INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY

REPORT

Analysis of IAEA Iran Verification and Monitoring Report

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This report assesses information in the International Atomic Energy Agency's (IAEA's) quarterly safeguards report for September 4, 2020, *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).

Summary and Breakout Estimate

Highlights of the IAEA report include:

1) Iran's low enriched uranium (LEU) stock now exceeds by ten-fold the limit set in the JCPOA. As of Aug 25, 2020, Iran has a stockpile of about 3114.5 kilograms (kg) of LEU (hexafluoride mass), all enriched below 5 percent, or the equivalent of 2105.4 kg (uranium mass).

2) Of the 2105.4 kg LEU (U mass), 638.8 kg are enriched to up to 2 percent. 215.1 kg LEU enriched up to 3.67 percent are in a stock enriched before July 8, 2019. The remainder is 1890 kg of LEU enriched to more than 2 percent but less than 4.5 percent.

3) Overall monthly LEU production has decreased slightly, from 181.5 kg per month in the previous reporting period (Feb 2020 - May 2020) to 165.1 kg per month during this reporting period (May 2020 - August 2020). This decrease only affected the below 2 percent uranium production. The monthly average production of 2 to 4.5 percent LEU increased slightly.

4) Iran's estimated breakout time as of late September 2020 is as short as 3.5 months. A new development is that Iran may have enough low enriched uranium to produce enough weapon-grade uranium for a second nuclear weapon, where the second one could be produced more quickly than the first, requiring in total as little as 5.5 months to produce enough weapon-grade uranium for two nuclear weapons.

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5) Iran's total estimated enrichment capacity has decreased slightly to 7693 separative work units (SWU) per year during this reporting period, although this maximum should not be used in breakout estimates (see text below).

6) Iran is starting the process of installing advanced centrifuges in the underground halls of the Natanz Fuel Enrichment Plant. However, only minimal activity has happened thus far, and Iran has already shifted its plans.

7) Iran has restarted the Heavy Water Production Plant, but its stock of heavy water decreased to 128.5 metric tonnes, below the JCPOA's heavy water limit.

8) The IAEA reported limited new information about the results from its investigation into the IAEA's detection of refined uranium particles at a warehouse in the Turquz-Abad neighborhood of Tehran. The agency first visited the site in February 2019 and detected "natural uranium particles of anthropogenic origin." Neither the site nor the presence of nuclear material had been declared to the IAEA. The investigation is on-going.

9) Iran has not pursued the construction of the Arak heavy water research reactor (IR-40 Reactor) based on its original design. It also has not produced or tested natural uranium pellets, fuel pins or fuel assemblies for the original reactor design.

Although not covered in detail in this assessment, the IAEA also issued a second report *NPT Safeguards Agreement with the Islamic Republic of Iran*, discussing its requests to visit two sites associated with Iran's Amad Plan, Tehran's crash nuclear weapons program in the early 2000s. These sites are alleged to have used undeclared nuclear material (e.g. uranium) or to have conducted undeclared nuclear activities. The IAEA visited one site recently and will inspect the other later in September, although it did not identify which site it visited. One of the sites is a dismantled pilot uranium conversion facility near Tehran that was razed in 2004. The other is the Marivan, Abadeh site in a remote part of Iran that was involved in high explosive experiments critical to the development of nuclear weapons.[2] Iran razed this site only in July 2019, suggesting that it may have continued nuclear weapons related activities after the end of the Amad Plan up to 2019, or that it kept the location on standby in case a decision was made to perform additional experiments. The Institute will discuss this second IAEA report in a separate analysis.

[2] David Albright, Sarah Burkhard, and Frank Pabian, "Abadeh is Marivan: A Key Iranian Former Secret Nuclear Weapons Development Test Site," *Institute for Science and International Security,* August 28, 2020, https://isis-online.org/isis-reports/detail/abadeh-is-marivan-irans-former-secret-nuclear-weapons-development-test-site

Part 1: Low Enriched Uranium Stocks

The IAEA reports that Iran has now exceeded by ten-fold the JCPOA's cap of 300 kilograms of low enriched uranium (hexafluoride mass), or 202.8 kg (uranium mass). On July 1, 2019, the IAEA first reported that Iran had surpassed the JCPOA's LEU stock limit by enriching 205.0 kg of LEU (uranium mass). Since then, it has added 1900.4 kg LEU (uranium mass) to its stockpile. Iran also continued, for over a year, to enrich to 4.5 percent, in violation of the JCPOA's 3.67 percent enrichment limit. The IAEA first stated on July 8, 2019, that Iran was enriching up to a level of 4.5 percent.

