INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY
REPORT

ISIS Analysis of IAEA Iran Safeguards Report

By David Albright, Serena Kelleher-Vergantini, Andrea Stricker, and Daniel Schnur

May 29, 2015

On May 29, 2015 the International Atomic Energy Agency (IAEA) released its report the implementation of the NPT safeguards agreement in Iran and the status of Iran's compliance with United Nation Security Council resolutions.

Key Findings:

1) The average rate of monthly production of low enriched uranium (LEU) went up slightly, as did the average centrifuge performance of the IR-1 centrifuges in the Natanz Fuel Enrichment Plant.

2) With regard to the possible military dimensions (PMD) issue, Iran has "shared some information" in relation to one of the measures in the IAEA/Iran Framework for Cooperation. The IAEA and Iran agreed to continue the dialogue and meet again in the near future. However, no major breakthrough was reported. Moreover, Iran did not propose any new practical measures to resolve the PMD issue and has rebuffed requests by the IAEA to speed up the process of resolving outstanding issues.

3) Iran has a total inventory of 8,714 kg of 3.5 percent LEU hexafluoride and another 1,822 kg (uranium mass) 3.5 percent LEU in various chemical forms at the Enriched UO_2 powder Plant (EUPP). In total, as of May 2015, Iran also has about 228 kilograms (kg) of near 20 percent LEU (uranium mass). Of this near 20 percent LEU, 61.5 kg are in uranium oxide powder, 44.9 are in TRR fuel assemblies, and 121.2 kg are in scrap and waste, and in-process (all in uranium mass).

4) During the last reporting period, Iran did not feed any additional LEU into the Enriched UO_2 powder Plant. So far, Iran has fed 2,720 kg of $LEUF_6$ into the EUPP. Thus, Iran has fallen behind in its pledge under the Joint Plan of Action (JPA) to feed any newly produced LEU hexafluoride into the EUPP. Its current deficit is 1,106 kg of 3.5 percent LEU hexafluoride, which will increase by a few hundred kilograms during May and June. Under the JPA, Iran must feed all of this LEU into the EUPP by the end of June.

5) After a lengthy delay, the EUPP has finally produced LEU dioxide. As of May 23, 2015, the plant had produced 151 kg of uranium in the form of UO_2 enriched up to 5 percent uranium 235. The problem, according to Iranian officials, is that the last section of the plant that produces the LEU dioxide did not work properly. In total, Iran produced the 151 kg of LEU dioxide from 402.6 kg of uranium in the form of ammonium diuranate enriched up to five percent.

6) Most of the near 20 percent LEU fed into the line to make Tehran Research Reactor (TRR) fuel continues to end up as scrap or is in-process rather than in TRR fuel assemblies.

7) Moreover, since July 24, 2014, Iran has used only 44.5 kg of near 20 percent LEU uranium oxide powder (uranium mass) for the manufacture of Tehran Research Reactor fuel elements. This value was 40.2 kg as of mid-April, 2015, implying that Iran had used only 4.3 kg since mid-April. Under the JPA, Iran has committed to use 60 kg of near 20 percent LEU oxide powder (uranium mass) from July 24, 2015 through the end of June 2015. To meet its commitment, Iran must use about 15 kilograms of this material in the next month. Thus, given its slow pace of using the LEU, it appears that Iran has fallen behind in this commitment.

8) Iran continues to conduct R&D activities related to the recovery of near 20 percent LEU from solid scrap, and there is concern that Iran may start recovering near 20 percent LEU scrap. According to senior U.S. officials, Iran has agreed under the extension agreements of the Joint Plan of Action not to process this near 20 percent LEU scrap. However, this issue requires clarification, at least. Better, Iran should commit not to commence operation of any process to recover near 20 percent LEU from scrap. The use of near 20 percent LEU can significantly speed up breakout timelines to well below 12 months, as required in a long term deal. The most straightforward manner to address this issue is to remove or blend down the over 100 kilograms of near 20 percent LEU (uranium mass) in scrap and waste, and in-process. However, preventing Iran from further developing a scrap recovery operation is also important in limiting Iran's ability to reduce breakout times to less than 12 months, if it did breakout and use residual stocks of near 20 percent LEU remaining in Iran.

9) Iran has cut by about 40 percent the rate of feeding of natural uranium hexafluoride (UF_6) into its advanced centrifuges at the Natanz Pilot Fuel Enrichment Plant (PFEP) after a marked increase observed during the last reporting period over three prior reporting periods. In the advanced centrifuges, after enrichment and the measurement of the enrichment level of the product, the product is remixed with the tails or waste, producing natural uranium; and

10) Iran has started to make sample fuel pellets for the Bushehr power reactor.

LEU Production and Centrifuge Levels at the Natanz Fuel Enrichment Plant (FEP)

Iran's total 3.5 percent low enriched uranium (LEU) production at the FEP through May 12, 2015 is reported to be 14,411 kilograms (kg). The FEP is Iran's primary enrichment facility, where the majority of its IR-1 centrifuges are installed. Activity at the Pilot Fuel Enrichment Plant (PFEP), where Iran has enriched uranium up to the 20 percent level until January 20, 2014, is discussed below. The Fordow enrichment plant also produces 3.5 percent LEU, and these stocks are considered below.

The average monthly production of 3.5 percent LEU at the FEP increased over the past reporting period from approximately 206 kg per month to approximately 217 kg per month of LEU hexafluoride. In the previous reporting period Iran had achieved the lowest monthly production rate since May 2013. During this reporting period it has managed to increase the monthly production rate, although it continues to be lower than the average production rate achieved in 2013 and the first half of 2014.

Since November 10, 2013, Iran has had 90 IR-1 centrifuge cascades fully installed for a total of 15,420 IR-1 centrifuges, the same as the previous reporting periods. The number of cascades enriching, namely 54 cascades, remains constant since the previous reporting period; these cascades fed with uranium hexafluoride contain 9,156 centrifuges.[1] Iran fed 8,104 kg of natural uranium hexafluoride into the cascades at the FEP, which corresponds to a daily feed rate of about 86 kg. This rate is slightly higher compared to previous daily feed rates.

Figures 1-5 describe IR-1 centrifuge trends with time, historical average monthly uranium feed and 3.5 percent LEU production rates, and cumulative LEU production at the Natanz FEP.

Between September and December 2014, the IAEA carried out a physical inventory verification (PIV) at the Fuel Enrichment Plant at Natanz and at the Pilot Fuel Enrichment Plant. The IAEA verified, within the measurement uncertainties normally associated with such facilities, the inventory of nuclear material as declared by Iran on November 16, 2014 and September 13, 2014.

Iran's centrifuge performance at the FEP can also be evaluated in terms of separative work units (swu). ISIS derives this value from information about LEU production. In the most recent reporting period, the LEU is taken as on average as being 3.5 percent enriched[2], and the waste is assumed to have on average a 0.711 percent feed assay and tails assay of 0.4 percent.[3] The

[1] It is possible that not all centrifuges within the cascades fed with uranium hexafluoride were operational during the reporting period.

[2] The IAEA safeguards report mentions an enrichment level of "up to 5 percent," which is a source of some uncertainty. But Iran has had difficulty achieving five percent enriched uranium, and its average value was 3.5 percent for many years. The ideal cascade model utilized by ISIS uses an enrichment level of 3.5 percent for the product. Although this is not a precise figure, it provides an estimate which is reasonable considering Iran's past performance in this area.

[3] The calculations are performed using an idealized cascade model, which does not account for a variety of issues in the actual performance of the cascade, including – but not limited to – centrifuges breaking down or performing below their nominal capacity. While an ideal cascade is not achievable in practice, this estimate provides a method to compare swu calculations.

IAEA did not provide updated concentrations in this report, but these older numbers are used, based on a variety of interviews with knowledgeable senior officials close to the IAEA. Using standard idealized enrichment calculations, 681 kg of LEU translates to roughly 1,675 swu, or an average of 17.8 swu/day. On an annualized basis, this is about 6,501 swu per year (see Figure 6). Although Iran had reached the lowest FEP operation numbers since 2012 in the previous reporting period, it has now registered operation numbers closer to the average ones.

Between November 2014 and February 2015, the average swu/centrifuge-year was 0.66 swu/centrifuge-year, significantly lower than the performance at the FEP in 2013 and 2014.[4] For most of 2010, this value was about 0.9 kg U swu per year per centrifuge (see Table 1, which lists these values on a quarterly basis since the FEP started operation, and Figure 6, which displays this data graphically). However, the latest report shows that Iran achieved an average swu/centrifuge-year of 0.71. This is still lower than the 2010 average, but closer to the average swu/centrifuge-year since 2011.

A Note on Iran's Lower Separative Work Output

The reason for the lower performance in the IR-1 centrifuges at the FEP is not provided in the report. In the previous report, we discussed the possibility that Iran was deliberatively lowering the centrifuge's average performance as part of its negotiating strategy with the P5+1 over centrifuge limits in a long term deal. We appear to have been at least partially right. We learned that the reason for the unusually lower average performance in the last reporting period reflected Iran's decision not to replace as many broken IR-1 centrifuges, effectively lowering the FEP's average performance. Moreover, during the negotiations earlier this year Iranians tried to argue that when considering breakout calculations, an average value of 0.6 kg U swu/year/centrifuge (1 kg UF_6 swu/year/centrifuge) should be used. With a requirement for a 12 month breakout and a fixed LEU stock, Iran's lower average value would lead to considerably more centrifuges staying at Natanz and Fordow, compared to choosing an average of 0.9-1.0 kg U swu/year/centrifuge. The United States and its partners have insisted that the latter values are more realistic if Iran decided to breakout, where Iran would undoubtedly seek to maximize the centrifuges' performance. In sum, the reason for Iran's decision not to replace all its broken IR-1 centrifuges remains unknown and may be due to a general decision not to build any more IR-1 centrifuges, regardless of the negotiations. However, Iran appears to have tried unsuccessfully to use the lower average centrifuge performance value as part of arguing to keep more centrifuges under a long-term deal.

