



September 2, 2011

## **IAEA Iran Safeguards Report:**

# **Deployment of Advanced Centrifuges Commences at Natanz Pilot Plant but Not Yet at Fordow Plant; LEU Monthly Production at Natanz Fuel Enrichment Plant Decreases Slightly; 19.75 Percent LEU Production Increases Significantly; IAEA “Increasingly Concerned” about Possible Existence of Past or Current Nuclear Weaponization Work**

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The International Atomic Energy Agency (IAEA) released on September 2, 2011 its latest report on the implementation of NPT safeguards in Iran and the status of Iran’s compliance with Security Council resolutions. The following analysis highlights the IAEA’s key findings, including: 1) Iran has started deploying advanced centrifuges, both the IR-2m and the IR-4, at the Pilot Fuel Enrichment Plant (PFEP) at Natanz; 2) Iran has deployed one IR-1 cascade but no advanced centrifuges at the Fordow Fuel Enrichment Plant (FFEP); 3) the average monthly rate of low enriched uranium (LEU) production at the Natanz Fuel Enrichment Plant (FEP) has decreased slightly and the number of centrifuges both enriching and installed has stayed the same; 4) the performance of the IR-1 centrifuges at the FEP has declined, implying continuing problems with the centrifuges; 5) monthly production rates of 20 percent LEU increased significantly, implying better performance of these two IR-1 cascades; 6) the IAEA is increasingly concerned about the possible existence in Iran of past or current undisclosed military nuclear activities including those related to the development of a nuclear payload for a missile; and, 7) Iran has produced over 4,500 kg of low enriched uranium, almost enough for four nuclear weapons after further enrichment to weapon grade.

**One special note: The IAEA continues to release less information about the Natanz Fuel Enrichment Plant’s operation, making it more difficult to evaluate the plant’s performance. The IAEA should again release a more complete set of data.**

## **LEU production and centrifuge levels at Natanz Fuel Enrichment Plant (FEP)**

**Iran’s total LEU production at the FEP through August 13, 2011 is reported to be 4,543 kg of low enriched uranium hexafluoride, including 438 kg estimated by Iran to have been produced since May 14, 2011. This amount of low enriched uranium if further enriched to weapon grade is almost enough to make four nuclear weapons. 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, where Iran has begun to enrich uranium up to the 20 percent level, is discussed below.

**The average production of LEU at the FEP reached 148 kg per month of LEU hexafluoride (for the last reporting period ISIS noted it was 156 kg per month of LEU hexafluoride).** This monthly rate is only slightly lower than Iran's rate from the previous reporting period. The current average represents about a five percent decrease compared to the last reporting period.

As of August 28, 2011, Iran was enriching in 35 cascades containing a total of 5,860 IR-1 centrifuges. The IAEA noted that some of these centrifuges "were possibly not being fed" with uranium hexafluoride. At the end of the last reporting period, Iran was enriching in the same number of cascades containing the same number of centrifuges. Iran has also not installed any new centrifuges since the last reporting period. According to the report, the total number of centrifuges installed is about 8,000 centrifuges, the same as in the last report. Uranium hexafluoride feed rates are not given. Figures 1-5 illustrate these trends at Natanz.

This situation can also be understood by using an equivalent method that is easier to compare to historical enrichment output at the FEP, namely the output measured in separative work units (swu). ISIS derives this value from the declared LEU production. In the most recent reporting period, the LEU value is used with an assumption that the material is 3.5 percent enriched and the waste has a tails assay of 0.4 percent. The IAEA did not provide updated numbers in this report, but these older numbers can be used. Using standard enrichment calculators, 438 kg LEU translates to 1,077 kg of separative work units (swu), or 11.84 kg swu/day. On an annualized basis, this is about 4,320 swu per year (see Figure 6). The number of centrifuges declared as enriching was 5,860 at both the end and the beginning of the reporting period, so the swu per centrifuge remains constant at 0.74 during this time. 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 5, which displays this data graphically). These numbers imply that not all of Iran's centrifuges in cascades fed with uranium are actually enriching, or that these centrifuges are enriching less efficiently.