On August 25, 2020, the IAEA's most recent verification date for LEU stocks, Iran possessed a total stockpile of about 3114.5 kg of low enriched uranium (hexafluoride mass), all enriched below 5 percent, or the equivalent of 2105.4 kg (uranium mass). Iran added 533.8 kg (uranium mass) to its low enriched uranium stockpile during this latest May 2020 - August 2020 reporting period. The IAEA reports that of the 2105.4 kg figure, Iran has a stock of 1890.3 kg of up to 4.5 percent LEU (uranium mass), including 638.8 kg all in the form of uranium hexafluoride (UF_6) enriched in advanced centrifuges to two percent (uranium mass), at the Natanz Pilot Fuel Enrichment Plant (PFEP). The remainder, 215.1 kg LEU, is uranium enriched up to 3.67 percent before July 8, 2019. In terms of uranium hexafluoride mass, Iran possesses 1851.3 kg of up to 4.5 percent but greater than 2 percent enriched uranium, 945.0 kg of uranium enriched up to 2 percent, and 318.2 kg of uranium enriched to about 3.5 percent, the latter which was produced before July 8, 2019.

Not all the LEU enriched between 2 and 4.5 percent was produced at the Natanz and Fordow Fuel Enrichment Plants; an unstated amount was produced in advanced centrifuges at the Pilot Fuel Enrichment Plant at Natanz.

In Table 1 below, a stockpile comparison from August 19, 2019, to August 25, 2020 shows how Iran has increased its stock of LEU throughout the year, as measured only in uranium mass. The net increase in the total stock of LEU in Iran from August 2019 to August 2020 was 1863.8 kilograms LEU (uranium mass), at an overall average rate of about 155.3 kilograms (uranium mass) per month. Alternatively, these values convert to 2757.1 kg LEU (hexafluoride mass), or an average of about 229.8 kg LEU (hexafluoride mass) per month. During this reporting period, covering May 2020 to September 2020, the average production rate was about 165.1 kg per month of enriched uranium (uranium mass) and 244.2 kg per month of enriched uranium (hexafluoride mass). During this reporting period, compared to the previous one, overall average monthly production of enriched uranium decreased slightly. This was due to decreased production of below 2 percent enriched uranium. The average monthly production of 2 to 4.5 percent enriched stock increased slightly.

Table 1. Enriched Uranium Quantities, less than 5 percent enriched uranium, all quantities in uranium mass*

	May 2019	August 2019	November 2019	February 2020	May 2020	August 2020
Chemical Form						
UF6 (kg)	153.2	218.9	349.9	996.5	1546.7	2073.8
Uranium oxides and their intermediate products (kg)	10.4	11.1	10.4	9.7	9.7	15.2
Uranium in fuel assemblies and rods (kg)	4.3	4.6	4.6	7.7	7.7	8.2
Uranium in liquid and solid scrap (kg)	6.2	7.0	7.4	7	7.5	8.2
Enrichment Level Subtotals						
Uranium enriched to 3.67 percent (kg)	174.1	216.5	212.6	214.6	215.1	215.1
Uranium enriched up to 4.5 percent (kg) but more than 2 percent	0.0	25.1	129.2	537.8	873.4	1251.5
Uranium enriched up to 2 percent (kg)	0.0	0.0	30.5	268.5	483.1	638.8
Totals of Enriched Uranium, <5% (kg)	**174.1**	**241.6**	**372.3**	**1020.9**	**1571.6**	**2105.4**

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

Part 2: Enrichment capacity

IR-1 Centrifuge Deployments at Natanz Fuel Enrichment Plant (FEP)

At the Natanz Fuel Enrichment Plant, the IAEA reported that Iran operated no more than 5060 IR-1 centrifuges in 30 cascades. Iran withdrew 104 IR-1 centrifuges from storage to replace broken ones in these cascades. During the previous reporting period, it withdrew 96 IR-1 centrifuges, and during the prior one, it withdrew 92 IR-1 centrifuges.

