



The IAEA's Iran NPT Safeguards Report - May 2023

By David Albright, Sarah Burkhard, and Andrea Stricker¹

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The latest quarterly International Atomic Energy Agency (IAEA) safeguards report on Iran indicates limited progress on safeguards and monitoring issues, and overwhelmingly shows that Iran is unwilling to cooperate on providing full and truthful answers. On the vast majority of safeguards issues, where Iran simply cannot refute IAEA allegations, it continues to stonewall. On reestablishing monitoring, Iran is moving very slowly. Iran shows an intention to wear down the IAEA, as Iran renders any progress marginal, extremely difficult, and time consuming to achieve.

Despite the IAEA's language in the report being difficult to understand, the IAEA has established a compelling case that Iran committed safeguards violations and has made little progress in reestablishing adequate monitoring. The Board of Governors needs to provide more support to the IAEA, condemning Iran's lack of cooperation and providing a deadline for compliance. If it does not, Iran will succeed in maintaining secrecy over past and potentially ongoing nuclear weapons activities, weakening the IAEA in the process. Coupled with a growing uranium enrichment program and breakout capability, as well as limited IAEA monitoring, Iran could more easily — and even secretly — abandon its nonproliferation obligations and build a small nuclear weapons arsenal at a time of its choosing.

To avoid this, the IAEA should pursue additional answers on Iran's nuclear activities and seek additional access to information, locations, and people — but on a larger scale than it has ever done before. The IAEA should release a report summarizing its understandings and findings about Iran's past nuclear weapons program and any nuclear weapons-related materials, equipment, or activities that have continued up to today.

Background

- Iran has consistently violated its obligations under its comprehensive safeguards agreement (CSA), a key part of the Nuclear Non-Proliferation Treaty (NPT), under which it must cooperate with the IAEA and fully account for nuclear material and past and present nuclear activities. The IAEA refers to this process as a country providing both a

¹ Andrea Stricker is deputy director of the Foundation for Defense of Democracies' (FDD) Nonproliferation and Biodefense Program and an FDD research fellow.

correct and complete nuclear declaration.

- For more than four years, the IAEA has been investigating the presence of man-made uranium particles at three Iranian sites. Earlier, it sought information about nuclear material and activities at a fourth site. In March 2022, the IAEA found Iran in breach of its safeguards obligations for failing to declare its use of nuclear material at the fourth site, a former Amad Plan site called Lavisian-Shian.
- The sites are related to Iran's past work on nuclear weapons under the Amad Plan, Iran's crash nuclear weapons program dating to the early 2000s, but concern its NPT compliance today, including the whereabouts of nuclear material and equipment and the nature of activities at the sites, as well as whether Iran continues nuclear weapons-related activities.
- The IAEA concluded in September 2022 it is "not in a position to provide assurance that Iran's nuclear program is exclusively peaceful." This means the IAEA cannot verify Iran's compliance with its CSA and the NPT and is implying Iran is violating both agreements.
- A November 2022 IAEA Board of Governors resolution spelled out four steps Iran must take in order to clarify the outstanding safeguards issues. These include providing technically credible explanations for the presence of uranium at the three sites, informing the IAEA on the current location(s) of the nuclear material and/or contaminated equipment, providing all the information the IAEA needs, and providing access to locations and materials as needed.
- A new safeguards issue arose, when, in January 2023, Iran made an undeclared change in the operation of two advanced centrifuge cascades at the Fordow Fuel Enrichment Plant (FFEP), followed by the IAEA's detection of near 84 percent highly enriched uranium (HEU) particles at the cascades, which Iran had declared were enriching only up to 60 percent HEU. Iran's explanation was that unintended fluctuations occurred. At a press conference, Director General Rafael Grossi stated that his inspectors would be able to find out whether the high enrichment level was a "one time shot, a one-time occurrence, or a more dedicated effort."
- Following high-level meetings between the IAEA and Iran, the two released a joint statement in March 2023 in which Iran pledged to take steps to cooperate with the IAEA, expedite a resolution over the outstanding safeguards issues, and allow the IAEA to implement appropriate verification and monitoring activities.²

² "Joint Statement by the Atomic Energy Organization of Iran (AEOI) and the International Atomic Energy Agency (IAEA)," March 4, 2023, <https://www.iaea.org/newscenter/pressreleases/joint-statement-by-the-atomic-energy-organization-of-iran-aeoi-and-the-international-atomic-energy-agency-iaea>

- This analysis summarizes and assesses information since the IAEA’s last NPT safeguards report on Iran — the latest report issued on May 31, 2023. It also provides extensive background information on the former Iranian nuclear weapons sites under IAEA investigation, in addition to IAEA findings.

Findings

Partial Implementation of Joint Statement

The Director General states that “some progress has been made in implementing the activities set out in the Joint Statement.” He reiterates, however, that “unless and until Iran provides technically credible explanations for the presence of [uranium] particles at undeclared locations in Iran and informs the Agency of the current location(s) of the nuclear material and/or of the contaminated equipment, the Agency will not be able to confirm the correctness and completeness of Iran’s declarations under its Safeguards Agreement.”

Marivan Site: Partial Progress but Main Safeguards Issue Remains

There are two areas of IAEA concern at Marivan – a high explosive testing area, where outdoor testing of nuclear-weapon components took place or was planned during the Amad Plan, and a nearby support/development area with buildings, demolished by Iran before the IAEA was able to visit the site and around a time the IAEA was asking questions about a related site (see Annex). In 2020, Iran initially denied IAEA access to Marivan, and then relented following Board of Governors censure. Later that year, the IAEA visited and discovered particles containing man-made uranium at the Marivan support area.

In its latest report, the IAEA says it received information from Iran on the nature of these uranium particles. During meetings with the IAEA in March 2023, Iran “maintained its previous statements that the support area of ‘Marivan’ was a mine operated by an organization from another Member State in the 1960s and 1970s.” Iran noted the prior existence of a chemical laboratory where miners used “laboratory instruments and equipment,” which may have been the source of the contamination. According to the IAEA, this answer provided a “possible” explanation for the presence of depleted uranium particles with uranium 236. However, the IAEA cannot prove or disprove this statement. In the absence of additional information, the IAEA has no more questions and stated the issue is no longer outstanding at this stage. However, it should be noted that the IAEA report did not call this issue closed.

The safeguards issues at the high explosive/bunker area at Marivan remain unresolved. Iran claimed that the bunkers at Marivan were used “to shelter the bomb disposal unit during the deactivation of worn-out or mal-functioned munitions” and did not address “the use of neutron detectors and the source of the neutrons, and has provided no evidence to support its responses to questions regarding the activities at the explosive test area at ‘Marivan.’” In its latest report, the IAEA stands by its assessment that “based on its analysis of all safeguards-

relevant information available to it...Iran conducted explosive experiments with protective shielding in preparation for the use of neutron detectors and nuclear material” at the high explosive site. The IAEA is describing a planned test during the Amad Plan, to be undertaken late in Iran’s nuclear weapons efforts, often called a cold test. A cold test involves the detonation of a fully assembled nuclear weapon, absent its weapon-grade uranium core. The neutron detectors would detect the neutrons produced by a neutron initiator at the center of the nuclear device, designed to initiate the atomic explosion. Thus, the IAEA is stating that while Iran may have prevailed on the relatively small point of the uranium particles, the elephant in the proverbial Marivan tent remains present.

