

Analysis of IAEA Iran Safeguards Report

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This report covers the International Atomic Energy Agency's (IAEA's) latest [safeguards report](#) on Iran dated November 18, 2015 and the reporting period since the last safeguards report from August 27, 2015, during which the interim Joint Plan of Action has remained in effect. It also discusses Joint Comprehensive Plan of Action (JCPOA) and IAEA/Iran Roadmap related activities and developments.

Key Findings:

- 1) **Since October 18, 2015, also known as Adoption Day, Iran removed 4,112 IR-1 centrifuges and related infrastructure from the Natanz Fuel Enrichment Plant (FEP) Hall A and stored them in Hall B.** Iran has been removing an average of about 147 IR-1 centrifuges per day. At this rate, Iran would need another one and a half months to finish dismantling the required number of IR-1 centrifuges at the FEP under the JCPOA. It appears to be dismantling these centrifuges faster than expected.
- 2) **Since October 18, 2015, Iran removed 160 IR-2m centrifuges and related infrastructure from the Natanz FEP Hall A and stored them in Hall B.** The dismantlement rate of the IR-2m centrifuges was only on average 6 per day, suggesting possibly more care being taken in dismantling these centrifuges or a recent start to their dismantlement. The latter would suggest a commitment to dismantle the IR-1 centrifuges first.
- 3) **Since October 18, 2015, Iran removed 258 IR-1 centrifuges and related infrastructure from the Fordow Fuel Enrichment Plant.** However, the removed centrifuges remained in the FFEP cascade hall.
- 4) **Iran has started recovering uranium from its near 20 percent liquid, solid, and fuel items scrap. As of November 2015, Iran has fed 95.9 kg of this scrap into the uranium recovery process, recovered 44.7 kg of uranium in the form of oxide, and has so far used 30.4 kg of this recovered material to manufacture Teheran Research Reactor (TRR) fuel items.** The

IAEA also reported that Iran ceased this recovery effort on November 7, 2015. However, 39.4 kg of uranium in scrap fed into the recovery line are stuck in process.

- 5) **After a lengthy delay, the Enriched UO₂ Powder Plant (EUPP) finally started producing more LEU dioxide.** As of November 9, 2015, the plant had produced 2,330 kg of uranium in the form of UO₂ enriched up to 5 percent uranium 235.
 - 6) Under the separate IAEA/Iran Roadmap, the IAEA reports that all of the activities set out for the period to October 15 were completed on schedule. **The IAEA report does not contain any details on the status or any preliminary findings of its investigation about the possible military dimensions (PMD) of Iran's nuclear programs.** The IAEA states that it will issue by December 15 a report to the IAEA Board of Governors regarding the PMD issue. The safeguards report provides no details about the controversial arrangement between the IAEA and Iran whereby Iran took environmental samples at the Parchin site under IAEA direction, albeit without IAEA inspectors being physically present during the sampling.
 - 7) **Based on the IAEA values in the report, Iran has in total the equivalent of 12,639.6 kg of 3.5 percent LEU hexafluoride.** The inventory is 8,305.6 kg of 3.5 percent LEU hexafluoride and the equivalent of another 4,334 kg of 3.5 percent LEU hexafluoride in various chemical forms at the EUPP. This stock of 3.5 percent LEU has increased by 460 kg since August 2015.
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JCPOA Developments

On October 18, 2015, Adoption Day of the JCPOA was reached. The IAEA reports that it “has begun conducting preparatory activities related to the verification and monitoring of Iran’s nuclear-related commitments under the JCPOA, including verification and monitoring of the steps Iran has begun taking towards the implementation of those commitments.” It has continued monitoring and verification in relation to the nuclear-related measures under the interim Joint Plan of Action.

ISIS has issued a [series of analyses](#) on the provisions of the JCPOA. It will continue to make available technical analysis of the IAEA’s or other national or UN body reporting on Iran and will monitor and assess new developments including Iran’s compliance with the JCPOA throughout its implementation.

Application of Additional Protocol at Implementation Day

On Adoption Day, Iran notified the IAEA that effective on JCPOA Implementation Day, it would provisionally apply the Additional Protocol and modified Code 3.1, pending seeking its ratification by the Majlis (Parliament) at Transition Day, or year 8 of the JCPOA.

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

Iran's total 3.5 percent low enriched uranium (LEU) hexafluoride production at the FEP through October 31, 2015 is reported to be 15,525 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 decreased over the past reporting period from approximately 227 kg per month to approximately 169 kg per month of LEU hexafluoride. This is the lowest monthly production rate registered since early 2012.

Between November 10, 2013 and October 18, 2015, also known as Adoption Day, Iran had 90 IR-1 centrifuge cascades fully installed for a total of 15,420 IR-1 centrifuges. **However, between October 18 and November 15, 2015, Iran removed 4,112 IR-1 centrifuges and related infrastructure from the FEP's Hall A and stored them in Hall B. Since Adoption Day, Iran has been removing an average of about 147 IR-1 centrifuges per day.** Therefore, as of November 15, 2015, Iran has 11,308 IR-1 centrifuges at the FEP. Of these, the number of cascades enriching, namely 54 cascades, remained constant throughout this period; these cascades fed with uranium hexafluoride contain 9,156 centrifuges.¹ Iran fed 5,363 kg of natural uranium hexafluoride into the cascades at the FEP, which corresponds to a daily feed rate of about 63 kg. This rate is much lower 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.

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 on average as being 3.5 percent enriched², with an assumed average feed assay of 0.711 percent and tails assay of 0.4 percent.³ The 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, 469 kg of LEU translates to roughly 1,153 swu, or an average of 13.5

¹ It is possible that not all centrifuges within the cascades fed with uranium hexafluoride were operational during the reporting period. Additionally, it is assumed that Iran started dismantling first the centrifuges that had not yet been fed with UF₆.

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.

swu/day. On an annualized basis, this is about 4,950 swu per year (see Figure 6). This is the lowest average swu/centrifuge-year registered since early 2012.

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 widely interpreted as Iran announcing that it had intended to install about 3,000 IR-2m centrifuges, which is the normal deployment in a module.

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. Up until October 18, 2015 (Adoption Day), 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. **However, between October 18 and November 15, 2015, Iran removed 160 IR-2m centrifuges and related infrastructure from the FEP’s Hall A and stored them in Hall B. Since Adoption Day, Iran has been removing an average of about 6 IR-2m centrifuges per day. As of November 15, 2015, Iran has 848 IR-2m centrifuges at the FEP in Natanz.**

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

Centrifuge Dismantlement Rates at FEP

At current rates of IR-1 centrifuge dismantlement at the FEP, Iran would need another one and half months to finish dismantling the required number of IR-1 centrifuges at the FEP under the JCPOA. It appears to be dismantling these centrifuges faster than expected.

The dismantlement rate of the IR-2m centrifuges was only on average 6 per day, suggesting possibly more care being taken in dismantling these centrifuges or a recent start to their dismantlement. The latter would suggest a commitment to dismantle the IR-1 centrifuges first.

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 interim Joint Plan of Action (JPA). It will face additional restrictions under the JCPOA. Under the JPA, Iran agreed 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, resulting in natural uranium.

Four out of six cascades at the pilot plant have been dedicated to this on-going centrifuge research and development. They are cascades 2, 3, 4 and 5. As of November 14, 2015, there were:

- In Cascade 2: 4 IR-6 centrifuges (down from 8 in previous report); 13 IR-4 centrifuges (up from 11 in previous report); 2 IR-6s centrifuges (new since previous report); 1 IR-1 centrifuge (down from 2 in previous report); and one unconnected IR-5 centrifuge and one unconnected prototype IR-8 centrifuge installed;
- In Cascade 3: 24 IR-1 centrifuges (up from 8 in previous report) and 9 IR-6 centrifuges (new since previous reports). Iran has removed IR-2m centrifuges and IR-4 centrifuges from Cascade 3 since the previous report;
- In Cascade 4: 164 IR-4 centrifuges (same as in the past year plus); and
- In Cascade 5: 162 IR-2m centrifuges (same as in the past year plus).

Natural UF₆ Feed Rate Remains Roughly Same 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, IR-6, and IR-6s centrifuges, sometimes into single machines and sometimes into cascades of various sizes.

