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Verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council resolution 2231 (2015)

Report by the Director General

A. Introduction

1. This report of the Director General to the Board of Governors and, in parallel, to the United Nations Security Council (Security Council), is on the Islamic Republic of Iran's (Iran's) implementation of its nuclear-related commitments under the Joint Comprehensive Plan of Action (JCPOA) and on matters related to verification and monitoring in Iran in light of Security Council resolution 2231 (2015).¹ It covers the period since the issuance of the Director General's previous reports.²

2. The estimated cost to the Agency for the implementation of Iran's Additional Protocol and for verifying and monitoring Iran's nuclear-related commitments as set out in the JCPOA is €9.8 million per annum, of which €4.5 million is funded by extrabudgetary contributions.³ As of 7 November 2023, extrabudgetary funding had been pledged sufficient to meet the cost of JCPOA-related activities for the remainder of 2023 and until early July 2024.⁴

¹ The background to the matters outlined in this report can be found in previous quarterly reports of the Director General (most recently in GOV/2021/39).

² GOV/2023/39 and GOV/INF/2023/14.

³ These figures have been adjusted to reflect current costs and the latest 2023 budget update.

⁴ The additional costs that the Agency has been incurring since 23 February 2021, while Iran has not been implementing its nuclear-related commitments under the JCPOA, will be communicated in due course once they have been assessed.

B. JCPOA Verification and Monitoring Activities

3. Between 16 January 2016 (JCPOA Implementation Day) and 8 May 2019, the Agency verified and monitored Iran's implementation of its nuclear-related commitments in accordance with the modalities set out in the JCPOA,⁵ consistent with the Agency's standard safeguards practices.^{6,7}

4. From 8 May 2019 onwards, however, Iran stopped implementing its nuclear-related commitments under the JCPOA on a step-by-step basis until, on 23 February 2021, it stopped implementing them altogether, including the Additional Protocol. As a result, Iran has not allowed the Agency to conduct the following verification and monitoring activities in relation to the JCPOA:

- Monitor or verify Iranian production and stocks of heavy water (paras 14 and 15⁸).
- Verify that use of shielded cells at two locations, referred to in the decision of the Joint Commission of 14 January 2016 (INFCIRC/907), are being operated as approved by the Joint Commission (para. 21).
- Implement continuous monitoring to verify that all centrifuges and associated infrastructure in storage remain in storage or have been used to replace failed or damaged centrifuges (para. 70).
- Perform daily access upon request to the enrichment facilities at Natanz and Fordow, including to monitor Iran's production of stable isotopes (paras 71 and 51).
- Verify in-process low enriched nuclear material at enrichment facilities as part of the total enriched uranium stockpile (para. 56).
- Verify whether or not Iran has conducted mechanical testing of centrifuges as specified in the JCPOA (paras 32 and 40).
- Monitor or verify Iranian production and inventory of centrifuge rotor tubes, bellows or assembled rotors; verify whether produced rotor tubes and bellows are consistent with the centrifuge designs described in the JCPOA; verify whether produced rotor tubes and bellows have been used to manufacture centrifuges for the activities specified in the JCPOA (paras 80.1 and 80.2); verify whether rotor tubes and bellows have been manufactured using carbon fibre which meets the specifications agreed under the JCPOA⁹.
- Monitor or verify the uranium ore concentrate (UOC) produced in Iran or obtained from any other source; and whether such UOC has been transferred to UCF (paras 68 and 69).
- Verify Iran's other JCPOA nuclear-related commitments, including those set out in Sections D, E, S and T of Annex I of the JCPOA.

5. This has seriously affected the Agency's JCPOA-related verification and monitoring activities. The situation was exacerbated in June 2022 by Iran's decision to remove all of the Agency's JCPOA-related surveillance and monitoring equipment.

⁵ Including the clarifications referred to in para. 3 of GOV/2021/39.

⁶ GOV/2016/8, para. 6.

⁷ Note by the Secretariat, 2016/Note 5.

⁸ The paragraph references in these bullet points correspond to the paragraphs of 'Annex I – Nuclear-related measures' of the JCPOA.

