FEED AND 3.5 AND 19.75 PERCENT LEU HEXAFLUORIDE PRODUCT IN IRAN

LOCATION	**0.711 percent feed**	**3.5 percent LEU product**	**3.5 percent LEU feed**	**19.75 percent LEU product**
FEP	110,590 kg	9,704 kg	N/A	N/A
PFEP	N/A	N/A	1,455 kg	178 kg
FFEP	N/A	N/A	1,422 kg	195 kg
GROSS TOTAL	110,590 kg	9,704 kg	2,877 kg	373 kg
NET TOTAL	110,590 kg	6,774 kg*	2,877 kg	186 kg**

*Number is less 3.5 percent enriched uranium hexafluoride used as feedstock at the PFEP and FFEP as well as 53 kg 3.5 percent LEU hexafluoride converted to uranium oxide.

**Number is less 185 kg of 19.75 percent LEU hexafluoride fed into the process at the Esfahan conversion and fuel fabrication plants and 1.6 kg 19.75 percent LEU hexafluoride down blended.