Text in red are the responses by R. Scott Kemp and Alexander Glaser to:

Nuclear Weapon Breakout Scenarios: Correcting the Record

By David Albright, Paul Brannan, and Jacqueline Shire
March 18, 2009

The original analysis by Kemp and Glaser is available at:
http://www.princeton.edu/~rskemp/can-iran-make-a-bomb.pdf

Some of the complaints discussed by ISIS are the result of different standards of evidence. Other complaints are misleading. In fact, our estimates on the fast side are very similar to those of ISIS. We have made comments where we feel the criticism is unfair.

The following is in response to a paper issued March 2 by Alexander Glaser and R. Scott Kemp of Princeton University regarding Iran's ability to make a nuclear weapon, and the significance of the 19 February 2009 International Atomic Energy Agency (IAEA) report on the status of Iran's nuclear program.

ISIS has reviewed the paper carefully and has several concerns with the analysis, described in more detail below. Our conclusion is that the estimate by the authors for Iran to implement a nuclear weapon breakout strategy, roughly a year to three years, is flawed and should be corrected.

First, Glaser and Kemp ignore the potential for breakout using a covert facility which would yield weapon grade uranium from a stock of low enriched uranium (LEU) significantly faster than their estimates, based on enrichment activity at the Natanz Fuel Enrichment Plant. Though the paper's summary and conclusion imply that the possibility of undeclared facilities or feedstock have been incorporated into the analysis, only on page three does the reader learn that they have been excluded, which skews the paper's conclusions. While ignoring one of the most likely breakout scenarios, namely the use of an undeclared facility, the authors make it appear that far less likely scenarios, in particular the exclusive use of Natanz for batch recycling, are the primary avenues for breakout.

We cannot estimate the performance of a purely speculative facility. We state in the very first sentence of our breakout analysis that our calculations are only for known capabilities at Natanz. If one admits the existence of a clandestine plant, it could be of any size, and could produce HEU directly from natural uranium, and could be doing so already. This debate, which is specific to the existing stockpile, becomes practically irrelevant.

ISIS continues to assess that the most likely breakout scenario in Iran would involve a clandestine facility, allowing for a configuration that would produce weapon-grade uranium efficiently. Unfortunately, given Iran's past construction of several secret centrifuge facilities, weakened IAEA inspections, and continued secret centrifuge manufacturing, the possibility of an undeclared centrifuge facility cannot be ignored.

Further, because of the status of the current inspections, the construction of an enrichment facility would not violate any of Iran's safeguards obligations. With all the discussion of bombing Iran's nuclear facilities, Iranian planners may have decided to create a back-up capability in case Natanz is actually attacked.

Second, the authors' analysis of breakout scenarios involving Natanz vastly overestimate the time required to convert low enriched uranium into weapon-grade uranium. Their analysis is premised on the average LEU production at Natanz during a scant 74 day period between November 18, 2008 and January 31, 2009, and appears to assume that all 4,000 centrifuges were enriching on a continuous basis during that period. This assumption leads to an extremely low average enrichment output, measured in terms of separative work units (SWU) per year per centrifuge. In fact, the number of centrifuges enriching during this period is not known and is probably not 4,000 centrifuges in any case. Moreover, Iran has achieved considerably higher outputs in prior periods. Nonetheless, the summary of the paper, derived from this lopsided projection, identifies this scenario as the most realistic breakout route.

We give numbers based on both the plant's actual output for the most recent operating period reported by the IAEA, and for the absolute maximum performance of the machines should Iran be able to fix their machines to work at the intended performance. The latter set of numbers are in agreement with those of ISIS.

Third, the authors ignore that there are almost 6,000 P1 centrifuges installed at Natanz, not just the 4,000 centrifuges they use in their analysis. This omission affects their estimates by about one-third.

We give estimates for both the current installed capability of 4000 operating machines, and for a future capability based on the current rate of new-machine installation, which includes the additional 2000 machines now being installed.

