Iran's enrichment for the Tehran Research Reactor: Update

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ISIS published yesterday an analysis of Iran's stated plans to produce its own fuel for the Tehran Research Reactor (TRR).

Later in the day ISIS learned that Iran plans to at least begin the enrichment process using the Natanz Pilot Fuel Enrichment Plant (PFEP), a small-scale facility that Iran has used previously for centrifuge R&D and testing. It is not clear from recent IAEA reports how many centrifuge cascades are currently operating at the PFEP. The PFEP was designed to hold six centrifuge cascades but only three or four were ever installed. recently, Iran has been using the PFEP for testing more advanced centrifuges in smaller cascades of 10 to 20 machines.

Reuters is reporting today that Iran says it has began introducing 3.5 percent enriched uranium hexafluoride at the Natanz PFEP today under IAEA supervision. As of mid-day February 9, the IAEA has not confirmed this to ISIS. The Reuters report indicates that Iran is using only a single cascade for the production of the research reactor's LEU.

What are the implications of using the pilot plant for enrichment?

Though we do not have performance data for the P-1 centrifuges in the pilot plant, they may prove to perform better than those in the FEP if Iran has assembled and used them with greater care and attention to detail than those mass-installed in the FEP.

Iran may also have more flexibility with the feed and withdrawal stations in the pilot plant, to allow for the introduction of LEU and withdrawal of 19.75 percent material with the necessary preparation work occurring quietly over the last several months.

The head of Iran's Atomic Energy Organisation, Ali Akbar Salehi, said today that Iran had a production capacity of "3 to 5 kg a month." It is unclear whether he is referring or uranium hexafluoride or to the uranium content of the uranium hexafluoride.

How much 19.75 percent LEU can a single cascade produce in one month?

Assuming that the 3 to 5 kg per month refers to the total quantity of low enriched uranium hexafluoride and not simply its uranium mass, it may prove difficult to produce 3 to 5 kg per month of 19.75 percent enriched LEU using only a single cascade. Thus far, Iran's 164 centrifuge cascades have encountered difficulties achieving expected enrichment outputs measured in separative work units (swu) per year. If one further assumes that the cascade can achieve between 164 and 250 separative work units (swu) per year, it should be able to produce between 30 and 53 kilograms of 19.75 percent material per year, or 2.5-4.4 kg/month. (This estimate includes two different tails assays.)

An important caveat is that this level of enrichment output (swu per year) for a P1 cascade is considerably higher than that achieved on average in the P1 cascades at the FEP during the last two years, raising doubts about Iran's ability to meet its goal of 3-5 kg per month in a single cascade.

Based on Iran's experience at the FEP to date, a more conservative estimate would be that a cascade can produce about 80-164 swu per year, or about 15-35 kg per year, or 1.25-2.9 kg per month. This calculation also assumes 100 percent reliability, which is unlikely, as Iran's centrifuges appear to malfunction regularly.

Overall, Salehi's estimates appear high for a single cascade of P-1 centrifuges. The output he seeks appears more likely using three to four cascades.

Producing 1.5 kg per month, or 18 kg per year, is at the high end of Iran's needs for the TRR, where again, these masses refer to the total amount of uranium hexafluoride and not just uranium mass. (In the ISIS study on the TRR's fuel needs, uranium mass is used.) Even accepting this requirement of 1.5 kilograms per month, Iran's plan to produce two to other three times this amount appears surplus to its needs for the TRR.

What are the proliferation implications?

Proliferation concerns remain, even with Iran using the PFEP to enrich the uranium. In addition to gaining important experience operating cascades at higher levels of enrichment, Iran is slowly expanding its breakout capability. At a production rate of 3-5 kilograms of 19.75 percent material per month, or 36-60 kg per year, Iran could convert its 3.5 percent enriched uranium at a rate of 300-550 kg per year.

In all, Iran appears to be seeking both enriched uranium for the TRR and a surplus stock of 19.75 percent material. An important issue remains how much of its accumulated LEU it dedicates to enrichment to 19.75 percent.

Given expected problems in making the fuel, Iran may not be able to produce very much fuel in the coming year. The *Washington Post* reports today that Iranian officials have acknowledged the difficulty of using homemade fuel to power the reactor. The piece quotes a December interview with Mohammad Ghannadi, vice president of the Atomic Energy Organization of Iran, noting "that while Iran could try to produce the fuel itself, 'there would be technical problems. Also, we'd never make it on time to help our patients'."

If enrichment proceeds smoothly, Iran may choose to add cascades to the effort. It is also possible that it could plan enrichment to the next level, 60 percent, claiming that it wishes to make targets for the production of medical isotopes at the TRR. While likely to provoke an international crisis, it is conceivable that if Iran continues along this path, it could eventually insist on the need to produce weapon-grade uranium in order for the targets to function

effectively. While this is may be unlikely under the current political climate, it is important to be alert to the proliferation implications of Iran's decision to produce its own TRR fuel.