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The Other Sides of Renegotiating the JCPOA Iran Nuclear Agreement

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Working Draft: April 15, 2021

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So far, most of the debate over the JCPOA agreement has been a repetition of the original debates that took place before the agreement was reached in 2015 and while the current agreement was first being negotiated. The public side of this debate focused almost exclusively on preventing Iran from getting enough fissile uranium and plutonium for a nuclear weapon, and it made no effort to describe what kind of nuclear weapon or nuclear force posture would be involved, what delivery systems would be involved, or what level of nuclear weapons yield and nuclear force Iran would or could acquire in a breakout effort.

These negotiations largely took place more than a half decade ago, and they took place at a time when few estimated how quickly Iran's missile and UCAV/drone forces could develop, how quickly it could acquire conventional precision-strike capabilities, how much it could expand its regional ties and influence, and what the potential effects could be of new Russian and Chinese arms transfers to Iran's other forces.

They did not attempt to address the overall stability of the future military balance in the Gulf and MENA region or to reach compromises that were valid at the time – assuming that the agreement would be the first step in achieving a broader level of stability in the region.

The U.S. withdrawal from the JCPOA, Iran's development progress, Israel's new attacks on Iran's underground centrifuge facility at Natanz, and the increasing level of instability in the region have all changed these conditions. This does not necessarily mean that the JCPOA should not be revived, but it does mean that the JCPOA should be addressed in very different terms.

Even if the JCPOA can be revised, it does not mean that Iran will halt its covert nuclear weapons development program. The new *Annual Threat Assessment* for 2021 issued by the U.S. Office of the Director of National Intelligence (ODNI) on April 9, 2021 warns that some of these activities are already taking place, and that Iran will probably increase them if it does not get some relief from U.S. sanctions:¹

We continue to assess that Iran is not currently undertaking the key nuclear weapons-development activities that we judge would be necessary to produce a nuclear device. However, following the US withdrawal from the JCPOA agreement in May 2018, Iranian officials have abandoned some of Iran's commitments and resumed some nuclear activities that exceed the JCPOA limits. If Tehran does not receive sanctions relief, Iranian officials probably will consider options ranging from further enriching uranium up to 60 percent to designing and building a new 40 Megawatt Heavy Water reactor.

Iran has consistently cast its resumption of nuclear activities as a reversible response to the US withdrawal from the JCPOA and messaged that it would return to full compliance if the United States also fulfilled its JCPOA commitments.

Since June 2019, Iran has increased the size and enrichment level of its uranium stockpile beyond JCPOA limits. Since September 2019, Iran has ignored restrictions on advanced centrifuge research and development and restarted uranium enrichment operations at the deeply buried Fordow facility. In January, Iran began to enrich uranium up to 20 percent and started R&D with the stated intent to produce uranium metal for research reactor fuel, and in February, it produced a gram quantities of natural uranium metal in a laboratory experiment.

This is particularly true after Israel's new attack on the Iranian underground nuclear centrifuge facility in Natanz on April 11, 2021, in the midst of the JCPOA negotiations involving Iran, the

United States, U.S. European partners, Russia, and China. Regardless of whether Iran and the U.S. can agree on some form of revived agreement, the nuclear duel is virtually certain to continue at covert levels. Iran is likely to exploit every loophole and covert opportunity it can to reduce the time it would need to deploy a nuclear weapon and nuclear-armed force – if not actually acquiring meaningful stocks of fissile material. In practice, arms control can all too easily become a form of gray area warfare by other means.

How quickly can Iran acquire fissile material if it decides on a rapid nuclear breakout?

There is no official U.S. estimate of how quickly Iran could acquire enough fissile material for a nuclear device or enough fissile material to have credible delivery capability. Most outside estimate also only try to assess “nuclear breakout” in terms of enough material for one nuclear device of an unstated size, yield, and level of weaponization. Some of the most sophisticated open source estimates examine an arrange of different ways Iran can acquire enough material, and these estimates put the time at a nominal year with some as short as 2.7 months, but they are not based on access to classified data – and even the best estimates are forced to rely on educated and technically sophisticated guesswork.