Failure to Address Concerns at Turqz-abad and Varamin

The IAEA reports that Iran has failed to address outstanding safeguards issues at Turqz-abad and Varamin, “including informing the Agency of the current location(s) of nuclear material and/or of contaminated equipment.” Turqz-abad contained numerous containers holding equipment and materials related to nuclear weapons development, and Varamin, aka the “Tehran Site” in Iran’s Nuclear Archive, was an Amad Plan uranium conversion site. See Annex for details on these sites.

Ongoing Discrepancy at the Uranium Conversion Facility (UCF) Linked to Undeclared Uranium at Lavisan

A discrepancy remains in the amount of uranium present at the UCF, involving the dissolution of what Iran states is 302.7 kilograms (kg) of natural uranium. The uranium came from the Jaber Ibn Hayan Multipurpose Laboratory (JHL), which has been linked to undeclared nuclear activities and materials. JHL has figured prominently in past IAEA efforts to understand the fate of undeclared uranium dating to Amad Plan activities at the Lavisan-Shian site in Tehran (see Annex). According to the *Wall Street Journal*, the discrepancy was “connected to Iran’s dissolution of a natural uranium metal disc the IAEA has been looking for as part of a probe into undeclared nuclear material found in Iran.”³

Initially the IAEA did not report whether the discrepancy meant a surplus or a shortfall in Iran’s declaration, but the latest IAEA report specifies that there was a shortfall in Iran’s declaration. This indicates that the IAEA did indeed verify the presence of more material than declared by Iran, and while not evidence, this is consistent with the media reporting that Iran may have mixed in undeclared nuclear material it used at Lavisan-Shian. In April 2023, Iran provided the IAEA with revised nuclear material accountancy information for the UCF, but the IAEA stated these revisions “neither addressed the discrepancy nor satisfied the requirements stipulated under’ its comprehensive safeguards report. The IAEA concluded that revisions are “not based on scientific grounds, and, therefore not acceptable.”

³ Laurence Norman, “U.N. Agency Confirms Iran Produced Enriched Uranium Close to Weapons Grade,” *The Wall Street Journal*, February 28, 2023.

An Overall Negative Account of Iran’s Cooperation to Establish Whether its Program is Peaceful

The safeguards report provides an overall negative account of Iran's cooperation and progress in addressing whether its program is peaceful and its nuclear declaration is complete, making clear that out of the four steps demanded by the November 2022 Board of Governors resolution, only one step was fulfilled — and only partially. A concern is that Iran is continuing to get away with not providing credible answers about suspicious nuclear activities and safeguards violations, both past and present, and that other matters, such as improving monitoring in the face of Iran’s stonewalling, are being prioritized. Some fear a slow-motion repetition of 2015, when the IAEA “closed” all files related to the possible military dimensions (PMD) of Iran’s program, despite having made incomplete assessments and the closure doing little more than the IAEA accepting Iran’s false and incomplete explanations regarding past nuclear weapons issues.

Near Weapon-Grade Uranium Explanation Accepted

Iran provided the IAEA with additional information that the agency deemed “not inconsistent” with Iran’s explanation for the origin of particles enriched up to 83.7 percent, detected in January 2023 at the FFEP. Despite this weak IAEA endorsement, encoded in traditional IAEA wording, “not inconsistent,” the IAEA stated it had “no further questions on this matter at this stage.” Although the high enrichment level appears to have been a one-time occurrence, this finding does not resolve whether Iran produced the 83.7 percent material on purpose.

Limited Monitoring Progress

The IAEA reports that Iran allowed the IAEA to install or restore some limited monitoring and verification measures, such as installing for the first time ever an “enrichment monitoring device” (EMD) at Fordow and one at the Natanz Pilot Fuel Enrichment Plant (PFEP). (The IAEA reports that the devices are functioning but are still under commissioning and calibration). Iran also allowed the IAEA to reinstall surveillance cameras at centrifuge manufacturing workshops in Esfahan on May 2 and 3. Iran stopped providing video footage and data from the Natanz on-line enrichment monitor, from its heavy water production plant, and from video cameras at all its centrifuge manufacturing and assembly facilities in February 2021 and removed such devices altogether in June 2022.

The IAEA’s latest reporting underscores that despite reinstalling cameras at the Esfahan workshops, Iran is still not providing any of the actual video footage that would allow the IAEA to re-establish a baseline inventory of Iran’s centrifuge production. It has not provided any video footage from 2021 to 2022 or even from May 2023 at the Esfahan workshops. Nor has Iran reinstalled cameras at its other, publicly unknown, centrifuge manufacturing and assembly workshops. The IAEA told Iran it needed access to the data to re-establish “a satisfactory understanding of Iran’s inventory of centrifuge rotor tubes and bellows, including those in

assembled centrifuges.” In addition, Iran has not restored surveillance and data collection at the Natanz Fuel Enrichment Plant or at the heavy water production facility.

Moreover, the IAEA reports in late May, nearly three months after Iran and the IAEA reached agreement on the March IAEA/Iran joint statement, that “the process of implementing the activities set out in the joint statement has *begun* [emphasis added], but there is a need to ensure that the process is sustained and uninterrupted in order that all of the commitments contained therein are fulfilled.” The IAEA adds, “the Agency expects to be able to start to address, without further delay, access to data and recordings and the gaps in the recordings.”

Still No Implementation of Modified Code 3.1

The IAEA calls on Iran to engage the agency on whether it plans to implement modified Code 3.1 of the subsidiary arrangements to its CSA, and continues to note this is a “legal obligation” that “cannot be modified unilaterally.”

An IAEA Plea for Help

The IAEA reminded member states that “the remaining outstanding safeguards issues stem from Iran’s obligations under the Comprehensive Safeguards Agreement between Iran and the Agency and need to be resolved for the Agency to be in a position to provide assurance that Iran’s nuclear programme is exclusively peaceful.” The IAEA welcomed progress made to date but emphasized the need for Iran to fulfill its commitments “without further delay.”

Recommendations

Despite all its work, and some limited progress, the IAEA is still no closer to resolving most safeguards issues in Iran, let alone being able to determine if Iran’s nuclear program is peaceful. Nonetheless, the IAEA has shown that Iran’s declaration is woefully incomplete. Iran had a large-scale nuclear weapons program in the past, and some aspects of that earlier effort remain. Meanwhile, Iran refuses to cooperate in any meaningful manner, as it continually looks for ways to undermine the IAEA's investigation.

Marivan is a case in point. While Iran proclaims that the Marivan issue is closed, the IAEA has actually cemented its assessment that undeclared, nuclear weapon-related activities took place at Marivan and that Iranian statements to the contrary are not technically credible. In the end, the issue of the uranium particles is, at most, one piece of evidence in the IAEA investigation and is of little lasting importance compared to the fact that the site was involved in actual and intended nuclear weaponization testing activities vital to the manufacture of nuclear weapons.

Despite the herculean task, the IAEA must continue its investigation into Iran’s violations of nuclear safeguards and work through its fallacious declarations. To compensate for the confidence deficit created by Iran’s lack of technically credible information regarding the presence of nuclear material at undeclared sites, the IAEA should pursue additional answers on

related nuclear activities and seek additional access to information, locations, and people — but on a larger scale than it has ever done.

The IAEA should release a report summarizing its understandings and findings about Iran’s past nuclear weapons program and any nuclear weapons-related materials, equipment, or activities that have continued up to today. While the IAEA’s recent effort to focus exclusively on undeclared nuclear material is understandable, that amounts to exploring the tip of the iceberg. It is time for the IAEA to expose the entire iceberg and reconstruct the history and nature of all aspects of Iran’s nuclear weapons activities.

