INSTITUTE FOR SCIENCE AND INTERNATIONAL SECURITY
REPORT

# ISIS Analysis of IAEA Iran Safeguards Report

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**November 7, 2014 (revised November 17, 2014, reflecting IAEA corrigenda)**

On November 7, 2014 the International Atomic Energy Agency (IAEA) released its report on the implementation of the NPT safeguards agreement in Iran and the status of Iran's compliance with United Nation Security Council resolutions. It subsequently issued a new version correcting slightly a few numbers in the original report. We wish to thank the IAEA for making these corrections and demonstrating a commitment to producing the most accurate report possible.

**Key Findings:**

1) The IAEA reports Iran has "not provided any explanations that enable the Agency to clarify the outstanding practical measures [regarding the military dimensions of its nuclear program], nor has it proposed any new practical measures in the next step of the Framework for Cooperation." The military dimensions issue is therefore effectively stalemated until progress is made on the P5+1/Iran talks.
2) The IAEA states in this report that Iran has fed $UF_6$ into the single installed IR-5 centrifuge in Cascade 2. Both the November 2013 and the February 2014 Iran safeguards reports stated that the "single installed IR-5 centrifuge has yet to be fed with $UF_6$." Thus under the interim deal, this centrifuge should not have been fed with $UF_6$ as reported in this safeguards report.
3) Recent activities at the Parchin military site are reaffirmed to have "further undermined" verification.
4) Iran's stock of 3.5 percent LEU continues to grow, at an average rate exceeding about 230 kilograms per month. The vast bulk of this LEU is produced at the Fuel Enrichment Plant.
5) Iran's stock of near 20 percent LEU oxide remains large, enough if reconverted into hexafluoride form and further enriched to weapon-grade, for one nuclear weapon.
6) Tehran Research Reactor (TRR) fuel assemblies manufactured thus far contain approximately 39 kilograms of near 20 percent LEU - 17 percent of the near 20 percent LEU sent for conversion. About 18 kilograms of this near 20 percent LEU have been irradiated in the TRR. The irradiated state is the most desirable form of any near 20 percent LEU in Iran.
7) Under the July extension of the JPA, Iran agreed to turn another 25 kilograms of the near 20 LEU oxide into fuel elements for the Tehran Research Reactor. Since July 20,

2014, Iran has used 17.1 kilograms for this purpose. However, not all this material ended up in fuel assemblies; some is in process, scrap, or waste.

8) As of October 19, 2014, Iran completed the downblending of 4,118 kilograms of uranium hexafluoride enriched up to 2 percent, which resulted in the production of 7,706 kilograms of natural uranium, most likely stored in hexafluoride form.
9) Since the commissioning of the Enriched UO2 Powder Plant (EUPP) in May 2014, Iran has fed a total of 4,174 kg of natural $UF_6$ into the conversion process and produced 553 kg of uranium in the form of $UO_2$. Since July 2014, Iran has also fed 1,505 kg of $UF_6$ enriched up to 5% U-235 into the conversion process.

## 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 October 14, 2014 is reported to be 12,945 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 average monthly production of 3.5 percent LEU at the FEP decreased slightly from the past reporting period from approximately 235 kg per month to approximately 233 kg per month of LEU hexafluoride. This rate is roughly consistent with Iran's production through 2013 and most of 2012.**

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 5,342 kg of natural uranium hexafluoride into the cascades at the FEP, which is lower than Iran's feed rate throughout 2013 and 2012.

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 in 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 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

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, 481 kg of LEU translates to roughly 1,183 swu, or an average of 18.76 swu/day. On an annualized basis, this is about 6,852 swu per year (see Figure 6). These numbers are roughly on par with FEP's operation throughout 2013.

The average swu/centrifuge-year for this period was similar to the performance at the FEP throughout 2013 at 0.75 swu/centrifuge-year.[4] However, 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). This consistently lower enrichment output likely indicates that Iran is continuing to have trouble with the IR-1 centrifuges installed at the FEP, although, reports state that fewer IR-1 centrifuges are breaking at the FEP than in earlier years.

**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.

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 August 13, 2014, 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 Joint Plan of Action. It did agree that it cannot feed uranium hexafluoride into any centrifuges that had not been fed with $UF_6$ as of November 2013. However, Iran may have violated the JPA by starting to feed $UF_6$ into one of its advanced centrifuges, namely the IR-5 centrifuge (see below).

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 September 4, 2014, there were:

below their nominal capacity. While an ideal cascade is not achievable in practice, this estimate provides a method to compare swu calculations.

[4] This value was the same during the last reporting period.

In Cascade 2: 13 IR-4 centrifuges (down from 14 IR-4 centrifuges in September); 9 IR-6[5] centrifuges (up from seven in September); one IR-5 centrifuge (same as previous report); 14 IR-1 centrifuges (up from three in September); no IR-2m centrifuges (down from one in September); and no IR-6s centrifuges installed (same as previous report). One prototype IR-8 centrifuge is installed in Cascade 2 but without connections (Iran allowed the IAEA to view the components inside what was earlier reported to be a "casing" and the IAEA confirmed that this was a prototype centrifuge containing a rotor, "but without some other essential components";[6]

In Cascade 3: 14 IR-1 centrifuges (same as in the three previous reports); and ten IR-2m centrifuges installed (replacing 10 IR-4 centrifuges installed in September);

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

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

**Iran violating JPA by feeding $UF_6$ into an IR-5 machine?**

**Of note, the IAEA states in this report that Iran has fed $UF_6$ into the single installed IR-5 centrifuge in Cascade 2. Both the November 2013 and the February 2014 Iran safeguards reports stated that the "single installed IR-5 centrifuge has yet to be fed with $UF_6$." Thus under the interim deal, this centrifuge should not have been fed with $UF_6$ as reported in this safeguards report.**

**Intermittent Feeding into Advanced Centrifuges**

Since the previous report, 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. As discussed above, feeding has started into the IR-5 centrifuge.

Between October 26, 2013 and February 9, 2014, Iran had fed a total of 430.1 kg of natural $UF_6$ into the centrifuges in the R&D area, but recombined the enriched product and depleted tails. Between February 10, 2014 and August 18, 2014, a total of approximately 397.8 kg of natural $UF_6$ was fed into centrifuges in the R&D area, and between August 19, 2014 and October 10, 2014, a total of approximately 166.2 kg of natural $UF_6$ was fed into centrifuges in the R&D area, but no LEU was withdrawn as the product and the tails were recombined at the end of the process. So, in total for these three periods, Iran fed a total of 994.1 kg of natural $UF_6$.

[5] The original number of 19 IR-6 centrifuges was changed to 9 IR-6's, as stated by the corrigenda issued by the IAEA.

