SWU and a Final Deal with Iran

JINSA's Gemunder Center Iran Task Force

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Overview

On July 18, 2014, Iran and the P5+1 agreed to a four-month extension of the Joint Plan of Action (JPA) interim framework for reaching a final deal on Iran's nuclear program. Negotiators on both sides echoed Secretary John Kerry that "very real gaps" remained on certain parameters of a comprehensive solution.[1]

Talks came to an impasse in large part over the total number and type of centrifuges Iran could keep for uranium enrichment. P5+1 officials have stated they want to roll back Iran's breakout timing to at least 6-12 months (currently it is around three months), which would require Iran, at the very least, to reduce its number of operating centrifuges. (This breakout timeframe translates to roughly 2,000-4,000 operating IR-1 centrifuges; Iran operates around 10,000 under the JPA.) However, Iranian regime leaders and negotiators have indicated their unwillingness to dismantle any of their nuclear infrastructure, including centrifuges.[2]

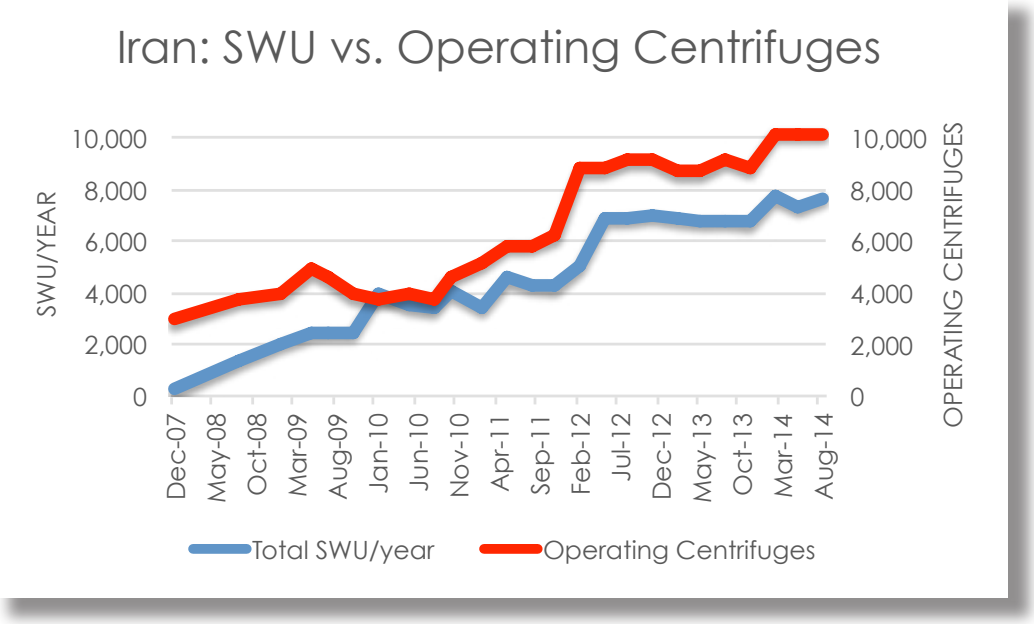
Given this apparent deadlock, there are reports negotiators may instead try to limit the total output of Iran's enrichment facilities, as measured in Separative Work Units (SWU). On July 8 – around the time negotiators were debating centrifuge numbers – the head of Iran's nuclear program Ali Akbar Salehi said "we don't define the enrichment needs on the basis of the number of centrifuge machines, but based on their units, meaning SWU." This echoed comments the day before by Supreme Leader Ali Khamenei which postulated Iran's enrichment needs in SWU rather than centrifuges.[3]

SWU is a more accurate metric than centrifuge numbers for gauging current enrichment output and breakout timing. However, by itself it is also less effective and reliable as a ceiling on Iran's total potential enrichment capability. Absent any additional limits – on centrifuge output, numbers and types of operating and installed centrifuges, research and development (R&D) activities, enrichment levels and others – Iran would not have to roll back any of its existing nuclear infrastructure and might still be able to expand and upgrade it. Therefore, a SWU approach could allow Iran to maintain a latent nuclear weapons capability and remain a flip of the switch away from sprinting for the bomb, even while it conforms to a comprehensive agreement on its nuclear program.

Understanding SWU

The Separative Work Unit measures the effort required to enrich a certain quantity of uranium to a certain concentration. For example, producing one kilogram of 3.5% enriched uranium from natural (unenriched) uranium requires 3.6 SWU. As such, it can be a useful metric for measuring enrichment capability and consequently breakout timing.

When measured over time, SWU indicates the enrichment output of a centrifuge or (on a much larger scale) an entire uranium enrichment program. All else being equal, the more centrifuges producing enriched uranium, the greater the total output of enriched uranium will be. Therefore, Iran's total annual SWU output can be expected to correlate, very broadly, to the number of operating centrifuges.