In February 2015, the average rate of feeding of natural UF₆ 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 May 2015 report indicated that Iran had cut its rate of feed by roughly 40 percent since the marked increase. The August 2015 report indicated that Iran's rate of feed remained roughly the same as in the May 2015 report. The November 2015 report shows this same trend, although the reporting time frame is somewhat shorter:

- February 2015 report: between October 11, 2014 and February 1, 2015, Iran fed 790.9 kg of natural UF₆ into centrifuges in the R&D area (113 days at 7.00 kg per day).
- May 2015 report: between February 2, 2015 and May 17, 2015, 410.7 kg of natural UF₆ was fed into the centrifuges in the R&D area (105 days at 3.9 kg per day).
- August 2015 report: between May 18, 2015 and August 17, 2015, 432.2 kg of natural UF₆ was fed into the centrifuges in the R&D area (92 days at 4.7 kg per day).
- November 2015 report: between August 18, 2015 and October 25, 2015, 370.7 kg of natural UF₆ was fed into the centrifuges in the R&D area (69 days at 5.4 kg per day).

So, for the past seven reporting periods, Iran fed a total of about 2,999 kg of natural UF₆ into the advanced centrifuges. No LEU was withdrawn as the product and the tails were recombined at the end of the process.

The IAEA reports provide no specific information about the performance of these advanced centrifuges. 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.

Overall, Iran appears to be experimenting with different configurations in cascades 2 and 3 but not making drastic changes to its natural UF₆ feed rate ahead of the implementation of the JCPOA, and the changes it will need to make to fall in line with advanced centrifuge R&D commitments.

Under the JPA, the IAEA has learned significantly more details about the failure rates of Iran's operational centrifuges. Overall, based on other information accumulated by ISIS, the failure rates of the IR-1 centrifuge are about 20-30 percent and the failure rates of the IR-2m centrifuges are about 20 percent. The latter rates are greater than expected but less than those of the IR-1 centrifuges.

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 (PFEP) for the production of LEU enriched to nearly 20 percent uranium-235, ostensibly for the Tehran Research Reactor (TRR). 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 August 21, 2015, Iran had fed 1,425.2 kg to produce 136.4 kg of LEU enriched up to 5 percent of U-235.

Between August 22 and October 10, 2015, Iran undertook a test run involving the feeding of depleted UF₆ into Cascade 6. During this period, Cascade 1 remained under vacuum. At the end of this test, the product and tails were recombined.

On January 20, 2013, in line with its commitment under the JPA, Iran began downblending some of its inventory of UF₆ 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 UF₆ 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. Starting in 2012, 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. However, 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.

Although Iran continues to enrich with the abovementioned 696 IR-1 centrifuges, between October 18 (Adoption Day) and November 15, 2015, Iran removed 258 IR-1 centrifuges and related infrastructure. However, the removed centrifuges remained in the FFEP cascade hall. Since Adoption Day, Iran has been removing on average about 9 IR-1 centrifuges per day at the FFEP. As of November 15, 2015, Iran had 2452 IR-1 centrifuges at the FFEP. Figure 11 displays the number of centrifuges enriching and installed at the FFEP graphically.

In total, the Fordow facility 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 October 25, 2015, Iran had fed 3942.3 kg of natural uranium hexafluoride to produce a total of 364.6 kg of LEU enriched up to 5 percent U-235.

In preparation for the annual physical inventory taking at the facility, Iran stopped feeding the cascades on October 25, 2015.

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,⁴ Iran had fed a total of 337.2 kg of 19.75 percent enriched uranium hexafluoride into the process at Esfahan to produce U₃O₈ 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

⁴ The entire inventory of this material had been processed by July 20, 2014.

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.

As of November 2015, Iran has used a total of 125.6 kg, out of 162.8 kg, for the manufacturing of fuel items for the TRR. About 51.5 kg are in TRR fuel assemblies, 33 kg of uranium are in solid scrap, 17.3 kg of uranium in manufactured fuel items were declared scrap (possibly because defective), and the remaining uranium is in process and waste.

The IAEA also reports that as of November 7, 2015, Iran had produced one experimental fuel assembly and 39 Tehran Research Reactor (TRR)-type fuel assemblies, which constitutes an increase of two fuel assemblies since August. The TRR fuel and assemblies and plates contain about 51.5 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 22 percent has so far been made into fuel assemblies for the TRR.

As of November 15, 2015, 22 of the 33 assemblies transferred to TRR were in the core. The core contains a total of 33 fuel assemblies. Since the last reporting period, one additional standard fuel assembly has been irradiated. This additional assembly contained a total of 1.4 kilograms of uranium enriched to near 20 percent.

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 November 2015, Iran had about 228 kilograms (kg) of near 20 percent LEU (uranium mass).

As of November 2015, Iran had an estimated 37.2 kg in uranium oxide powder, 51.5 kg in TRR fuel assemblies, and 138.9 kg in scrap, waste, and in-process (see figure 12).

An important development is represented by the fact that Iran has started recovering uranium from its near 20 percent liquid, solid, and fuel items scrap. As of November 2015, Iran has fed 95.9 kg of this scrap into the uranium recovery process, recovered 44.7 kg of uranium in the form of oxide, and has so far used 30.4 kg of this recovered material to manufacture TRR fuel items. The IAEA also reported that Iran ceased this recovery effort on November 7, 2015. However, 39.4 kg of uranium in scrap fed into the recovery line are stuck in process.

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 November 14, 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 and was being used for R&D activities for the production of ^{99}Mo , ^{133}Xe , and ^{132}I isotopes. Iran has used 0.084 kg of near 20 percent uranium oxide for the purpose of producing ^{99}Mo .

Enriched UO₂ 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 November 9, 2015, Iran has fed a total of 6319 kg of natural UF₆ into the conversion process and produced 1828.8 kg of natural uranium in the form of UO₂.

From July 2014 through November 2014, Iran fed 2,720 kg of UF₆ enriched up to 5% U-235 into the conversion process for the production of UO₂. Between November 2014 and May 2015 Iran had not fed any additional UF₆ enriched up to 5% U-235 into the conversion process. Between May 2015 and August 17, 2015, Iran fed an additional 1,584 kg of UF₆ enriched up to 5% U-235 into the conversion process, and another 30 kg since then. Therefore, Iran has fed a total of 4,334 kg of UF₆ enriched up to 5% U-235 into the conversion process at the EUPP.

After a lengthy delay, the EUPP finally started producing more LEU dioxide. As of November 9, 2015, the plant had produced 2,330 kg of uranium in the form of UO₂ enriched up to 5 percent uranium 235.

Taking Stock

According to the most recent IAEA report, Iran has produced a total of 16,141.6 kilograms of 3.5 percent LEU hexafluoride, which constitutes an increase of 490.2 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 had been used to make the 19.75 percent LEU hexafluoride, leading to a total of 12,214.4 kg of 3.5 percent LEU hexafluoride. Another 4,334 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 8,317.6 kg of LEU hexafluoride. The IAEA reports that the total 3.5 percent LEU hexafluoride inventory is 8,305.6 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 8,305.6 kg of 3.5 percent LEU hexafluoride and the equivalent of another 4,334 kg of 3.5 percent LEU hexafluoride in various chemical forms at the EUPP. In total, Iran has the equivalent of 12,639.6 kg of 3.5 percent LEU hexafluoride.

Across its three centrifuge facilities, Iran has 14,088 IR-1 centrifuges and 848 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 November 2015, Iran had 37.2 kg in uranium oxide powder, 51.5 kg in TRR fuel assemblies, and 138.9 kg in scrap, waste, and in-process (all in uranium mass).

Table 2 summarizes these findings.

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. Over the last reporting period it has achieved a 0.54 swu/centrifuge-year, the lowest recorded since November 2009. During this reporting period, the FFEP achieved 0.72 swu/centrifuge-year, lower than the last reporting period. The PFEP cascades achieved 0.57 swu/centrifuge-year, 0.07 lower than 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

During a Design Information Verification (DIV) on November 16, 2015, the IAEA confirmed that Iran had not installed any additional major components at the IR-40 reactor at Arak, in line with its commitment under the JPA. Additionally, a recent DIV and an inspection verified that Iran has not manufactured any more UO_2 fuel assemblies at the Fuel Manufacturing Plant (FMP) for the IR-40 reactor, and all of the pre-existing assemblies remain at the FMP.

