

Restoring the JCPOA's Nuclear Limits

FEBRUARY 2021

A year after former U.S. President Donald Trump withdrew the United States from the 2015 nuclear deal, known as the Joint Comprehensive Plan of Action (JCPOA), and reimposed sanctions on Iran in violation of the deal, Iran began to breach limits under the accord.

Iranian officials maintain that Iran will reverse its activities that violate the JCPOA and return to full compliance if the other parties to the deal meet their obligations under the accord. Iran's violations of the JCPOA are largely reversible and could likely be undone within 3 months with sufficient political will.

However, breaches planned for 2021 will result in Iran gaining new knowledge and expertise that cannot be reversed and could create gaps in the International Atomic Energy Agency's (IAEA) monitoring and verification that may be difficult to fill in, even if Iran returns to full compliance with the JCPOA.

The following is a summary of the steps necessary to rectify Iran's current breaches of the JCPOA. The steps are listed in the order of Iran's violations of the JCPOA, beginning with its first breach in May 2019.

1. Restoring the stockpile limits on enriched uranium and heavy water

Background: Iran announced in May 2019 that it would no longer observe the JCPOA-imposed stockpile limits of 300 kilograms of uranium hexafluoride (UF₆) gas (202 kilograms of uranium by weight) enriched 3.67 percent and 130 metric tons of heavy water. The IAEA confirmed that Iran breached the 300-kilogram limit on July 1, 2019 and the heavy water limit in November 2019. As of November 2020, Iran's stockpile of uranium gas enriched to less than 4.5 percent was about 3,600 kilograms in gas form (2,443 kilograms of uranium by weight)—roughly 12 times the

cap. While Iran's heavy water stockpile has exceeded the 130 metric ton cap, the IAEA measured the stockpile at 128.5 metric tons in November 2020.

Restoring Compliance: Iran can reverse its stockpile violations quite quickly. Tehran can either ship out enriched uranium in excess of the 300-kilogram limit of 3.67 percent gas or blend it down to natural levels. Excess heavy water could be used, shipped abroad for storage, or sold, all of which Iran has done in the past to stay below the cap. To help facilitate Iran's return to compliance, the Biden administration should issue sanctions waivers allowing Tehran to export excess uranium and heavy water. These waivers were revoked by the Trump administration. The United States could also offer to purchase a quantity of heavy water for U.S. applications. The Obama administration did this in the past after deeming Iran's heavy water of sufficient quality for U.S. purposes.

2. Restoring the limit on uranium enrichment to no more than 3.67 percent uranium-235

Background: Iran announced in July 2019 that it would begin enriching uranium up to 4.5 percent, which was immediately confirmed by the IAEA. On Jan. 4, 2021, the agency confirmed that Iran began enriching uranium to 20 percent uranium-235 (see below for details). Iran enriched to 20 percent, which constitutes about 90 percent of the effort necessary to enrich to weapons grade levels, prior to negotiations on the JCPOA.

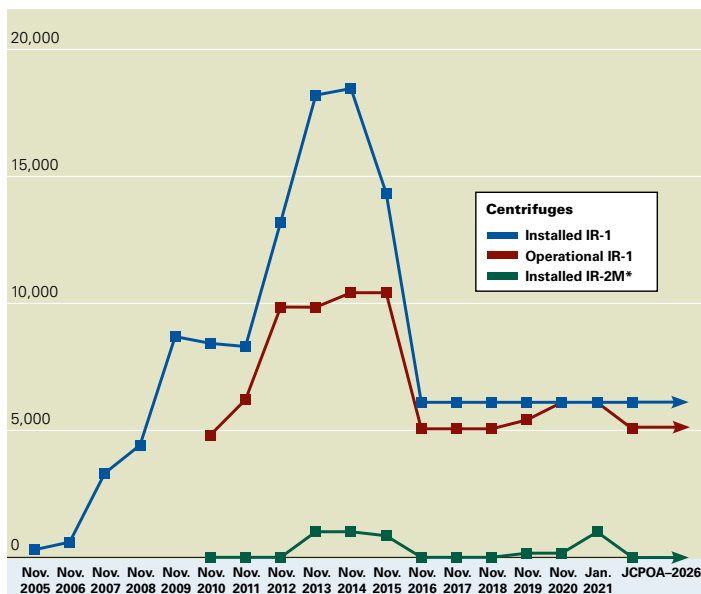
Restoring Compliance: Iran will need to halt enrichment to levels above 3.67 percent uranium-235 and recalibrate its centrifuges that were being used to enrich above that level. Given that Iran’s enrichment is monitored in real time using online enrichment monitors (OLEMs), the IAEA will be able to quickly confirm when Iran halts enrichment above the JCPOA limit. As noted above, material produced above the JCPOA’s limits can be blended down or shipped out.