In its future reports and statements, the IAEA may want to consider language that more clearly avoids giving the impression that matters are forever settled or further questions cannot be asked. Moreover, the IAEA should clearly indicate that when it states an issue is not outstanding or does not require Board action, it does not mean that the issue cannot be revisited or is necessarily resolved in a safeguards sense. The current language gives the impression that no further action is needed by the IAEA or the Board of Governors, when in fact, more action could be required to obtain a resolution.

Due to Iran’s prolonged, ongoing lack of cooperation, the IAEA Board of Governors should pass a resolution condemning Iran’s failure to fully meet the demands spelled out in the November 2022 resolution and provide a deadline for Iran to cooperate, after which the board will refer Iran’s case to the UN Security Council. Such a referral would not in any way halt the IAEA’s investigations of Iran’s undeclared materials and activities; in fact, it should encourage IAEA members to provide additional information and resources aimed at assisting the IAEA in pressing Iran to come into compliance with its safeguards obligations.

The United States and Europe should not press the IAEA to end the ongoing investigation, and should refuse any such Iranian demands that involve pressuring the IAEA to end the inquiry as a condition for revival of the nuclear deal, or Joint Comprehensive Plan of Action (JCPOA), or as a condition for implementing a new, interim nuclear deal. The West should instead pressure Iran to cooperate with the IAEA by strengthening sanctions, including moving to enact the so-called snapback of UN sanctions, allowed in case of Iranian non-compliance with the JCPOA. Iran’s unjustified delays in reestablishing JCPOA monitoring adds urgency to taking such action.

Annex. The Tip of the Iceberg: Four Locations Under IAEA Investigation

For four years, the IAEA has been investigating four sites linked to Iran's former nuclear weapons program, called the Amad Plan, and more current efforts to preserve its nuclear weapons capabilities. The four sites are Turqz-Abad, Varamin, Marivan, and Lavisian-Shian.⁴ Out of the four sites of concern, three were discussed in Iran's Nuclear Archive.⁵

It is unlikely that these four locations are the only remaining sites in Iran with traces of undeclared uranium or other evidentiary links to the Amad Plan. In reports and press briefings, Director General Grossi has voiced concerns about additional unknown locations from which or to which Iran may have moved nuclear material or contaminated equipment.⁶ Further, the IAEA may have identified additional sites it seeks to access based on information in the Nuclear Archive. The IAEA has been corroborating information in the Nuclear Archive against Iran's mandatory declaration of nuclear material and activities, in line with the IAEA's mandate to ensure that Iran's declaration is correct and complete. On September 7, the Institute published the location of yet another site identified in the Nuclear Archive, where Iran may have carried out tests using uranium.⁷ The site, called Golab Dareh, is one of four known sites associated with explosive testing of nuclear weapons components and the development of associated, high-speed diagnostic equipment. It appears to be another site that may harbor traces of undeclared uranium, and there are likely others.

Location 1: Turqz-abad Warehouse

The open-air warehouse in Tehran's Turqz-abad district held cargo containers and other items that contained nuclear-related equipment and material (see Figure 1).⁸ In 2018, the IAEA observed activities consistent with sanitization of the site. Commercial satellite imagery confirms this activity and documents Iran's speedy removal of all shipping containers and scraping of the grounds.⁹ The IAEA requested access to the site and took environmental

⁴ The Varamin site is also referred to in Iran's Nuclear Archive as the Tehran Plant.

⁵ For fuller descriptions of these four locations and their relationship to today, see David Albright with Sarah Burkhard and the Good ISIS Team, *Iran's Perilous Pursuit of Nuclear Weapons* (Washington, D.C.: Institute for Science and International Security Press, 2021).

⁶ For example, Grossi wrote in a May 2022 safeguards report: "[Some of the] isotopically altered particles [found at Turqz-Abad] must have come from another unknown location." See: IAEA Director General, "NPT Safeguards Agreement with the Islamic Republic of Iran," GOV/2022/26, May 30, 2022, <https://isis-online.org/uploads/iaea-reports/documents/gov2022-26.pdf>.

⁷ David Albright and Sarah Burkhard, "The Fourth Nuclear-Weapons-Related Testing Site Located: Another Parchin Site, More Undeclared Nuclear Material Possible," *Institute for Science and International Security*, September 7, 2022, <https://isis-online.org/isis-reports/detail/the-fourth-nuclear-weapons-related-testing-site-located/>.

⁸ John Irish and Arshad Mohammed, "Netanyahu, in U.N. Speech, Claims Secret Iranian Nuclear Site," *Reuters*, September 27, 2018, <https://www.reuters.com/article/us-un-assembly-israel-iran/netanyahu-in-un-speech-claims-secret-iranian-nuclear-site-idUSKCN1M72FZ>.

⁹ David Albright, Sarah Burkhard, Olli Heinonen, and Frank Pabian, "Presence of Undeclared Natural Uranium at the Turqz-Abad Nuclear Weaponization Storage Location," *Institute for Science and International Security*,

samples in February 2019, detecting processed natural uranium particles, potentially produced through undeclared uranium conversion activities. Through additional analysis, traces of isotopically altered uranium particles were detected as well, including “low enriched uranium with a detectable presence of U-236, and of slightly depleted uranium.”

The IAEA concluded the “containers that had been stored at this location had contained nuclear material and/or equipment that had been heavily contaminated by nuclear material, or both.” The Agency also assessed that while some of the containers at Turqz-Abad were dismantled, others were removed from the location intact in 2018 and moved to an unknown location.” This finding is confirmed by available commercial satellite imagery.

Some containers present at Turqz-abad came from the Varamin site, aka the Tehran Plant, which is another former site associated with Iran’s pre-2004 crash nuclear weapons program known as the Amad Plan¹⁰ (see below). However, the nuclear activities carried out at Varamin do not explain the presence of the multiple types of isotopically altered particles found at Turqz-abad. The IAEA concluded that those isotopically altered particles must have come from yet another, unknown location or locations.

Iran has stated that it was unable to identify the current location of the containers or their contents following their removal from Turqz-abad in 2018. Iran has also failed to provide technically credible explanations to the agency to account for the uranium particles. The IAEA concluded in June 2022, “On the basis of the process conducted and the exchanges of information with Iran as described in the Joint Statement of 5 March 2022, the presence of anthropogenic uranium particles at Turqz-Abad is not clarified.” In its latest report, the IAEA reports there has been no additional clarification from Iran.

November 20, 2019, <https://isis-online.org/isis-reports/detail/presence-of-undeclared-natural-uranium-at-the-turqz-abad-nuclear-weaponiza>.

¹⁰ *Iran’s Perilous Pursuit of Nuclear Weapons*.



Figure 1. Turqz-abad, also known as the “Atomic Warehouse,” where Iran secretly stored shipping containers and other items associated with the Amad Plan and possibly other undeclared nuclear activities. Iran later emptied it.

Location 2: Lavisan-Shian

The IAEA previously reported that the use and processing of uranium metal and related activities at Lavisan-Shian were undeclared and constituted violations of Iran’s safeguards agreement. It found, “activities and the nuclear material used therein at Lavisan-Shian were not declared by Iran to the Agency as required under the Safeguards Agreement.” Specifically, the IAEA assesses that “in 2003 at Lavisan-Shian, at least one natural uranium metal disc, out of ten such discs available (totaling approximately 10 kg), underwent drilling to produce metallic flakes. These flakes were subsequently subjected to chemical processing on at least two occasions at the same location.”

