INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

Analysis of IAEA Iran Verification and Monitoring Report — February 2024

By David Albright, Sarah Burkhard, Spencer Faragasso, and Andrea Stricker[1]

March 4, 2024

Background

- This report summarizes and assesses information in the International Atomic Energy Agency's (IAEA's) quarterly report, dated February 26, 2024, *Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)*, including Iran's compliance with the Joint Comprehensive Plan of Action (JCPOA).

Findings

- Iran is able to produce more weapon-grade uranium (WGU) and at a faster rate since the IAEA's last report in November 2023 due to increased stocks of enriched uranium and increased uranium enrichment capacity.
- Iran's stocks of enriched uranium and its centrifuge capacity combined are sufficient to make enough WGU, taken as 25 kilograms (kg) of WGU, for seven nuclear weapons in one month, nine in two months, eleven in three months, 12-13 in four months, and 13 in five months.
- With Iran's growing enrichment experience and using only a portion of its stock of 60 percent highly enriched uranium (HEU), Iran could produce its first quantity of 25 kg of WGU in as little as seven days. The short timeframe results from a scenario in which Iran dedicates four advanced centrifuge cascades to the task and uses a higher tails assay, causing faster production of WGU but requiring more 60 percent feed to do so. This breakout could be difficult for the IAEA to detect promptly, if Iran delayed inspectors' access.
- The net overall enriched uranium stock, including all levels of enrichment and all chemical forms, increased by 1038.7 kg, from 4486.8 kg to 5525.5 kg (Uranium mass or U mass).
- Iran's stockpile of 60 percent HEU was 121.5 kg (U mass) or 179.7 kg uranium hexafluoride mass (hex mass) as of February 10, 2024, a decrease of 6.8 kg (U mass) since October 2023.

[1] Andrea Stricker is deputy director of the Foundation for Defense of Democracies' (FDD's) Nonproliferation and Biodefense Program and an FDD research fellow.

- The decrease in Iran's stock of 60 percent HEU equals the difference between the amount of 60 percent HEU Iran produced (25 kg U mass) and the amount Iran downblended from 60 percent HEU to 20 percent enriched uranium (31.8 kg U mass).
- The average production rate of 60 percent HEU more than doubled from 2.9 kg (U mass) to 7.1 kg (U mass). At this rate, Iran can produce about 87 kg (U mass) annually.
- Iran continued to produce 60 percent HEU from 5 percent low enriched uranium (LEU) feed in two pairs of interconnected advanced centrifuge cascades at the above-ground Pilot Fuel Enrichment Plant (PFEP) and the below-ground Fordow Fuel Enrichment Plant (FFEP); the latter pair includes an IR-6 centrifuge cascade that is easily modifiable to change operations. This cascade was enriching at the higher rather than at the lower stages of enrichment in an IAEA-detected undeclared mode of operation in January 2023, after which the IAEA detected the presence of near-84 percent HEU particles at the cascade's product sampling point. While Iran temporarily reversed the configuration of the two IR-6 cascades over the summer 2023, this is the configuration Iran has been using again since December 2023.
- The IAEA's technical report is shorter in length and omits previously reported details, including how much of the 20 percent enriched uranium and 60 percent HEU stocks Iran keeps at the Esfahan Fuel Plate Fabrication Plant (FPFP), where Iran maintains a capability to make enriched uranium metal. According to previous reports, Iran was storing the majority of those stocks at Esfahan. Storage of so much proliferation-sensitive material at the FPFP, which may not be as thoroughly monitored as Natanz and Fordow, requires enhanced IAEA safeguards to detect and prevent diversion to a secret enrichment plant. For example, there should be stepped-up inspector presence and remote camera surveillance. Iran's action is also a violation of the JCPOA, and therefore the IAEA should report on the whereabouts of these stocks and relevant safeguards in place.
- As of February 10, 2024, Iran had an IAEA-estimated stock of 712.2 kg of 20 percent enriched uranium (U mass and in the form of UF_6), equivalent to 1053.6 kg (hex mass), representing an increase of 145.1 kg from 567.1 kg (U mass). Iran also had a stock of 31 kg (U mass) of 20 percent uranium in other chemical forms.
- The average production rate of 20 percent enriched uranium at the FFEP remained steady at about 13.5 kg (U mass) or 20 kg (hex mass) per month.
- The majority of the increase in Iran's 20 percent enriched uranium stock stems from Iran downblending 60 percent HEU to produce 97.9 kg 20 percent enriched uranium (U mass).
- Iran's deployment of advanced centrifuges has increased significantly. After a slowdown from February 2023 to November 2023, Iran installed six new advanced centrifuge cascades during this reporting period. Iran now has almost 7400 advanced centrifuges at Natanz and Fordow, where most are deployed at the Natanz Fuel Enrichment Plant (FEP) (see Figure 1). The FEP now has all projected centrifuge cascades installed, pending any future design information changes by Iran.
- Including the installed IR-1 centrifuges at the FEP and FFEP brings the total number of installed centrifuges to about 14,600. It should be noted that many of the advanced centrifuges are deployed but not enriching uranium, and the IR-1 centrifuges have a far lesser ability to enrich uranium than the advanced ones.

- Iran did not install any additional advanced centrifuge cascades at the FFEP, where it is currently operating six IR-1 centrifuge cascades and two IR-6 centrifuge cascades, although it plans to install up to an additional 14 IR-6 centrifuge cascades.
- Iran's current, total operating enrichment capability is estimated to be about 19,800 separative work units (SWU) per year, where only cascades enriching uranium during this reporting period are included in the estimate. As of this reporting period, Iran was not yet using its fully installed enrichment capacity at the FEP, which, if operational, would total about 34,500 SWU/yr.
- Iran's stockpile of near 5 percent LEU increased by 178.8 kg (U mass) to 2396.8 kg (U mass), or 3545.6 kg (hex mass). Average production of near 5 percent LEU at the FEP remained similar to the last reporting period, consistent with the reporting that Iran continued to use natural uranium as feedstock instead of up to 2 percent LEU.
- Despite the increase during this reporting period in the amount of uranium enriched between two and five percent, Iran has not prioritized stockpiling this material. For example, it has not made planned progress on the Enriched Uranium Powder Plant, a key civil facility to convert less than 5 percent enriched uranium hexafluoride into a uranium oxide powder for use in nuclear power reactor fuel. These two choices are at odds with Iran's contention that its primary goal is to accumulate 4-5 percent enriched uranium for use in nuclear power reactor fuel. Instead, Iran has used this stock extensively to produce near 20 percent and 60 percent enriched uranium, far beyond Iran's civilian needs.
- The IAEA again reports that Iran has not started commissioning the Arak reactor, now called the Khondab Heavy Water Research Reactor (KHRR), or IR-20. Iran previously informed the IAEA that it expected to commission the reactor in 2023 and start operations in 2024, but construction efforts on the reactor continue and Iran has provided no update.
- The IAEA underscores that it has been "three years since Iran stopped provisionally applying its Additional Protocol and, therefore, since it provided updated declarations and the Agency was able to conduct complementary access to any sites and other locations in Iran."
- The IAEA reports no new progress on installing new surveillance cameras at Iran's nuclear-related facilities, including centrifuge manufacturing and assembly sites. Iran has also said it will not turn over data or footage associated with monitoring devices and cameras, as it committed in an IAEA/Iran Joint Statement from March 2023, unless sanctions are removed, essentially holding the IAEA hostage to political developments outside the agency's control.
- The absence of monitoring and surveillance equipment, particularly since June 2022, has caused the IAEA to doubt its ability to ascertain whether Iran has diverted or may divert advanced centrifuges. A risk is that Iran could accumulate a secret stock of advanced centrifuges, deployable in the future at a clandestine enrichment plant or during a breakout at declared sites. Another risk is that Iran will establish additional centrifuge manufacturing sites unknown to the IAEA. Iran has proven its ability to secretly move manufacturing equipment to new, undeclared sites, further complicating any future verification effort and contributing to uncertainty about where Iran manufactures centrifuges.