Installation of Advanced Centrifuges at Natanz Fuel Enrichment Plant

In a letter dated January 23, 2013, Iran informed the IAEA that its advanced, carbon fiber-based centrifuge, designated the IR-2m, "will be used" in one of the modules of Production Hall A. This statement is being widely interpreted as Iran announcing that it intended to install about 3,000 IR-2m centrifuges, which is the normal deployment in a module.

[4] The value from the previous two reporting periods was 0.75 swu/centrifuge-year.

Under the Joint Plan of Action, Iran agreed to halt installation of any additional centrifuges and to not begin enriching in any new IR-2m machines. In the unit containing IR-2m centrifuges, as of May 17, 2015, the situation remained unchanged from the IAEA's previous report: six cascades had been fully installed with IR-2m centrifuges; none of these cascades had been fed with natural uranium hexafluoride; and preparatory installation work had been completed for the other 12 IR-2m cascades in the unit.

Iran had not begun enriching in any of these cascades. Figure 7 tracks the IR-2m installation at the FEP.

Centrifuge Research and Development (R&D) at the Natanz Pilot Fuel Enrichment Plant

Iran is not precluded from continuing its centrifuge R&D activities under the extended Joint Plan of Action. It did agree that it cannot feed uranium hexafluoride into any centrifuges that had not been fed with UF6 as of November 2013. Moreover, in the advanced centrifuges, after enrichment and the measurement of the enrichment level of the product, the product is remixed with the tails or waste, producing natural uranium.

Four out of six cascades at the pilot plant are dedicated to this on-going centrifuge research and development. They are cascades 2, 3, 4 and 5. As of May 25, 2015, there were:

- In Cascade 2: 11 IR-4 centrifuges (down from 12 IR-4 in February, and 13 IR-4 in November); 12 IR-6 centrifuges (down from 13 IR-6 in February and up from nine in November); 2 IR-1 centrifuges (same as previous report, and down from 14 in November); and one unconnected IR-5 centrifuge and one unconnected prototype IR-8 centrifuge installed;

- In Cascade 3: 8 IR-1 centrifuges (down from 15 in February, and 14 in four previous reports); 26 IR-2m centrifuges (up from two in February and November); and 2 IR-4 centrifuges installed (down from 23 in the previous report);

- In Cascade 4: 164 IR-4 centrifuges (same as in the past year plus);

- In Cascade 5: 162 IR-2m centrifuges (same as in the past year plus).

Natural UF_6 Feeding Increased into PFEP Advanced Centrifuges

As in previous reports, Iran has intermittently fed natural uranium hexafluoride into IR-6s centrifuges as single machines and into IR-1, IR-2m, IR-4, and IR-6 centrifuges, sometimes into single machines and sometimes into cascades of various sizes.

In the previous reporting period, the average rate of feeding of natural UF_6 was significantly greater than the feed rate in three prior reporting periods (October 2013 to October 2014) and

more than double the rate of the previous reporting period's feed rate (August 2014 to October 2014).

The current IAEA report indicates that Iran has cut its rate of feed by roughly 40 percent since the marked increase noted in the last reporting period:

- According to the IAEA's February 2015 report, between October 11, 2014 and February 1, 2015, 790.9 kg of natural UF6 was fed into centrifuges in the R&D area (113 days at 7.00 kg per day), but no LEU was withdrawn as the product and the tails were recombined at the end of the process.

- According to the IAEA's May 2015 report, between February 2, 2015 and May 17, 2015, Iran fed a total of 410.7 kg of natural UF6 into the centrifuges in the R&D area (105 days at 3.9 kg per day), but recombined the enriched product and depleted tails.

So, for the past five reporting periods, Iran fed a total of 2,196 kg of natural UF_6 into the advanced centrifuges.

There is no new, specific information about the performance of these advanced centrifuges in the report. Because the product and tails are remixed, the IAEA cannot learn about the amount of enriched uranium produced in these advanced centrifuges and is unable to judge the performance of the advanced centrifuges. However, Iran appears to be continuing to make advancements in its advanced centrifuges within the allowed parameters of the Joint Plan of Action and its two extension agreements.

19.75 Percent LEU Production at the Natanz Pilot Plant: Still Halted

From February 2010 to January 2014, Iran designated two, tandem cascades at the smaller, above-ground Pilot Fuel Enrichment Plant for the production of LEU enriched to nearly 20 percent uranium-235, ostensibly for the Tehran Research Reactor. One of these cascades enriched from 3.5 percent LEU to almost 20 percent LEU, while the second one received the tails from the first and outputted roughly 10 percent LEU and a tails of natural uranium. The ten percent material was fed into the first cascade in addition to 3.5 percent LEU. This process allowed Iran to more efficiently use its 3.5 percent LEU stock. **In total, Iran fed 1,631 kg of 3.5% LEU to produce 202 kg of 19.75% uranium since the beginning of operations in February 2010.**

Per its agreement with the P5+1, Iran ceased production of 19.75 percent enriched uranium in these cascades. As of January 21, 2014, the IAEA reported that Iran began enriching to 3.5 percent in the cascades previously designated for 19.75 percent enrichment. Between January 20, 2014 and May 17, 2015, Iran had fed 1,213.8 kg to produce 114.8 kg of LEU enriched up to 5 percent of U-235.

On January 20, 2013, in line with its commitment under the JPA, Iran began downblending some of its inventory of UF_6 enriched to 20 percent U-235 to no more than five percent LEU

hexafluoride. Between January 20 and July 20, 2014, Iran down blended a total of 108.4 kg of that material, fulfilling its commitment to down blend half of the 209.1 kg of the nuclear material that had been in the form of UF_6 enriched up to 20% U-235 on 20 January 2014. As of June 19, 2014, it had also fed 100 kg of the remaining near 20 percent LEU hexafluoride into the conversion process at its Fuel Plate Fabrication Plant at Esfahan.

Fordow Fuel Enrichment Plant (FFEP)

The Fordow site has two enrichment halls, Units 1 and 2, which together are designed to contain up to 2,976 centrifuges in 16 cascades. Iran was operating the four cascades of 174 IR-1 centrifuges each in two, tandem sets to produce 19.75 percent LEU in a total of 696 enriching centrifuges, the same number of centrifuges enriching as was reported since 2012. In compliance with the Joint Plan of Action, Iran stopped enriching to 19.75 percent in these cascades and began enriching to no greater than 5 percent LEU hexafluoride.

The Fordow facility remains nearly fully outfitted with centrifuges, though Iran has not increased the number of centrifuges enriching. Figure 11 displays the number of centrifuges enriching and installed at the FFEP graphically.

In total, the Fordow facilty produced 245.9 kg of near 20 percent LEU hexafluoride from 1,806 kg 3.5 percent LEU hexafluoride. As of January 21, 2014, the IAEA reported that Iran began enriching to 3.5 percent in the cascades previously designated for 19.75 percent enrichment. Between January 20 and May 10, 2015, Iran had fed 3,098 kg of natural uranium hexafluoride to produce a total of 295.3 kg of LEU enriched up to 5 percent U-235. Between January 24 and February 8, 2015, the IAEA carried out a PIV at the Fordow Fuel Enrichment Plant. The results are still being evaluated by the IAEA. On February 8, 2014, as previously reported by the IAEA, Iran updated the facility's Design Information Questionnaire as it "had taken measures due to change in level of enrichment and that the measures are temporarily taken during the first step implementation of the JPA."

Production of Near 20 Percent Uranium Oxide at Fuel Plate Fabrication Plant

Iran reported in August 2012 that it began feeding its 19.75 percent uranium hexafluoride into the Fuel Plate Fabrication Plant at Esfahan (FPFP). In total,[5] Iran had fed a total of 337.2 kg of 19.75 percent enriched uranium hexafluoride into the process at Esfahan to produce U_3O_8 containing about 162.8 kg of enriched uranium oxide (uranium mass). The 337.2 kg of near 20 percent LEU hexafluoride contains about 227.6 kg of enriched uranium (uranium mass). Of the total produced, 0.6 kg of this material was stored in hexafluoride form as reference material for mass spectrometry and placed under IAEA seal. The IAEA verified 55.4 kilograms of this near 20 percent LEU in liquid or solid scrap form. Thus, approximately 9.4 kg of near 20 percent LEU (uranium mass) remain held up in the process or in waste.

[5] The entire inventory of this material had been processed by July 20, 2014.

According to the IAEA, Iran has used a total of 101.3 kg for the manufacturing of fuel items for the TRR. The IAEA also reports that as of May 18, 2015, Iran had produced one experimental fuel assembly and 34 Tehran Research Reactor (TRR)-type fuel assemblies, which constitutes an increase of two fuel assemblies since February. The TRR fuel and assemblies and plates contain about 45 kilograms of near 20 percent LEU (U-mass). Thus, of the total amount of 227.6 kg of near 20 percent LEU (uranium mass) sent for conversion, about 19 percent has so far been made into fuel assemblies for the TRR.

Iran temporarily stopped manufacturing fuel assemblies on November 25, 2014 in preparation for the IAEA's verification of the "physical inventory taking" at the facility. This verification was carried out between 14 and 16 December 2014. The IAEA verified, within the measurement uncertainties normally associated with such facilities, the inventory of nuclear material as declared by Iran on December 13, 2014.

As of May 12, 2015, 19 of the 30 assemblies transferred to TRR were in the core, which on this date comprised a total of 33 fuel assemblies. Since the last reporting period, three additional standard fuel assemblies have been irradiated. These additional assemblies contained a total of 4.2 kilograms of uranium.

