



HARVARD Kennedy School

BELFER CENTER

FOR SCIENCE AND INTERNATIONAL AFFAIRS

August 2015

The Iran Nuclear Deal

A Definitive Guide

Belfer Center for Science and International Affairs

Harvard Kennedy School

79 JFK Street

Cambridge, MA 02138

Fax: (617) 495-8963

Email: belfer_center@harvard.edu

Website: <http://belfercenter.org>

Design & Layout by Andrew Facini

Cover Photo: U.S. Secretary of State John Kerry meets with Iranian Foreign Minister Javad Zarif one-on-one in the Palais Coburg Blue Salon, Vienna, Austria on July 1, 2015. (State Dept. Photo)

Copyright 2015, President and Fellows of Harvard College

Printed in the United States of America



HARVARD Kennedy School

BELFER CENTER

FOR SCIENCE AND INTERNATIONAL AFFAIRS

August 2015

Contributors to the Iran Briefing Book have reviewed the draft and provided their comments and advice. While the substance and analysis in this report are presented as objectively as possible, contributors do have differing views on a number of issues. These differences are reflected in the report.

Contributors do not endorse every judgment and assessment in the report. The Belfer Center as an institution does not take positions on public policy issues and thus does not take a position on whether Congress should accept, reject, or modify the Joint Comprehensive Plan of Action. Individuals at the Center are free to make such recommendations in their personal capacity.

Acknowledgments

Research for this briefing book conducted by Belfer Center research assistant **Henry Rome**.

For more information...

To speak with the contributors to this publication, contact Associate Director of Communications **Sharon Wilke**, sharon_wilke@hks.harvard.edu.

Lead Author and Editor

Gary Samore

Executive Director for Research,
Belfer Center for Science and International Affairs
Telephone: 617-496-4410
Email: gary_samore@hks.harvard.edu

Contributors

Graham Allison

Douglas Dillon Professor of Government, Harvard Kennedy School
Director, Belfer Center for Science and International Affairs
Telephone: 617-496-6099
Email: graham_allison@harvard.edu

Aaron Arnold

Associate, Project on Managing the Atom,
Belfer Center for Science and International Affairs
Email: aaron_arnold@hks.harvard.edu

Matthew Bunn

Professor of Practice, Harvard Kennedy School
Co-Principal Investigator, Project on Managing the Atom,
Belfer Center for Science and International Affairs
Telephone: 617-495-9916
Email: matthew_bunn@harvard.edu

Nicholas Burns

Professor of the Practice of Diplomacy and International Politics,
Harvard Kennedy School
Telephone: 617-495-2495
Email: nicholas_burns@hks.harvard.edu

Shai Feldman

Professor of Politics, Brandeis University
Judith and Sidney Swartz Director of the Crown Center for Middle East
Studies, Brandeis University
Telephone: 781-736-5321
Email: sfeldman@brandeis.edu

Chuck Freilich

Senior Fellow, International Security Program,
Belfer Center for Science and International Affairs
Telephone: 617-495-8898
Email: chuck_freilich@harvard.edu

Olli Heinonen

Senior Fellow, Belfer Center for Science and International Affairs
Telephone: 857-334-8377
Email: olli_heinonen@hks.harvard.edu

Martin B. Malin

Executive Director, Project on Managing the Atom,
Belfer Center for Science and International Affairs
Telephone: 617-496-0432
Email: martin_malin@harvard.edu

Steven E. Miller

Director, International Security Program
Editor-in-Chief, International Security
Co-Principal Investigator, Project on Managing the Atom,
Belfer Center for Science and International Affairs
Telephone: 617-495-1411
Email: steven_miller@harvard.edu

Payam Mohseni

Inaugural Director, Belfer Center's Iran Project
Fellow for Iran Studies, Belfer Center for Science and International Affairs
Visiting Assistant Professor in the Department of Government at
Harvard University
Telephone: 617-496-0461
Email: payam_mohseni@hks.harvard.edu

Richard Nephew

Program Director, Economic Statecraft, Sanctions and Energy Markets
Center on Global Energy Policy, School of International and Public Affairs,
Columbia University
Telephone: 212-854-9016
Email: rmn2130@columbia.edu

Laura Rockwood

Executive Director
Vienna Center for Disarmament and Non-Proliferation
Email: LRockwood@miis.edu

James K. Sebenius

Gordon Donaldson Professor of Business Administration,
Harvard Business School
Telephone: 617-495-9334
Email: jsebenius@hbs.edu

William Tobey

Senior Fellow, Belfer Center for Science and International Affairs
Telephone: 617-496-0518
Email: william_tobey@hks.harvard.edu

Table of Contents

Introduction	1
---------------------------	----------

1. Executive Summary	4
-----------------------------------	----------

Limits on Fissile Material Production

2. Plutonium	18
---------------------------	-----------

2.1 Description	18
-----------------------	----

2.2 Assessment.....	20
---------------------	----

3. Uranium	23
-------------------------	-----------

3.1 Description	23
-----------------------	----

3.2 Assessment.....	27
---------------------	----

Verification and Compliance

4. Inspections and Monitoring	31
--	-----------

4.1 Description	31
-----------------------	----

4.1.1 Monitoring of declared facilities.....	32
--	----

4.1.2 Access to undeclared facilities.....	34
--	----

4.1.3 Drawing the Broader Conclusion	36
--	----

4.2 Assessment.....	37
---------------------	----

5. Possible Military Dimensions/Weaponization	42
--	-----------

5.1 Description	42
-----------------------	----

5.1.1 Limitations on weaponization activity	44
---	----

5.2 Assessment.....	45
---------------------	----

6. Procurement Channel	48
-------------------------------------	-----------

6.1 Description	48
-----------------------	----

6.2 Assessment.....	49
---------------------	----

7. Joint Commission and Dispute Resolution	52
---	-----------

7.1 Description	52
-----------------------	----

7.2 Assessment.....	54
---------------------	----

Sanctions Relief and Nuclear Cooperation

8. Sanctions Relief	58
----------------------------------	-----------

8.1 Description.....	58
----------------------	----

8.1.1 United Nations Security Council Sanctions.....	58
--	----

8.1.2 United States Sanctions.....	59
------------------------------------	----

8.1.3 European Union Sanctions	60
--------------------------------------	----

8.2 Assessment.....	60
---------------------	----

8.2.1 Lifting Sanctions.....	61
------------------------------	----

8.2.2 Untangling the U.S., UN, and EU Designated Entities Lists	61
---	----

8.2.3 Re-imposing Sanctions	62
-----------------------------------	----

9. Civil Nuclear Cooperation	65
---	-----------

9.1 Description	65
-----------------------	----

9.2 Assessment	66
----------------------	----

The UN Security Council votes in favor of a resolution endorsing the Iran nuclear deal, Monday, July 20, 2015.

(AP Photo/Mark Lennihan)



Introduction

In Vienna, Austria, on July 14, 2015, negotiators from Iran and the P5+1 countries (the U.S., U.K. France, Germany, Russia, and China), along with the EU, announced completion of a comprehensive nuclear agreement with Iran—otherwise known as the **Joint Comprehensive Plan of Action (JCPOA)**.

The product of nearly two years of intense international negotiations, and 13 years after Iran’s clandestine nuclear activities were initially exposed, the JCPOA is a lengthy and complicated document, including the main agreement and five annexes.¹ To endorse and operationalize the JCPOA, the United Nations Security Council passed **Resolution 2231** on July 20, 2015, which contains two annexes.² Several documents relevant to the overall agreement are not public, including a side agreement among the P5+1 on future UN action in 10 years and the contents of Iran’s “enrichment and enrichment R&D plan,” which Iran will eventually submit to the International Atomic Energy Agency (IAEA).

On July 14, 2015, the same day that the JCPOA was announced, IAEA Director General Yukiya Amano and the head of the Atomic Energy Organization of Iran, Ali Akbar Salehi, signed a “**Roadmap for Clarification of Past and Present Outstanding Issues**” to resolve issues associated with the IAEA’s investigation

¹ Annex I: Nuclear-related Measures; Annex II: Sanctions-related commitments; Annex III: Civil Nuclear Cooperation; Annex IV: Joint Commission; and Annex V: Implementation.

² Annex A: the JCPOA and Annex B: a joint P5+1 statement.

of past and possible ongoing weaponization activity. However, the specific measures required by the Roadmap are not public.

The Belfer Center for Science and International Affairs at the Harvard Kennedy School has produced this briefing book on the Iran deal in the interest of contributing to informed Congressional review and public discourse on the agreement. First, we have provided a concise description of the complex agreement and the accompanying UN Security Council Resolution 2231, including areas that appear ambiguous. Second, we have tried to provide a balanced assessment of the agreement's strengths and weaknesses with respect to its central objective to prevent Iran from acquiring nuclear weapons. We have not tried to address larger political questions, such as the implications of the agreement on Iran's behavior in the region and domestic politics, implications of the agreement on regional dynamics in the Middle East and the larger non-proliferation regime, or the relationship between the nuclear issue and other areas of dispute between the U.S. and Iran.

Our focus is on the merits and drawbacks within the four corners of the agreement itself. The team of experts who prepared this report includes Democrats, Republicans, independents, and internationals. Noting areas of disagreements among themselves, they ultimately agreed that this report provides an accurate description and balanced assessment of the agreement.

Of course, we recognize that members of Congress and the public will form an overall judgment of the agreement based on broader considerations and factors beyond the elements of

the agreement itself. The Belfer Center as an institution does not take positions on public policy issues and thus does not take a position on whether Congress should accept, reject, or modify the Joint Comprehensive Plan of Action. Individuals at the Center are free to make such recommendations in their personal capacity. In this case, some of us would advise Congress to accept the agreement as the best option among possible alternatives to address the Iranian nuclear threat, while others would urge Congress to reject the agreement and seek to intensify sanctions in order to negotiate better terms. We hope that our assessment of the strengths and weaknesses of the JCPOA will assist Congress as it makes that decision.

We invite readers who disagree with our presentation or who have additional questions or points to send their comments to iran_matters@hks.harvard.edu. If suitable, we will post these contributions with attribution on our website *Iran Matters*.

1. Executive Summary

The Joint Comprehensive Plan of Action (JCPOA) is intended to stop Iran from acquiring nuclear weapons. If fully implemented, the physical constraints and verification provisions of this comprehensive nuclear agreement will effectively prevent Iran from producing fissile material for nuclear weapons at its *declared* nuclear facilities for at least 10 to 15 years. During this period, the provisions of the JCPOA—along with continuing national intelligence efforts—increase the likelihood of detecting any Iranian attempts to build covert facilities to produce fissile material, thus helping to deter Tehran from attempting to do so. Over 10 to 15 years, the physical constraints on fissile material production at declared facilities and most of the specialized verification and enforcement provisions of the JCPOA expire. At that point, Iran could expand its nuclear capabilities within a few years to create more practical options to produce fissile material for nuclear weapons, whether at declared or secret facilities. Actual production of nuclear weapons would violate Iran’s safeguards agreement with the International Atomic Energy Agency (IAEA), the JCPOA, and the Non-Proliferation Treaty (NPT). The agreement poses no restrictions on what the U.S. or other countries could do in that circumstance.

The central nuclear limits of the JCPOA are physical restrictions on Iran’s ability to produce fissile material for nuclear weapons (either separated plutonium or enriched uranium) at its declared nuclear facilities.³

3 No plausible agreement could reliably detect and prevent the “wild card” option of Iran buying nuclear weapons-ready materials or even nuclear weapons themselves from other states. U.S. and international nuclear security measures are intended to reduce this risk.

The Plutonium Route

The physical limits on plutonium production in the JCPOA essentially close that pathway for the foreseeable future. The redesigned Arak heavy-water research reactor will not be able to produce large amounts of plutonium, its spent fuel will be shipped out of the country for the lifetime of the reactor, and Iran is not allowed to build additional heavy-water reactors or a reprocessing facility to separate plutonium from spent fuel for at least 15 years. Any Iranian attempt to secretly produce or divert plutonium from the Bushehr nuclear power plant would be quickly detected. Even after 15 years, when the ban on building new heavy-water reactors and a reprocessing plant becomes “voluntary” (i.e. Iran expresses the “intent” not to build such facilities), Iran would require years to build them. Although the Arak reactor will not be dismantled, it would require at least a few years to convert the reactor back to its original specifications and the effort would be easily detected.

The Uranium Route

The physical limits on enrichment at declared facilities in the JCPOA are less robust. While the agreement requires Iran to dismantle two-thirds of its installed centrifuges and eliminate 98% of its current enriched uranium stock, it permits Iran to retain a substantial uranium enrichment infrastructure and to begin to expand that infrastructure after 10 years. For 10 to 15 years, Iran will restrict the number and types of centrifuges installed and operating at Natanz, end enrichment at Fordow, limit research and development on advanced centrifuges, maintain a small stockpile of low-enriched uranium, and cap the level of enrichment. While these measures are reversible over a period of a few months to a few years, any reversal would be quickly detected.