[6] For more on Iran's IR-8 centrifuge see ISIS's analysis: David Albright, "Technical Note: Making Sense out of the IR-8 Centrifuge," ISIS Report, September 23, 2014. http://isis-online.org/isis-reports/detail/technical-note-making-sense-out-of-the-ir-8-centrifuge/

There is no specific information about the performance of these advanced centrifuges in the report. However, because enrichment in these centrifuges is intermittent and not continuous, questions arise whether any of the advanced centrifuges work well.

## 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. **Per its agreement with the P5+1, Iran ceased production of 19.75 percent enriched uranium in these cascades and began producing 3.5 percent enriched uranium as of January 20, 2014.**

Between October 26, 2013 and January 20, 2014, 90 kg of 3.5 percent low enriched uranium in the form of uranium hexafluoride was introduced into the two, interconnected cascades. Iran withdrew from the tandem cascades a total of 13 kg of nearly 20 percent LEU hexafluoride during this reporting period. This rate, approximately 4.6 kg per month, represented a slight decrease of 0.35 kg per month from previous reporting periods. **In total, Iran has fed 1,631 kg of 3.5% LEU to produce 202 kg of 19.75% uranium since the beginning of operations in February 2010.**

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 October 10, 2014, Iran had fed 660.4 kg to produce 62.7 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 in the August, May, and February 2013 reports as well as the November, August, and May 2012 safeguards reports. 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 in five reporting periods.** Figure 11 displays the number of centrifuges enriching and installed at the FFEP graphically.

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 11, 2014, Iran had fed 1,683.4 kg of natural uranium hexafluoride to produce a total of 174 kg of LEU enriched up to 5 percent U-235. On February 8, 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

Iran reported in the August 2012 report that it began feeding its 19.75 percent uranium hexafluoride into the Fuel Plate Fabrication Plant at Esfahan. As of October 17,[7] 2014, 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).[8] The 337.2kg 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 54.4 kilograms of uranium in liquid or solid scrap form. Thus, approximately 10.4 kg of near 20 percent LEU (uranium mass) remain held up in the process or in waste.

The IAEA also reports that as of October 17, 2014, Iran had produced 30 Tehran Research Reactor (TRR)-type fuel assemblies and one test fuel assembly. Twenty eight of these assemblies, including the test assembly, had been transferred to the TRR. The IAEA has continued its publication of additional data in annexes to its report. From this data, the TRR fuel and assemblies and plates contain about 39 kilograms of near 20 percent LEU (U-mass). Of the total amount of 227.6 kg of near 20 percent LEU (uranium mass) sent for conversion, about 17 percent has so far been made into fuel assemblies for the TRR. Since the last quarterly report, Iran has fabricated 3 additional fuel assemblies.

Under the extension of the Joint Plan of Action, it has pledged to use 25 kg of its oxide stock to manufacture fuel plates for the TRR. Since July 20, 2014, 17.1 kilograms were used for that purpose. Not all of this material ended up in fuel assemblies; some of it remains in process, or is in scrap or in waste.

## Enriched $UO_2$ Powder Plant (EUPP)

[7] The entire inventory of this material had been processed by July 20, 2014; the date given merely serves as a reference point for the IAEA.

[8] Since the previous IAEA report, 0.5 kilograms were produced from the material which had been in the process.

The commissioning of the EUPP facility began in May 2014 using natural uranium. The IAEA's most recent report states that as of October 14, 2014, Iran has fed a total of 4,174 kg of natural $UF_6$ into the conversion process and produced 553 kg of uranium in the form of $UO_2$. Since July 2014, when the plant began operations, has fed 1,505 kg of UF6 enriched up to 5% U-235 into the conversion process for the production of UO2. The enriched material evidently is in the processing equipment; none has emerged in the final oxide form yet.

## Slightly Enriched Uranium Blended Down Under Joint Plan of Action (JPA)

On August 17, 2014, Iran informed the IAEA that it would blend down into natural uranium about 4,118 kilograms of uranium hexafluoride enriched up to 2 percent in the isotope uranium 235. This downblending was completed as of October 19, 2014, with 22 kilograms remaining in the equipment used for the downblending process. The resulting material totals 7,706 kilograms of natural uranium, and is likely in hexafluoride form. Iran committed to this downblending under the extension of the Joint Plan of Action in late July, 2014. The slightly enriched nuclear material originates from the tails, or waste, produced during the enrichment of uranium hexafluoride up to 20 percent LEU and from dump tanks associated with the cascades. Enriched material in the cascades is evacuated into the dump tanks as an emergency measure when there is a risk that the centrifuges in the cascade could break or "crash."

It is important to note that all of this slightly enriched uranium was not included in the IAEA's statement of the total amount of LEU enriched up to 5 percent that had been produced so far and thus also not included in ISIS's reporting. In its September report on the Status of Iran's Nuclear Programme in Relation to the Joint Plan of Action, the IAEA specified that all this material had a level of enrichment below 2 percent.

The properties of this material are unknown – for example, did the dump tank material contain impurities that would have complicated reuse? In any case, because of questions about its ability to be reused in a straightforward manner, ISIS has not factored this enriched uranium into its breakout estimates.

## Taking Stock

According to the most recent IAEA report, Iran has produced a total of 13,397.3 kilograms of 3.5 percent LEU hexafluoride, which constitutes an increase of 625.3 kilograms since the previous report (**the IAEA corrigenda corrected the value of 13,397.3 to 13,297.3, as discussed in this paragraph and in footnote 10**).[9] It should be noted that tabulating the amounts of 3.5 percent LEU produced in each centrifuge plant that are listed in the IAEA report, and from downblending, gives a slightly lower value of 13,297.3 kilograms of 3.5 percent LEU.[10]

[9] The value of 13,397.3 kilograms comes from paragraph 14, first bullet, of the original IAEA report. The IAEA has since issued a list of corrections, among them a correction from 13,397.3 kilograms to 13,297.3 kilograms, as calculated by ISIS (see footnote 10).

[10] Totaling the individual values found in other paragraphs of the report for the amount of near 5 percent LEU at each of three enrichment plants, namely the FEP, PFEP, and FFEP, and the LEU resulting from downblending the 20

In any case, 115.6 kg of this material comes from downblending. About 3,437 kilograms had been used to make the 19.75 percent LEU hexafluoride. 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. **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 0.85 swu/centrifuge-year, a decrease from the previous reporting period's 0.88 swu/centrifuge-year, and the PFEP cascades achieved 0.65 swu/centrifuge-year, the same as in the previous reporting period. 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

According to the latest Design Information Verification (DIV) inspection at the IR-40 Reactor that took place on October 16, 2014, Iran has not installed any major components at the IR-40 Reactor since the previous report, in line with its obligations under the interim deal of the Joint Plan of Action. On August 3, 2014 Iran concluded with the IAEA a safeguards approach for the IR-40 reactor. This was one of the practical measures in the third step of the Framework for Cooperation agreement Iran had agreed to implement with the IAEA by August 25, 2014.

