



June 2016

IRAN NUCLEAR AGREEMENT

The International Atomic Energy Agency's Authorities, Resources, and Challenges

Accessible Version

GAO Highlights

Highlights of [GAO-16-565](#), a report to congressional requesters

Why GAO Did This Study

In July 2015, multilateral talks with Iran culminated in an agreement called the JCPOA, through which Iran committed to limits on its nuclear program in exchange for relief from sanctions put in place by the United States and other nations. IAEA, an independent international organization that administers safeguards designed to detect and deter the diversion of nuclear material for nonpeaceful purposes, was requested to verify and monitor Iran's implementation of these commitments. The U.S. Department of State coordinates the United States' financial and policy relationship with IAEA.

GAO was asked to review the authorities and resources IAEA has to carry out its activities regarding the JCPOA. This report, which updates the preliminary findings from an interim report released in February 2016 (GAO-16-417), examines (1) the JCPOA commitments that IAEA has been asked to verify and monitor and its authorities to do so, (2) the resources IAEA has identified as necessary to verify and monitor those JCPOA commitments, and (3) potential challenges and mitigating actions IAEA and others have identified with regard to verifying and monitoring the JCPOA. GAO analyzed the JCPOA and key IAEA documents and interviewed current and former IAEA officials, U.S. government officials, national laboratory representatives, and experts from research institutions.

What GAO Recommends

GAO is not making any recommendations.

View [GAO-16-565](#). For more information, contact David C. Trimble at (202) 512-3841 or trimbled@gao.gov.

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The International Atomic Energy Agency's Authorities, Resources, and Challenges

What GAO Found

As outlined in the Joint Comprehensive Plan of Action (JCPOA), the International Atomic Energy Agency (IAEA) was asked to verify and monitor Iran's implementation of a range of nuclear-related commitments. IAEA is using its safeguards authorities and conducting additional activities agreed to by Iran under the JCPOA to do so. Iran's commitments include limits on uranium enrichment levels and on enriched uranium inventories. IAEA is verifying and monitoring Iran's implementation of these commitments through a range of activities conducted by its Safeguards Department, such as inspecting Iran's nuclear facilities, analyzing environmental samples, and monitoring Iran's uranium mines and mills. Under the JCPOA, Iran agreed to provisionally apply the Additional Protocol, an agreement that will give IAEA's inspectors access to an expanded range of locations, including where the agency seeks assurance regarding the absence of undeclared nuclear material and activities. The JCPOA also includes a mechanism in which participants to the agreement commit to resolve an access request from the agency within 24 days after the request is made.

IAEA has identified the financial, human, and technical resources necessary to verify and monitor Iran's nuclear-related commitments in the JCPOA. IAEA has estimated that it needs approximately \$10 million per year for 15 years in additional funding above its current safeguards budget for JCPOA verification. According to IAEA documents, this \$10 million will be entirely funded through extra-budgetary contributions through 2016. IAEA officials said that the agency intends to propose that of the \$10 million approximately \$5.7 million for all Additional Protocol activities and inspector costs attributable to the JCPOA be funded through IAEA's regular budget after 2016; approximately \$4.4 million will be supported through extra-budgetary contributions from member states, such as the United States. IAEA also plans to transfer 18 experienced inspectors to its Office of Safeguards Verification in Iran from other safeguards divisions and to hire and train additional inspectors. According to IAEA officials, existing safeguards technical resources are sufficient to implement the JCPOA.

IAEA may face potential challenges in verifying and monitoring Iran's implementation of certain nuclear-related commitments in the JCPOA. According to current and former IAEA and U.S. officials and expert organizations, these potential challenges include (1) integrating JCPOA-related funding into IAEA's regular budget and managing human resources in the safeguards program, (2) access challenges depending on Iran's cooperation and the untested JCPOA mechanism to resolve access issues, and (3) the inherent challenge of detecting undeclared nuclear materials and activities. IAEA has identified mitigating actions, such as utilizing remote monitoring and cost-free experts to address potential understaffing of IAEA safeguards activities in other countries as additional experienced inspectors are transferred to work on Iran-related safeguards. In addition, according to IAEA and U.S. officials as well as a former IAEA official GAO interviewed, IAEA has improved its capabilities in detecting undeclared activity. For example, according to U.S. officials, IAEA has adapted its inspector training program to focus on potential indicators of undeclared activities.

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Abbreviations

CSA	comprehensive safeguards agreement
DOE	U.S. Department of Energy
IAEA	International Atomic Energy Agency
INFCIRC	information circular
JCPOA	Joint Comprehensive Plan of Action
LG-SIMS	Large Geometry Secondary Ionization Mass Spectrometer
NNSA	National Nuclear Security Administration
NPT	Treaty on the Nonproliferation of Nuclear Weapons
OLEM	online enrichment monitor
PMD	possible military dimensions

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June 9, 2016

The Honorable Mark Kirk
Chairman
Subcommittee on National Security and International Trade and Finance
Committee on Banking, Housing, and Urban Affairs
United States Senate

The Honorable Nita Lowey
Ranking Member
Subcommittee on State, Foreign Operations, and Related Programs
Committee on Appropriations
House of Representatives

The Honorable Robert Menendez
United States Senate

Iran's past efforts to develop a nuclear weapons program threatened regional and global security and presented significant challenges to the United States. The United States and other nations imposed sanctions on Iran that adversely affected the Iranian economy.¹ In July 2015, multilateral talks with Iran culminated in an agreement—the Joint Comprehensive Plan of Action (JCPOA)—in which the United States, France, Germany, the United Kingdom, Russia, and China, with the High Representative of the European Union for Foreign Affairs and Security Policy, agreed to reciprocal commitments with Iran.² These commitments include providing sanctions relief if Iran implements its nuclear commitments as laid out in the JCPOA.

¹For a description of the effects of sanctions on Iran, see GAO, *Iran: U.S. and International Sanctions Have Adversely Affected the Iranian Economy*, [GAO-13-326](#) (Washington, D.C.: Feb. 25, 2013).

²In November 2013, these multilateral talks resulted in the Joint Plan of Action, an initial understanding with Iran to explicitly block near-term Iranian pathways to a nuclear weapon and allow further talks to reach a long-term comprehensive solution. The participants in the talks in addition to Iran are collectively referred to as the E3/EU+3 (i.e., France, Germany, and the United Kingdom, plus China, Russia, and the United States, coordinated by the European Union High Representative).

The JCPOA details Iran’s commitments related to its nuclear facilities, equipment, materials, and activities, among other things. On July 20, 2015, the United Nations Security Council endorsed the JCPOA and requested that the International Atomic Energy Agency (IAEA) verify and monitor these commitments.³ IAEA—an independent international organization based in Vienna, Austria, and affiliated with the United Nations—has the dual mission of promoting the peaceful uses of nuclear energy and verifying that nuclear technologies and materials are used for peaceful purposes and not diverted to nuclear weapons. Specified U.S., European Union, and United Nations nuclear-related sanctions on Iran were lifted on January 16, 2016—the JCPOA’s “Implementation Day”—when IAEA verified and reported that Iran had fully implemented its commitments defined in Annex V, paragraph 15, of the JCPOA.⁴ The JCPOA also provides for a “Transition Day,” when the United States and European Union will take further steps to eliminate nuclear-related sanctions on Iran, either on October 18, 2023, or earlier if IAEA reaches what it calls a “broader conclusion” regarding the peaceful nature of Iran’s nuclear program.⁵

The Treaty on the Nonproliferation of Nuclear Weapons (NPT), which came into force in 1970, requires non-nuclear weapon states that are party to the treaty—countries that had not manufactured and detonated a nuclear device before January 1, 1967, such as Iran—not to acquire nuclear weapons and to subject all nuclear material used in peaceful

³S.C. Res. 2231, U.N. Doc. S/RES/2231 (July 20, 2015).

⁴These commitments are specified in Sections 15.1-15.11 of Annex V of the JCPOA. The JCPOA also contains provisions describing the circumstances under which a participant may cease performance of its commitments. These commitments include the provision of sanctions relief. Furthermore, United Nations Security Council Resolution 2231 (2015), which endorses the JCPOA, provides a mechanism for United Nations Security Council sanctions to be re-imposed in certain circumstances.

⁵A broader conclusion refers to IAEA’s determination for a country that for a given year all nuclear material remained in peaceful activities. This conclusion is based on IAEA’s findings that for that year there were no indications of diversion of declared nuclear material or of undeclared nuclear material or activities in the country.

activities to IAEA safeguards.⁶ IAEA has previously found Iran to be in noncompliance with its safeguards obligations.

You asked us to review the authorities and resources IAEA has to carry out its activities to monitor and verify certain nuclear-related commitments under the JCPOA. In February 2016, we issued an interim report on our preliminary findings.⁷ This report, which updates the preliminary findings in the interim report, examines (1) the JCPOA commitments that IAEA has been asked to verify and monitor, and its authorities to do so; (2) the resources IAEA has identified as necessary to verify and monitor Iran's nuclear-related commitments under the JCPOA; and (3) potential challenges and mitigating actions, if any, IAEA and others have identified with regard to verifying and monitoring Iran's nuclear-related commitments under the JCPOA.

To identify the nuclear-related commitments in the JCPOA that IAEA has been asked to verify and monitor and IAEA's authorities for verifying and monitoring these commitments, we analyzed the JCPOA, and IAEA documentation concerning the safeguards legal framework, including the Statute of the IAEA (the Statute),⁸ information circular (INFCIRC)/153, which provides the basis for a comprehensive safeguards agreement (CSA), Iran's CSA, and INFCIRC/540, which provides the basis for an Additional Protocol. To examine the resources IAEA has identified as necessary to verify and monitor Iran's nuclear-related commitments under the JCPOA, we reviewed IAEA planning and budget documents and statements by the IAEA Director General. In addition, to further understand IAEA authorities and resource needs, and to examine

⁶Under Article II of the NPT, each non-nuclear weapon state party agrees, among other things, not to receive any transfer of nuclear weapons or other nuclear explosive devices, not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices, and not to seek or receive any assistance in the manufacture of nuclear weapons or other nuclear explosive devices. Under Article III of the NPT, each non-nuclear weapon state party agrees, among other things, to accept IAEA safeguards on all source or special fissionable material in all peaceful nuclear activities within the territory of such state, under its jurisdiction, or carried out under its control anywhere.

⁷GAO, *Nuclear Nonproliferation: Preliminary Observations on IAEA's Role in Verifying the Iran Agreement*, [GAO-16-417](#) (Washington, D.C.: Feb. 12, 2016).

