Key Limitations on Iran's Uranium Enrichment Program

By Olli Heinonen, October 2014

Introduction

In the preamble of the November 2013 Joint Plan of Action (JPOA), the P5+1 concurred that a comprehensive agreement would involve an Iranian domestic enrichment capability. This concession, immediately pocketed by Tehran, marked a fundamental change in the negotiations. Instead of a complete suspension of enrichment and reprocessing activities, as called for in multiple Security Council resolutions and a foundational plank of all previous negotiating positions, the P5+1 negotiators are now attempting to reach a comprehensive agreement with Iran that will establish a credible "threshold time window," or "breakout time,"[1] which would provide sufficient time to detect breakout and give the international community adequate time to respond to Iranian violations. "Breakout" means the point at which Iran could dash to produce enough weapon-grade uranium (or separated plutonium) for one bomb so quickly that the IAEA or a Western intelligence service would be unable to detect and respond to the dash in time. Obama administration officials have reportedly sought a breakout time of six months to one year.[2]

To achieve this goal, P5+1 negotiators are seeking agreement with Iran on defining the scope and features of Iran's nuclear program to irreversibly reduce its enrichment capacity[3] and implement a robust monitoring and verification process to detect and deter any potential Iranian breakout to a nuclear weapon. ***But achievement of such an agreement is highly unlikely, as it would require Iranian negotiators to abandon the stated positions of their Supreme Leader,*** who has recently demanded that Iran's enrichment capacity be increased to 190,000 SWU (Separative Work Units) ostensibly to produce fuel for Bushehr.[4] As Iran's current 18,000

1. Breakout time is the time required to produce enough weapons grade uranium (WGU) for one or more nuclear weapons. The amount of WGU needed for a nuclear weapon is one significant quantity (SQ), which is commonly defined as 25 kilograms of 90 % enriched uranium.

2. Jay Solomon & Laurence Norman, "Obama Administration Shows Optimism on Iran Nuclear Talks," *The Wall Street Journal*, April 7, 2014; (http://online.wsj.com/news/articles/SB10001424052702303456104579487582292336344) & Stuart Winer, "Kerry: Iran Could Produce Nuclear Bomb In Two Months" *Times of Israel*, April 9, 2014. (http://www.timesofisrael.com/kerry-iran-could-produce-nuclear-bomb-in-two-months/)

3. For more information on irreversible constraints see David Albright, Olli Heinonen, & Andrea Stricker, "'The Six's' Guiding Principles in Negotiating with Iran," *Institute for Science and International Security*, June 3, 2014. (http://www.isisnucleariran.org/assets/pdf/Principles_and_Compromises-_july_22_2014-final1.pdf)

4. Saeed Kamali Dehghan & Julian Borger, "Iran Needs Greater Uranium Enrichment Capacity, Says Ayatollah Ali Khamenei," *The Guardian* (UK), July 8, 2014. (http://www.theguardian.com/world/2014/jul/08/iran-increase-uranium-enrichment-capacity-supreme-leader-ali-khamenei)

IR-1 centrifuges operate at less than one kg SWU/year,[5] ***Khamenei in effect called for nearly 200,000 IR-1 centrifuges or a smaller number of more advanced centrifuges.***

The Supreme Leader has also stated that Iran will never compromise on the retention of a robust R&D program[6] to develop more powerful and efficient advanced centrifuges, which would require fewer machines to achieve the same enriched uranium output. ***This has raised fears that Iran's goal is to develop more powerful centrifuge machines that would be more difficult to detect if they were installed in clandestine enrichment facilities and an industrial-size nuclear program, which would provide Iran with a rapid nuclear breakout capacity.***

As the nuclear talks face an impasse regarding the size and scope of Iran's enrichment, many "creative solutions" are being contemplated. ***Given Iran's refusal to dismantle any of its centrifuges, one idea that has recently been put forward is to disconnect and not dismantle some of Iran's cascades of centrifuges.*** This idea needs further exploration to assess its viability as one of the measures to prevent Iran from getting the capability to produce nuclear weapons.

Options to Reduce Enrichment Capacity – Disconnect Piping

Since Iran started larger scale uranium enrichment at Natanz in 2007, it has installed approximately 5,000 new centrifuges per year during peak periods. This effort has included assembling centrifuge rotors; installing rotors into casings; and laying cables for control electronics, piping for cooling of centrifuges, and the piping for feed and withdrawal of uranium hexafluoride gas to each individual centrifuge.

A recent *New York Times* story indicated that the parties are discussing the disconnection of centrifuges to reduce enrichment capacity.[7] ***There are technical distinctions between merely disconnecting centrifuges, disabling the feed pipes to these centrifuges, or removing centrifuges and piping.***

There are ***three possible scenarios.***

1. The simplest scenario, a disconnection of centrifuges from the uranium gas feeding lines, ***can be reversed in a matter of a week.***[8] Indeed, during 2003 when Iran agreed to suspend enrichment as part of an agreement with the EU3 negotiators, Iran did precisely this and