There are also other scenarios that Glaser and Kemp did not consider. A more realistic approach for breakout at Natanz would be to use sets of the additional cascades, which are either under vacuum or being installed, to enrich in stages, with 1,300 of the recently installed centrifuges enriching from 3.5 percent to 20 percent, and approximately 600 centrifuges enriching to weapon-grade in two further stages. In essence, this strategy would use a facility designed to make weapon-grade uranium that is similar to the one Pakistan created and A.Q. Khan peddled. For the stage from 3.5 percent to 20 percent, the existing cascades could be used, and the feed and withdrawal systems would require minor modifications. For the other two stages, fewer P1 centrifuges would be used per cascade, but this is a straightforward modification of the existing cascades. Some modifications would be needed to address criticality risks in the feed and withdrawal portions of these cascades. These modifications could be made while enriching up to 20 percent.

In fact, our analysis considers this scenario. In addition to batch recycle and total cascade reconfiguration, we consider exactly the multi-cascade arrangement peddled by A.Q.

Khan. This is made clear in a peer-reviewed paper by Glaser cited in footnote 6. The reason we do not mention this scenario explicitly is because it is no faster than the ideal-cascade scenario in producing HEU. The only place where it makes a difference is in the amount of time it takes to reconfigure the cascade, but we did not factor in reconfiguration delay in our scenarios, and neither has ISIS done so in theirs.

The time necessary for any cascade reconfiguration and subsequent enrichment, under the scenario described above, is considerably shorter than the Kemp-Glaser estimate. ISIS calculates that it would take less than 6 months to modify the cascades and produce 20-25 kg of weapon-grade uranium metal, assuming approximately 1.5-2 SWU per year per machine.

A clandestine plant with about 3,000 P1 centrifuges organized in a similar fashion as above would be able to produce the 20-25 kilograms of weapon-grade uranium from 3.5 percent material in 2.5-3.6 months at 2 SWU per year per machine, or 3.3-4.8 months at 1.5 SWU per year per machine.

All of these estimates are based on machines performing near their maximum performance, estimates which we also give. We estimated 7-8 weeks for a 4000-machine cascade, in agreement with ISIS' estimates stated above. However, we also believe, for various technical reasons, that it is extremely unlikely that Iran can operate its IR-1 centrifuges at these performance levels. If Iran could improve the performance of its machines, why has it not done so already?

The advantage of stockpiling LEU is that it would allow Iran to more quickly produce weapon-grade uranium than if it started with natural uranium. However, all estimates are scenario driven. Kemp and Glaser selected those that might be frequently discussed and warrant consideration, but by excluding other more likely scenarios, produced a misleading assessment. After all, the method of breakout and the decision to do so are in Iran's control. Inherent in the decision to break out is the desire for speed. Most of the faster scenarios involve a clandestine facility, making them more likely. Moreover, Iran is well aware that the IAEA would detect its break out, inviting swift military action by Israel and perhaps the United States. As a result of these considerations, Kemp and Glaser's exclusive focus on the more time-consuming options at Natanz misses the mark.

There is one other scenario using Natanz that could bring Iran significantly closer to weapon-grade uranium and at the same time challenge the international community. Iran could decide to produce slightly less than 20 percent enriched uranium at Natanz, declaring that the material will be used in research reactors. As mentioned above, only minimal changes would be required to do so. Iran has a research reactor at the Tehran Nuclear Research Center which uses fuel at that enrichment. Iran should be discouraged from this path.

Iran should also be persuaded in the short-term to resume declaring new nuclear facilities prior to construction, rather than six months before the introduction of nuclear material.

This minimal request, part of traditional safeguards applied worldwide, would help reduce the breakout risk posed by undeclared centrifuge facilities.

Ultimately, breakout is a political decision. Such a decision appears unlikely at least over the near term given Iran's preoccupation with the upcoming presidential election in June and Iran's possible interest in sounding out the new Obama administration's approach to Iran policy. But Iran has crossed a technical milestone, and it is important to adjust to it while recognizing that Iran can still concede such progress in negotiations. It is better to work toward mutually acceptable diplomatic solutions than attempt to wish away the problem with unrealistic assessments.