As mentioned in previous reports, the IAEA has not had access to the Heavy Water Production Plant (HWPP) since December 2013 or to stored heavy water at the Uranium Conversion Facility at Esfahan since February 2014.

IAEA Roadmap/Possible Military Dimensions (PMD) Investigation

Under the separate IAEA/Iran Roadmap, the IAEA reports that all of the activities set out for the period to October 15 were completed on schedule. The IAEA report does not contain any details on the status or any preliminary findings of its PMD investigation. The IAEA states that it will issue by December 15 a report to the IAEA Board of Governors, **“the final assessment on the resolution of these issues, as set out in the annex of GOV/2011/65”** [the IAEA’s November 2011 report detailing evidence of possible work by Iran relating to nuclear weapons].

On September 8, as specified under the Roadmap, the IAEA submitted questions to Iran on ambiguities regarding the information Iran had provided to the Agency on August 15. The IAEA

and Iran held technical expert meetings and discussions in Iran on September 15, 16, 17, 29, and 30 and October 10 and 14 and **“conducted safeguards activities at particular locations of interest to the Agency in Iran”** on October 9 and 15. The report does not specify which sites the IAEA visited.

On September 20, IAEA Director General Amano held talks with Iranian President Rouhani, Vice President Salehi, and Foreign Minister Zarif on the implementation of the Roadmap. They also “exchanged views on issues related to the implementation by Iran of its nuclear-related commitments under the JCPOA.” Director General Amano also met members of the Iranian Majlis Special Commission for Reviewing the JCPOA. On September 25, Director General Amano and Foreign Minister Zarif met again in New York to discuss implementation of the Roadmap.

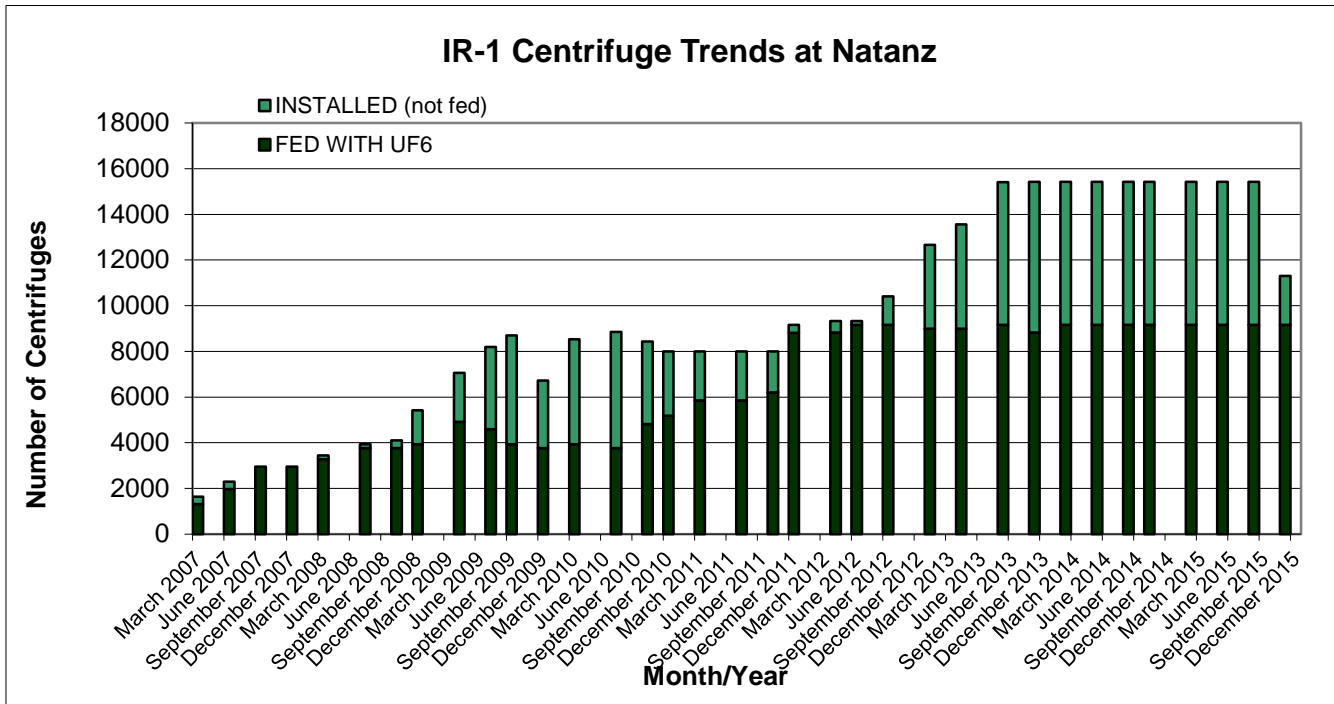
Parchin Sample Taking and Visit

In mid-September, the IAEA remotely supervised sample taking by Iran at a particular building at the Parchin military site where Iran is alleged to have conducted high explosives tests relating to nuclear weapons. The IAEA was not physically present at the sample taking but directed the locations from which Iran took the samples in the building and viewed the process via video recording. It is unclear whether the videotaping was done in real-time, such as with a live feed to IAEA inspectors located elsewhere, or was accomplished by the Iranians and the digital files then given to the inspectors for analysis and review.

On September 20, Director General Amano and the Deputy Director General for Safeguards Tero Varjoranta visited the building of interest at the Parchin military site. Director General Amano had [earlier announced](#) and the report states again that the two IAEA officials saw “indications of recent renovation” and “there was no equipment in the building.” The IAEA states that the environmental samples taken at the site in the days prior and the “visual observations” made by the two officials are being assessed.

ISIS continues to [assess](#) that the manner in which environmental samples were taken at Parchin raises troubling precedents for both the IAEA’s investigation into Iran’s past work on nuclear weapons and the verifiability of the long term nuclear deal. This is due in large part to the sanitization efforts that ISIS, the IAEA, and U.S. and other governments have observed Iran conducting at the Parchin site since the IAEA’s first request for access in February 2012 (see Figure 13). ISIS remains concerned that non-physically present IAEA inspectors would not have been able to adequately determine where Iran may have carried out concealment or renovation activities at Parchin and adequately direct sample taking in those areas. The physical presence of trained, experienced inspectors, with the ability to investigate the building or site up-close, is critical to detecting the best places to sample, particularly in the case of a country that has a history of violating its safeguards obligations.