Under these limits, “breakout time” at Natanz over the next decade would be extended to roughly a year, from the current estimated breakout time of 2 to 3 months.⁴ From year 11 to year 15, breakout time at Natanz will decline as Iran is permitted to replace its first-generation centrifuges with limited numbers of advanced models, although the restrictions on enriched uranium stocks and enrichment level continue through year 15. Estimating breakout time during years 11 to 15 is difficult. The number and type of advanced centrifuges that Iran is permitted to deploy during this period is not public, and the performance of advanced centrifuge models under development is uncertain.

Some contributors to this report believe that breakout time by year 15 could be comparable to what it is today—a few months—while others believe it could be reduced to a few weeks. In any event, Iran is unlikely to attempt breakout at Natanz during this period because detection would be swift and the risk of provoking a military attack would be high. Since all enrichment will be limited to Natanz for 15 years under the JCPOA, Iran’s nuclear program would be vulnerable to military attack.

After 15 years, all physical constraints on enrichment imposed by the agreement will be lifted. At that point, Iran could build an enrichment plant large enough to produce low-enriched uranium to fuel a nuclear power reactor within a matter of years.

4 “Breakout time” is a technical benchmark for measuring enrichment capacity in terms of how long it would take to produce a “significant quantity” of highly enriched uranium, nominally enough for a single nuclear device. Whether breakout at a declared facility is a practical option for producing nuclear weapons depends on a host of other considerations, such as the likelihood and timing of detection and possible international responses.

Such a facility could make breakout a more credible option, and the availability of advanced centrifuges and large stocks of enriched uranium would create additional options for Iran to pursue secret enrichment activities, especially as the specialized monitoring provisions of the JCPOA expire. Once the cap on enrichment level expires in 15 years, Iran could also claim that it needs to begin producing highly enriched uranium under safeguards for civil uses, such as research-reactor fuel or isotope production. If Iran accumulated a stockpile of material that could be directly used to produce nuclear weapons, it could achieve the same threshold status as countries like Japan.

The Covert Option

If the agreement effectively deters Iran from producing fissile material for nuclear weapons at its *declared* nuclear facilities for at least 10 to 15 years, will it deter or detect Iranian cheating on the agreement by producing fissile material for nuclear weapons at *undeclared* facilities? On one hand, the verification regime of the JCPOA will make it more difficult for Iran to conceal covert nuclear activities, while the provisions for reinstating UN sanctions increase the likelihood of penalties if Iran is caught cheating. If U.S. and allied intelligence capabilities are maintained at their current level, there is a high probability of detecting major covert activity (e.g., construction of a secret conversion or enrichment plant). The provisions of the JCPOA improve the odds that intelligence agencies and international inspectors would detect covert facilities to process nuclear material.

On the other hand, the provisions of the JCPOA (as well as national intelligence) are less likely to deter or detect more incremental Iranian cheating, such as covert nuclear weapons

research or advanced centrifuge research. While such activities are less significant than covert fissile material production, they could enhance and accelerate Iran's nuclear weapons options if fissile material for nuclear weapons production becomes available. Finally, the detection of covert activities is heavily dependent on effective intelligence, and some nuclear activities, such as weaponization, are inherently difficult intelligence targets because they involve a small number of people and relatively little infrastructure. To the extent that Iran improves its ability to hide nuclear activities from U.S. and allied intelligence agencies, the likelihood of detecting covert nuclear activities will be diminished.

Long Term Implications

The long term implications of the JCPOA for Iran's nuclear program are extremely difficult to predict and assess. The JCPOA constrains Iran's nuclear option for at least 10 to 15 years through a combination of physical limits on fissile material production and verification provisions. It does not eliminate the risk that Iran will seek to acquire nuclear weapons after 15 years. JCPOA proponents argue that it could ultimately undermine advocates of nuclear weapons inside Iran by reducing the threat of military conflict with the U.S. and increasing the benefits of economic integration, all of which would be jeopardized if Iran pursues nuclear weapons. JCPOA opponents argue that it will legitimize Iran's nuclear program and will not fundamentally change Tehran's hostility toward the U.S., including the perceived need for nuclear weapons to defend itself against the "Great Satan" and to assert the Islamic Republic's dominance in the region.

While it is impossible to resolve this issue, answers may become

more apparent in 15 years. Assuming that Iran's motivations have not fundamentally changed, the risk is less that Iran will suddenly dash for a bomb after 15 years, because Iran's declared nuclear facilities will still be vulnerable to military attack. The more likely risk is that Iran will begin to gradually expand its enrichment capabilities and enrich at higher levels to create a more credible option to break out on short notice or to build covert facilities. At that point, the U.S. would have the option of accusing Iran of pursuing a nuclear weapons capability under the guise of an expanded enrichment program, or of producing higher levels of enrichment that are unnecessary for its nuclear power needs. However, rallying international support for renewed sanctions or military action to block Iran's efforts is likely to be difficult once all nuclear sanctions have been removed and after Iran has complied with the JCPOA for 15 years.

Approve or Reject?

The ultimate question for Congress and the American public is whether to approve or reject the existing agreement.

Supporters of the JCPOA believe that U.S. rejection of the agreement would likely lead Iran to resume nuclear activities that are currently limited under the interim agreement of November 2013. Without the agreement in place, Iran could manufacture, install, and bring more centrifuges on line (including the more advanced centrifuges); accelerate research on even more advanced centrifuges; increase its stockpile of low-enriched and near 20% enriched uranium; and resume construction of the Arak heavy-water research reactor. While precise estimates of how fast and how far Iran could go are difficult, Iran could clearly achieve a greater capacity to produce fissile material faster without an agreement than it could under the limits imposed by

the JCPOA over 15 years. Moreover, this expansion would take place without the additional monitoring and verification provisions of the JCPOA, increasing the risk that Iran could build covert nuclear facilities without detection and produce nuclear weapons before it could be stopped.

Opponents of the JCPOA argue that the U.S. should hold out for a better deal. First, opponents advocate tighter restrictions on Iran's enrichment infrastructure, including reducing the number of centrifuges at Natanz, eliminating centrifuges at Fordow, and dismantling (rather than storing) retired centrifuges. Second, they advocate a longer duration for the physical limits on Iran's nuclear program and specialized inspection provisions or linking duration of the agreement to verified changes in Iranian behavior rather than the passage of time. Finally, they demand more robust inspection and verification provisions, including full Iranian cooperation to resolve the Possible Military Dimensions (PMD) issue and "anytime, anywhere" challenge inspections (or a deadline for access shorter than the challenge inspection procedure in the JCPOA).

Opponents of the JCPOA also argue that the U.S. can reject the agreement and still mobilize international support for more intense sanctions against Iran because most countries will choose to protect their economic and political relationship with the U.S. over the potential for economic opportunities and better relations with Iran. Over time, opponents of the JCPOA argue, the economic pressure against Iran will be sufficient to compel Iran to make greater nuclear concessions than it was prepared to make in the latest round of negotiations. Most opponents of the JCPOA concede that any new negotiations are not likely to take place until the next U.S. administration takes office in 2017, but

they argue that any nuclear advances Iran makes in the meantime will be limited by Iran's desire to avoid triggering a military attack.

Supporters of the JCPOA argue that proposals to reject the current agreement, sustain sanctions and negotiate a better deal are highly risky. If the United States unilaterally rejects a deal that the rest of the P5+1 and the world's other leading economic powers support, the coalition that the U.S. painstakingly built to pressure Iran would likely unravel, and much of the global sanctions effort, beyond just U.S. sanctions, would crumble with it. U.S. rejection of the JCPOA would discredit Iranian leaders who have advocated compromise, enable Iran to blame the U.S. for walking away from a diplomatic settlement, and hobble U.S. efforts to retain, much less intensify, the existing sanctions regime. Thus, the U.S. would be left with less leverage, while Iran would have more freedom to advance its nuclear program. Despite the economic costs of sanctions, Iran has withstood international pressure for nearly a decade and there is no way of knowing whether or when Iran can be compelled to make larger concessions.

Proponents and opponents of the Iran deal also differ on its implications for the politics and security of the Middle East. By reducing the chance that Iran will acquire nuclear weapons, proponents argue that the JCPOA improves the security of Israel, the Gulf States, and others in the region, and also enhances efforts by the U.S. and its regional allies and partners to deal with the other security threats that Iran poses. Moreover, they argue that the deal and the resulting increased integration of Iran's economy with the rest of the world are likely to strengthen moderate political factions in Iran and could moderate Iran's

behavior or create increased opportunities for cooperation in other areas where Western and Iranian interests overlap (such as the fight against the Islamic State). Critics, by contrast, argue that leaving a substantial uranium enrichment infrastructure in Iran is likely to provoke Arab states to seek comparable capabilities of their own, setting off a nascent nuclear competition. They also argue that the sanctions relief offered by the JCPOA, including access to frozen funds, will give Iran more money to finance aggression and terrorism in the region.

Conclusion

If Iran complies, the JCPOA buys at least 10 to 15 years before Tehran can significantly expand its nuclear capabilities. If Iran cheats during this period, JCPOA monitoring and national intelligence are likely to detect major violations, which would enhance U.S. and international options to intensify sanctions and take military action if necessary. If the agreement survives after 15 years, Iran will be able to expand its nuclear program to create more practical overt and covert nuclear weapons options. There are different views on whether the JCPOA will create conditions that help to reduce Iran's incentives to pursue nuclear weapons in the long term. Ultimately, the decision to support or oppose the existing agreement boils down to assessing relative risks—accepting the current agreement (with its known strengths and weaknesses) or taking the chance that a better agreement can be achieved down the road. That choice will have profound implications for U.S. foreign policy, the politics of the Middle East and relations among the major powers, international economics, and the global effort to stem the spread of nuclear weapons.

Figure 1: **Key Nuclear Actions Before Sanctions Relief**¹

Uranium Route	Plutonium Route	Inspections, Monitoring, Verification
<ul style="list-style-type: none"> Down-blend to natural uranium or sell all enriched uranium in excess of 300 kg LEU UF₆ or equivalent in other chemical forms.² Fabricate into fuel plates, export, or dilute all uranium oxide enriched to between 5% and 20%.³ Natanz: Remove and store under continuous IAEA monitoring all but 5,060 IR-1 centrifuges.⁴ Fordow: Remove nuclear material and cease uranium enrichment.⁵ Remove and store under monitoring all but 1,044 IR-1s (348 IR-1s will produce stable isotopes).⁶ Continue enrichment only at or below 3.67%.⁷ Remove ~1,000 IR-2m and remove advanced centrifuges, except individual machines and small cascades permitted under agreed R&D program.⁸ 	<ul style="list-style-type: none"> Remove and render inoperable existing calandria for Arak reactor.⁹ Modify existing Arak fuel production line.¹⁰ Make all excess heavy water “available for export.”¹¹ 	<ul style="list-style-type: none"> Provisionally apply Additional Protocol.¹² Implement Modified Code 3.1.¹³ Declare to IAEA initial inventory of centrifuge rotor tubes and bellows, and declare all locations and related equipment.¹⁴ Complete all activities in paragraphs 2, 4, 5, and 6 of Iran-IAEA Road Map to resolve PMD issue.¹⁵ Store under continuous IAEA monitoring all natural uranium pellets and IR-40 fuel assemblies.¹⁶ Declare to IAEA inventory at heavy-water production plant and allow monitoring.¹⁷ “Complete the modalities and facilities-specific arrangements to allow the IAEA to implement all transparency measures provided for in Annex I.”¹⁸

1 Per UNSCR 2231 Operative ¶ 5, Iran must take steps outlined in Annex V ¶ 15.1-15.11 of JCPOA before receiving sanctions relief.

2 Iran will receive natural uranium in return for any LEU sold on the international market. Annex I ¶ 57, as called for in Annex V ¶ 15.7, as called for in UNSCR 2231 Operative ¶ 5.

3 Annex I ¶ 58 as called for in Annex V ¶ 15.7, as called for in UNSCR 2231 Operative ¶ 5.

4 Annex I ¶ 27, 29, 29.1, 29.2, as called for in Annex V ¶ 15.3, as called for in UNSCR 2231 Operative ¶ 5. Stock of excess IR-1 will be used as replacement for broken machines. Annex I ¶ 62 as called for in Annex V ¶ 15.8, as called for in UNSCR 2231 Operative ¶ 5.

5 Annex I ¶ 45 as called for in Annex V ¶ 15.5, as called for in UNSCR 2231 Operative ¶ 5.

6 Annex I ¶ 46, 46.1, 46.2, 47.1, 48.1 as called for in Annex V ¶ 15.5, as called for in UNSCR 2231 Operative ¶ 5.

7 Annex I ¶ 28, as called for in Annex V ¶ 15.3, as called for in UNSCR 2231 Operative ¶ 5.

8 Annex I ¶ 32, 33, 34, 35, 36, 37, 38, 39, 41, 42 as called for in Annex V ¶ 15.4, as called for in UNSCR 2231 Operative ¶ 5. Uranium testing can only occur at PFEF and mechanical testing can only occur at PFEF and Tehran Research Center. See Annex I ¶ 40. Agree on definitions and standards for advanced centrifuge type and performance. Annex I ¶ 52, 54, 55 as called for in Annex V ¶ 15.6, as called for in UNSCR 2231 Operative ¶ 5.

