Iran: Breaking Out Without Quite Breaking the Rules?

A Nonproliferation Policy Education Center Analysis

Most analyses of Iran's nuclear program are riveted on Iran's covert efforts and the question of when Iran might get its first bomb. While interesting, this question tends to downplay a much more important point: Iran can come within weeks of acquiring a large arsenal of weapons without breaking the rules of the NPT or IAEA and perhaps do so even sooner than when it might get its first covert bomb. If Iran's overt program all stays on schedule, Tehran, in fact, could get a large arsenal of nuclear weapons -- 50 to 75 bombs by 2006. First, it would have to operate its LWR at Busheir for 12 to 15 months. It could then chemically separate the plutonium (approximately 300 kgs of 85 percent 239 isotopic content plutonium, i.e., near weapons-grade) from the spent fuel and, then, convert it into metal. Metal conversion and the chemical separation of the plutonium from the spent fuel might take an additional 12-16 additional weeks beyond the time Iran extracts the spent fuel from the LWR. Under the Nuclear Nonproliferation Treaty (NPT), all of this is legal. It also is legal under the NPT for Iran to make as many implosion devices (sans fissile cores) as it might want and have them on the ready to receive metal plutonium cores. At this point, some time by or before 2006, Iran could break out of the NPT and have a large arsenal of weapons in a matter of days or weeks.

In contrast, if Iran uses its centrifuges to enrich natural uranium to weapons grade, it can only make 2 to 6 bombs a year by the middle or end of 2006. Why, then, would Iran bother with building slower bomb material-making centrifuges? First, Iran might be thinking that a bomb's a bomb, and that the more ways it has to make them, the merrier. Second, it also is easier to evade IAEA inspection accounting with the centrifuges than with the LWRs. Third, Tehran may be interested in making plutonium bombs and power and wants to protect its investment by making sure that when and if it kicks out the IAEA inspectors, it will still be able to supply its LWR with fresh fuel to produce more power and bombs.

There is, however, one other possible explanation. Fresh LWR fuel, if it is used as fresh feed for the enrichment plant, could (see below) dramatically increase the speed or number of bombs that otherwise could be produced. Of course, Iran may choose to develop covert nuclear capabilities (e.g., a heavy water reactor program) in addition. These covert programs could produce uranium and plutonium bombs more slowly without access to lightly enriched uranium reactor fuel. But the key point is that if Iran's declared program proceeds, Iran will soon have the ability to breakout not with one, but a large arsenal's worth of bombs and do so without breaking either the NPT or IAEA rules.

Rough estimates on Iran's planned centrifuge enrichment activities

Kilograms, pounds, and long tons

1 kg = 2.2. lbs
1000 kg = 2,200 lbs = a long ton

Number of kgs of Highly Enriched Uranium (HEU) required to make a nominal 20 kiloton-yield weapon

5 kilograms if there is no wastage and you have a high technology weapons design

20 kilograms if you have large amount of wastage and a very low-technology weapons design

Rough Number of Separative Work Units (SWUs) required for a variety of nuclear tasks

Approximate number of SWUs needed to make 1 kg of HEU = 200
Approximate number of SWUs needed to make a 20-kg HEU bomb = 4,000 SWUs

**Estimated SWU performance of Iranian designed (aka. North Korean and possibly Pakistani modified aluminum) centrifuges**

Reported number of Pakistani centrifuges required to make 100 kgs. HEU/year = 3,000

Number of SWUs needed to produce 100 kgs. of HEU = 20,000 (i.e., 200 swus x 100 kgs of HEU)

SWUs/year/number of Pakistani-type centrifuges = 6.7 SWUs

Adjusted SWU performance accounting for Iranian aluminum vice steel centrifuge design = 2-4 SWUs

**Estimated SWU/Iranian-designed centrifuge requirements to maintain the fueling of a two one-gigawatt Light Water Reactor (i.e., Iran's projected enrichment requirements)**

Approximate annual fuel reload requirement for a 1-gigawatt LWR = 20,000 kgs of 3.5 % low enrichment uranium

Approximate SWUs needed to meet this requirement = 80,000 SWUs

SWUs needed to meet this annual requirement for two one-gigawatt LWRs = 160,000 SWUs

Approximate number of Iranian-type centrifuges needed to meet this requirement = ~ 50,000

**Centrifuge and related bomb making capacity of planned Iranian centrifuge facilities**

Iran has floor space for at least 50,000 centrifuges and it claims it intends to make this many machines. 50,000 centrifuges are needed to produce 160,000 SWU,-- i.e., enough to meet the annual fuel requirements for two 1,000 MWe LWR reactors.

Possible kgs of HEU/yr from 50,000 Iranian-type centrifuges = 160,000 SWU

Divided by 200 SWU per kg HEU = 800 kgs HEU or 40 bombs' worth assuming 20 kgs of HEU per bomb.

**Enrichment requirements for making a large number of bombs starting with low enrichment uranium as feed for the HEU line**

To give an idea of how much better one can do starting with LEU as feed consider the following: To make 20 kg of HEU (90%) starting with natural uranium takes about 20x200 = 4,000 SWU. But starting with 3.5% LEU it can take only a little over 700 SWU if you "skim the cream"--reject the tails at an assay of 2%. In other words, in terms of separative work, the 3.5% material is already most of the way to 90%. The 700 SWUs entail using about 200 Iranian -type centrifuges. This small cascade of machines would take a feed of a little over a ton of the LEU. In this way, by diverting the LEU from two LWR reload of 20 tons-for a total of 40 tons-you could produce nearly 40 bomb quantities of HEU with an input of a little over 40x700 SWU, or about 30,000 SWU, which is a lot less than the 160,000 that it takes starting with natural uranium.