While the IAEA has been unable to find the uranium metal and has apparently stopped looking – at least for the time being – the safeguards violation seems certain. The IAEA added that it has “no additional questions on the issue related to Lavisan-Shian and, therefore, [this] issue [is] no longer outstanding.”

This statement should not be seen as the IAEA giving Iran a pass on activities at Lavisian-Shian, but more as an indication of the agency giving up for the time being on trying to determine the fate of the discs in question, likely a result of Iran's ongoing lack of cooperation. However, the IAEA investigation of a uranium discrepancy at the Uranium Conversion Facility may suggest an on-going interest in the uranium metal that was at Lavisian (see above). Whatever the outcome of further investigations, the operative conclusion is that Iran's use and processing of this disc at Lavisian violated its safeguards obligation under the comprehensive safeguards agreement.

What was Lavisian-Shian? Lavisian-Shian was a former headquarters of Iran's nuclear weapons program and a key site during the Amad Plan.¹¹ Iran razed the site in 2003 and 2004 as the IAEA's investigation into its covert nuclear program intensified (see Figure 2).¹²

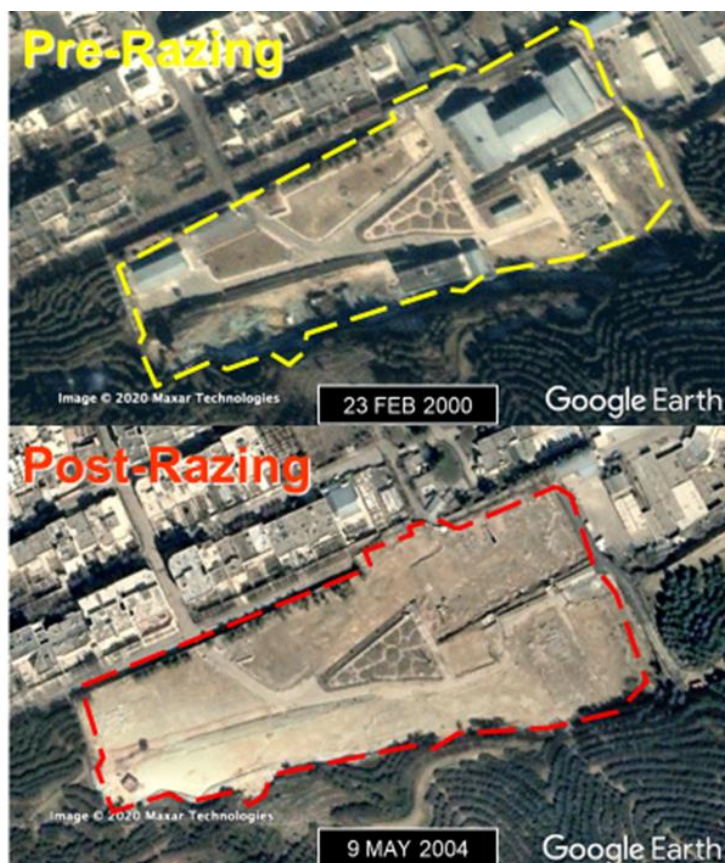


Figure 2. Before and after pictures from 2000 (above) and 2004 (below) show the extent of razing and sanitization that took place at Lavisian-Shian.

The metal disc at Lavisian was apparently part of Iran's nuclear weapons-related work, detailed in Iran's Nuclear Archive. Among the files was information about Iran's work on producing

¹¹ *Iran's Perilous Pursuit of Nuclear Weapons*.

¹² David Albright, Paul Brannan, and Andrea Stricker, "The Physics Research Center and Iran's Parallel Military Nuclear Program," *Institute for Science and International Security*, February 23, 2012, https://isis-online.org/uploads/isis-reports/documents/PHRC_report_23February2012.pdf. See also: *Iran's Perilous Pursuit of Nuclear Weapons*.

uranium deuteride (UD₃) for a neutron initiator used in nuclear weapons. The information detailed procedures Tehran used to make uranium deuteride, with an initial step involving drilling into a piece of uranium metal to obtain small pieces or flakes.¹³

The IAEA's assessment of the metal flakes undergoing chemical processing stops short of specifying the achieved or intended chemical product but is consistent with the production of uranium deuteride. Further, the IAEA stated in its June 5, 2020 report that the uranium metal disc had "indications of it undergoing drilling and hydriding."¹⁴ The statement about "drilling and hydriding" more directly refers to the production of uranium deuteride.¹⁵

The production of UD₃ typically involves producing uranium metal chips or shavings from a solid uranium metal piece and combining them under controlled temperatures and pressures with deuterium gas. Iran's Nuclear Archive contains an image of equipment in a glove box producing the uranium metal flakes (see Figure 3); other documents in the archive describe a step-by-step effort to produce UD₃, including practicing its synthesis with surrogate materials. The testing of a UD₃ neutron initiator is also extensively discussed in the Nuclear Archive, incidentally, helping explain the IAEA's detection in 2015 of uranium from environmental sampling done at the Parchin high explosive chamber, despite Iran's extensive sanitization efforts.¹⁶

¹³ "Neutron Source: Iran's Uranium Deuteride Neutron Initiator," *Institute for Science and International Security*, May 13, 2019, <https://isis-online.org/isis-reports/detail/neutron-source-irans-uranium-deuteride-neutron-initiator-1/>. See also, *Iran's Perilous Pursuit of Nuclear Weapons*.

¹⁴ IAEA Director General, "Verification and Monitoring in the Islamic Republic of Iran in Light of United Nations Security Council resolution 2231 (2015)," GOV/2020/26, June 5, 2020, https://isis-online.org/uploads/iaea-reports/documents/IAEA_Iran_Quarterly_Safeguards_Report_June_2020_.pdf

¹⁵ "Neutron Source: Iran's Uranium Deuteride Neutron Initiator."

¹⁶ David Albright, Sarah Burkhard, Olli Heinonen, and Frank Pabian, "New Information about the Parchin Site: What the Atomic Archive Reveals About Iran's Past Nuclear Weapons Related High Explosive Work at the Parchin High Explosive Test Site," *Institute for Science and International Security*, October 23, 2018, <http://isis-online.org/isis-reports/detail/new-information-about-the-parchin-site>.

Sensitive Equipment – UD₃ Manufacturing



A drilling machine in a glove box

Figure 3. A photo from Iran’s Nuclear Archive, obtained by the media and shared with the Institute, shows a glove box containing a drilling machine, with what appears to be a black object that is likely the uranium metal disc at issue at Lavisan-Shian.

Under the Amad Plan, the production of uranium deuteride had a codename, Project 3.20. When the Amad Plan was downsized and reconstituted as a smaller, more disguised effort in late 2003 and early 2004, Project 3.20 was to be closed, but a few of the project staff needed to make the “Source” – a codeword for the uranium deuteride neutron initiator – were slated to continue their activities.¹⁷

Evidence of post-2003 Iranian work on UD₃ and neutron initiators includes an Iranian document that surfaced in 2009. The document, dated to 2007, discusses how, although work on neutron sources made progress in the past, it was reduced in scale, leading to a decision to increase that work starting in about 2007, including continuing ongoing work on the production and testing of a UD₃ initiator.¹⁸

¹⁷ Memorandum, Statement of Mohsen Fakhri-zadeh, October 25, 2003. From Nuclear Archive. See: *Iran’s Perilous Pursuit of Nuclear Weapons*.