## **Deployment of Advanced Centrifuges at Pilot Fuel Enrichment Plant (PFEP), 20 Percent Enrichment Continues**

Iran has started installing two cascades of advanced centrifuges at the PFEP as it said it would. As of August 28, 2011, Iran had installed 136 IR-2m centrifuges in cascade 5 and 27 IR-4 centrifuges in cascade 4. Iran started feeding 54 of the 136 IR-2m centrifuges with natural uranium hexafluoride. The purpose of operating these cascades is likely to demonstrate performance prior to installation of such cascades at Natanz, Fordow, or other enrichment sites.

Iran has designated two cascades at the smaller, above-ground pilot fuel enrichment plant for the production of LEU enriched to nearly 20 percent uranium-235 for the Tehran Research Reactor (TRR). One of these cascades enriches from 3.5 percent LEU to almost 20 percent LEU, while the second one takes the tails from the first one and outputs about 10 percent LEU and a tails of natural uranium. The ten percent material is fed into the first cascade in addition to 3.5 percent LEU. This process allows Iran to more efficiently use its 3.5 percent LEU stock.

Between May 22, 2011 and August 20, 2011, 98.4 kg of 3.5 percent low enriched uranium in the form of uranium hexafluoride was introduced into the two, interconnected cascades, an 8 percent increase in the feed rate. Iran withdrew a total of 14.1 kg of nearly 20 percent LEU hexafluoride. **During the reporting period, Iran produced 19.75 percent enriched uranium at a rate of 4.80 kg/month, a 23 percent increase from the average rate of 3.91 kg per month since February 12, 2011. In total, Iran has fed 672.5 kg of 3.5% LEU to produce 70.8 kg 19.75% uranium since the beginning of operations in February 2010.** The relatively small number of centrifuges in these cascades likely allows Iran to pay greater attention to improving their performance, accounting for the marked improvement of the IR-1 centrifuge at the PFEP in comparison to the decline in performance of IR-1 machines installed at the FEP.

## **New Information on Advanced Centrifuges**

The report states that on August 18, Iran provided the IAEA with access to a facility involved in the research and development of advanced centrifuges. During this visit, Iran provided the IAEA extensive information on its current and future research and development work on advanced centrifuges.

### **Iran installs IR-1 centrifuges at the Fordow enrichment site**

The IAEA reports that Iran has installed one cascade of centrifuges at the Fordow site to be designated for production of 19.75 percent enriched uranium. ISIS has learned that these machines are new IR-1 centrifuges, not existing ones transferred from Natanz.

Earlier this summer, the Vice President of Iran and head of Iran's Atomic Energy Organization of Iran (AEOI), Fereydoun Abbasi-Davani, implied that Iran would soon deploy advanced centrifuges at Fordow, stating that these machines would be installed in 164-machine cascades. The reason IR-1 centrifuges have been installed first is not discussed in the IAEA report. One possibility is that Iran wants to test them longer in the Natanz pilot plant before deploying any at Fordow.

Iran also previously announced that it would transfer the production of 19.75 percent uranium from the Pilot Fuel Enrichment Plant at Natanz to the Fordow site. The IAEA report notes that on June 25, 2011, Iran submitted a revised Design Information Questionnaire (DIQ) which stated that Fordow would be used to enrich uranium to 19.75 percent and that it would initially use two cascades of centrifuges for this purpose.

In a July 27, 2011 letter to the IAEA, Iran answered more of the Agency's questions about the original circumstances and timing of construction of the Fordow site. Iran also submitted yet another revised DIQ on Fordow. While Iran should indeed be submitting DIQs that accurately reflect the changing characteristics of its nuclear facilities, the fact that Iran has submitted so many revised DIQs in a relatively short period of time raises questions about the original intended purpose of the Fordow facility. The IAEA notes that "additional information from Iran is still needed in connection with this facility."

### **IAEA increasingly concerned about Iran's possible nuclear weaponization activities**

In stark language, the IAEA reports that it is increasingly concerned about possible military dimensions to Iran's nuclear program, that it continues to receive and collect new information, and that the information appears credible. Since the Agency first raised these concerns with Iran in August 2008, Iran has not provided access to locations, personnel, and information the Agency seeks in order to investigate these issues. It writes it is "...increasingly concerned about the possible existence in Iran of past or current undisclosed nuclear related activities involving military related organizations, including activities related to the development of a nuclear payload for a missile, about which the Agency continues to receive new information." It continues, "The information available to the Agency in connection with these outstanding issues is extensive and comprehensive and has been acquired both from many Member States and through its own efforts." The IAEA finds regarding this information, "It is also broadly consistent and credible in terms of technical detail, the time frame in which the activities were conducted and the people and organizations involved."

