



Update on Iran's Compliance with the JCPOA Nuclear Limits: Iran's Centrifuge Breakage Problem: Accidental Compliance

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Iran has repeatedly tested the boundaries of the Joint Comprehensive Plan of Action (JCPOA) and in many cases crossed the line into a violation. Many of these violations and efforts to push the boundaries have not been reported by the International Atomic Energy Agency (IAEA) in its quarterly reports to member states, reflecting a failing on its part. But the information is not classified, and we have reported on these violations and controversies in previous reports. This memo serves to update some of the findings in those earlier reports and report on several on-going compliance issues.¹ However, this report is not a comprehensive report on Iranian compliance with the JCPOA or United Nations Security Council resolution 2231.

There has been one important development that concerns Iran's violations of the number of allowed advanced centrifuges. Iran's key advanced IR-6 and IR-8 centrifuges have broken much more than expected, leading to a significant reduction in the number of advanced centrifuges. This reduction in numbers has brought Iran more into compliance with the limitations in the deal. But this development is more accurately described as unintentional or accidental compliance. Iran in fact may soon build far more IR-6 and IR-8 centrifuge rotor assemblies than before, aggravating further the compliance issue.

This development shows that Iran is unlikely to ever develop an economically viable centrifuge plant. This means that Iran's centrifuge program, if expanded, would be either a colossal waste of money reflecting national hubris or the basis for a nuclear weapons program, which would not care about costs. Either way, this program should be discouraged as much as possible.

Advanced Centrifuge Numbers and the Failure of Carbon Fiber Bellows

There are several aspects to the issue of the number of advanced centrifuges Iran can operate. Two of the most important are the number of IR-8 centrifuge rotor assemblies Iran has built and the number of IR-6 centrifuges Iran operates in a cascade. By August 2017, Iran had built 8

¹ For several earlier violations and compliance issues, some of which are on-going, see for example, *Testimony of David Albright on Assessing Iran Nuclear Deal by David Albright before the House Subcommittee on National Security, Committee of Oversight and Government Reform, April 5, 2017*. <http://isis-online.org/conferences/detail/house-subcommittee-testimony-of-david-albright-on-assessing-iran-nuclear-de/8>

IR-8 centrifuges, when it could operate one at most with uranium hexafluoride, signifying a much larger stock than should be allowed. It had also run 13-15 IR-6 centrifuges in a cascade that was supposed to be limited to ten centrifuges.

Both the IR-6 and IR-8 centrifuges depend on connecting rotor tubes with carbon fiber bellows, where the IR-6 has two rotor tubes and one bellows and the IR-8 has four rotor tubes and three carbon fiber bellows. We understand that Iran's effort to use carbon fiber bellows is failing, resulting in all but one of the IR-8 centrifuges breaking and many of the IR-6 centrifuges breaking. Iran is now running IR-6s centrifuges, which have one rotor tube and no bellows.

It is unknown if Iran has started or will seek to make many more IR-6 and IR-8 centrifuge rotor assemblies to replace the broken ones. This issue needs to be carefully watched, and centrifuge manufacturing needs to be carefully monitored by the IAEA. Moreover, it would be a mistake to interpret Iran's failure to develop carbon fiber bellows and subsequent breakage of advanced centrifuges as an indication of compliance. Iran could replace them within weeks or at most a few months. It could seek to build far more IR-6 and IR-8 centrifuge rotor assemblies, claiming that the large breakage rate dictates the manufacture of many more of them.

We reported earlier² that Iran was operating 13-15 IR-6 centrifuges in a cascade when limits of the JCPOA specify that it can test roughly 10 IR-6 centrifuges in a cascade at this time.³ Most interpret roughly 10 as plus or minus one, not several. The Trump administration along with European allies have insisted that Iran limit the number of IR-6 centrifuges in the cascade to 10. We assume Iran has come into compliance on this issue.

Iran's advanced centrifuge program is experiencing significant problems. The breakages and issues with the carbon fiber bellows underscore the difficult technical and managerial challenges Iran faces in its enrichment program. Moreover, the persistent failures and problems in the entire centrifuge program underscore that Iran will likely never develop an economically viable centrifuge enrichment program to make low enriched uranium for nuclear

² Ibid.

³ Iran's long-term enrichment [plan](#) provides the following limits on its operation of IR-6 and IR-8 centrifuges: **Opening sentence of section 2:** "Between years 1 to 8 and a half, in addition to continue the abovementioned activities."

Section 2.1 "Will continue the testing of the IR-6 on single centrifuges and intermediate cascades (testing with uranium of roughly 10 centrifuges and then roughly 20 centrifuges, with each of these groups being tested with uranium **for approximately equal time periods**)."

Section 2.2 "Will start, upon implementation of the JCPOA, testing of the IR-8 centrifuge on single centrifuges and its intermediate cascades (completion of mechanical testing of single centrifuges in 1 year, testing with uranium of a single centrifuge, 3 centrifuges, roughly 10 centrifuges, and roughly 20 centrifuges sequentially with each of these groups being tested **for approximately equal time periods**)."