⁹ Decision of the Joint Commission of 14 January 2016 (INFCIRC/907).

B.1. Verification and monitoring of Iran’s nuclear-related commitments

6. The status of the Agency’s verification and monitoring of Iran’s nuclear-related commitments under the JCPOA is as follows:

JCPOA Section	Commitment	Most recently verified
B	Arak Heavy Water Research Reactor	7 November 2023
C	Heavy Water Production Plant (HWPP)	February 2021 ^{10*}
D	Other Reactors	Unavailable since February 2021
E	Spent Fuel Reprocessing Activities	TRR: 21 October 2023 MIX Facility: 12 November 2023 JHL: 8 November 2023 Shielded cells: February 2021
F	Enrichment Capacity	FEP: 21 October 2023 FFEP: 7 November 2023 PFEP: 8 November 2023
G	Centrifuge Research and Development	8 November 2023
H	Fordow Fuel Enrichment Plant	7 November 2023
I	Other Aspects of Enrichment	See Sections F, G and H
J	Uranium Stocks and Fuels	27 October 2023
K	Centrifuge Manufacturing	February 2021*
L	Additional Protocol (AP) & Modified Code 3.1	February 2021*
N	Modern Technologies and Long-term Presence of IAEA	OLEM: June 2022 130-150 designated inspectors: September 2023
O	Transparency related to UOC	February 2021*
P	Transparency related to enrichment	February 2021*
Q	Access	Unavailable since February 2021
R	Centrifuge Component Manufacturing Transparency	February 2021*
S	Other Uranium Isotope Separation Activities	February 2021*
T	Activities Which Could Contribute to the Design and Development of a Nuclear Explosive Device	February 2021*

* Verification and monitoring no longer allowed by Iran

¹⁰ Based on its analysis of commercially available satellite imagery, the Agency assessed that HWPP continued to operate during the reporting period.

B.2. Consequences of limitations to Agency monitoring and surveillance

7. In the event of a full resumption of implementation by Iran of its nuclear-related commitments under the JCPOA, the Agency would not be able to re-establish continuity of knowledge in relation to the production and inventory of centrifuges, rotors and bellows, heavy water and UOC. Instead, the Agency would need to establish a new baseline in relation to such production and inventories. It would face major challenges in doing so, including the difficulty in confirming the accuracy of any declaration by Iran of its production of centrifuges, rotors and bellows, heavy water and UOC for the period when no verification and monitoring equipment had been in operation. In order to try to fill the gaps in its knowledge and minimize the margin of error, the development of specific arrangements with Iran would be indispensable.

B.3. Activities Related to Heavy Water and Reprocessing

8. As of 7 November 2023, civil construction work was ongoing on all floors of the Khondab Heavy Water Research Reactor (KHRR) building. Iran had previously informed the Agency that the commissioning of KHRR was expected in 2023 using the IR-20 dummy fuel assemblies;¹¹ no update has been formally communicated to the Agency. The Agency did not observe any significant changes compared to the Director General's previous quarterly report.

¹¹ The IR-20 dummy fuel assemblies have been already manufactured based on an Iranian design.

B.4. Activities Related to Enrichment

B.4.1. Enrichment Capacity

Facility	Centrifuge Type	Total Planned Cascades ¹²	Installed Cascades	Total Operating Cascades ¹³
Fuel Enrichment Plant (FEP) ¹⁴	IR-1	36	36	36
	IR-2m	21	21	9
	IR-4	12	6	3
	IR-6	3	3	3
Fordow Fuel Enrichment Plant (FFEP) ¹⁵	IR-1	16 ¹⁶	6	6
	IR-6		2	2
Pilot Fuel Enrichment Plant (PFEP) ¹⁷	IR-4 (Line 4)	1	1	1
	IR-6 (Line 6)	1	1	1
	IR-4 and IR-6 (Line 5)	1	1	1
	Various (Lines 1, 2 and 3)			
	Various (Building A1000)	See Section B.4.2		

There has been no change in the number of operating cascades since the previous report.