One key estimate by David Albright and Sarah Burkhard of the Institute for Science and International Security (ISIS) was made in April 2020, and it defines its methodology as follows:²

...this report presents recent Iranian breakout estimate sand compares them to pivotal historical ones, where breakout is defined as the time Iran would need to produce 25 kilograms of weapon-grade uranium (WGU), enough for a nuclear weapon. As of late February 2020, the breakout estimate is 3.8 months, with a range of 3.1 to 4.6 months. This estimate is based on an Institute breakout calculator, utilizing modified ideal cascade calculations, adjusted with results from an earlier multi-year program of complex computer simulations of Iranian breakout, conducted in collaboration with centrifuge experts at the University of Virginia, and supplemented by operational data on Iranian centrifuges.

The breakout estimates result from Iran’s installed enrichment capacity and its stock of low enriched uranium (LEU), as reported by the International Atomic Energy Agency (IAEA) in its quarterly reports on Iran. A significant development is that Iran is at the threshold of having enough LEU to move from a four-step enrichment process to a three-step one, allowing a significant reduction of breakout times, a phenomenon referred to in the media as a “key threshold” or “enough LEU for a nuclear weapon.” A potential covert enrichment plant utilizing 3000 IR-2m centrifuges is also assessed, giving a breakout of 3.1 months. The Annex to this report contains a summary of Iran’s stock of low enriched uranium, based on the IAEA’s most recent quarterly report on Iran, summarizing the situation as of late February 2020 and identifying which of the LEU stocks are used in the breakout calculations.

This assessment is well worth reading in full, and it is available on the ISIS website. In spite of its need to rely on unclassified source, it makes a good case that Iran could have rapidly acquired enough material for one nuclear device at the start of 2020, even without its later 20% enrichment activity and any future activity that rose to 60%. It put the time range at 3.1-4.6 months, and an average of 3.8 months, if Iran used its already existing known capability at its plants at Fordow and Natanz. It put the time range at only 2.7-3.9 months, and an average of 3.1 months, if Iran could add the capacity of one clandestine plant the size of Fordow to its enrichment efforts.

The analysis also suggests that a “worst case” covert program could have reduced the breakout time needed to acquire enough fissile material dropped from six months in 2010 to less than one month by 2016. Such a case seems unlikely, but “worst cases” do happen.

It is critical to note, however, that the ISIS assessment makes it clear *that it only examines the time necessary to get enough material for weapons-size explosion, and it does not examine the issues in creating an effective nuclear weapon or enough weapons to make an effective force.*³

Breakout estimates do not include the additional time that Iran would need to convert WGU into weapons components and manufacture a nuclear weapon. This extra time could be substantial, particularly if Iran wanted to build a reliable warhead for a ballistic missile. However, these preparations would most likely be conducted at secret sites and would be difficult to detect; many relevant activities may have been ongoing for years. If Iran successfully produced enough WGU for a nuclear weapon, the ensuing weaponization process might not be detectable until Iran tested its nuclear device underground or otherwise revealed its acquisition of nuclear weapons. Therefore, the most practical strategy to prevent Iran from obtaining nuclear weapons remains preventing it from ever accumulating sufficient nuclear explosive material, particularly in secret or without adequate warning. This strategy depends on knowing how quickly Iran could make WGU.

In practice, Iran would probably need to conduct some form of underground test and have a deployed delivery force of at least 2-3 nuclear-armed long-range ballistic missiles to have a credible capability to deliver one weapon against a city sized target or critical petroleum facility, and it would risk Israeli, U.S., and Arab Gulf preemption during this build-up. Iran also, as is discussed later, could now successfully attack most critical infrastructure facilities in Gulf with precision guided missiles and UCVA's with far less risk of triggering catastrophic escalation, affecting its own economy or subjecting its own military forces and civilian population to devastating retaliation.