- The IAEA concludes that "Iran's decision to remove all of the Agency's equipment previously installed in Iran for JCPOA-related surveillance and monitoring activities in relation to the JCPOA has [had] detrimental implications for the Agency's ability to provide assurance of the peaceful nature of Iran's nuclear [program]."
- The IAEA categorically states, "The Agency has lost continuity of knowledge in relation to the production and inventory of centrifuges, rotors and bellows, heavy water and [uranium ore concentrate] UOC."
- Concern about Iran's installation of advanced centrifuges at an undeclared site increases as the 60 percent HEU stocks grow. Such a scenario is becoming more worrisome and viable, since a relatively small number of advanced centrifuge cascades would suffice for the rapid enrichment of the 60 percent HEU to weapon-grade. This hybrid strategy involves Iran diverting safeguarded HEU and enriching the material to weapon-grade using three or four secretly manufactured and deployed cascades of advanced centrifuges. With greater uncertainty about the number of advanced centrifuges Iran is making, there is a greater chance of Iran hiding away the requisite number of advanced centrifuges to carry out this scenario.
- Combined with Iran's refusal to resolve outstanding safeguards violations, the IAEA has a significantly reduced ability to monitor Iran's complex and growing nuclear program, which notably has unresolved nuclear weapons dimensions. The IAEA's ability to detect diversion of nuclear materials, equipment, and other capabilities to undeclared facilities remains greatly diminished.

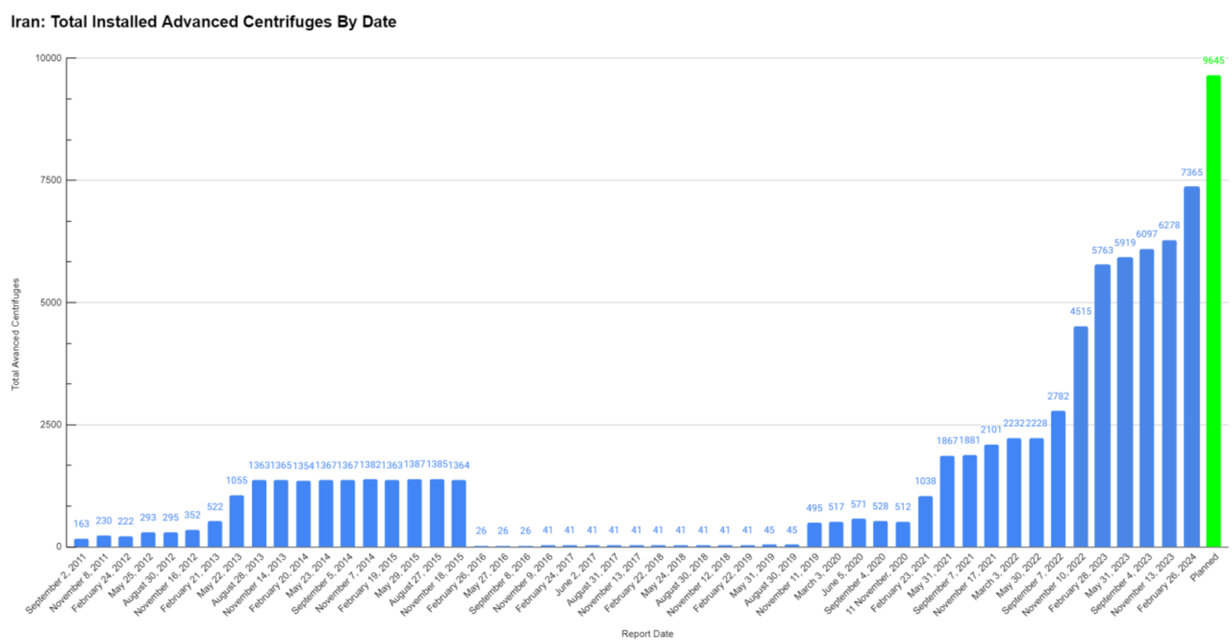

Figure 1. The total number of advanced centrifuges installed at all three enrichment facilities. Six cascades of IR-4 centrifuges were reportedly added at Natanz during this quarterly report. As can be seen, centrifuge installation has accelerated in the last quarter, following relatively small incremental increases for most of 2023.

Part 1: Enriched Uranium Stocks

At the Natanz FEP, Iran produced approximately 1440 kg of UF_6 enriched up to 5 percent U-235 during the reporting period, which spanned 105 days from October 28, 2023 to February 9, 2024.[2] The report discusses this amount as kilograms of UF_6 in units of UF_6 mass, which the authors refer to as hex mass. The total uranium mass, ignoring the fluorine elements, is 973.4 kilograms, for a monthly average production rate of 278.1 kg U mass and a daily average production rate of 9.3 kg U mass. These average production rates increased slightly from 268.5 kg U mass per month, or 9 kg U mass per day, during the previous reporting period, but are largely comparable, consistent with the fact that only natural uranium was used as feed during both reporting periods.

At the FFEP, during the last reporting period, which spanned October 28, 2023 to February 9, 2024, Iran produced 23.5 kg (hex mass) of near 60 percent enriched uranium, or 15.9 kg U mass. The daily average production rate was 0.15 kg (U mass), resulting in a monthly average production rate of 4.5 kg (U mass), more than double the average production during the last reporting period, when it was 2 kg (U mass). Annually, at this rate, Iran could produce 81.7 kg (hex mass) or 55.2 kg (U mass) at Fordow alone.