Fordow Fuel Enrichment Plant (FFEP)

The IAEA reported that since January 22, 2020, the Fordow plant was enriching uranium in six cascades, containing 1044 IR-1 centrifuges, in one wing of the plant called Unit 2. An additional 12 IR-1 centrifuges were installed in a layout of 16 IR-1 centrifuge positions and one IR-1

centrifuge was installed in a single position in Unit 2; all were involved in initial research and development activities related to stable isotope production. In total, as of September 2020, 1057 IR-1 centrifuges were installed in Unit 2 of the FFEP.

Advanced Centrifuges

Iran continued to take steps during the IAEA reporting period to violate the JCPOA's limitations on advanced centrifuges. The following summarizes the impending installation of advanced centrifuges in the underground halls of the Natanz Fuel Enrichment Plant, and the deployment of advanced centrifuges in the six lines at the Natanz Pilot Fuel Enrichment Plant, their enrichment status, and their enrichment capacity, if known, as of the end of the last reporting period.

Advanced Centrifuges in the FEP

Iran is starting the process of installing advanced centrifuges in the FEP. However, only minimal activity has happened thus far and Iran has shifted its plans. In a letter dated July 20, 2020, Iran informed the IAEA that the operator of the PFEP at Natanz "intends to transfer and displace 3 production cascades (No. 4, 5 and 6) from this facility" to FEP. Cascades 4, 5, and 6 contain IR-2m, IR-4, and IR-6 cascades respectively (see below). Subsequently, Iran changed its plans, and now intends to "install equivalent cascades at FEP, rather than transfer the existing ones, and that when these become operational at FEP, the three corresponding cascades at PFEP will cease operation." This change could reflect problems in these centrifuges in the PPEP, leading Iran to install new centrifuges rather than already used ones.

On September 2, 2020, inspectors verified that Iran had started to install the cascade piping and ancillary equipment for these three cascades. It had installed the "headers and sub-headers of one unit at FEP where the three cascades of IR-4, IR-2m and IR-6 centrifuges will be installed."

Operations of Advanced Centrifuges at the PFEP

Iran is no longer remixing the product and tails (waste) of uranium produced at the PFEP, but collecting it separately, meaning that Iran accumulated enriched uranium at the PFEP. As of August 25, 2020, 638.8 kilograms (uranium mass) of uranium enriched up to two percent had been collected from lines 2 and 3 of the six lines at the PFEP. The IAEA does not provide the average enrichment of this material, although it can be safely assumed that it varies from just above natural uranium (0.71 percent uranium 235) up to 2 percent uranium 235. (This average value matters because the amount of separative work to make, for example, a quantity of two percent enriched uranium, is several times the amount needed to make the same quantity of one percent enriched uranium.) The IAEA did not reveal how much enriched uranium was collected in lines 4, 5, and 6 of the PFEP, but included this enriched uranium in the total amount of LEU enriched up to 4.5 percent.

Lines 2 and 3 contain a variety of centrifuge types and numbers, many accumulating enriched uranium. The following is a summary, as of the end of the last reporting period (August 31,

2020), of all the centrifuges installed in lines 2 and 3, where there were about 74 in total that were accumulating enriched uranium (so far about 638.8 kg, as mentioned above):

1. Zero IR-2m centrifuges in a cascade;
2. Up to 15 IR-4 centrifuges in a cascade;
3. Up to 10 IR-5 centrifuges in a cascade;
4. Up to 29 IR-6 centrifuges, in a centrifuge cascade of 9 IR-6 centrifuges and another one of 20 IR-6 centrifuges;
5. Up to 10 IR-6s centrifuges in cascades; and
6. Up to 10 IRs centrifuges.

According to the IAEA report, as of August 31, 2020, Iran was testing the following single centrifuges with uranium hexafluoride in lines 2 and 3 but not accumulating enriched uranium:

1. One IR-2m centrifuge;
2. one IR-3 centrifuge;
3. two IR-4 centrifuges;
4. one IR-5 centrifuge;
5. zero IR-6 centrifuges;
6. one IR-6m centrifuge;
7. one IR-6s centrifuge;
8. one IR-6sm centrifuge;
9. one IR-7 centrifuge;
10. zero IR-8 centrifuges;
11. one IR-8s centrifuge;
12. one IR-8B centrifuge;
13. one IR-s centrifuge; and
14. one IR-9 centrifuge.

Iran also accumulated enriched uranium in lines 4, 5, and 6. Lines 4 and 5 contain redeployed IR-4 and IR-2m centrifuge cascades containing 156 and 164 centrifuges, respectively. Line 6 has a IR-6 cascade (120 centrifuges). The IAEA did not specify how much enriched uranium had been produced so far or its level of enrichment in these three lines. This enriched uranium is likely included in the IAEA's aggregate reported amount of enriched uranium, or that enriched up to 4.5 percent.

