



November 8, 2011

## **ISIS Analysis of IAEA Iran Safeguards Report: Part 1<sup>1</sup>**

### **IAEA Details Evidence of Nuclear Weaponization Activities in Violation of the Nuclear Non Proliferation Treaty; Enrichment at Natanz Continues to Stagnate; Three Cascades of IR-1 Centrifuges Installed at Fordow, Low Enriched Uranium Cylinder Moved to Fordow**

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The International Atomic Energy Agency (IAEA) released on November 8, 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) IAEA lays out most detailed evidence to date of nuclear weaponization activities in Iran; 2) Centrifuge performance and enrichment at the Natanz Fuel Enrichment Plant continues to stagnate; 3) Three cascades of IR-1 centrifuges installed at the Fordow facility; 4) Cylinder of low enriched uranium moved to Fordow.

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

**Iran's total LEU production at the FEP through November 1, 2011 is reported to be 4,922 kg of low enriched uranium hexafluoride, including 379 kg estimated by Iran to have been produced since August 14, 2011. This amount of low enriched uranium if further enriched to weapon grade is 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 was 145 kg per month of LEU hexafluoride a rate that has fallen slightly from the last reporting period, where Iran produced 148 kg per month.**

As of November 2, 2011, Iran was enriching in 37 cascades containing a total of 6,208 IR-1 centrifuges. The IAEA noted that "not all of the centrifuges in the cascades being fed with uranium hexafluoride may have been working." At the end of the last reporting period, Iran was enriching in

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<sup>1</sup> Part II analysis of the Annex section on weaponization evidence in the safeguards report is forthcoming

two fewer cascades and 348 fewer centrifuges. While Iran is enriching in more cascades, 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 two reports. 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, 379 kg LEU translates to 932 kg of separative work units (swu), or 11.65 kg swu/day. On an annualized basis, this is about 4,252 swu per year (see Figure 6). The number of centrifuges declared as enriching was 5,860 at the beginning of the reporting period and rose to 6,208 at the end of the reporting period, corresponding with a swu/centrifuge-year of 0.73 and 0.68 respectively. 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, and that these centrifuges are enriching less efficiently.

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

Over the last reporting period, Iran completed its installation of one, 164-machine cascade of IR-2m centrifuges and continued to install a cascade of IR-4 centrifuges. As of October 22, 2011, Iran had installed 164 IR-2m centrifuges in cascade 5 and 66 IR-4 centrifuges in cascade 4. All 164 IR-2m machines were under vacuum, and the IAEA report does not state whether they are being fed uranium hexafluoride. None of the IR-4 centrifuges had been fed with 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 continues to feed natural uranium hexafluoride into single machines as well as ten and twenty machine cascades of IR-1, IR-2m, and IR-4 centrifuges.

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 August 21, 2011 and October 28, 2011, 93 kg of 3.5 percent low enriched uranium in the form of uranium hexafluoride was introduced into the two, interconnected cascades, an slight decrease from the last reporting period. Iran withdrew a total of 8.9 kg of nearly 20 percent LEU hexafluoride. **During the reporting period, Iran produced 19.75 percent enriched uranium at a rate of 3.94 kg/month, approximately a 20 percent decrease from the previous reporting period. In total, Iran has fed 765.5 kg of 3.5% LEU to produce 79.7 kg 19.75% uranium since the beginning of operations in February 2010.**

## **Fordow Fuel Enrichment Plant**

On October 17, 2011, Iran transferred from the FEP at Natanz a large cylinder of LEU in the form of uranium hexafluoride and a smaller cylinder containing depleted uranium. Iran informed the Agency of this action in an October 11, 2011 letter and stated that LEU will be used as feed at Fordow. Iran also requested that the IAEA remove the seal on the cylinder containing LEU on November 8, 2011.

During an inspection on October 23 and 24, 2011, the IAEA observed that Iran had installed all 174 IR-1 centrifuges in two tandem cascades in accordance with the third revised design information questionnaire (DIQ) from June 25, 2011. Iran plans to install a fourth cascade. This latest revised DIQ states that these cascades will be used for the production of 19.75 percent enriched uranium. The IAEA also noted that 64 IR-1 centrifuges had been installed in a third cascade. Iran informed the IAEA that the main power supply had been connected to the Fordow facility.