¹⁸ “New Document Reopens Question on Whether Iran’s Nuclear Weaponization Work Continued Past 2003,” *Institute for Science and International Security*, December 14, 2009, <https://isis-online.org/isis-reports/detail/new-document-reopens-question-on-whether-irans-nuclear-weaponization-work-c/8>; Farsi and English versions of the document are available at: <http://isis-online.org/isis-reports/detail/farsi-and-english-versions-of-document-on-neutron-initiator/>.

Location 3: Tehran Plant, near Varamin

The agency has reported information regarding the Varamin site while noting Iran's refusal to address safeguards violations at the site.

Varamin is identified in Iran's Nuclear Archive as the "Tehran Plant," or what the IAEA calls the Varamin site, after a nearby town. The site, visible in Figure 4, was a secret pilot and laboratory-scale uranium conversion plant under the Amad Plan.¹⁹ The November 2022 IAEA report adds more detail about the conversion facility; it provides an IAEA assessment that the site, used between 1999 and 2003, was an undeclared pilot plant for the processing and milling of uranium ore and conversion into uranium oxide, as well as for laboratory-scale conversion into uranium tetrafluoride and uranium hexafluoride.

Iran demolished the site in 2004. According to earlier IAEA reports, this location "underwent significant changes after 2003, including the demolition of most buildings, scraping and landscaping that was consistent with sanitisation, as well as the removal of containers." This can also be seen in commercial satellite imagery published by the Institute.

The IAEA originally asked for access to the site in January 2020, but Iran refused until August 2020. The IAEA took environmental samples whose analysis indicated the presence of undeclared man-made uranium particles.

Earlier IAEA reports link materials at this site to Turqz-abad. The IAEA reported in its September 2021 report that Iran removed containers from the site in 2004 and that "there are indications, supported by the results of the environmental samples analysis, that containers moved from Location 3 [Varamin] were subsequently also present at Location 1 [Turqz-abad]." The November 2022 report states that the containers were "eventually transferred to Turqz-Abad." However, the IAEA further reports that the uranium conversion activities carried out at Varamin "do not explain the presence of the multiple types of isotopically altered particles" found at Turqz-abad. This finding is in line with assessments that Turqz-abad was a storage location for a wide variety of equipment related to Iran's undeclared nuclear activities. Iran's subsequent explanations were judged as lacking support or inconsistent with the evidence. In its latest report, the IAEA reports no additional clarification from Iran.

¹⁹ *Iran's Perilous Pursuit of Nuclear Weapons*, Chapters 8 and 12; and David Albright, Sarah Burkhard, and Frank Pabian, "The Amad Plan Pilot Uranium Conversion Site, Which Iran Denies Ever Existed," *Institute for Science and International Security*, November 9, 2020, <https://isis-online.org/isis-reports/detail/the-amad-plan-pilot-uranium-conversion-site/8>.

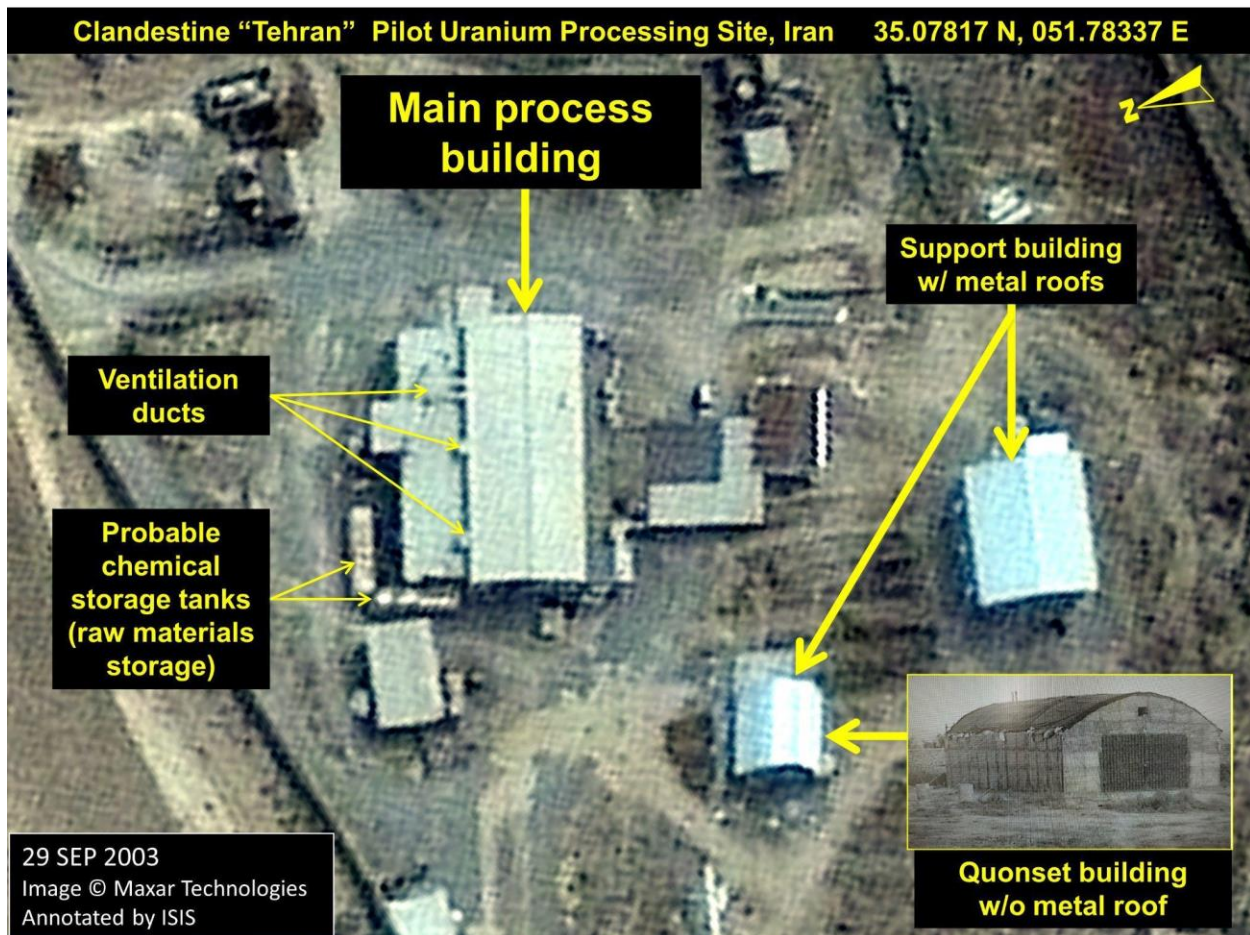


Figure 4. The undeclared Varamin uranium conversion facility, used between 1999 and 2003 as part of the Amad Plan.

Location 4: Marivan Site

The IAEA has apparently set aside resolving safeguards issues at Marivan, even though the main ones remain unresolved. The formerly secret Marivan site, near Abadeh, is another Amad Plan facility identified in the Nuclear Archive.²⁰ The IAEA noted in previous reports that Marivan “consists of two proximate areas where the Agency found indications that Iran had, in 2003, planned to use and store nuclear material.” Figure 5 shows these two areas at Marivan; one, an outdoor area for high explosive testing, and the second, a development site with several buildings about 1.5 kilometers away from the outdoor testing site.