Iran justifies its enrichment to 20 percent as necessary to produce uranium fuel for its Tehran Research Reactor (TRR), which produces medical isotopes. The United States should re-issue sanctions waivers that the Trump administration let lapse to allow Iran to import the necessary fuel for the TRR, removing the justification that 20 percent enrichment is necessary.

3. Returning to compliance with advanced centrifuge limits

Background: Iran announced in September 2019 that it would no longer be bound by any research and development limitations on advanced centrifuges imposed by the JCPOA. The deal’s restrictions include a 10-year prohibition on producing enriched uranium using advanced machines and caps on the number and type of advanced centrifuges that Iran can install and operate for testing its designs. Since announcing this breach, Iran has installed full cascades of IR-2, IR-4, and IR-6 machines and

Capping Iran’s Deployment of Centrifuges



*These numbers do not include machines used in mechanical testing.
Source: IAEA, JCPOA

is using them to enrich uranium. Iran has also introduced new advanced centrifuges not covered by the JCPOA.

The nuclear deal does permit Iran to design new centrifuge machines, but Tehran must receive approval from the Joint Commission before beginning testing. In what would be a further violation of research limits, a December 2020 nuclear law (see details below) calls for Iranian authorities to install 1,000 IR-2 centrifuges and 1,000 IR-6 centrifuges in 2021. According to recent IAEA reports issued in January and February 2021, Iran is operating two cascades of IR-2 centrifuges (348 machines) at the main enrichment hall at Natanz and two more cascades of IR-2s are being installed. Iran plans to install up to eight cascades of IR-6 machines at Fordow, according to those reports.

Returning to compliance: To return to compliance with the accord’s limits, Iran will need to dismantle and store under IAEA seal the advanced machines that it installed and is operating outside of the JCPOA’s parameters. It will also need to provide the IAEA with information about the new advanced centrifuges using an agreed-upon template designed by the JCPOA’s Joint Commission. The Joint Commission may also consider when and if Iran will be able to conduct any mechanical testing using those machines, as allowed by the JCPOA.

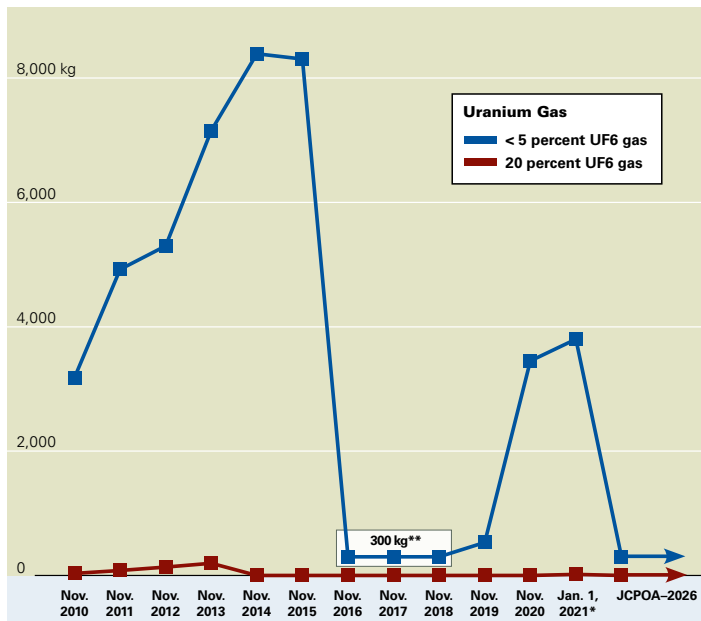
While the machines can be dismantled and stored relatively easily, the knowledge Iran has gained about the performance and capacity of its advanced machines is not reversible. This knowledge might have a slight impact on the overall breakout time of 12 months when the deal is fully implemented, but the IAEA would immediately detect any attempt to remove and reinstall the advanced machines. Iran’s testing of so many separate centrifuges design also suggests that the country has not established a designated successor for future enrichment when the JCPOA’s limits on enriching using IR-1s expire. The knowledge gained about advanced centrifuge performance could, however, be taken into account as the U.S. devises its plans for follow-up negotiations on a longer-term nuclear framework.