The IAEA gained managed access to the Arak Heavy Water Production Plant in December 2013 and gained mutually agreed relevant information. At the time, the IAEA also gained access to the heavy water storage location at the Uranium Conversion Facility (UCF) at Esfahan and was

percent LEU results in 13,297.3 kg. This same value results from totaling the relevant values in table 1, Annex 3. This total is 100 kg less than the value given in the first bullet in paragraph 14 of the original report, since corrected.

able to characterize the heavy water. The latest report continues to not state the results of this characterization.

Finally, Iran continues not to produce or test fuel for the IR-40 Reactor under the JPA. The Mini IR-40 prototype fuel assembly remains in the storage pool as of October 6, as agreed.

## No Progress on Framework for Cooperation or Resolution of Possible Military Dimensions (PMD)

The IAEA reports Iran has "not provided any explanations that enable the Agency to clarify the outstanding practical measures, nor has it proposed any new practical measures in the next step of the Framework for Cooperation." The IAEA has stated it needs to conduct a "system" assessment of the outstanding PMD issues. It reiterates in this report, "This will involve considering and acquiring an understanding of each issue in turn, and then integrating all of the issues into a "system" and assessing that system as a whole." In this regard, the Agency is ready to accelerate the resolution of all outstanding issues under the Framework for Cooperation."

Iran and the IAEA held technical discussions in Tehran on October 7 and November 2, 2014 to discuss the lack of implementation of two practical measures agreed in May in the third step under the Framework for Cooperation. These two measures concern the initiation of high explosives and neutron transport calculations possibly related to the development of nuclear weapons. In August, the IAEA had also invited Iran to propose new measures for a new step in the Framework for Cooperation, but Iran has failed to do so. The IAEA reports that another technical meeting was agreed to take place as soon as possible but not prior to the November 24 deadline for Iran and the P5+1 to conclude a long term agreement over Iran's nuclear program.

**Recent activities at Parchin reaffirmed to have "further undermined" verification**

Although Iran has pledged to cooperate on addressing the past and present issues relative to the possible military dimensions of its nuclear program, the latest IAEA report notes that the Agency continues to seek answers and access to a particular location at the Parchin military site where high explosive activities related to nuclear weapons development are alleged to have taken place.

The IAEA reports that the construction activity identified in the previous safeguards report (consisting of the removal/replacement or refurbishment of the walls of the two main buildings at the site) has ceased. The Agency reaffirms that this activity is likely to have "further undermined the Agency's ability to conduct effective verification."

Previous safeguards reports had highlighted that satellite imagery showed construction activity related to the "removal/replacement or refurbishment of the site's two main buildings' external wall structures." Prior to 2004, one of these buildings was alleged to contain a high explosive chamber; the alleged contents of the other building (located on the north end of the

site) were never specified. Additionally, the Agency reported that "one of these buildings has also had a section of its roof removed and replaced." Finally, the Agency observed that the increased presence of deposits of material and/or debris and equipment suggests that "construction activity had expanded to two other site buildings."

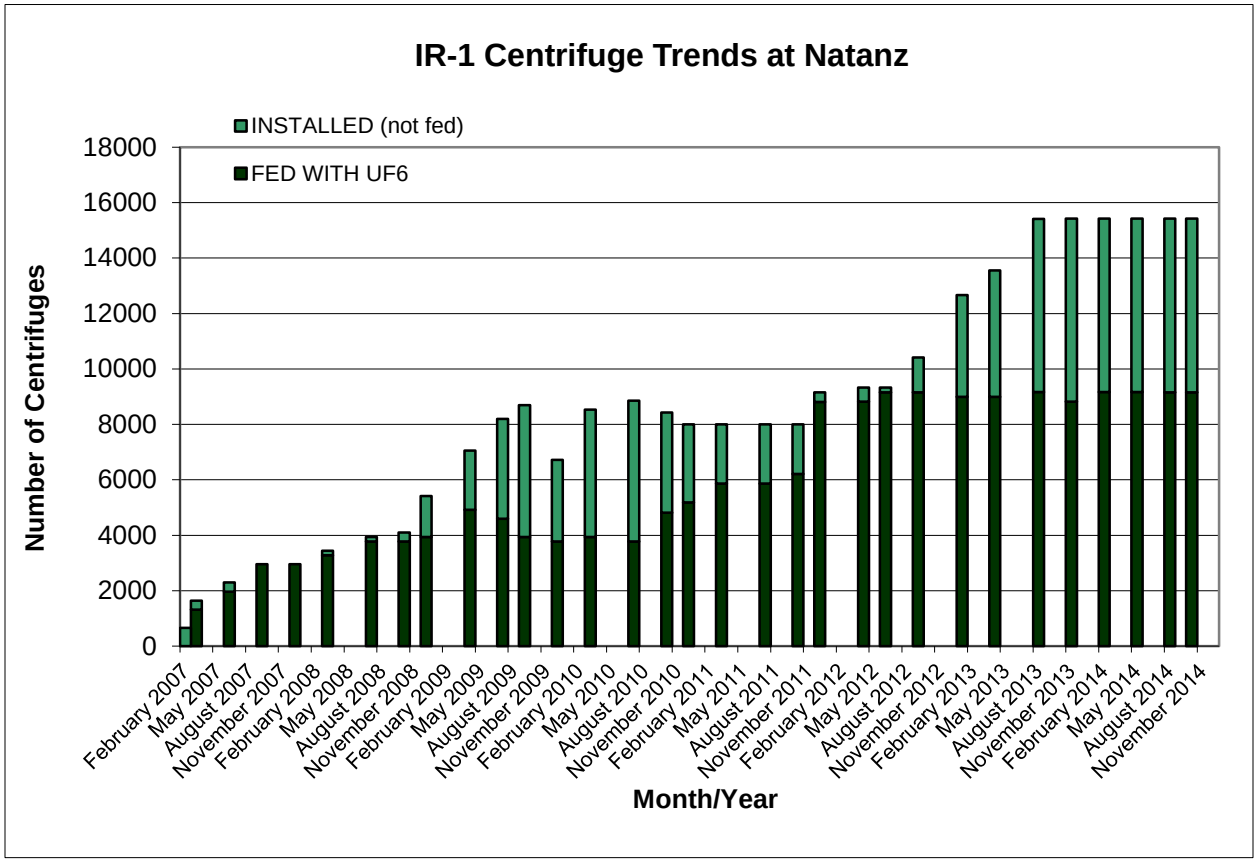
Most of these activities were highlighted in a September 2014 ISIS Imagery Brief and are visible in Figures 12 and 13 below.