9 Annex I ¶ 3, as called for in Annex V ¶ 15.1, as called for in UNSCR 2231 Operative ¶ 5.

10 Annex I ¶ 10, as called for in Annex V ¶ 15.1, as called for in UNSCR 2231 Operative ¶ 5.

11 Annex I ¶ 14, as called for in Annex V ¶ 15.2, as called for in UNSCR 2231 Operative ¶ 5.

12 Annex I ¶ 64, as called for in Annex V ¶ 15.10, as called for in UNSCR 2231 Operative ¶ 5.

13 Annex I ¶ 65, as called for in Annex V ¶ 15.10, as called for in UNSCR 2231 Operative ¶ 5.

14 Annex I ¶ 80.1, 80.2, as called for in Annex V ¶ 15.11, as called for in UNSCR 2231 Operative ¶ 5.

15 Annex I ¶ 66, as called for in Annex V ¶ 9. See Iran-IAEA Road Map. Not mandatory under UNSCR 2231 but required under “Adoption” period in JCPOA.

16 Annex I ¶ 10, as called for in Annex V ¶ 15.1, as called for in UNSCR 2231 Operative ¶ 5.

17 Annex I ¶ 15, as called for in Annex V ¶ 15.2, as called for in UNSCR 2231 Operative ¶ 5.

18 Annex V ¶ 15.9, as called for in UNSCR 2231 Operative ¶ 5.

Figure 2: Durations of JCPOA Provisions

Duration ¹	Uranium Route	Plutonium Route	Inspections, Monitoring, Verification	UN Sanctions
5 years				Ban on sale to Iran of major weapons systems ^{*2} Ban on sale by Iran of all arms ^{*3}
8 years				Iran "called upon" not to undertake ballistic missile activity related to nuclear weapons ^{*4} Restrictions on ballistic missile trade ^{*5}
10 years	Natanz FEP: Maximum 5,060 IR-1 in current cascade configuration ⁶ Uranium testing only with IR-4, 5, 6, 8 ⁷ <i>Note: some R&D restrictions lifted at year 8.5</i> Mechanical testing only with IR-2m, 4, 5, 6, 6s, 7, 8 ⁸ No mechanical testing on new models without approval ⁹ No R&D for other forms of uranium separation ¹⁰		Mandatory use of procurement channel ^{*11}	UNSCR 2231 ¹² Automatic snapback procedure ¹³

* Denotes sanction that terminates prior to listed date if IAEA issues Broader Conclusion.

1 Depending on each provision, the clock begins either on "Adoption Day" or "Implementation Day." In general, nuclear restrictions take effect upon "Implementation Day," as does the relief of U.S., EU and UN sanctions. But remaining UN sanctions on arms and ballistic missiles are clocked from "Adoption Day." This distinction is not incorporated into the above chart for simplicity's sake.

2 UNSCR 2231, Operative ¶ 7(b) and Annex B ¶ 5

3 UNSCR 2231, Operative ¶ 7(b) and Annex B ¶ 6(b)

4 UNSCR 2231, Operative ¶ 7(b) and Annex B ¶ 3

5 UNSCR 2231, Operative ¶ 7(b) and Annex B ¶ 4

6 Annex I ¶ 27

7 Annex I ¶ 32; no accumulation of enriched uranium; Annex I ¶ 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 53, 63 detail specific limits on R&D for each IR model

8 Annex I ¶ 32

9 Annex I ¶ 43

10 Annex I ¶ 81, footnote 2

11 UNSCR 2231, Annex B ¶ 2; Annex IV ¶ 6 and all sub-components therein UNSCR 2231, Operative ¶ 8. At least one aspect of the Procurement Channel extends beyond 10 years. According to the Verification Assessment Report submitted by the State Department to Congress, procurement of hot-cell-related equipment will be handled through the Channel for 15 years.

12 UNSCR 2231, Operative ¶ 8

13 JCPOA ¶ 36 and UNSCR 2231, Operative ¶ 8. The U.S. administration has indicated that this duration will extend by 5 years beyond year 10, per unreleased political agreement.

Duration	Uranium Route	Plutonium Route	Inspections, Monitoring, Verification
15 years	Maximum enrichment level 3.67% ¹⁴ Maximum stockpile 300 kg 3.67% UF ₆ (or equivalent in different chemical forms) ¹⁵ Fordow: No uranium enrichment or enrichment R&D. No nuclear material ¹⁶ ; Maximum 1,044 IR-1 ¹⁷ ; Only 348 IR-1 will work with stable isotopes at a time, with other centrifuges on stand-by ¹⁸ No other enrichment facilities ¹⁹ No facilities for converting fuel plates or scrap back to UF ₆ ²⁰	All excess heavy water exported ²¹ No spent fuel reprocessing or R&D except for irradiated enriched uranium targets for medical / industrial use ²² No spent fuel separation facilities (small hot-cell permitted at Arak) ²³ No additional heavy-water reactors ²⁴	Special challenge inspection procedure ²⁵ Continuous monitoring of excess centrifuges at Natanz Hall B ²⁶ Daily access to Natanz buildings ²⁷ No engagement with any other country on enrichment or enrichment R&D without approval ²⁸ IAEA use of modern monitoring technology ²⁹ No production of Pu or U metals or alloys or R&D on Pu or U metallurgy ³⁰ No production or acquisition of separated plutonium or HEU ³¹
20 years			Monitoring of centrifuge rotor tubes and bellows ³²
25 years			Monitoring of uranium ore concentrate production and transfer to Esfahan ³³
Permanent		All spent fuel exported for lifetime of Arak reactor ³⁴	Additional Protocol and Modified Code 3.1 ³⁵ Certain activities related to design and development of weapon prohibited ³⁶
Unspecified duration			Joint Commission in existence ³⁷

14 Annex I ¶ 28

15 Annex I ¶ 56

16 Annex I ¶ 45

17 Annex I ¶ 46, 46.1, 46.2

18 Annex I ¶ 46, 46.1, 46.2, 49, 50

19 Annex I ¶ 31, 72

20 Annex I ¶ 58

21 Annex I ¶ 14

22 Annex I ¶ 18-19

23 Annex I ¶ 20, 21, 22, 23

24 JCPOA ¶ 10

25 Limitation in JCPOA ¶ 15; description of procedure in Annex I ¶ 74, 75, 76, 77, 78.

26 Annex I ¶ 70

27 Annex I ¶ 71

28 Annex I ¶ 73

29 Annex I ¶ 67, 67.1, 67.2, 67.3, with specification of "15 years of longer"

30 Annex I ¶ 24, with exception in ¶ 26

31 Annex I ¶ 25

32 Annex I ¶ 79, 80, 80.1, 80.2

33 Annex I ¶ 68

34 Annex I ¶ 11

35 Additional Protocol and Modified Code 3.1 are permanent as long as Iran remains party to the NPT.

36 Annex I ¶ 82, 82.1, 82.2, 82.3, 82.4

37 Annex IV

Figure 4: Primary Iranian Nuclear Facilities

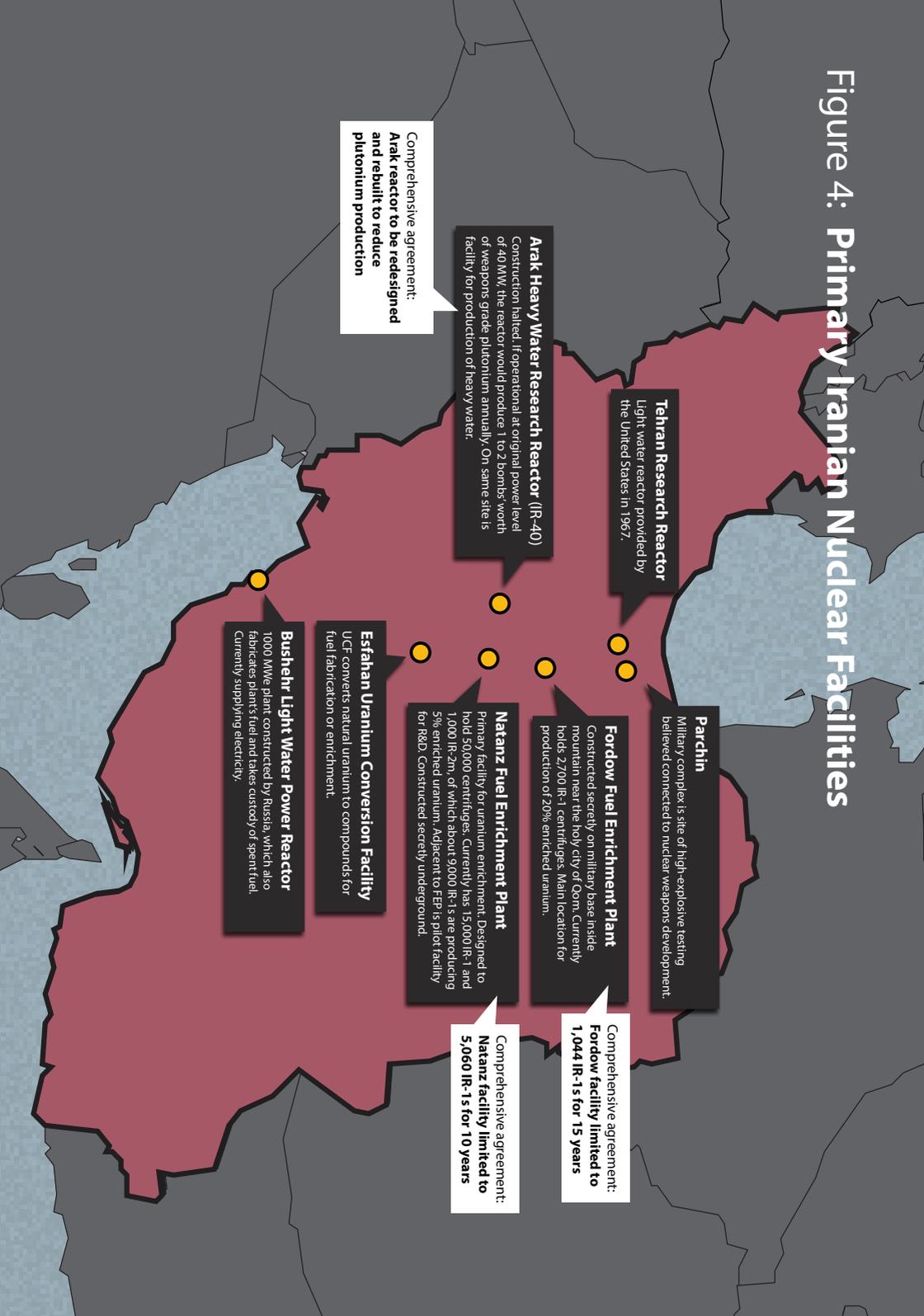


Figure 3: Duration of Select Nuclear-Related Provisions



2. Plutonium

2.1 Description

Iran's primary option to produce plutonium for nuclear weapons is the Arak heavy-water research reactor, which, if completed and operated as planned, could produce enough weapons grade plutonium in its spent fuel for one or two nuclear weapons annually.⁵ Under the JCPOA, Iran will work with an international consortium (including all of the P5+1) to redesign and rebuild the Arak reactor to a new design agreed to by the P5+1. The new design will reduce the reactor's power level from 40 megawatts-thermal (MWt) to 20 MWt, and replace the natural uranium fuel with low enriched uranium (LEU) fuel enriched to 3.67% U-235 (see Figure 5). The initial fuel load for the redesigned reactor will be manufactured outside of Iran, and the international consortium will provide technical assistance to help Iran build facilities to test and fabricate fuel thereafter. Iran will cease production of the original natural uranium fuel for Arak and destroy the original calandria or core for the Arak reactor by filling the openings with concrete.

In addition to redesigning Arak, the comprehensive agreement calls for Iran to ship all of the spent fuel from Arak out of the

5 The Russian-built Bushehr light-water power reactor produces large amounts of plutonium—about 200 kg annually—but Iran has agreed to return all Russian-origin spent fuel to Russia for the lifetime of the reactor. In addition, IAEA safeguards at Bushehr would detect with high confidence diversion of spent fuel or irradiation of clandestine targets to produce plutonium.

country.⁶ Under the JCPOA, Iran will not build any additional heavy-water reactors for at least 15 years. Iran will sell on the international market all of its heavy water that is not needed for Arak and a supporting zero-power test reactor, and will keep doing so for 15 years. The JCPOA estimates that Iran will need roughly 130 tons of heavy water until the redesigned Arak reactor begins operations and roughly 90 tons thereafter. Iran will allow the IAEA to monitor its heavy-water stocks and heavy-water production plant to verify this commitment indefinitely.

Reprocessing is the technology for chemically separating plutonium contained in the spent fuel from uranium and highly radioactive waste products. Under the accord, Iran will not conduct research and development on reprocessing or build any facilities capable of reprocessing for at least 15 years. During that period, Iran will only be permitted to build small (less than six cubic meters) hot cells for producing medical isotopes. For the same period, Iran can only examine spent fuel non-destructively—that is, no chemical processing of the fuel, which could contribute to reprocessing knowledge in Iran. Instead, the P5+1 will “make available their facilities” to allow for destructive post-irradiation examination of fuel outside Iran.

