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How much is enough: What are the necessary constraints on Iran's ability to produce fissile material

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Ephraim Asculai details the factors negotiators must consider in determining an acceptable limit on Iran's fissile material production capacity. He explains the link between centrifuge capability and breakout time, and offers options for acceptable modifications to Iran's Arak facility.

By Ephraim Asculai

Given Iran's well-known animosity towards Israel, including its declared desire for the destruction of Israel and official holocaust denial, an ideal nuclear deal would include the total denial of Iran's ability to produce fissile materials and develop a nuclear explosive mechanism (DEM). In reality, this is no longer a viable possibility, given the Joint Plan of Action (JPA) that came into force in January 2014. The JPA tacitly recognized the Iranian uranium enrichment program. With total denial off the table, Western negotiators need to answer the key question of the nuclear talks: what are the necessary constraints on Iran's ability to produce fissile material? In an effort to find an answer, three major areas will be discussed here: the uranium enrichment program, the plutogenic IR-40 heavy-water reactor and the DEM.

The answer will depend on a somewhat elusive quantity: the time it would take to uncover undeclared, covert activities meant to acquire enough fissile material for the production of a single nuclear explosive mechanism. That quantity is determined by two factors: the time it would take to produce the desired amount of the fissile material and to bring it to the desired engineered form (commonly named the "breakout time"), and, the time it would take the verification/intelligence organizations to uncover these covert activities. Another, external factor would be the time for the world decision-makers to react to the uncovered facts. *The basic requirement for a stable situation would be that the breakout time be longer than the other factors put together.*

In the uranium enrichment route to a breakout, two factors determine the breakout time: the quality of the uranium input into the process (uranium-235 abundance, and its chemical form), and the uranium enrichment capacity. This last factor is measured by the Separative Work Units (SWU) of any enrichment system, not specifically designated for gas-centrifuges. For an enrichment program beginning with natural uranium (0.7% abundance of uranium-235) and working up to the military value of 90%, one would need approximately 5000-5500 SWU. For the IR-1 model of centrifuges this means that some 6000 machines working for a year would produce 1 “significant quantity” of 90% uranium-235, sufficient for the first nuclear explosive device. Double this number of centrifuges, and the quantity would be produced in 6 months. If one would begin the enrichment process with 3.5% and use the same number of SWU, the quantity could be produced in 1/4 the time. With an input of 20% enriched uranium, the time to breakout would be much less.

Thus, as an example, should we want to set a breakout time of one year, we would have to limit the number of present-day IR-1 centrifuges to about 6000, and make the present stocks of 3.5% enriched uranium and above unavailable for further enrichment. This could be done by selling this uranium abroad at market prices, or contracting Russia, e.g., for producing fuel for the Bushehr reactor with this uranium, selling it back to Iran. Letting Iran keep this uranium, even under a thorough verification mechanism, would be a prescription for a potential disaster, should Iran decide to breakout and produce a nuclear explosive mechanism in minimum time.

Although much less readily available than uranium enrichment, the prospect of Iran eventually using the IR-40 reactor, under its present design, for the production of military-grade plutonium is not less daunting. Therefore, the potential for producing plutonium in this reactor should be physically limited, and not by administrative means. This could be done by modifying the cooling systems, limiting the power of the reactor to, say, some 5 megawatts and thus reducing the production to 1 kilogram of plutonium per year. The insertion of non-uranium neutron absorbers into the reactor core would be another means of lowering the reactor’s power, but one that would be more prone to relatively quick reverse modifications. Another, secondary, means of control would be to insist on long burnup values of the reactor fuel, thus lowering the worth of the plutonium for weapons production. The uranium dioxide fuel can withstand high burnup values. The idea of transforming the reactor to a light-water one is interesting, but the catch here is that this reactor would need enriched uranium as fuel, and where would this come from? Dealing with this reactor, and with any other future reactors, must be a part of any future agreement with Iran.

The issue of DEM is a serious one, and cannot be detached from the other issues, since it is the final link in the production of a nuclear explosive device. Since this activity has been going on for more than a decade, it must be assumed that at least one version of a nuclear explosive mechanism is ready. Therefore, no delay can be credited to it. There are no technical viable means to limit Iran’s DEM activities, and intensive verification system must be enacted and carried out to provide the necessary assurances. Verification should take place both at known sites and at suspect sites. This is important for all the

above reasons. Without this, the whole system can fail, and will fail should the Iranian leadership decide to breakout, whether overtly or covertly, and produce a first nuclear explosive device, and then test it. *From that moment no one will be able to assume that Iran is not a de-facto nuclear weapons state.*

From sad past experience with Iran, one cannot assume that Iran will hold to any of its obligations. Therefore, physical measures will be the best, and perhaps the only, means to assure that Iran will not be able to breakout and produce a nuclear explosive device in short order. *Diplomatic, legal and administrative measures must not be enough, at least for the foreseeable future.*

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