**Iran must demonstrate concrete steps in addressing PMD issues prior to the signing of a long-term agreement**

By failing to address the IAEA's concerns, Iran is complicating, and even threatening, the achievement of a long term nuclear deal. The United States and its allies have repeatedly stated that Iran must demonstrate concrete progress on addressing the IAEA's concerns. The importance of Iran doing so cannot be overstated.[11] Unless Iran takes some measures soon, any deal that could be reached will likely need to link any significant economic or financial sanctions relief to Iran addressing the IAEA concerns about Iran's military nuclear programs and nuclear weapon related activities, some of which may be on-going.

[11] For more on how Iran could initially signify cooperation with the PMD probe, see David Albright and Olli Heinonen, "A New Approach to Resolve Military Aspects of Iran's Nuclear Program," ISIS Report, November 5, 2014. http://isis-online.org/isis-reports/detail/a-new-approach-to-resolve-military-aspects-of-irans-nuclear-program/

**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**

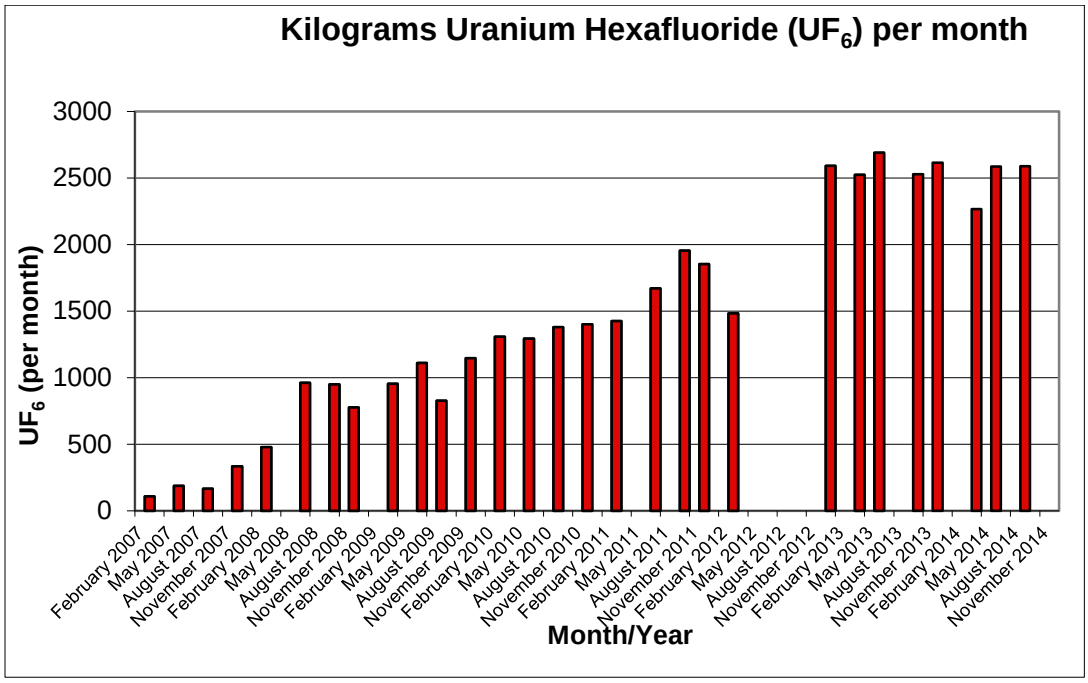


**Figure 3: LEU Production (kilograms uranium hexafluoride per month) at Natanz FEP**

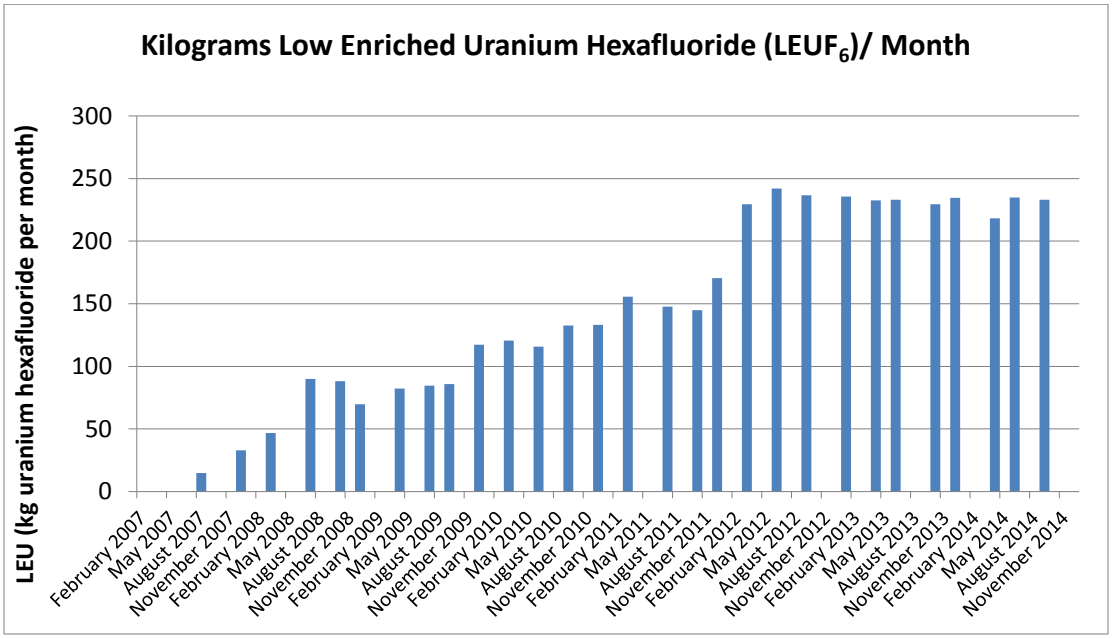



**Figure 4: Overall Trends at Natanz FEP**

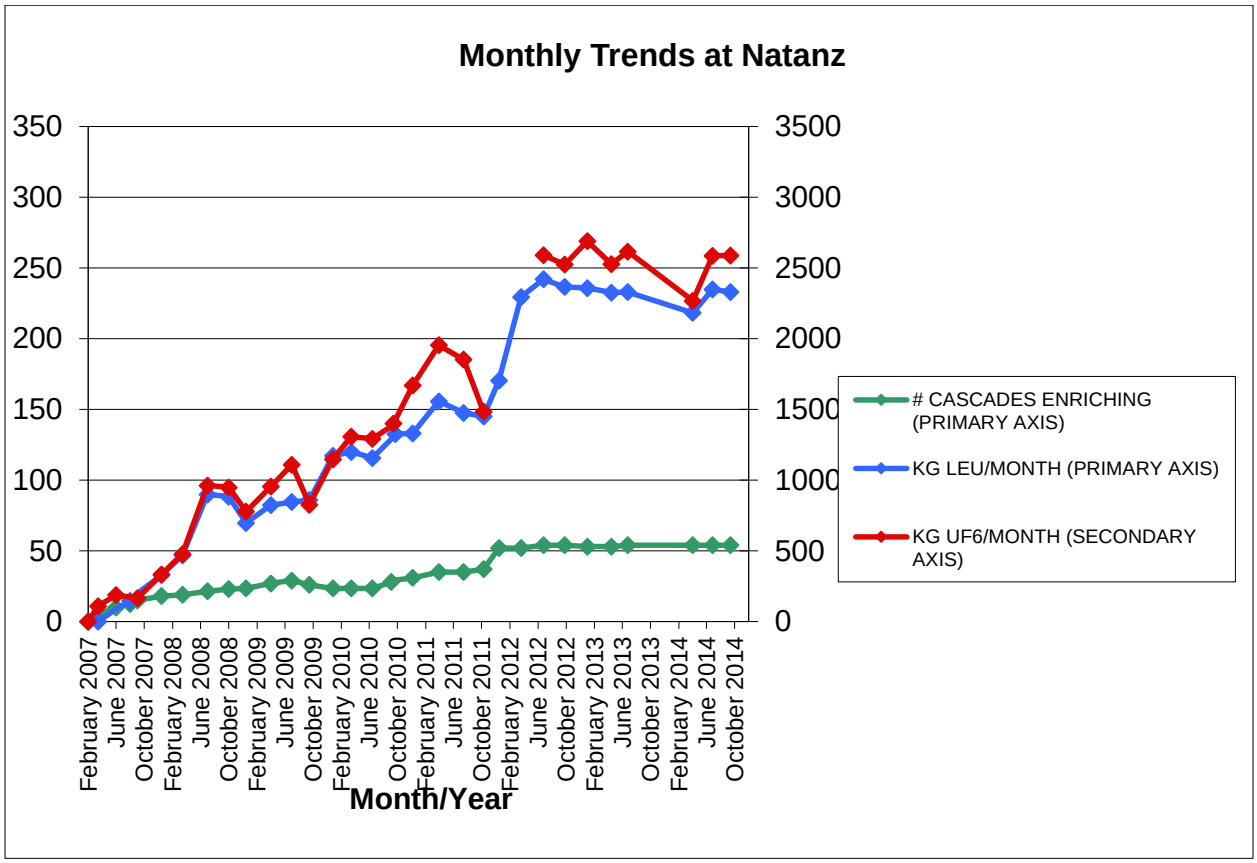