How far can Iran go in centrifuge development and stockpiling centrifuges?

There is no one approach to using centrifuges to produce weapons grade uranium (WGU), and – as the ODNI report notes – Iran may have the ability of using a covert heavy water reactor and, it has already come close to deploying one before it complied with the terms of the JCPOA. The study by Albright and Burkhard notes that the,

...analysis utilized a modified form of the well-known four-step enrichment process that was developed under A.Q. Khan for Pakistan's centrifuge program and transferred to other countries, such as Iran. Using all four steps, Iran would enrich natural uranium to 3.5 percent in step one, then to 20 percent in step two, 60 percent in step three, and finally to WGU in step four. The analysis also considered a subset of the four-step process with three-step and two-step processes starting with the then-existing 3.5 and near-20 percent LEU stockpiles.

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These uncertainties are critical because it is unclear from the open-source literature on the JCPOA as to how the negotiators of the JCPOA assessed Iran's centrifuge programs and its future development capacity. Iran has stated openly since the U.S. withdrawal from the JCPOA, however, that it has resumed enrichment at a 20% level – which allows it to enrich to weapons-grade more quickly. It also has threatened to go to 60% enrichment if the JCPOA negotiations do not give it relief from sanctions.

Iran has also made major progress in new centrifuge developments. Iran has made it clear that it has gone far beyond the IR-1 centrifuges it initially deployed. It deployed the fourth improved version – the IR-4 – at the facility that Israel attacked at Natanz. It has now deployed its first chain of some 164 IR-6 centrifuges, is developing an IR-8 series, and has designed IR-9 centrifuges which it claims would be able to separate uranium isotopes 50 times more quickly than the IR-1.

It also extremely likely that Iran has modified its existing centrifuge facilities and designed new centrifuge facilities in ways that steadily increase their protection from the type of cyberattacks used by Israel and the U.S. in the Stuxnet attacks in 2010, from any outside sabotage like the cause of the fire that occurred at Natanz in 2020, and from the methods Israel used in its attack on Natanz in April 2021. Iran virtually said as much when declaring immediately after the attack on Natanz that it would replace some of the older centrifuges that were damaged by Israel's latest attacks on the underground facilities at Natanz with more modern types.

Creating more efficient centrifuges might also allow Iran to create a network of small covert centrifuge facilities and to move enriched material from one set to another – making them less vulnerable as well as cutting the vulnerability of such facilities to outside attack. The technical feasibility of such efforts is uncertain, but some analysts have suggested such an approach.

It seems doubtful that Iran could deploy a covert reactor to produce plutonium, although this might be possible. Suppose, however, that Iran makes major advances in centrifuge output, reliability, and power demands, as well as in its ability to covertly transfer the output. It could then create multiple small underground or covert facilities as well as stockpiles, or it could actually deploy more advanced centrifuges.

Finally, one needs to be careful about the level of enrichment needed to produce weapons-grade uranium and plutonium. The conventional percentage of U-235 in a uranium weapon normally assumes an enrichment level of 90%. The nominal level for plutonium is 93%. It seems unlikely that Iran would risk creating weapons designs with marginal levels of fissile capability, but it should be noted that it is possible to create a significant nuclear explosion using far less enrichment with a truly massive-sized weapon.

Moreover, combined enriched uranium with plutonium may well be beyond Iran's capacity for years to come, but the open literature does note that, "Later US nuclear weapons usually use plutonium-239 in the primary stage, but the jacket or tamper secondary stage, which is compressed by the primary nuclear explosion often uses HEU with enrichment between 40% and 80% along with the fusion fuel lithium deuteride. For the secondary of a large nuclear weapon, the higher critical mass of less-enriched uranium can be an advantage as it allows the core at explosion time to contain a larger amount of fuel."⁴

The atmospheric byproducts of such a deception effort would probably make it detectable, as might intelligence sources, but the first U.S. nuclear weapon dropped on Hiroshima – Little Boy – used 64 kilograms of uranium with only 80% enrichment. It does not take 90% enrichment of U-235 to achieve critical mass and make one hell of a bang.⁵

So far, no open-source reporting indicates that the negotiations are examining how credible such options are under the present JCPOA arrangements, or how far Iran has already gotten.