That Iran was caught building the Fordow plant in secret, and since Iran has subsequently changed the DIQ for this facility three times, raises concerns that the plant was built in order to provide Iran with the ability to quickly and securely make highly enriched uranium in the event of a breakout to make nuclear weapons. The IAEA has asked Iran for clarification on the circumstances that led to the construction of this facility

## **Possible Military Dimensions to Iran's Nuclear Program**

Included in the report is the most comprehensive detail and analysis to date that the IAEA has gathered on evidence of nuclear weaponization-related activities conducted by Iran. In several previous reports, the IAEA has described in general terms the information it possessed indicating military dimensions to Iran's nuclear program and that Iran's refusal to engage with the Agency over these issues was of concern. This report, however, contains unprecedented detail of the evidence.

A key detail in the report is an assessment that certain activities taking place under the organization in Iran responsible for various nuclear weaponization work resumed at some point after a 2003 "halt order" issued by senior Iranian officials. The IAEA also reports that Mohsen Fakrizadeh, the long-standing director of nuclear weaponization activities in Iran, remains as the director of these efforts at a recently re-named organization. In early 2011, Fakhrizadeh moved the organization to [a new compound in Tehran, known as Mojdeh](#). The IAEA notes that it "is concerned because some of the activities undertaken after 2003 would be highly relevant to a nuclear weapons program."

If true, the evidence of weaponization activities that took place before and after 2003 constitute a major violation of the Nuclear Non Proliferation Treaty.

Notably absent, however, is any assessment by the IAEA of Iran’s capability to make a nuclear explosive device based on what it learned through these activities. The IAEA made such an assessment in a [2009 working document](#) that was to become an annex on weaponization evidence to an earlier Safeguards report, but which the Agency never published. The working document assessed that, based on a review of the evidence, “Iran has sufficient information to be able to design and produce a workable implosion nuclear device based upon HEU [highly enriched uranium] as the fission fuel.” The IAEA has also assessed in this working document that Iran still had work to do before it could build a reliable warhead for the Shahib III missile.