In sum, despite the fact that Iran no longer has a stock of near 20 percent low enriched uranium (LEU) in hexafluoride form (UF_6), it continues to retain a significant portion of this material in the form of oxide. In total, as of May 2015, Iran has about 228 kilograms (kg) of near 20 percent LEU (uranium mass). Of this, 61.5 kg are in uranium oxide powder, 44.9 are in TRR fuel assemblies, and 121.2 kg are in scrap, waste, and in-process (see figure 12).

Iran Seeking to Produce Miniature Fuel Plates for Production of Molybdenum-99

On December 28, 2014 Iran notified the IAEA that it would start manufacturing miniature fuel plates for the Molybdenum, Iodine and Xenon Radioisotope Production (MIX) Facility, for the production of Molybdenum-99. As of May 13, 2015 the IAEA confirmed that one fuel plate containing a mixture of U_3O_8 enriched up to 20 percent U-235 and aluminum was at the MIX Facility after transfer from the FPFP and was being used for R&D activities for the production of ^{99}Mo, ^{133}Xe, and ^{132}I isotopes. As the IAEA reports, since July 24, 2014, Iran has used 0.084 kg of near 20 percent uranium oxide for the purpose of producing ^{99}Mo.

According to a May 13, 2015 DIV at the MIX Facility and a May 12, 2015 DIV at the TRR, the IAEA confirms no ongoing reprocessing activities are taking place at those facilities.

Near 20 Percent LEU Scrap Recovery Processing Line: Another Conflict with the Joint Plan of Action?

In producing near 20 percent LEU oxide from its hexafluoride form and in making TRR fuel elements at the Fuel Plate Fabrication Plant at Esfahan (FPFP), Iran has generated a considerable amount of scrap in solid and liquid forms (see above). LEU in scrap is generally recoverable, and according to the IAEA report, Iran is creating the capability to recover the near 20 percent LEU from this scrap at the FPFP.

According to the previous IAEA report, "In a letter dated 28 December 2014, Iran informed the Agency [IAEA] of the operational schedule for FPFP [Fuel Plate Fabrication Plant at Esfahan] and **indicated its intention to establish process lines for the recovery of uranium from solid and liquid scrap.** In its reply dated January 19, 2015, the Agency requested that Iran provide further clarification. On February 10, 2015, the Agency observed that the process lines had yet to commence operation and that Iran had started R&D activities related to the recovery of uranium from solid scrap." In the most recent report the IAEA observed that, as of May 19, 2015, the process lines for the recovery of uranium were not yet operational, but that R&D activities relating to the recovery of uranium from solid scrap were ongoing.

Under the Joint Plan of Action extension agreements, Iran has agreed to process near 20 percent LEU oxide into TRR fuel elements—25 kilograms under the July 2014 extension agreement and another 35 kilograms under the November 2014 extension. The negotiators recognized that much of this LEU would not end up in TRR fuel elements and would instead end up as scrap or waste (see above for amounts of material in each form). But once the near 20 percent LEU was either in fuel or scrap form, it would be less useful in a nuclear weapons breakout scenario. However, this pledge would be undermined if Iran recovered the LEU from the scrap. As a result, Iran committed under the extension agreements not to work on the near 20 percent LEU scrap.

It is unknown how much near 20 percent LEU scrap would be recovered, or whether the scrap sent for processing would be covered explicitly by the extension agreements. However, **Iran moving to institute a scrap recovery capability poses a challenge to the extension agreements of the Joint Plan of Action. This issue requires clarification, at least, and better, a commitment by Iran not to commence operation of such a scrap recovery capability.**

Enriched UO_2 Powder Plant (EUPP)

The commissioning of the EUPP facility began in May 2014 using natural uranium. The IAEA's most recent report states that as of May 23, 2015, Iran has fed a total of 6319 kg of natural UF_6 into the conversion process and produced 1828.8 kg of natural uranium in the form of UO_2.

From July 2014 through November 2014, Iran fed 2,720 kg of UF_6 enriched up to 5% U-235 into the conversion process for the production of UO_2. This number remains unchanged since November 2014. Therefore, Iran has not yet fed any additional 3.5 percent LEU into the Enriched UO_2 powder Plant in the second extension period. Thus, Iran has fallen behind in its

pledge under the Joint Plan of Action to feed any newly produced LEU hexafluoride into the EUPP. In order to meet its JPA pledge, Iran needs to feed 1,106 kg of UF_6 enriched up to 5% U-235 produced from last November until early May 2015 and any additional LEU that it will produce through the end of June 2015.

After a lengthy delay, the EUPP has finally produced LEU dioxide. As of May 23, 2015, the plant had produced 151 kg of uranium in the form of UO_2 enriched up to 5 percent uranium 235. The problem, according to Iranian officials, is that the last part of the plant that produces the LEU dioxide did not work properly. In total, Iran produced the 151 kg of LEU dioxide from 402.6 kg of uranium in the form of ammonium diuranate enriched up to 5 percent.

Taking Stock

According to the most recent IAEA report, Iran has produced a total of 14,936.7 kilograms of 3.5 percent LEU hexafluoride, which constitutes an increase of 761.8 kilograms since the previous IAEA report. Almost all of this LEU was produced at the Natanz and Fordow enrichment facilities; 115.6 kg of this material comes from down blending near 20 percent LEU hexafluoride. About 3,437 kilograms of the 14,936.7 kg had been used to make the 19.75 percent LEU hexafluoride, leading to a total of 11,499.7 kg of 3.5 percent LEU hexafluoride. Another 2,720 kg of this LEU hexafluoride was fed into the EUPP to make oxide, and 53 kg of this LEU was fed in the uranium conversion facility to produce uranium dioxide, for a remaining total of 8,726.7 kg of LEU hexafluoride. The IAEA reports that the total 3.5 percent LEU hexafluoride inventory is 8,714 kg, a difference of 12 kg from the value derived above. We could not explain the reason for the difference.

Based on the IAEA values in the report, the total inventory is 8,714 kg of 3.5 percent LEU hexafluoride and another 1,822 kg (uranium mass) 3.5 percent LEU in various chemical forms at the EUPP.

Across its three centrifuge facilities, Iran has installed 18,458 IR-1 centrifuges and 1,008 IR-2m centrifuges. Figure 7 shows IR-2m trends in Iran, and Figure 8 shows historical cumulative IR-1 centrifuge trends in Iran.

Combined, the PFEP at Natanz and the FFEP have produced 448 kg of 19.75 percent uranium, though Iran ceased production of this material on January 20, 2014. Figure 9 represents the cumulative production of 19.75 percent enriched uranium in Iran.

Under the terms of the Joint Plan of Action, Iran has downblended a total 110 kg of 19.75 percent LEU hexafluoride into LEU enriched to less than five percent, including 1.6 kg diluted previously. Since Iran began conversion at its declared facilities, it has fed into the process line at the Fuel Plate Fabrication Plant at Esfahan 337.2 kilograms of uranium hexafluoride enriched up to 20 percent uranium-235, or 227.6 kilograms of enriched uranium, and it produced 162.8 kilograms of near 20 percent enriched uranium in the form of U_3O_8 powder (U-mass). At present, Iran does not possess a stock of near 20 percent LEU hexafluoride. However, as of

May 2015, Iran has 61.5 kg in uranium oxide powder, 44.9 in TRR fuel assemblies, and 121.2 kg in scrap, waste, and in-process.

Table 2 summarizes these findings. It should be noted that Iran retains a large total stock of near 20 percent LEU in oxide form. The size of this stock poses a challenge to the P5+1/Iran negotiations.

Iran has achieved varying rates of separative work in the IR-1 centrifuge at its enrichment plants. Although Iran continues to install and enrich in additional centrifuges at the FEP, the enrichment output measured in swu/centrifuge-year at this plant has varied and declined overall. During this reporting period, the FFEP achieved again 0.80 swu/centrifuge-year, same as the last reporting period but a 0.05 swu/centrifuge-year decrease from the January-October 2015 reporting period. The PFEP cascades achieved 0.65 swu/centrifuge-year, the same as in the previous reporting periods. Table 3 compares the enrichment output at the FEP, PFEP, and FFEP. Figure 10 shows the average swu per year per centrifuge at the PFEP and FFEP.

Arak IR-40 Reactor and Heavy Water Production Plant

Through a Design Information Verification (DIV) inspection of the IR-40 Reactor on May 11, 2015, the IAEA verified that Iran has not installed any major components at the IR-40 Reactor, nor has it manufactured fuel assembles for the reactor at the Fuel Manufacturing Plant (FMP) since the previous report in accordance with the extended Joint Plan of Action.

On May 17, 2015, the IAEA carried out DIV inspection at the Fuel Manufacturing Plant (FMP) at Esfahan and "verified that Iran had continued its cessation of production of nuclear fuel assemblies using natural UO_2 for the IR-40 Reactor and that all of the fuel assemblies that had been produced previously remained at FMP."

No Major Movement on Resolving Possible Military Dimensions

Since the previous report, Iran and the IAEA have held discussions about Iran's past and possibly ongoing work related to nuclear weapons development, or possible military dimensions (PMD) of Iran's nuclear program, under the IAEA/Iran Framework for Cooperation. The framework laid out a series of steps of issues to be addressed with new steps added as progress is made. Of two outstanding practical measures regarding high explosives initiation and neutron transport calculations agreed to by Iran and the IAEA in May 2014 in a third step under the framework, Iran has shared partial information on one, although the IAEA does not specify which. In a news article dated April 20, 2015 by the semi-official Fars News Agency, Behrouz Kamalvandi, the spokesman of the Atomic Energy Organization of Iran (AEOI), was quoted stating that the IAEA had been convinced of the "academic nature" of papers published in Iran and which it asked about regarding neutron transport and associated modeling but was still considering its acceptance.[6]

[6] "IAEA Convinced about Neutron Transport Issue," Fars News Agency, Iran, April 20, 2015, http://english.farsnews.com/newstext.aspx?nn=13940131001075

The IAEA states in its report that it remains "ready to accelerate the resolution of all outstanding issues under the Framework for Cooperation," and that this can be "realized by increased co-operation by Iran and by the timely provision of access to all relevant information, documentation, sites, material and personnel in Iran as requested by the Agency" which will "[establish] an understanding of the whole picture concerning issues with possible military dimensions..." However, Iran did not agree to accelerate its effort.