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

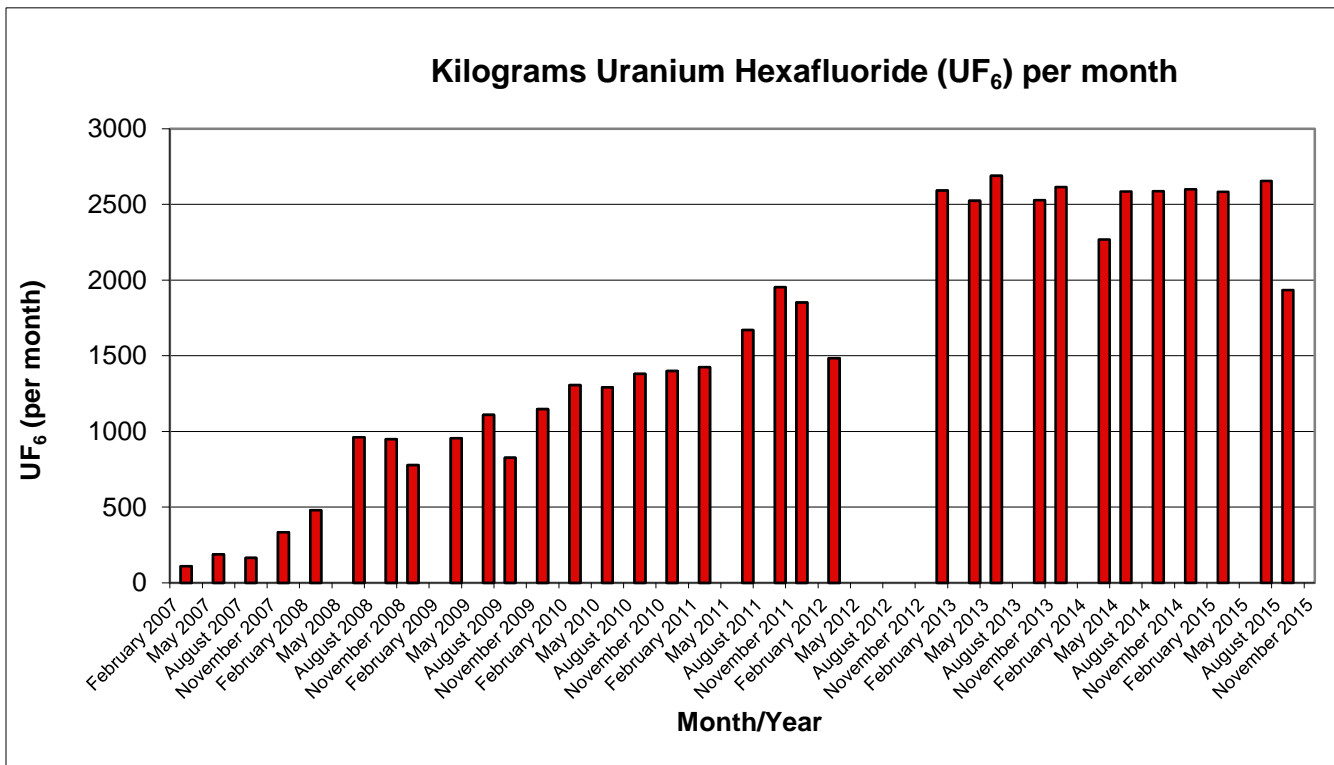


Figure 3: LEU Production (kilograms uranium hexafluoride per month) at Natanz FEP