Iran also produced 69.9kg of UF_6 (hex mass) enriched up to 20 percent enriched uranium, or 47.3 kg U mass. Average production of 20 percent enriched uranium at the FFEP remained steady compared to the last reporting period, at 0.67 kg (hex mass) or 0.45 kg (U mass) per day, resulting in a monthly average production rate of 20 kg (hex mass) or 13.5 kg (U mass). Annually, Iran could produce 243 kg (hex mass) or 164.3 kg (U mass).

From its production of 60 and 20 percent enriched uranium at the FFEP, Iran accumulated 775 kg (hex mass) or 523.9 kg (U mass) of up to 2 percent enriched uranium in tails.

At the PFEP, Iran continued to produce 2 percent enriched uranium, 5 percent enriched uranium, and up to 60 percent enriched uranium stock during the reporting period. Between October 28, 2023 and February 9, 2024, the PFEP produced 13.5 kg (hex mass) of near 60 percent enriched uranium or 9.1 kg (U mass); 165.2 kg (hex mass) of up to 5 percent LEU (111.7 kg U mass); and 254.7 kg (hex mass) of uranium enriched up to 2 percent U-235 (172.2 kg U mass).

The 60 percent enriched uranium production rate at the PFEP during this reporting period was 13.5 kg (hex mass) or 9.1 kg (U mass) over 105 days, resulting in a monthly average production rate of 3.9 kg (hex mass) or 2.6 kg (U mass) per month, or a daily average production rate of 129 grams (hex mass) or 87 grams (U mass) per day. This rate is three times higher than the previous reporting period's monthly average production rate, which was 1.29 kg (hex mass) or 0.87 kg (U

[2] That production values are reported in uranium hexafluoride mass can be discerned only by comparing the production values to the differences in stockpile from one reporting period to the next. The differences in stockpile are consistently two-thirds of the given produced quantity, showing that the former is in uranium mass and the latter is in uranium hexafluoride mass.

mass) per month. Annually, using only the two advanced production-scale centrifuge cascades at the PFEP, Iran could produce 46.9 kg (hex mass) or 31.7 kg (U mass) of 60 percent enriched uranium. Together with production at the FFEP, Iran is producing 7.1 kg (U mass) or 10.6 kg (hex mass) per month on average and could produce 128.6 kg (hex mass) or 86.9 kg (U mass) of near 60 percent enriched uranium per year.

During this reporting period, Iran mixed 31.8 kg (U mass) of near 60 percent enriched uranium with 66.4 kg (U mass) of up to 2 percent LEU and produced 97.9 kg (U mass) of near 20 percent enriched uranium.

Estimates of additional amounts of LEU in oxides and intermediate products, fuel assemblies and rods, targets, and scrap, add up to 361 kg (U mass). The report specifies that of the 361 kg enriched to unspecified levels (U mass), 31 kg are up to 20 percent enriched uranium and 2 kg are up to 60 percent HEU. Of the 31 kg (U mass) of near 20 percent enriched uranium, 22.7 kg (U mass) (down by 1.5 kg from the previous reporting period) are specified to be in the form of fuel assemblies and 2.8 kg are in targets. The report specifies that 1.5 kg were "loaded into the reactor core at [Tehran Research Reactor] TRR" and "thus removed from the stockpile." What this means is unclear, since the uranium in the irradiated fuel is still subject to safeguards. This could be referring to past, defective exemptions of nuclear material under the JCPOA.

Of its near 5 percent LEU stock, Iran fed 912.1 kg hex mass (or 616.6 kg U mass) into the cascades at Fordow, for an average feed rate of about 8.7 kg per day hex mass, or 5.9 kg U mass, about one third more than during the previous reporting period. It is unclear why the feed increased by one third while the amount produced doubled. Iran dumped 5.2 kg of near 5 percent LEU feed at the FFEP (hex mass), or about 3.5 kg in uranium mass, or less than one percent of the feed. Iran also fed 433.4 kg of near 5 percent hex mass (293 kg U mass) into PFEP R&D lines 4, 5, and 6, for a daily average feed rate of 4.1 kg (hex mass) or 2.8 kg U mass per day, slightly more than the amount during the previous reporting period.

Based on this information, Iran's new stockpile of near 5 percent LEU in uranium mass should be the sum of 2218.1 kg U mass from the last reporting period, 973.4 kg from the FEP, and 111.7 kg from the PFEP, with the feed of 909.6 kg subtracted. Adding back the 3.5 kg (U mass) feed dumped at the FFEP, this total becomes 2397.1 kg (after rounding of addends), close to the 2396.8 kg U mass of near 5 percent LEU in UF_6 form that the IAEA reported.

The net overall enriched uranium stock, including all levels of enrichment and all chemical forms, increased by 1038.7 kg from 4486.8 kg to 5525.5 kg (U mass) (see Table 1). This increase stems from an increase across three out of four enriched uranium stocks. The near 2 percent LEU stock in the form of UF_6 increased by 716.8 kg (U mass), the near 5 percent LEU stock in the form of UF_6 increased by 178.7 kg (U mass), the near 20 percent enriched uranium stock increased by 145.1 kg from 567.1 kg to 712.2 kg (U mass), while the near 60 percent enriched uranium stock decreased by 6.8 kg from 128.3 kg to 121.5 kg (U mass).

At the PFEP, Iran continued to use a combination of R&D lines 4, 5, and 6 to feed 5 percent LEU into the interconnected cascades in lines 4 and 6 and produce 60 percent enriched uranium, while using centrifuges in line 5 to increase the enrichment level of the tails (see below). During this reporting period, spanning October 28, 2023 to February 9, 2024, of the 433.4 kg (hex mass) of 5 percent LEU fed into lines 4 and 6, Iran turned 13.5 kg (hex mass) (3.1 percent) into 60 percent enriched uranium and 165.5 kg (hex mass) back into 5 percent enriched uranium (38 percent). 254.7 kg (hex mass) (59 percent) remained as tails enriched up to 2 percent.

Table 1. Enriched Uranium Inventories,* including less than 5%, up to 20%, and up to 60% enriched uranium (all quantities in uranium mass)

Chemical Form	February 12, 2023	May 13, 2023	August 18, 2023	October 28, 2023	February 10, 2024
UF6 (kg)	3402	4384.8	3441.3	4130.7	5164.5
Uranium oxides and their intermediate products (kg)	215.3	207.5	206.9	205.6	203.6
Uranium in fuel assemblies, rods, and targets (kg)	58.4	59.5	54	54.1	52.6
Uranium in liquid and solid scrap (kg)	85.1	92.7	93.37	96.4	104.8
Enrichment Level Subtotals					
Uranium enriched up to 5 percent (kg) but more than 2 percent	1324.5	1340.2	1950.9	2218.1	2396.8
Uranium enriched up to 2 percent (kg)	1555.3	2459.6	833	1217.2	1934
Uranium enriched up to 20 percent (kg)	434.7	470.9	535.8	567.1	712.2
Uranium enriched up to 60 percent (kg)	87.5	114.1	121.6	128.3	121.5
Uranium in chemical forms other than UF6 with unspecified enrichment level (kg) (including 31 kg up to 20% LEU and 2 kg up to 60% HEU)	358.8	359.7	354.4	356.1	361
Totals of Enriched Uranium in UF6, <5 % (kg)	2879.8	3799.8	2783.9	3435.3	4330.8
Totals of Enriched Uranium in UF6, including near 20% and near 60% (kg)	3402	4384.8	3441.3	4130.7	5164.5
Totals of Enriched Uranium in all chemical forms, <5% <20% and <60% enriched	**3760.8**	**4744.5**	**3795.6**	**4486.8**	**5525.5**

* These totals do not include undisclosed stocks of enriched uranium exempted by the JCPOA Joint Commission.