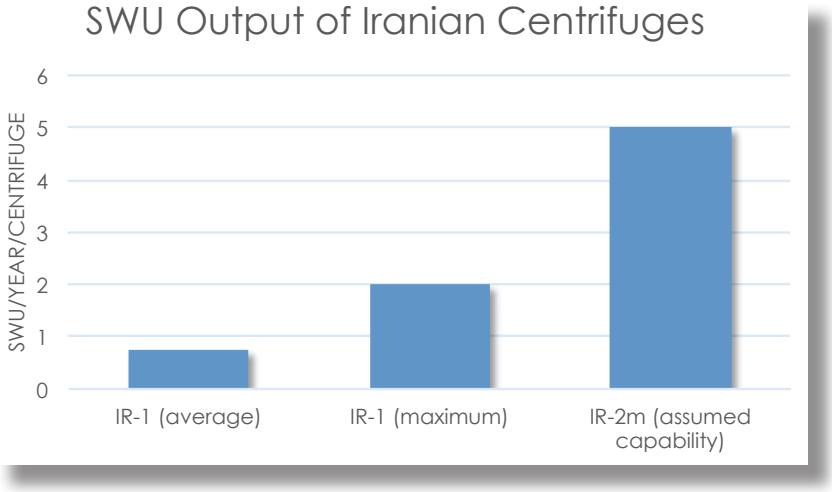
However, everything else is not always equal, and total SWU production can fluctuate even without adding or removing centrifuges. That is because it is a function of both the number of operating centrifuges and the enrichment rate of those centrifuges:

$$\frac{\text{SWU total}}{\text{year}} = \text{number of operating centrifuges} \times \frac{\overline{\text{SWU}}\ \text{centrifuge}}{\text{year}}$$

Defining Iran's enrichment ceiling purely in terms of total annual SWU output would be problematic because this metric is infrastructure-independent. Such an approach would fail to constrain both elements of the above equation: average centrifuge output, and operating versus installed centrifuges.

First, Iran could reduce total SWU output simply by decreasing the rates at which its operating centrifuges spin, without taking any of them out of operation. Importantly, this process of cutting centrifuge output can be temporary and reversible, meaning Iran could just as easily increase it at a later date with the flip of a switch. Even while reducing the efficiency of its operating IR-1 centrifuges, Iran also could continue research and development (R&D) that would allow it to raise the potential performance of these machines, as it is permitted already by the JPA.

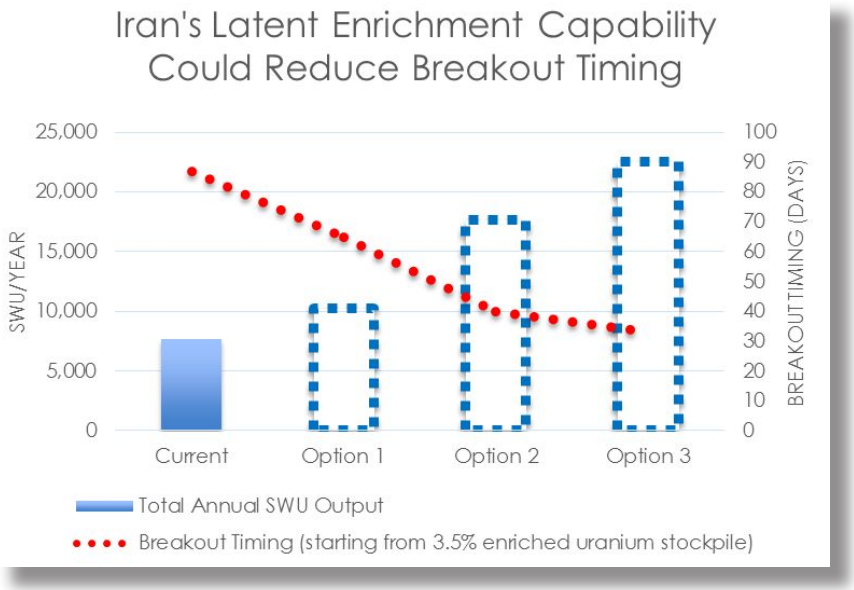
Moreover, if total SWU output is the only enrichment threshold, Iran could turn on some of its 8,000 installed but inactive IR-1 centrifuges or begin operating its IR-2m centrifuges (both currently prohibited by the JPA). The latter is particularly worrisome because this next-generation model, of which 1,000 are already installed, is likely to have a much greater SWU output than the IR-1. Though they would probably have to operate below capacity to conform to any SWU limit, the IR-2m would have the same dimmer-switch potential as the IR-1, and thus Iran could dial up their enrichment rate in the future.