The redeployed cascades of IR-2m and IR-4 centrifuges in lines 4 and 5 of the PFEP represent Iran's most successful advanced centrifuge types. When previously operated in a production-scale cascade, each IR-2m centrifuge had an enrichment capacity of about 3.7 SWU per year. The total cascade thus has an estimated enrichment capacity of about 607 SWU per year. This is equivalent to about 675 IR-1 centrifuges operating in production cascades, where each IR-1 is assumed to have a capacity of 0.9 SWU per year. The IR-4 has a lower capacity than the IR-2m,

estimated here as ten percent lower, or about 3.3 SWU per year per centrifuge. The production cascade would have a total output of about 514.8 SWU per year, or equivalent to about 572 IR-1 centrifuges. These two cascades represent a total capacity of about 1122 SWU/year, or the equivalent of about 1246 IR-1 centrifuges.

Line 6 at the PFEP held 120 IR-6 centrifuges in a single cascade (down from 135 during the last reporting period). Iran stated earlier that the line will hold 164 IR-6 centrifuges in a cascade.[8] The IR-6 has a single machine estimated capacity of 6.8 SWU per year. No recent data are available publicly on its performance in a cascade. Assuming that the cascade value would be about 90 percent of the capacity achieved by an IR-6 operating by itself, or 6.12 SWU per year, 120 IR-6 centrifuges in cascade would have an output of about 734.4 SWU per year, and a cascade of 164 IR-6 would have total capacity of about 1,000 SWU per year, or the equivalent of about 1,115 IR-1 centrifuges.

Line 1 currently holds an inoperable cascade of IR-1 centrifuges. However, Iran announced planned modifications of line 1 that include removal of the inoperable centrifuges, to clear space for upcoming R&D activities. Iran told the IAEA that line 1 will be used for testing IR-5 and IR-6s centrifuges in a full cascade of up to 172 centrifuges or two intermediate cascades of 84 centrifuges. As of August 31, 2020, the IAEA verified that Iran was continuing to prepare for the installation of these centrifuges in R&D line 1.

In addition, according to the quarterly report, Tehran was violating an additional JCPOA limitation by conducting mechanical testing of centrifuges at the Tehran Research Centre and a workshop at Natanz. According to the IAEA report, "On 24 August 2020, the Agency verified that Iran had conducted at different times mechanical testing of up to ten IR-4 centrifuges simultaneously for three days at the workshop in Natanz, and up to three IR-4 centrifuges simultaneously for 79 days at the Tehran Research Centre (para. 40). As of 24 August 2020, Iran had not started using a new location, beyond those specified in the JCPOA, for mechanical testing of centrifuges."

As can be seen, Iran is developing a large number of centrifuges simultaneously, an unusual practice. The centrifuges being developed at the PFEP include: IR-1, IR-2m, IR-3, IR-4, IR-5, IR-6, IR-6m, IR-6s, IR-6sm, IR-7, IR-8, IR-8s, IR-8B, IR-s, and IR-9. No information was provided in the IAEA report on how well these centrifuges work, their failure rates, or why so many of them are being developed. Typically, a centrifuge program with such characteristics is likely failing at developing a commercially viable centrifuge, although several of these centrifuges could work adequately in a nuclear weapons program, where efficiency, low failure rates, and low cost are not priorities.

Table 2 summarizes the enrichment capacity by facility. Iran's enrichment capacity has decreased from an estimated 7835.4 SWU/yr to 7693 SWU/yr during this reporting period, representing a slight decrease.

This total enrichment capacity represents the equivalent of 8548 IR-1 centrifuges. However, as will be noted below, this entire capacity cannot be used in a breakout capacity, since many of the advanced centrifuges are not properly organized to contribute meaningfully to a breakout.

Table 2. Number of enriching centrifuges and enrichment capacity

	Number of centrifuges	Enrichment capacity in SWU/yr	IR-1 equivalent
Natanz	5060	4554	5060
Fordow	1044	940	1044
Natanz PFEP (advanced)*	514	2199	2444
Lines 2&3	See text		
Lines 4,5,6	See text		
Total	6618	7693	8548

*The value for lines 2 and 3 of the PFEP is a rough estimate based on the use of estimated and measured values for the separative output of these centrifuges in cascades, drawn from IAEA information. The values for lines 4, 5, and 6 of the PFEP are given in the text. All the values used to make these estimates reflect historical enrichment output values obtained by Iran prior to the nuclear deal and do not reflect current values, which are not included in the IAEA's quarterly reports.