After 15 years, the restrictions and limits of the JCPOA with respect to heavy-water reactors, spent fuel, and reprocessing are expressed as Iran's plans and intentions rather than firm commitments. In effect, Iran states that it “plans” to rely on light-water reactors rather than heavy-water reactors for its power and research reactors; “intends” to ship out spent fuel

6 This must take place within one year of when it is unloaded from the reactor, or as soon as the recipient country thinks it has cooled enough to be safe to ship.

from all present and future power and research reactors; and “does not intend” to engage in any spent fuel reprocessing or construction of a reprocessing facility. (Light-water reactors are less suitable for producing weapons grade plutonium than heavy-water reactors.)

2.2 *Assessment*

The JCPOA effectively blocks the plutonium pathway for more than 15 years. The result of the Arak redesign will be a dramatic reduction in the amount of plutonium that will be produced in the spent fuel. Rather than producing six to eight kilograms of plutonium per year, the reactor will produce just over one kilogram of plutonium per year. At that rate it would take several years for the reactor to produce enough plutonium for a single bomb. Moreover, the plutonium produced will not be weapons-grade, because it will have more of the undesirable higher plutonium isotopes than it would have had under the original design. (Nuclear weapons can be made with reactor-grade plutonium, although this requires relatively sophisticated nuclear weapons designs.)

Once the reactor begins operating and becomes intensely radioactive, it will be difficult to reverse the modification in order to produce more plutonium. Iran would need to manufacture a new core and swap it in, a process that would likely take 1.5 to 2.5 years and be highly visible. Also, the accord means that Iran will not complete testing of the fuel for the original design or produce any more fuel for the original design, further reducing the plausibility of any effort to reverse the modification. Iran could attempt to operate the redesigned reactor to produce more plutonium (for example, by inserting additional uranium

targets), but this would only modestly increase plutonium production and would be readily detectable.

Additionally, the fuel from the Arak reactor will be shipped out of Iran for the lifetime of the reactor, and Iran will not build the facilities needed to separate plutonium from the spent fuel for 15 years. Any change in these arrangements, such as any halt in shipments of spent fuel out of the country, would be noticed quickly, long before Iran could produce enough plutonium for a bomb. Any attempt by Iran to build a covert reprocessing plant or a covert reactor—both large-scale facilities with distinctive signatures—is likely to be detected. Iran’s commitment to ship out surplus heavy water not required by Arak and to purchase reactor components and hot cells through the monitored Procurement Channel (see Section 6) further limits options to build a covert reactor and reprocessing facility.

But like the other elements of the agreement, the restraint on the plutonium pathway is not absolute. Once the Arak reactor goes “hot,” any future military strike on it would likely cause increased environmental damage. Several of Iran’s key obligations—including the commitment not to build heavy-water reactors or reprocessing facilities—shift from commitments to declared intentions after 15 years. Even if Iran changes its intentions at that point, however, it would take several years for Iran to build indigenous reactors to produce plutonium and a reprocessing plant to separate plutonium from spent fuel.

Figure 5: **Plutonium Pathway Restrictions**

		Before Interim Agreement Reached (November 2013)	After JCPOA Implemented
Arak reactor	Power level	40 megawatts-thermal	20 megawatts-thermal
	Fuel type	Natural uranium (~0.7% U-235)	Low-enriched uranium (3.67% U-235)
	Bombs' worth of plutonium produced*	1 or 2 bombs/year	Less than 1/6 of one bomb/year
	Plutonium quality	Weapons-grade plutonium	Fuel-grade plutonium (somewhat more difficult to weaponize)
	Spent fuel	No restrictions	All spent fuel exported for lifetime of reactor (and same intended for future reactors)
General plutonium restrictions	Plutonium separation from spent fuel (reprocessing)	No restrictions	No spent fuel separation facilities or R&D for 15 years (and no intention thereafter)
	Future heavy-water reactors	No restrictions	No additional heavy-water reactors for 15 years
	Excess heavy water	No restrictions	All excess heavy water exported for 15 years
	Foreign procurement	Illicit procurement	Procurement permitted only in declared, monitored channel for 10 years

* After reprocessing. IAEA defines one Significant Quantity as 8 kg of plutonium.

3. Uranium

3.1 Description

Iran's current enrichment program consists of nearly 18,500 first generation IR-1 centrifuges (approximately 15,500 installed at Natanz and 3,000 installed at Fordow) and another 1,000 more-advanced IR-2 centrifuges at Natanz, for a total of about 19,500 centrifuges, with an additional nearly 400 more-advanced centrifuge machines undergoing various tests and experimentation at the Pilot Fuel Enrichment Plant at Natanz. Of the total, approximately 9,200 IR-1 centrifuges at Natanz and 700 IR-1 centrifuges at Fordow are actually enriching uranium.⁷ Iran's current stockpile of enriched uranium includes about 7.6 tons of low-enriched uranium (up to 3.67% U-235) in the form of UF₆, and about 2.4 tons of low-enriched uranium (LEU) in the form of oxide (or being converted to oxide). None of Iran's near 20% enriched uranium remains in the form of UF₆, but it retains about 230 kilograms of near 20% enriched uranium oxide.⁸

The JCPOA includes a detailed set of physical limits on numbers and types of centrifuges, centrifuge research and development, centrifuge manufacturing, locations and levels of enrichment, and stocks of enriched uranium. The physical limits phase out over 10 to 15 years (see Figure 6).

7 Enrichment is a process to increase the concentration of U-235 relative to U-238. In natural uranium, the U-235 concentration is 0.7%. Low-enriched uranium is typically used for fuel for light water power reactors. Depending on their design, research reactors can be fueled with natural uranium, low enriched uranium, nearly 20% U-235, or even highly enriched uranium (about 90% U-235). Typically, nuclear weapons use highly enriched uranium.

8 The oxide is either in powder form, in the process of conversion to oxide, or has been used to fabricate fuel for the Tehran Research Reactor.

Under the agreement, Iran is required to remove about two-thirds of its installed centrifuge machines (or about one-third of its operating centrifuges), leaving it with about 5,000 IR-1 centrifuges at Natanz and about 1,000 IR-1 centrifuges at Fordow (see Figure 7).

The excess centrifuge machines and related enrichment infrastructure removed from Natanz and Fordow will be stored at Natanz under IAEA monitoring. For 10 years, enrichment capacity at Natanz is capped at about 5,000 IR-1 machines in their current cascade configuration, which will continue to produce LEU.⁹ At Fordow, one-third of the remaining 1,000 IR-1 centrifuges will be converted to produce stable isotopes (i.e., not uranium) for medical or industrial purposes and the remaining two-thirds will be kept on standby status. No uranium enrichment or nuclear material is permitted at Fordow for 15 years.

The agreement also defines the range of centrifuge research and development permitted at Natanz over 10 years, specifying the type and number of advanced machines that can be tested and the type of tests that can be conducted. For example, Iran must dismantle the 164-machine test cascades of IR-2m and IR-4 centrifuges during the initial implementation of the JCPOA, thus preventing Iran from continuing to experiment with production-scale cascades of advanced centrifuges for 10 years. But, Iran can continue research on the IR-6 and IR-8 centrifuges—its most advanced designs—and is permitted to scale up to 30-machine test cascades of IR-6 and IR-8 centrifuges at year 8.5. None of the test activities during this 10-year period are

⁹ The JCPOA requires the IAEA and Iran to agree on a procedure to measure and define centrifuge performance data so that any significant improvement in the performance of the IR-1 would exceed the 10-year enrichment cap.

allowed to accumulate enriched uranium. Iran also commits not to pursue any research and development on enrichment technologies other than gas centrifuge technology for 10 years.

Under the JCPOA, Iran's centrifuge manufacturing is limited to meeting the enrichment and enrichment research and development requirements of the agreement. In particular, production of additional IR-1 centrifuges is suspended for 10 years unless the reserve stock of machines in storage (which are used to replace failed or damaged machines at Natanz and Fordow) falls below 500 centrifuges. At that point, Iran can resume IR-1 production to maintain a stock of 500 machines. Production of more-advanced machines will not exceed the requirements of the initial research and development plan. However, at the end of year 8, Iran is allowed to begin production of IR-6 and IR-8 centrifuges without rotors at a rate of up to 200 centrifuges per year through year 10. After year 10, Iran can begin producing complete IR-6 and IR-8 centrifuges at the rate of 200 per year of each type and can begin installing the necessary enrichment infrastructure for IR-8 centrifuges at Natanz. The JCPOA does not appear to impose any limits on production of IR-2m and IR-4 centrifuges after year 10.

Between year 11 and year 15 of the JCPOA, Iran is allowed to begin replacing the 5,000 IR-1 centrifuges with more-advanced machines, according to an "enrichment and enrichment R&D plan" that Iran will submit to the IAEA during the initial implementation of the JCPOA. The contents of the enrichment plan are not public and are not included in the JCPOA, but the substance of the plan is known to U.S. officials and has been provided to Congress. Reportedly, the plan calls for Iran to replace its entire inventory of operating IR-1 centrifuges with a

few thousand IR-2m or IR-4 centrifuges by the end of year 13 of the agreement. The IR-2m and IR-4 centrifuges are expected to be 3 to 5 times more powerful than the IR-1. After year 13, Iran plans to deploy the more advanced IR-6 and IR-8 centrifuges for enrichment at Natanz. At that point, according to the centrifuge production schedule, Iran could have upwards of 1,000 machines of each type available for deployment. During this period, enrichment levels will continue to be limited to LEU (up to 3.67% U-235), the stockpile of LEU will be capped at 300 kg, and enrichment will be limited to the Natanz facility.

The JCPOA limits Iran's stockpile of enriched uranium. For 15 years, Iran will maintain a total stockpile of no more than 300 kg of LEU, whether as UF_6 or other chemical forms. Excess enriched uranium—nearly 12 tons of LEU in various chemical forms at present—will be down-blended to natural uranium or sold on the international market in exchange for natural uranium. The 300-kg limit includes various scrap and waste materials containing low-enriched uranium but does not include enriched uranium that has been fabricated into fuel elements for Iran's reactors, including the near 20% enriched uranium produced by Iran for fabrication of fuel for the Tehran Research Reactor. Iran will not build or operate a facility to convert fuel back to UF_6 for 15 years.

After 15 years, all physical restraints on enrichment are removed, including numbers and types of centrifuge machines, enrichment levels, locations for enrichment facilities, and stocks of enriched uranium.

3.2 Assessment

As a benchmark to measure enrichment capacity, “breakout time” is defined as the time required to produce a single “significant quantity” of weapons grade uranium. One significant quantity is defined by the IAEA as 25 kilograms of U-235 metal, equal to about 28 kilograms of 90% enriched uranium metal or about 40 kilograms of 90% enriched UF_6 . Currently, Iran's estimated breakout time is in the range of 2 to 3 months, assuming Iran used all the centrifuges installed at Natanz and Fordow and its stock of LEU.

For the first 10 years of the JCPOA, the reduction in the number and type of centrifuges and stockpile of LEU will extend breakout time to roughly one year. This estimate is based on the observed performance of the IR-1 centrifuge, which is several times below theoretical capacity, and the current configuration of cascades at Natanz, which are not optimized for production of high-enriched uranium (HEU).

Some non-government experts have argued that breakout time during the initial 10 years could be reduced by a few months or more if Iran improves the performance of the IR-1, re-configures cascades for more efficient production of HEU, accumulates more than 300 kg of LEU, and reinstalls centrifuges stored at Natanz. In addition, the definition of “significant quantity” is somewhat arbitrary because Iran could theoretically make a nuclear implosion device with less than 25 kg of U-235 metal. As a practical matter, however, Iran cannot be confident of calculating precise breakout time because of the possibility of encountering unanticipated technical problems in the production of HEU, which it has never practiced.

From years 11 to 15 of the JCPOA, breakout time will gradually shorten below one year as Iran phases out the first generation IR-1 centrifuges and replaces them with more-advanced centrifuges such as the IR-2m, IR-4, IR-6, and IR-8. Estimating the decline in breakout time during this period is difficult because Iran’s “enrichment and enrichment R&D plan,” which specifies the number and type of centrifuges that Iran is permitted to deploy, is not public. Moreover, the performance characteristics for the advanced centrifuges have not been defined, and it is uncertain whether Iran can achieve these goals, especially for the most-advanced IR-6 and IR-8 models. The continuing cap on enrichment level and stock of LEU over 15 years will limit the decline in breakout time. Some contributors believe that breakout time at year 15 will be comparable to today’s rate of 2 to 3 months, while others believe it could be shortened to a few weeks, if Iran can perfect its more-advanced centrifuges. Because breakout at declared facilities would be quickly detected by the IAEA, however, Iran is unlikely to run the risk of provoking swift international reaction by using declared facilities to produce weapons-grade uranium for a single device.