Therefore, an agreement that caps Iran's total annual SWU production without addressing its 9,000 non-operating installed IR-1 and IR-2m centrifuges would leave Iran a flip of a switch away from at least doubling its SWU output, if it chose to do so.

Second, the SWU metric captures only the enrichment that actually takes place. On its own, it does not take into account the number or type of centrifuges Iran has installed. As long as Iran does not operate centrifuges, they do not produce any enriched uranium and therefore do not contribute to SWU output. Under such an arrangement, Iran could feasibly continue to install more and faster centrifuges without running afoul of the SWU cap, as long as they are not switched on.

Indeed, Iran would be able to expand its already sizable nuclear capability, and reduce its breakout timing, in a number of ways. It could potentially: replace all its operating centrifuges (0.7 SWU/year average overall) with its most efficient existing IR-1s (1.0 SWU/year, shown as Option 1 below); turn on every installed centrifuge (including IR-2m; Option 2); or both (Option 3).



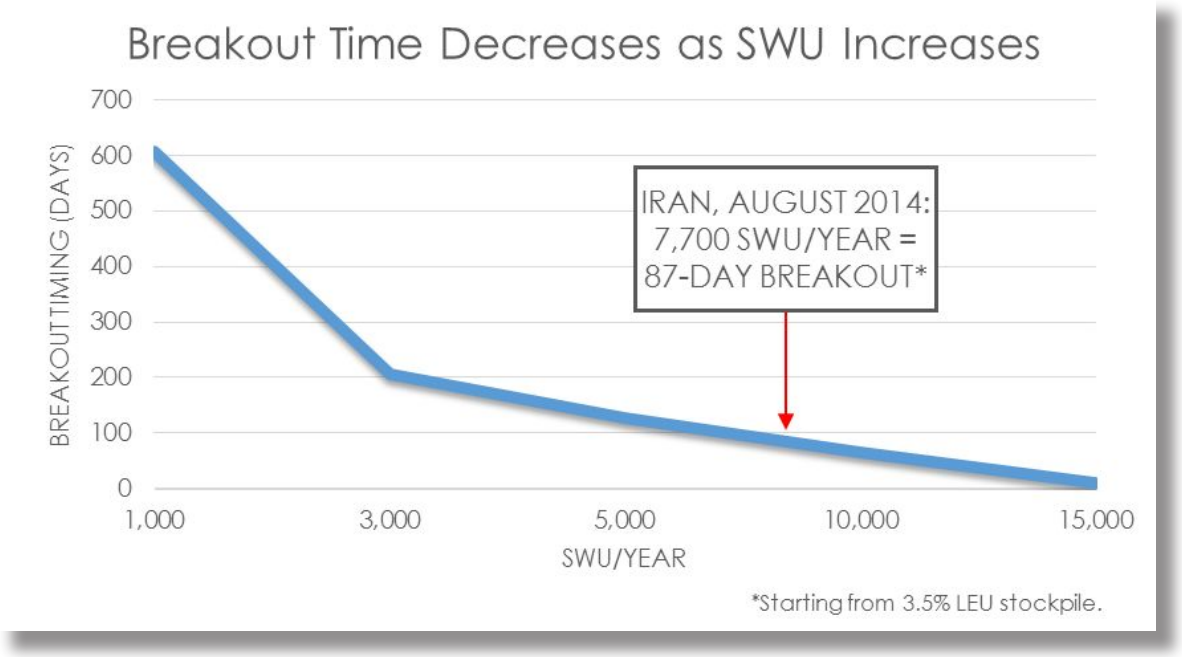
The JPA interim framework, which caps Iran's centrifuge levels and types but not SWU output, prohibits each of these scenarios.

Implications for Iran's Nuclear Program

Simply put, using SWU output as the benchmark for Iran's enrichment program would leave it with a potent latent nuclear capability that could easily be activated. The potential proliferation risks should be understood on several levels.

In terms of verifying Iran's compliance with a final deal, International Atomic Energy Agency (IAEA) inspectors can determine SWU output from their regular inspections under Iran's IAEA Safeguards Agreement. All else being equal, this should leave them no less able to detect any violation – including a potential breakout attempt – at Iran's declared facilities, than if it were operating too many centrifuges at those same facilities. The difference is that Iran can much more easily violate a SWU cap than a limit on the number of installed and operating centrifuges. The former requires the flip of a switch, the latter the building of new infrastructure. It is this speed with which Iran could renege on a deal built around limiting total annual SWU output that is most alarming.

Additionally, because it could maintain or even expand its latent SWU capacity while reducing its actual SWU output under such a deal, Iran could move closer to an undetectable nuclear weapons capability, should it ever choose to activate this untapped SWU potential.