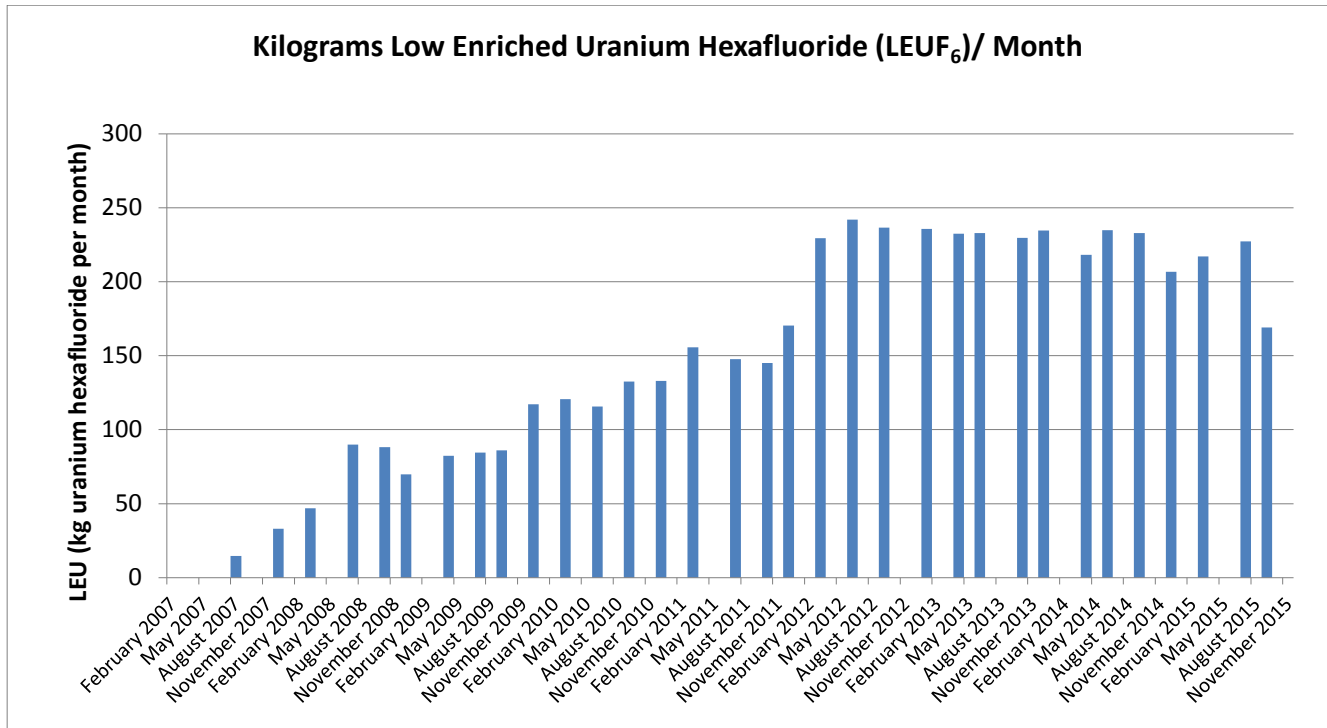


Figure 4: Overall Trends at Natanz FEP

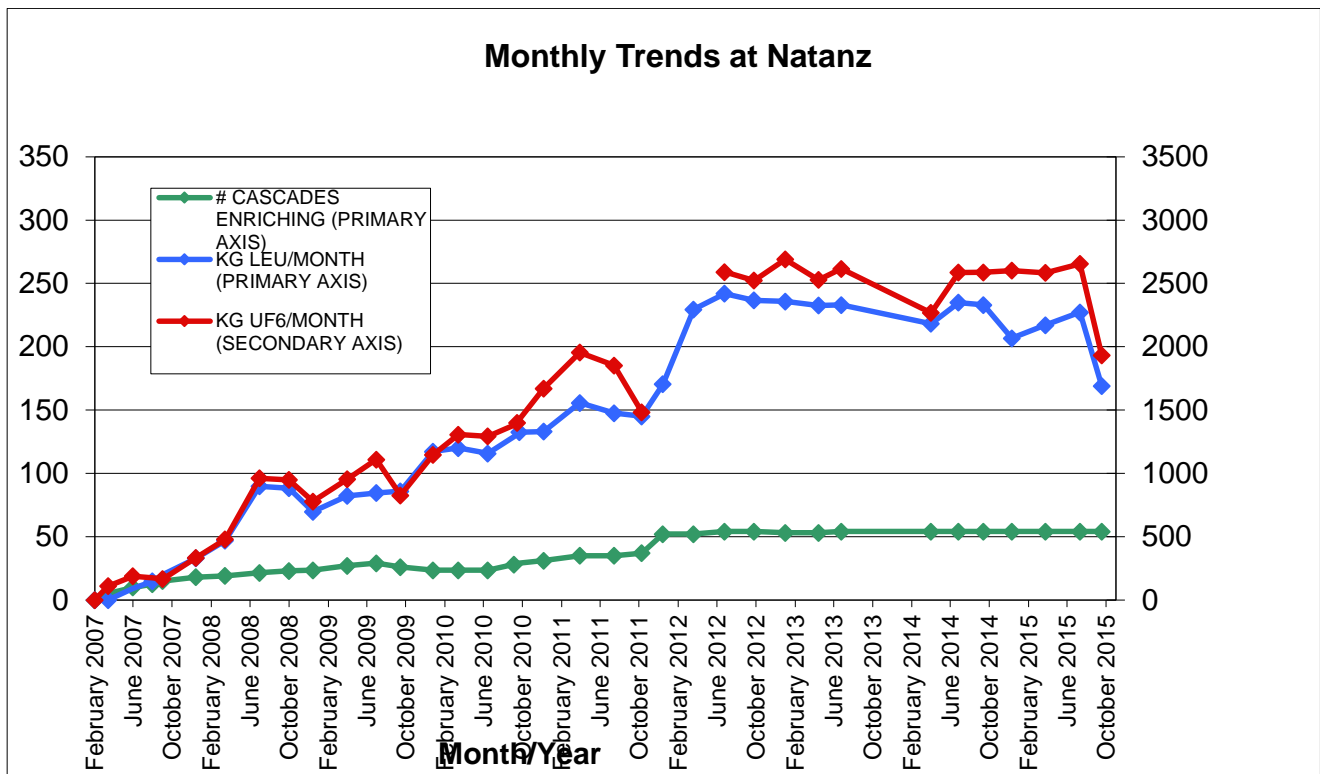


Figure 5: Cumulative LEU Production at the Natanz FEP

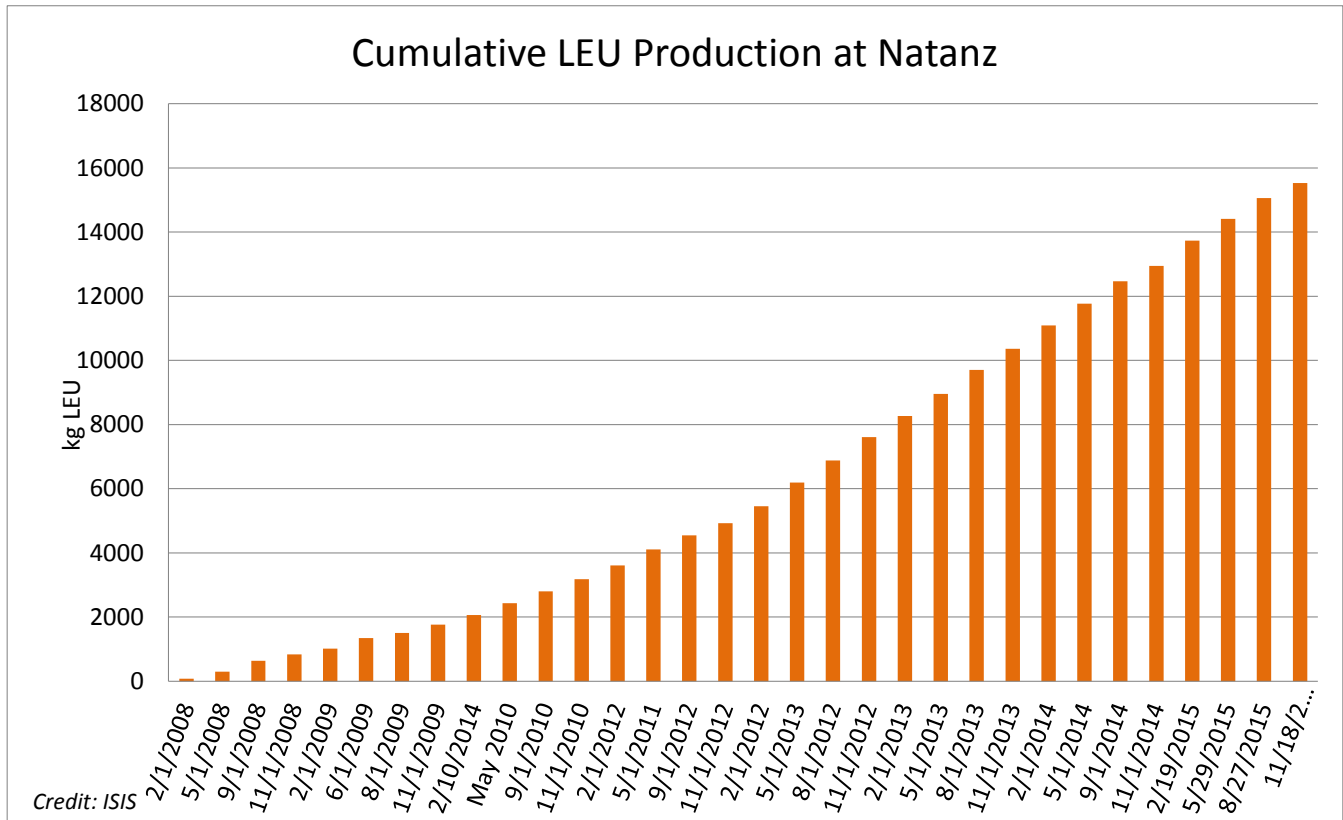


Figure 6: Annualized SWU at Natanz FEP

