



July 30, 2013

Critical Capability

Priority is limiting the number and type of centrifuges at Natanz, Fordow, and any other centrifuge site Iran may now be constructing.

By David Albright and Christina Walrond

[Based on an ISIS assessment](#), Iran is expected to achieve a critical capability in mid-2014, which is defined as the technical capability to produce sufficient weapon-grade uranium from its safeguarded stocks of low enriched uranium for a nuclear explosive, without being detected. Iran would achieve this capability principally by implementing its existing, firm plans to install thousands more IR-1 centrifuges, and perhaps a few thousand IR-2m centrifuges, at its declared Natanz and Fordow centrifuge sites. Iran's criticality date could be achieved a few months earlier if Iran successfully deploys and operates several thousand IR-2m centrifuges and continues installing thousands of IR-1 centrifuges. A priority is preventing Iran from achieving a critical capability via non-military means.

Preventing Iran from reaching critical capability will require a broad set of responses, but the most important is limiting the number and type of centrifuges Iran builds. Although increasing the frequency and type of inspections at the enrichment plants is important, it is by no means sufficient to prevent Iran from achieving critical capability.

Inspections

As Iran moves closer to a critical capability, assessing the efficacy of additional safeguards becomes increasingly important. An important option to limit Iran's ability to achieve a critical capability involves increasing the rate at which the International Atomic Energy Agency (IAEA) inspects Iranian centrifuge facilities, particularly the underground Fuel Enrichment Plant at Natanz. ISIS has recommended that inspections should increase to at least twice per week at Iran's enrichment facilities. However, there is an inherent limitation and dilemma to increasing the rate of inspections, despite their importance.

If Iran's ability to break out decreases below a certain threshold the IAEA could face problems providing sufficient warning of that breakout. The warning would need to allow for a response, here limited mainly to a military response, to prevent Iran from accumulating enough weapon-grade uranium for a nuclear weapon. The most fundamental problem is that Iran could simply deny inspectors access to enrichment facilities for an ostensibly innocent reason, such as on account of a fire or an accident involving uranium hexafluoride (fluorine gas is highly toxic). Iran has in the past denied inspectors access with little or no recourse. Will denial of access be viewed on its own as tantamount to breakout and thus precipitate an immediate military response to prevent Iran from making enough weapon-grade uranium for a bomb? Or will the United States and Israel hesitate to strike out of fear of facing international opposition and that Iran may be telling the truth? In the latter case, Iran could have time to make enough weapon-grade uranium for one or more nuclear weapons.

Breakout times at critical capability would be so short that there simply would not be enough time to organize an international diplomatic or military response. Olli Heinonen, former head of safeguards at the IAEA and a well-respected, seasoned, former inspector of Iran's nuclear program, has cautioned those that believe the IAEA will necessarily sound the alarm quickly. The IAEA processes, which stress caution and substantiation of information, may delay two to four weeks the inspectors reaching a course of action in response to being denied access to a site and calling together its Board of Governors, he wrote in an email to one of the authors. (ISIS assumes that word of the breakout would leak out quickly to the United States and its allies.) The Board, as well as the United Nations Security Council, may then ask Iran to halt the activities, he added. But IAEA inaction or caution could make an international response all but impossible before Iran has produced enough weapon-grade uranium for one or more nuclear weapons.

One could argue that the best response is to station IAEA inspectors permanently at the enrichment plants with reliable, independent communication gear. But this option carries with it the problem that IAEA inspectors could be held hostage in a breakout crisis. This would likely affect the calculus on military action in the event that Iran chooses to breakout and pursue a nuclear weapon. Effectively, the decision would force the international community to choose between striking a facility and killing IAEA personnel or allowing Iran to build a nuclear weapon.

Moving to remote IAEA monitoring could be one answer to the above dilemma, but Iran has resolutely opposed it, and remote monitoring may not matter, in any case, during a breakout. The P5+1 Almaty proposal has a condition that Iran accept remote camera monitoring capable of sending continuously real time encrypted images to IAEA headquarters in Vienna. But again, Iran could sabotage the equipment, professing ignorance or claiming an innocent reason for the failure. It could subsequently refuse inspector access. And what would be the response by the international community?

Nonetheless, ISIS still supports both increasing the frequency of inspections and pushing for remote monitoring as conditions for progress in negotiations. The point is that by themselves these measures are not sufficient if Iran reaches critical capability.

Neither is a cap sufficient on the amount of 19.75 percent low enriched uranium (LEU) that Iran can stockpile. A cap is useful but Iran has installed the centrifuge capability to rapidly make a considerable amount of near 20 percent LEU, so it could overcome any cap within a few months, while professing to need this LEU for its civil nuclear program. It is in any case slowly building up toward the limit imposed by the international community, namely that it produce no more than about 250 kilograms of near 20 percent LEU hexafluoride. As of June 2013, it possessed about 180 kilograms. Iran's stockpile of near 20 percent LEU hexafluoride certainly affects how rapidly Iran could breakout, making a cap worthwhile. By itself, however, this cap cannot prevent Iran reaching a critical capability.