⁸The Statute of the International Atomic Energy Agency, done Oct. 26, 1956, 8 U.S.T. 1093, 276 U.N.T.S. 3 (entered into force July 29, 1957).

potential challenges and mitigating actions IAEA and others have identified with regard to verifying and monitoring Iran’s nuclear-related commitments under JCPOA, we interviewed officials of IAEA, the Department of State (State Department), and the Department of Energy’s (DOE) National Nuclear Security Administration (NNSA);⁹ as well as representatives of Oak Ridge National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, Lawrence Livermore National Laboratory, and Brookhaven National Laboratory. We also interviewed 9 former IAEA officials, 10 former U.S. government and national laboratory officials, and officials from 10 expert organizations—research institutions and nongovernmental organizations with knowledge in the areas of nuclear verification, monitoring, and safeguards.¹⁰ Appendix I provides a more detailed discussion of our objectives, scope, and methodology.

We conducted this performance audit from July 2015 to June 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes (1) IAEA’s structure and budget, (2) IAEA safeguards, (3) the nuclear fuel cycle, and (4) Iran’s nuclear program.

⁹NNSA is a separately-organized agency within DOE, with responsibility for the nuclear weapons and nonproliferation programs, among other things. NNSA conducts its activities at headquarters and at research and development laboratories, production plants, and other facilities. NNSA also provides technical assistance to IAEA’s safeguards and nuclear security programs.

¹⁰We selected these experts by first identifying organizations that had previously served as sources of IAEA subject matter experts for GAO. To ensure a wide range of viewpoints, we supplemented our initial selection with individuals and organizations identified through a literature search and by recommendations from our initial set of expert organizations. We requested interviews from all the identified experts and suggested contacts and interviewed all who agreed to participate (two experts provided written responses in lieu of in-person interviews). When referring to former U.S. and IAEA officials and expert organizations throughout the report, we use “some” to refer to three of a group, “several” to refer to four or five members of a group, and “many” to refer to more than five members of a group.

IAEA's Structure and Budget

IAEA is structured into six major programs, including Nuclear Verification, which carries out the agency's safeguards activities. Other IAEA programs are generally intended to help promote safe and secure uses and applications of nuclear energy for civilian purposes. For example, IAEA's Technical Cooperation program helps member states achieve their sustainable development priorities by providing relevant nuclear technologies and expertise. IAEA funds its programs primarily through (1) its regular budget, for which all member countries are assessed,¹¹ and (2) voluntary extra-budgetary contributions from certain member countries and other donors to meet critical needs.¹² IAEA's operational budget requirements for 2016 totaled to \$436.6 million, including \$155.3 million for the nuclear verification program (i.e., safeguards).¹³ See table 1 for IAEA projected budget requirements for 2016 by program.

¹¹ Assessed contributions are payments made as part of the obligations that countries undertake as members of IAEA. The current payment structure for assessed contributions to IAEA is based on the United Nations scale of assessment, adjusted for membership, with a maximum base rate (25 percent) and a minimum base rate (.001 percent). The scale for IAEA also includes a slight premium to cover the costs of the nuclear safeguards program.

¹² In addition, financing of Technical Cooperation projects is generally supported through the annual voluntary contributions of member states to IAEA's Technical Cooperation Fund.

¹³ International Atomic Energy Agency, "The Agency's Programme and Budget 2016-2017," GC (59)/2, July 2015. These figures were calculated based on the average exchange rate used by the Department of the Treasury of €0.919 to \$1 and do not include capital expenditures, unfunded requirements, or the Technical Cooperation Fund. Requirements unfunded in the regular budget are for core activities which should, if funding permitted, be part of the Agency's regular budget programme. They comprise activities (a) which are financed from expected extra-budgetary funds, and (b) activities for which no funding is currently available. Unless the latter are financed by contributions from Member States or from savings, they will not be implemented.

Table 1: International Atomic Energy Agency’s (IAEA) Projected Operational Budget Requirements for Major Programs for 2016

Dollars in millions

Program^a	Regular budget requirements	Extra-budgetary requirements	Total
Nuclear Power, Fuel Cycle, and Nuclear Science	\$42.3	6.4	\$48.7
Nuclear Techniques for Development and Environmental Protection	43.0	4.1	\$47.1
Nuclear Safety and Security	37.8	31.0	\$68.8
Nuclear Verification	146.9	8.4	\$155.3
Policy, Management and Administration Services	85.5	3.3	\$88.8
Management of Technical Cooperation for Development	26.7	1.2	\$27.9
Total	\$382.3	\$54.4	\$436.6

Source: GAO analysis of IAEA data. | GAO-16-565

Note: IAEA denominates its budget requirements in euros (€). GAO re-calculated these requirements in dollars using the average exchange rate used by the Department of the Treasury on December 31, 2015, of \$1 to €0.919. IAEA budgets by calendar year. Numbers may not add to totals because of rounding.

^aThe Nuclear Power, Fuel Cycle, and Nuclear Science program helps interested IAEA member states develop the capacity and infrastructure to manage nuclear programs, among other things. The Nuclear Techniques for Development and Environmental Protection program provides member states with advice and various technical documents, among other things. The Nuclear Safety and Security program promotes the worldwide achievement and maintenance of high levels of nuclear safety and security. The Nuclear Verification program establishes and administers safeguards. The Policy, Management and Administration Services program coordinates the agency’s functions. The Management of Technical Cooperation for Development program develops, implements, and manages technical cooperation projects.

IAEA has a Board of Governors, which provides overall policy direction and oversight for the agency. A Secretariat, headed by the Director General, is responsible for implementing the policies and programs of the IAEA General Conference and the Board of Governors.¹⁴ The State Department coordinates the United States’ financial and policy relationship with IAEA.

¹⁴The General Conference is composed of representatives of all member states (167 countries at the end of 2015) that contribute to IAEA’s budget.

IAEA Safeguards

IAEA safeguards are a set of technical measures and activities by which IAEA seeks to verify that nuclear material subject to safeguards is not diverted to nuclear weapons or other proscribed purposes. To carry out its safeguards activities, inspectors and analysts in IAEA's Safeguards Department collaborate to verify that the quantities of nuclear material that non-nuclear weapon states have formally declared to the agency are correct and complete.

Most countries have concluded a CSA with IAEA that covers all nuclear material in all peaceful nuclear activities and serves as the basis for the agency's safeguards activities. Most countries with a CSA have also brought into force an Additional Protocol to their CSAs, which requires that country to provide IAEA with a broader range of information on the country's nuclear and nuclear-related activities. IAEA developed the Additional Protocol to obtain additional information about and access to countries' nuclear and nuclear-related activities as part of its response to the discovery in 1991 of a clandestine nuclear weapons program in Iraq. The Additional Protocol gives the agency's inspectors access to an expanded range of locations, including those where the agency seeks to assure the absence of undeclared nuclear material and activities. Undeclared nuclear material and activities are those a state has not declared and placed under safeguards but is required to do so pursuant to its CSA or Additional Protocol. Iran's CSA entered into force in May 1974.¹⁵ According to IAEA officials, Iran applied the Additional Protocol beginning in December 2003, ceased to do so in February 2006, and has been provisionally applying it since January 16, 2016. IAEA regards Iran's provisional application as if the Additional Protocol were in force.¹⁶

IAEA implements safeguards through a range of activities and techniques to help ensure that all nuclear material is where it was declared to be and to verify that there was no misuse of the facility, no diversion of declared nuclear material, and no undeclared nuclear material or activities. Safeguards activities include on-site inspections, environmental sampling,

¹⁵International Atomic Energy Agency, "The Text of the Agreement between Iran and the Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons." (INFCIRC/214) December 13, 1974.

¹⁶According to IAEA and the State Department, when an Additional Protocol enters into force, it becomes legally binding for the State.

and remote monitoring. For example, to verify nondiversion of nuclear material, IAEA inspectors count items (e.g., containers of uranium or plutonium), measure attributes of these items (e.g., isotopic composition), and compare their findings with records and declared amounts. Inspectors typically verify the nuclear material inventory by reviewing a facility's nuclear material accounting documentation (e.g., reports and records) and through, for example, visual observation, radiation detection and measurement, and application of seals and other identifying and tamper-indicating devices, according to IAEA documents.¹⁷ Visual observation allows inspectors to observe the processes within a location and the equipment it contains, and to check the consistency of observations with declarations. Inspection activities are supported by off-site safeguards activities, such as analysis of the environmental samples collected during inspections,¹⁸ remote monitoring through the equipment installed, analysis of commercial satellite imagery, and analysis of open source documents, such as technical journals.

IAEA may conduct three types of inspections pursuant to comprehensive safeguards agreements: ad hoc, routine, and special inspections. For example, IAEA may conduct ad hoc inspections to verify a state's initial declaration under the CSA and any changes to these declarations. Routine inspections give IAEA access to strategic points at a location to verify, among other things, the location, identity, quantity, and composition of all nuclear material subject to safeguards under the CSA. Notification of inspections can be transmitted from 1 week to 24 hours in advance or less.¹⁹ Routine inspections may also be unannounced. IAEA may also conduct special inspections in certain circumstances, either in addition to the routine or ad hoc inspection effort or involving access to

¹⁷IAEA containment and surveillance equipment, such as seals, is designed to make tampering more difficult or reduce the probability that tampering could take place without detectable physical evidence. Tampering is interference to defeat the integrity of safeguards equipment.

¹⁸IAEA inspectors collect environmental samples from nuclear facilities and other locations, and IAEA's Network of Analytical Laboratories analyzes these samples to verify that their isotopic signatures match the declared activities of the location and to detect traces, if any, of undeclared nuclear material.

¹⁹Inspections conducted with less than 48 hours' notice are considered to be "short notice" inspections.

locations or information beyond those subject to a routine or ad hoc inspection.²⁰

The Additional Protocol also authorizes “complementary access” for IAEA, which is access to nuclear sites and other locations related to a state’s nuclear fuel cycle—beyond declared nuclear facilities that are routinely subject to inspections under the CSA— including locations at which nuclear fuel-cycle research and development not involving nuclear material is carried out; manufacturing and import locations; and all buildings on a nuclear site, including undeclared locations.

IAEA may also negotiate “managed access” with a state to prevent the dissemination of proliferation-sensitive information, meet safety or physical protection requirements, or protect proprietary or commercially sensitive information.²¹ According to an IAEA document, an example of managed access is the designation by the operator, based on arrangements made with IAEA, of the routes to be followed on a site to prevent the exposure of inspectors to high levels of radiation or to protect proprietary sensitive information associated with certain equipment. Furthermore, managed access should not hinder IAEA inspectors or prevent them from fulfilling the purposes of the complementary access—that is, the arrangements shall not preclude the agency from conducting activities necessary to provide credible assurance of the absence of undeclared nuclear material and activities at the location in question.

IAEA plans inspections according to its reporting requirements and its goals for timely detection. The safeguards agreements with a given country, its nuclear materials, and the nature of its fuel cycle and facilities to be safeguarded inform the frequency of inspections and other in-field

²⁰Special inspections allow for access to information or locations beyond those specified in the provisions of the CSA on ad hoc and routine inspections. For example, IAEA may make special inspections if it considers the information the state makes available—including the state’s explanations and information obtained from routine inspections—to be inadequate for fulfilling its responsibilities under the CSA.