The IAEA also notes that Abbasi-Davani explained Iran's position on the military dimensions issue in a [communication](#) to the IAEA dated May 24, 2011. ISIS assessed [several of](#) the claims in this [communiqué](#) and found them to be lacking in factual basis, and, among other things, an attempt to avoid dealing with the issue of military dimensions altogether. In a reply letter dated June 3, the IAEA reports that Director General Amano wrote Dr. Abbasi-Davani that Iran "should fully implement all of its obligations in order to establish international confidence in the exclusively peaceful nature of Iran's nuclear programme."

## Uranium conversion and Fuel fabrication

Iran's uranium conversion and fuel fabrication activities have picked up significantly at the Esfahan Uranium Conversion Facility (UCF) and Fuel Manufacturing Plant (FMP). Iran provided the IAEA with an updated schedule for the operation of the UCF on June 15. In several letters throughout the summer, Iran informed the IAEA of its new plans and activities.

Iran notified the IAEA it would "restart production of natural UF<sub>6</sub> using uranium ore concentrate (UOC) produced at the Bandar Abbas Uranium Production Plant." This indicates that the Bandar Abbas facility is in use. The IAEA report does not state the amount of uranium produced at Bandar Abbas.

Iran said that tests for the conversion of UF<sub>6</sub> enriched up to 20 percent U-235 into U<sub>3</sub>O<sub>8</sub> would begin on September 6, 2011. Iran also informed the IAEA it would resume "R&D activities at the UCF for the conversion of UF<sub>6</sub> enriched to 5 percent U-235 into UO<sub>2</sub>."

Iran told the IAEA on May 31 that the Fuel Manufacturing Plant (FMP) had made a fresh fuel rod of natural UO<sub>2</sub> and would ship it to the Tehran Research Reactor for irradiation and post-irradiation analysis. The IAEA learned that at the FMP Iran had not yet started to install equipment for the fabrication of fuel for the Tehran Research Reactor (TRR). This may indicate that Iran is not on schedule for the production of 20 percent LEU fuel for this reactor or a possible lack of urgency for this fuel. However, its activities reflect plans to start the process of making this fuel.

## Heavy Water

Iran told the IAEA during an August 9 visit to the Arak IR-40 Reactor that the start of the operation of the reactor is planned for the end of 2013. During the visit, the IAEA observed the reactor's construction was ongoing. Moderator heat exchangers had been installed and coolant heat exchangers had been delivered to the site.

On August 17, the IAEA visited the Arak Heavy Water Production Plant (HWPP) for the first time since 2005. Iran told the IAEA that the plant was operational and it had produced a total of 60 tonnes of heavy water to date. Iran continues to refuse the IAEA access to the heavy water stored at the Uranium Conversion Facility (UCF) for sampling.

### **Still no information on additional enrichment plants, laser enrichment**

The IAEA reports that it continues to lack information from Iran about whether it has begun constructing any additional enrichment plants; Iran has stated it plans to build ten more enrichment plants and earlier announced it would start construction of one of them earlier this year. The IAEA reports that it also continues to lack information pertaining to Iran's announcement on February 7, 2010 that it possesses laser enrichment technology. The IAEA writes, "As a result of Iran's lack of cooperation on those issues, the Agency is unable to verify and to report fully on these matters."