5. David Albright, "Technical Note: Making Sense out of the IR-8 Centrifuge," *Institute for Science and International Security*, September 23, 2014, page 5. (http://isis-online.org/uploads/isis-reports/documents/IR8_Sept__2014.pdf)
6. "Supreme Leader: Iran Not to Stop Nuclear R&D Activities," *Fars News Agency* (Iran), April 9, 2014. (http://english.farsnews.com/newstext.aspx?nn=13930120001380)
7. David Sanger, "U.S. Hopes Face-Saving Plan Offers a Path to a Nuclear Pact With Iran," *The New York Times*, September 19, 2014. (http://www.nytimes.com/2014/09/20/world/middleeast/us-hopes-face-saving-plan-offers-a-path-to-a-nuclear-pact-with-iran-.html?_r=0)
8. Estimates regarding how quickly Iran could reverse these scenarios are based on observations from the 2003 suspension, the rate of installation of new centrifuges, and projected scenarios for reinstallation.

disconnected the feed lines. When the agreement broke down, Iran was able to resume all of its previous enrichment activities in a relatively straightforward manner and short period of time.

2. If Iran were to completely remove the cascade feed piping and withdrawal piping from all but one cascade unit (leaving in 3,000 IR-1s operable in Natanz), the dismantled piping for IR-1 and IR-2m centrifuges ***could be reinstalled in a couple of months.***

3. A third option is to remove all excess centrifuges and cascade piping (i.e. above the number of operable centrifuges agreed upon) and put them into storage. This would push reinstallation and reconnection times to beyond six months (for example, if 15,000 IR-1s and IR-2ms including their cascade piping were removed). Again, it is insufficient to disconnect all piping and associated equipment. Rather, all excess centrifuges would also have to be removed and put into storage. ***Any proposal that doesn't include the removal of the excess centrifuges doesn't meet adequate standards of irreversibility and stability.***

However, there is a problem with this approach: Since the IAEA does not have access to the sites at which Iran manufactures centrifuges, it does not know the total inventory of centrifuges available today to Iran. Therefore Iran could reduce the time required to reinstall the centrifuges and cascade piping it removed if it reinstalled and reconnected a smaller number of IR-2ms instead of IR-1s. For example, if Iran were to reinstall 3,000 IR-2ms instead of 15,000 IR-1s (based on a SWU ratio of 5:1), this ***would cut reinstallation times back down to two to three months and make it more difficult to respond to an Iranian breakout scenario.***

There are additional factors affecting Iran's enrichment capacity. As such, even the removal of excess centrifuges and piping would be insufficient without other steps to limit Iran's enrichment. Because of the nature of enrichment, it is a mistake to look at the piping issue in isolation in calculating breakout time. There are other parameters and variables to consider. Iran has reached an industrial capacity to produce centrifuge rotors although it may be facing some limitations due to a lack of key raw materials. To construct a credible scenario that would push breakout times beyond one year, other steps would be required beyond the removal of all excess centrifuges and piping. All already manufactured centrifuge rotors and their components would have to be fully disclosed and subject to monitoring, the inventory of enriched uranium would need to be brought below one metric ton of UF6 enriched up to five percent, and the rest of the enriched UF6 would need to be converted to uranium oxides.

The Nuclear Time Window

A comprehensive agreement must extend Iran's breakout time as long as possible and certainly longer than one year. Achieving the necessary evidence to judge with high confidence that a violation has occurred is time consuming and heavily reliant on intelligence to detect clandestine Iranian nuclear activities. Iran also has a history of clandestine nuclear activity, which was later discovered, including the once-covert Natanz and Fordow Fuel Enrichment Plants, clandestine centrifuge R&D at Kalaye Electric, and black market nuclear-related importation of nuclear material, some with possible military uses.

Moreover, the ability of the international community to respond in a timely way depends on several parameters that may not be entirely within the control of policymakers and intelligence officials.

Concerns about Iran's nuclear program can be partly alleviated if Iran agrees to dismantle key components of its uranium enrichment program that could be used to produce nuclear weapons.[9] Since Iran has repeatedly claimed that its nuclear program is intended only for peaceful purposes, it should ***take the following steps to reassure the international community of its nuclear intentions:***

1) significantly limiting the number and types of centrifuges installed and removing and dismantling all excess centrifuges, piping, and associated equipment from its enrichment facilities to storage;

2) capping its enriched uranium stocks so that they are limited to civilian nuclear energy use and not reversible for military-nuclear purposes;

3) fully disclosing and strictly limiting the manufacturing of centrifuges and centrifuge components and any advanced centrifuge R&D; and

4) ending the acquisition of raw materials and equipment through illicit procurement.

Iran must also accept a robust verification and monitoring regime that goes beyond the Additional Protocol. To show seriousness and ensure sustainability, Iran must agree to these undertakings as legally binding commitments.

9. For more information on the components of Iran's illicit nuclear program that must be dismantled, see "Parameters of an Acceptable Agreement," *Iran Task Force*, June 2014. (http://taskforceoniran.org/pdf/Parameters_Memo.pdf)

The Iran Task Force's goal is to lend expertise on Iran's internal politics, nuclear science, and sanctions regime to the legislative branch. By providing the necessary intellectual capital, this group can help to strengthen Congress's role in a potential final nuclear agreement with Iran. This group of former government officials and nuclear, legal, and sanctions experts provides advice and recommendations to policymakers in order to ensure that any final deal prevents Iran's uranium and plutonium pathways to a nuclear weapon.

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