²¹An Additional Protocol has explicit provisions under which a state may invoke “managed access.” A CSA has no explicit provisions for “managed access” but, according to State Department officials, sets forth similar principles for safeguards implementation.

activities.²² For example, according to IAEA documents, in countries without an Additional Protocol in force or where IAEA has not drawn a broader conclusion, IAEA's inspections would be timed to detect the diversion of unirradiated direct use material—nuclear material that can be used for the manufacture of nuclear explosive devices in its present form—within 1 month. The goal for irradiated direct use material, such as spent fuel, which would require more time and effort to be converted to components of nuclear explosive devices, would be to detect any diversion in 3 months. The goal for all other nuclear material, such as depleted, natural, and low-enriched uranium, as well as thorium, would be to detect any diversion in a year. IAEA plans its supporting safeguards activities—such as analysis of satellite imagery before inspections, of Additional Protocol declarations, and of information obtained during inspections (such as environmental samples)—in proportion to the frequency of inspections.

The Nuclear Fuel Cycle

A nuclear weapon requires fuel in the form of special nuclear material—either plutonium or highly enriched uranium—as well as the development of the nuclear explosive device itself. Natural uranium consists primarily of 2 isotopes: uranium-238 (99.3 percent) and uranium-235 (0.7 percent). Most commercial nuclear power reactors are fueled by uranium that contains 3 to 5 percent uranium-235; nuclear weapons require a higher concentration. Uranium enrichment, which is most commonly conducted by gas centrifuge technology, is the process of separating uranium-235—the form, or isotope, that can sustain a chain fission reaction to release enormous amounts of energy in nuclear reactors and weapons—from uranium-238 to increase the concentration of uranium-235.²³ As a nuclear reactor operates, some of the uranium is converted to plutonium, which can also be used as a weapons material. Heavy water reactors can be

²²According to IAEA officials, the chemical form of the material, as well as the isotopic composition, informs the frequency of safeguards activities in the field. For example, in a country that has 20 metric tons of depleted uranium, IAEA's standard for timely detection of diversion would be 1 year, but for highly enriched uranium in a certain form—for example, for uranium hexafluoride (UF₆)—timeliness would be several months for tens of kilograms of material.

²³Gas centrifuge technology employs rapidly spinning cylinders to separate uranium-235 from uranium-238. There are other enrichment technologies available, including gaseous diffusion and laser enrichment.

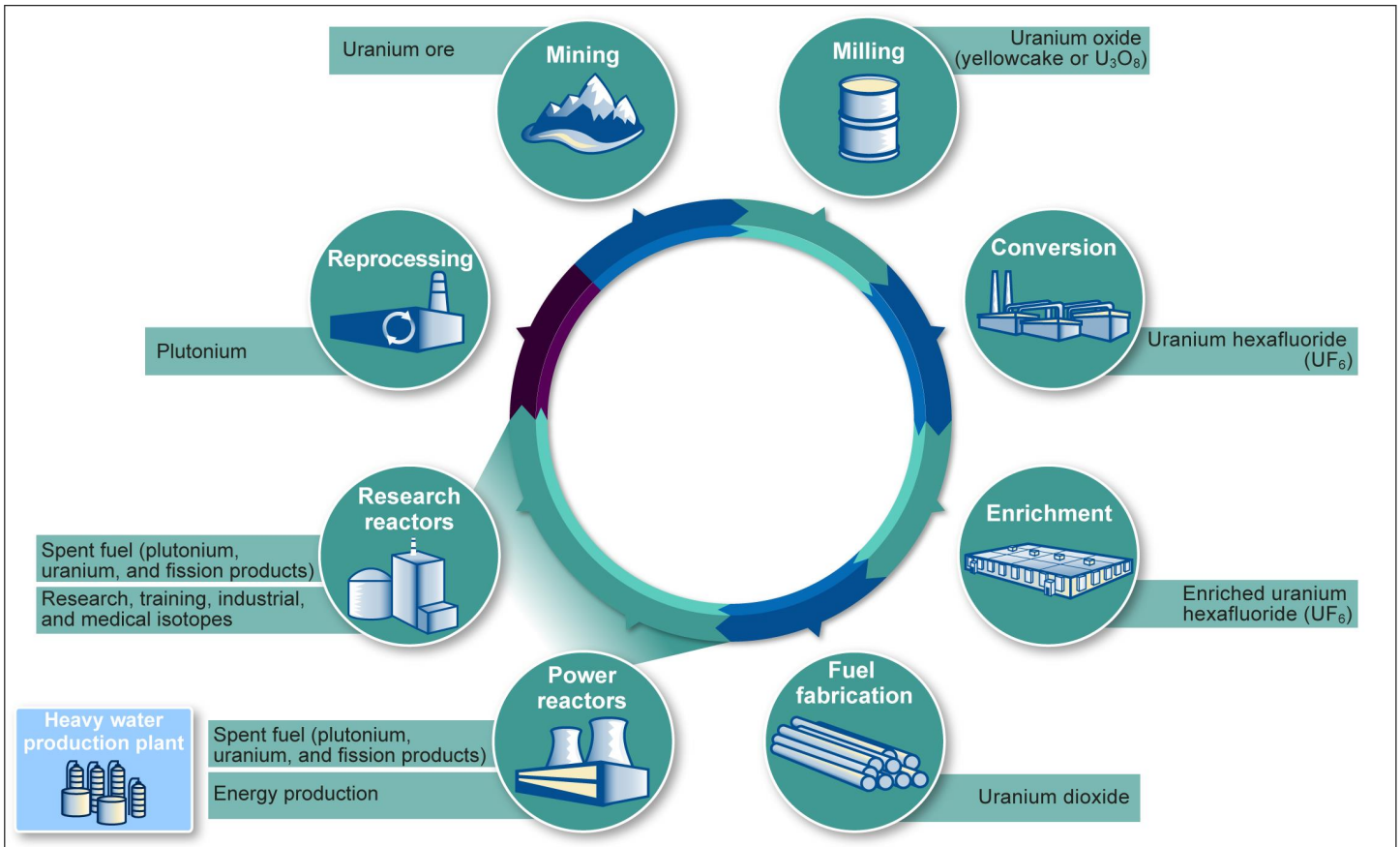
efficient at producing plutonium under certain circumstances; the operating power, among other things, influences how much plutonium is produced.²⁴

The fuel cycle—the series of processes used to make fuel for and manage spent fuel from nuclear reactors—may also be used to produce special nuclear material for weapons. The uranium nuclear fuel cycle consists of three stages: (1) the front end, in which uranium is mined, milled, enriched, and fabricated into fuel; (2) reactor operation; and (3) the back end, in which spent fuel is either disposed of (open fuel cycles) or processed to produce new fuel (closed or partially closed fuel cycles). IAEA verifies that nuclear material subject to safeguards is not diverted. Under a CSA, the starting point of safeguards is when nuclear material reaches the stage in the nuclear fuel cycle where it is suitable, by composition and purity, for enrichment or fuel fabrication and leaves the plant or the process stage by which it has been produced,²⁵ or when material that has not yet reached such a stage is imported into the state or exported to a non-nuclear weapon state. See figure 1 for an illustration of the nuclear fuel cycle.

²⁴Heavy water, which contains deuterium (heavy hydrogen), is used in heavy water reactors as a moderator.

²⁵Material in the earlier stages must be further processed before it can be used for the manufacture of nuclear explosive devices.

Figure 1: The Nuclear Fuel Cycle



Sources: GAO analysis of International Atomic Energy Agency, Nuclear Regulatory Commission, Congressional Research Service, and Department of Energy documents. | GAO-16-565

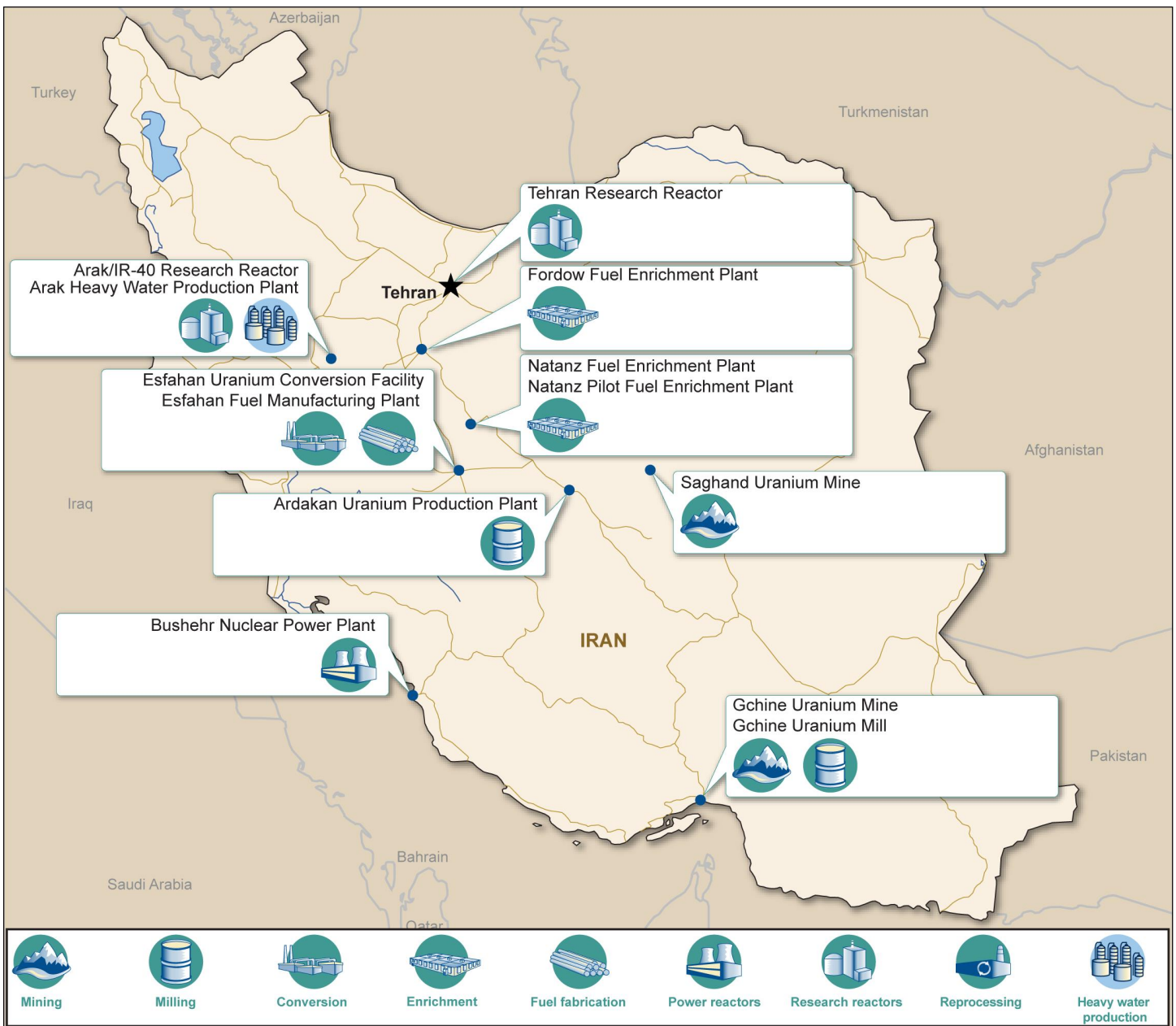
Iran's Nuclear Program

Iran's nuclear program includes two uranium mines and mills—the Gchine uranium mine and mill, the Saghand mine, and the Ardakan mill. Iran operates a conversion facility and fuel fabrication plant in Esfahan, the *Tehran Research Reactor*, and the *Bushehr Nuclear Power Plant*. *Iran's*

nuclear program also includes the Arak/IR-40 heavy water reactor, enrichment facilities at Natanz and Fordow, and a heavy water production plant in Arak.²⁶ See figure 2 for a map of major facilities in Iran's nuclear program.