Limiting the Number and Type of Centrifuges

The most important condition that could be placed on Iran is achieving a halt to the installation of more centrifuges of any type. The type and number of centrifuges Iran operates can dramatically decrease the amount of time Iran needs to enrich to weapon-grade uranium in a breakout. Thus, Iran's continued installation of IR-1 and more powerful IR-2m centrifuges must be addressed in future negotiations. If Iran continues to install about 3,000 IR-2m centrifuges at Natanz as it plans, it will have effectively doubled the total enrichment capacity of this facility. Centrifuges that are fully installed but not yet operating should also count towards Iran's total, particularly if the amount of time needed to bring them online is minimal. Any future nuclear deal must include a limit on the number and type of centrifuges Iran can install. A numerical limit would need to be well below the number of centrifuges currently installed at Natanz and Fordow and more akin to the number of centrifuges actually enriching as of June 2013.

With a limit on the number and type of centrifuges at Natanz and Fordow, a critical capability can be avoided. Adding the other two measures, namely more frequent inspections and a cap on stocks of near 20 percent LEU, this limit would provide additional assurances that breakout times will be much longer at these sites and detectable in a timely manner.

A Secret Site?

ISIS judges that if Iran has one, it has likely not yet finished a secret centrifuge facility composed of about 2,000-3,000 advanced centrifuges, similar in size to the deeply buried Fordow centrifuge site. Such a facility could produce sufficient weapon-grade uranium relatively quickly if the centrifuges worked well.¹ So far, few experts believe that Iran has finished such a plant. But is Iran building one?

That question is much harder to answer, but there are reasons to conclude the Iran could now be building a new centrifuge plant, based primarily on Iranian officials' past statements.

Iran has built each of its centrifuge plants in secret, revealing them when caught, a fact well documented by the IAEA. It secretly constructed the Natanz centrifuge site, the Kalaye Electric centrifuge research and development plant, and the deeply buried Fordow centrifuge facility.

Iran has for several years falsely claimed that it can essentially build a nuclear facility without notifying the IAEA as long as it informs the IAEA about this facility six months before it introduces nuclear material there. It has said the same about the Arak heavy water reactor which is now [nearing completion](#). While it would be absurd for Iran to deny the existence of the Arak reactor, which can easily be seen in commercial satellite imagery, Iran continues to deny the IAEA vital information about the design of this reactor based on its fallacious claim that it does not need to do so until six months before it introduces nuclear material, a date not yet reached. In fact, reactor is now nearly complete, and Iran has yet to notify the IAEA of the required design information.

Is Iran now trying to do the same with a new centrifuge plant, essentially seeking to finish it before it is revealed to the IAEA? Past statements by Iranian officials indicating a timeline of possibly nearing completion on a secret facility raise suspicions. Former Iranian nuclear chief, and current foreign minister, Ali Akbar Salehi, said on August 16, 2010 that "studies for the location of 10 other uranium enrichment facilities" had ended and that "the construction of one of these facilities will begin by the end of the (current Iranian) year (March 2011) or start of the next year."² Succeeding nuclear head Fereydoun Abbassi-Davani [said](#) in mid-2011 that construction of an additional enrichment plant was delayed by two years.³ Now, two years later, what is the status of a new centrifuge plant in addition to the Natanz and Fordow centrifuge plants? Is Iran carrying out just what it said it would do?

The growing uncertainty about this question calls for Iran to become more transparent. Most importantly, Iran must agree to comply with the IAEA's requirement of early notification of construction. It must also provide far more information about its now secret centrifuge manufacturing and assembly complex and permit the

¹ ISIS and its colleagues at the University of Virginia are currently calculating the amount of time needed to produce weapon-grade uranium at such a centrifuge site. The uncertainties derive from the lack of data about the operational performance of the IR-2m centrifuge, particularly in cascades. Overall, the IR-2m is judged to have 3-5 times the enrichment output of an IR-1 centrifuge. At the upper bound of output, or about 5 separative work units per year per machine in cascades, 3,000 IR-2m centrifuges could produce 25 kg of weapon-grade uranium in as little as about four months, starting with natural uranium feed. This value is a minimal bound and assumes that the plant is designed to make weapon-grade uranium highly efficiently and the centrifuges all work optimally, both very uncertain assumptions. If LEU feed is used instead, the time to make sufficient weapon-grade uranium decreases significantly.

² "Iran Specifies Location for 10 New Enrichment Sites," Fars News Agency, August 16, 2010.

³ Siavosh Ghazi, "Iran Atomic Chief Says Fuel Swap Talks Over: IRNA," AFP, Aug 29, 2011.

IAEA to monitor these activities, allowing for greater confidence about the number of centrifuges Iran could build in the future. Iran should also ratify the Additional Protocol that facilitates the IAEA's right and obligation to provide assurance that Iran is not building a secret centrifuge plant or does not have undeclared nuclear materials or facilities.

Conclusion

No doubt, P5+1 negotiators have a substantial task to achieve all of these conditions. However, a critical capability is unlikely to be prevented simply by instituting better inspections, whether through increased inspection frequency, remote monitoring, or even implementation of the the Additional Protocol. Although these steps are critical, the immediate priority must be limiting the number and type of Iran's centrifuges at Natanz, Fordow, or a site not yet finished. This goal needs to be obtained soon.