Along with the Varamin site, the IAEA sought access to Marivan in January 2020, which Iran refused until August 2020, when the IAEA took environmental samples that revealed the presence of uranium particles in the development/support area.

²⁰ David Albright, Sarah Burkhard, and Frank Pabian, “Abadeh is Marivan: A Key, Former Secret Nuclear Weapons Development Test Site,” *Institute for Science and International Security*, November 18, 2020, <https://isis-online.org/isis-reports/detail/abadeh-is-marivan-irans-former-secret-nuclear-weapons-development-test-site>.

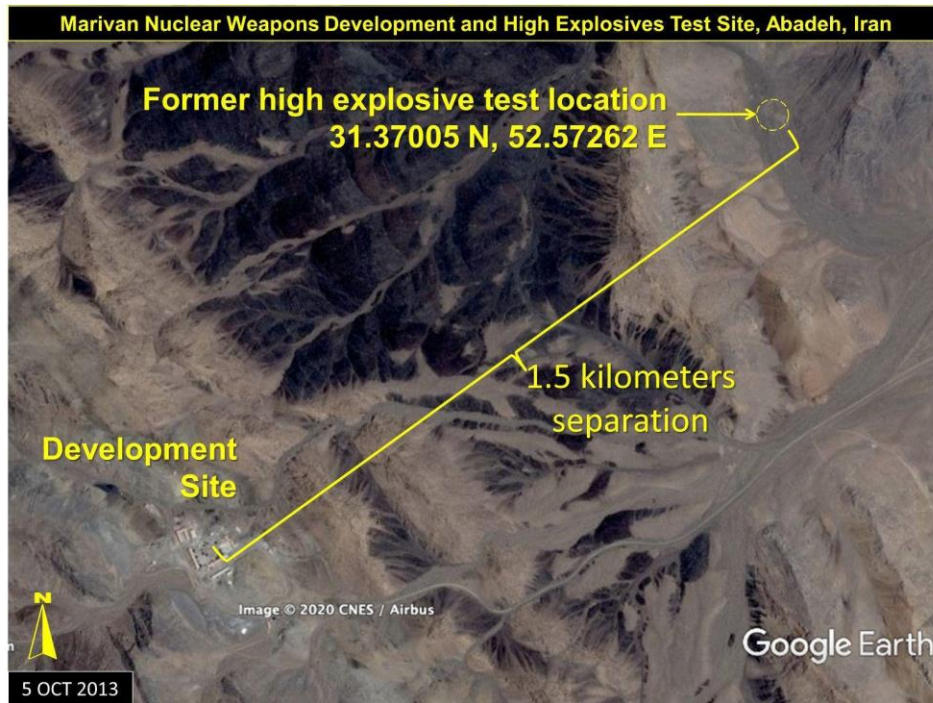


Figure 5. The Marivan high explosive test site and its relative location to the development site, also called the logistical support site.

In one area (see Figures 6 and 7), according to earlier IAEA reports, “where outdoor, conventional explosive testing may have taken place,” the IAEA found “indications relating to the testing of shielding in preparation for the use of neutron detectors in that same area” (see Figure 8). In the November 2022 report, the IAEA was more definitive, stating: “The analysis of all safeguards-relevant information available to the Agency related to ‘Marivan’ is consistent with Iran having conducted explosive testing with protective shielding in preparation for the use of neutron detectors.”

The November 2022 safeguards report indicated that the IAEA’s environmental sampling revealed the presence of anthropogenic uranium particles not at this outdoor testing site, but at “another area” of Marivan, since identified by the IAEA as the development/support area.

The IAEA states in its November 2022 report that it “found indications that Iran had in 2003 planned to use and store nuclear material at ‘Marivan’ for explosive testing.” This finding is independent of the origin of the uranium measured in environmental samples discussed above but relates to information found in the Nuclear Archive.

Earlier, the IAEA reported that from July 2019 onwards, it “observed via commercial satellite imagery, activities consistent with efforts to sanitize the area, including the demolition of buildings.” Figure 9 shows the razed development site as of July 2020.

The IAEA attempted to engage Iran regarding Marivan in September 2021, providing Iran with “graphics based on commercially available satellite imagery that illustrated the activities identified by the Agency as inconsistent with Iran’s statement that there had been no activity at this location between 1994 and 2018.” In a reply, Iran stated, “‘only the mining activities, which were main activities at this location, have been stopped during the said period’ and that the activities observed at the location had involved guards ‘to secure the properties at location.’”

An Institute assessment of satellite imagery of the site found that Iran appeared to have conducted further demolition activities following the IAEA’s visit, possibly to stymie future verification activities (see Figure 10).²¹ In its previous report, the IAEA stated that following its access to the site, it “observed through the analysis of commercially available satellite imagery that the aforementioned bunkers had been removed.”

The IAEA reported in its September 2021 report that in addition to explaining the presence of uranium, Iran must also provide answers regarding “the source of the neutrons that the neutron detectors were to measure” at the location. Iran has only provided unsubstantiated information about activities at the high explosive site at Marivan, which the IAEA has dismissed.

The source of the neutrons was likely a uranium deuteride neutron initiator that would have been placed at the center of a nuclear weapons high explosive system lacking its fissile material. When the system is detonated, the inward compression from the high explosive would squeeze the surrogate core with the neutron initiator at its center, creating fusion of the deuterium, resulting in a spurt of neutrons. If the core had contained fissile material, or weapons-grade uranium in the Iranian design, the neutrons would have started the chain reaction and the nuclear explosion. This type of test, often called a “cold test,” is done near the end of a nuclear weapons development program and is often the last test before starting the manufacture of nuclear weapons. According to information in the Nuclear Archive, Iran was approaching the point at which it would conduct a cold test, but had not done so by the time the Amad Plan was halted in 2003. It is unknown if Iran conducted such a test elsewhere after 2003.

Despite the evidence, Iran stated in May 2022 that the photographs previously provided by the IAEA of the bunkers at Marivan were “fabricated.” According to the IAEA, “This is despite the photographs being consistent with the Agency’s observations through the analysis of commercially available satellite imagery and visual observations during the complementary access at this location.”

The IAEA further drew a connection between Marivan and Turquz-abad, noting that based on analysis of commercially available satellite imagery, “trucks observed at Marivan and Turquz-

²¹ David Albright and Sarah Burkhard, “More Demolition at the Marivan Former Nuclear Weapons Development Site,” *Institute for Science and International Security*, March 1, 2022, <https://isis-online.org/isis-reports/detail/more-demolition-at-the-marivan-former-nuclear-weapons-development-site>.

Abad between mid-July and mid-August 2018 had similar features,” and that major parts of the Marivan site were demolished right after the IAEA shared its sampling results from Turquz-abad.

In its May 31, 2023 Iran safeguards report, the IAEA states that Iran provided a possible answer about the presence of anthropogenic uranium particles at the support site. According to Iran, this uranium is linked to earlier mining activity at the site when miners used “laboratory instruments and equipment” that contaminated the area with depleted uranium particles with uranium 236. Unable to prove or disprove this statement, the IAEA has stated that the issue of this uranium is no longer outstanding.