These scenarios underscore the vital importance of a strict inspections regime to monitor Iranian activity as part of any final deal. By granting Iran the potential to cut its breakout timing by nearly two-thirds, enrichment limits based on SWU output would make verification and enforcement mechanisms even more critical. Furthermore, these scenarios do not account for the possibility of Iran expanding its latent enrichment capability under a final deal. This would further strain inspectors' resources, even assuming Iran adheres to the IAEA Additional Protocol's more frequent and intrusive inspections as part of a comprehensive agreement.

The challenges in using SWU output as a metric do not start and stop with Iranian compliance. According to the JPA, any final deal would not be permanent but instead "have a specified long-term duration to be agreed upon," after which "the Iranian nuclear program will be treated in the same manner as that of any non-nuclear weapon state party to the [Nuclear Nonproliferation Treaty]." Therefore, because it could grow its latent enrichment capability under a final deal limiting only SWU output, Iran could be well-positioned to have an industrial-sized nuclear program unfettered by safeguards for preventing a nuclear breakout after the deal expires.

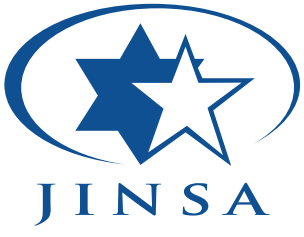
This is significant, because the regime's stated ambitions extend far beyond any reasonable scope or timeframe for its civilian nuclear energy program. Khamenei's July 7 comment specified 190,000 SWU as "the final need of the country." This is approximately 25 times Iran's current output of 7,700 SWU, and would be sufficient to fuel all three of its existing reactors (the completed Bushehr light water and Tehran Research [TRR] reactors, and a reconfigured Arak heavy water reactor still under construction) as well as an additional nuclear power plant it says it intends to start building. However, Iran could massively reduce its enrichment capability and still meet these requirements more economically than if it expanded its program. It buys fuel for Bushehr from Russia, and could do so for any new power plants as well; it already possesses more than a decade of fuel for the TRR, whose annual requirements are minimal anyway; and if it reconfigures the Arak reactor as part of a final deal, this would require only a fraction of Iran's current SWU output once completed.[4]

Salehi's comment the following day targeted "the next eight years" to reach Khamenei's announced level, purportedly because Russia's current contract for Bushehr ends by 2022. This timeframe is unrealistic and unnecessary, since Iran can renew this contract for the lifetime of the Bushehr reactor, and for any new power plants Russia would help build. Moreover, Iran likely would be unable to bring an indigenously-constructed power plant online in anywhere near eight years. However, though the specific duration has yet to be agreed, Salehi's timeframe falls within or around that of a possible sunset clause for a final deal.[5]

Under a comprehensive agreement limiting annual SWU output, but not centrifuges, Iran could make substantial progress toward these goals by expanding its latent nuclear capability. Given its minimal civilian enrichment needs, once the comprehensive agreement expired it would be a flip of a switch away from using this infrastructure to develop a much greater nuclear weapons capability much faster than before the final deal was agreed.

Endnotes

1. U.S. Department of State Office of the Spokesperson, "Statement by Secretary Kerry: Extension of Iran Nuclear Talks," July 18, 2014.
2. Iran has an additional 9,000 installed centrifuges which remain out of operation, as per the JPA. Of these, approximately 1,000 are more efficient second-generation IR-2m centrifuges. On July 22, Iran's Foreign Ministry listed differences over Iran's enrichment capacity, heavy-water reactor at Arak and sanctions as the main causes of the JPA extension, with Foreign Minister Mohammad Zarif saying Iran's position on its centrifuge numbers under a final deal is clear. On September 7, Iranian negotiator Abbas Araqchi rejected reports that Iran might reduce its number of operating centrifuges to 7,000 as part of a final deal. See: "Zarif specifies sticking points in Iran nuclear talks," *Tehran Times*, July 22, 2014; "No agreement on number of centrifuges yet: Araqchi," *Tehran Times*, September 8, 2014.
3. Office of the Supreme Leader of the Islamic Republic, "Remarks in a meeting with officials," July 7, 2014 (translated); "Salehi said we need approximately 190,000 SWU for the next 8 years," Islamic Republic News Agency (Tehran), July 8, 2014 (translated).
4. "Solving the Iranian Nuclear Puzzle: Toward a Realistic and Effective Comprehensive Nuclear Agreement," Arms Control Association, June 2014 (3rd Edition).
5. Former U.S. nonproliferation official Robert Einhorn estimates it could take Iran 15-20 years to complete an indigenously-constructed nuclear power plant; see: Robert J. Einhorn, "Preventing a Nuclear-Armed Iran: Requirements for a Comprehensive Nuclear Agreement," *Brookings Arms Control and Non-Proliferation Series*, No. 10 (March 2014). For Salehi's comment, see: Arash Karami, "Chief of Iran's Atomic Energy Organization clarifies nuclear needs," *Al-Monitor*, July 9, 2014.



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