It is worth noting that the phrase "approximately equal time periods" indicates that between years 1 through 8 of the JCPOA, each of the allowed activities must take place divided equally between the eight years. Thus, Iran should only be testing with uranium "roughly 10" IR-6 centrifuges up until year 4. It should be testing only one IR-8 centrifuge until year 3 begins. The plan does not specify that Iran can keep a stock of IR-6 or IR-8 centrifuges.

power plants, confirming an on-going conviction that this program makes sense in the long term only as a method to produce highly enriched uranium for nuclear weapons.

Other Centrifuge R&D Compliance Issues

A few of the other on-going violations or controversies as of late August 2017 involving centrifuge R&D include:

- Iran allegedly continued to exploit allowed “quality assurance” criteria at Kalaye Electric for IR-8 centrifuge rotor assemblies in order to conduct additional mechanical testing of centrifuges beyond those allowed under the JCPOA.
- Iran has continued to refuse the testing of carbon fiber acquired before Implementation Day.

Section T Compliance Issues⁴

Iran is likely violating some of the conditions of Section T, Annex I of the JCPOA with regards to certain dual-use equipment suitable for the development of a nuclear explosive device and multi-point high explosive testing activities suitable for a nuclear explosive. The nature of the Section T conditions is analogous to verifying that allowed activities and equipment are not misused in a manner similar to verifying declared nuclear activities. Moreover, certain activities and equipment are subject to Joint Commission approval. Verification of Section T will undoubtedly require IAEA access to military sites.

Other Key Nuclear Compliance Issues

In addition, there remain several other issues:

- The way the heavy water cap is calculated violates the intention of the nuclear deal.⁵ This cap should include all the heavy water Iran owns and controls, whether in or outside Iran. Currently, it includes only that which is inside Iran.
- As of its last quarterly report in August 2017, the IAEA had not visited any military site in Iran since Implementation Day, risking the *de facto* creation of no-go zones in Iran, a development that would render verification of the JCPOA moot. There is concern that this reflects Iranian bullying on the issue, where the Iranian regime takes the position that it will not allow inspectors access to military sites and the IAEA does not want to create a conflict that could bring down the entire deal by asking to go.

⁴ David Albright and Olli Heinonen, “Verifying Section T of the Iran Nuclear Deal: Iranian Military Site Access Essential to JCPOA Section T Verification,” Institute for Science and International Security, August 31, 2017. <http://isis-online.org/isis-reports/detail/verifying-section-t-of-the-iran-nuclear-deal/8>

⁵ More information about the heavy water exports can be found in, “Heavy Water Loophole in the Iran Deal,” by David Albright and Andrea Stricker, Institute for Science and International Security Report, December 21, 2016. <http://isis-online.org/isis-reports/detail/heavy-water-loophole-in-the-iran-deal>

- Iran may be making large numbers of centrifuge components outside of IAEA monitoring.⁶ The IAEA is limited to monitoring a few critical components, in particular rotor tubes and bellows, but Iran may be making many others that would allow a more rapid buildup in the event of a breakout or Iran's withdrawal from the JCPOA centrifuge limits.

Arak Fuel Design Controversy

In the summer, controversy developed on proposed Iranian changes to the fuel design for the modified Arak reactor. China objected to the Iranian modifications in the fuel specification as stated in the attachment to Annex I of the JCPOA, in particular the number of pins per assembly and the diameter of the fuel pellets. China stated that the changes do not offer any technical advantages over the design laid out in the attachment, and they will bring about various uncertainties in political, technical, and practical terms. Because this modified fuel would require additional development and testing to ensure it is safe and reliable, China stated it was not willing to fabricate the Iranian-designed fuel. This issue was likely resolved but we do not know what the resolution entailed. In any case, it shows that Iran is willing to ignore limits clearly stated in the JCPOA in order to pursue its agenda, whatever it may have been in this case.

Conclusion

Certain violations in advanced centrifuge numbers may have been rectified inadvertently via breakage, although other violations persist. To the credit of the Trump administration, its policy to better enforce the deal appears to be improving Iranian compliance with the nuclear limits. However, it is too soon to conclude that Iran is complying or will comply fully with the deal's nuclear limits. Iran can be expected to continue to push the deal's limits, commit violations, and seek interpretations that are unfounded. One should expect many struggles to keep Iran within the nuclear limits for the duration of the deal.

With this in mind, and the fact that Iran is unlikely to ever develop an economically viable centrifuge plant, the P5+1 should seek a long term method to permanently curtail or severely limit Iran's enrichment program and prevent it from again posing the threat of a bomb program in the Middle East.

⁶ David Albright and Olli Heinonen, "Is Iran Mass Producing Advanced Gas Centrifuge Components? Can we even know with the way the Iran deal has been structured and implemented so far?" Institute for Science and International Security, May 30, 2017. <http://isis-online.org/isis-reports/detail/is-iran-mass-producing-advanced-centrifuges/8>