Part 2: Enrichment Capacity

Natanz Fuel Enrichment Plant

Installed Centrifuges. As of February 24, 2024, the IAEA reports that Iran had installed at the Natanz FEP 36 cascades of IR-1 centrifuges,[3] 21 cascades of IR-2m centrifuges, 12 cascades of IR-4 centrifuges (up from six during the previous reporting period), and three cascades of IR-6 centrifuges. The FEP now has all the projected centrifuge cascades installed, pending any future design information changes by Iran. Iran now has an estimated total of 6264 advanced centrifuges installed at the FEP, of which 3654 are IR-2m centrifuges.

Enriching Centrifuges. As of February 24, 2024, the IAEA reports that at the FEP, in total, 36 cascades of IR-1 centrifuges, nine cascades of IR-2m centrifuges, three cascades of IR-4 centrifuges, and three cascades of IR-6 centrifuges were being fed with natural UF_6, the same as during the last reporting period. Overall, the enrichment capacity of enriching centrifuges remains significantly below that of installed centrifuges, as a total of 12 IR-2m cascades and nine IR-4 cascades are installed but not enriching at the FEP.

The quantity of IR-1 centrifuges Iran withdrew from JCPOA-mandated storage continues to be unavailable for this reporting period because of Iran's refusal since February 2021 to provide the IAEA with access to data and recordings collected by agency equipment, and since June 2022, to continue collecting such data. In general, these centrifuges are believed to be coming from stocks of IR-1 centrifuges dismantled before JCPOA Implementation Day in January 2016 rather than representing newly built machines.

No new cascades of IR-2m centrifuges have been installed since February 2023, but for those installed prior to February — specifically the approximately 2600 installed over a short period of time between September 2022 and February 2023 — it is unclear whether they are newly produced machines or were drawn from a secret storage site. The total number of IR-2m centrifuges installed remains three times the quantity Iran had installed prior to the JCPOA and even exceeds the quantity Iran declared, prior to the JCPOA, that it planned to install at the FEP. Iran may have built many of these machines prior to the JCPOA's Implementation Day in early 2016 while declaring falsely that it had not done so. The rapid installation of six cascades of IR-4 centrifuges raises questions about how Iran manufactured and assembled so many, and if they had been kept in storage from a previous time or were newly built over the last quarter.

Planned Expansion. Iran is planning to commission up to eight enrichment units in Building B1000 at Natanz, based on previous IAEA reports. Each of the eight enrichment units can hold 18 cascades (same general design as Building A1000), but Iran has not specified how many centrifuges and what type it plans to install there. The current report provides no update on this planned commissioning.

[3] In August 2022, Iran had announced its intention to reconfigure some of the IR-1 cascades to include additional centrifuges, and in December 2022, this process was completed with 120 total IR-1 centrifuges added.

Fordow Fuel Enrichment Plant

Overall, no changes in centrifuge deployment have occurred at Fordow. At the FFEP, Iran currently has 1044 IR-1 centrifuges installed in three sets of two interconnected cascades, and two interconnected cascades of 166 IR-6 centrifuges. Iran has not installed any additional IR-6 or IR-1 centrifuges toward its plans of installing up to 14 additional cascades to the FFEP (where the six currently installed IR-1 cascades would be replaced, for a total of 16 cascades) but the installation of necessary infrastructure for eight new cascades was ongoing.

Iran continues to use the three sets of two interconnected IR-1 cascades to produce 20 percent enriched uranium from up to 5 percent LEU. Two interconnected IR-6 cascades have produced 60 percent HEU from 5 percent LEU feed. In late January 2023, the IAEA detected near-84 percent enriched HEU at the product sampling point, suggesting that the enrichment level temporarily rose above 60 percent.

60 Percent HEU Production at the FFEP. On November 22, 2022, Iran started using the two cascades of IR-6 centrifuges to produce UF_6 enriched up to 60 percent from near 5 percent LEU feed "by operating the two IR-6 cascades as one set of two interconnected cascades." In a footnote, the IAEA specified that the declared mode of interconnection used the IR-6 cascade without modified sub-headers for the last stage of enrichment to 60 percent, and this mode appears to have been used through January 16, 2023. At some point after an unannounced inspection (UI) on January 16, 2023, Iran made an undeclared change to the operation, where the IR-6 cascade with modified sub-headers was used for the last stage of enrichment. While Iran temporarily reversed this change over the summer 2023, this is the configuration Iran has been using again since December 2023.[4]

Pilot Fuel Enrichment Plant

New Underground PFEP. Iran plans to transfer its enrichment research and development activities to "a segregated area of Building A1000 at the FEP, to create a new area of the PFEP." On April 24, 2023, Iran provided the IAEA with an updated design information questionnaire (DIQ) for Building A1000, stating it intends to commission there six of the 18 R&D lines (A-F), consisting of "up to 174 IR-4 or IR-6 centrifuges, or various configurations of smaller cascades and single machines." It further declared that it may accumulate enriched uranium product of up to 5 percent LEU from enrichment activities in that area. A third line, line C, was commissioned during this reporting period, bringing the total number of lines containing centrifuges to three. Iran had begun installing centrifuges in three of the lines, lines A, B, and C, where line A consists of 20 IR-4 centrifuges, line B consists of 20 IR-6s centrifuges, and Line C consists of 20 IR-6 centrifuges. On January 23, 2024, the IAEA verified that no additional centrifuges had been installed, but that the

[4] "Statement on Iranian nuclear steps reported by the IAEA," United Kingdom Foreign, Commonwealth & Development Office, December 28, 2023, https://www.gov.uk/government/news/statement-on-iranian-nuclear-steps-reported-by-the-iaea?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=2f47a885-843f-4f0e-b89d-7c0e6285e3cc&utm_content=immediately.

installation of infrastructure for the overall 18 cascades and the installation of feed and withdrawal infrastructure was on-going.

The report does not provide an anticipated start date for this new area. Given that this new R&D area represents a three-fold increase from the six lines in the above-ground PFEP, and each could hold a full production-scale cascade of Iran's advanced centrifuges, this area could be devoted to production-scale enrichment in case of a surge in enriched uranium production or a breakout.