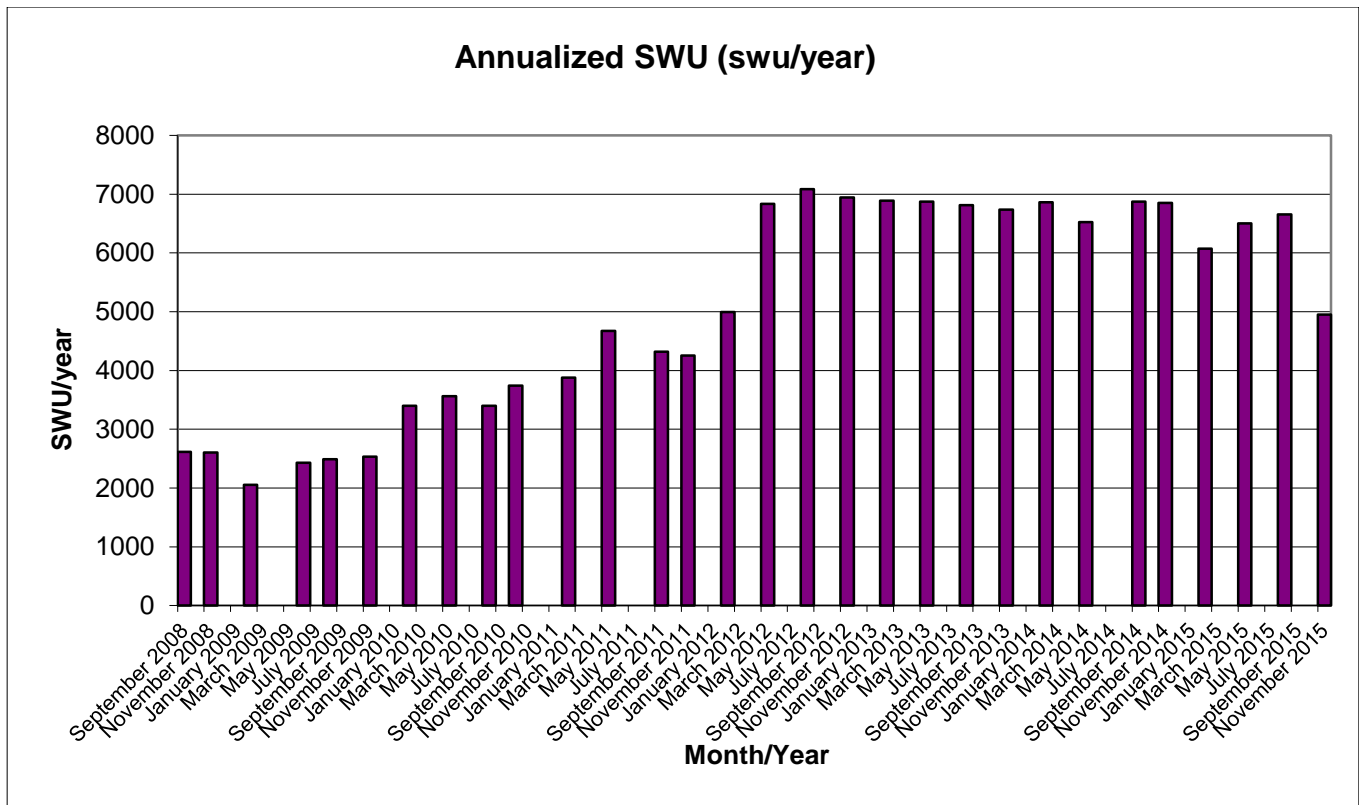


Figure 7: IR-2m Progress at the FEP

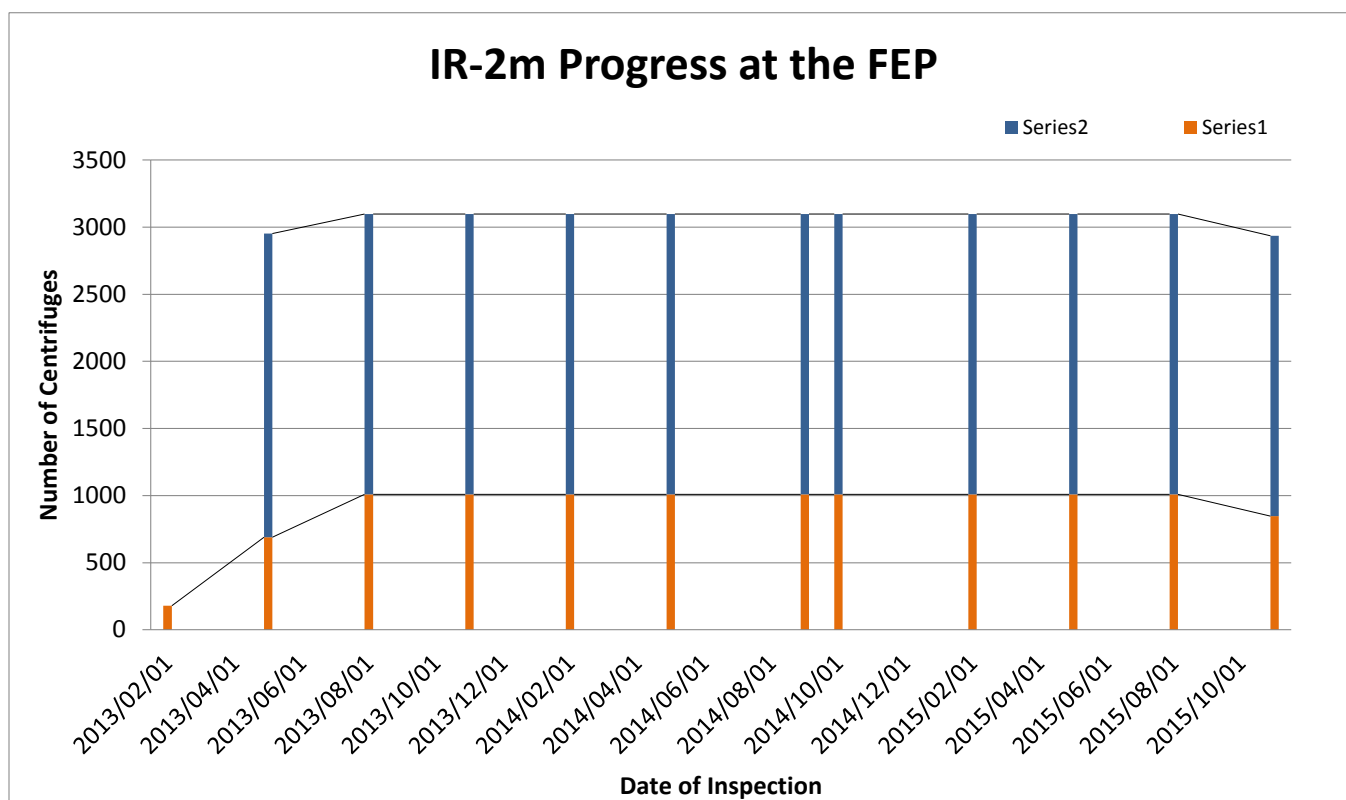


Figure 8: Total Number of Deployed IR-1 Centrifuges in Iran

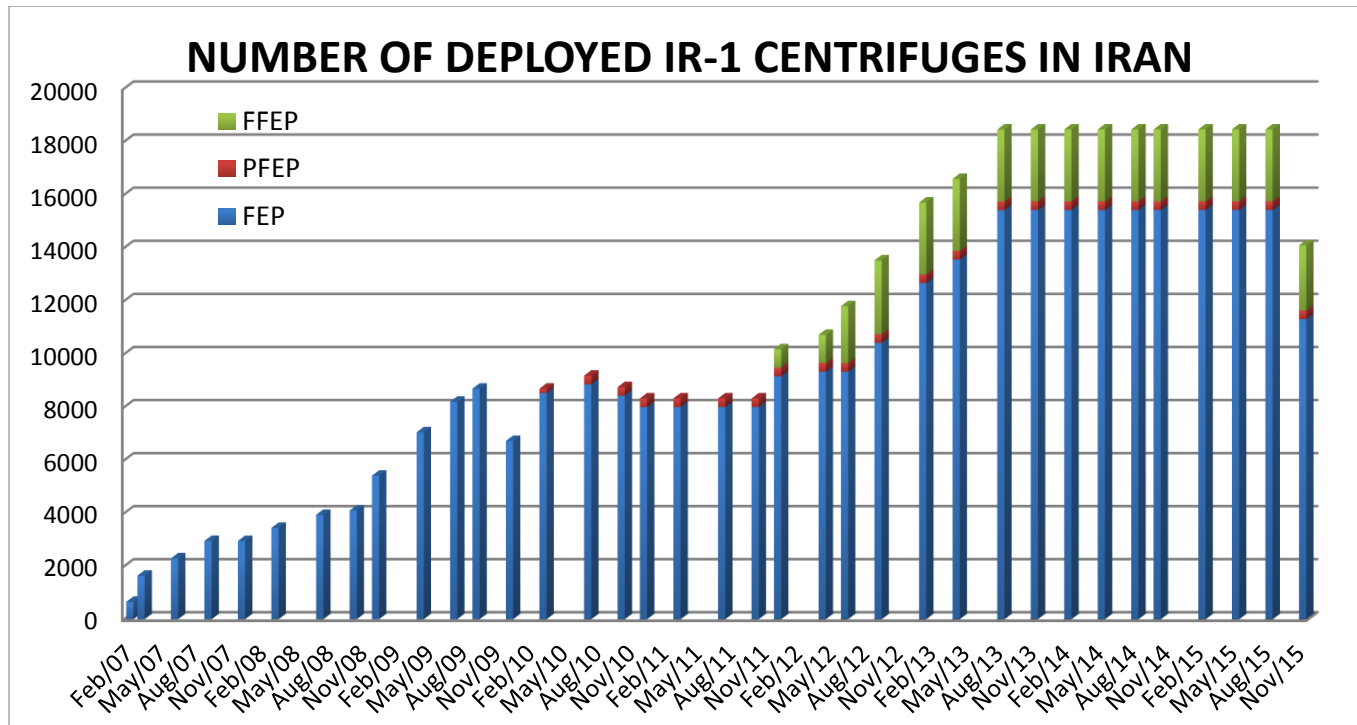


Figure 9: Cumulative 19.75 Percent Uranium Production in the PFEP and FFEP