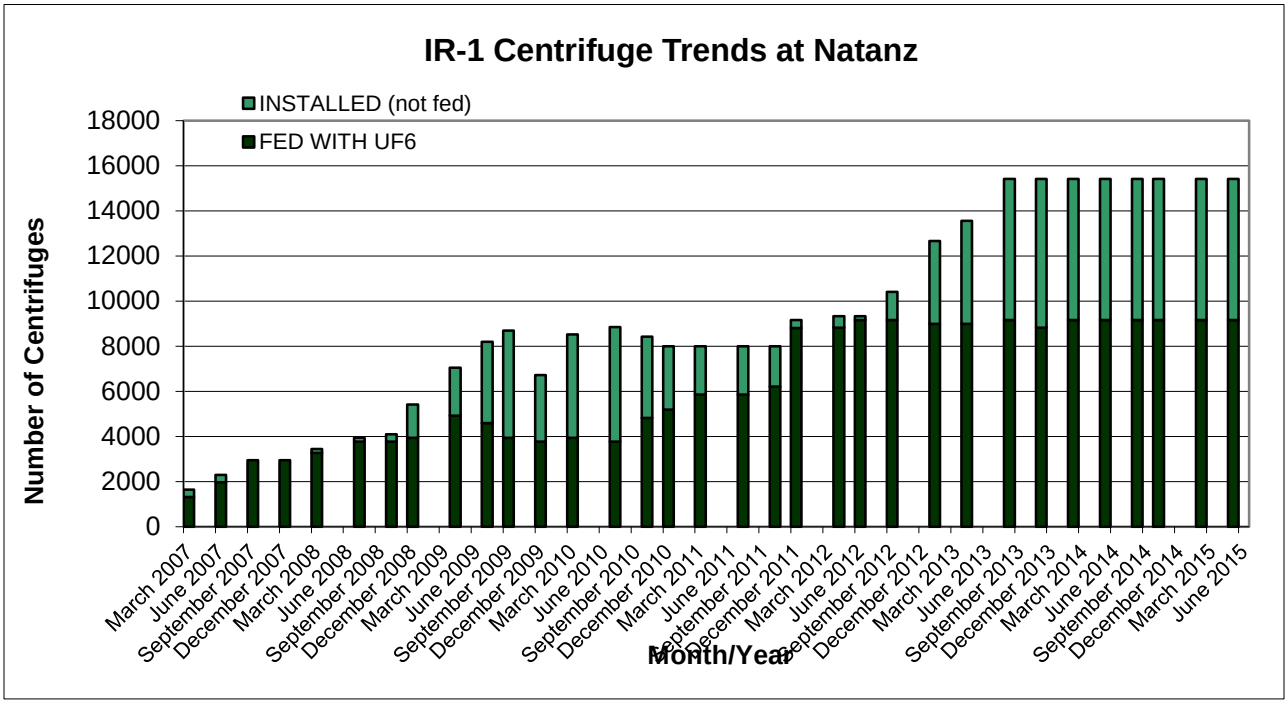
Ongoing Activities Observed at Parchin

As in prior reports, the IAEA has observed the "presence of vehicles, equipment, and probable construction materials" at the Parchin military through satellite imagery but does report any further external changes to the buildings at the site. ISIS analysis of satellite imagery dated between January 31, 2015 and May 18, 2015 noted structural changes to buildings at the site, as well as the activity and debris consistent with the findings reported by the IAEA. The changes observed by ISIS include the removal of a small building on the north end of the site as well as the construction of eight unidentified objects running adjacent to the length of the site (see figure 12). A more in-depth analysis of these activities can be found in a recent ISIS Imagery Brief.

As the IAEA report highlights, these and previous activities that have taken place at the site since February 2012 apparently aimed at sanitizing and modifying the site have likely undermined any future efforts at accurate verification. In the Fars News article referenced above, the AEOI spokesman reiterated a past statement by Iran that it would provide the IAEA with one-time only access to Parchin. While this would be a start, if actually planned, Iran cannot under its comprehensive safeguards agreement which allows the IAEA to determine the correctness and completeness of its declarations of a peaceful nuclear program, set arbitrary limitations on the IAEA's rights and requirements to inspect sites of concern.

Increased cooperation by Iran in answering the IAEA's questions regarding the PMD issue and urgent access to Parchin remain necessary with or without a comprehensive nuclear agreement.

Figure 1: IR-1 Centrifuge Trends at Natanz FEP**



** The dark green bar represents the number of IR-1 centrifuges enriching, while the light green represents the number of IR-1 centrifuges installed but not enriching. The sum of the two represent the total number of IR-1 centrifuges installed at the FEP.

Figure 2: Uranium Hexafluoride Feed at the Natanz FEP

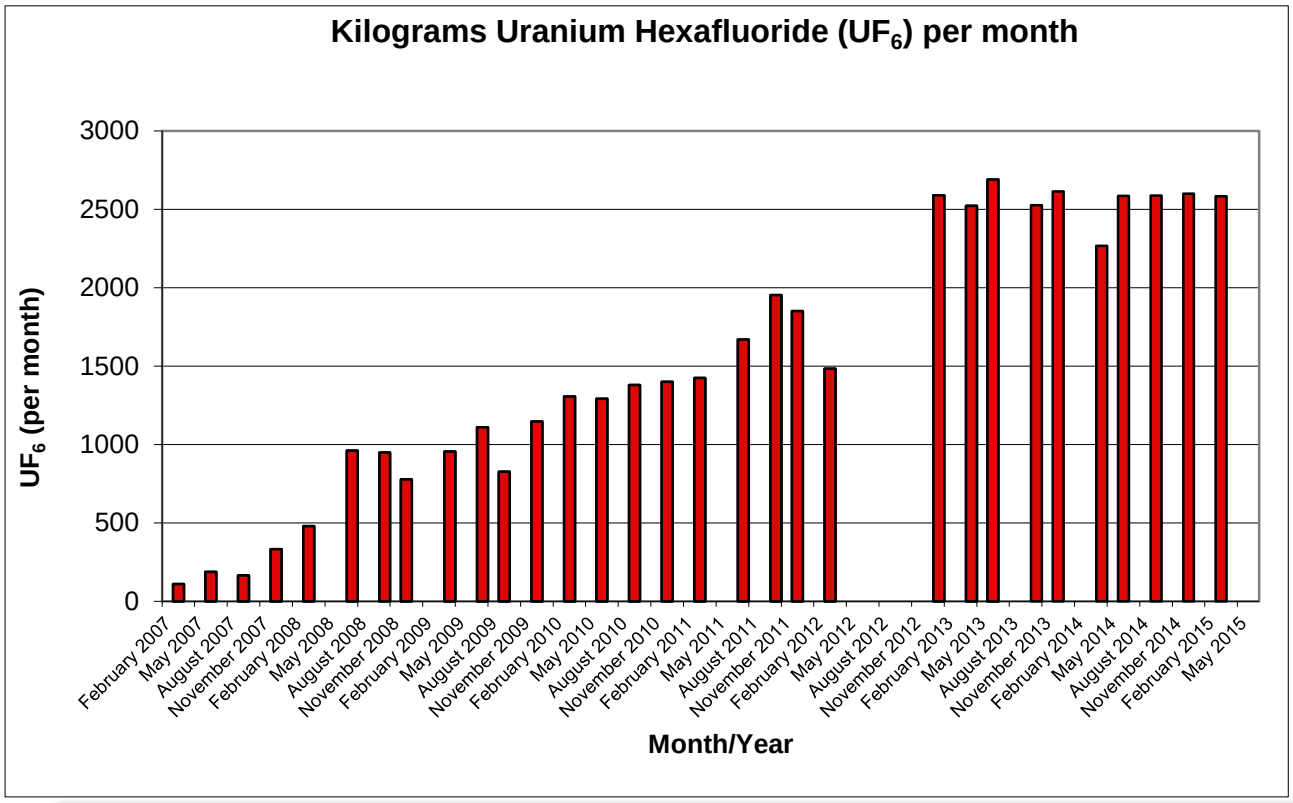


Figure 3: LEU Production (kilograms uranium hexafluoride per month) at Natanz FEP