Figure 1: Centrifuge Trends at Natanz

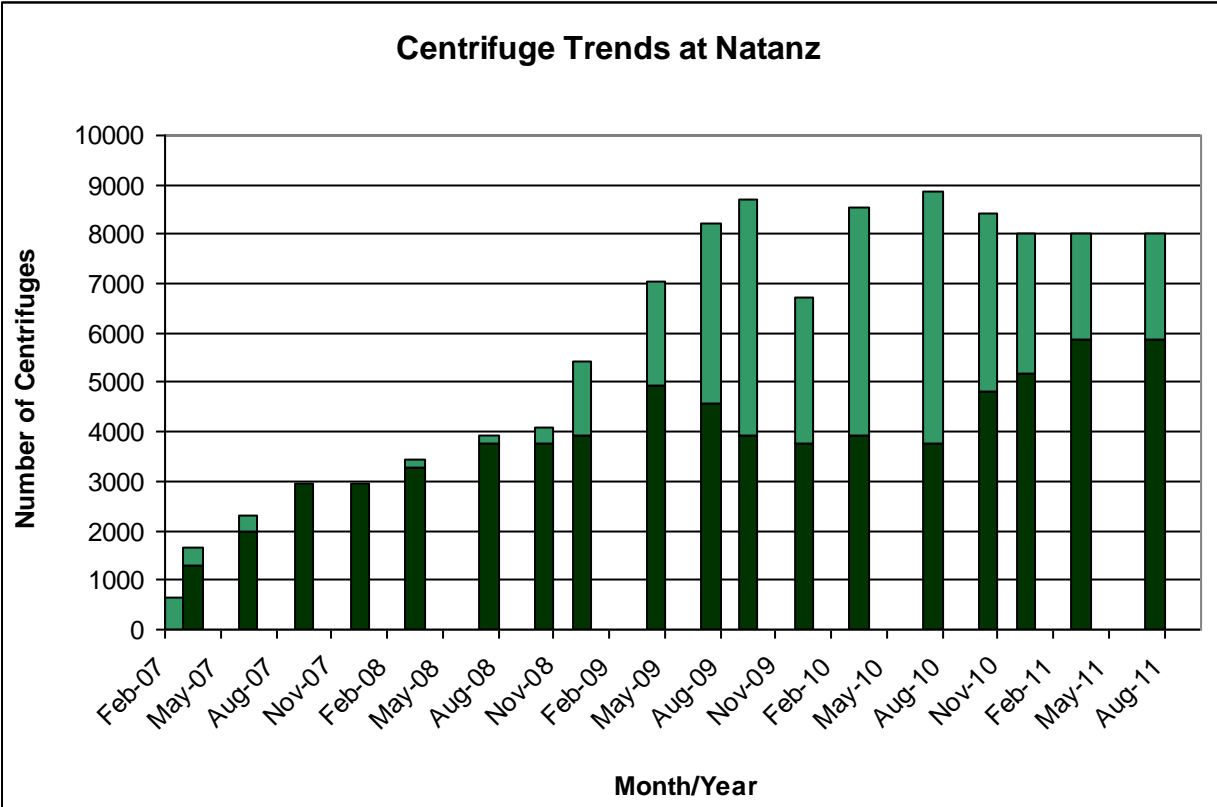


Figure 2: Uranium Hexafluoride Feed at Natanz (no new data since late 2010)

