INSS Insight No. 1421, January 13, 2021

How Close is Iran to a Nuclear Bomb?

Amos Yadlin and Ephraim Asculai

On January 4, 2021, Iran announced that it had begun enriching uranium to a level of 20 percent at a well-protected facility in Fordow. This level of enrichment departs completely from Iran's commitment stipulated in the agreement reached with the world powers in 2015 (JCPOA). There are two main possible reasons for this Iranian announcement. One, it is intended as a provocation, designed to exert pressure on the world powers to lift the sanctions imposed on Iran, which were renewed by the United States. Two, Iran intends to accumulate uranium enriched at a level and quantity that will reduce the breakout time that Iran needs from the moment it decides to produce a nuclear explosive device. For 12 years Iran has been at a breakout range of between several months to two years, and has not yet taken the decision to break out to the bomb. This article analyzes the processes that Iran must go through from a breakout decision until it attains a nuclear weapon, and highlights the need to examine assumptions for calculating breakout times.

The agreement between Iran and the P5 +1 (United States, Britain, France, China, Russia, and Germany) from July 2015 stipulates, inter alia, that Iran is allowed to hold up to 300 kg of its self-enriched uranium at a level of 3.67 percent. The agreement also stipulates the number of centrifuges that perform the enrichment, their type, and location. At the time, President Barack Obama stated that in light of the agreement, the breakout schedule (as he defined it, for the production of enriched uranium sufficient for a first bomb) was one year, instead of a much shorter time before the agreement.

According to the Israel Defense Intelligence estimate, as published in an interview with the outgoing head of its research division (October 9, 2020), from the moment of a breakout decision, Iran will be two years away from a bomb. If so, how is it possible that in the current situation in Iran, given that its centrifuges today are more efficient than five years ago, and that since 2019 it has enriched uranium beyond what is allowed under the agreement and has already accumulated more than eight times as much material as allowed in the agreement, it is still so far from a bomb? A partial answer to the question is that as of November 2020, some of the advanced centrifuges were installed but are not yet fed by uranium gas, i.e., some are installed and some are still in development / production. And the fuller answer is that in the past, the time to the bomb was calculated

up to the fissile material accumulation, while today some add to uranium enrichment the setup of the nuclear explosive mechanism, essential for the production of the weapon itself.

Nuclear weapons require three main components: fissile material – in the Iranian case, military grade enriched uranium; the weapons system; and a platform for delivering the nuclear bomb. Iran already has platforms – missiles that can carry nuclear weapons – and also has the ability to produce fissile material, i.e., uranium enrichment capability, which is allegedly intended for civilian purposes but is dual-use and can be used for a bomb.

The key to the differences in estimates is found in the assumptions for calculating Iran's time distance from the bomb. At the heart of the various assessments is **a controversy over the duration and the level of concurrency of the development of the weapon system** – which Iran denies it is developing. And beyond the issue of the time for developing the explosive mechanism, any overall estimate should consider eight parameters that affect Iran's time to a bomb:

- Is the goal a first bomb, an operational arsenal (five bombs), or an operational array (operational launch platforms)? It is common to focus on the time to the first bomb on the assumption that after the first bomb it is difficult to stop a nuclear program. It is commonly assumed that a first bomb requires 25-30 kilograms of military grade uranium, about 90 percent, the significant quantity (SQ).
- Are the standards of "cold" trials and safety "Western," or will the project be conducted in an emergency procedure with shortcuts and minimal safety margins? The prevailing assumption is that Iran’s breakout time will be characterized by as short a time as possible and therefore safety margins or tests of Western standard should not be accounted for.
- Is the Iranian breakout overt or covert? Covert breakout requires small disguised or hidden facilities, which by definition are slower. On the other hand, if Iran has secret facilities that join the declared enrichment capabilities in an overt breakout, the time to the bomb will be shortened. In most calculations, the assumption is that there are no concealed facilities in Iran, or that they are insignificant. If the covert element is significant, calculating the breakout time could be meaningless.
- The generation of centrifuges to be operated by Iran: Until the 2015 agreement, Iran's centrifuges were first generation, IR-1. Three thousand centrifuges of this model were required to spin for a year to reach a high enrichment SQ (25 kilograms). But as of November 2020, Iran began installing advanced model centrifuges at the main enrichment facility, and the enrichment rate will be shortened accordingly.