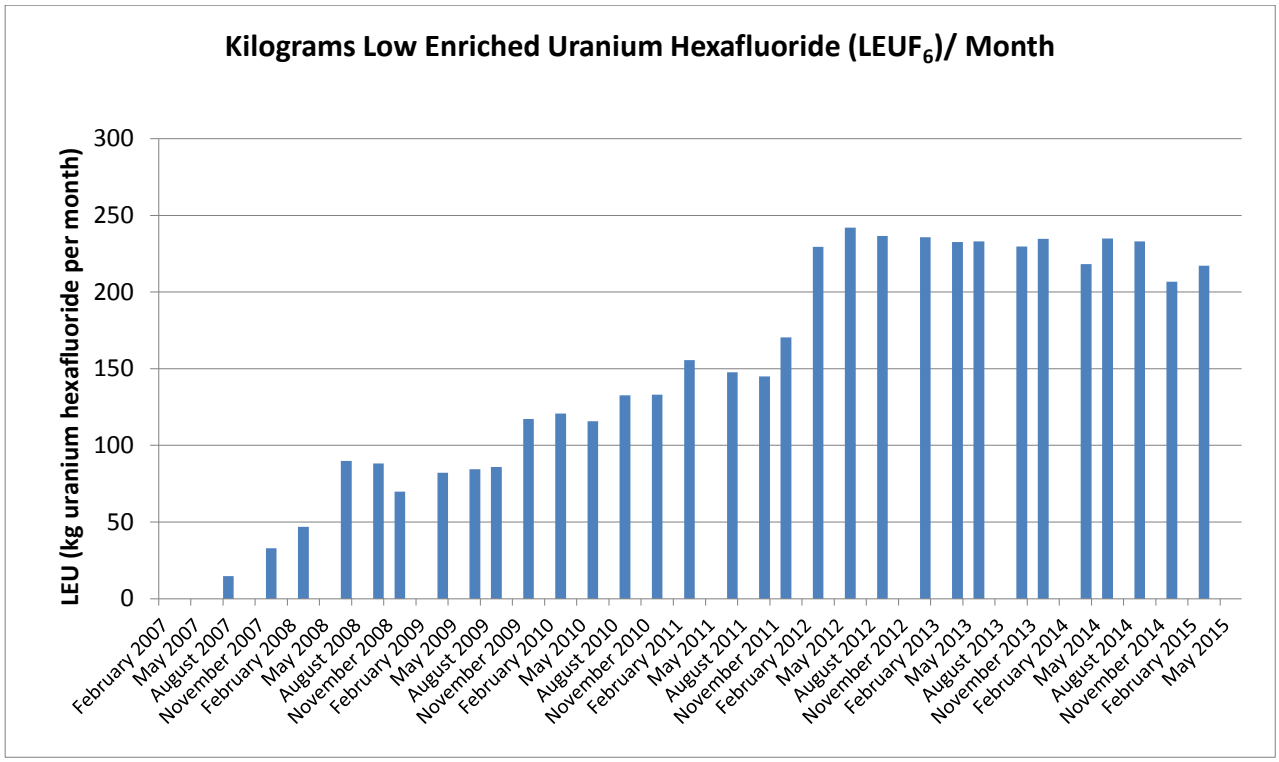


Figure 4: Overall Trends at Natanz FEP

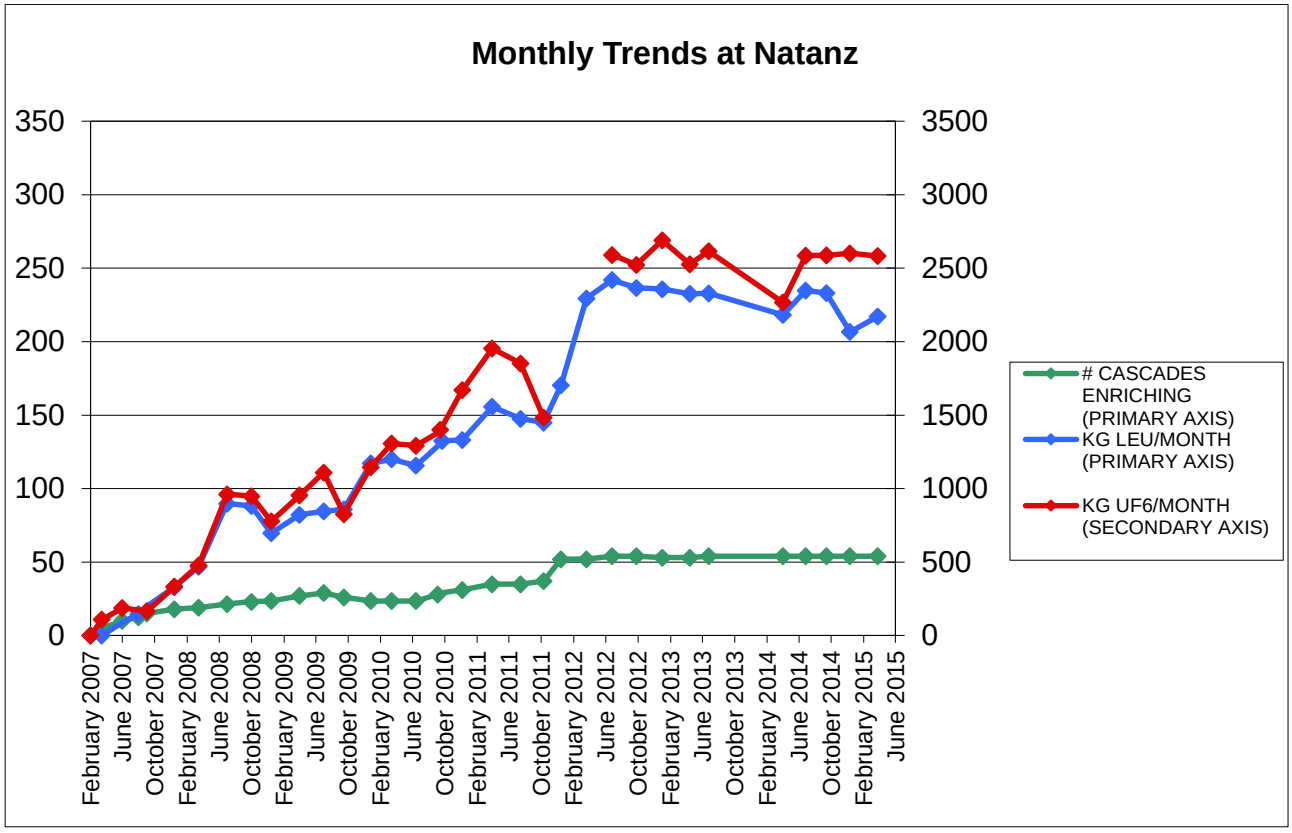


Figure 5: Cumulative LEU Production at the Natanz FEP

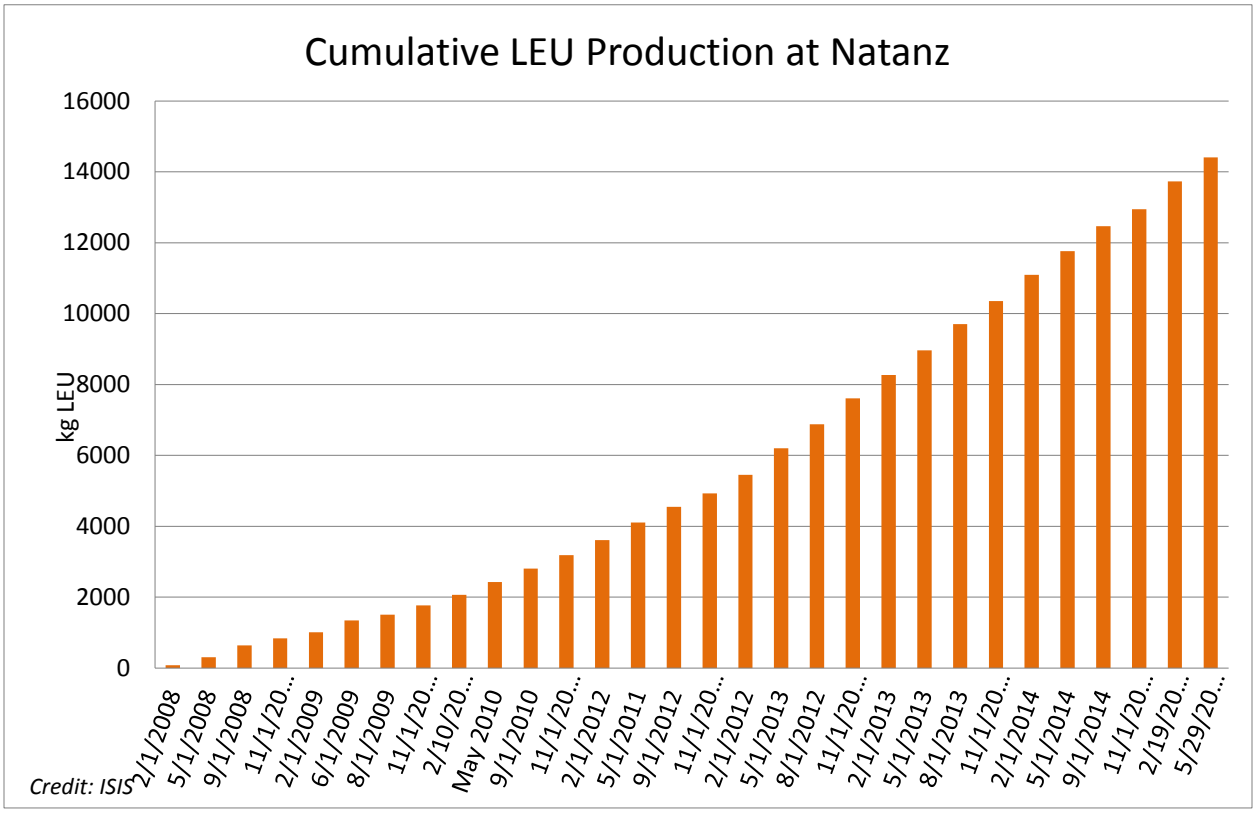


Figure 6: Annualized SWU at Natanz FEP