¹² The figures for FEP do not include the planned installation of centrifuges in Hall B1000 or in an additional enrichment unit in A1000 (see GOV/2023/39, para. 16.), for which no details of centrifuge types or numbers of cascades have yet been provided by Iran.

¹³ Cascades are considered to be operating if they have been fed with UF₆ for enrichment of collected product.

¹⁴ On 21 October 2023, the Agency verified at FEP that 36 IR-1 cascades, 9 IR-2m cascades, 3 IR-4 cascades and 3 IR-6 cascades were being fed with natural UF₆ to produce UF₆ enriched up to 5% U-235.

¹⁵ On 7 November 2023, the Agency verified at FFEP in Unit 2 that Iran was continuing to feed UF₆ enriched up to 5% U-235 into: up to 1044 IR-1 centrifuges in three sets of two interconnected cascades to enrich UF₆ up to 20% U-235; and into one set of two interconnected cascades of 166 IR-6 centrifuges to enrich UF₆ up to 60% U-235.

¹⁶ Iran has declared that the eight cascades planned in Unit 1 could contain either IR-1 or IR-6 centrifuges and that it will replace the six cascades of IR-1 centrifuges in Unit 2 with IR-6 centrifuges.

¹⁷ On 8 November 2023, the Agency verified that the activities involving R&D lines 1–6 in the original area of PFEP were as follows:

R&D lines 1, 2 and 3: Iran has continued to accumulate uranium enriched up to 2% U-235 through feeding natural UF₆ into small and intermediate cascades of up to: 18 IR-1 centrifuges; 93 IR-2m centrifuges; 20 IR-4 centrifuges; six IR-5 centrifuges and 19 IR-5 centrifuges; ten IR-6 centrifuges and 19 IR-6 centrifuges; and 19 IR-6s centrifuges. The following single centrifuges were being tested with natural UF₆ but not accumulating enriched uranium: two IR-2m centrifuges; seven IR-4 centrifuges; one IR-5 centrifuge; three IR-6 centrifuges; three IR-6s centrifuges; one IR-7 centrifuge; one IR-8 centrifuge; one IR-8B centrifuge; and one IR-9 centrifuge.

R&D production lines 4, 5 and 6: Iran was feeding UF₆ enriched up to 5% U-235 into two interconnected cascades in R&D production lines 4 and 6, comprising up to 164 IR-4 and up to 164 IR-6 centrifuges, respectively, to produce UF₆ enriched up to 60% U-235 and that the tails produced from line 6 were being fed into a cascade of 164 IR-4 and three IR-6 centrifuges in R&D production line 5 to produce UF₆ enriched up to 5% U-235.

9. In addition to the installed cascades listed in the table above:

- **FEP:** On 21 October 2023, the Agency verified that one additional IR-4 cascade was being installed; sub-headers in the remaining planned five IR-4 cascades were installed. Installation of sub-headers in three additional cascades in the additional enrichment unit in Hall A1000¹⁸ was completed and the planned installation of additional enrichment units in the B1000 building had yet to start.
- **FFEP:** On 7 November 2023, the Agency verified that installation of the necessary infrastructure for the planned eight new cascades in Unit 1, containing either IR-1 or IR-6 centrifuges, was ongoing; installation of centrifuges had yet to begin. No IR-1 centrifuges had been replaced with IR-6 centrifuges in Unit 2.

B.4.2. Centrifuge R&D

10. In April 2023, Iran informed the Agency that, at PFEP, it planned to start the commissioning of six (identified as lines A–F) of the 18 R&D production lines to be installed in Building A1000 at Natanz.¹⁹ Each R&D production line would be dedicated to R&D activities, with or without the accumulation of product, using full cascades of up to 174 IR-4 or IR-6 centrifuges, small and intermediate cascades of any type of centrifuge or single centrifuges of any type. UF₆ enriched up to 5% U-235 could be produced from these activities.