**Figure 5: Cumulative LEU Production at the Natanz FEP**

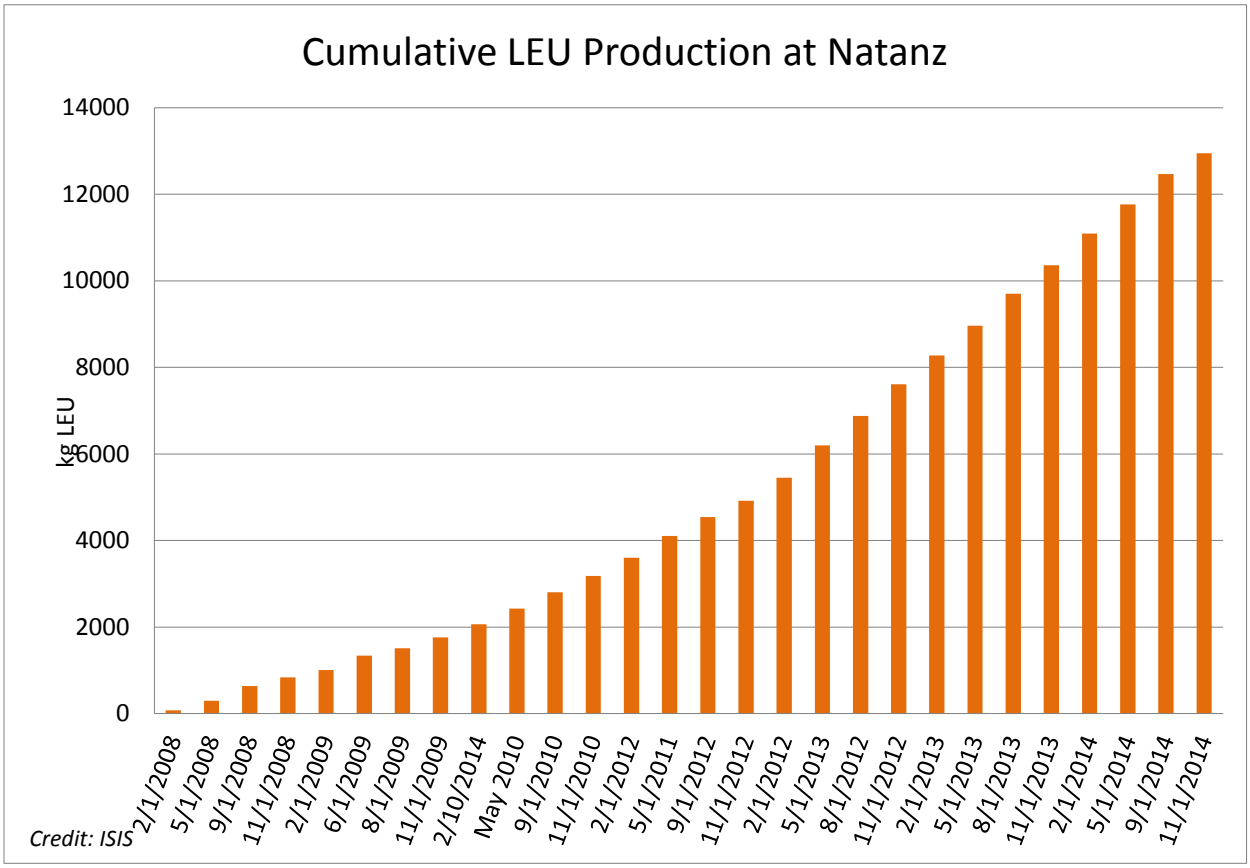


**Figure 6: Annualized SWU at Natanz FEP**

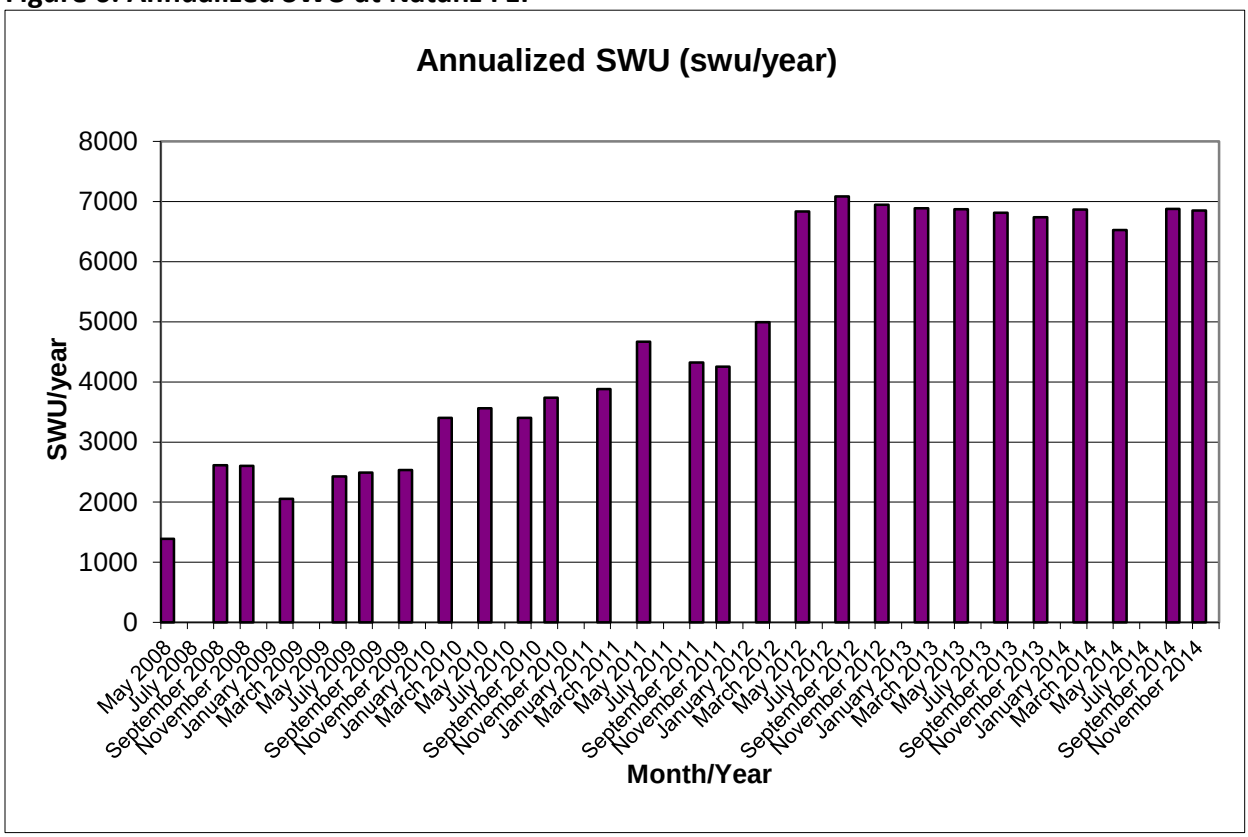


**Figure 7: IR-2m Progress at the FEP**

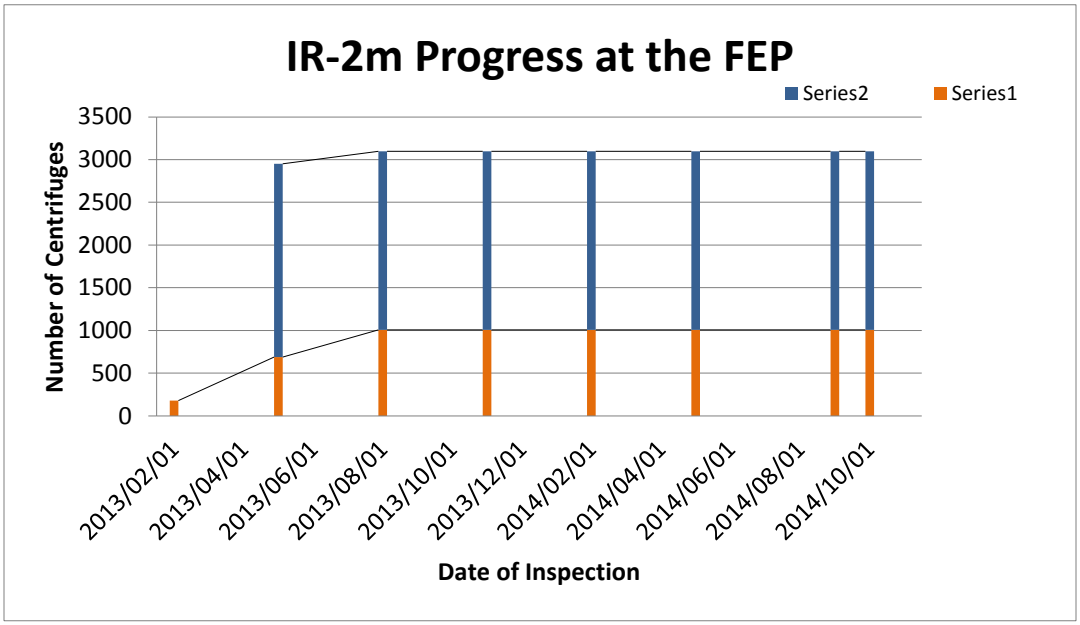



**Figure 8: Total Number of Deployed IR-1 Centrifuges in Iran**

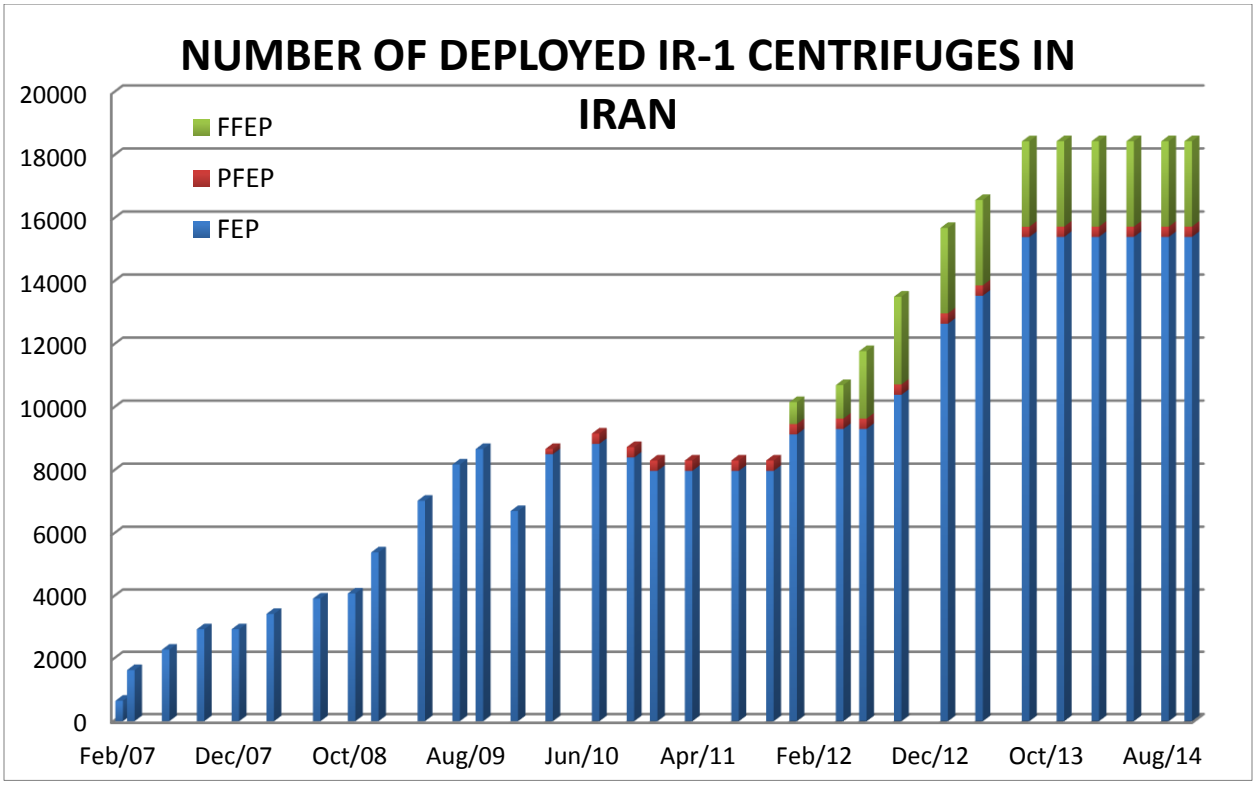


**Figure 9: Cumulative 19.75 Percent Uranium Production in the PFEP and FFEP**

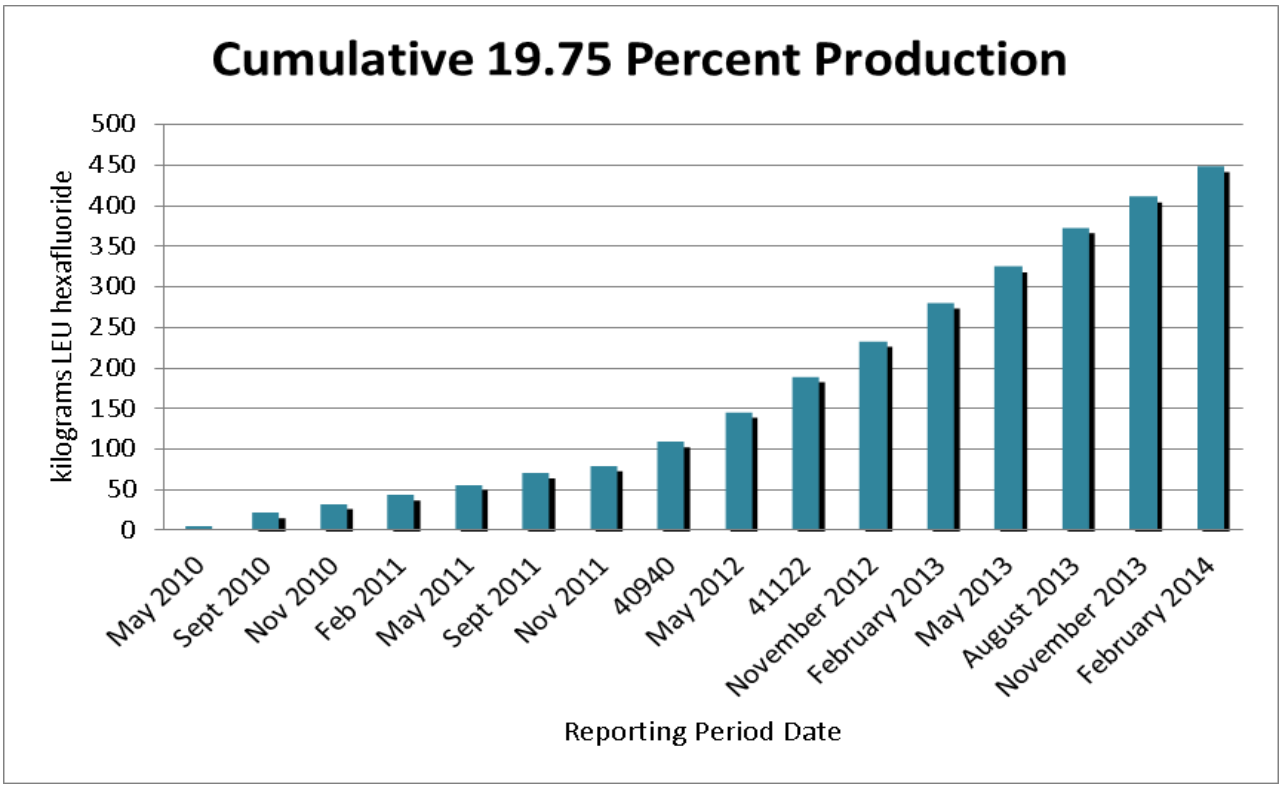



**Figure 10: SWU/Centrifuge-year at the Fordow Fuel Enrichment Plant and Pilot Fuel Enrichment Plant**

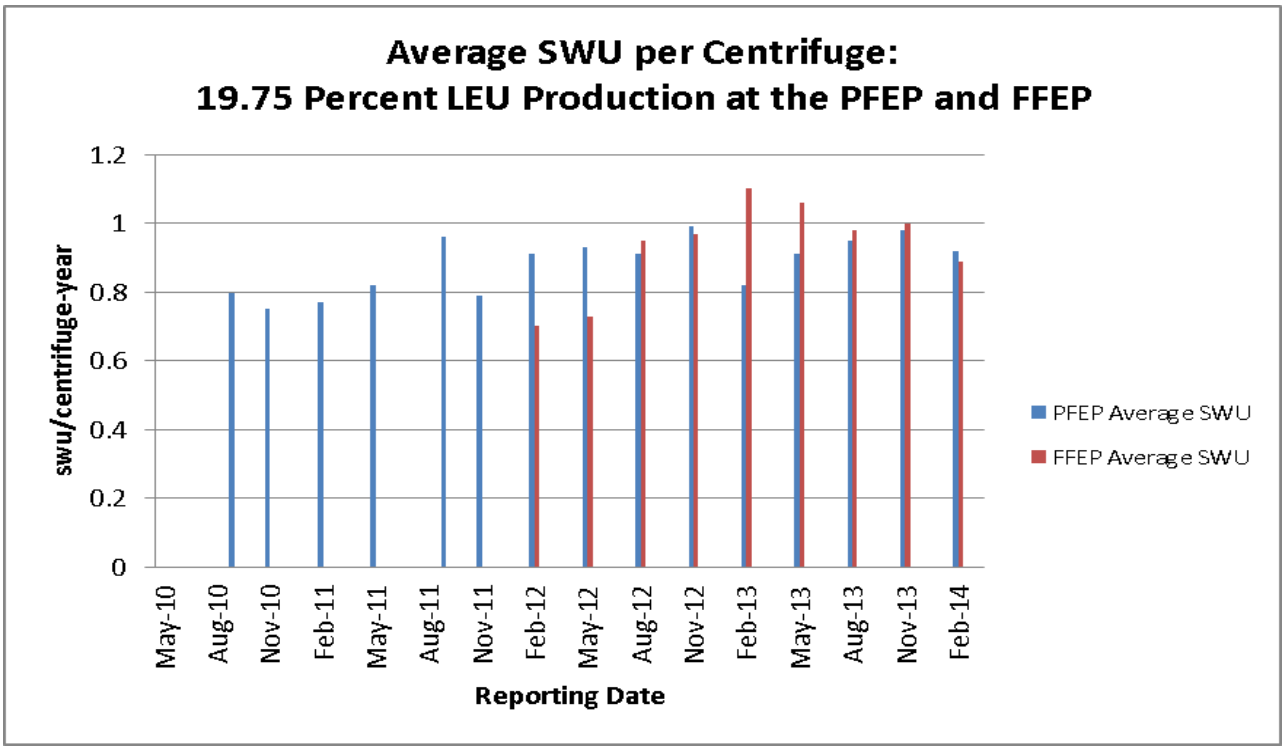
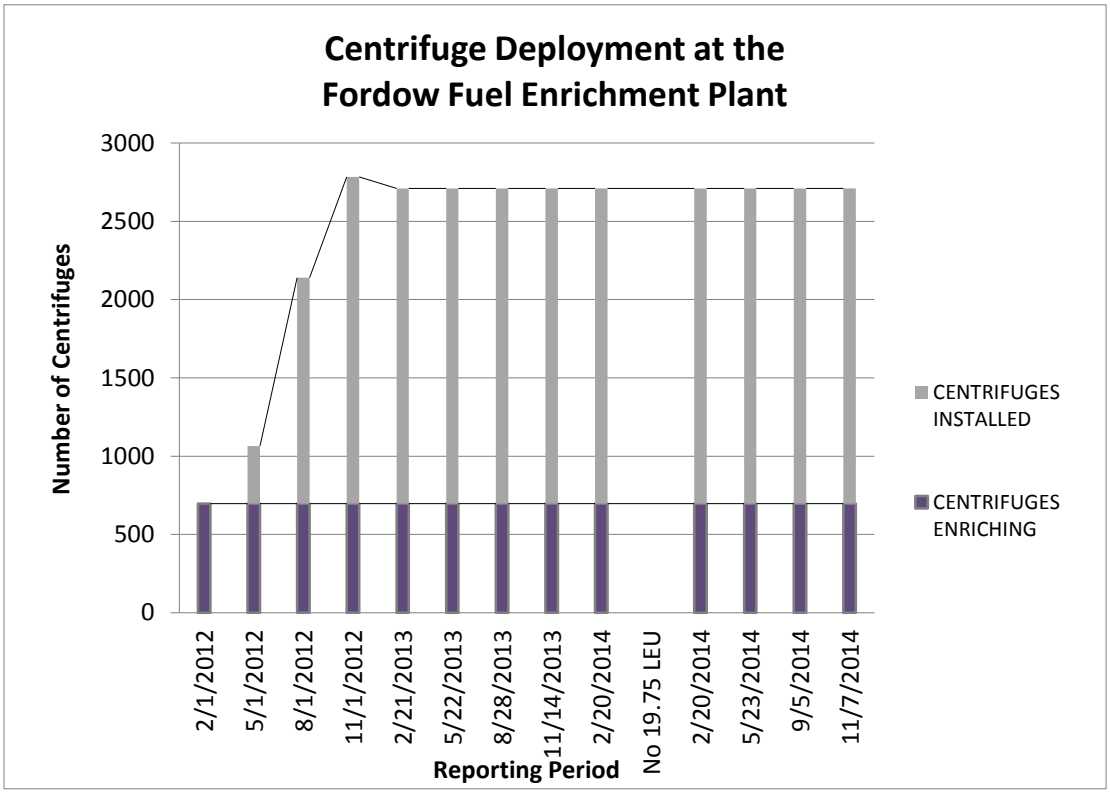