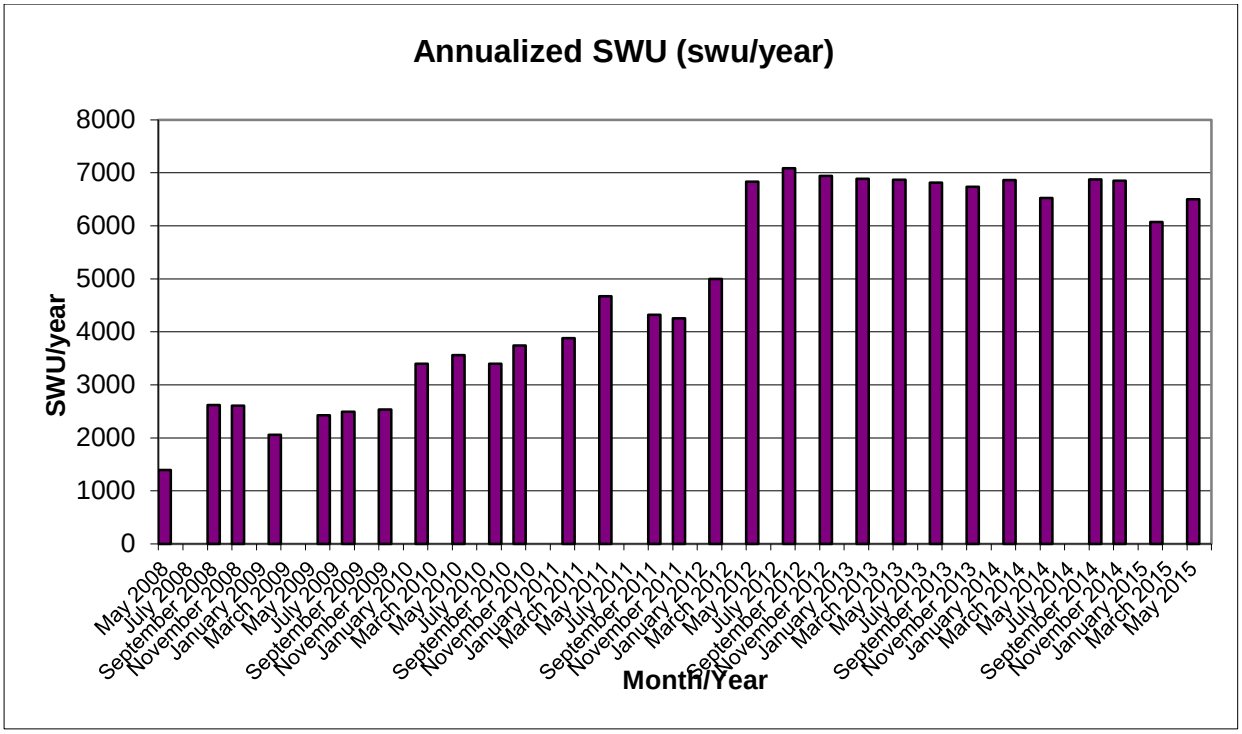


Figure 7: IR-2m Progress at the FEP

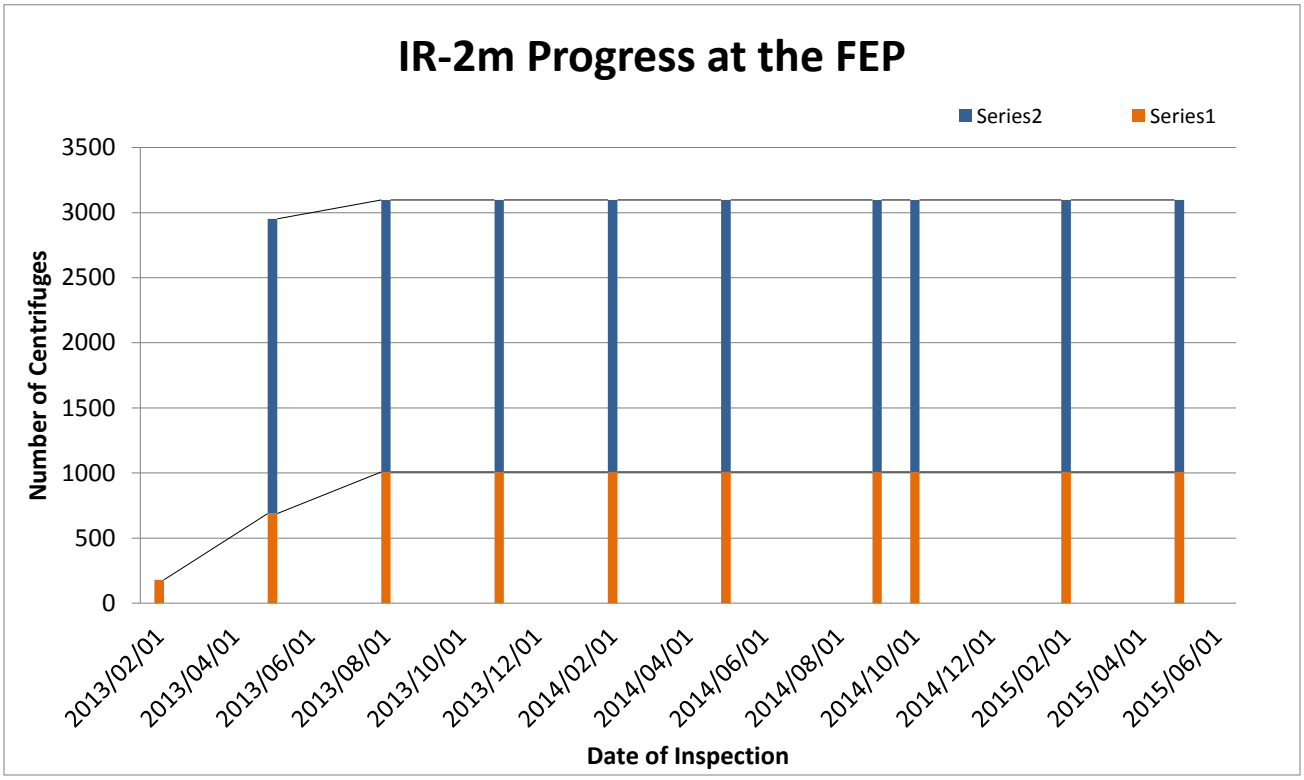


Figure 8: Total Number of Deployed IR-1 Centrifuges in Iran

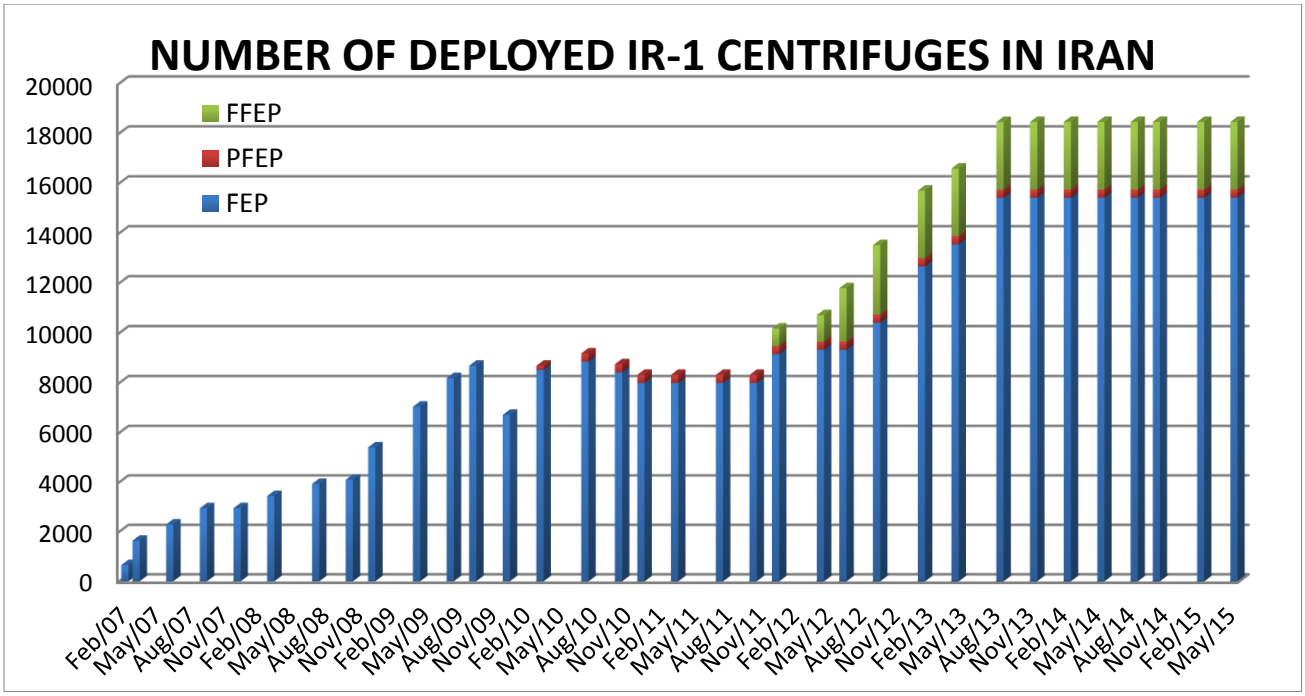


Figure 9: Cumulative 19.75 Percent Uranium Production in the PFEP and FFEP