**Figure 1: Centrifuge Trends at Natanz**

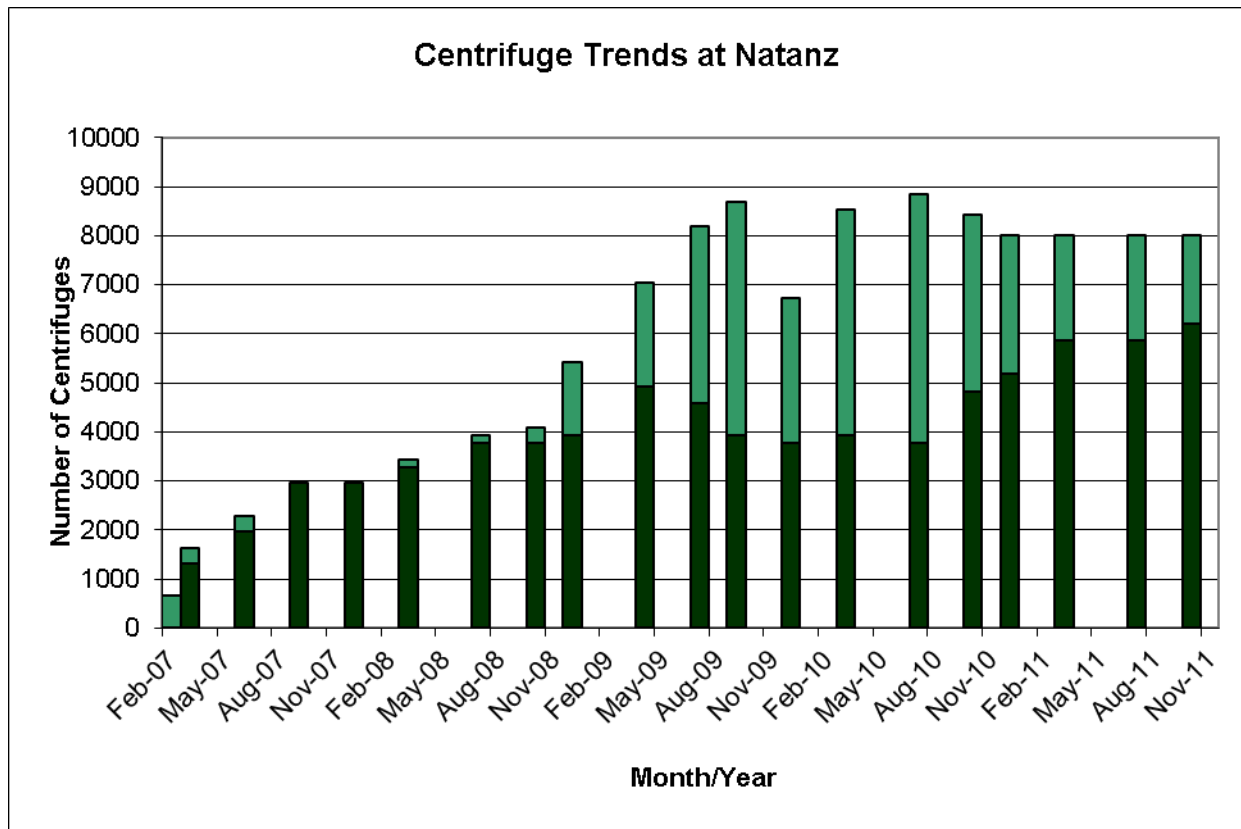


Figure 2: Uranium Hexafluoride Feed at Natanz (data no longer reported quarterly by the IAEA)