4. Halting uranium enrichment at Fordow

Background: In November 2019, Iran announced it would start enriching uranium up to 4.5 percent at Fordow. In January 2021, the IAEA noted that Iran is currently using the 1,044 IR-1 centrifuges at that site for producing 20 percent enriched uranium-235. A February 2021 IAEA report confirmed that

Capping Iran's Uranium Gas Stockpile

This graph does not include enriched uranium that was converted into powder.



*estimated

**IAEA reports released while Iran was fully implementing its commitments under the JCPOA only specify that Iran's stockpile of enriched uranium was below the threshold of 300 kilograms of uranium gas enriched to 3.67 percent, not the precise amount produced.

Source: IAEA, JCPOA

Iran intends to install additional IR-1s and IR-6s at the sites to enrich uranium up to 20 percent uranium-235. Under the JCPOA, Iran is permitted to keep 1,044 IR-1 centrifuges at Fordow, but the deal prohibits from any uranium-related activities at the site for 15 years. As a result of Iran's decision to resume uranium enrichment at Fordow, efforts to convert the facility to a medical isotope research and development facility as required by the JCPOA, stalled.

Returning to compliance: To reverse this violation, Iran will need to halt production of enriched uranium using centrifuges at Fordow and remove all uranium from the facility. Iran will also need to remove the piping for the interconnected cascades that it is using for 20 percent enrichment, as that design is prohibited by the JCPOA. Iran may also choose to remove and store centrifuges that had been used for enrichment and replace them with excess IR-1s currently under storage that are not contaminated with uranium for isotope research and production, which is the intended use of Fordow for 15 years under the JCPOA.

Planned and In-Progress Iranian JCPOA Violations

In an effort to put pressure on the United States and other JCPOA parties to deliver on sanctions relief envisioned

by the JCPOA and respond to the assassination of Iranian nuclear scientist Mohsen Fakrizadeh, the Iranian government enacted a law in late December 2020 requiring the Atomic Energy Organization of Iran (AEOI) to take a number of steps to further breach the accord in 2021. These breaches can be suspended if certain sanctions relief is granted. Several of these activities (advanced centrifuge installation and enrichment to 20 percent uranium-235) are already way and are referenced in the list above.

• Limits on Uranium Enrichment (in progress and discussed above)

Background: Iran is required to produce 120 kilograms of uranium enriched to 20 percent uranium-235 on an annual basis under the December 2020 law. The IAEA confirmed that Iran began enriching to this level at Fordow on Jan. 4, 2021. Iran notified the IAEA of its intentions to increase enrichment levels at that site prior to doing so.

Restoring compliance: Iran could either ship out or blend down its uranium enriched above 3.67 percent uranium-235 and reconfigure the centrifuges being used for enrichment to that level.

• Limits on Iran's Use of Advanced Centrifuges (in progress and discussed above)

Background: The nuclear law requires Iran to install and operate 1,000 IR-2 centrifuges within three months of the legislation's enactment (late-March 2021) and install 1,000 IR-6 centrifuges by the end of 2021. The IAEA confirmed that Iran had installed 348 IR-2 centrifuges as of January 2021 and preparations were being made for another two cascades. In a Feb. 2, 2021 report, the IAEA stated that Iran had notified the agency of its intentions to begin installing IR-6 centrifuges at Fordow and would use two cascades of those machines to produce uranium enriched up to 5 percent uranium-235. Iran also notified that agency that it may install up to eight cascades of IR-6 machines at Fordow.

