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Has Iran Achieved a Nuclear Weapons Breakout Capability? Not Yet, But Soon.

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As Iran's operation of its gas centrifuges has expanded and improved, there is growing focus on the quantity of low enriched uranium (LEU) produced at the Natanz Fuel Enrichment Plant (FEP).

This is understandably an important topic deserving of close scrutiny. However, lost in often imprecise reporting are important qualifiers such as units of measurement. As we explain below, understanding these units is relevant to Iran's timetable to a weapons capability, or "break-out."

It is important to understand whether the mass of LEU cited in reports is the entire amount of uranium hexafluoride or just the uranium content of the LEU. Most reports discussing the LEU requirements of nuclear power plants, or offering projections of how much LEU would be necessary to produce weapon-grade uranium for a weapon, are referring to the uranium content of the LEU.

The quantity of LEU referenced in the latest report by the International Atomic Energy Agency (IAEA) refers to the mass of the uranium hexafluoride. Uranium hexafluoride contains six atoms of fluorine and one atom of uranium. [The November IAEA safeguards report on Iran](#) states that Iran had produced a total of 630 kilograms of enriched uranium hexafluoride at the FEP. This material contains only about 425 kilograms of enriched uranium, the rest being fluorine.

Break-Out Capability

ISIS has estimated that about [700-800 kilograms of LEU](#) (where the mass refers to total uranium (U) and the average enrichment level is four percent) would give Iran the capability to produce enough weapon-grade uranium for a nuclear weapon. In terms of uranium hexafluoride mass, 700-800 kilograms of LEU corresponds to about 1,030-1,180 kilograms of low enriched uranium hexafluoride.

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To produce sufficient material for a nuclear weapon, Iran would need to further enrich the LEU in centrifuge cascades, either at the Natanz Fuel Enrichment Plant or an undeclared facility. This enrichment can occur quickly and this process is referred to as “break-out.”

If Iran decided to break-out, the IAEA is expected to determine quickly that the LEU was removed from storage, provoking an international crisis. However, the inspectors may not in fact learn quickly that the LEU was gone from Natanz. Using some pretext, possibly defensible under the weakened inspection rules Iran has demanded, Iran may delay the inspectors access to the underground enrichment plant where the LEU is stored, complicating any IAEA determination about the fate of the LEU. Uncertainty about the circumstances of a break-out scenario helps explain why it is important to understand when Iran reaches this capability. It also underscores the need for strengthened IAEA inspections, particularly Iran’s implementation of the Additional Protocol.

The ISIS estimate assumes an efficient, reliable centrifuge capability able to further enrich the LEU into weapon-grade uranium, a capability more likely to reside in a clandestine facility than at the Natanz enrichment plant. It also assumes that Iran would need about 20-25 kilograms of weapon-grade uranium to fashion a crude nuclear weapon. The actual amount that Iran might require is unknown, but this range of values is sufficient for several designs of crude nuclear weapons, some of which are small enough to be mounted on ballistic missiles.

Based on Iran’s current stock of LEU, ISIS concludes that Iran has not yet achieved a break-out capability. According to senior officials close to the IAEA, Iran’s LEU is on average about four percent enriched, meaning that about four percent of Iran’s LEU (U mass) is the isotope uranium 235, the most important isotope for fueling a power reactor or building a weapon. Thus, the 425 kilograms of uranium contain approximately 17 kilograms of uranium 235. This quantity appears insufficient for Iran to make a nuclear weapon, when inevitable losses in the Iranian enrichment and potential weaponization processes are included. In total, these losses could easily exceed 20 percent.

Time to Break-Out Capability

As noted above, 700-800 kilograms of LEU (in terms of U) corresponds to 1,030-1,180 kilograms of low enriched uranium hexafluoride. Iran must therefore produce another 275-375 kilograms of LEU (in terms of U) or 400-550 kilograms of low enriched uranium hexafluoride to achieve a break-out capability.

Iran is bringing into operation a second centrifuge module at the FEP, which will result in the [operation of about 6,000 centrifuges](#). Assuming that the first module continues to operate at its current level and the second gradually increases its enriched uranium output, ISIS estimates that Iran needs another three months to produce enough LEU to have 700 kilograms of LEU. The upper limit of 800 kilograms would be reached about a month or two later. If the cascades operate better than historically achieved levels, these

dates could occur earlier. If the second module does not operate as well as the first one, these dates could be delayed by several months.

Note About Other Estimates

Some experts believe ISIS's estimate of 700-800 kilograms of LEU (mass of U) is too low to signify a break-out capability. One expert believes that the minimum value should be 900 kilograms of LEU (mass of U), given the expected large losses Iran might encounter. A senior official close to the IAEA in September 2008 placed that value at over 1,000 kilograms. Others argue that Iran would want enough LEU for two or three nuclear weapons before it could be said to have a break-out capability. A 900 kilogram estimate would delay the date of Iran achieving a nuclear weapons capability by only one or two months. The other estimates would add months to that date.

Despite these differences over defining "break-out," the estimate of 700-800 kilograms of LEU represents a level of accomplishment that would permit Iran with a good chance of success to produce enough weapon-grade uranium to fashion a crude nuclear weapon, small enough to fit on a ballistic missile. Smaller quantities of LEU might be enough for a nuclear weapon, but they might also overestimate Iran's ability to produce such a nuclear weapon. Quantities greater than 1,000 kilograms appear overly conservative about Iranian capabilities or assume a definition of break-out as more than one weapon's worth of LEU. The latter also assumes knowledge about Iranian intentions that cannot be determined with any degree of certainty. Because of the cumulative effect of weakened inspections, there are growing uncertainties about Iran's gas centrifuge capabilities, particularly the size of its stock of centrifuges and any efforts to build clandestine centrifuge plants. Faced with these uncertainties, a more technically defensible approach is to focus on the amount of LEU needed to make one nuclear weapon.

Conclusion

Although some media reports in November 2008 concluded prematurely that Iran has reached a nuclear weapons capability, Iran is moving steadily toward this capability and is expected to reach that milestone during 2009 under a wide variety of scenarios. In the short term, the response should include increasing economic sanctions on Iran and accelerating the timetable for U.S.-led negotiations with Iran over the fate and transparency of its nuclear program.