Part 3: Current Breakout Estimates

The Institute's breakout calculator is used to estimate current breakout times based on Iranian LEU stocks and installed enrichment capacity, using the above values.

In the breakout estimate, the following conditions are assumed:

- An enrichment capacity at the Natanz and Fordow Fuel Enrichment Plants, as drawn from the latest IAEA report. The enrichment contribution from advanced centrifuges at the Pilot Fuel Enrichment Plant is not included, as their use in a breakout would be complicated and likely not contribute to reducing breakout timelines;
- Only LEU stocks above two percent enriched uranium are used. Stocks of less than two percent enriched uranium are not used, since to do so would require additional modifications of the cascades to handle the lower enrichments, likely significantly slowing or contributing only slightly to, rather than speeding up breakout timelines; and
- Iran redeploying its 1000 IR-2m centrifuges, removed from the Natanz FEP prior to the JCPOA's Implementation Day; however, the rest of the centrifuges deployed are IR-1 centrifuges from Iran's existing stock. Iran may in fact deploy additional advanced centrifuges, but this effect is not included in this estimate, as none of the dozen

advanced centrifuge types Iran is testing at the PFEP stand out as Iran's clear centrifuge of choice; many are assessed to perform poorly.

Iran's stock of LEU has grown sufficiently to not only decrease breakout timelines to a minimum for this level of enrichment, given the current enrichment capacity at the Natanz and Fordow Fuel Enrichment Plants. However, under certain conditions, Iran's stock is now sufficient to produce enough weapon-grade uranium for a second nuclear weapon. Two basic cases are considered.

First Case: If Iran's stock of uranium enriched up to 4.5 percent (1851 kg) is assumed all to be enriched at 4.5 percent, admittedly a worst case, then its current stock has grown sufficiently to support the production of enough weapon-grade uranium for two nuclear weapons. In this new situation, breakout for one nuclear weapon can be accomplished in 3.1 months, utilizing only this stock of enriched uranium, and assuming no initial setup time. Including a setup time would increase this value to 3.6 months. If breakout continued, a second significant quantity of weapon-grade uranium would be produced two months later. The second is produced more quickly because of the increased enrichment capacity installed during the first three months of breakout. So, enough weapon-grade uranium could be produced for two nuclear weapons in 5.5 months.

Second Case: Iran's stock of uranium enriched up to 4.5 percent is assumed to be all 3.5 percent enriched (likely an overly conservative assumption). This stock is added together with the stock of up to 3.5 percent LEU produced prior to the end of the JCPOA limits, resulting in a total stock of 2169.2 kilograms). In this case, the breakout timeline to produce enough weapon-grade uranium for one nuclear weapon is 3.4 months, assuming no setup time, and 3.9 months if a setup time is included. Under this scenario, there is not enough enriched uranium to produce the second nuclear weapon. But the additional amount of enriched uranium needed is only about 330 kilograms, an additional amount likely to be achieved in the next reporting period.

In addition to the IR 2-m re-deployment, a major factor in the first scenario is that the LEU is already enriched to 4.5 percent instead of 3.5 percent, a significant change from estimates performed before the JCPOA's Implementation Day, since this one percent increase in enrichment can provide up to a 15 to 20 percent reduction in breakout time to produce 25 kilograms of weapon-grade uranium. The greater enrichment level also means that the production of 25 kilograms of weapon grade uranium requires less LEU than if it were enriched to 3.5 percent: 900 kilograms of 4.5 percent LEU vs. 1250 kilograms of 3.5 percent LEU in hexafluoride mass. This last condition is particularly significant in the first scenario, since it means that the existing amount of LEU enriched up to 4.5 percent is enough to reach the requisite amount of weapon-grade uranium for two nuclear weapons without the need to also use some lesser enriched uranium, the 3.5 percent stock, or natural uranium to make a portion of the needed WGU. As a result, the process is strictly a three-step one instead of a three-step followed by a four-step one, if natural uranium were required. This ability to use only three

steps to reach weapon-grade, instead of four, is why the media often discusses a key threshold of about 1000 kg of LEU as significant.[3]

In summary, both cases are calculated because of the lack of information about the average enrichment of the LEU stocks. If the average of the range of 3.1 to 3.9 months is used, the estimated breakout time as of late September 2020 is as little as 3.5 months. A new development is that Iran may have enough enriched uranium to produce enough weapon-grade uranium for a second nuclear weapon, where the second would be produced more quickly than the first, requiring, in total, as little as 5.5 months to produce enough weapon-grade uranium for two nuclear weapons.