What kind of nuclear weapons can Iran design, partially test, and deploy?

Acquiring enough fissile material for one weapon is a "breakout" of any kind. It is not, however, any guarantee that a country can actually design and assemble a reliable weapon with a predictable yield and reliability – a weapon that Iran can trust to be almost totally reliable, and one that it can deploy in enough numbers to create a credible force.

There is a massive increase in the complexity of a nuclear weapon as one goes from a simple heavy gun device to a credible bomb that an aircraft can deliver with a low weight, reliable warhead. The

yield of a warhead can vary from a few kilotons to megatons and really does matter, particularly given the uncertainties in real-world missile accuracy and launching a weapon when a given country may never have actually tested a weapon and still has a very low inventory.

So far, there has been virtually no discussion of how far Iran has gotten in weapons design; what level of fission weapons design it may have reached; how close it is to high yield fission, boosted, and early thermonuclear designs; how credible its capabilities are to deploy a working and reliable weapon without a nuclear test; what level of yield it could plan on versus the design yield; and how long it would take to create a large enough inventory to matter or how visible this effort would be.

The International Atomic Energy Agency (IAEA) has warned several times that Iran might also be initiating non-fissile tests of a nuclear weapons design – following in the footsteps of Pakistan. The IAEA has been extremely careful, however, to not even hint at what tests might be involved or to provide anyone with the elements of a nuclear weapons “cookbook.” The open-source literature on the subject is both dated and equally careful, and it does not provide a credible basis for estimating what kind of inspection would be needed to detect any given design and simulation efforts reliably and whether they are credible.⁶

North Korea’s early failures are a possible indication of the problems involved, but Iran has now been involved in such problems since the time of the Shah. There currently are not enough open-source data to compare the North Korean, Indian, Pakistani, and Chinese design efforts to show how much design data are now available to Iran or to indicate what kinds of credible non-fissile weapons testing Iran can conduct. There also is no indication that the present JCPOA negotiations are addressing any aspects of these issues.

What kind of bombs and missile warheads can Iran design, partially test, and deploy?

Iran’s capability to design a functional nuclear bomb and missile warhead for actual delivery is a critical serious uncertainty. Nothing in the JCPOA clearly lays out in any way the ability of inspection or intelligence to detect whether Iran has conducted bomb or missile warheads using all the elements of a weapons design, including heavy metals or non-fissile uranium, to test a weapons design. Iran is, in theory, not supposed to develop missiles (and UCAVs) that can carry nuclear weapons, but this limitation borders on the ridiculous.

Iran’s present air force is far too limited in age, performance, and operational capability to compete with the forces of the U.S. and Arab Gulf states. Conventionally armed missiles/UCAVs are its key deterrent and warfighting forces, and those forces need to have large warheads and high range-payloads to be effective.

All of Iran’s longer-range missile and UCAV systems have warheads that can be loaded with an advanced nuclear weapon, and all are inherently dual-capable. All could be covertly converted to having nuclear capability, creating a massive lottery as to which Iranian systems in Iran’s growing missile forces and in its new “missile cities” could pose such a threat.

The JCPOA is often criticized for dodging this issue. What is far from clear is how anyone can expect Iran to accept an agreement that would deprive it of its most critical force element in deterring and defending itself.

How important are Iran's conventional, precision-strike missile capabilities in substituting for a nuclear breakout?

At the same time, no one negotiating the original JCPOA anticipated the speed with which Iran could develop a family of precision-strike, conventionally armed missiles and UCAVs that can attack critical military and civil targets in Israel and the Arab Gulf states – including air bases and critical infrastructure like water purification, desalination, electric generation, refinery, petrochemical, as well as petroleum or gas transit and loading facilities – some of which have long-lead repair times and values in the hundreds of millions to billions level.