60 Percent HEU Production in Lines 4, 5, and 6. The IAEA reported no changes to the deployment of centrifuges in production lines 4 and 6, which are used for production of 60 percent enriched uranium. Since 60 percent enriched uranium production started on April 17, 2021, Iran has changed the mode of production several times, described in previous IAEA reports.

On February 21, 2024, the IAEA verified that Iran was continuing to feed up to 5 percent LEU into the two interconnected cascades in lines 4 and 6, comprising up to 164 IR-4 and up to 164 IR-6 centrifuges, respectively, and producing up to 60 percent enriched uranium. Line 5 is used to re-enrich tails from lines 4 and 6 to near 5 percent LEU. The assay of the tails is likely about 2-3 percent. In a footnote in a previous report, the IAEA confirmed that the tails from lines 4 and 6 that were not re-enriched in line 5 were accounted for as part of the stockpile enriched up to 5 percent, rather than the stockpile enriched up to 2 percent. As of February 21, line 5 was enriching tails from lines 4 and 6 in a cascade of 164 IR-4 and three IR-6 centrifuges.

The IR-4 cascade in line 4 and the IR-6 cascade in line 6 have similar estimated production-scale enrichment outputs of about 600 SWU per year each, where the enrichment outputs for these two centrifuge types in a production-scale cascade are taken from separate Institute reports.[5] The IR-6 centrifuge cascade has a production-scale enrichment output that is lower than expected. The two lines together have an estimated output of 1200 SWU per year, or the equivalent of about 1330 IR-1 centrifuges.

Line 1. Iran was feeding natural UF_6 into an intermediate cascade of 18 IR-1 centrifuges and an intermediate cascade of 94 IR-2m centrifuges in line 1 to produce uranium enriched up to 2 percent U-235.

Lines 2 and 3. On February 21, 2024, the IAEA verified that lines 2 and 3 continued to accumulate uranium enriched up to 2 percent through feeding of natural UF_6. The IAEA verified that Iran had been using for this purpose small and intermediate cascades of up to: 4 IR-2m centrifuges; 19 IR-4 centrifuges; six IR-5 centrifuges and 19 IR-5 centrifuges; ten IR-6 centrifuges, 20 IR-6 centrifuges, and 19 IR-6 centrifuges. The previously installed IR-6s centrifuges were no

---

[5] David Albright, Sarah Burkhard, and Spencer Faragasso, "A Comprehensive Survey of Iran's Advanced Centrifuges," *Institute for Science and International Security*, December 2, 2021, https://isis-online.org/isis-reports/detail/a-comprehensive-survey-of-irans-advanced-centrifuges. The enrichment output for the IR-6 is further adjusted based on: David Albright and Sarah Burkhard, "The IR-6 Centrifuge Needs Further Development," *Institute for Science and International Security,* September 9, 2022, https://isis-online.org/isis-reports/detail/the-ir-6-centrifuge-needs-further-development/

longer present during this reporting period. Iran has not redeployed any IR-s centrifuges, which had previously been installed in lines 2 and 3. The following single centrifuges were being tested with natural UF_6 but were not accumulating enriched uranium: two IR-2m centrifuges, 11 IR-4 centrifuges; two IR-5 centrifuges; two IR-6 centrifuges; two IR-6s centrifuges; one IR-7 centrifuge; one IR-8 centrifuge; one IR-8B centrifuge; and one IR-9 centrifuge.

Capacity of Centrifuges Enriching Uranium

Table 2 lists the estimated enrichment capacity by facility for those centrifuges that are currently enriching (not including machines installed but not yet enriching), leading to a total of 19,830 SWU per year, or the equivalent of 22,030 IR-1 centrifuges.

By contrast, including the installed but not yet enriching centrifuges results in an increase of enrichment capacity by 74 percent, for roughly 34,500 SWU per year. This difference is especially significant at the moment, because Iran has 15 additional advanced centrifuge cascades installed, which it was not using to enrich during the latest reporting period.

Of note, the total enrichment capacity used in breakout calculations is different. It includes currently installed centrifuges but excludes many of the advanced centrifuges in the PFEP, except production-scale advanced cascades, as they would likely not contribute meaningfully to the quick production of enough WGU for a nuclear explosive when starting with up to 5 percent or near 20 percent enriched uranium.

Table 2. Quantity of enriching centrifuges and enrichment capacity

	Number of enriching centrifuges	**Enrichment capacity in SWU/yr**	**IR-1 equivalent**
Natanz FEP	8780	15,100	16,790
Fordow	1376	2140	2370
Natanz Above-Ground PFEP*	703	2590	2870
Lines 1, 2 & 3	See text		
Lines 4, 5 & 6	See text		
Natanz Below-Ground PFEP	N/A (not enriching yet)	–	–
Total	10,8595	19,830	22,030

* The values for lines 1, 2 and 3 of the PFEP are rough estimates based on the use of estimated and measured values for the separative output of these centrifuges in cascades, as drawn from IAEA and Iranian information.

Practicing Breakout by Producing Highly Enriched Uranium

During this reporting period, Iran continued to produce 60 percent enriched uranium, or HEU, and its stock now exceeds three significant quantities of HEU, despite blending down a fraction of it to near 20 percent enriched uranium.[6] Thus, Iran continues to have enough nuclear explosive material to have assurance it can directly fashion a nuclear explosive device, since 60 percent enriched uranium can be used directly in nuclear weapons. About 40 kg (U mass) is more than enough to make a nuclear explosive, compared to 25 kg (U mass) of 90 percent enriched uranium, the quantity the Institute uses as a "sufficient quantity" for Iran to manufacture a nuclear explosive.

Iran could also enrich the 60 percent enriched uranium to weapon-grade uranium. After all, 60 percent enriched uranium is 99 percent of the way to WGU.

Sixty percent enrichment is also a level associated with a key step in the traditional A.Q. Khan stepwise process of climbing from natural uranium to 90 percent enriched uranium in four enrichment steps – enriching natural uranium to 4-5 percent enriched uranium, then further enriching this material to 20 percent, then to 60 percent, and finally to 90 percent.

Iran has thoroughly practiced the main steps of breakout under a civilian cover and has also learned to reduce the number of steps that it would need to go from natural uranium to WGU, such as by going directly from five percent to 60 percent. Moreover, the Iranians are experimenting with transferring enriched UF_6 as a gas from one step to the next, instead of having to solidify the intermediate product gas and turn it back into a gas in the next step, as Khan needed to do to make Pakistani nuclear weapons.

Iran may have covertly produced small quantities of WGU from near 20 percent enriched uranium, despite not collecting this product. In November 2021, Iran fed an unspecified amount of its near 20 percent enriched uranium stock into a variety of advanced centrifuges at the PFEP. Since Iran was not accumulating enriched uranium, and was instead combining the product and tails, the levels of enriched uranium achieved are not included in the report and may also not be known to the IAEA. The levels reached may include 90 percent, or weapon-grade.