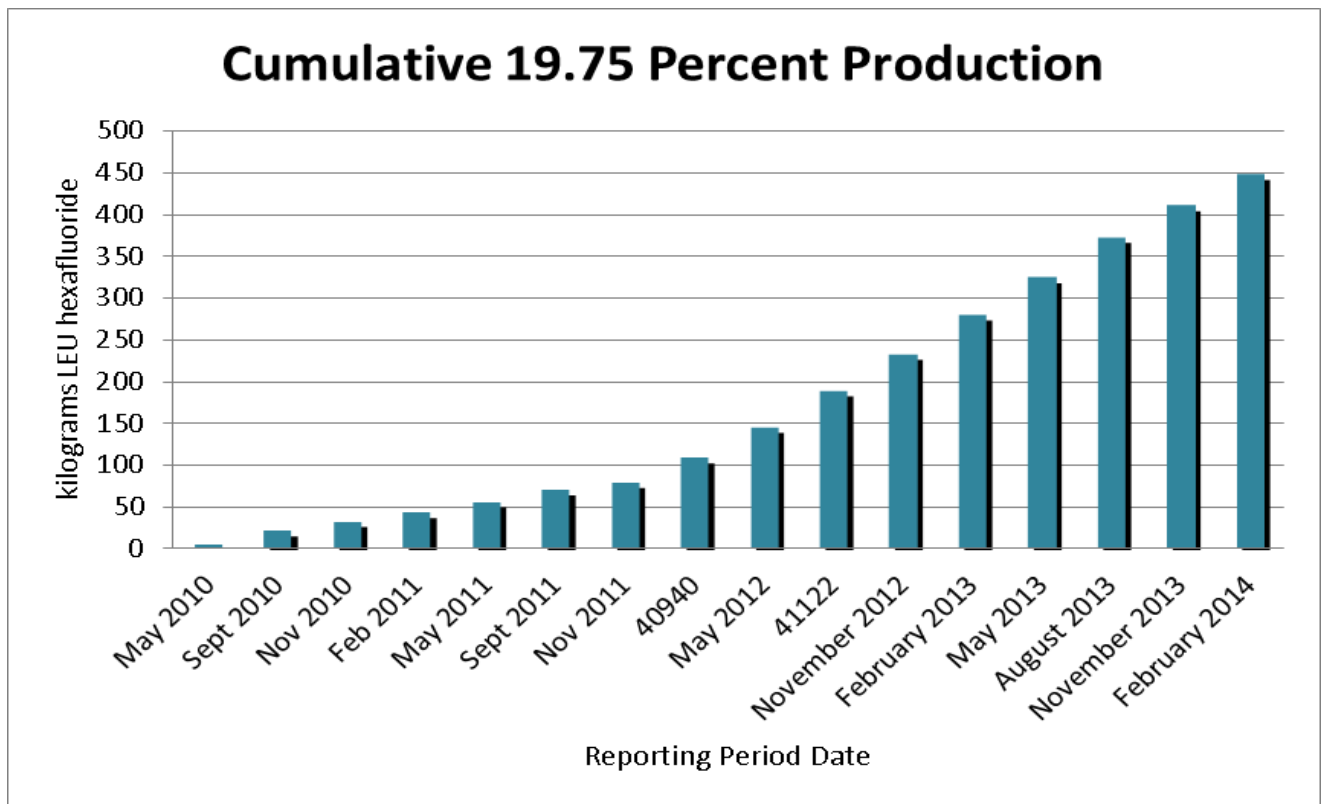


Figure 10: SWU/Centrifuge-year at the Fordow Fuel Enrichment Plant and Pilot Fuel Enrichment Plant

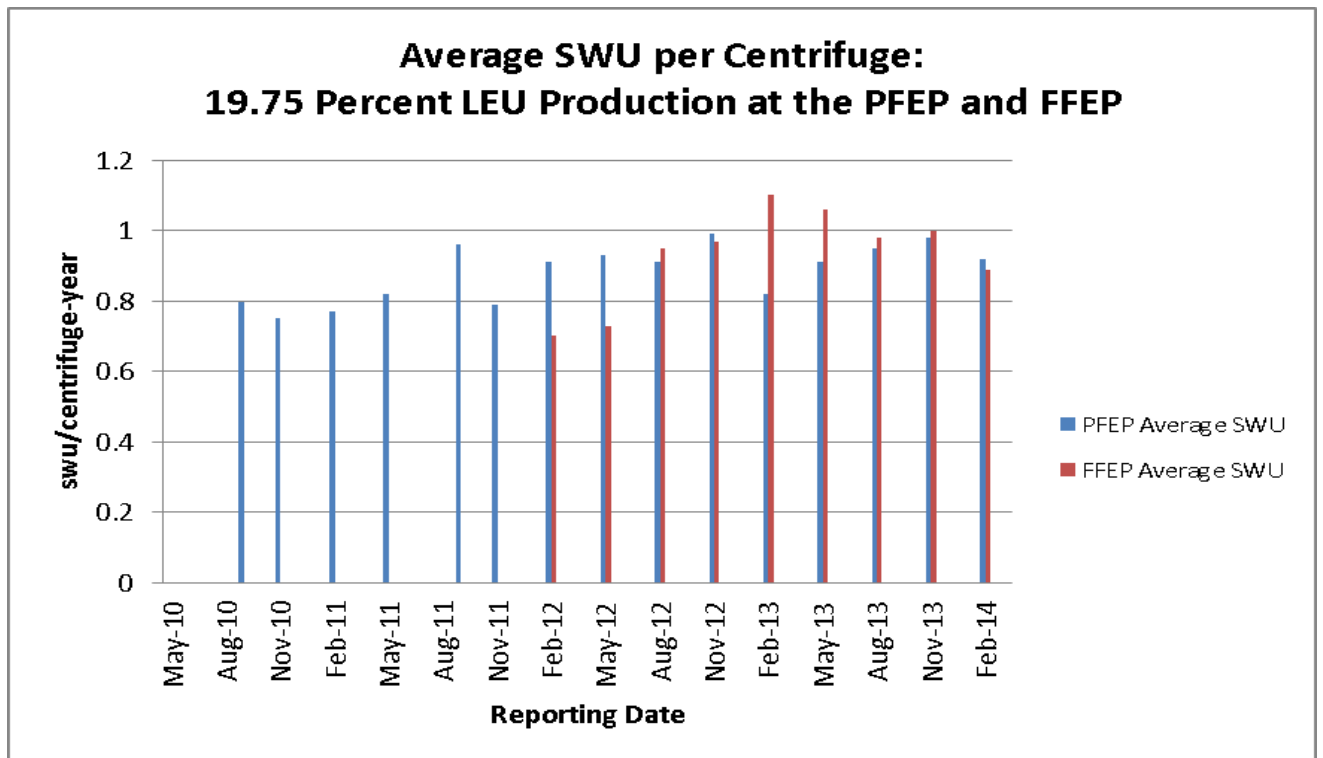
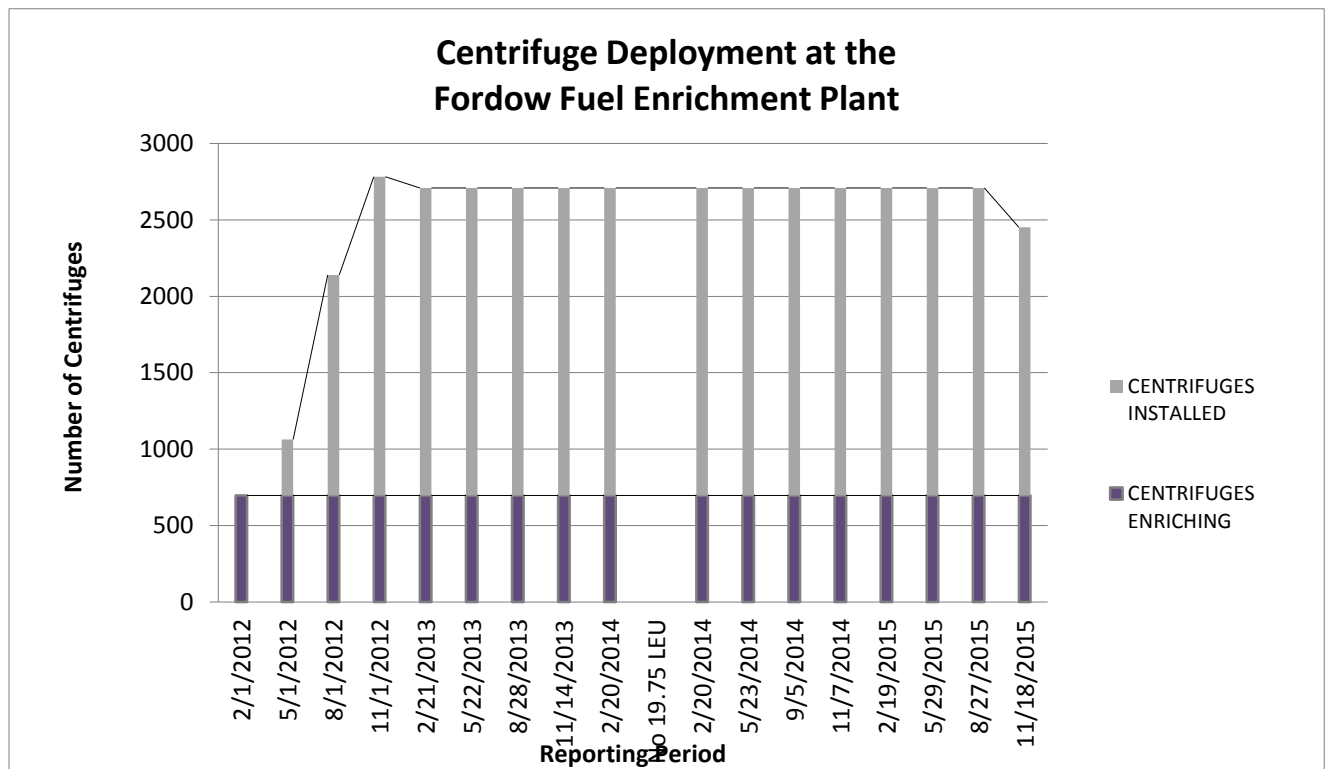
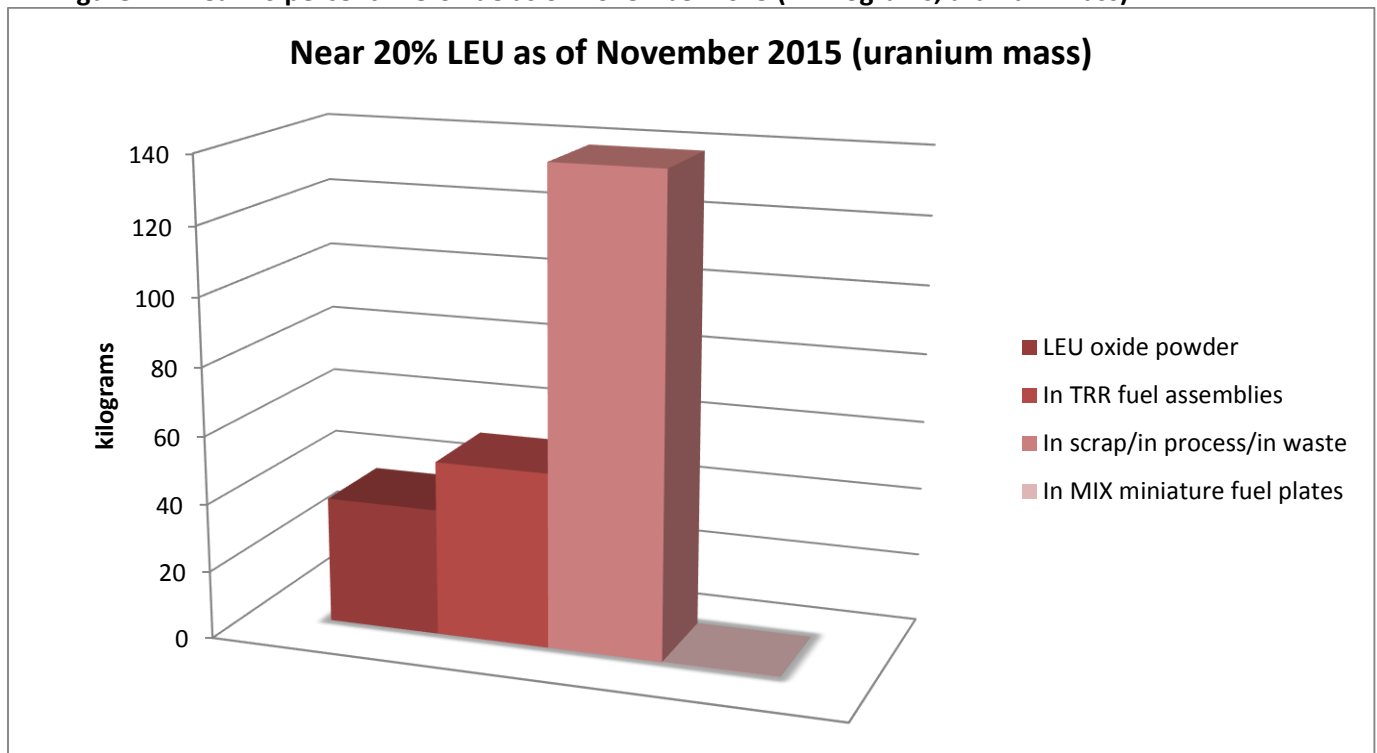