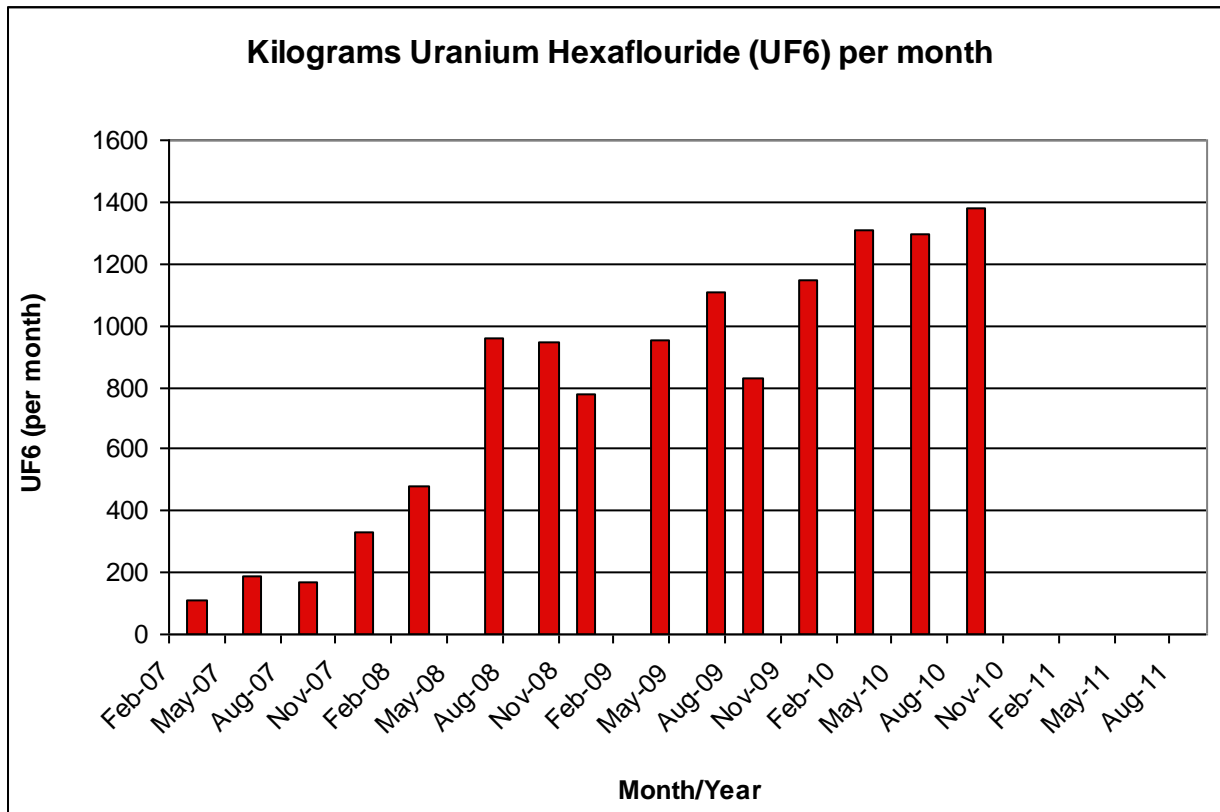
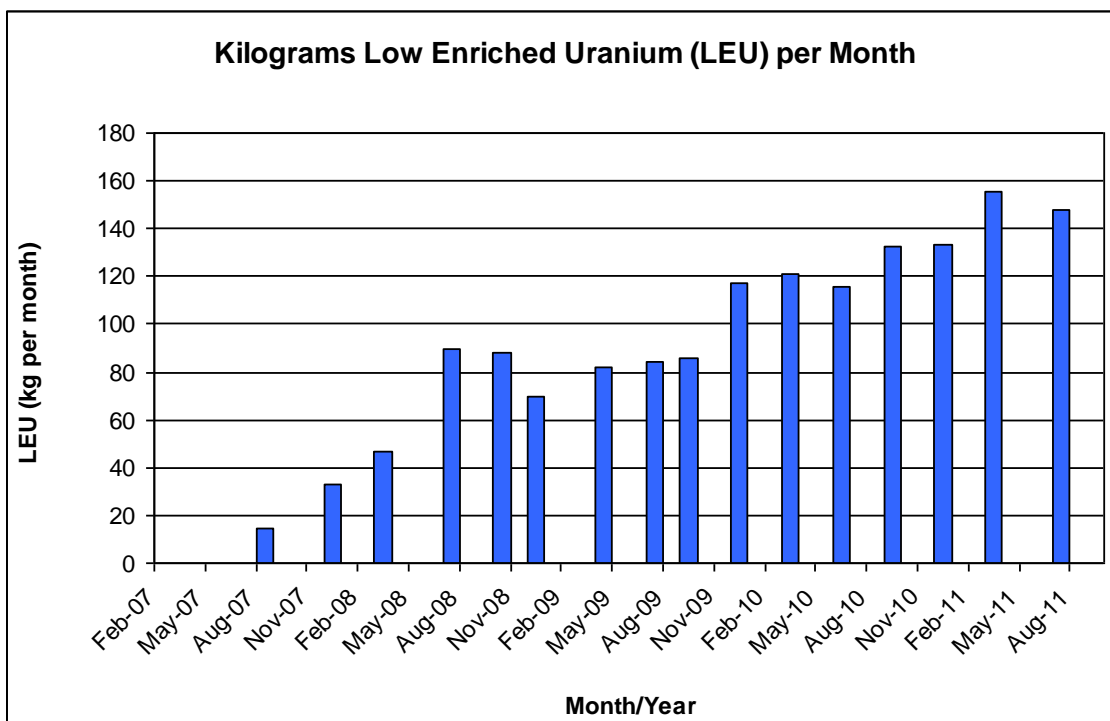