All this experimentation has led Iran to be more capable of breaking out, if the leadership orders production of WGU or moves toward the construction of nuclear weapons. Undoing Iran's acquisition of this knowledge is not possible.

[6] A significant quantity of 60 percent enriched uranium is 41.7 kg, and it contains 25 kilograms of uranium-235, all in uranium mass.

Transfer of 20 Percent Enriched Uranium and 60 Percent HEU from Natanz to Esfahan

This and the previous IAEA report do not discuss additional transfers or existing stocks of near 20 and 60 percent enriched uranium to the Esfahan FPFP from Natanz and Fordow. The reason for the omission is not provided.

Earlier reports discussed Iran's transfer of 20 percent enriched uranium and 60 percent HEU in hexafluoride form from the Natanz site to the FPFP, which it declared to be for the production of HEU targets for the TRR. However, almost none of this enriched uranium has been turned into targets. Iran's storage of so much proliferation-sensitive material at the FPFP requires enhanced IAEA safeguards to detect and prevent diversion to a secret enrichment plant. It is unclear if such safeguards have been applied, such as stepped-up inspector visits, more frequent inventory verification, or camera surveillance. The IAEA should report on this matter urgently.

Based on past reports, in January 2022, Iran transferred 23.3 kg (U mass) of 60 percent material to the FPFP. On April 19, 2022, the IAEA verified the receipt of an additional quantity of 15.3 kg (U mass) 60 percent HEU, bringing the total to 38.6 kg (U mass). On September 11, 2022, the IAEA verified the receipt of 16.5 kg (U mass) of 60 percent enriched uranium, bringing the total to 55.1 kg. On October 24, 2022, the IAEA verified the presence of a total of 53 kg (U mass) 60 percent HEU at the "storage area" of FPFP. The difference of about 2 kg matches the amount of 60 percent HEU reported to be in forms other than uranium hexafluoride, specified to contain 1.6 kg (U mass) in mini-plates. As of August 19, 2023, this 1.6 kg of HEU in 264 targets had been irradiated in the TRR, and the targets were being stored in the TRR reactor pool. Another 0.4 kg (U mass) was in liquid and solid scrap.

On February 15, 2023, the IAEA verified the receipt at the FPFP of 16.55 kg (U mass) of 60 percent enriched uranium in the form of uranium hexafluoride. On July 19, 2023, the IAEA verified receipt at the FPFP of 30.92 kg of 60 percent enriched uranium, and on August 20, 2023, it verified an overall total of 100.52 kg of 60 percent enriched uranium at the FPFP.

On May 30, 2023, the IAEA verified receipt from the PFEP of 64.5 kg (U mass) of 20 percent enriched uranium in the form of uranium hexafluoride, bringing the total of 20 percent enriched uranium to 454.64 kg. No additional transfer or production of mini-plates (targets) has been reported since the previous reporting period.

As of August 2023, of Iran's total stock of 121.6 kg (U mass) of 60 percent HEU at that time, about 83 percent of this stock was in storage at the FPFP. This represented an increase from the total of 60 percent of this material stored at the FPFP at the end of the prior reporting period in May 2023. Of Iran's total stock of 20 percent enriched uranium, nearly 85 percent of this stock was in storage at the FPFP at that time. The November 2023 and February 2024 reports provides no information about the size of these stocks at the FPFP.

Given that Esfahan holds Iran's capabilities to turn enriched uranium hexafluoride into metal, the IAEA should carefully monitor these stocks, as well as guard against diversion to a secret enrichment facility. It should also be noted that the presence of these stocks of 20 and 60 percent stocks violates the JCPOA, and therefore the amounts should be available in the IAEA report.

Part 3: Current Breakout Estimates

During this reporting period, Iran's installed centrifuge capacity used for breakout calculations grew with the installation of about 1000 IR-4 centrifuges at the FEP. Because Iran no longer allows the IAEA to monitor its manufacture and assembly of advanced centrifuges, it could also be stockpiling advanced centrifuges without the IAEA's knowledge.

Iran's formal breakout timeline remains at zero. It has enough 60 percent enriched uranium, or HEU, to be assured it could directly fashion three nuclear explosives.[7]

If Iran wanted to further enrich all its 60 percent HEU up to weapon-grade, it could do so quickly, using only three to four advanced centrifuge cascades that are already installed at the PFEP and FFEP. The length of time needed to further enrich the 60 percent HEU to WGU also depends on its choice of tails assay, or the enrichment level of the "waste" material. The two most expected enrichment levels of the tails assay would be 5 percent or 20 percent enriched uranium, which would allow Iran to reuse the tails as feed in cascades making 20 percent or 60 percent enriched uranium. The penalty of using a higher tails assay is that less WGU is produced. With Iran's existing stock of 60 percent enriched uranium, and using four IR-6 and IR-4 cascades, Iran could produce about 70 kg of WGU in three weeks, if it used a tails assay of 20 percent, and about 80 kg of WGU, using a tails assay of 5 percent. If Iran emphasized speed to obtain its first 25 kg of WGU, where a weapon is assigned 25 kg of weapon-grade uranium (U mass) (see below for a brief explanation for this choice), then it would likely prefer choosing a 20 percent tails assay, allowing Iran to have its first such quantity of WGU in about 7 days. If Iran wanted more WGU, and chose a tails assay of 5 percent enriched uranium, then it would need about 12 days. In both cases, within the first month after a breakout started, Iran could use its stock of 60 percent "feed" to produce almost enough WGU for three quantities of 25 kg of WGU.

In parallel to further enriching 60 percent material, Iran could enrich its near 20 percent enriched uranium stock to weapon-grade uranium in its production-scale cascades at the FEP and FFEP. Using the Institute's breakout calculator, and assuming a set-up time of two weeks, Iran is

[7] According to the IAEA, Iran has 121.5 kg of 60 percent enriched uranium (uranium mass) in the form of uranium hexafluoride, more than three significant quantities, where the IAEA defines a significant quantity as the "approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive cannot be excluded." By definition, it is the amount of HEU containing 25 kg of uranium-235, or 41.7 kg of 60 percent enriched uranium.

estimated to be able to accumulate, in one month, enough weapon-grade uranium for over five nuclear weapons from its stock of near 20 percent enriched uranium.

Looking at the issue differently, in one month, using 20 and 60 percent stocks, with a set-up time applied to the 20 percent enriched uranium, Iran could produce enough weapon-grade uranium for seven nuclear weapons, an increase of one since the last IAEA report. Smaller amounts may be sufficient for each nuclear weapon, indicating that the breakout calculation is conservative.

In the second month, Iran could continue enriching to weapon-grade using its feedstocks of enriched uranium, in particular its remaining 20 percent stock and its less than five and above two percent (taken as 4.5 percent) enriched uranium stock, producing enough weapon-grade uranium for two more nuclear weapons, or a cumulative total of nine nuclear weapons.