Restoring compliance: Iran would need to dismantle and store under IAEA seal the excess advanced centrifuges. While Iran will have gained some knowledge about producing and operating these machines, it does not significantly impact the country's breakout or proliferation risk, given the relatively small number of centrifuges in question and the IAEA's ability to immediately detect any attempt to access and install the machines.

- **Restrictions on Iran's Implementation of the Additional Protocol and JCPOA-Specific Verification Measures (planned)**

Background: According to the nuclear law, Iran will suspend implementation of the additional protocol to its safeguard's agreement and the JCPOA-specific verification mechanisms on Feb. 21 if certain sanctions relief is not granted. Iran will continue to implement its comprehensive safeguards agreement (CSA), which is required by the Nuclear Nonproliferation Treaty (NPT), according to officials.

Restoring Compliance: Iran can notify the IAEA of its intention to adhere to the additional protocol and the JCPOA required verification mechanisms to restore full implementation of the deal's monitoring mechanisms. While more intrusive inspections could resume quickly after Iran notifies the IAEA, the time required to return to full compliance with these obligations may depend on if, and to what extent, the means of monitoring and surveilling Iran's program are removed and will need to be returned.

The reversibility of this violation also depends on the length of time that Iran is in violation of the obligations and Iran's willingness to take additional steps/provide information to fill in any gaps that may emerge from the breaks in monitoring. If the measures are suspended for too long, it may create gaps in knowledge that could complicate the IAEA's task of determining if Iran's nuclear materials remain in peaceful purposes and increase speculation about illicit nuclear activities.

- **Uranium Metal Production (planned)**

Background: The December 2020 law requires the AEOI to "inaugurate the metallic uranium factory" at the Isfahan Fuel Fabrication Plant within five months, or by late May 2021. Iran notified the IAEA of its intentions to begin installing and designing equipment and its plans for producing a new uranium metal fuel for the Tehran Research Reactor, which produces medical isotopes. According to the timeline that Iran provided to the IAEA, designing and installing equipment for the first stage of the project—converting UF₆ to UF₄—will take 4–5 months. The JCPOA prohibits Iran from producing or acquiring uranium metals for

15 years because of its applicability to nuclear weapons development. After 10 years, the JCPOA allows Iran to initiate research into uranium metal fuel for the TRR, with the approval of the Joint Commission. *The Wall Street Journal* [reported Feb. 10](#) that the IAEA confirmed that Iran had produced several grams of uranium metal using natural uranium in a laboratory experiment. This appears to be separate from work to equip the Isfahan facility, but is still a violation of the 15-year prohibition on producing uranium metal.

Restoring Compliance: Iran may have produced a limited amount of uranium metal in the past as part of its pre-2003 nuclear weapons program, but it does not appear to have significant experience with the process. Evidence from the IAEA's investigations and the material Israel stole from Iran suggest that Iran conducted experiments on producing metal using surrogate materials and was in the process of constructing a uranium metal production facility, but the decision was made to abandon it. The IAEA also had evidence that Iran received a document on how to produce uranium metal in shapes relevant to weapons development from the AQ Khan network. While Iran could quickly uninstall any equipment put in place for this project and ship out any uranium metal produced, the knowledge gained would be irreversible and relevant if Iran decided to pursue nuclear weapons in the future.

- **Work on a New Heavy Water Reactor (planned)**

Background: Iran announced plans to build a new heavy water reactor based on the original design of the unfinished heavy-water reactor at Arak. As originally designed, that reactor would have produced enough plutonium annually that, when separated, would be enough for two nuclear weapons. Iran is prohibited from building new heavy water reactors for 15 years under the JCPOA and from separating plutonium for the same time period.

Restoring Compliance: While the AEOI has submitted plans for the reactor, construction has not yet begun, making the decision easy to reverse. Even if Iran were to take steps to begin constructing the reactor, it could be dismantled quickly, or the unfinished reactor monitored to ensure Iran does not continue any building activities until the 15-year ban on heavy-water reactors expires.