It is likely that there was a mining support camp at this location, later repurposed by Iran’s nuclear weapons program. The area is replete with clay mines and mining activity is visible (typical of sedimentary extraction mining) all around the Marivan site including linear prospecting scars dug by backhoes. However, the site was entirely razed before the IAEA was able to go – and just following the IAEA’s detection of uranium particles at Turquz-abad. In addition, other abandoned mining camps in Iran are not razed, e.g. the Talmesi uranium mining camp. Previous mining was most likely for refractory illitic clay for ceramics, as the Abadeh region is the home of one of the largest refractory clay mines (Esteghlal Mine) in the Middle East for the manufacture of ceramics and high temperature fire-bricks for kilns. A mining support camp, later co-opted by the Amad project, circa 2002 and beyond, would likely raise less suspicion when used for high explosive testing, given that it is located in a known mining environment.

However, on the broader issue of the activities at the high explosive site and Marivan’s purpose, the IAEA has not made any progress and “stands by its assessment of the activities that were undertaken by Iran at ‘Marivan’.” The IAEA is indicating that while Iran may have prevailed on the relatively small point of the uranium particles, the elephant in the proverbial Marivan tent remains present.

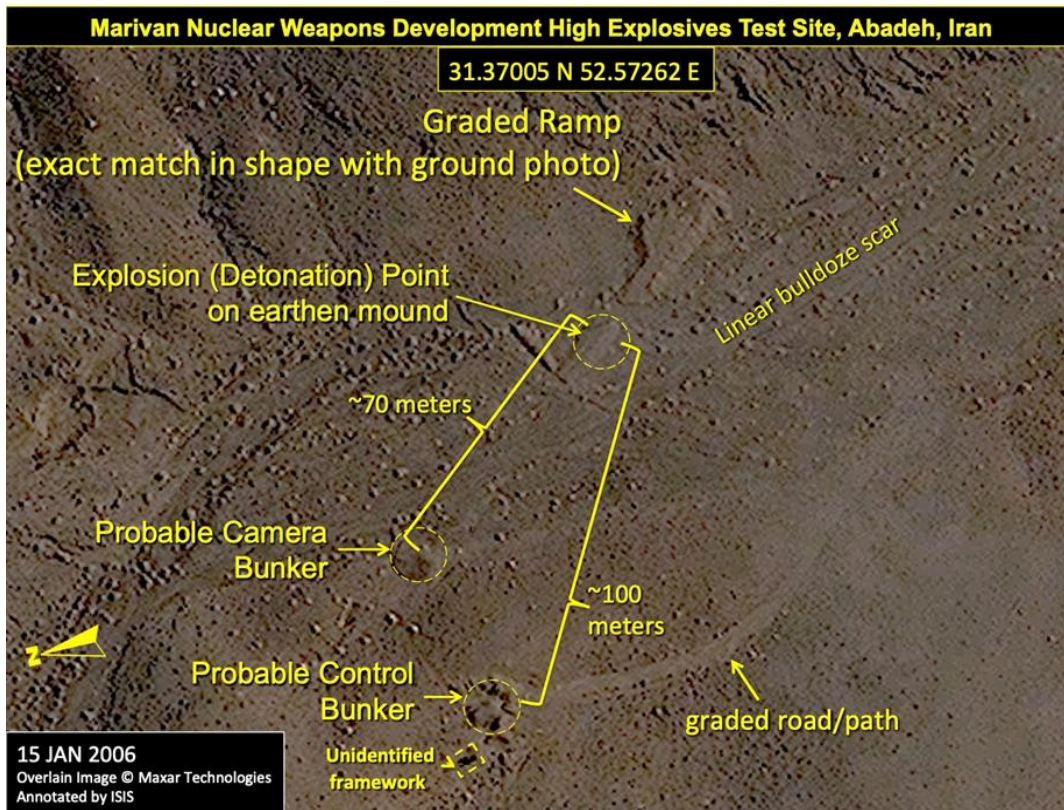


Figure 6. The Marivan high explosives test site near Abadeh, Iran, as it appeared in 2006, showing the location of the two bunkers and a future cold test that would be monitored by the neutron detectors.

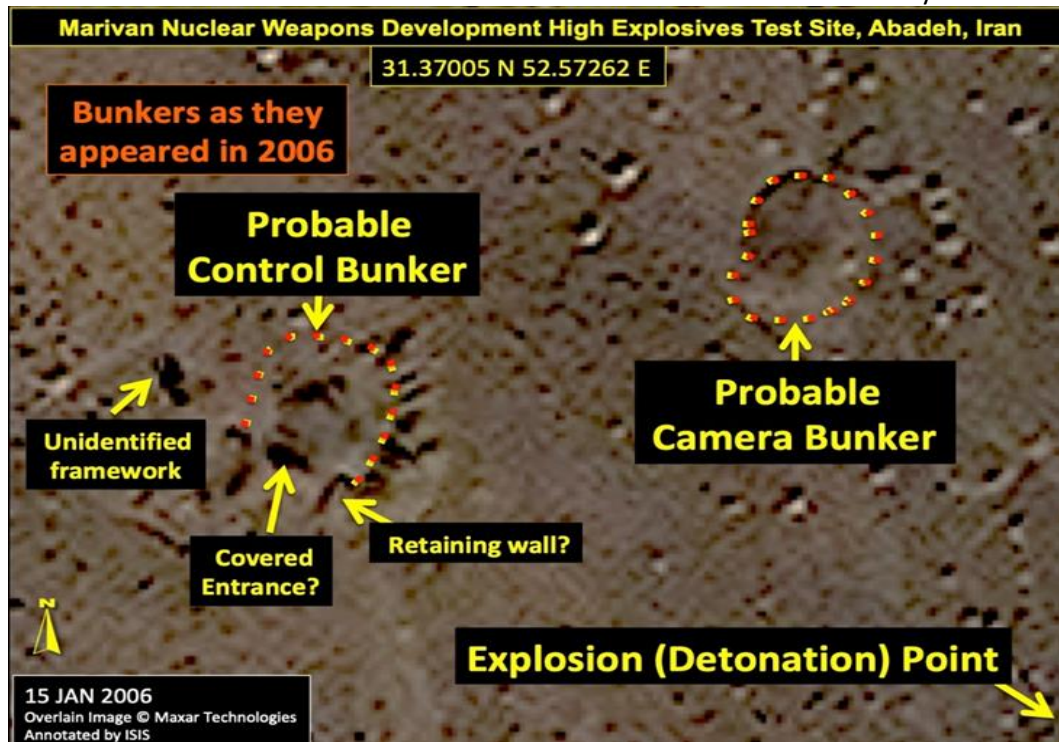


Figure 7. A close-up of the explosive test site's associated bunkers as they appeared in 2006, the nearest-in-time, available high-resolution image to the 2003 tests.