On the plus side, the JCPOA imposes physical limits on Iran’s enrichment capacity that makes break out at its declared enrichment facilities impractical for at least the next 15 years. In the absence of the agreement, Iran could expand its enrichment capabilities more quickly by deploying more centrifuges, more advanced centrifuges, and a larger stock of LEU that might shrink breakout time to a few weeks or days—perhaps to the point where breakout becomes a more credible (though still risky) maneuver. The JCPOA postpones that day. On the negative side, the JCPOA allows Iran to retain a substantial enrichment infrastructure, with the technical capacity to expand its enrichment program after 15 years if it makes a political decision to do so.

Figure 6: **Uranium Pathway Restrictions**

	Before interim agreement reached (Nov. 2013) ¹	JCPOA physical limits (10–15 years)	After 15 years
First-gen (IR-1) centrifuges	18,472	Capped at 6,104	Unconstrained
Second-gen (IR-2) centrifuges	1,008	None ²	Unconstrained
Breakout time¹	1–2 months	Approximately 12 months	Unknown
R&D of new centrifuge technology	Unconstrained	Constrained	Unconstrained
Stockpile of low-enriched UF₆⁴	7,154 kg ⁵	Capped at 300 kg ⁶	Unconstrained
Stockpile of 20%-enriched UF₆	196 kg ⁷	None	Unconstrained
Maximum enrichment level	No restrictions	3.67%	Unconstrained
Centrifuge production	Unconstrained	Constrained to producing only replacement IR-1 for 10 years; no production of IR-6 or IR-8 for 8 years	Unconstrained

1 As described in IAEA GOV/2013/56 on November 14, 2013.
 2 Except for mechanical testing.
 3 Defined as time required for produce 25 kg of 90% enriched uranium.
 4 In addition, Iran fed into conversion 53 kg of LEU UF₆ that produced 27.2 kg of UO₂.
 5 Includes 7,154 kg in uranium hexafluoride form and 53 kg converted to oxide.
 6 Certain forms of uranium mass are exempted from this cap.
 7 In addition, Iran fed into conversion 213.5 kg of UF₆ enriched to near-20% that produced 104.2 kg of U₃O₈ plus scrap and waste.

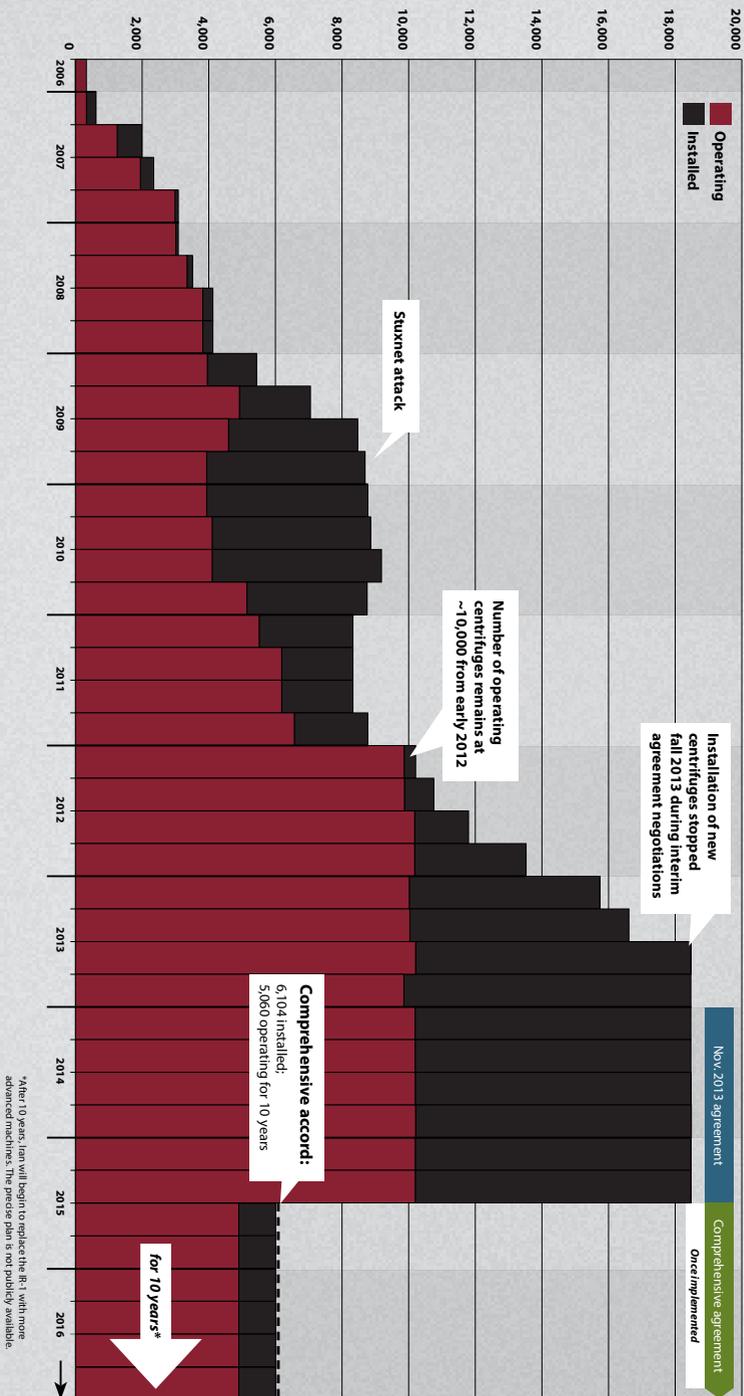
4. Inspections and Monitoring

4.1 Description

International monitoring of Iran’s nuclear program under the JCPOA consists of three tiers: (1) Iran’s Comprehensive Safeguards Agreement (CSA) with the IAEA, which it currently implements; (2) the Additional Protocol (AP) to Iran’s CSA, which Iran will implement under the JCPOA; and (3) additional verification measures in the JCPOA, which are unique to the agreement. Initially, Iran will implement the AP on a provisional basis (as it did from 2003 to 2005). Iran will “seek” ratification by the Majles (Iran’s parliament) when the IAEA reaches the “broader conclusion” that all of Iran’s nuclear material is in peaceful uses, or after 8 years, whichever comes first. Iranian adherence to the CSA and the AP is permanent, so long as Iran remains party to the Non-Proliferation Treaty (NPT). The specific JCPOA verification measures remain in effect for 10 to 25 years.

Overall, the JCPOA verification regime has two basic objectives. First, it is intended to verify that specified limits are being observed at *declared* nuclear facilities, such as Natanz, Fordow, Arak, and Esfahan, and that nuclear material at these facilities is not diverted to undeclared uses. Second, the verification regime is designed to complement national intelligence efforts to help deter or detect any Iranian effort to engage in clandestine or *undeclared* nuclear activities prohibited by the JCPOA.

Figure 7: IR-1 Centrifuges at Natanz and Fordow, 2007-present



4.1.1 Monitoring of declared facilities

Comprehensive Safeguards Agreement

Under Iran's existing safeguards agreement, Iran is required to declare to the IAEA a complete inventory of the quantities and locations of all nuclear material in the country and the activities associated with this material.¹⁰ Iran will also accept the modified version of Code 3.1, which requires Iran to give the IAEA notice of a new facility as soon as Iran decides to build it, rather than just before it introduces nuclear material. Modified Code 3.1 gives the IAEA a better understanding of a country's nuclear plans and eases the process of designing safeguards approaches for facilities as they are being built.

Additional Protocol

The Additional Protocol (AP) requires Iran to provide the IAEA additional information about its nuclear program and additional access to nuclear-related facilities. Under the AP, Iran is required to provide additional information on the sites of nuclear facilities and other locations normally associated with nuclear material; nuclear material not otherwise routinely inspected under a CSA; key activities associated with the nuclear-fuel cycle; and exports and imports of specified nuclear-fuel cycle related equipment and materials. For example, the AP requires Iran to declare information on fuel-cycle-related research and development activities that do not involve nuclear materials, information on uranium mines and concentration plants, and information on the scale and location of facilities involved in manufacturing equipment for enrichment or reprocessing.

¹⁰ Nuclear material refers to any nuclear material of a composition and purity suitable for fuel fabrication or enrichment.

The AP also bolsters IAEA access to nuclear-related facilities, beyond the routine inspections of nuclear facilities and design information verification under the traditional safeguards agreement. Under the AP, the IAEA can request short-notice access to any location on the site of declared nuclear facilities through a provision known as “complementary access.” The notification time of the IAEA's intention to carry out complementary access is 2 hours if the IAEA is already on a nuclear site carrying out an inspection or design information verification and 24 hours in all other cases. As discussed below, the AP also gives the IAEA the right to access locations outside of declared nuclear facilities if needed to fulfill its verification responsibilities.

JCPOA

Under the JCPOA, the IAEA will have the authority to inspect and monitor to confirm that Iran it is implementing the JCPOA's terms, including a set of monitoring measures that go beyond what the CSA and AP normally require. At declared facilities such as Natanz, Iran will provide the IAEA with daily access to all relevant buildings for 15 years and will let the IAEA use modern technologies—such as equipment for continuously monitoring the enrichment level of uranium and electronic seals that automatically communicate changes in their status to inspectors—for 15 years “or longer.” The IAEA will be able to use equipment that sends its measurements electronically to inspectors at the nuclear site (though it will not be able to beam the data directly back to IAEA headquarters in Vienna, as is done in some countries). Iran also will expand the number of people authorized to carry out inspections in Iran. But it will only designate inspectors from countries that have diplomatic relations with Iran.

Additional monitoring measures include:

- For 25 years, declaration and monitoring of all of Iran's stocks of uranium ore concentrate, which could be converted into uranium hexafluoride for enrichment.
- For 20 years, declaration and monitoring of Iran's stocks of centrifuge rotors and bellows that it could use to make new centrifuges, along with key equipment for centrifuge production (such as flow-forming machines for metal centrifuges and filament-winding machines for those made of carbon fiber).
- For 15 years, continuous monitoring of excess centrifuges stored in Natanz Hall B.
- For 10 years, mandatory use of Procurement Channel (see Section 6).

4.1.2 Access to undeclared facilities

Comprehensive Safeguards Agreement

Under Iran's Comprehensive Safeguards Agreement, the IAEA can seek access to an undeclared site through a "special inspection" if the IAEA Director General believes that access is required to confirm the correctness and completeness of information provided by Iran. In circumstances that may lead to a special inspection, the IAEA is required to consult with Iran. There is no deadline specified in the CSA for resolving disputes between the IAEA and Iran over special inspections, but the Director General would normally report the situation to the IAEA Board of Governors.

Additional Protocol

The Additional Protocol permits the IAEA broader access on a more routine basis to follow up questions or inconsistencies. In the event of a question or inconsistency, the IAEA is required to provide Iran with an opportunity to clarify and facilitate the resolution of the question or inconsistency before the request for access is made (unless the IAEA considers that any delay in access would prejudice the purpose for which the access is sought). In any event, the IAEA may not draw any conclusions regarding the question or inconsistency until Iran has been provided with such an opportunity. If Iran is unable to provide the requested access, it is required to make every reasonable effort to satisfy the IAEA's requirements, without delay, through other means.

The IAEA is required to offer Iran at least 24 hours notice before access occurs in order to explain the reason for seeking access, and to give Iran an opportunity to resolve issues by other means. If Iran is "unable" to allow access at the requested location, there is no deadline specified in the AP for resolving disputes over complementary access to suspect sites. The AP also allows for "managed access" to sites in order to protect sensitive or proprietary information.

JCPOA

The JCPOA incorporates a mechanism designed to strengthen the IAEA's ability to gain access to any facility within a defined time if the IAEA has concerns regarding undeclared nuclear materials or activities inconsistent with the JCPOA. This "access" provision—a euphemism for challenge inspections—includes any facility in Iran, including military facilities, with the caveat

that the inspections are designed to verify compliance with nuclear obligations and not “aimed at interfering with Iranian military or other national security activities.”

The mechanism provides for a specific timetable and dispute resolution mechanism (see Section 7).¹¹ Upon the IAEA’s request for access to a suspect facility, Iran and the IAEA have 14 days to make arrangements for access to the facility or to establish alternative means to resolve the IAEA’s concerns. If this procedure fails, the issue is referred to the Joint Commission, which has 7 days to decide on appropriate action either by consensus or by a vote of 5 or more of its 8 members. Iran then has 3 days to implement the Joint Commission’s decision. Failure to comply could trigger the procedure to re-impose international sanctions. The access mechanism in the JCPOA expires after 15 years.

4.1.3 Drawing the Broader Conclusion

The IAEA has confirmed that none of Iran’s *declared* nuclear material has been diverted since 2005, but the IAEA has never received the cooperation from Iran needed to draw the “broader conclusion” that all of Iran’s nuclear material has been declared to the IAEA and is under safeguards. This includes the IAEA investigation of Iran’s past weaponization activities, known as “Possible Military Dimensions.” (See Section 5.) The JCPOA envisions that, with the AP and the full set of other verification

¹¹ Prior to seeking access, the IAEA is required to raise its concerns with Iran and seek clarification, allowing Iran an unspecified period of time to provide an explanation. If this explanation does not resolve the IAEA’s concerns, the IAEA may request access, beginning the 24-day clock. Since there is no time limit specified in the JCPOA for the initial exchange, the entire procedure will be longer than 24 days.

tools available under the agreement, the IAEA will eventually be able to make this broader assessment. In particular, certain sanctions will only be lifted—and Iran will only move to ratify the AP, making its application in Iran permanent—when the IAEA has reached the broader conclusion or 8 years have elapsed, whichever comes first.