²⁶Pursuant to the JCPOA, the Arak/IR-40 heavy water reactor has had its core filled with concrete and is to be reconstructed and redesigned. According to State Department officials, the Fordow enrichment facility has been repurposed and is no longer used for uranium enrichment, in accordance with commitments made in the JCPOA.

Figure 2: Major Facilities in Iran's Nuclear Program



Source: GAO analysis of International Atomic Energy Agency and Congressional Research Service information. | GAO-16-565

Iran had previously failed to declare some of these facilities to IAEA. For example, in 2002, IAEA was informed by member states of previously undeclared nuclear facilities—a uranium enrichment plant in Natanz and a heavy water production plant in Arak. In the same year, IAEA started to become increasingly concerned about the possible existence of undisclosed nuclear-related activities in Iran involving military-related organizations and, in 2011, reported to the Board of Governors on outstanding issues related to possible military dimensions (PMD) to Iran’s nuclear program.²⁷ The information indicated that Iran had carried out activities relevant to the development of a nuclear explosive device, such as studies in high explosives and exploding bridgewire detonators, and work to manufacture neutron initiators.²⁸

IAEA has also previously found instances where Iran was in non-compliance with its obligations under its CSA. For example, in June 2003, IAEA’s Director General reported that Iran had failed to meet its obligations under its CSA with respect to the reporting of nuclear material imported into Iran, among other things. In November 2003, the Director General concluded that Iran had failed to report uranium conversion experiments and the separation of plutonium from material irradiated in its Tehran Research Reactor, and had failed to provide IAEA design information for various nuclear facilities. In 2009, the Board of Governors noted that Iran’s failure to notify the agency of the construction of the Fordow uranium enrichment plant until September of that year was inconsistent with its obligations under the subsidiary arrangements to its CSA.

In July 2015, Iran made commitments under the JCPOA related to its nuclear facilities, equipment, materials, and activities, among other things,

²⁷International 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 (Nov. 8, 2011).

²⁸According to this report, the development of safe, fast-acting detonators (such as exploding bridgewire detonators), and equipment suitable for firing the detonators, is an integral part of a program to develop an implosion-type nuclear device. According to the report, neutron initiators, if placed in the center of a nuclear core of an implosion-type nuclear device and compressed, could produce a burst of neutrons suitable for initiating a fission chain reaction.

and the United Nations Security Council endorsed the JCPOA and requested that IAEA verify and monitor these commitments.

IAEA Uses Its Safeguards Authorities to Carry Out Verification and Monitoring Activities under the JCPOA

IAEA has been requested by the United Nations Security Council, and authorized by the Board of Governors, to verify and monitor Iran's implementation of a range of nuclear-related commitments. To do so, IAEA is using its safeguards authorities and conducting additional verification and monitoring activities agreed to by Iran.

IAEA Has Been Asked to Verify and Monitor Iran's Implementation of a Range of Nuclear-Related Commitments under the JCPOA

The JCPOA commitments IAEA has been asked to verify include limits on Iran's nuclear program, including those on

- numbers of centrifuges (for example, no more than 5,060 of specified centrifuges at Natanz for 10 years);
- uranium enrichment levels (no more than 3.67 percent for 15 years);
- stocks of enriched uranium (no more than 300 kilograms for 15 years);²⁹
- heavy water inventories; and
- centrifuge manufacturing.

Iran also agreed to conditions on uranium ore concentrate,³⁰ and agreed not to engage in spent fuel reprocessing, uranium or plutonium

²⁹The JCPOA specifies that Iran will maintain a total enriched uranium stockpile of no more than 300 kilograms of up to 3.67 percent enriched uranium hexafluoride (UF₆) (or the equivalent in different chemical forms) for 15 years. However, the agreement also details cases when certain enriched uranium will not count against the limit. For example, Russian-designed, fabricated, and licensed fuel assemblies for use in Russian-supplied reactors in Iran do not count against the 300-kilogram UF₆ stockpile limit.

metallurgy, or activities that could contribute to the design and development of a nuclear explosive device. The duration of certain commitments ranges from 8 years for certain centrifuge restrictions to 25 years for monitoring of uranium ore concentrate. The JCPOA does not contain any provisions relating specifically to Iran's Bushehr Nuclear Power Plant, so according to IAEA, the agency will not carry out verification or monitoring activities in relation to the JCPOA at Bushehr beyond its standard safeguards under Iran's CSA and Additional Protocol.

Iran also agreed to fully implement the "Roadmap for Clarification of Past and Present Outstanding Issues." The roadmap sets out a process for IAEA to address issues relating to the possible military dimensions of Iran's nuclear program.³¹ IAEA issued a report on the results of its PMD investigation in December 2015,³² and the Board of Governors subsequently adopted a resolution closing its consideration of the "past and present outstanding issues." The resolution noted the board's decision to transition IAEA's work in Iran from under previous Board of Governors and United Nations Security Council resolutions to JCPOA implementation and verification, in light of United Nations Security Council Resolution 2231.³³ State Department officials noted that the board, in its resolution, stated that it will be watching closely to verify that Iran fully

³⁰The JCPOA states that Iran will permit IAEA to monitor all uranium ore concentrate produced in Iran or obtained from any other source to ensure that it is transferred to a uranium conversion facility in Iran for 25 years through agreed measures that will include containment and surveillance measures. Uranium ore is the product of uranium mining, and uranium ore concentrate is the product of uranium milling. The two steps in the uranium nuclear fuel cycle prior to conversion are mining and milling. IAEA discusses its activities related to uranium ore concentrate as monitoring mines and mills.

³¹In 2002, IAEA became increasingly concerned about the possible existence in Iran of undisclosed nuclear-related activities involving military-related organizations. Information indicated that Iran had carried out activities relevant to the development of a nuclear explosive device.

³²International Atomic Energy Agency, "Final Assessment on Past and Present Outstanding Issues regarding Iran's Nuclear Programme," GOV/2015/68 (Dec. 2, 2015).

³³This transition would occur upon the Board of Governors' receipt of the Director General's report that IAEA has verified that Iran has taken actions required to reach Implementation Day. These actions are specified in paragraphs 15.1-15.11 of Annex V of the JCPOA. The Director General submitted this report to the board on Implementation Day. See International Atomic Energy Agency, "Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)," a report by the Director General to the Board of Governors, GOV/INF/2016/1 (Jan. 16, 2016).

implements its commitments under the JCPOA and will remain focused going forward on the full implementation of the JCPOA to ensure the exclusively peaceful nature of Iran's nuclear program.

IAEA Is Using Its Safeguards Authorities and Conducting Additional Activities to Verify and Monitor Iran's Commitments

According to officials in IAEA's Office of Legal Affairs, the agency draws on its safeguards authorities to verify and monitor Iran's implementation of its nuclear-related commitments. For example, using its safeguards authorities, including the CSA, IAEA will verify and monitor Iran's implementation of most of its nuclear-related commitments largely through a range of traditional safeguards approaches and techniques that it has used in the past, such as inspecting nuclear facilities and conducting nuclear material accountancy to verify quantities of nuclear material declared to the agency and any changes in the quantities over time. Under the JCPOA, Iran agreed to provisionally apply, and seek ratification of the Additional Protocol,³⁴ which gives the agency's inspectors access to an expanded range of locations, including those where the agency seeks assurance regarding the absence of undeclared nuclear materials and activities. According to IAEA officials, Iran previously applied the Additional Protocol beginning in December 2003 but ceased to do so in February 2006, and has been provisionally applying it since Implementation Day (January 16, 2016). IAEA regards this as if the Additional Protocol were in force.

Under the JCPOA, IAEA is also conducting certain additional verification and monitoring activities agreed to by Iran, such as containment and surveillance measures for monitoring Iran's uranium mines and mills, according to IAEA officials. Containment and surveillance measures include the use of video cameras to detect any movement of nuclear material and any tampering with agency equipment as well as seals that indicate whether the state has tampered with installed IAEA safeguards systems. Material in mining or ore processing activities (e.g., uranium at mines and mills) is not yet suitable for enrichment and so is not subject to the agency's safeguards under a CSA, though the Additional Protocol

³⁴In general, ratification refers to a state's domestic procedures for approving an international agreement and indicating its consent to other parties to be bound by the obligations in the agreement.

does require states to declare the location and status, among other things, of uranium mines and uranium and thorium mills.³⁵

Iran also committed under the JCPOA to cooperate with IAEA and facilitate its safeguards activities. For example, Iran agreed to make arrangements to allow for the long-term presence of IAEA inspectors by issuing long-term visas, among other things. Iran also agreed to permit the use of modern technologies, such as online enrichment monitors, to increase the efficiency of monitoring activities. The JCPOA includes a mechanism in which its participants commit to resolve access issues with the agency regarding an undeclared location within 24 days after the request is made. The JCPOA also describes a dispute resolution mechanism through which a participant in the agreement can bring a complaint if it believes that commitments are not being met and which allows the participant to cease performance of its commitments in certain cases if dispute resolution fails to resolve the participant's concerns.

Iran also agreed, under the JCPOA, to fully implement Modified Code 3.1 of the subsidiary arrangements to its CSA.³⁶ According to IAEA, the text of the Modified Code 3.1 in Iran's subsidiary arrangements is based on model language under which a country is required to provide preliminary design information for new nuclear facilities "as soon as the decision to

³⁵Specifically, this provision of the Additional Protocol requires information specifying the location, operational status, and estimated annual production capacity of uranium mines and concentration plants, among other things. IAEA refers to concentration plants as uranium mills.