By the end of the third month, using its remaining stock of less than five but greater than two percent enriched uranium, Iran could accumulate enough WGU for 11 nuclear weapons, and by the end of the fourth month, enough WGU for 12-13 nuclear weapons. The latter variation reflects the functioning of the calculator and transition times to the use of 4.5 percent enriched uranium.

Regardless, by the end of the fifth month, Iran could produce WGU for a total of 13 nuclear weapons.

In summary, Iran can use a fraction of its 60 percent enriched uranium to rush to its first quantity of 25 kg of WGU in as little as seven days. Its enriched uranium stocks are sufficient to make enough weapon-grade uranium for seven nuclear weapons in one month, nine nuclear weapons in two months, 11 in three months, 12-13 in four months, and 13 in five months.

When Iran ended its crash nuclear weapons program in 2003, called the Amad Plan, its biggest bottleneck was the lack of WGU; it still needed at least a few more years to accumulate enough WGU for a nuclear weapon.[8] Under intense international pressure, Iran decided in 2003 to downsize and better camouflage its nuclear weapons effort, while pushing to establish a robust capability to enrich uranium. Today, that decision has borne fruit. While it could only aim for enough nuclear explosive material for five nuclear weapons in 2003, today it can have enough for those five weapons in less than one month. With its residual and covert nuclear weaponization capabilities, Iran could test a nuclear explosive underground or deploy a crude nuclear weapon in six months after it decides to build nuclear weapons. It could also re-establish and complete its Amad Plan infrastructure in two years, before serially producing nuclear weapons for ballistic missiles.[9]

[8] David Albright with Sarah Burkhard and the Good ISIS Team, *Iran's Perilous Pursuit of Nuclear Weapons* (Washington, D.C.: Institute for Science and International Security Press, 2021).

[9] David Albright, "Iran Building Nuclear Weapons," *Institute for Science and International Security,* December 5, 2022, https://isis-online.org/isis-reports/detail/iran-building-nuclear-weapons/8.

Breakout Calculator. The Institute's breakout calculator is used to estimate the breakout time, as in previous reports. The methodology is described in earlier Institute reports. The production of WGU from the 4.5, 20, and 60 percent enriched uranium stocks significantly reduces the timeline for the production of multiple quantities of 25 kg of WGU (U mass). The authors' benchmark reflects a reasonable, assured quantity of WGU for a variety of nuclear weapon designs available to Iran and the creation of a pipeline for production of multiple WGU cores. As before, the total enrichment contribution from small, non-production-scale cascades of advanced centrifuges installed at the PFEP is not included, as their use in a breakout would be complicated and likely would not contribute significantly to reducing breakout timelines. Stocks of less than 2 percent enriched uranium are also not included, since to do so would require additional modifications of the cascades to handle lower enrichments, likely significantly slowing or contributing only slightly, rather than speeding up, breakout timelines. Lastly, only enriched uranium hexafluoride stocks are used; Iran's chemical conversion of other stocks is assessed as too time consuming, and involving too little material, to significantly affect breakout estimates.

The breakout timelines are credible, worst-case estimates, likely representing the shortest timelines to breakout, with longer timelines possible. Uncertainties include ongoing ones, such as the exact enrichment level of the uranium stock enriched between 2 and 5 percent and operational efficiencies of the advanced centrifuges, particularly the IR-4 and IR-6 cascades, although the calculations use a significantly lower estimated enrichment output for the IR-6 cascades than expected.

Part 4: Enriched Uranium Metal Production Remains Halted, Nuclear Material Discrepancy at Uranium Conversion Facility

During the last nine reporting periods, Iran has not produced any uranium metal at the Esfahan FPFP. However, Iran's capability to produce uranium metal remains intact.

In December 2020, Iran informed the IAEA that it would begin producing uranium metal, including uranium metal enriched up to 20 percent, a step that alarmed many. Iran is using the uranium metal in civil applications, including to produce experimental fuel rods for the TRR. However, Iran has no pressing need to develop this fuel or to use this material for other civilian activities, lending weight to concern that Iran is installing the wherewithal to make uranium metal to increase its nuclear weapons capabilities and is producing it to practice the manufacture of enriched uranium metal components of nuclear weapons. Prior to 2003, under the Amad Plan, Iran was constructing both pilot and large-scale uranium metallurgy facilities to make nuclear cores and was practicing with surrogate materials for WGU.[10]

[10] *Iran's Perilous Pursuit of Nuclear Weapons*; David Albright, Sarah Burkhard, and Frank Pabian, "Shahid Mahallati: 'Temporary' Plant for Manufacturing Nuclear Weapon Cores," *Institute for Science and International Security*, April 8, 2020, https://isis-online.org/isis-reports/detail/shahid-mahallati-temporary-plant-for-manufacturing-nuclear-weapon-cores/8.

On February 2, 2021, Iran began producing uranium metal using natural uranium in a laboratory experiment at the Esfahan FPFP. As of August 14, 2021, the IAEA verified that Iran had begun producing enriched uranium metal from 20 percent enriched UF_6. It produced 200 grams of enriched uranium metal, starting with 257 grams of enriched uranium in tetrafluoride form.

Iran stated this enriched uranium metal was for use in silicide fuel for the TRR. Iran produced "two batches of uranium silicide" containing 0.43 kg of uranium enriched to 20 percent. Assuming this is in uranium mass, the uranium silicide contains twice the amount of metal that was reported previously (430 grams compared to 200 grams). As of May 20, 2023, three irradiated silicide fuel elements, containing 70 grams of 20 percent enriched uranium, were in the TRR spent fuel pond. As of that date, another two such fuel elements were being irradiated in the TRR. As of August 19, 2023, the situation remained the same, with these three fuel elements still in the TRR reactor pond and another two still being irradiated in the TRR. The November 2023 report does not update this information, although the report implies that no new silicide fuel elements were introduced into the TRR.

On February 21, 2022, the IAEA verified that the installation of equipment for the first of three stages for the production of enriched UF_4 from enriched UF_6 at the FPFP, while almost complete, had progressed only slightly. Uranium tetrafluoride can be the intermediate product of uranium metal. The IAEA noted that on May 17, 2022, installation had been completed but Iran had not yet tested it with nuclear material, and the IAEA observed the same through February 12, 2024.

At the nearby Uranium Conversion Facility (UCF) at Esfahan, in November 2021, Iran had finished installing equipment for producing uranium metal, and the facility was ready to operate with depleted or natural uranium. As of February 14, 2024, the IAEA verified that no nuclear material had been introduced into the production area.