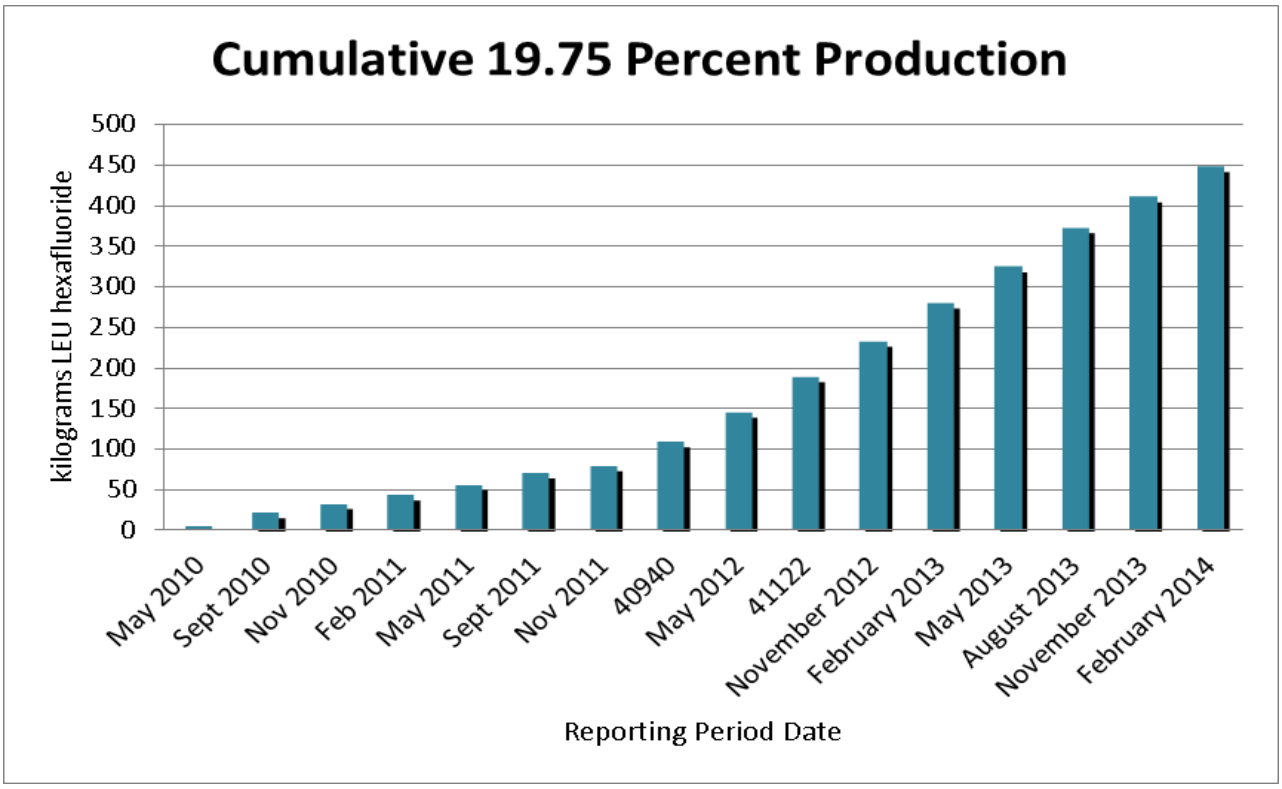


Figure 10: SWU/Centrifuge-year at the Fordow Fuel Enrichment Plant and Pilot Fuel Enrichment Plant

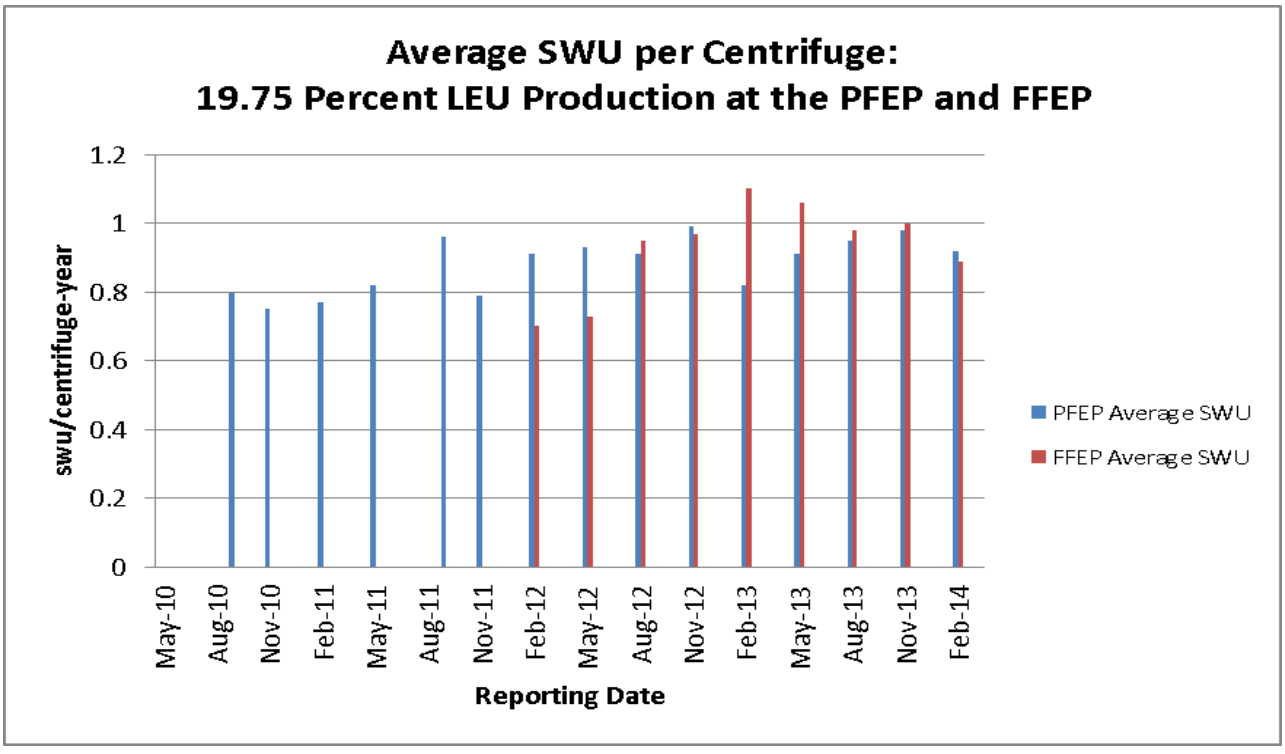
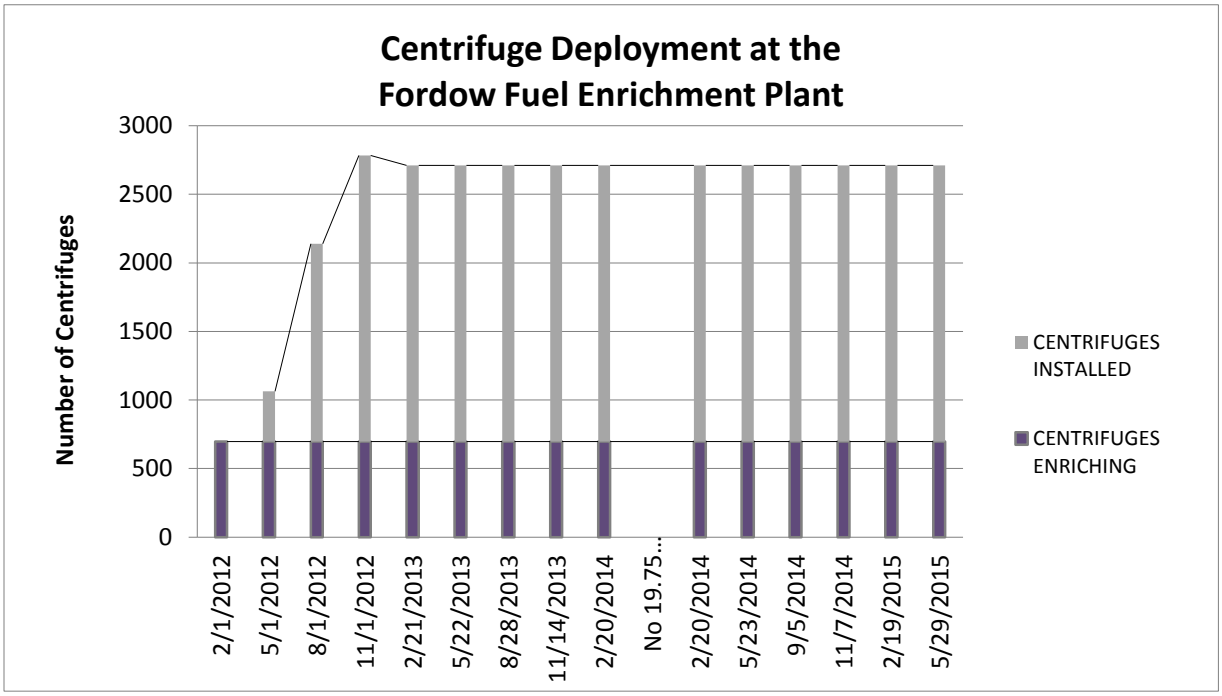
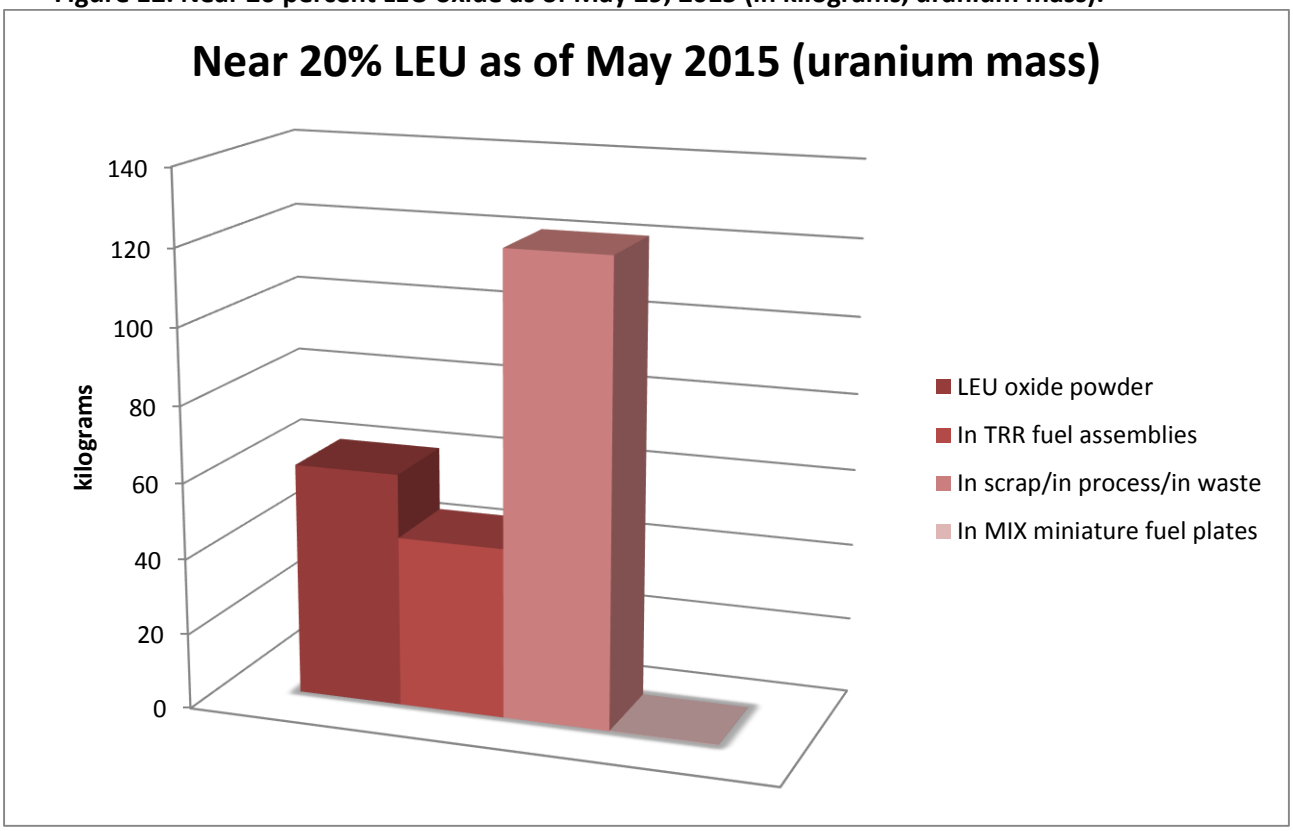


