



IAEA's December 6th Update on Iran

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Background

- On December 6, 2024, the International Atomic Energy Agency (IAEA) released an update on its verification and monitoring activities in Iran. The two-page report sounded an alarm about a dangerous increase in Iran's enrichment activities at the Fordow enrichment plant. On December 5, Iran began feeding 20 percent enriched uranium in two interconnected IR-6 cascades previously fed with up to 5 percent low enriched uranium, to make far more 60 percent highly enriched uranium (HEU), along with enriching in more cascades at Fordow.

Findings

- Iran is instituting a capacity to make weapon grade uranium (WGU), under the guise of making 60 percent HEU, at the Fordow underground enrichment plant. It can now start producing WGU quickly without even using its existing stocks of 60 percent HEU.
- The IAEA reports that Iran is setting up a three step, interconnected enrichment process at Fordow, going from natural uranium up to 5 percent enriched uranium in up to 8 IR-6 cascades, from 5 to 20 percent in six current IR-1 cascades, and 20 to 60 percent in two interconnected IR-6 cascades. This three-step process allows the near continuous, sequential enrichment of natural uranium to 60 percent HEU. This process can be easily modified to produce WGU.
- With this new arrangement, Iran could multiply its average 60 percent HEU production rate at Fordow by four to six times. The IAEA reports Iran could make "more than 34 kg" per month. This is consistent with an ideal cascade calculation, which results in an estimate of about 35 kg of 60 percent HEU (Uranium mass) on average per month. A more conservative approach leads to the assessment that Iran could produce about 25 kg (Uranium mass) on average per month, still an alarming increase.
- If it decided to make weapon-grade uranium in the third step of the two interconnected IR-6 cascades instead, starting with 20 percent enriched uranium feed, Iran could produce about 15 kg WGU per month, assuming an ideal cascade calculation as above, or a few kilograms less, about 10-11 kg WGU per month, in a more conservative calculation. The latter gives an annual rate of 120 to 130 kg WGU per year, enough for

about five nuclear weapons. Iran could supplement this at any point by using its existing stock of 60 percent HEU in a few other cascades to produce sufficient WGU for four to five nuclear weapons in a month, providing a surge capacity on top of a steady state production of WGU.

- The IAEA warned that without urgent adjustments with regards to the frequency and intensity of its safeguards measures, it cannot provide assurances of the timely detection of enrichment beyond 60 percent HEU and/or the diversion of nuclear material. The IAEA now must wrestle with Iran to fulfill its safeguards obligations, ensuring the IAEA can detect any such move in a timely manner.

Changes at the Fordow Fuel Enrichment Plant

The December 6th interim report by the IAEA outlines multiple changes Iran has made at the Fordow Fuel Enrichment Plant (FFEP). On December 5th, Iran started to use 20 percent enriched uranium feed to produce 60 percent HEU in the two interconnected IR-6 cascades previously fed with up to 5 percent LEU to produce 60 percent HEU. By increasing the enrichment of the feed material, significantly more 60 percent HEU can be produced.

Of note, this arrangement of two IR-6 cascades includes one cascade with modifiable sub-headers, allowing Iran to change the enrichment output of the cascade quickly. These two IR-6 cascades, as well as the six IR-1 cascades producing up to 20 percent enriched uranium, are in Unit 1 of the FFEP.

In Unit 2 of the FFEP, also on December 5th, Iran started to feed two of eight IR-6 cascades that were previously installed but had not yet been fed with uranium hexafluoride. The two cascades were being fed with natural UF₆ for the production of up to 5 percent LEU. Iran previously informed the IAEA that it would use the remaining six IR-6 cascades in Unit 2 also to produce up to 5 percent enriched uranium, and that it intended to use natural or depleted uranium as feed.

Emergence of Fordow as a One-Stop-Shop for WGU Production

Iran is setting up a three step, interconnected enrichment process at Fordow, going from natural uranium up to 5 percent enriched uranium in up to 8 IR-6 cascades in unit 1, from 5 to 20 percent in six current IR-1 cascades in unit 2, and 20 to 60 percent in the two interconnected IR-6 cascades in unit 2. This three-step process works as a system to produce 60 percent HEU from natural uranium, with the capability to rapidly switch to making WGU.