Part 5: Heavy Water and Khondab (Arak) Reactor

The IAEA reports that since February 2021, due to Iran's reductions in agency monitoring, it has not been able to ascertain the status of Iran's Heavy Water Production Plant (HWPP) nor the production and inventory of heavy water. Since June 11, 2022, when Iran removed Flow-rate Unattended Monitoring (FLUM) equipment at the HWPP, the IAEA has had no monitoring capabilities. Based on commercial satellite imagery, the IAEA included in its February 2024 report its assessment that the HWPP continued to operate during the reporting period.

The IAEA reports that as of February 7, 2024, civil construction work was ongoing on all floors of the Khondab Heavy Water Research Reactor (KHRR), or IR-20, formerly known as the Arak reactor or IR-40. Iran agreed to re-orient the reactor's design under the JCPOA. In May 2023, the IAEA reported that Iran provided an updated DIQ for the reactor, indicating "that the reactor power of 20 MW(th), the fuel enrichment and the preliminary core design are consistent with the 'Fundamental Principles' and 'Preliminary Characteristics' for the re-design of the research reactor" were consistent with the conceptual design set out in Annex I of the JCPOA.

The IAEA reports observing no significant changes to the project since the previous report. Previously, Iran informed the IAEA that it expected to commission the reactor and the primary circuit in 2023 using dummy IR-20 fuel assemblies, and the reactor would start operations in 2024. Iran has not communicated any formal update to the agency regarding these plans.

Part 6: Additional Protocol and JCPOA Monitoring

Iran stopped implementing the Additional Protocol (AP) to its comprehensive safeguards agreement (CSA) and the JCPOA's additional monitoring arrangements on February 23, 2021. Iran's actions and its refusal to cooperate with the IAEA across a wide range of monitoring issues causes the IAEA to consistently express doubt about understanding key aspects of Iran's nuclear activities. Without monitoring in place for three years, for example, the IAEA cannot determine the number of centrifuges Iran has manufactured.

Although the IAEA can ascertain the number of centrifuges deployed at Fordow and Natanz, it cannot know how many more Iran has made and stored or deployed at an undeclared site. A risk is that Iran will accumulate a secret stock of advanced centrifuges, deployable in the future at a clandestine enrichment plant. At the least, this situation complicates any future verification effort and contributes to uncertainty about the status of Iran's nuclear activities and facilities.

Monitoring and Surveillance Equipment

After halting implementation of the AP and JCPOA monitoring measures in February 2021, Iran agreed to continue operating IAEA monitoring and surveillance equipment installed for JCPOA monitoring purposes, but to keep footage and data in its custody until it received sanctions relief. Iran pledged to continue collecting and storing these data "with the aim of enabling the Agency to recover and re-establish the necessary continuity of knowledge" at the affected nuclear sites. On June 8, 2022, following IAEA board censure over its failure to cooperate on the IAEA's separate safeguards probe, Iran notified the IAEA that it would remove the IAEA's JCPOA-related monitoring and surveillance equipment. From June 9 to 11, 2022, the IAEA removed, in total, 27 surveillance cameras, the on-line enrichment monitor (OLEM) at the Natanz FEP, and the FLUM equipment installed at the HWPP. The equipment was placed in storage under IAEA seal. The IAEA noted, "This seriously affected the Agency's JCPOA-related verification and monitoring."

Cameras and Surveillance at the Natanz Centrifuge Workshops. During the September 2023 meeting with Eslami, the IAEA proposed to Iran the voluntary measure of installing agency cameras in the centrifuge component workshops at Natanz and "a limited number of consistency checks" of the data stored in those cameras. Iran dismissed the request as "not acceptable." The IAEA reports no further developments on the issue.

Cameras and Surveillance at the Esfahan Centrifuge Manufacturing Plant. The IAEA reported in May 2023 that in line with the March 2023 Iran/IAEA Joint Statement, "the Agency installed surveillance cameras at workshops in Esfahan where centrifuge rotor tubes and bellows are manufactured," although Iran has not turned over the video footage to the IAEA.

In a previous report, the IAEA reported that Iran delayed the IAEA from servicing these cameras at Esfahan. Under standard safeguards practice, these cameras should not be left for more than three months without being serviced by the inspectors, including replacing the storage medium. When the IAEA asked for access to service these cameras in early August, Iran delayed responding. It subsequently agreed to allow the inspectors to service the cameras on September 2, 2023 – four months after they had been installed. The IAEA proposed to conduct consistency checks on the data stored in the Esfahan cameras, but Iran refused. In the latest report, Iran finally allowed the IAEA to service the cameras in December 2023, but refused access to the data. Iran retains the data under agency and Iranian seals at the Esfahan location.

Lack of Updated AP Declarations, Complementary Access, and Enhanced JCPOA Monitoring

Due to Iran's refusal to implement the AP, the IAEA reports that it has "been three years since Iran stopped provisionally applying its Additional Protocol and, therefore, since it provided updated declarations and the Agency was able to conduct complementary access to any sites and other locations in Iran."

The IAEA can no longer carry out daily visits to Iran's enrichment facilities or measure in-process low enriched nuclear material. It has not had access to data from on-line enrichment monitors and electronic seals, or access to measurement recordings registered by installed measurement devices.

The IAEA also no longer receives data and recordings of test stands engaged in quality control tests of advanced centrifuge rotor assemblies, prior to their installation at Natanz and Fordow enrichment plants. It no longer has information about Iran's production of uranium ore concentrate (UOC) or its transfer to the Esfahan facility for conversion, or about UOC obtained from any other source. Table C.2 in the IAEA report describes these and other reduced provisions under JCPOA enhanced monitoring.

The IAEA previously reported in several reports:

> *In the event of a full resumption of implementation by Iran of its nuclear-related commitments under the JCPOA, the Agency would not be able to re-establish continuity of knowledge in relation to the production and inventory of centrifuges, rotors and bellows, heavy water and UOC. Instead, the Agency would need to establish a new baseline in relation to such production and inventories. It would face major challenges in doing so, including the difficulty in confirming the accuracy of any declaration by Iran of its production of centrifuges, rotors and bellows, heavy water and UOC for the period when no verification and monitoring equipment had been in operation. In order to try to fill the gaps in its knowledge and minimize the margin of error, the development of specific arrangements with Iran would be indispensable.*

In the most recent report, however, the IAEA categorically states, "The Agency has lost continuity of knowledge in relation to the production and inventory of centrifuges, rotors and bellows, heavy water and UOC."

Iran has augmented centrifuge manufacturing, assembly, and mechanical testing activities in violation of the JCPOA, while halting IAEA monitoring. Without any monitoring in place, for nearly three years, the IAEA cannot ascertain the total quantities of centrifuges Iran has manufactured.

Combined with Iran's refusal to resolve outstanding safeguards violations, the IAEA has a significantly reduced ability to monitor Iran's complex and growing nuclear program, which notably has unresolved nuclear weapons dimensions. The IAEA's ability to detect diversion of nuclear materials, equipment, and other capabilities to undeclared facilities remains greatly diminished.