Part 4: Other Information - Heavy water, Arak reactor, Undeclared uranium particles, Additional Protocol

Heavy Water Production Plant (HWPP): Iran has restarted the HWPP. According to the IAEA report, "On 22 August 2020, the Agency verified that the HWPP had restarted operation, following a period during which it had been shut down for scheduled maintenance." The IAEA also reported that Iran's stock of heavy water had "decreased to 128.5 metric tonnes (-4.1 metric tonnes since the previous quarterly report), below the nuclear deal's heavy water limit." During the reporting period, Iran produced 3.1 metric tonnes of heavy water and used 2.3 metric tonnes for the production of deuterated compounds for medical applications.

The IAEA reported that Iran also exported 4.9 metric tonnes of heavy water, bringing it under the 130 metric tonnes cap of heavy water Iran is permitted to possess under the JCPOA. On August 24, Iran's Atomic Energy Organization spokesman, Behrouz Kamalvandi, stated regarding Iran's exports of heavy water, "We sell to countries in Asia and Europe. In order to avoid pressure on the companies in these countries, we do not name them." He explained that withholding the names of companies and individuals to which Iran sells heavy water protects them from U.S. pressure and sanctions. Kamalvandi stated, "[The Americans] exert pressure on companies as well as on individuals."[4]

Pursuant to understandings with the JCPOA Joint Commission, Iran is permitted to export excess heavy water to international buyers.[5] In May 2019, however, the Trump administration tightened U.S. sanctions waivers over foreign nuclear activities and assistance to Iran, including one related to heavy water. In December 2019, administration officials clarified to the Washington Free Beacon that purchasing Iran's heavy water would be a sanctionable activity.

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[3] David E. Sanger and William J. Broad, "Iran Crosses a Key Threshold: It Again Has Sufficient Fuel for a Bomb," *The New York Times,* March 3, 2020, https://www.nytimes.com/2020/03/03/world/middleeast/iran-nuclear-weapon-trump.html

[4] Middle East Media Research Institute, "Translation of Interview with AEOI Spokesman Behrouz Kamalvandi of August 24, 2020 on Al-Alam TV," August 26, 2020, https://www.memri.org/reports/iranian-atomic-energy-organization-spokesman-behrouz-kamalvandi-natanz-explosion-was

[5] David Albright and Andrea Stricker, "Heavy Water Loophole in the Iran Deal," *Institute for Science and International Security*, December 21, 2016, https://isis-online.org/isis-reports/detail/heavy-water-loophole-in-the-iran-deal

An unnamed State Department official stated, "We have made clear that such transactions are potentially sanctionable... Iran has no credible reason to continue its heavy water production activities."[6] It is unclear whether Washington is pressuring such buyers of Iran's heavy water to halt purchases or considering sanctions against those it identifies.

Arak Reactor: The IAEA again reported that Iran "has not pursued the construction of the Arak heavy water research reactor (IR-40 Reactor) based on its original design." It also "has not produced or tested natural uranium pellets, fuel pins or fuel assemblies" for the original reactor design.

The United States announced in May that it would end a sanctions waiver by July which permitted the conversion of the Arak reactor to a new design.[7] This is a project carried out in Iran under the JCPOA with the assistance of British and Chinese companies. The IAEA stated that on August 23, "Iran...installed a main component of the [reactor's] refuelling machine. Iran indicated that this machine was constructed based on the original design and is planned to be adapted to the new design of the reactor." It is unclear from this reporting whether the conversion project continues. The Joint Commission stated on September 1 that the parties reaffirmed their support for the modernization project, and affirmed, "Taking into account the potential consequences of the U.S. decision in May to end the Arak waiver, participants reiterated their strong support and collective responsibility for the continuation of the project."[8]