11. On 8 November 2023, the Agency verified at PFEP that, in preparation for the installation of the 18 R&D production lines, installation of infrastructure for feeding and withdrawing UF₆ was ongoing. On the same day, the Agency also verified that the installation of centrifuges in this area had not progressed beyond the five IR-4 centrifuges in Line A and 20 IR-6s centrifuges in Line B, reported previously.

B.5. Activities Related to Fuel

12. **FPFP:** On 9 October 2023, the Agency verified that no progress had been made regarding the remaining two stages of the process²⁰ for the production of UF₄ from UF₆. Installation of the equipment for the first stage of the process had been completed but had yet to undergo testing using nuclear material. Iran has not produced any uranium metal in this reporting period.

13. **UCF:** As of 30 October 2023, the Agency verified that no nuclear material had been introduced into the production area of the UCF at Esfahan, where installation of equipment for the production of uranium metal had been completed and which was ready to operate.^{21,22}

14. **TRR:** As of 21 October 2023, the Agency verified that all previously irradiated TRR fuel elements in Iran had a measured dose rate of no less than 1 rem/hour (at one metre in air), except one control fuel assembly.²³ On the same day, the Agency verified that 14 fresh TRR standard fuel assemblies and two control fuel assemblies, previously received from FPFP, had yet to be irradiated.

¹⁸ GOV/2023/39, para. 16.

¹⁹ GOV/INF/2020/15, para. 2.

²⁰ GOV/INF/2021/3, para. 5.

²¹ GOV/2023/24, para. 49.

²² The discrepancy in the amount of nuclear material verified by the Agency compared to the amount declared by Iran, identified in March 2022, still needs to be resolved (for more details see GOV/2023/58, Section C.2).

²³ The amount of uranium in the irradiated control fuel assembly has been included in the enriched uranium stockpile.

B.6. Enriched Uranium Stockpile

15. Iran has estimated²⁴ that at FEP from 19 August 2023 to 27 October 2023, 926.8 kg of UF₆ enriched up to 5% U-235 were produced from natural UF₆.

16. Iran has estimated that at PFEP from 19 August 2023 to 27 October 2023:

- 171.0 kg of UF₆ enriched up to 2% U-235 were produced in R&D lines 1, 2 and 3;
- 274.7 kg of UF₆ enriched up to 5% U-235 were fed into cascades installed in R&D production lines 4, 5 and 6;
- 166.0 kg of UF₆ enriched up to 5% U-235 were produced in R&D production line 5;
- 105.7 kg of UF₆ enriched up to 2% U-235 were accumulated as tails from R&D production line 5 and from R&D production lines 4 and 6;²⁵ and
- 3.0 kg of UF₆ enriched up to 60% U-235 were produced in R&D production lines 4 and 6.²⁶

17. Iran has estimated that at FFEP from 19 August 2023 to 27 October 2023:

- 6.9 kg of UF₆ enriched up to 60% U-235 were produced;²⁷
- 46.4 kg of UF₆ enriched up to 20% U-235 were produced;²⁸
- 429.8 kg of UF₆ enriched up to 5% U-235 were fed into cascades at FFEP;²⁹ and
- 292.4 kg of UF₆ enriched up to 2% U-235 were accumulated as tails.

18. Since 16 February 2021, the Agency has not been able to verify Iran's total enriched uranium stockpile³⁰ precisely on any given day, needing to rely instead on a small proportion of the total being based on Iran's estimates. Based on the information provided by Iran as described in the previous paragraphs and summarised in Annex I, the Agency has estimated that, as of 28 October 2023, Iran's total enriched uranium stockpile was 4486.8 kg. This figure represents an increase of 691.3 kg since the previous quarterly report. The estimated stockpile comprised: 4130.7 kg of uranium in the form of UF₆; 205.6 kg of uranium in the form of uranium oxide and other intermediate products; 49.7 kg of uranium

²⁴ Since 23 February 2021, as the Agency has only been able to verify Iran's production of enriched UF₆ at FEP once the enriched uranium product has been removed from the process, the quantity of nuclear material that remains in the process can only be estimated. Out of the overall production of UF₆ enriched up to 5% U-235 at FEP since 16 February 2021, the Agency has verified 10 325.4 kg of UF₆ enriched up to 5% U-235.