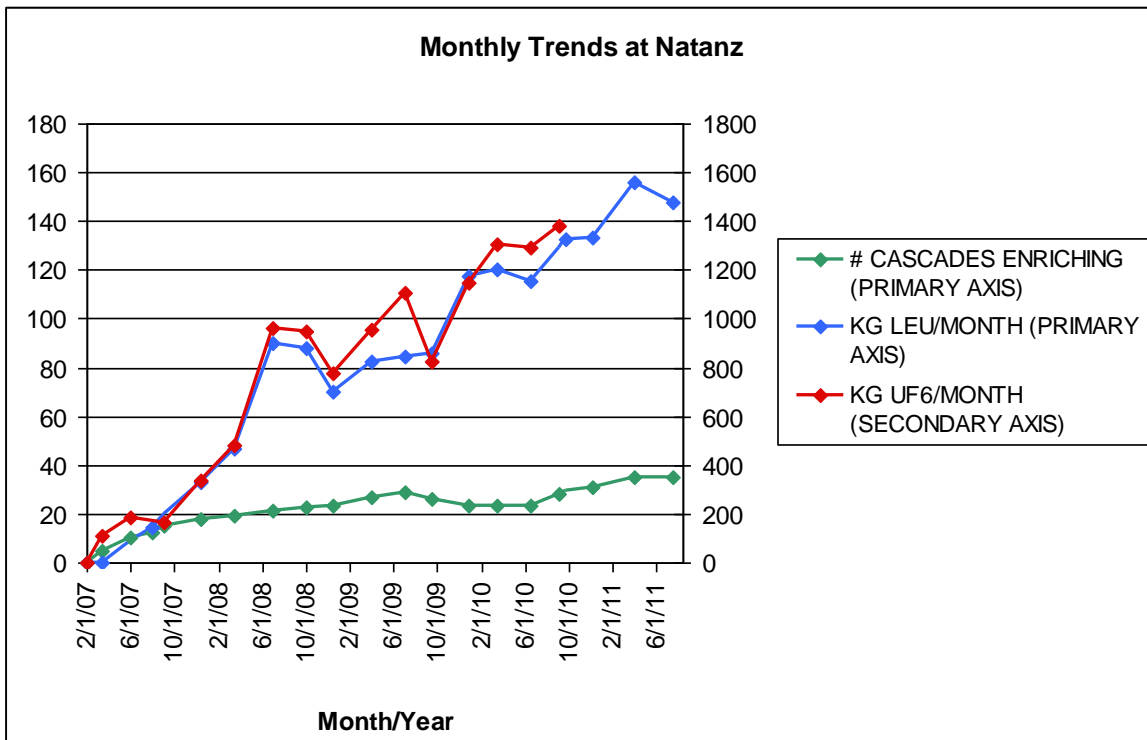