- What is the initial stock of enriched uranium, and at what level of enrichment? Iran can accumulate enriched uranium at different levels of enrichment and in different amounts. Given the same quantity and quality of centrifuges, breakout time from 0.7 percent enrichment or uranium at 20 percent, and even from 4.5 percent enrichment, is completely different. In November 2020 Iran had only 1.7 tons of enriched uranium at up to 4.5 percent (in varying degrees), but with 1000 advanced centrifuges it will be possible to reach enough material for one bomb within a month to three months, depending on the model. Furthermore, if Iran enriches a sufficient amount of uranium, the breakout time will be further shortened, as enrichment to about 90 percent, which is the level required for nuclear weapons, requires a small number of centrifuges and a short time for enrichment.

Assumptions regarding the development and status of the weapon system:

- Complexity and length of the weapons development project: This parameter is the most significant for the length of time it will take to attain a bomb. Some argue that developing a weapon system is not as difficult a challenge as it was 50 or 70 years ago. Knowledge of nuclear weapon systems, advanced computer systems, and dual-use technologies enables the development of weapon systems within a period of several months. On the other hand, others, led by the US intelligence community, argue that the challenge is still significant, that the time period has not yet been shortened, and that it is a sensitive development process of at least one and maybe even two years.
- Concurrency of the enrichment program and the weapons program: It is unclear whether after 2003 Iran continued to work simultaneously on both the weapons program and the enrichment. Working in parallel shortens times, especially on the assumption that weapons development is short. In most if not all countries that developed nuclear weapons, the critical route was the production of the fissile material, whereas the explosive mechanism was developed faster but refined over time. From intelligence published by the IAEA and from the nuclear archive seized by the Mossad, it is known that Iran engaged in the development of the explosive mechanism as early as 2003 and probably even before that.
- Iranian progress in the weapons team since 2003: If the team has been inactive, as most intelligence organizations assume, development of not-so-simple components of the bomb is required, with the reasonable assumption that the weapon will use the implosion technique: processing the uranium and manufacturing the core, building an accurate explosive system, installing a neutron source, integrating all the components, and preparing and performing a series of complex tests and experiments. But if the Iranians have a secret

weapons team and the development of the weapon system is over, then the breakout time should be estimated at a few months until the final integration.

How can such different results be posited as to how long it will take for Iran to reach a bomb? To demonstrate the difference, three sets of assumptions will be illustrated – pessimistic, probable, and optimistic. In all three scenarios the reference is to a first bomb as the finish line, assuming that Iran does not meet Western standards and there are no concealed enrichment facilities.

***Pessimistic scenario*:** The explosive mechanism development occurs in parallel with enrichment to a military level. Most of the components for the weapon system have been secretly developed and the additional extra time required to develop the weapon is three months. Iran has at least 1,000 advanced centrifuges that estimate the enrichment of the quantity required to produce a single core (SQ) as three months. In this case, it is estimated that Iran could develop a bomb within four to six months of its decision.

Probable scenario: The development of the weapon has not been completed, but is at an advanced state and will take about six months, and only three months of which are in parallel to complete the enrichment. Iran has no active advanced centrifuges, and it will be three months before these are activated and the others installed. Therefore enrichment time to SQ is five months. In this case, Iran's time to a bomb is eight months to a year, as of the end of 2020.

***Optimistic scenario*:** Due to a cautious approach to weaponization, the time required to develop the weapon is one and a half years; it occurs after the SQ is attained (by first-generation operational centrifuges only), which requires half a year. In this case, the time to the bomb is two years. This assessment, which is extreme, is based on an intelligence concept (relatively strong but risky) that Iran has not dealt with weaponization since 2003.

These assessments do not take into account political moves such as an Iranian withdrawal from the Nuclear Non-Proliferation Treaty (NPT), which requires three months from the moment of declaration until actual application. But it is likely that this procedure will not interest Tehran, if it decides to break out to a bomb.

In conclusion, it remains to be seen whether there is a justification for an optimistic assumption, based on the assessment that Iran has suspended the activities on nuclear weapons and trials to advance its components it – all very significant aspects of the nuclear project. It is therefore advisable to rely on the reasonable scenario, which posits an addition of about three months beyond the end of the uranium enrichment and about

eight months to a maximum of one year from the decision to break out to the bomb until the completion of the first bomb. Beyond this discussion, the actual enrichment of uranium in significant quantities to the level of 20 percent will require a comprehensive reassessment of the schedule of the Iranian nuclear weapons project.