Uranium particles found at Turquz-Abad warehouse: The IAEA reported limited new information about the results from its investigation into the IAEA's detection of refined uranium particles at an open-air warehouse in the Turquz-Abad neighborhood of Tehran. The agency first visited the site in February 2019 and detected "natural uranium particles of anthropogenic origin." Neither the site nor the presence of nuclear material had been declared to the IAEA. The site was first disclosed by Israel in September 2018 when it alleged that shipping containers at the site contained nuclear-related equipment and material from Iran's past and potentially ongoing nuclear weapons program.[9] Iran moved the containers from the site and sanitized the area during the summer of 2018, up until the IAEA's visit in February

[6] Adam Kredo, "U.S. Pursues Mystery Buyer of Contested Iranian Nuclear Materials," *Washington Free Beacon*, December 12, 2019, https://freebeacon.com/national-security/u-s-pursues-mystery-buyer-of-contested-iranian-nuclear-materials/

[7] Arshad Mohammed and Humeyra Pamuk, "U.S. to End Sanctions Waivers Allowing Some Work at Iran Nuclear Sites," Reuters, May 27, 2020, https://www.reuters.com/article/us-usa-iran-nuclear/u-s-to-end-sanctions-waivers-allowing-some-work-at-iran-nuclear-sites-idUSKBN2332W1

[8] European Union External Action, "Chair's Statement Following the 1 September Meeting of the Joint Commission of the Joint Comprehensive Plan of Action," September 1, 2020, https://eeas.europa.eu/headquarters/headquarters-homepage/84643/chairs-statement-following-1-september-meeting-joint-commission-joint-comprehensive-plan_en

[9] John Irish and Arshad Mohammed, "Netanyahu, in UN Speech, Claims Secret Iranian Nuclear Site," Reuters, September 27, 2018, https://www.reuters.com/article/us-un-assembly-israel-iran/netanyahu-in-un-speech-claims-secret-iranian-nuclear-site-idUSKCN1M72FZ

2019.[10] The nature of the particles could indicate undeclared uranium conversion activities in Iran. The IAEA is investigating Iran's previous uranium conversion activities and potentially the past presence of an undeclared pilot uranium conversion facility that was part of the Amad Plan under a related investigation into Iran's compliance with its safeguards obligations under the Nuclear Non-Proliferation Treaty (NPT).[11]

In January 2020, the IAEA took additional samples at two other declared locations, pursuant to information provided by Iran to explain the origin of the warehouse particles. In its latest report, the IAEA stated that in its assessment of the samples, "some findings are not inconsistent with the additional information provided by Iran… However, the Agency has recently informed Iran that there are a number of other findings for which further clarifications and information need to be provided and questions need to be answered." According to knowledgeable officials, the IAEA is planning to report more fully in November the results of its Turquz-Abad warehouse investigation. It hopes Iran will have provided additional information by that time. The agency will also have finished inspecting two other sites potentially related to undeclared nuclear material and activities in Iran and will report its findings for all relevant sites and activities.[12]

Additional Protocol implementation: The IAEA reported that Iran continues to provisionally apply the Additional Protocol, which it agreed to do under the terms of the JCPOA. The IAEA stated that it "continues to evaluate Iran's declarations" and "has conducted complementary accesses under the Additional Protocol to all the sites and locations in Iran which it needed to visit, with the exception of a location at which a complementary access will be conducted later in September 2020 on a date already agreed with Iran." The IAEA refers here to its separate NPT safeguards investigation under which it has sought access to two sites and Iran's explanations about a third site. The Institute will issue a separate analysis of this IAEA Iran NPT compliance report.

[10] David Albright, Sarah Burkhard, Olli Heinonen, and Frank Pabian, "Presence of Undeclared Natural Uranium at the Turquz-Abad Nuclear Weaponization Storage Location," *Institute for Science and International Security*, November 20, 2019, https://isis-online.org/isis-reports/detail/presence-of-undeclared-natural-uranium-at-the-turquz-abad-nuclear-weaponiza

[11] David Albright, Sarah Burkhard, Frank Pabian, and Andrea Stricker, "Iran Defies the International Atomic Energy Agency: the IAEA's Latest Iran Safeguards Report," *Institute for Science and International Security,* June 10, 2020, https://isis-online.org/isis-reports/detail/iran-defies-the-international-atomic-energy-agency/8

[12] Andrea Stricker and Jacob Nagel, "Iran Nuclear Challenge Looms for the Next U.S. President," Foundation for Defense of Democracies, September 2, 2020, https://www.fdd.org/analysis/2020/09/02/iran-nuclear-challenge-for-next-us-president/