These are also systems that Iran has already transferred, to some degree, to the Hezbollah and the Houthis – and that it might deploy to Syria or any area that it has dominated in Iraq.

This raises the issue as to whether Iran still needs to go beyond constantly showing the U.S. and its neighbors that it has a near-term nuclear breakout capability that gives it, at most, as much real-world strategic leverage as a small nuclear force when coupled to a major conventionally-armed, precision strike missile/UCAV force; Iranian influence of arms transfers and train and assist forces; and unconventional naval, air, and anti-ship/smart mine forces.

It also raises the issue that missile accuracy, warhead design, and reliability are as important as range-payload – particularly any calculations that are not based on highly classified intelligence on design and test data. One of the factors that reduce much of the think tank and open literature on Iranian missiles and UCAVs to near drivel is the lack of any real-world data on missile performance other than unverified range-payload and guidance platform accuracy data.

These issues are particularly important, given the real-world cost to the Arab Gulf states in buying missiles and layered air/drone/UCAV defenses. It will be especially true if Russia and China selectively or covertly sell Iran more advanced missiles and UCAVs weapon or technologies. The end result could drive other regional states to acquire their nuclear forces, a recent example is that the UAE's first nuclear power reactor has just gone online.

Are biological and chemical weapons an alternative?

Finally, the various open-source U.S. and other assessments of Iranian chemical and biological weapons (CBW) capabilities essentially dodge the chemical and biological aspects of Iran's current capabilities. Iran did, however, become a declared chemical weapons state as part of its accession to the *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*.

It has not declared its chemical weapons inventories or capabilities, and there does not seem to be any open-source assessment of Iran's capability to produce next generation chemical weapons. (Some of which may use ingredients not covered by the now-dated schedule of chemicals included in the Convention's *Schedule of Chemicals*.)

The U.S. Office of the Director of National Intelligence (ODNI)'s latest threat assessment of Iran's chemical and biological capabilities was issued in 2020. It focused on nuclear weapons, briefly addressed chemical weapons, but did not address biological weapons at all. It stated that,⁷

We continue to assess that Iran is not currently undertaking the key nuclear weapons-development activities we judge necessary to produce a nuclear device. However, Iranian officials have publicly threatened to reverse some of Iran's Joint Comprehensive Plan of Action (JCPOA) commitments—and resume nuclear activities that the JCPOA limits—if Iran does not gain the tangible trade and investment benefits it expected from the deal.

- In June 2018, Iranian officials started preparations, allowable under the JCPOA, to expand their capability to manufacture advanced centrifuges.
- Also in June 2018, the Atomic Energy Organization of Iran (AEOI) announced its intent to resume producing natural uranium hexafluoride (UF₆) and prepare the necessary infrastructure to expand its enrichment capacity within the limits of the JCPOA.
- Iran continues to work with other JCPOA participants—China, the European Union, France, Germany, Russia, and the United Kingdom—to find ways to salvage economic benefits from it. Iran’s continued implementation of the JCPOA has extended the amount of time Iran would need to produce enough fissile material for a nuclear weapon from a few months to about one year.

Iran’s ballistic missile programs, which include the largest inventory of ballistic missiles in the region, continue to pose a threat to countries across the Middle East. Iran’s work on a space launch vehicle (SLV)—including on its Simorgh—shortens the timeline to an ICBM because SLVs and ICBMs use similar technologies.

The United States determined in 2018 that Iran is in noncompliance with its obligations under the Chemical Weapons Convention (CWC), and we remain concerned that Iran is developing agents intended to incapacitate for offensive purposes and did not declare all of its traditional CW agent capabilities when it ratified the CWC.

The U.S. also cited Iran’s non-compliance in a State Department report in June 2020, but one that did not mention biological weapons. It stated that,⁸

Iran signed the CWC on January 13, 1993, ratified the CWC on November 3, 1997, initial declarations in 1998 and 1999. Previous IO(C) Reports and Compliance reports have addressed Iran’s sulfur and nitrogen mustard production before entry into force. Iran did not declare any CW weapons or agent stockpiles.