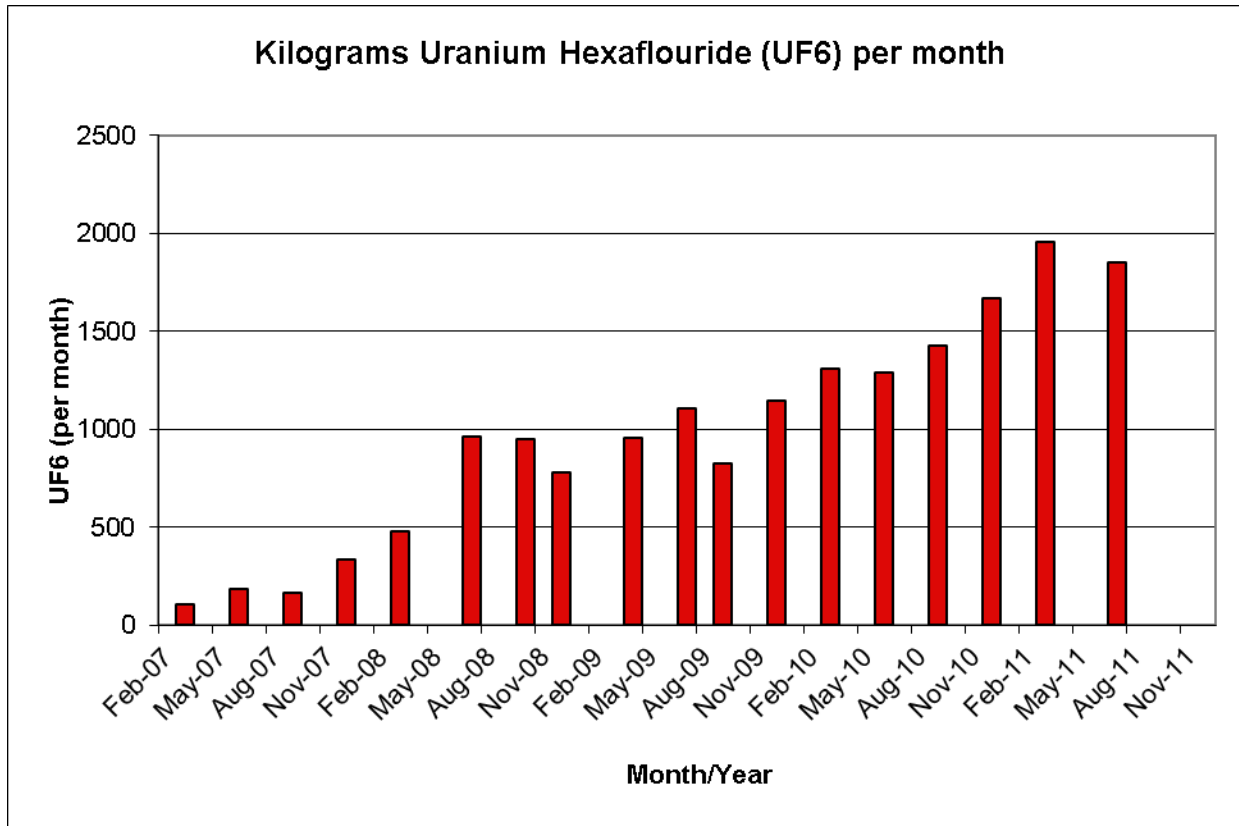


Figure 3: LEU Production (per month) at Natanz