³⁶According to reports from the IAEA Director General to the Board of Governors, Iran agreed to implement Modified Code 3.1 beginning in 2003 and ceased to implement it in 2007. In March 2007, Iran notified IAEA that it had suspended the implementation of Modified Code 3.1, and that it would revert to the previous version of the code, which only required submission of design information for a new facility 180 days before introducing nuclear material into it. The Director General disagreed and asserted that Iran remained bound by the revised Code 3.1. See International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement and Relevant Provisions of Security Council Resolutions in the Islamic Republic of Iran," GOV/2007/22 (May 23, 2007) and International Atomic Energy Agency, "Implementation of the NPT Safeguards Agreement and relevant provisions of Security Council resolutions 1737 (2006), 1747 (2007), 1803 (2008) and 1835 (2008) in the Islamic Republic of Iran," GOV/2009/74 (Nov. 16, 2009).

construct, or to authorize construction, of such a facility has been taken, whichever is earlier.”³⁷

Furthermore, Iran has agreed to import any enumerated nuclear-related and nuclear-related dual-use materials and equipment exclusively through a new “procurement channel” established under the JCPOA and United Nations Security Council Resolution 2231.³⁸ The JCPOA details the establishment of a Joint Commission comprising representatives of participants in the agreement, under which a procurement working group will review and make recommendations on proposed imports.

Furthermore, pursuant to United Nations guidance, the exporting state will provide information to IAEA on these proposed imports.³⁹ Under the JCPOA, IAEA may access the locations of intended use of specified nuclear-related imports.⁴⁰ IAEA officials told us that they expect the information provided through the procurement channel to support the agency’s efforts to detect undeclared activity.

³⁷According to IAEA, the text of Iran’s Modified Code 3.1 is based on language contained in the Model Subsidiary Arrangements General Part (Fifth Revision) dated July 3, 1992.

³⁸The items to be imported through the procurement channel include certain nuclear material, equipment, and technology as well as certain nuclear-related dual-use equipment, materials, software, and related technology listed in two IAEA documents: INFCIRC/254/Rev.12/Part 1 and INFCIRC/254/Rev.9/Part 2.

³⁹The JCPOA details the establishment of a Joint Commission comprising representatives of participants in the agreement (i.e., Iran and the E3/EU+3) and provides that the Joint Commission may establish working groups in particular areas, as appropriate. The JCPOA states that the Joint Commission is to establish a Procurement Working Group to review and decide on proposals by states seeking to supply, sell, or transfer certain nuclear-related or dual-use materials or technologies to Iran.

⁴⁰The JCPOA states that, “Iran will provide to the IAEA access to the locations of intended use of all items, materials, equipment, goods and technology set out in INFCIRC/254/Rev.12/Part 1 (or the most recent version of these documents as updated by the Security Council)...”

IAEA Has Identified the Financial, Human, and Technical Resources Necessary to Verify and Monitor Iran's Nuclear-Related Commitments in the JCPOA

IAEA has estimated the financial, human, and technical resources necessary to verify and monitor Iran's implementation of its nuclear-related commitments in the JCPOA. IAEA's process for estimating resource needs is based on the frequency of its verification and monitoring activities, which, as previously noted, is driven by timely detection goals and reporting requirements. IAEA reports to the Board of Governors on its work under the JCPOA quarterly.⁴¹

Financial Needs

IAEA has estimated that it needs approximately \$10 million per year for 15 years in additional funding above its current safeguards budget to fund additional inspections, among other things, under the JCPOA.⁴² Of this amount, IAEA estimates that it will need about \$3.3 million for costs associated with implementing the Additional Protocol; about \$2.4 million for other inspector and direct staff costs; and about \$4.4 million in other costs, such as travel, equipment, and support services beyond those associated with Additional Protocol implementation (see table 2).

IAEA officials said that consistent with its Statute, the Director General intends to propose to the Board of Governors that the approximately \$5.7

⁴¹The Board of Governors requests the Director General to provide written reports before each regular quarterly Board meeting on Iran's implementation of its commitments under the JCPOA and on matters relating to the verification and monitoring of those commitments until the Board is no longer seized of the matter. International Atomic Energy Agency, "Joint Comprehensive Plan of Action implementation and verification and monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)," GOV/2015/72 (Dec. 15, 2015).

⁴²International Atomic Energy Agency, "Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)," a report by the Director General to the Board of Governors, GOV/2015/53, (Aug. 14, 2015). This report provides this estimate based on activities foreseen as being applicable for 15 years. IAEA officials told us that after 10 years, they will consider incoming information to refine the estimate going forward. The preliminary estimates for the safeguards budget for 2016 and 2017 are approximately \$146.9 million per year, according to "The Agency's Programme and Budget 2016 –2017."

million in costs associated with Additional Protocol activities and inspector and other direct staff costs attributable to the JCPOA be funded through IAEA's regular budget after 2016. These officials said that the remaining \$4.4 million in estimated funding needs in each of the following 15 years will remain unfunded in the regular budget and therefore be supported through extra-budgetary funding. Under its Statute, IAEA is to apportion the costs of implementing safeguards, which would include inspector salaries and the cost of implementing the Additional Protocol, through assessments on member countries.⁴³ As previously noted, such assessments form IAEA's regular budget. IAEA's Statute also states that any voluntary contributions may be used as the Board of Governors, with the approval of the General Conference, may determine.⁴⁴ The JCPOA was not finalized in time for the agency to include these costs for 2016 in its assessments. Consequently, according to a 2015 IAEA report, all of IAEA's JCPOA work through 2016 will be funded through extra-budgetary contributions.⁴⁵ According to IAEA officials, how quickly the \$5.7 million in JCPOA costs are incorporated into the regular budget depends on member state support. These officials told us that IAEA hopes to resolve the questions about funding the JCPOA through the regular budget by the June 2016 Board of Governors meeting.

⁴³Article XIV B.1(b) and Article XIV.D of the Statute of the IAEA, respectively.

⁴⁴Article XIV.F of the Statute of the IAEA.

⁴⁵International Atomic Energy Agency, "Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)," a report by the Director General to the Board of Governors, GOV/2015/53 (Aug. 14, 2015).

Table 2: International Atomic Energy Agency’s (IAEA) Estimates of Annual Funding Requirements for Joint Comprehensive Plan of Action (JCPOA) Activities for 15 Years

Dollars in millions

Funding requirements by category	Human Resources	Other Costs	Total
Additional Protocol: inspector and direct staff costs	\$1.6	N/A	\$1.6
Additional Protocol: travel, equipment, support staff from other safeguards divisions, and other	1.0	0.7	\$1.6
Subtotal: Additional Protocol	2.6	0.7	\$3.3
Other nuclear-related commitments: inspector and direct staff costs	2.4	N/A	\$2.4
Other nuclear-related commitments: travel, equipment, support staff from other safeguards divisions, and other	2.5	1.8	\$4.4
Subtotal: other nuclear-related commitments	4.9	1.8	\$6.7
Total	\$7.5	\$2.5	\$10.0

Source: GAO analysis of IAEA data. | GAO-16-565

Notes: IAEA denominates its budget requirements in euros (€). GAO re-calculated these requirements in dollars using the average exchange rate used by the Department of the Treasury on December 31, 2015, of \$1 to €0.919. Numbers may not add to totals because of rounding.

IAEA’s estimate of \$10 million per year for funding requirements related to JCPOA activities is approximately 6 percent of the agency’s \$155.3 million operational safeguards requirements for 2016.⁴⁶ These requirements are consistent with historical operational safeguards expenditures from 2006 to 2014—the latest year for which expenditure data are available. During this timeframe, IAEA’s operational safeguards expenditures ranged from \$127.1 million to \$202.6 million, with amounts from \$10.8 million to \$46.9 million coming from extra-budgetary contributions (see table 3).

⁴⁶International Atomic Energy Agency, “The Agency’s Programme and Budget 2016-2017,” GC (59)/2, July 2015. This figure is based on a €0.919 to \$1 exchange rate and does not include capital expenditures or unfunded safeguards requirements.

Table 3: International Atomic Energy Agency's (IAEA) Operational Safeguards Expenditures for 2006 to 2014

Dollars in millions

Year	Safeguards regular budget expenditures	Safeguards extra-budgetary expenditures	Total operational safeguards expenditures
2006	\$116.3	\$10.8	\$127.1
2007	139.4	17.8	\$157.2
2008	140.9	15.6	\$156.5
2009	146.3	18.2	\$164.4
2010	146.0	24.1	\$170.0
2011	159.5	38.7	\$198.2
2012	155.8	46.9	\$202.6
2013	162.3	19.2	\$181.5
2014	165.6	29.1	\$194.7

Source: GAO analysis of IAEA data. | GAO-16-565

Notes: IAEA funds its programs primarily through (1) its regular budget, for which all member countries are assessed and (2) voluntary extra-budgetary cash contributions from certain member countries and other donors to meet critical needs. IAEA budgets by calendar year. The most recent year for which expenditure data are available is 2014. Values reflect the United Nations average rate of exchange for euros to U.S. dollars, as noted in the IAEA annual reports for each year. These values include reimbursable work for others and transfers to the major capital investment funds.

As we previously noted, funding for IAEA's safeguards activities—including those related to the JCPOA—comes from member state contributions to IAEA's regular budget and from member state extra-budgetary voluntary contributions to IAEA. According to State Department officials, the balance of JCPOA-related costs not covered by IAEA's 2017 regular budget will require extra-budgetary contributions from member states. The total level of voluntary contributions needed in fiscal year 2017 to cover JCPOA-related requirements remains unclear pending resolution of IAEA's 2017 budget process.

IAEA officials told us that many member states have pledged financial support for JCPOA implementation. Regarding funding from the United States, the State Department and DOE have requested approximately \$190 million for fiscal year 2017 to support IAEA generally and JCPOA-related IAEA activities specifically, in the form of both regular contributions to the IAEA budget and extra-budgetary funding:

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- The State Department has requested approximately \$101.1 million for fiscal year 2017 to be contributed to IAEA's regular budget.⁴⁷ State Department officials told us that they expect some of the regular budget contribution to support IAEA safeguards, but that the budget request does not designate a specific amount within this total for IAEA's safeguards program or JCPOA verification and monitoring activities. According to IAEA officials, contributions to the agency's regular budget cannot be designated for specific IAEA programs or activities.
 - The State Department has requested \$89.8 million for fiscal year 2017 for its extra-budgetary contribution to IAEA. State Department officials told us that some of this funding may be used to support JCPOA verification and monitoring activities, but that none of this funding is specifically designated for these activities. State officials said the final amount of U.S. voluntary contributions to JCPOA-related funding requirements will depend on the amount of international donor support made available to IAEA, but that the United States plans to provide ongoing support to IAEA to meet these requirements. Furthermore, because the United States pays its assessed (regular budgetary) contribution on a largely deferred basis, the funds requested for fiscal year 2017 will be largely used to pay 2016 calendar year assessments, which include no JCPOA-related costs.
 - The United States' extra-budgetary contribution to IAEA generally includes funding for the U.S. Support Program to IAEA Safeguards, which was established in 1977 to augment IAEA's regular budget for safeguards activities with U.S.-sponsored expertise, equipment, and techniques. The program supports IAEA's overall safeguards mission, and some of what it funds may benefit JCPOA implementation. The program may fund, among other things, equipment (for example, cameras or seals), research and development of safeguards technologies, subsidies for the analysis of environmental samples at IAEA's Network of Analytical Laboratories, and training for IAEA

⁴⁷The State Department requested \$111.6 million for fiscal year 2016; its actual expenditure was \$98.1 million. According to State Department officials, the difference between the amount requested and expended resulted from the decline in the value of the euro relative to the dollar.

inspectors at DOE laboratories.⁴⁸ This training covers, among other things, the use and analysis of safeguards tools and equipment, as well as concealment scenarios—for example, where material being measured may have been altered to mislead the detectors.