Figure 11: IR-1 Centrifuges Enriching and Installed at the Fordow Fuel Enrichment Plant



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

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



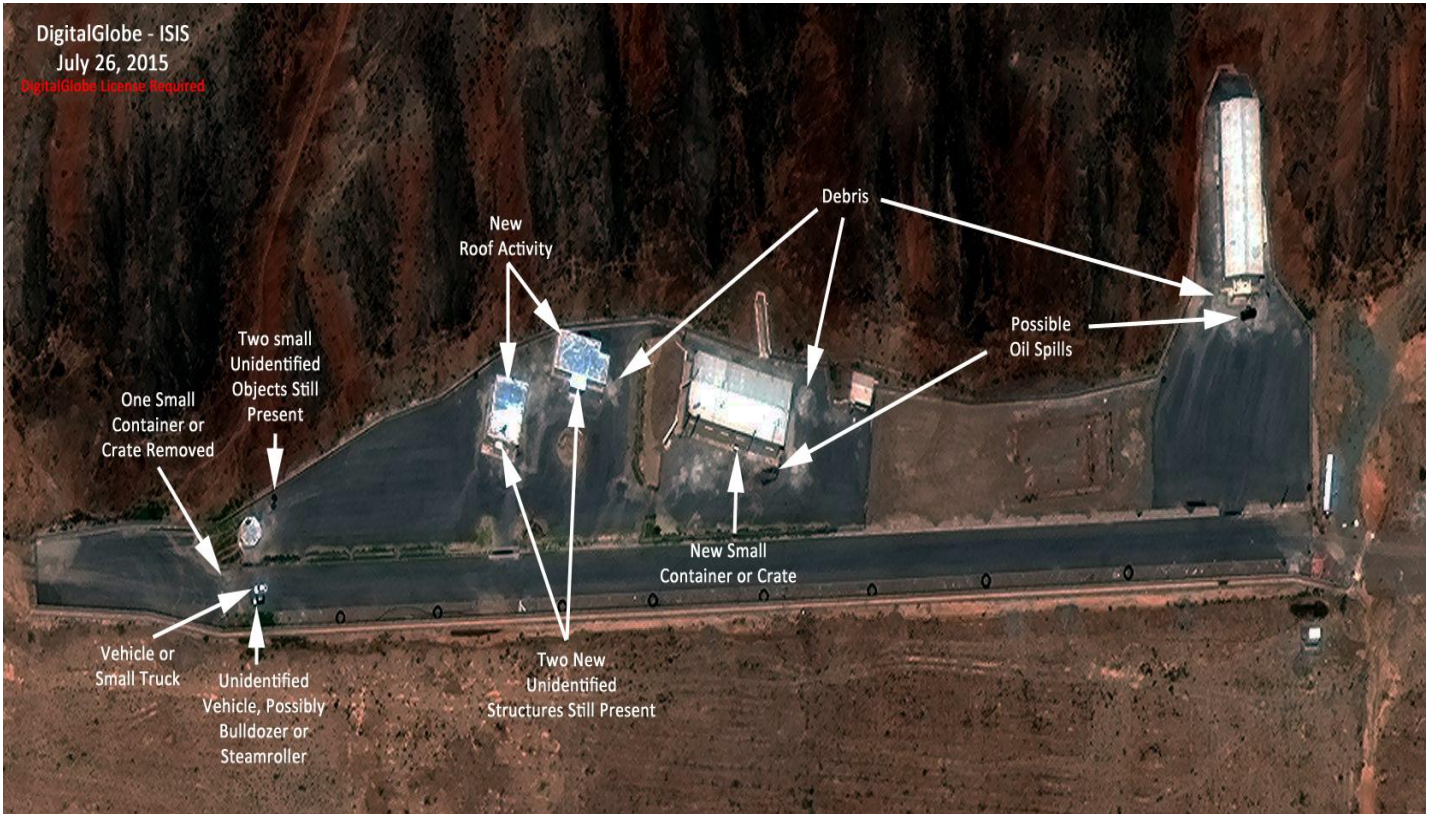


Figure 13. DigitalGlobe imagery showing the status of the alleged high explosive test site at the Parchin military complex on July 26, 2015.

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

<i>Period</i>	<i>Start of Period</i>	<i>End of Period</i>
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 ⁵
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 ⁶	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
5/13/2015-8/7/2015	0.73	0.73
8/8/2015 – 10/31/2015	0.54	0.54

⁵ 1.0 if 1,000 questionable centrifuges ignored.

⁶ 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	177,738 kg	15,525 kg	N/A	N/A
PFEP	1,425.2 kg	136.4 kg	1,631 kg*	202 kg*
FFEP	3,942.3 kg	364.6 kg	1,806 kg*	246 kg*
GROSS TOTAL	183,105.5 kg	16,141.6 kg**	3,437 kg	448 kg
NET TOTAL	183,105.5 kg	8,317.8 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 8,305.6 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	0.54 swu/cent-year	N/A
PFEP	0.57 swu/cent-year	N/A
FFEP	0.72 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.