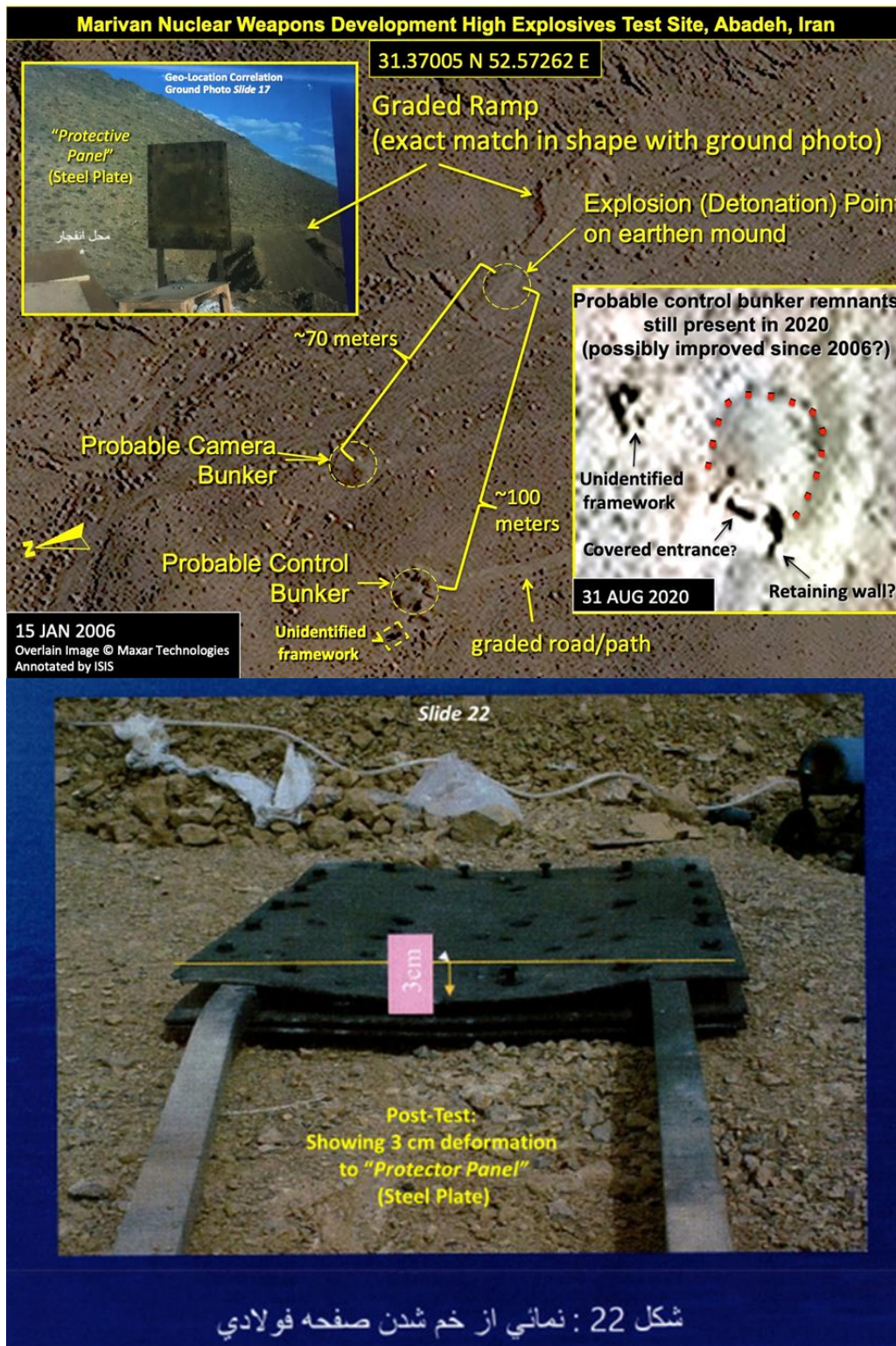


Figure 8. Top image: A 2006 image of the test site at Marivan, with a ground photo inset from the Nuclear Archive, showing shielding material, pre-test. Bottom image: Shielding material post-test.

Abadeh Nuclear Weapons Development Site **31.36163N 52.56055E**



Figure 9. During a press conference, then-Prime Minister Benjamin Netanyahu used these before (left) and after (right) images of Marivan, also known after the nearby town of Abadeh, to show the site's abrupt razing in July 2019.

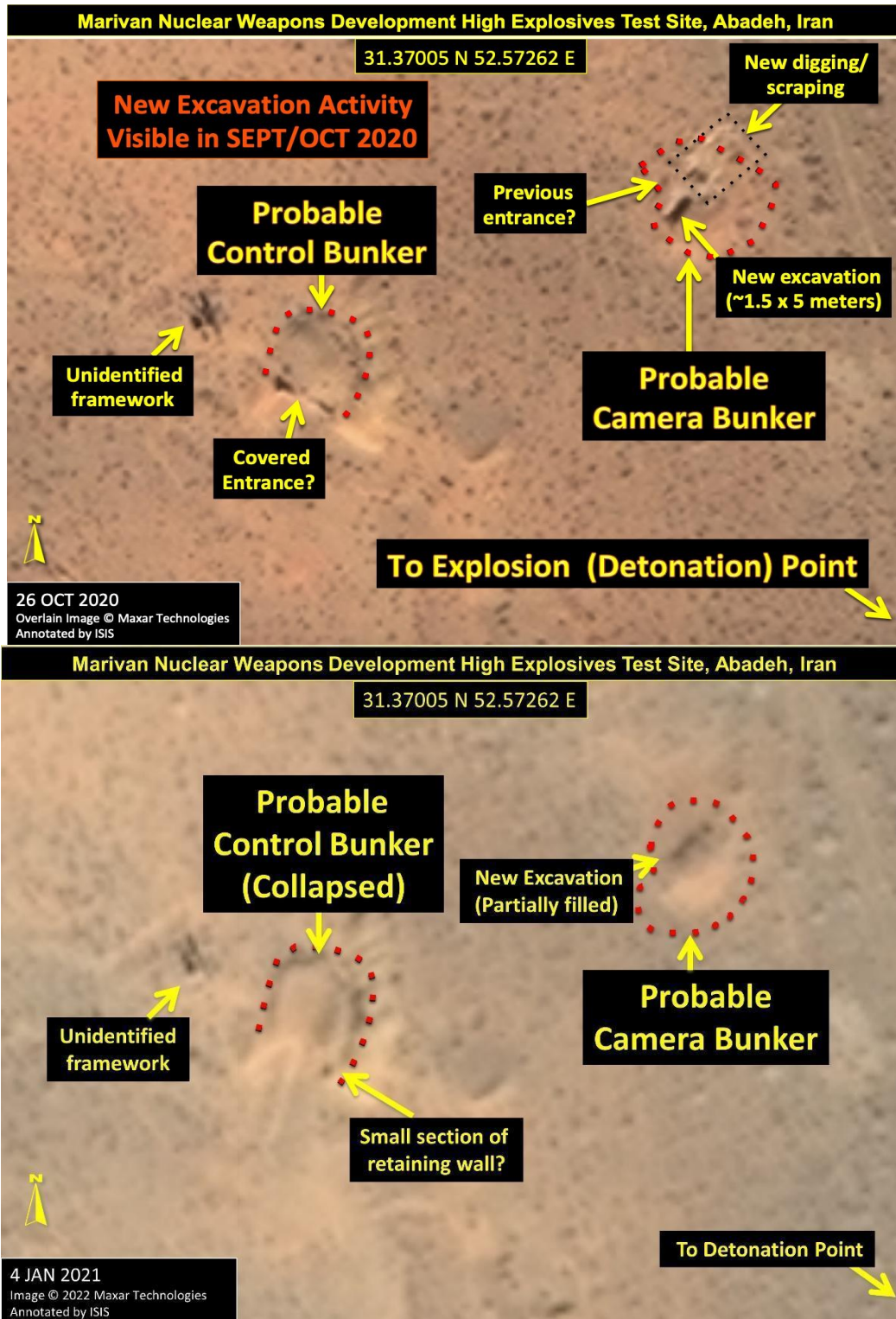


Figure 10. In top image, detected excavation and digging/scraping activity at the probable camera bunker, post-August 31, 2020. In bottom image, the excavation appears partially filled and the probable control bunker appears collapsed as of January 2021.