Iran is assessed to have transferred CW munitions to Libya during the 1978-1987 Libyan-Chad war. Specifically, Iran is assessed to have transferred sulfur mustard-filled chemical weapons to Libya in 1987. After the collapse of the Gaddafi regime in 2011, the Libyan Government located newly found munitions suspected to be of a chemical nature, which are assessed to have originated from Iran in the late 1980s.

Iran clearly, however, has the capability to develop genetically advanced biological weapons, and its UCAVs and drones can easily be adapted to create highly effective and advanced line source systems for dispensing chemical and biological weapons. Covertly testing and weaponizing such agents is at least possible, and advanced biological weapons do have nuclear levels of lethality and could present major problems in detection until the results became apparent as mass casualties.

¹ U.S. Office of the Director of National Intelligence, *Annual Threat Assessment of the U.S. National Intelligence Community*, April 9, 2021, pp. 14.

² David Albright and Sarah Burkhard, “Iranian Breakout Estimates and Enriched Uranium Stocks,” ISIS, April 21, 2020, https://isis-online.org/uploads/isis-reports/documents/Breakout_and_LEU_stocks_April_21%2C_2020_final.pdf.

³ David Albright and Sarah Burkhard, “Iranian Breakout Estimates and Enriched Uranium Stocks,” ISIS, April 21, 2020, https://isis-online.org/uploads/isis-reports/documents/Breakout_and_LEU_stocks_April_21%2C_2020_final.pdf.

⁴ Wikipedia, “Enriched Uranium,” https://en.wikipedia.org/wiki/Enriched_uranium, accessed April 14, 2021.

⁵ Wikipedia, “Enriched Uranium,” https://en.wikipedia.org/wiki/Enriched_uranium, accessed April 14, 2021.

⁶ The author has no interest in providing any indication of the sensitive technology and trends involved. Responsible open-source studies of some of the issues involved include Giorgio Franceschini and Annette Schaper, “Nuclear Weapons Research and Modernization Without Nuclear Testing: The CTBT in danger?,” *Peace Research Institute Frankfurt*, no. 77 (2006), <https://unov.tind.io/record/70490?ln=en>; and Richard L. Garwin and Vadim A. Simonenko, *Nuclear Weapon Development without Nuclear Testing?*, November 19, 1997, https://fas.org/rlg/dev_no_test.htm?_cf_chl_jschl_tk_=98cd4390d7f72d72abca5670e19b9d393798fb7e-1617803649-0-AQLdQ-gXfMFjRXxwFtvFv2QDsHViL2UluBHuePUiU28jVilPH31za9sR14fliopspF6nJV8iyMUa0U4el19VKogBaFNFDpVd7vDkKZ8wMYL66Rd2s28x3ODQKZZdod2yZtgCzaAA_AaMuBciRqe3341UYLdavF448SoGaIoH_suobXg0BjPjmB6DQjvxI-u3R5q9Oosn7JPaZhGCKW5aX_j2d72Mkfzq0eIM5-wkNnWQgzQSDzgMtp3rCPYIdW5E3kSL7HkAH7USKxb4tjfab4v_pfp2brvhBK5MLX7FXwEay505GE4ZYiVkr0blU8Oh-FbMf91L4PyrN1LNCL3Wz4R_JFvwzTkaaXCox-aoINSmYPHN4V_Zpnnng7jOuShQGzOfqF9nH5PZVyVU9WtZ6cso.

⁷ Daniel Coats, Statement for the Record on *Worldwide Threat Assessment of the U.S. Intelligence Committee*, Senate Select Committee on Intelligence, January 29, 2019, <https://www.dni.gov/files/ODNI/documents/2019-ATA-SFR---SSCI.pdf>.

⁸ U.S. Department of State, *Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction*, June 2020, <https://www.state.gov/wp-content/uploads/2020/06/2020-10C-Report-Unclassified-Version-for-H.pdf>.