Figure 11: IR-1 Centrifuges Enriching and Installed at the Fordow Fuel Enrichment Plant



Note: All centrifuges are now dedicated to the production of 3.5 percent LEU.

Figure 12. Near 20 percent LEU oxide as of May 29, 2015 (in kilograms, uranium mass).



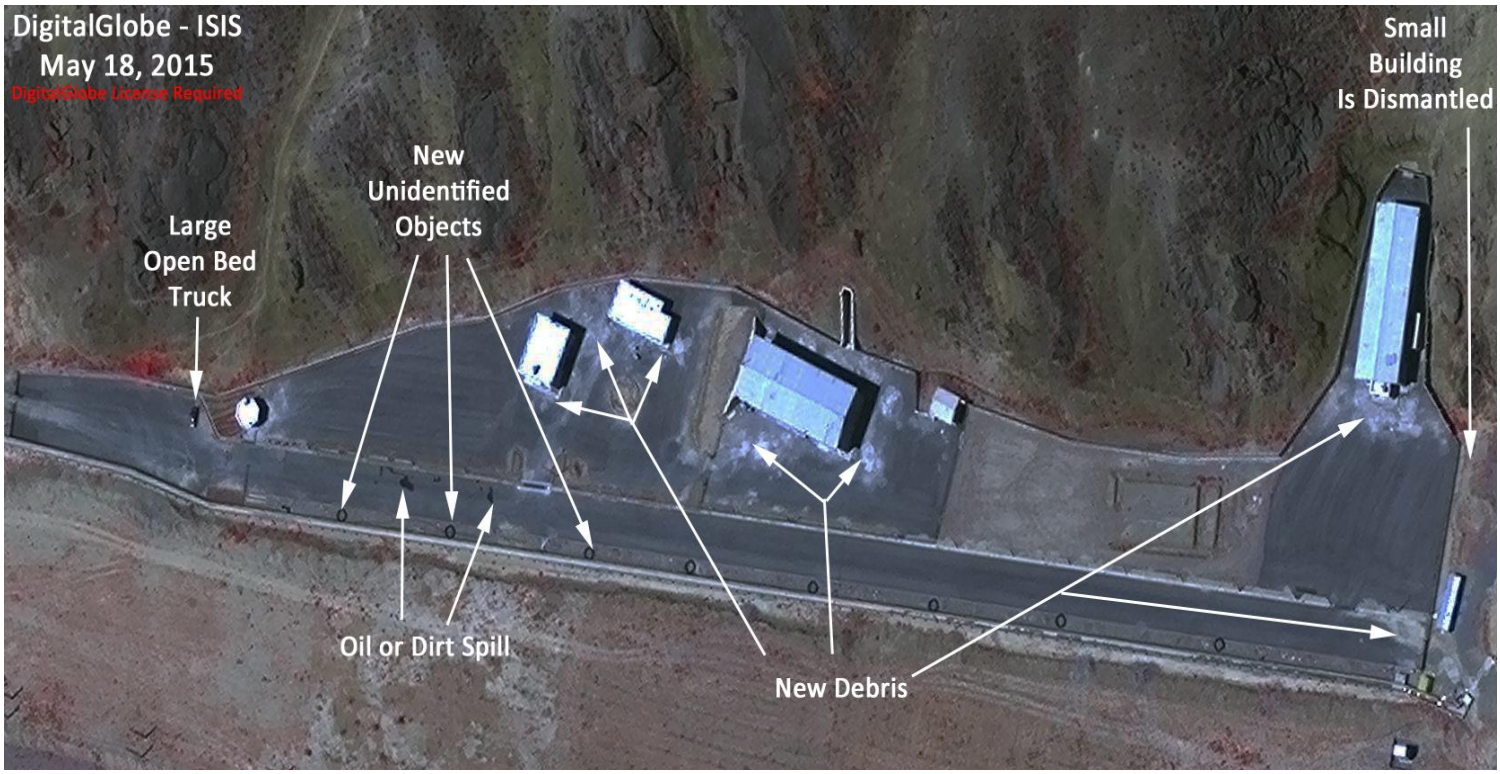


Figure 13. DigitalGlobe imagery showing the status of the alleged high explosive test site at the Parchin military complex on May 18, 2015.

Table 1: Minimal Average Separative Capacity of an IR-1 Centrifuge at the FEP (kg U swu/year-centrifuge)

Period	*Start of Period*	*End of Period*
12/13/2007 – 05/06/2008	0.47	0.43
05/07/2008 – 08/30/2008	0.80	0.69
08/31/2008 – 11/07/2008	0.69	0.69
11/08/2008 – 11/31/2009	0.55	0.52
02/01/2009 – 05/31/2009	0.62	0.49
06/01/2009 – 07/31/2009	0.51	0.54
08/01/2009 – 10/30/2009	0.55	0.64
11/23/2009 – 01/29/2010	0.88	0.92
01/30/2010 – 05/01/2010	0.92	0.90
05/02/2010 – 08/06/2010	0.90	0.92
08/07/2010 – 10/31/2010	0.99	0.78
10/18/2010 – 02/05/2011	0.75	0.81[7]
02/06/2011 – 05/13/2011	0.90	0.80
05/14/2011 – 08/13/2011	0.74	0.74
08/14/2011 – 11/01/2011	0.73	0.68
11/02/2011 – 02/04/2012	0.76[8]	0.53
02/05/2012 – 05/11/2012	0.77	0.77
05/12/2012 – 08/06/2012	0.77	0.77
08/07/2012 – 11/09/2012	0.77	0.76
11/10/2012 – 02/03/2013	0.75	0.76
02/04/2013 – 05/04/2013	0.76	0.76
05/05/2013 – 08/16/2013	0.76	0.74
08/17/2013 – 11/05/2013	0.74	0.76
11/06/2013 – 02/09/2014	0.78	0.75
02/10/2014 – 05/13/2014	0.71	0.71
05/14/2014 – 08/13/2014	0.75	0.75
08/14/2014 – 10/15/2014	0.75	0.75
10/15/2014 – 02/07/2015	0.66	0.66
02/08/2015 – 05/12/2015	0.71	0.71

[7] 1.0 if 1,000 questionable centrifuges ignored.

[8] Note: Iran began enriching in approximately 2,600 additional centrifuges during this period. Therefore, these data are likely skewed.

Table 2: CUMULATIVE TOTALS OF NATURAL AND ENRICHED URANIUM FEED AND 3.5 AND 19.75 PERCENT LEU HEXAFLUORIDE PRODUCT IN IRAN

LOCATION	0.711 percent hex feed	3.5 percent LEU hex product	3.5 percent LEU hex feed	19.75 percent LEU hex product
FEP	164,838 kg	14,411 kg	N/A	N/A
PFEP	1213.8 kg	114.8 kg	1,631 kg*	202 kg*
FFEP	3,098 kg	295.3 kg	1,806 kg*	246 kg*
GROSS TOTAL	169,149.8 kg	14,936.7 kg**	3,437 kg	448 kg
NET TOTAL	169,149.8 kg	8,726.9 kg***	3,437 kg	0.6 kg****

* Figures as of January 20, 2014, when the production of 20 percent enriched LEU has ceased.
** This total also includes the LEU (<5% uranium 235) resulting from downblending the near 20 percent LEU hexafluoride covered by the Joint Plan of Action, or 115.6 kg.
*** This number, based on step-by-step calculations, differs slightly from the amount given by the IAEA in its latest report, which is 8714.7 kilograms, for a difference of 12.2 kilograms. This difference was also present in every report dating back to February 2014. The difference in the November 2013 report was 0.4 kilograms. The reason for the differences are unclear.
**** Reference material, under IAEA seal. It should also be noted that Iran maintains a relatively large stock of new 20 percent LEU oxide.

Table 3: COMPARATIVE SWU Rate* IN IR-1 CENTRIFUGES AT IRAN'S ENRICHMENT FACILITIES

LOCATION	IR-1 centrifuges producing 3.5 percent enriched uranium	IR-1 centrifuges producing 19.75 percent enriched uranium
FEP	**0.71 swu/cent-year**	**N/A**
PFEP	**0.65 swu/cent-year**	**N/A**
FFEP	**0.80 swu/cent-year**	**N/A**

***SWU rate represents an average of the SWU/centrifuge-year calculated using the number of centrifuges at both the beginning and the end of the reporting period.