4.2 Assessment

The verification arrangements of the JCPOA have strengths and weaknesses. At declared facilities, the JCPOA verification regime provides the IAEA with sufficient tools to verify with high confidence that Iran is complying with the nuclear limits and to detect and report in a timely manner any substantial diversion of nuclear material or use of undeclared material. As a practical matter, these measures prevent Iran from using significant amounts of nuclear material from its declared facilities in secret nuclear activities without a high risk of detection. In other words, to build nuclear weapons secretly using HEU, Iran would need to acquire or build a separate and secret fuel cycle—a secret source of natural uranium, a secret conversion facility to produce UF₆, and a secret enrichment plant to produce high-enriched uranium, plus secret facilities to produce uranium metal and fabricate nuclear weapons components.

This is not impossible, but seems very unlikely if U.S. and allied intelligence agencies continue to effectively monitor Iran’s nuclear program. Intelligence is the key. The IAEA is very effective at verifying compliance at declared, inspected facilities, but intelligence agencies are most likely to detect clandestine activities. For example, both Natanz and Fordow were originally detected by Western intelligence agencies before the first

centrifuges were installed, without expanded inspections or constraints in place. Under the JCPOA, inspections and intelligence would work in tandem. Information obtained by IAEA inspections under the agreement will strengthen collection and assessment by intelligence agencies, and intelligence information will help guide IAEA inspections. For example, the most likely scenario for triggering the 24-day (plus) access mechanism is a request from the IAEA based on credible information that the CIA or another intelligence agency has provided to the IAEA. The 24-day (plus) deadline and provisions for automatically restoring UN sanctions strengthen the IAEA's standard "special inspection" provisions, which have no deadline for action or specified penalty for non-compliance.

Nevertheless, confidence in the absence of covert facilities and activities will always be lower than confidence in verification at declared, inspected facilities. Confidence will be lowest with respect to small-scale nuclear-related activities that do not involve nuclear material, such as initial mechanical testing of a new centrifuge design or explosives testing, and highest with respect to covert activities involving processing of nuclear materials. Fortunately, it is the nuclear material production activities that are the most fundamental constraint on Iran's ability to build a nuclear bomb.

Evaluating the 24-day access procedure

Whether the 24-day (plus) procedure is effective depends on the nature of the secret facility or activity involved and Iranian perception of the consequences if it fails to comply. At one extreme, if the secret activity involves construction of a facility to process nuclear materials (like a conversion or enrichment facility), then the 24-day (plus) procedure will be sufficient because the facility

cannot be hidden or removed in that time period. Moreover, the IAEA—working with member states—is likely to delay a request for clarification or access until construction of the facility is too advanced to conceal but before the facility is operational. Even small-scale activities that involve nuclear material may be difficult to hide. For example, Iran had more than six months to sanitize the Kalaye Electric Company (a centrifuge research facility) in 2003 after it was publicly identified before allowing the IAEA access to take samples. Nevertheless, the samples revealed the presence of enriched uranium particles.

At the other extreme, if the secret activity involves small-scale activities *not* involving nuclear material, such as research on nuclear weapons, production of non-nuclear weapons components, or non-nuclear work with centrifuges, it is less likely that the 24-day (plus) procedure will be effective because Iran can take steps to remove evidence or sanitize the site. In 2004, for example, Iran bulldozed the Lavisan-Shian facility (suspected of conducting research on centrifuges and nuclear weapons) and planted a garden and constructed a playground before allowing inspectors access to the site, at which point no traces of nuclear activity were found. Of course, any suspect facility designated by the IAEA for access will be closely monitored by U.S. and other intelligence agencies for evidence of concealment during the 24-day (plus) process. Finally, even if the 24-day (plus) measure fails to expose a secret activity because Iran is able to successfully hide and remove evidence, the U.S. (and other governments) could still conclude that Iran was cheating and adjust their policies toward the agreement and toward Iran itself.

Verifying additional constraints

None of the provisions under the JCPOA that are beyond the AP are perfectly verifiable. The JCPOA requires Iran to declare its entire stock of centrifuges, but the IAEA may not be able to verify that Iran has declared all of its centrifuges and other sensitive uranium enrichment equipment. Key dual-use manufacturing equipment and materials, such as flow-forming and filament-winding machines, maraging steel, high-strength aluminum, and high-quality carbon fiber, are used for other purposes in Iran, particularly by the ballistic missile program. Since Iran is not required to declare and allow inspections of this equipment and material involved in non-nuclear use, it is possible that Iran could secretly divert this equipment and material to centrifuge production in the future. Similarly, Iran might attempt to circumvent the Procurement Channel by purchasing nuclear and dual-use materials and equipment on the black market (see Section 6).

The JCPOA also includes a number of provisions designed to further hem in any potential nuclear weapons program in Iran, which are discussed in detail in Section 5. While it is useful to prohibit these activities (there is evidence to suggest that Iran has conducted most of these activities in the past), these prohibitions will be quite difficult to verify using the provisions of the JCPOA. Similarly, it will be difficult to know for sure that Iran is not testing centrifuges on a small scale at an undeclared location or storing additional centrifuges beyond those declared. In some cases, the U.S. or allied intelligence agencies may have information indicating that Iran is conducting activities in violation of the JCPOA but may choose not to share that information with the IAEA, either to protect sensitive intelligence sources and methods or because it is judged that the access procedure is unlikely to expose a violation. Rather than seek to expose illicit activities, governments may choose to monitor them to gain information or mount covert operations to sabotage them.

5. Possible Military Dimensions/ Weaponization

5.1 Description

Possible Military Dimensions (PMD) refers to the IAEA's long-running investigation of Iran's program to develop nuclear weapons prior to 2003 and possible continuing research and development on nuclear weapons since then. In November 2011, the IAEA reported that:

Since 2002, the Agency has become increasingly concerned about the possible existence in Iran of undisclosed nuclear related activities involving military related organizations, including activities related to the development of a nuclear payload for a missile.¹²

The November 2011 report also warned: “There are also indications that some activities relevant to the development of a nuclear explosive device continued after 2003, and that some may still be ongoing.”¹³ The possible military dimensions of the Iranian nuclear program identified by the IAEA consist of:

- A program management structure overseen by the Iranian military

¹² International Atomic Energy Agency, “Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions in the Islamic Republic of Iran,” GOV/2011/65, November 8, 2011, p. 7 as of July 17, 2015, available at <https://www.iaea.org/sites/default/files/gov2011-65.pdf>

¹³ IAEA, November 8, 2011, p. 8.

- Undeclared procurement activities
- Undeclared nuclear material acquisition
- Work on nuclear components for an explosive device
- Detonator development
- Initiation of high explosives and associated experiments
- Hydrodynamic experiments (testing nuclear weapons designs without fissile material)
- Modeling and calculations on explosive compression of highly enriched uranium
- Neutron initiator manufacture
- Planning and preparatory experimentation for a nuclear test
- Engineering studies to integrate a spherical payload into a missile delivery vehicle
- Studies on a fuzing, firing, and arming system

The “Roadmap for Clarification of Past and Present Outstanding Issues,” signed by Iran and the IAEA prior to the announcement of the JCPOA, is based on the 2013 Framework for Cooperation that was never fully implemented by Iran. The roadmap includes “the provision by Iran of explanations regarding outstanding issues. It provides for technical expert meetings, technical measures and discussions, as well as a separate arrangement regarding the issue of Parchin” (a military research and development complex and testing ground). Iran is to provide written explanations by August 15, 2015, with the IAEA response including follow-up questions on any ambiguities by September 15, 2015. The joint work is to be completed by October 15, 2015. Completion of these measures as verified by the IAEA is required before “Implementation Day,” when sanctions relief

is provided. The IAEA Director General will submit his final assessment on the resolution of all past and present outstanding issues to the Board of Governors by December 15, 2015. The specific measures that Iran is committed to take with respect to technical expert meetings and discussions and access to Parchin are contained in two separate documents between Iran and the IAEA that are not public.

5.1.1 Limitations on weaponization activity

In addition to the resolution of PMD, the JCPOA contains several provisions intended to limit Iranian activities related to research and development of nuclear weapons. For 15 years, Iran will not produce, seek, or acquire separated plutonium or highly enriched uranium and will not produce or acquire any plutonium or uranium metals or alloys, or do any research and development on plutonium and uranium metallurgy, casting, forming, or machining. The one exception, which must be approved by the Joint Commission, would allow Iran to conduct research on uranium metal fuel for the Tehran Research Reactor.

In perpetuity, Iran will not engage in the following activities that could contribute to the development of a nuclear explosive device:

- Designing, developing, acquiring, or using computer models to simulate nuclear explosive devices.
- Designing, developing, fabricating, acquiring, or using multi-point explosive detonation systems suitable for a nuclear explosive device, unless approved by the Joint Commission for non-nuclear purposes and subject to monitoring.

- Designing, developing, fabricating, acquiring, or using explosive diagnostic systems (streak cameras, framing cameras and flash x-ray cameras) suitable for the development of a nuclear explosive device, unless approved by the Joint Commission for non-nuclear purposes and subject to monitoring.
- Designing, developing, fabricating, acquiring, or using explosively driven neutron sources or specialized materials for explosively driven neutron sources.

5.2 Assessment

The provisions of the JCPOA to resolve the PMD issue cannot be fully evaluated because the actions required by Iran are not public. Whatever the details of the agreement between the IAEA and Iran, however, it seems unlikely that Iran is prepared to provide the IAEA with genuine access to documents, individuals, and locations that would be necessary for the IAEA to verify a complete and correct declaration of Iranian past and possibly present nuclear weapons-related activities. Instead, Iran probably intends to meet the letter of the Roadmap requirements, while continuing to deny that it was engaged in a nuclear weapons research and development program before 2003 or since. Iran will continue to reject evidence to the contrary, such as substantial documentation that Iran claims are forgeries. If the IAEA is granted access to Parchin, it is unlikely to yield evidence of nuclear weapons research since the facility has been extensively modified in recent years.

In this scenario, the IAEA will complete its final report on the basis of the available evidence, including Iranian denials and refusal to provide complete cooperation to resolve outstanding

issues. Depending on the substance of the final report, Iran will presumably contest any conclusion that it was pursuing nuclear weapons development, and the IAEA Board of Governors would likely approve a resolution endorsing the Director General's report and calling on Iran to comply with the requirements in the JCPOA that prohibit future activities related to nuclear weapons development. Lack of genuine Iranian cooperation will likely delay or prevent the IAEA from reaching its "broader conclusion" that all nuclear material in Iran is in peaceful uses.

This resolution of the PMD issue will be controversial. On the negative side, it will allow Tehran to maintain the fiction that its nuclear program has always been purely peaceful. Politically, the absence of any Iranian acknowledgment of past nuclear weapons-related research undermines confidence in the sincerity of Iranian commitments under the JCPOA to not pursue nuclear weapons in the future. More practically, if Tehran does not disclose who did what work, and where and when they did it, it will be more difficult for the IAEA to monitor Iranian nuclear activities to ensure that any weapons work has ceased and will not recur.

On the other hand, proponents of this plan argue that it is politically unrealistic to expect Tehran to admit its past behavior and doing so is practically unnecessary, because the most essential details of Iran's previous nuclear weapons program, including who was involved, are already well known. Any additional details that would come from a complete accounting are relatively secondary. Even if Tehran were willing to cooperate, proponents argue that it would not provide confidence about future activity. A full accounting would likely take years to complete and would impede implementation of the JCPOA, which is focused on future behavior.

The prohibitions under the JCPOA on future Iranian activities related to nuclear weapons research and development are helpful as benchmarks to evaluate Iran's nuclear intentions and as possible constraints on Iran's actual behavior. As discussed in Section 4, however, most of these provisions would be difficult to verify under the inspection and monitoring provisions of the JCPOA. Nonetheless, detection of such prohibited Iranian nuclear weapons research in the future could provide a basis for a range of actions, such as restoring sanctions, conducting covert operations, and considering military options.

6. Procurement Channel

6.1 Description

The JCPOA calls for, and Resolution 2231 codifies, a Procurement Channel. Under the resolution, all states are legally required to seek prior approval from the UN Security Council, on a case-by-case basis, to transfer or sell “directly or indirectly” to Iran “all items, materials, equipment, goods, and technology” contained in the Nuclear Suppliers Group (NSG) Trigger List of nuclear items and its list of nuclear related dual-use items.¹⁴ Curiously, the requirement in the JCPOA for dual-use items is less comprehensive, only requiring approval “if the end-use will be for Iran’s nuclear programme set out in this JCPOA or other non-nuclear civilian end-use.” This language would seem to exempt from approval items on the NSG dual-use list that are intended for military uses, but that potential loophole is closed by Resolution 2231.¹⁵ In addition, Resolution 2231 includes a “catch-all” provision requiring approval for transfer of “any further items if the State determines they could contribute to reprocessing or enrichment-related or heavy water-related activities inconsistent with the JCPOA.”