- DOE has requested \$1 million for fiscal year 2017 for IAEA verification and monitoring related to the JCPOA, as part of \$13 million to support JCPOA implementation.⁴⁹ This \$1 million includes funding for any DOE staff loaned to IAEA to assist with the agency's JCPOA-related activities or contractors who are made available on a short-term basis to IAEA.

Human Resource Needs

IAEA's annual \$10 million funding estimate includes approximately \$7.5 million in funding to cover estimated human resource costs associated with additional inspectors and support services under the JCPOA. IAEA officials told us that the agency identified the need for 18 experienced inspectors and nearly twice that number of other staff for its Iran Task Force—now the Office of Safeguards Verification in Iran. The agency plans to transfer these inspectors from divisions within its Safeguards Department that cover countries and regions beyond Iran.⁵⁰ According to IAEA officials, the other Safeguards divisions would backfill the vacancies created by the transfer of inspectors to verification and monitoring related to Iran by hiring and training new inspectors. State Department officials noted that IAEA may draw on U.S. and other member-state support to temporarily fill vacated positions until new staff can be permanently hired and brought into place.

⁴⁸Oak Ridge National Laboratory, Lawrence Livermore National Laboratory, Pacific Northwest National Laboratories, and Los Alamos National Laboratory provide laboratory support for IAEA environmental sampling as part of this network.

⁴⁹In addition to the \$1 million that DOE requested for IAEA activities, DOE requested an additional \$12 million for other JCPOA implementation costs, including \$6 million for nuclear material removal, \$4 million related to the conversion of the Arak heavy water reactor, and \$2 million to support review of proposed transfers of export-controlled items to Iran submitted through the JCPOA procurement channel, including the development and use of an Information Technology system to manage the process.

⁵⁰In March 2016, the new Office of Safeguards Verification in Iran replaced the Iran Task Force as the office in the Department of Safeguards that discharges IAEA's responsibilities related to verification and monitoring activities in Iran.

Technical Resource Needs According to IAEA officials, IAEA’s existing technical resources are sufficient to implement its verification and monitoring activities under the JCPOA. IAEA officials generally did not specify the technical measures that IAEA will use to verify and monitor each of Iran’s nuclear-related commitments under the JCPOA. However, some technical measures that IAEA generally uses to supplement visual observations and examination of records include the following:

- Portable radiation detectors and gamma spectrometers to take measurements—for example, on pipework and equipment—to verify that nuclear material is as declared (for example, at the declared level of enrichment).
- Tamper-indicating seals and cameras for containment and surveillance over previously verified material and equipment. Such measures increase the efficiency of safeguards by reducing inspection costs and allowing IAEA to focus inspection efforts where most needed.⁵¹ See figure 3 for an image of an inspector replacing a seal.

⁵¹Because it is prohibitively expensive to provide continuous human surveillance, IAEA uses surveillance systems to provide ongoing surveillance when no inspector is physically present on-site. IAEA widely uses unattended optical surveillance techniques to support and complement nuclear material accountancy and to provide continuity of knowledge about nuclear materials and other items of safeguards significance between on-site inspection visits.

Figure 3: An Inspector Replaces a Seal



Source: IAEA Imagebank (03210500); Author: Petr Pavlicek. IAEA; license: <https://creativecommons.org/licenses/by-sa/2.0/legalcode>. | GAO-16-565

- Mass spectrometers to analyze environmental samples for traces of undeclared material and activity.⁵² IAEA conducts bulk and particle analysis of environmental samples. Particle analysis provides information on the history of a facility's operation—for example, whether enrichment had occurred beyond the level declared. Bulk analysis provides information on the average enrichment level in a facility and the presence of trace elements that may provide information about where material is from or what processes it had been subject to.

⁵²Enrichment facilities, for example, tend to have some sort of environmental discharge of the UF_6 gas that is contained in the cascades—especially around key withdrawal or transfer points. The UF_6 reacts immediately with the water in the air to form uranyl fluoride (UO_2F_2), which is an aerosol and coalesces on dust particles. These particles fall from the air and accumulate on equipment and surfaces inside buildings and occasionally outside buildings on the ground or vegetation.

Under the JCPOA, Iran agreed to allow IAEA to use online enrichment measurement. IAEA's online enrichment monitor (OLEM) continuously monitors enrichment levels, allowing for more efficient enrichment monitoring. IAEA is using the OLEM in the Natanz Fuel Enrichment Plant to confirm that enrichment levels are at or below 3.67 percent, as per Iran's commitment under the agreement.⁵³ IAEA has previously used continuous enrichment monitors, but the OLEM is a newer technology that improves upon older monitoring systems.

IAEA May Face Challenges in Verifying and Monitoring Iran's Nuclear-Related Commitments and Has Identified Some Mitigating Actions

IAEA may face challenges in verifying and monitoring Iran's implementation of certain nuclear-related commitments in the JCPOA. These potential challenges include (1) detecting undeclared nuclear materials and activities, (2) accessing sites in Iran, and (3) managing safeguards budgetary, human, and technical resources. IAEA has identified mitigating actions for some of these challenges.

IAEA Faces an Inherent Challenge in Detecting Undeclared Nuclear Materials and Activities and Has Taken Steps to Mitigate This Challenge

Detection of undeclared nuclear materials and activities is an inherent challenge for IAEA; IAEA and member states have taken some steps to improve the agency's ability to detect undeclared activities. According to IAEA, the agency can draw a broader conclusion that all nuclear material in Iran remains in peaceful activities only after the agency has completed its evaluations and found no indications of diversion of declared nuclear material from peaceful nuclear activities and no indications of undeclared nuclear material or activities in the state as a whole.

⁵³The OLEM includes a gamma spectrometer that measures the uranium-235 flowing through the enrichment process at key points and measures the temperature and pressure of the UF₆ flowing through the processing pipes out of the cascades of centrifuges of the enrichment plant.

Challenges in Detecting Undeclared Nuclear Materials and Activities

According to current U.S. officials, a former U.S. official, some former IAEA officials, and officials from several expert organizations we interviewed, detection of undeclared nuclear material and activities is an inherent challenge for IAEA. Iran has previously failed to declare activity to IAEA. For example, according to IAEA documents and officials, prior to 2003, Iran failed to provide IAEA with information on a number of nuclear fuel cycle-related activities and nuclear material. In addition, according to IAEA documents, Iran also failed to notify the agency at the time of its decision to construct the Fordow enrichment facility, as required under Modified Code 3.1 of the subsidiary arrangements to Iran's CSA.

To detect undeclared material and activities,⁵⁴ IAEA looks for indicators of such activities, including equipment and infrastructure necessary for the activities, as well as nuclear and nonnuclear material or traces of such material in the environment, according to an IAEA document. According to current U.S. and IAEA officials, some former U.S. officials, some former IAEA officials, and officials from several expert organizations, IAEA faces inherent challenges and limitations in identifying indicators of undeclared activity. For instance:

- Some activities may not be visible to IAEA—for example, through satellite imagery—or do not involve nuclear material, and may not leave traces in the environment, such as centrifuge manufacturing and some weapons development activities. According to a former U.S. official, some former IAEA officials, and officials from several expert organizations, this poses a challenge for IAEA in detecting undeclared activity.
- The Board of Governors' decision to close its consideration of the PMD issue without a complete accounting of Iran's past nuclear program could reduce indicators of potential undeclared activity, according to one expert organization. Officials from this organization said that without a complete accounting, only part of Iran's nuclear program is visible to IAEA, and IAEA is missing information that could inform future safeguards planning.

⁵⁴For all states with a CSA and an Additional Protocol in force, IAEA seeks to verify that there is no (1) diversion of declared nuclear material from peaceful activities or (2) undeclared nuclear material or activities.

Efforts to Mitigate Challenges
in Detecting Undeclared
Nuclear Material and Activities

- The procurement channel established under the JCPOA may serve as a source of indicators for IAEA on potential undeclared activities in Iran, according to current and two former U.S. officials as well as officials from two expert organizations. However, IAEA officials told us that there is additional work to be done in informing exporting countries of their obligations and standardizing the data that the countries would report to IAEA so that they are usable to the agency. These officials told us that ensuring that countries report the data as required is particularly challenging for countries that do not have a robust export control system.

Current IAEA and U.S. officials as well as a former IAEA official said that IAEA has taken steps to improve its ability to detect undeclared nuclear activities and materials and told us that there are other mitigating factors to the challenges IAEA faces in this area.

First, according to a current IAEA official, current U.S. officials, and a former IAEA official, IAEA has improved its capabilities in detecting undeclared activity. For example, according to U.S. officials, IAEA has adapted its inspector training program to focus on potential indicators of undeclared activity beyond the agency's traditional safeguards focus on nuclear materials accountancy. IAEA also has analytical tools at its disposal, some of which IAEA officials demonstrated to us, to detect undeclared activities worldwide. IAEA also receives member-state support in detecting undeclared activities. For example, member states provided some of the information that formed the basis of IAEA's PMD investigation.

In addition, State Department officials said that they have conducted outreach to exporters and exporting countries about the procurement channel so that the suppliers know their responsibilities and requirements. According to State Department officials, this outreach included sending cables to all posts with instructions to inform host countries and their industries of procurement channel requirements. The United Nations has provided information regarding the procurement channel on its website.

Further, according to IAEA and U.S. officials, Iran's application of the Additional Protocol improves IAEA's ability to investigate indicators of undeclared activities in Iran. For instance, on the PMD issue, DOE officials noted that under the JCPOA, IAEA will have the authorities of the Additional Protocol and enhanced transparency measures of the JCPOA with which to investigate any indication of undeclared activities, including

those activities suspected of having possible military dimensions or potential weaponization activities not involving nuclear materials. Furthermore, State Department officials noted that the JCPOA puts IAEA in a better position to detect such activities in Iran, as inspectors will have increased access to information and locations to clarify and resolve inconsistencies or other indicators of noncompliance and will have an increased scope of materials accountancy at various sites, such as mining and milling processes.