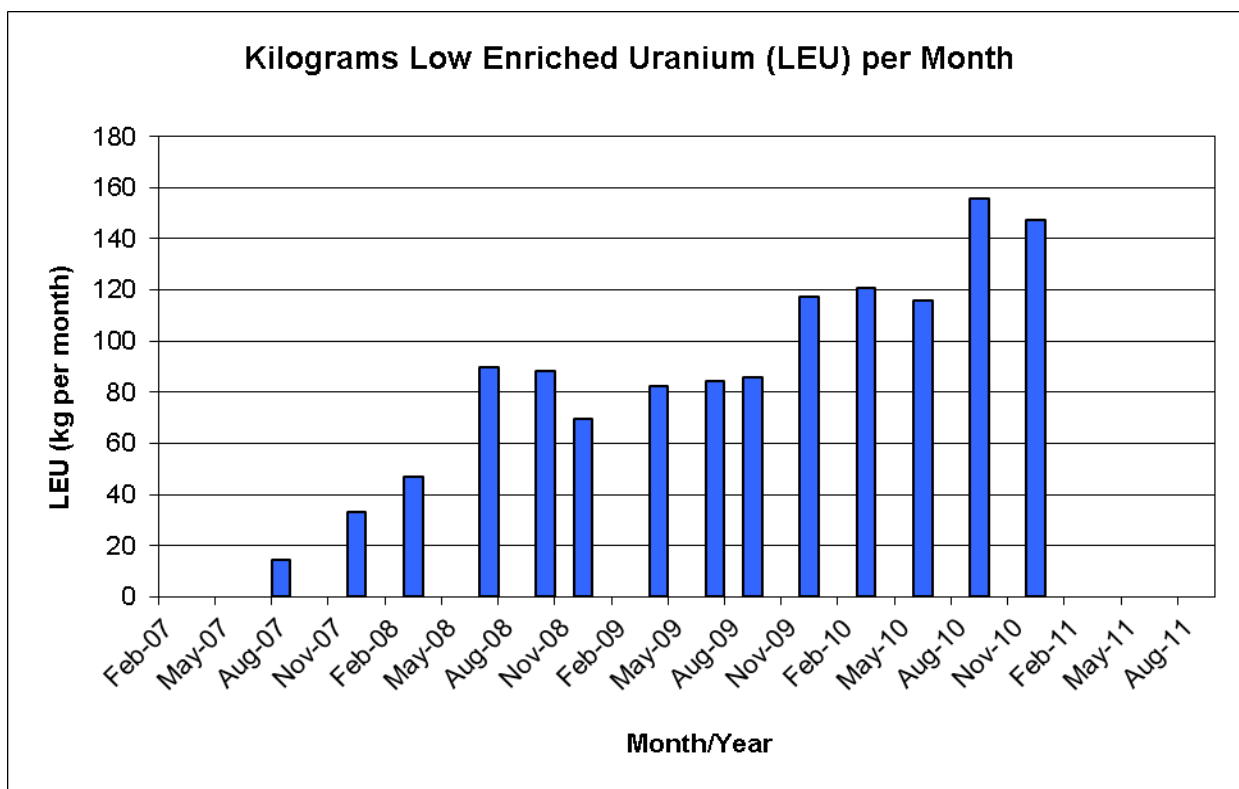
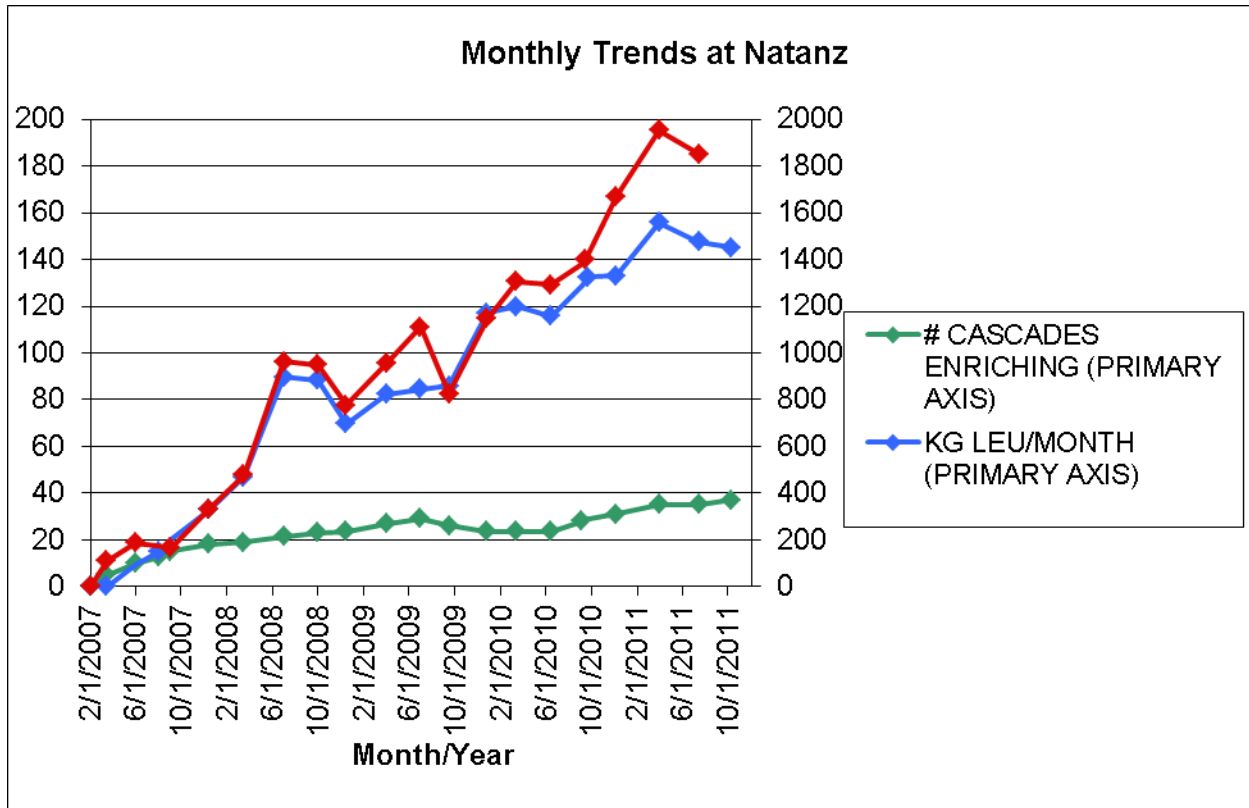
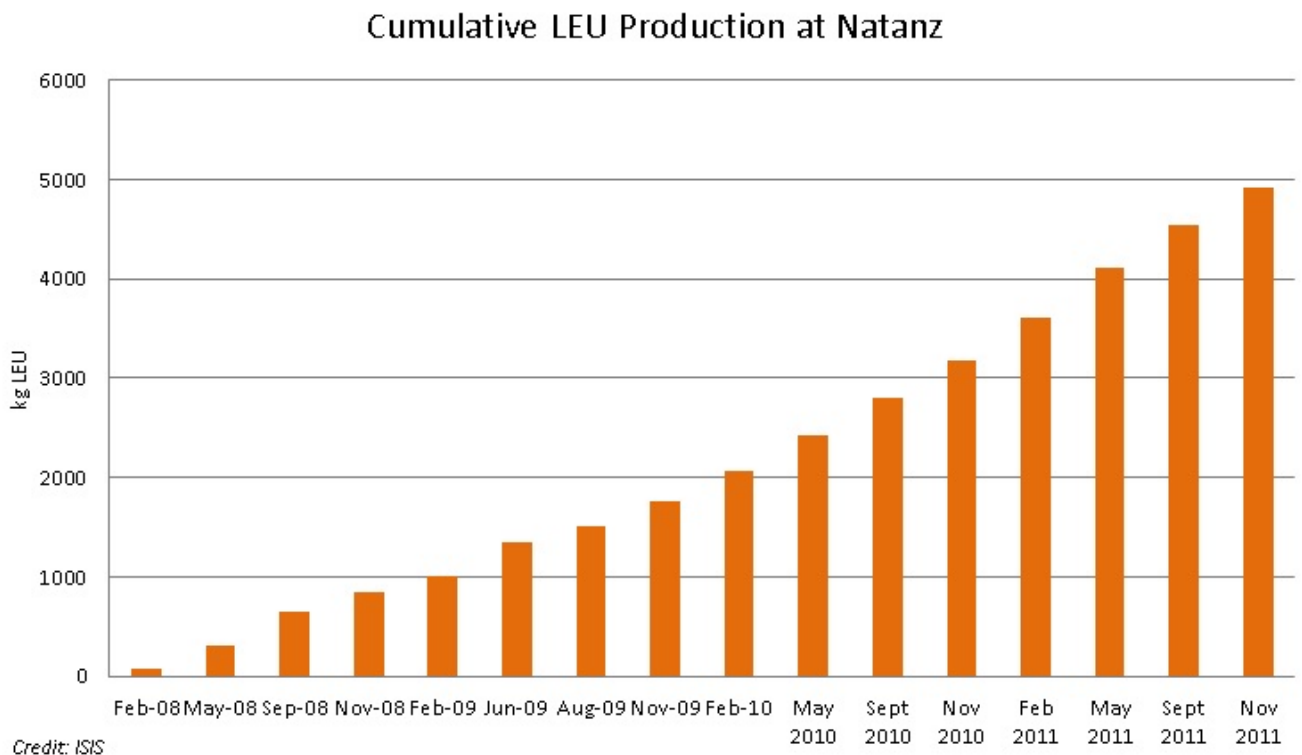