The Procurement Channel will also oversee and approve provision of technical assistance, financial services, and brokering in support of nuclear activities, as well as acquisition by Iranian entities of foreign commercial entities involving “uranium

¹⁴ NSG Trigger List refers to items whose export would require the application of IAEA safeguards.

¹⁵ This discrepancy could lead to compliance and implementation issues if, for example, Iran asserts that it is allowed to purchase NSG dual-use items for military purposes outside the Procurement Channel.

mining, production or use of nuclear materials and technologies as listed in” the NSG Trigger List. Specifically exempted from the approval process are items and fuel for light-water reactors (e.g., the Bushehr nuclear power plant), as well as nuclear projects specifically required by the JCPOA, such as the conversion of the Fordow facility to produce stable isotopes, modification of the Arak research reactor, and export of Iran’s LEU stocks.

Although the UN Security Council has ultimate responsibility for approving exports, day-to-day decision-making is delegated to the Procurement Working Group of the Joint Commission, composed of representatives of the P5+1 and Iran, with the EU representative serving as “Coordinator” (see Section 7). The JCPOA establishes a process for Procurement Working Group review of proposed transfers, including necessary documentation, deadlines, and dispute resolution. Procurement Working Group decisions will be made by consensus, meaning that any participant can veto a proposed transfer. After an item is approved for sale or transfer, the exporting state is required to inform the Security Council within 10 days of the supply. After shipment, Iran is required to provide access to the IAEA to verify the end use and locations of items on the NSG Trigger List as well as access to the exporting state (or, if it requests assistance, the P5+1) to verify the end-use of items on the nuclear-related dual-use list. The Procurement Channel expires in 10 years when Resolution 2231 terminates.

6.2 Assessment

The Procurement Channel is intended to control Iran’s acquisition of nuclear-related goods and technology and obstruct Iranian efforts to acquire foreign goods and technology for use

in covert nuclear facilities or activities. On paper, the Procurement Channel is a powerful tool provided that (1) Iran does not already possess all the equipment and materials necessary to build covert nuclear facilities and (2) Iranian efforts to circumvent the Procurement Channel can be detected. With respect to the first issue, Iran's nuclear program remains heavily dependent on certain specialized materials and equipment that Iran is not able to manufacture itself. It seems highly unlikely that Iran has been able to acquire and stockpile all the necessary ingredients for a covert nuclear program without requiring any further substantial imports.

With respect to the second issue, the Procurement Channel faces several challenges. First, the scale of global commerce and the wide range of technologies that are relevant to a nuclear program inherently make monitoring a difficult challenge. For years, Iran has sought to evade sanctions against its nuclear program by hiding transactions under layers of front companies and false end-users. Nonetheless, the U.S. and its allies have often succeeded in identifying and blocking transfers of the most critical items and technologies, and any effort by Iran to purchase such items illicitly would pose a significant risk of detection.

Second, the responsibility for seeking approval from the Procurement Working Group rests with "a State seeking to engage in transfers and activities" rather than with Iran. Iran might try to use private dealers and middle men to obtain covert supplies from a state with lax export controls or a commercial entity without approval of the Procurement Working Group. Technically, this would violate Iran's JCPOA commitment not to acquire or seek to procure items covered by the Procurement

Channel for "nuclear activities which are inconsistent with the JCPOA", but Tehran may attempt to claim that the procurement effort was unauthorized by Iranian authorities.

Third, the "catch-all" controls only cover items that a State determines could contribute to reprocessing, enrichment-related, or heavy-water-related activities. By their nature, catch-all controls apply to items that have many legitimate non-nuclear uses. In its procurement activity, Iran has learned to target such items, that can be useful for nuclear purposes, but are not on the international control lists. For example, the UN has reported that the most recent interdictions of shipments to Iran's nuclear program were based on catch-all controls that stopped transfers to specific end-users in Iran because they were associated with Iran's nuclear program. The removal of most of Iran's nuclear-related entities and individuals from designation lists will complicate the ability of export control authorities to apply catch-all controls.

Despite these challenges, the Procurement Channel is a powerful tool if U.S. and allied intelligence agencies are able to detect Iranian procurement activity outside the authorized channel. Any undeclared procurements would be *prima facie* violations of the JCPOA.

7. Joint Commission and Dispute Resolution

7.1 Description

The JCPOA establishes an eight-member Joint Commission, composed of the eight “JCPOA Participants” (the U.S., U.K., France, Germany, Russia, China, Iran, and the EU). The commission will include at least four Working Groups that focus on procurement, sanctions lifting, Arak modernization, and technical issues (see Figure 8). The Joint Commission also has the authority to review and approve various nuclear measures, such as the final plans for the redesign of the Arak heavy-water research reactor and Iranian requests to obtain certain types of hot cells, test new types of centrifuges, or begin research on uranium metal fuel for the Tehran Research Reactor.

The Joint Commission will be informed in advance of plans to convert the Fordow enrichment facility into a technology center to produce stable isotopes, but it does not have authority to approve those plans. Commission decisions are made by consensus among the eight members, with the exception of decisions to authorize IAEA access to suspect sites, which requires a simple majority. The Joint Commission will meet quarterly in New York, Geneva, or Vienna.

The most important responsibility of the Joint Commission is dispute resolution, which can be triggered by any member of the Joint Commission that believes JCPOA commitments are not being met (see Figure 9). The dispute resolution mechanism includes a 35-day process to resolve any such concerns,

including referral to the Foreign Ministers of Iran and the P5+1 and establishment of an Advisory Board to provide a non-binding opinion to the Joint Commission. Under Resolution 2231, all JCPOA participants are “encouraged” to use the dispute resolution mechanism to resolve issues, but its use is not legally required.

At any point in the dispute resolution process, any JCPOA participant can trigger the process to re-impose UN sanctions by notifying the President of the Security Council that it believes a “significant non-performance of commitments under the JCPOA has occurred.” The Security Council, in accordance with its procedures, would then be required to vote on a resolution within 30 days to *continue* sanctions relief. Under this procedure, any permanent member could veto the *continuation* of sanctions relief (as opposed to a procedure requiring consensus of the permanent members to re-impose sanctions).

At any point in the 30-day process, the JCPOA participant making the original notification of non-compliance can halt the process by informing the Security Council that the original issue has been resolved. If the Security Council fails to pass a resolution continuing sanctions relief within 30 days, all sanctions under previous Security Council Resolutions 1696, 1737, 1747, 1803, 1835, 1929 and 2224 would be reapplied and the Procurement Channel would be terminated. In this event, Iran notes in the resolution that it will “treat this as grounds to cease performing its commitments under the JCPOA.”

The provision for automatic re-imposition of UN sanctions expires after 10 years, although U.S. officials say there is a side agreement among the P5+1 to pass a new Security Council Resolution in 10

years that would extend the procedure for re-imposing sanctions for an additional 5 years. Iran has stated that it does not accept or recognize this agreement among the P5+1.

7.2 Assessment

On paper, the construction of the Joint Commission provides the U.S. (and other JCPOA participants) with an effective mechanism to manage implementation of the JCPOA. Since decisions of the Joint Commission require consensus (aside from voting on access to suspect sites), the U.S. is able to block any procurement proposals or plans to modify the Arak reactor or authorize Iranian research in certain areas that the U.S. believes could pose a proliferation risk. The same requirement for consensus, however, could impede timely implementation of the JCPOA unless the P5+1 maintain their political unity. With respect to access decisions, the U.S. can achieve approval for IAEA inspection of suspect sites as long as the three European countries and the EU vote with the U.S., even if Russia, China, and Iran oppose it. The provisions in Resolution 2231 to terminate sanctions relief provide a powerful mechanism for the U.S.—or any permanent member of the Security Council—to crash the JCPOA if they believe that Iran has committed a “serious” violation of the JCPOA.

In reality, the threat of invoking this provision may turn out to be the most effective way to address compliance issues, especially if the suspected violations are ambiguous or marginal. The possibility of automatic and swift re-imposition of UN sanctions for 10 or 15 years under the JCPOA will also increase the risk to Iran of attempting to pursue large-scale covert activities that are likely to be detected.

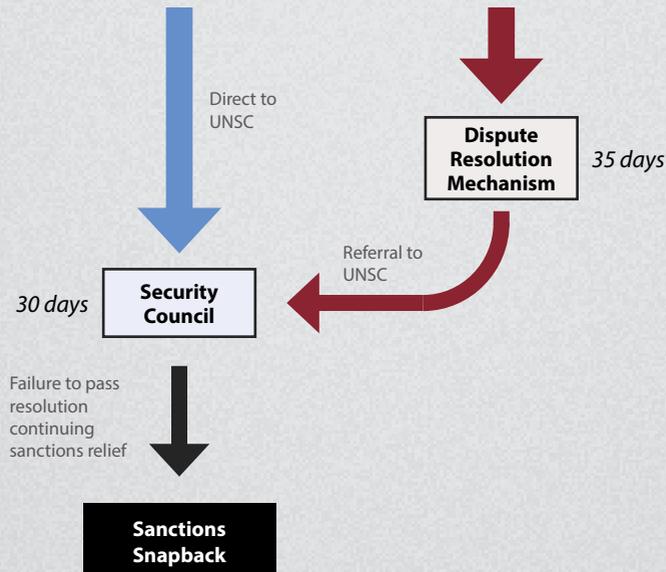
Figure 8: **Joint Commission**



Composition	Eight members (P5+1, Iran, and EU). EU's foreign policy chief is chairperson.
Decision-making	Consensus, except for decisions based on challenge inspections (simple majority).
Organization	At least four working groups dealing with Procurement, Sanctions Lifting, Arak Modernization, and Technical issues.
Schedule	Quarterly meetings in New York, Vienna, or Geneva.
Responsibilities	<ul style="list-style-type: none"> Facilitating Dispute Resolution Mechanism, which can be initiated by any party for perceived noncompliance. Reviewing and approving sales of certain nuclear-specific and nuclear-related dual-use items, equipment, materials and technology to Iran, through Procurement Channel (10-year duration). Reviewing and approving final plans for redesign of Arak reactor and centrifuge testing.

Figure 9: Challenge Inspection, Dispute Resolution, and Snapback

Challenge Inspection Procedure	
"If the IAEA has concerns regarding undeclared nuclear materials or activities, or activities inconsistent with the JCPOA, at locations that have not been declared under the comprehensive safeguards agreement or Additional Protocol." ¹	
Duration: Not limited	IAEA will inform Iran of the concern and request clarification. If Iran's responses "do not resolve the IAEA's concerns," it can make formal request for access. ²
Duration: 14 days	Following formal request, Iran is required to provide access or "alternative means of resolving the IAEA's concerns." ³
Duration: 7 days	If Iran does not provide the necessary access, the issue is referred to the Joint Commission for consultation. The Joint Commission can "advise on the necessary means to resolve the IAEA's concerns" with a majority vote of members of the Commission. ⁴
Duration: 3 days	Iran is required to comply. ⁵
If access is not granted, issue is referred to Dispute Resolution Mechanism or directly to UN Security Council .	



Dispute Resolution Mechanism	
"If Iran believed that any or all of the E3/EU+3 were not meeting their commitments under this JCPOA, Iran could refer the issue to the Joint Commission for resolution; similarly, if any of the E3/EU+3 believed that Iran was not meeting its commitments under this JCPOA, any of the E3/EU+3 could do the same." ⁶	
Duration: 15 days	Issue discussed by Joint Commission and/or Ministers of Foreign Affairs. ⁷
Duration: 15 days	Issue referred to three-member Advisory Board (one member from each side of dispute, and independent member) that can provide non-binding opinion. ⁸
Duration: 5 days	Joint Commission can consider Advisory Board opinion. ⁹
If issue remains unresolved and if complainant "deems the issue to constitute significant non-performance ," complainant could "treat the unresolved issue as grounds to cease performing its commitments under this JCPOA in whole or in part and/or notify the UN Security Council that it believes the issue constitutes significant non-performance." ¹⁰	

UN Security Council Referral*	
Any party could bring complaint of "significant non-performance" directly to UNSC. ¹¹	
Duration: 30 days	Upon receiving complaint, UNSC has 30 days to adopt a resolution to continue sanctions relief. Per UNSC rules, any P5 member can veto this resolution. ¹²
At end of day 30, if no resolution passed, all previous UN sanctions —1696, 1737, 1747, 1803, 1835, 1929, 2224—are reapplied. ¹³	

* UNSCR 2231 only "encourages"—but does not require—parties to first use Dispute Resolution Mechanism. A state can directly introduce complaint to UNSC, triggering 30-day process.

1 Annex I ¶ 75
 2 Annex I ¶ 75, 76
 3 Annex I ¶ 76, 77, 78
 4 Annex I ¶ 78
 5 Annex I ¶ 78
 6 JCPOA ¶ 36
 7 JCPOA ¶ 36
 8 JCPOA ¶ 36
 9 JCPOA ¶ 36
 10 JCPOA ¶ 37
 11 UNSCR 2231, Operative ¶ 10, 11
 12 UNSCR 2231, Operative ¶ 11
 13 UNSCR 2231, Operative ¶ 12

8. Sanctions Relief

8.1 Description

Under the JCPOA, all of the UN sanctions and the most economically damaging U.S. and EU nuclear-related sanctions will be lifted or suspended once Iran implements, and the IAEA verifies, its nuclear commitments (see Figure 1). The U.S. and the EU will lift the remaining sanctions, which primarily target designated individuals and entities associated with Iran's ballistic missile and nuclear proliferation activities, on Transition Day, which occurs after 8 years, or once the IAEA issues a "broader conclusion" verifying the peaceful nature of Iran's nuclear program.