IAEA's Work toward a Broader Conclusion for Iran

IAEA officials told us that any uncertainties regarding the peaceful nature of Iran's nuclear program that may arise would have to be resolved for the agency to reach a broader conclusion that all nuclear material in Iran remains in peaceful activities. As noted above, broader conclusion refers to IAEA's determination for a country that, for a given year, all nuclear material remained in peaceful activities. The JCPOA states that the United States and European Union will take further steps to eliminate nuclear-related sanctions on Iran either on October 18, 2023, or before if IAEA reaches a broader conclusion. According to State Department officials, on October 18, 2023, under the JCPOA, the United States and European Union would take these steps to eliminate these sanctions on Iran regardless of whether IAEA has reached a broader conclusion.

IAEA officials told us that the agency does not draw a broader conclusion lightly, for any state, and that it has taken on average 3 to 5 years for states with CSAs and Additional Protocols.⁵⁵ The estimates for the amount of time needed for IAEA to reach a broader conclusion for Iran varied among the former IAEA and U.S. officials and the expert organization officials we interviewed. Some former U.S. officials, two former IAEA officials, and officials from two expert organizations stated that it is possible for IAEA to reach a broader conclusion before October 18, 2023. The former U.S. officials stated that this could be possible if Iran cooperates with IAEA and provides the access and information needed.

Others we interviewed did not believe IAEA would be able to reach a broader conclusion in that time frame, citing examples of countries in

⁵⁵A broader conclusion is not a permanent designation. Instead, IAEA determines whether it can reach a broader conclusion annually, with new or updated information incorporated as needed.

which IAEA took considerable time to reach broader conclusions. For instance, a former U.S. official and an official from one expert organization told us that it took IAEA 10 years to reach a broader conclusion for Turkey even with the country’s relatively basic fuel cycle. Both also stated that Turkey’s former involvement in the illicit procurement network and black market contributed to the length of time to reach a broader conclusion in that country. The former U.S. official also said that the broader conclusion for Taiwan took from 6 to 8 years, noting that Taiwan, which had a weapons program, made a strategic decision to shut down the program and fully cooperate with IAEA. An official from one expert organization stated that the broader conclusion process is very technical and complex, and that even in compliant countries such as Australia and Canada, arriving at a broader conclusion is an “incredibly difficult feat” for IAEA.

State Department officials told us that in their view it would not be an impediment to the JCPOA if IAEA does not reach a broader conclusion regarding Iran’s nuclear program by October 18, 2023. These officials said that they believed it is more important for IAEA to draw a broader conclusion in an appropriate manner and time frame, and less important that a broader conclusion be reached before the United States and European Union take further steps to eliminate sanctions in October 2023. These officials added that Iran’s nuclear-related commitments under the JCPOA extend beyond this date, as well as IAEA’s authorities and capabilities to continue to verify the peaceful nature of Iran’s nuclear program.

IAEA May Face Access Challenges, but the Additional Protocol and the JCPOA’s Access Mechanism May Mitigate These Challenges

IAEA may face challenges in gaining access to sites in Iran, according to officials and expert organizations we interviewed. IAEA officials stated that access depends on the cooperation of the member state and the operators of its facilities under safeguards. However, two former U.S. officials, a former IAEA official, and officials from one expert organization we interviewed told us that Iran has a history of denying access to IAEA inspectors. For example, IAEA requested access in February 2012 to the Iranian military complex at Parchin—where high explosive experiments were believed to have been conducted—and Iran did not allow access until the fall of 2015 as part of IAEA’s PMD investigation. In addition, earlier IAEA reports stated that Iran did not cooperate with IAEA on access to the Heavy Water Production Plant, although Iran eventually granted the agency managed access in December 2013. Prior IAEA reports also stated that Iran had denied the agency’s requests for access to locations related to the manufacturing of centrifuges, research and

development on uranium enrichment, and uranium mining and milling, among other things.

IAEA and U.S. officials said that IAEA is taking action to facilitate access and cooperation. For instance, IAEA officials stated that they plan to work to train operators in Iran who are less experienced in working with IAEA and who may be less experienced in keeping records that facilitate the agency's safeguards activities, such as the operators of the Heavy Water Production Plant, which IAEA officials stated was the only type of facility subject to verification and monitoring under the JCPOA that is new to the agency.

Iran's agreement to provisionally apply the Additional Protocol will facilitate the agency's access to sites in Iran, according to IAEA officials. Specifically, they told us that, under the Additional Protocol, the agency has authority to access any part of a site that it is inspecting within 2 hours' notice and any other location within 24 hours. Furthermore, IAEA officials disputed the view of one expert organization that Iran's limited cooperation during the PMD investigation may have set a precedent for limiting IAEA access going forward. IAEA officials told us that the closure of the PMD investigation would not preclude future IAEA access requests to the sites that were part of the investigation, should IAEA determine that such access is warranted. These officials added that IAEA's PMD investigation was conducted without the Additional Protocol, and that any future investigations into potential undeclared activity would be conducted under the expanded legal authority of the Additional Protocol.

In addition, as we noted earlier, the JCPOA includes a mechanism that limits the time for resolution of access issues between the participants to 24 days for matters related to JCPOA implementation. IAEA officials told us that the 24-day period under the mechanism would begin once the agency raises a given access issue. Appendix II discusses this mechanism in detail. Officials and expert organizations we interviewed discussed two potential challenges regarding the mechanism. First, they noted that the mechanism is untested and may not facilitate access. Second, they differed on whether the mechanism's 24-day limit would help IAEA gain timely access before Iran could hide certain activities.

First, a former IAEA official and an official from one expert organization told us that the mechanism is untested in that an access dispute has not yet arisen under the JCPOA; therefore, it is too soon to tell how it will work and whether it will improve access. Specifically, according to the official from the expert organization, the agreement is not clear about how

the Joint Commission will coordinate with the Board of Governors or IAEA as a whole if the mechanism is invoked. Furthermore, a former U.S. official expressed concern that the politics among members of the Joint Commission may mean that access disputes raised by IAEA may not be resolved in IAEA's favor. Nonetheless, State Department officials said that the JCPOA access mechanism provides additional recourse to IAEA and is supplementary to the Additional Protocol, and that it does not take authority away from the Board of Governors. IAEA officials also said that if Iran were to deny an IAEA request for access at any site, the agency has various options for resolving the matter, including referral to IAEA's Board of Governors, the Joint Commission, or both.

Second, officials and expert organizations differed on whether the mechanism's 24-day time frame could allow Iran to hide activities from IAEA before the agency gained access.⁵⁶ These officials and expert organizations differed on the activities that Iran could hide within 24 days and the proliferation significance of such activities. For example, two former IAEA officials and officials from two expert organizations specifically stated that small-scale enrichment activities and activities not including nuclear material could be hidden within the 24-day time frame. A former U.S. official also said that Iran could clean up traces of nuclear materials within 24 days and, even if it were unable to hide all evidence, it could create enough ambiguity to preclude further investigation or action. However, other officials and expert organizations said that the potential for a 24-day access delay in the mechanism was generally not a concern. Specifically, several former IAEA officials, some former U.S. officials, and officials from some expert organizations noted that nuclear material, even in trace amounts, cannot be cleaned up within that time. A former IAEA official also stated that much of what IAEA is looking for is not easily disguised, cleaned, or removed in 24 days.

U.S. officials stated that they believed that it is unlikely that Iran would risk reinstatement of sanctions by denying IAEA access. For instance, State Department officials told us that refusal by Iran to comply with the access provisions of the Additional Protocol or JCPOA could lead to the

⁵⁶According to a former U.S. official, the other parties to the agreement may reinstate sanctions if Iran does not cooperate with IAEA access requests in accordance with this mechanism, and continued noncooperation may result in the termination of the agreement and an expansion of sanctions in the future.

reinstatement of sanctions. Additionally, DOE officials said that the JCPOA's provisions for the reinstatement of sanctions will encourage Iranian cooperation with and access for IAEA.

IAEA May Face Resource Challenges and Is Taking Actions to Mitigate Them

IAEA faces potential resource management challenges stemming from the monitoring and verification workload in Iran, and is taking actions to mitigate them. These challenges include (1) integrating the additional JCPOA-related funding needs that IAEA has identified into the agency's regular budget, (2) managing human resources within the safeguards program, which could affect IAEA's safeguards efforts internationally, and (3) addressing potential challenges with technical resources.

The Reliability of Long-Term Funding for JCPOA Activities

State Department officials told us that they are confident that IAEA will obtain the funding it needs for JCPOA activities in the near term, but IAEA officials expressed concerns about the reliability of long-term funding. State Department officials told us that the United States and other member states would provide extra-budgetary contributions to support IAEA's JCPOA activities. However, IAEA officials expressed concerns, which State Department officials acknowledged, about possible donor fatigue with regard to extra-budgetary contributions in the long run, as IAEA will be conducting certain JCPOA verification activities for 10 or more years. We have previously concluded that IAEA cannot necessarily assume that donors will continue to make extra-budgetary contributions at the same levels as in the past.⁵⁷ IAEA and State Department officials, as well as a former IAEA official and an official from one expert organization, stated that funding the JCPOA from the IAEA regular budget—rather than through extra-budgetary contributions—would give the safeguards program a more stable and predictable funding base for its verification and monitoring activities.

As we previously noted, IAEA proposes to integrate approximately \$5.7 million in JCPOA costs into IAEA's regular budget after 2016. However, IAEA may face challenges in integrating some JCPOA funding needs into its regular budget. IAEA officials, as well as a former IAEA official, two former U.S. officials, and an official from one expert organization stated

⁵⁷GAO, *Nuclear Nonproliferation: IAEA Has Made Progress in Implementing Critical Programs but Continues to Face Challenges*, [GAO-13-139](#) (Washington, D.C.: May 16, 2013).

that the proposal to move funding for verification and monitoring efforts under the JCPOA into IAEA's safeguards regular budget could face resistance from some member states without corresponding budget increases for other IAEA programs, such as the Technical Cooperation program, which supports nuclear power development and other civilian nuclear applications.

State Department officials said that delay or failure to incorporate costs into the regular budget would increase IAEA's reliance on extra-budgetary contributions but would not prevent IAEA from carrying out JCPOA-related activities as long as those contributions are forthcoming. State Department officials also told us that no member state has opposed integration of certain JCPOA costs into the regular budget or proposed corresponding increases for other programs. These officials added that they recognize that long-term reliance on extra-budgetary contributions risks donor fatigue, and that they will plan for providing support with a view toward filling any future funding gaps that arise.