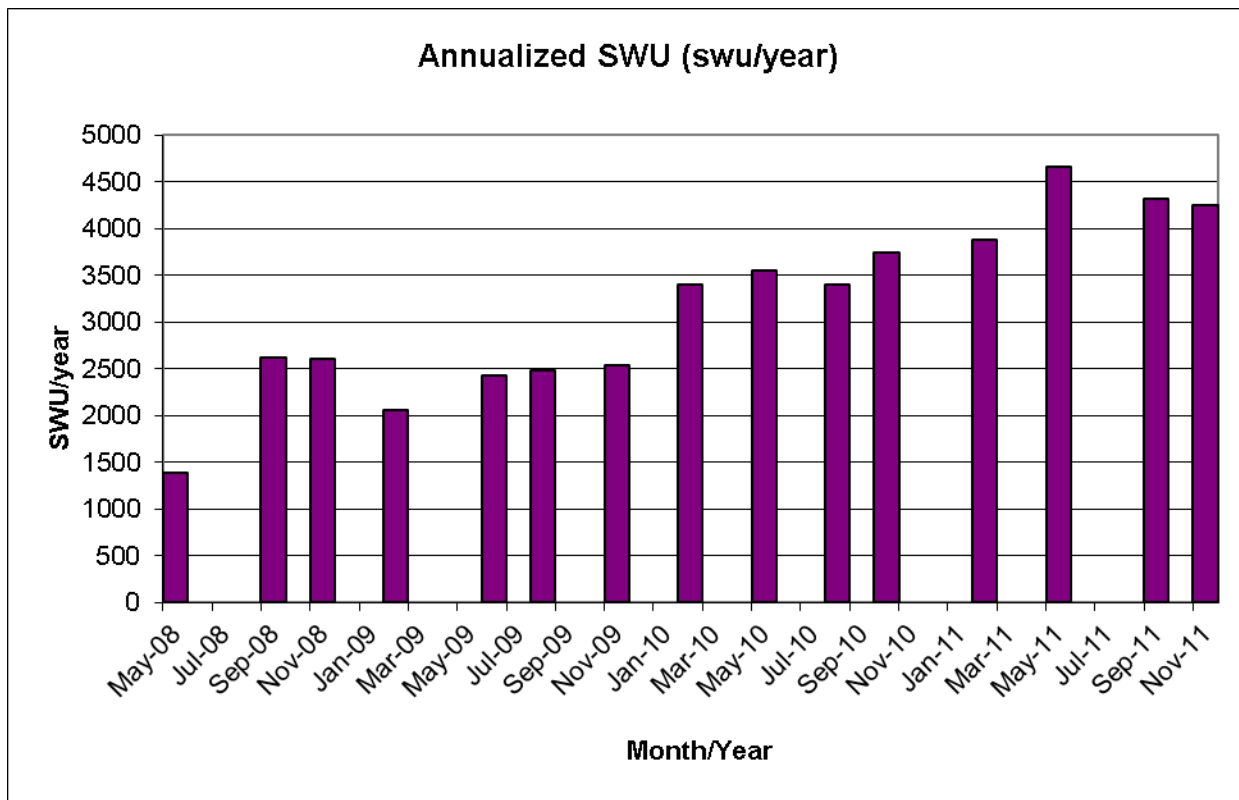
Figure 4: Overall Trends at Natanz



**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
08/14/2011 – 11/01/2011	0.73	0.68