**Figure 11: IR-1 Centrifuges Enriching and Installed at the Fordow Fuel Enrichment Plant**




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


**Figure 12.** Digital Globe imagery showing the status of the alleged high explosive test site at the Parchin military complex on October 7 and 9, 2014.


**Figure 13.** Digital Globe imagery shows the status of the alleged high explosive test site at the Parchin military complex on August 12, 2014.

**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<br>(1.0 if 1,000 questionable centrifuges ignored) |
| 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<br>(Note: Iran began enriching in approximately 2,600 additional centrifuges during this period. Therefore, these data are likely skewed.) | 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 – 11/9/2012 | 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 |

## 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 | 146,855 kg | 12,945 kg | N/A | N/A |
| PFEP | 660.4 kg | 62.7 kg | 1,631 kg* | 202 kg* |
| FFEP | 1,683.4 kg | 174 kg | 1,806 kg* | 246 kg* |
| **GROSS TOTAL** | 149,198.8 kg | 13,297.3 kg** | 3,437 kg | 448 kg |
| **NET TOTAL** | 149,198.8 kg | 8,302.5 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 corrected report, which is 8,290.3 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** | **0.75 swu/cent-year** | **N/A** |
| **PFEP** | **0.65 swu/cent-year** | **N/A** |
| **FFEP** | **0.85 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.