Figure 3: LEU Production (per month) at Natanz



**Figure 4: Overall Trends at Natanz**



**Figure 5: Cumulative LEU Production at the Natanz Fuel Enrichment Plant**

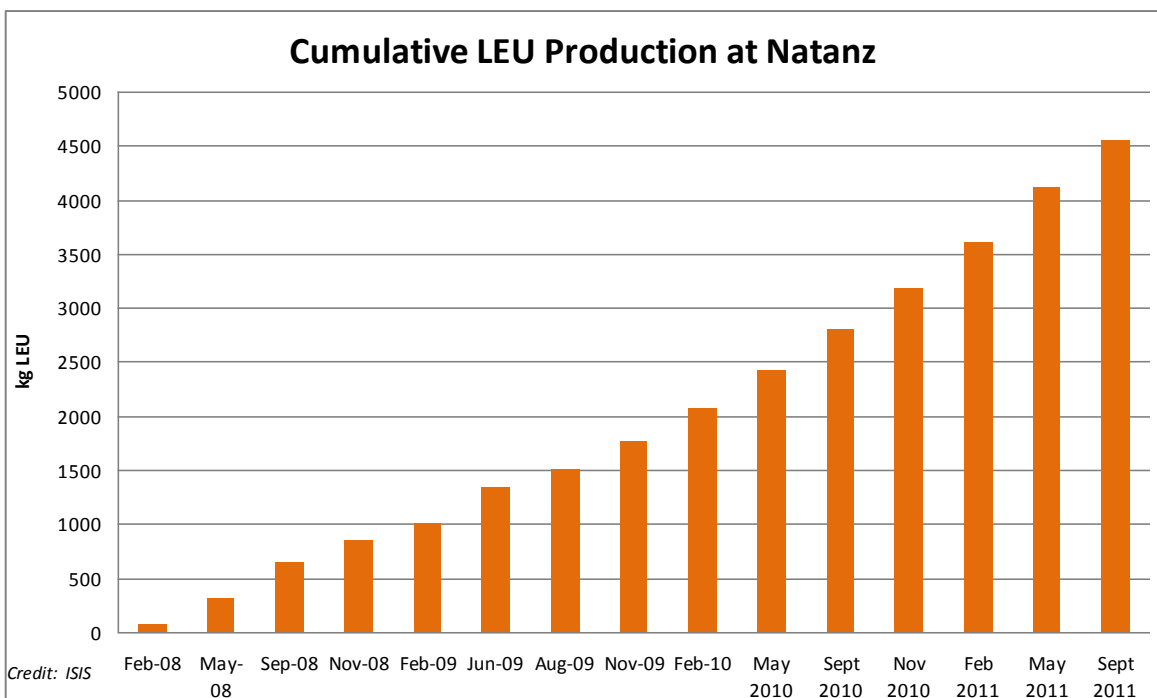
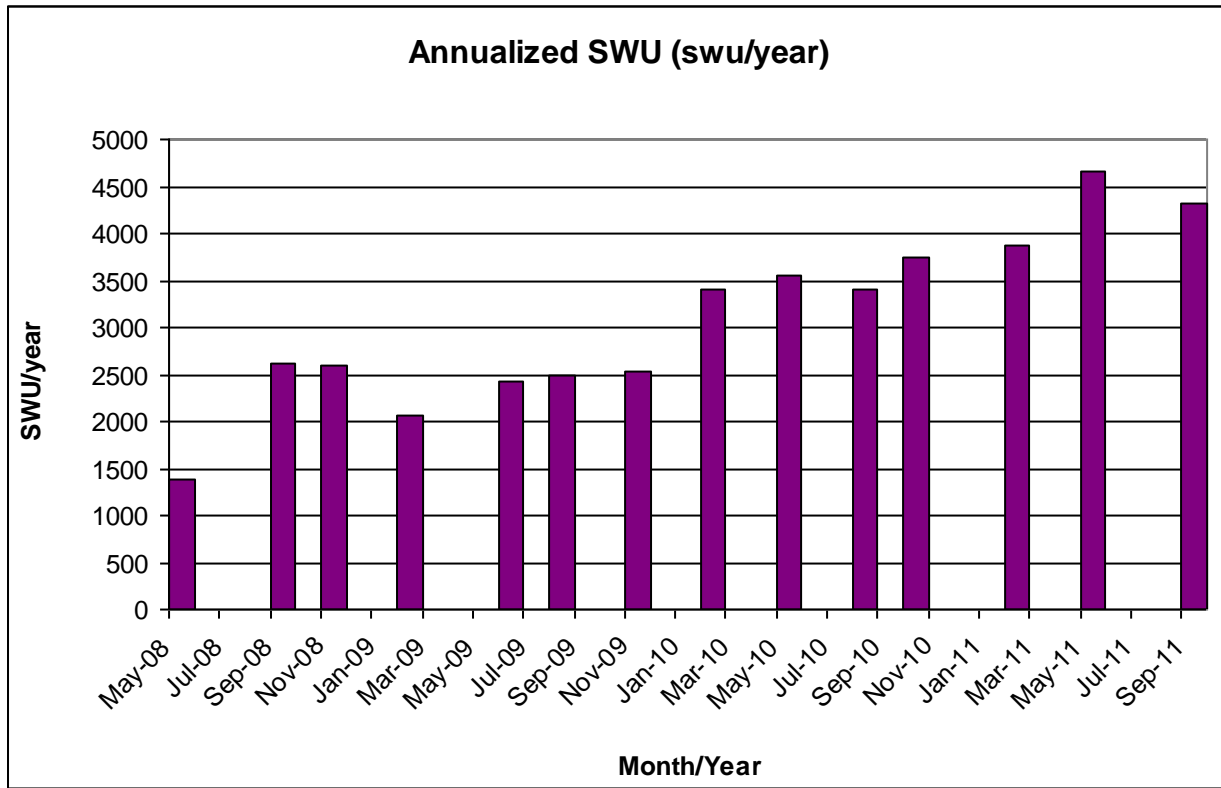


Figure 6: Annualized SWU at Natanz



**Table 1: Minimal Average Separative Capacity of an IR-1 Centrifuge at 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 (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