²⁵ The combined tails from line 5 and tails from lines 4 and 6 have an estimated enrichment below 2% U-235.

²⁶ On 28 October 2023, out of the overall production at PFEP using R&D production lines 4, 5 and 6, since 14 April 2021, the Agency verified that the following amounts of UF₆ had been produced: 1882.9 kg of UF₆ enriched up to 5% U-235, 25.1 kg of UF₆ enriched up to 20% U-235 and all 145.7 kg of UF₆ enriched up to 60% U-235 produced.

²⁷ On 28 October 2023, the Agency verified all 63.3 kg of UF₆ enriched up to 60% U-235 that had been produced since 21 November 2022.

²⁸ Out of the overall production of UF₆ enriched up to 20% U-235 at FFEP since 16 February 2021, the Agency verified 779.7kg of UF₆ enriched up to 20% U-235.

²⁹ Iran estimated that 7.6 kg of UF₆ enriched up to 5% U-235 were "dumped" (i.e., not used for the enrichment of UF₆ up to 20% U-235 but remaining in the process). This amount is included in the inventory of LEU at FFEP. Upon its removal from the process, it will be verified by the Agency.

³⁰ Comprising enriched uranium produced at FEP, PFEP and FFEP and used as feed material at PFEP and FFEP.

in fuel assemblies, plates and rods; 4.4 kg of uranium in targets;³¹ and 96.4 kg of uranium in liquid and solid scrap.

19. As of 28 October 2023, the estimated total enriched uranium stockpile in the form of UF₆ of 4130.7kg comprised:

- 1217.2 kg of uranium enriched up to 2% U-235 (+384.2 kg since the previous quarterly report);
- 2218.1 kg of uranium enriched up to 5% U-235 (+267.2 kg);
- 567.1 kg of uranium enriched up to 20% U-235 (+31.3 kg); and
- 128.3 kg of uranium enriched up to 60% U-235 (+6.7 kg).

20. As of 28 October 2023, the Agency verified that the inventory of uranium enriched up to 20% U-235 in forms other than UF₆ was 32.7 kg, consisting of 24.2 kg of uranium in fuel assemblies, plates and rods, 2.8 kg of uranium in targets,³² 5.0 kg of uranium in other intermediate products, and 0.7 kg of uranium in liquid and solid scrap.

21. As of 28 October 2023, the inventory of uranium enriched up to 60% U-235 in forms other than UF₆ remains as 2.0 kg of uranium as previously reported, consisting of 1.6 kg of uranium in targets,³³ verified at TRR on 13 November 2023, and 0.4 kg of uranium in liquid and solid scrap, verified at FPPF on 28 October 2023.

C. Other Relevant Information

22. As previously reported,³⁴ in a letter to the Director General dated 16 September 2023, Iran informed the Agency of its decision to withdraw the designation of several experienced Agency inspectors designated for Iran. This followed a previous recent withdrawal of the designation of another experienced Agency inspector designated for Iran. This measure, while formally permitted by the NPT Safeguards Agreement, was exercised by Iran in a manner that directly and seriously affects the Agency's ability to conduct effectively its verification activities in Iran, in particular at the enrichment facilities. The Director General, in a letter dated 31 October 2023, requested Vice-President Eslami to reconsider the withdrawal of the designations of the Agency inspectors (for a fuller report on this matter see GOV/2023/58, Section D.2.1).

23. In his reply, received by the Director General on 15 November 2023, Vice-President Eslami reiterated Iran's position that it was within its rights to de-designate the Agency inspectors and stated that the Agency's "assertion" of the potential risks of impeding the conduct of inspections "is not compelling and lacks any legal basis". Vice-President Eslami also stated that he was "exploring possibilities to address the request mentioned in your letter".

³¹ A new category is created to account for targets. The related amount of nuclear material was previously reported under the category of fuel assemblies, plates and rods.