8.1.1 United Nations Security Council Sanctions

The UN Security Council unanimously approved Resolution 2231 on July 20, 2015. The resolution endorses the JCPOA and "decides," once Iran takes its key nuclear-related steps, to nullify six previous resolutions. It also maintains restrictions on trade in conventional weapons for 5 years and on ballistic missile-related technologies for 8 years or until the IAEA reaches the broader conclusion, whichever is sooner.

In addition, the resolution codifies a "snapback" mechanism described in the JCPOA. Under this mechanism, any participant in the JCPOA can lodge a non-compliance complaint with the UN Security Council, triggering a 30-day deadline for the Security Council to pass a new resolution extending the suspension

of sanctions. If a permanent member of the Security Council vetoes such a resolution, then sanctions under the previous Security Council resolution would be automatically restored. Resolution 2231 takes effect on October 18, 2015, 90 days following the vote, to allow both the U.S. Congress and the Iranian Majles to exercise their respective review over the nuclear agreement. After 10 years, if sanctions are not re-enforced, the resolution expires and the Security Council will close the Iran nuclear file. According to U.S. officials, the P5+1 have agreed among themselves to sponsor a new resolution after 10 years that would extend the UN Security Council snap-back provisions for an additional five years, but this is not in the JCPOA and Iranian officials have publicly objected to a new resolution.

8.1.2 United States Sanctions

Upon completion of Iran's key nuclear steps, the U.S. has agreed to "cease the application" of the major economic sanctions against Iran's financial and energy sectors. The U.S. will cease "efforts to reduce Iran's crude oil sales," and Iran will be permitted access to the roughly \$115 billion of oil revenue frozen abroad in a special form of escrow, about half of which would be available (roughly \$58 billion is tied up in contracts or non-performing loans). The U.S. will also rescind many banking sanctions, allowing Iranian banks to reconnect to the global financial system, although they will remain frozen out of the U.S. market.

In addition, the U.S. will lift restrictions on third parties engaged in trade with Iran's automotive, shipping and insurance industries, and on trade in gold and precious metals. The U.S. will cancel four Executive Orders (13574, 13590, 13622, and 13645)

and part of a fifth (13628) and remove 444 companies or individuals, 76 planes, and 227 ships from its sanctions blacklist. Non-nuclear sanctions, such as those relating to human rights abuses and support for terrorism, will remain in place, as will nearly all restrictions on trade with Iran by American businesses, with the exception of the import of food and carpets and the export of airplanes and airplane parts.

After 8 years, or once the IAEA reaches a broader conclusion, whichever is sooner, the U.S. will “seek such legislative action as may be appropriate to terminate” most sanctions related directly to nuclear proliferation. At that time, the United States will also remove 43 companies or individuals from its sanctions rolls, including Dr. Mohsen Fakhrizadeh, who led Iran’s nuclear weapons program before 2003.

8.1.3 European Union Sanctions

Upon completion of Iran’s key nuclear steps, the European Union will end its financial and energy sanctions against Iran, including the lifting of the oil embargo imposed in 2012. The EU will also lift sanctions on shipping and shipbuilding and on gold and precious metals. It will lift asset freezes on Iranian institutions, including on the Central Bank of Iran. The EU’s arms embargo and restrictions on the transfer of ballistic missile technology will remain in place for 8 years after implementation of the deal or until the IAEA reaches a broader conclusion, whichever is earlier.

8.2 Assessment

In the run-up to the JCPOA, the sanctions discussion focused on two main questions: When and how would Iran receive sanctions

relief? And, if Iran failed to implement its commitments, how would sanctions snap back, given the complexities of disentangling a large, multilateral sanctions regime?

8.2.1 Lifting Sanctions

While lifting UN and EU sanctions is relatively straightforward, lifting U.S. sanctions poses a peculiar challenge. Not all U.S. sanctions are nuclear-related, and the authorities to lift the sanctions are a mixed bag of executive waivers and legislative action. While the president has the authority to cancel executive orders or waive some of the most severe sanctions—those that target Iran’s financial, energy, shipping, insurance, transportation, and automotive sectors— it will take legislative action to terminate the remaining sanctions related to Iran’s nuclear proliferation activities. The language in the JCPOA calls upon the United States to “seek such legislative action” at Transition Day—language that falls significantly short of a guarantee, leaving uncertainty both in terms of whether the U.S. will be able to fulfill its promise, and how Iran would respond if it does not.

8.2.2 Untangling the U.S., UN, and EU Designated Entities Lists

One of the more complex features of the JCPOA is the approach to lifting sanctions on designated entities associated with Iran’s nuclear proliferation activities. Under the agreement, these individuals and entities will remain subject to EU and U.S. sanctions until Transition Day. But, the EU, UN, and U.S. each have their own blacklists, and while there is considerable overlap, significant differences remain.

The case of General Qassem Suleimani, commander of the Quds Force of the Islamic Revolutionary Guard Corps (IRGC), highlights the complexities in unwinding these designations. The U.S., EU, and UN have designated Suleimani for his role in Iran's nuclear *proliferation-related* activities, and although Suleimani will receive UN and EU sanctions relief on Transition Day, he will still remain designated under U.S. *terrorism-related* sanctions.

In other cases, some individuals who will receive sanctions relief still face multiple criminal charges in the United States. Milad Jafari, for example, led a procurement network that supported Iran's Aerospace Industries Organization—an organization involved in Iran's ballistic missile program. In July 2010, the U.S. Department of Justice charged Jafari (in absentia) with violating U.S. export laws, the International Emergency Economic Powers Act, and the Iranian Transaction Regulations. Although Jafari will no longer be subject to EU or UN sanctions after Transition Day, he—and his associates—will still be wanted in the U.S. and subject to extradition should he travel outside Iran.

8.2.3 *Re-imposing Sanctions*

The JCPOA and Resolution 2231 establish a process for UN sanctions to automatically snap back in the event of a substantial violation. The efficacy of this snapback procedure has faced considerable scrutiny.

As some have pointed out, the economic benefits derived from sanctions relief could “immunize” Iran from the snapback of sanctions. To be sure, foreign investors are lining up as Iran begins laying the groundwork for economic reintegration.

Western energy companies are poised to sign new energy deals, and Iran's oil minister, Bijan Zanganeh, estimates that Iran will be able to ramp up oil production by 500,000 barrels per day immediately after sanctions are lifted, and up to one million barrels per day 6 months thereafter—increasing output by 50% in 5 years. On one hand, the current sanctions regime is complex and the product of decades of political and diplomatic maneuvering. Securing significant oil reductions from Iran's top importers, for example, required the threat of extraterritorial sanctions. Whether or not the U.S. and EU would be able to once again capture and sustain broad-level support for cutting back Iranian energy imports is unclear and depends on a variety of factors, such as the state of the global energy market and the ambiguity and severity of an Iranian violation. Moreover, as direct investment in Iran increases, private sector support for sanctions is likely to decrease—undermining the ability to reapply coercive economic measures.

On the other hand, a number of factors are likely to mitigate the speed and extent to which Western companies will engage in the Iranian market. If Iran violates the agreement and sanctions are re-applied, neither the agreement nor the Security Council Resolution includes a clause that would permit the fulfillment of contracts already signed. The “grandfather” clause in Resolution 2231 only covers imposition of sanctions for activities that were legal at the time they were conducted, not future activities in the event that sanctions are re-imposed. Therefore, companies signing long-term contracts with Iran would have to consider the possibility that sanctions would be snapped back and they would be prohibited from continuing to execute their commitments.

Short of the full snap back of sanctions, the international community still retains the ability to selectively re-impose sanctions—either as U.S. and EU unilateral sanctions or through the UN. Further, the U.S. Treasury Department said it will continue to target individuals or entities involved in non-nuclear prohibited activity, including those who were previously de-listed from nuclear-related sanctions. These non-nuclear sanctions include secondary sanctions on interactions with the Islamic Revolutionary Guard Corps (IRGC). Because the IRGC maintains significant influence over domestic contracts in Iran, foreign firms will run the risk that investment could trigger American IRGC-related sanctions.

Moreover, outside of international factors, many investors still view Iranian markets as high risk, due to corruption, state-dominated institutions and subsidies, bureaucratic inefficiencies with official procurement, and a crippled financial sector that lacks liquidity to support anticipated projects. Iran's banking sector still lacks comprehensive anti-money laundering and counter-terrorist financing laws and regulations—a deficiency that has earned Iran a designation as a jurisdiction of primary money laundering concern under Section 311 of the USA PATRIOT Act, and a spot on the Financial Action Task Force blacklist. Until Iran addresses these deficiencies, investors and financiers may be slow to return to Iran.

In conclusion, Iran will receive substantial economic benefits under the JCPOA, although the benefits may not be as large or as rapid as many Iranians hope. The snapback provisions of the JCPOA and Resolution 2231 create a potent threat to restore UN sanctions in response to a substantial violation, as long as those provisions are in force for 10 to 15 years. However, the snapback

provision may not be credible in response to minor violations, so the U.S. will need to work with the P5+1 to develop strategies for calibrated responses, including unilateral actions or partial re-imposition of UN sanctions if minor violations take place.

9. Civil Nuclear Cooperation

9.1 Description

The JCPOA contains provisions for civil nuclear cooperation with Iran in a wide range of areas, subject to review and decision by the Procurement Working Group of the Joint Commission.

Several areas of cooperation are worth noting:

- The P5+1 have agreed to facilitate Iran's acquisition of light water research and power reactors, including help with construction, supply of instrumentation, supply of equipment, training, and technical review.
- The construction of the modified Arak heavy-water project will entail extensive cooperation, facilitated by a working group of the P5+1 and Iran, and supported by an international partnership that could involve other countries as mutually agreed.
- The P5+1 will support assistance to Iran in meeting international standards for the fabrication of nuclear fuel and will seek to cooperate on the supply of fabrication technologies and equipment.
- Iran will seek cooperation on a broad range of R&D activities and request proposals for “cooperative international nuclear, physics, and technology projects.”

- Russia has agreed to partner with Iran on setting up two centrifuge cascades for stable isotope production (i.e., not involving uranium) in the Fordow facility.
- Iran will establish a Nuclear Safety Center and seek to engage regulatory authorities in other countries to cooperate on sharing lessons learned and best practices on regulatory independence, safety culture, emergency preparedness, and accident management, among other topics.
- Iran will seek help in the area of nuclear medicine, including upgrades to its infrastructure for radio-isotope production.
- The P5+1 are prepared to cooperate with Iran on strengthening security of nuclear materials through training and workshops.
- The P5+1 are prepared to cooperate on issues of waste management and facility decommissioning.

9.2 *Assessment*

Civil nuclear cooperation potentially provides positive incentives to Iran to fulfill its obligations under the JCPOA. Like sanctions relief, access to nuclear assistance is one of the benefits of the JCPOA that would disappear if Iran were found in major violation of the agreement. In addition, cooperation that develops peaceful applications of nuclear technology in Iran provides Iranian scientists and engineers with professionally fulfilling civilian work. Moreover, the personal and organizational ties with Iranian scientists and engineers can be an important means of gaining insight into the speed, direction, and, to a certain extent, intent of Iran's nuclear development.

Cooperation also reduces Iran's isolation on the crucial matters of nuclear safety and security. The Bushehr reactor is in a seismically active area, and Iran is not a party to the international Nuclear Safety Convention. Little is publicly known about Iran's nuclear security measures and practices. Iran faces serious terrorist threats that could result in a sabotage of the Bushehr plant or theft of industrial or medical radioactive sources for terrorist use outside of Iran's borders. Cooperation on nuclear security gives the United States and others more insight into the measures Iran has in place to reduce the risk of nuclear or radiological terrorism, and it provides a means of helping Iran to strengthen those measures.

On the negative side, the agreement could allow Iran to form partnerships and gain access to technology that would help it sustain and eventually expand its nuclear program once restrictions are lifted. The JCPOA carefully avoids any commitments to nuclear assistance in sensitive areas, such as enrichment or reprocessing, but it includes assistance to help Iran develop fuel fabrication capabilities for the redesigned Arak research reactor. This could end up supporting Iran's rationale for building a commercial scale enrichment facility in the future to produce LEU fuel for its nuclear power program.

For more, visit
Iran Matters

the Belfer Center's online source for
best analysis and facts on the Iranian
nuclear challenge.



<http://iranmatters.belfercenter.org>



Belfer Center for Science and International Affairs

Harvard Kennedy School

79 JFK Street

Cambridge, MA 02138

Fax: (617) 495-8963

Email: belfer_center@hks.harvard.edu

Website: <http://belfercenter.org>

Copyright 2015 President and Fellows of Harvard College