Iran is also taking new steps to operate this interconnected enrichment process more efficiently. The IAEA reports that the product from the cascades making up to 5 percent enriched uranium was being collected in the same receiving cylinder as that used for collecting the tails produced from Unit 2, i.e. the tails from producing 60 percent HEU from 20 percent enriched uranium feed. This 5 percent enriched uranium can then be fed into the cascades making 20 percent enriched uranium.

Ability to Produce More 60 Percent HEU

Starting with 20 percent enriched uranium feed enables Iran to multiply its average monthly production of 60 percent HEU. The IAEA report cites that the change could increase Iran's average production to "over 34 kg of uranium" per month. However, it is not clear whether this number was calculated by Iran or the IAEA, and whether the intent was to gauge actual future production or to provide a possible maximum for safeguards implementation purposes.

This number is close to the ideal cascade calculation, which provides that Iran could produce about 35 kg (Uranium mass) in one month with the estimated monthly separative work provided by the two IR-6 cascades, a tails assay of 5 percent, and no constraints on the amount of available feedstock.

A more conservative approach would be to calculate the reduced separative work requirement of producing 60 percent HEU from 20 percent enriched uranium rather than from 5 percent LEU. The separative work required per kilogram of product is slightly less than one quarter; thus, Iran is estimated to be able to produce more than four times as much 60 percent HEU as previously. Given that the highest, recent average monthly production of 60 percent HEU at Fordow was 5.7 kg, this would translate to an ability to produce 24 kg 60 percent HEU (Uranium mass). This is rounded to 25 kg for convenience.

Ability to Produce Weapon-Grade Uranium

If Iran decided to make weapon grade uranium instead of 60 percent HEU, it could do so quickly. Without changing the feed material into the third step, namely 20 percent enriched uranium, it could adjust the enrichment level of the product of this step to 90 percent. If this change was instituted year-round, it could produce at Fordow alone about 10-11 kg of WGU per month, or 120-130 kg of WGU per year. Its existing stock of 60 percent HEU could be used in a few, additional cascades to make more WGU in parallel, a stock currently enough to make 4 to 5 nuclear weapons in about one month, providing a surge capacity on top of a steady state production rate.¹

Concerns on the Timely Detection of Breakout

The IAEA reports that it needs to increase the frequency and intensity of its safeguards measures to detect a breakout in a timely manner. It also reports that Iran implemented its measures more quickly than it could adapt its safeguards procedures.

¹ For recent breakout estimates, see David Albright, Sarah Burkhard, and Spencer Faragasso, "Analysis of IAEA Iran Verification and Monitoring Report — November 2024", *Institute for Science and International Security*, November 21, 2024, <https://isis-online.org/isis-reports/detail/analysis-of-iaea-iran-verification-and-monitoring-report-november-2024>.

On December 2, the IAEA reports it “requested that Iran only change the current operation of FFEP once these necessary additional safeguards measures had been determined and implemented by the Agency.” On the next day, however, the IAEA verified that “notwithstanding the request it [the IAEA] had made in its letter to Iran of 2 December 2024 and in subsequent discussions with Iranian officials, Iran had begun preparing for the installation of additional pipework at FFEP.” The IAEA reports that Iran agreed to implement “temporary additional safeguards activities.”

The IAEA does not provide details but it reports that it has assessed “changes on the required frequency and intensity of its safeguards measures at FFEP, the implementation of which will need to be facilitated by Iran as a matter of urgency to enable the Agency to provide timely and technically credible assurances that the facility is not being misused to produce uranium of an enrichment level higher than that declared by Iran, and that there is no diversion of declared nuclear material.”

Of note, a significant amount of 20 percent enriched uranium was transferred to the FFEP. The IAEA states that Fordow received “six cylinders containing a total of 145 kg of UF₆ enriched up to 20% from the Fuel Plate Fabrication Plant (FPFP) at Esfahan.”

As such, the FFEP will be housing much larger amounts of both 20 percent enriched uranium feed and 60 percent HEU product than previously at any given time. Both stocks, due to their potential contribution in a quick breakout to weapon-grade uranium, need to be monitored very closely.

A new IAEA report is expected soon, according to a post on X by Laurence Norman of the *Wall Street Journal*, that may provide an update on additional safeguards measures taken by Iran.