³² Out of the 3.0 kg of uranium previously reported under the category of fuel assemblies, plates and rods, 2.8 kg of uranium is reported separately in this report as targets and 0.2 kg of uranium is removed from the stockpile since they have been irradiated at TRR and dissolved at the MIX facility.

³³ Irradiated at TRR and stored in the reactor pool.

³⁴ GOV/INF/2023/14, para. 1.

D. Summary

24. The Agency's JCPOA-related verification and monitoring has been seriously affected by the cessation of Iran's implementation of its nuclear-related commitments under the JCPOA. The situation has been exacerbated by the subsequent decision to remove all of the Agency's JCPOA-related surveillance and monitoring equipment.

25. The Agency has not been able to perform JCPOA verification and monitoring activities in relation to the production and inventory of centrifuges, rotors and bellows, heavy water and UOC for two years and nine months. In the event of a full resumption of implementation by Iran of its nuclear-related commitments under the JCPOA, the Agency would not be able to re-establish continuity of knowledge in these areas. Instead, the Agency would need to establish a new baseline. To mitigate the lengthy gap in its knowledge and minimize the margin of error, the development and implementation of specific, tailored measures would be required.

26. Iran's decision to remove all of the Agency's equipment previously installed in Iran for JCPOA-related surveillance and monitoring activities has also had detrimental implications for the Agency's ability to provide assurance of the peaceful nature of Iran's nuclear programme.

27. It is also two years and nine months since Iran stopped provisionally applying its Additional Protocol and, therefore, since it provided updated declarations and the Agency was able to conduct complementary access to any sites and other locations in Iran.

28. Iran's decision to withdraw the designation of several experienced Agency inspectors designated for Iran has directly and seriously affected the Agency's ability to conduct its verification activities in Iran effectively, in particular at the enrichment facilities.

29. The Director General will continue to report as appropriate.

Annex I

Enriched UF₆ Feed, Production and Inventory since the Director General's previous Quarterly Report

Facility	Centrifuge Type	Feed Enrichment Level (% U-235)	Quantity Fed (kgUF ₆)	Product Enrichment Level (% U-235)	Quantity Produced (kgUF ₆)
FEP	IR-1	Natural	–	<5%	926.8
	IR-2m				
	IR-4				
	IR-6				
FFEP	IR-1	<5%	429.8	<2%	292.4
	IR-6			<20%	46.4
				<60%	6.9
PFEP	IR-4 (Line 4)	<5%	274.7	<60%	3.0
	IR-6 (Line 6)				
	IR-4 and IR-6 (Line 5)	Tails from Lines 4 & 6	N/A	<5%	166.0
				<2%	105.7
Various (Lines 1, 2 and 3)	Natural	–	<2%	171.0	

Enrichment level (% U-235)	Inventory as at 19 August 2023 (kgU)	Quantity Fed (kgU)	Quantity Produced (kgU)	Inventory as at 28 October 2023 (kgU)
<2%	833.0		384.1	1217.2
<5%	1950.9	475.5	737.6	2218.1 ³⁵
<20%	535.8		31.3	567.1
<60%	121.6		6.7	128.3

³⁵ See footnote 29.

Annex II

List of acronyms

AEOI	Atomic Energy Organization of Iran
DIQ	Design Information Questionnaire
DIV	Design Information Verification
EUPP	Enriched Uranium Powder Plant
FEP	Fuel Enrichment Plant
FLUM	Flow-rate Unattended Monitoring
FMP	Fuel Manufacturing Plant
FPFP	Fuel Plate Fabrication Plant
FFEP	Fordow Fuel Enrichment Plant
HWPP	Heavy Water Production Plant
JCPOA	Joint Comprehensive Plan of Action
JHL	Jaber Ibn Hayan Multipurpose Laboratory
KHRR	Khondab Heavy Water Research Reactor
MIX facility	Molybdenum, Iodine and Xenon Radioisotope Production facility
OLEM	On-Line Enrichment Monitor
PFEP	Pilot Fuel Enrichment Plant
PIV	Physical Inventory Verification
TRR	Tehran Research Reactor
UCF	Uranium Conversion Facility
UOC	Uranium Ore Concentrate