Managing Human Resources in the Safeguards Program

IAEA also faces a potential human resource management challenge in its safeguards program as it implements actions to verify and monitor the JCPOA, which could affect its broader international safeguards mission. Specifically, IAEA's strategy of transferring inspectors to its Office of Safeguards Verification in Iran from other safeguards divisions may pose a challenge to IAEA and its safeguards work in other countries because of the extensive time it takes IAEA to hire and train new inspectors for those divisions.

According to current IAEA and U.S. officials as well as two former IAEA officials and officials from two expert organizations we interviewed, hiring and training qualified inspectors can take years. A former IAEA official and current officials said that recruiting inspectors is difficult because their skills are highly specialized—typically requiring a combination of nuclear engineering knowledge with analytical abilities. These officials also said that IAEA's hiring process requires multiple interviews and examinations. Furthermore, current IAEA officials and two former IAEA officials, as well as an official from one expert organization, said that training new inspectors to be proficient in executing their safeguards responsibilities can be a time-consuming process. As a result, IAEA faces a potential challenge as it prioritizes JCPOA activities in meeting the need for additional experienced inspectors to work on Iran-related safeguards, while ensuring that other safeguards efforts in other countries are not understaffed. IAEA officials have said that its work in Iran is its priority.

Potential Technical Resource Challenges

IAEA officials, as well as a former IAEA official, some former U.S. officials, and officials from several expert organizations told us that IAEA could mitigate human resources challenges in the short term through remote monitoring and the use of cost-free experts in its headquarters. According to State Department officials, the United States, as well as other IAEA member states, have provided a list of qualified candidates to IAEA to backfill positions of IAEA staff transferred within the agency for JCPOA work to avoid gaps while full-time staff are hired and trained. Many of these have previously worked as IAEA inspectors and are already trained.

As we previously noted, IAEA officials told us that the agency's existing technical resources are sufficient for JCPOA verification and monitoring. However, IAEA officials also noted that they expect an increase in environmental sampling as a result of the JCPOA. IAEA laboratories handle approximately 500 environmental samples a year at IAEA's Environmental Sample Laboratory in Seibersdorf, Austria, and other laboratories within the Network of Analytical Laboratories.⁵⁸ The IAEA laboratory at Seibersdorf handles about 20 percent of the overall environmental sample analysis, with the other network facilities processing the remainder.

According to IAEA officials, particle analysis is time-consuming and expensive. IAEA uses a spectrometer called the Large Geometry Secondary Ionization Mass Spectrometer (LG-SIMS) for particle analysis at its Seibersdorf Analytical Laboratory. IAEA officials at the laboratory told us that the LG-SIMS is expensive and is operating at capacity, raising concerns about IAEA's ability to meet any future environmental sampling demands at the Seibersdorf laboratory alone. These officials told us that a second LG-SIMS would cost approximately \$5 million, plus additional personnel costs to operate and maintain the equipment. Other IAEA officials and some U.S. officials told us, however, that other laboratories in the network could accommodate increases in environmental sampling analysis workload, and that there was no need at this time for IAEA to procure a second LG-SIMS in light of other critical funding priorities for technical needs.

⁵⁸Samples are sent to multiple laboratories for quality control.

Agency Comments

We are not making any recommendations in this report. We provided the Departments of State and Energy and the International Atomic Energy Agency a draft of this report to for their review and comment. State, DOE, and IAEA provided technical comments, which we incorporated as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to appropriate congressional committees, the Secretaries of State and Energy, and other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or trimbled@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



David C. Trimble
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

This report examines (1) the Joint Comprehensive Plan of Action (JCPOA) commitments that the International Atomic Energy Agency (IAEA) has been asked to verify and monitor and its authorities to do so, (2) the resources IAEA has identified as necessary to verify and monitor Iran's nuclear-related commitments under the JCPOA, and (3) potential challenges and mitigating actions, if any, IAEA and others have identified with regard to verifying Iran's nuclear-related commitments under the JCPOA.

To identify the nuclear-related commitments in the JCPOA that IAEA has been asked to verify and monitor and IAEA's authorities for verifying and monitoring these commitments, we analyzed the JCPOA, in close coordination with IAEA and the Department of State. We also analyzed IAEA documentation concerning the safeguards legal framework, including the Statute of the IAEA,¹ which authorizes the agency to apply safeguards, at the request of parties, to any bilateral or multilateral arrangement; "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons" (information circular (INFCIRC)/153), which provides the basis for the comprehensive safeguards agreement that most countries have concluded with IAEA and that covers all of the countries' nuclear material in peaceful activities; Iran's Comprehensive Safeguards Agreement (INFCIRC/214); the Model Additional Protocol (INFCIRC/540), which provides the basis for an Additional Protocol that most countries with a CSA have concluded with IAEA to provide additional information about countries' nuclear and nuclear-related activities; and the November 2011 IAEA Safeguards Report,² which details items concerning "possible military dimensions" of Iran's nuclear program; IAEA's report on its investigation of the possible military dimensions; and the related Board of Governors' resolution. We also analyzed the Treaty on the Non-Proliferation of Nuclear Weapons and United Nations Security Council Resolution 2231, which requests IAEA to

¹The Statute of the International Atomic Energy Agency, done Oct. 26, 1956, 8 U.S.T. 1093, 276 U.N.T.S. 3 (entered into force July 29, 1957).

²International 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 (Nov. 8, 2011).

undertake the necessary verification and monitoring of Iran's commitments.

To examine the resources IAEA has identified as necessary to verify and monitor Iran's nuclear-related commitments under the JCPOA, we reviewed IAEA planning and budget documents, such as "The Agency's Programme and Budget 2016 –2017," the Director General's report titled "Verification and Monitoring in the Islamic Republic of Iran in light of United Nations Security Council Resolution 2231 (2015)," and pertinent Director General's statements to the Board of Governors.

In addition, to further understand IAEA authorities and resource needs, and to examine potential challenges and mitigating actions IAEA and others have identified with regard to verifying and monitoring Iran's nuclear-related commitments under the JCPOA, we interviewed officials of IAEA, the Department of State, and the Department of Energy's (DOE) National Nuclear Security Administration (NNSA);³ as well as representatives of Oak Ridge National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories, and Brookhaven National Laboratory. We also held classified interviews with officials in the Office of the Director of National Intelligence and representatives of Lawrence Livermore National Laboratory. The information from these interviews is not reflected in this report.

We also interviewed 8 former IAEA officials, 10 former U.S. government and national laboratory officials, and officials from 10 expert organizations—research institutions and nongovernmental organizations with knowledge in the areas of nuclear verification, monitoring, and safeguards. We selected these expert organizations by first identifying organizations that had previously served as sources of IAEA subject matter experts for GAO. To ensure a wide range of viewpoints, we supplemented our initial selection with individuals and organizations identified through a literature search and by recommendations from our initial set of expert organizations. We requested interviews from all the

³NNSA is a separately organized agency within DOE, with responsibility for nuclear weapons and nonproliferation programs, among other things. NNSA conducts its activities at headquarters and at research and development laboratories, production plants, and other facilities. NNSA also provides technical assistance to IAEA's safeguards and nuclear security programs.

identified officials from expert organizations and suggested contacts and interviewed all who agreed to participate (officials from 2 expert organizations provided written responses in lieu of in-person interviews). We analyzed their responses and grouped them into overall themes related to different elements of the objective. When referring to these categories of interviewees throughout the report, we use “some” to refer to three members of a group, “several” to refer to four or five members of a group, and “many” to refer to more than five members of a group.

We conducted this performance audit from July 2015 to June 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Procedures for Resolving International Atomic Energy Agency Access Issues under the Joint Comprehensive Plan of Action

Section Q of Annex I of the Joint Comprehensive Plan of Action (JCPOA) details procedures for the International Atomic Energy Agency (IAEA) access to sites in Iran. These procedures together total no more than 24 days, as follows:

1. If IAEA has concerns about undeclared materials or activities—or activities otherwise inconsistent with the JCPOA—at locations that have not been declared under the comprehensive safeguards agreement or additional protocol, the agency may first seek clarification from Iran and if Iran’s explanations do not resolve IAEA’s concerns, then request access to the sites in question.
2. Iran may propose means other than access to the site for resolving IAEA’s concerns, but if IAEA cannot verify the absence of undeclared nuclear materials and activities or activities inconsistent with the JCPOA after implementation of the alternative means or the two sides cannot come to an agreement on alternative means within 14 days of the agency’s original request for access, Iran, in consultation with the Joint Commission, would resolve IAEA’s concerns through necessary means agreed upon with IAEA.
3. If there is no agreement between Iran and IAEA, the Joint Commission would, by consensus or a vote of 5 or more of its 8 members, advise on the necessary means to resolve the IAEA’s concerns. This process would not exceed 7 days. Iran would then have 3 days to carry implement the necessary means.

According to IAEA, these procedures are for the purpose of JCPOA implementation and are without prejudice to the Comprehensive Safeguards Agreement (CSA) and Additional Protocol. Generally, IAEA notifies the state of a request for access (e.g., inspections and complementary access), specifying the location, date and time, purpose, and activities to be carried out as required in the CSA and Additional Protocol. The state is to confirm the receipt of the notification and facilitate IAEA’s access. If there were issues related to the implementation by the member state of its obligations under the CSA or the Additional Protocol, the Director General would inform the Board of Governors. In the case of Iran, if there were issues affecting the fulfilment

**Appendix II: Procedures for Resolving
International Atomic Energy Agency Access
Issues under the Joint Comprehensive Plan of
Action**

of JCPOA commitments, the Director General would inform the Board and in parallel the Security Council, as appropriate. Should IAEA's concerns regarding undeclared nuclear materials or activities, or activities inconsistent with the JCPOA continue to be unresolved after engaging with Iran, the access procedures set out above, from Section Q of Annex I of the JCPOA, may be used.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, William Hoehn (Assistant Director), Alisa Beyninson, Antoinette Capaccio, R. Scott Fletcher, Bridget Grimes, Joseph Kirschbaum, Grace Lui, Thomas Melito, Alison O'Neill, Sophia Payind, Timothy M. Persons, Steven Putansu, Vasiliki Theodoropoulos, and Pierre Toureille made key contributions to this report.

Appendix IV: Accessible Data

Accessible Text

Accessible Text for Figure 1: The Nuclear Fuel Cycle

1. Mining: Uranium ore
2. Milling: Uranium oxide (yellowcake or U₃O₈)
3. Conversion: Uranium hexafluoride (UF₆)
4. Enrichment: Enriched uranium hexafluoride (UF₆)
5. Fuel fabrication: Uranium dioxide
6. Power reactors: Spent fuel (plutonium, uranium, and fission products)
7. Energy production
8. Research reactors:
9. Spent fuel (plutonium, uranium, and fission products)
10. Research, training, industrial, and medical isotopes
11. Reprocessing: Plutonium

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