



## **Iranian Breakout Timelines Under JCPOA-Type Limits**

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Breakout timelines were fundamental to negotiating the Joint Comprehensive Plan of Action (JCPOA). The United States insisted on setting limits on Iran's centrifuge program that, if reversed, would require 12 months to produce enough weapon-grade uranium (WGU) for a nuclear weapon. Re-imposing those same limits today could not achieve a 12-month breakout timeline, only about a four-to-five-month timeline. Worse, in subsequent months, Iran could more rapidly accumulate significant quantities of WGU than under the original deal.

The situation has changed so fundamentally that new limits are needed, the most important of which is that Iran destroy centrifuges and related equipment, rather than store them. A focus on only limiting enriched uranium stocks will not provide sufficient breakout timelines. Even proposals that essentially eliminate all stocks of enriched uranium would lead to breakout timelines that are just too short to provide a worthwhile agreement. A proposal only eliminating Iran's 20 and 60 percent uranium stocks is essentially worthless.

### **Re-imposing the JCPOA's Initial Enrichment Limits**

The key JCPOA limits on Iran's gas centrifuges that extended the breakout timeline during the first ten years of JCPOA implementation were:

- No enrichment above 3.67 percent
- A total enriched uranium stockpile of no more than 300 kg of up to 3.67% enriched uranium hexafluoride (or the equivalent in different chemical forms) (202.8 kg, uranium mass)
- An active enrichment output that was limited by the numbers and type of installed centrifuges: 5060 IR-1 centrifuges at the Natanz Fuel Enrichment Plant and 1044 non-enriching IR-1 centrifuges at Fordow. This limitation translates into a capacity of about 5000 separative work units (swu) per year.
- Centrifuge cascades above this limit at the time of agreement were dismantled and stored under monitoring.

- Manufacturing of new centrifuge rotor assemblies capped at no more than several tens of centrifuges per year.<sup>1</sup>

At the time of the negotiation of the JCPOA, the vast bulk of centrifuges were relatively poorly performing IR-1 centrifuges, with about 1000 more advanced IR-2m centrifuges in six cascades.

In independently evaluating the breakout timeline of this arrangement, if only the reinstallation of IR-1 centrifuge cascades were considered in a breakout, the breakout timelines exceeded 12 months, as desired by the United States. However, if the six IR-2m cascades were also re-installed, the breakout timeline dropped to about 8 months, reflecting the far greater enrichment output of the IR-2m centrifuge, a fact acknowledged in private by Department of Energy officials but not mentioned publicly.

As of early February 2025, Iran had installed 13,555 advanced centrifuges, including IR-2m, IR-4, and IR-6 centrifuges. The IR-6 is its most powerful deployed centrifuge. The enrichment output of each type exceeds by more than fourfold that of the IR-1 centrifuge.

In addition, Iran has much greater experience in deploying centrifuges than it had in 2015. At that time, a reasonable reinstallation rate was about two centrifuge cascades per month per type. Today that rate is faster. In a three-month period, between May 27, 2024, and August 29, 2024, reflecting its greater experience and skill in rapidly deploying cascades, Iran deployed 3226 centrifuges in 19 cascades, the most centrifuges ever deployed in a single IAEA reporting period. Iran deployed 10 cascades of IR-2m at the Natanz plant, 8 cascades of IR-6 at Fordow, and 1 full cascade of IR-6 at the pilot Natanz plant. That is 19 cascades in the three-month period, or 6.3 cascades per month, more than 1.5 per week. In a national emergency, Iran could likely redeploy cascades faster.

If there is a return to JCPOA-type limits, and Iran stores all its excess advanced centrifuges, it will have a much shorter breakout timeline.

Given a reinstallation schedule of six cascades per month—specifically two cascades at Fordow and four cascades at Natanz—the resulting breakout timelines are as follows:

- 4.5 months to produce 25 kilograms of WGU, defined as enough for one nuclear weapon
- 7 months to produce enough WGU for two nuclear weapons
- 10 months to enough WGU for almost four nuclear weapons
- 13 months to produce enough WGU for six nuclear weapons
- 15 months to produce enough for almost eight nuclear weapons.

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<sup>1</sup> A partial exception is that at the end of year 8 of the deal, Iran can commence manufacturing of IR-6 and IR-8 centrifuges without rotors through year 10 at a rate of up to 200 centrifuges per year for each type. The lack of centrifuge rotors should be noted.

If instead, Iran decided to build back its inventory of 60 percent enriched uranium, which was 275 kilograms in early February 2025, it would have half of it back in 9.5 months, producing it at a rate of 26 kilograms per month. It would reach 275 kilograms of 60 percent enriched uranium early in month 15, producing it at a rate of 34 kilograms per month.

Notable in this case is that Iran does not have to re-deploy all its stored enrichment capacity to achieve the short timelines. By the end of the 5<sup>th</sup> month, Iran would have enough WGU for a nuclear weapon, with only 40 percent of its excess centrifuges re-installed. The additional enrichment capacity in later months increases the subsequent quantities of WGU produced. By the end of the tenth month, about 70 percent of the advanced centrifuges would be redeployed. Final redeployment would occur in the 15<sup>th</sup> month.

A faster cascade re-installation rate would lead to shorter breakout timelines. On the other hand, if only two cascades, rather than four, were reinstalled per month at Natanz, the breakout timelines would lengthen only slightly to:

- 5 months to produce enough WGU for one nuclear weapon
- 8 months to produce enough WGU for two nuclear weapons
- 12 months to produce enough WGU for four nuclear weapons

These estimates do not include the effect of Iran making new centrifuges during this re-installation period or drawing from a secret stock of centrifuges made earlier but not declared. The JCPOA did not have a requirement for Iran to declare its total stock of centrifuges, let alone allow that declaration to be verified. Under the above assumptions, these centrifuges would not affect the above calculations, but they would allow for the installation of new centrifuges rather than dismantled ones, and they would allow for a growth in centrifuge capacity after the 15th month.

## **Another Proposed Scenario**

During recent public discussions, some have proposed that Iran eliminate its stocks of 20 and 60 percent enriched uranium but keep its stock of uranium enriched to less than 5 percent and leave its centrifuge capacity in place. The resulting breakout timelines speak for themselves:

- 0.83 months (25 days) to produce enough WGU for one nuclear weapon
- 2 months to produce enough WGU for four nuclear weapons
- 5 months to produce enough WGU for eight nuclear weapons