

Passive Defense Measures in Saving Iran's Ballistic Missile Arsenal

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Introduction

For decades, the Islamic Republic of Iran's ballistic missile program has been securitized by the West as a threat to peace. To compensate for economic sanctions, arms sanctions, and limitations on airpower, Iran focused on enhancing its ballistic missile program. As a result, its ballistic missiles became a deterrent principle in its national defense doctrine. Consequently, the United States and its allies applied embargos on Iran's program via related individuals and entities, states, and companies suspected of boosting the program, which in turn furthered Iran's need to secure the program and center its scope on maintaining its second-strike capability. The West's constant pressure, met by a renewed focus on Iran, created an escalatory process where the United States would emphasize military options and Iran would increase missile development. Using primary and secondary sources and a descriptive methodology, this article analyzes how Iran has attempted to safeguard its ballistic missile arsenal through passive defense measures.

The Passive Defense Concept

The U.S. Department of Defense defines *passive defense* as measures other than active defense that are made toward reducing the effectiveness of rival strikes. Passive defense is not involved in employing weapons or active measures toward a threat despite its impact on increasing survivability. Passive defense measures include the following:

1. **Detection and warning.** These are measures that, by timely detection, provide reaction time for taking proper action. A combination of surface-, air-, and space-based detection sensors and communication assets are required to maximize detection and warning.
2. **Reduction of enemy targeting effectiveness.** This reduces the enemy's targeting ability through mobility, deception, and operations security.
 - a. **Mobility.** This complicates the enemy's detection of friendly units through mobility.
 - b. **Deception.** This misleads the enemy by manipulating or falsifying the friendly unit's actions, feeding false intelligence to a rival's intelligence, surveillance, and reconnaissance (ISR) capabilities.
 - c. **Operations security.**
 - I. **Communication security and emissions control.** This denies the enemy's sensors and reconnaissance systems the ability to identify friendly units through communications security and measures to control infrared, acoustic, and electromagnetic signatures.
 - II. **Unit security and countersurveillance.** This protects local units, such as defensive counterair assets, from attack by enemy agents, saboteurs, terrorists, and small tactical units by employing ground force patrols.
 - III. **Nighttime support operations.** These employ nighttime operations to decrease the enemy's capacity for ISR monitoring.
 - IV. **Camouflage and concealment.** The employment of camouflage and concealment measures protect friendly units.
3. **Reducing vulnerability.** These measures are designed to increase the likelihood of friendly units surviving and enduring enemy attacks by lessening the former's vulnerability, including through:
 - a. **Hardening.** Hardening facilities host and store valuable assets, including missiles, command and control nodes, and other assets.

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- b. **Redundancy.** This prevents the failure of the systematic capacity for defense when under attack by ensuring that there are reinforcements and backup support units in place.
 - c. **Dispersal.** This decreases the concentration of units to reduce vulnerability to the enemy's targeting system.
 - d. **Chemical, biological, radiological, and nuclear (CBRN) defense equipment and facilities.** These protect friendly units from enemy CBRN attacks by providing detection, sheltering, and decontamination.
4. **Recovery and reconstitution.** This restores units to appropriate levels of combat effectiveness following an enemy attack, including managing available resources and defining priorities for assigning them.¹

Ballistic Missiles in Iran's Military Doctrine

Until the victory of the Iranian Revolution and the establishment of the Islamic Republic of Iran in 1979, Iran played an important role in the global confrontation between the Soviet Union and the West during the early Cold War. Iran's importance to the West stemmed from its energy resources and its geographic location on the Persian Gulf and adjacent to the Soviet Union.² The election of U.S. president Richard M. Nixon in 1968 introduced a new approach in U.S. foreign policy, which came to be known as the Nixon Doctrine. This doctrine saw the United States serve as a nuclear shield that protected its allies, including Iran, and empowered them to take more responsibility for their own regional security.³

The Islamic revolutionary government initiated fundamental changes in relations between Iran and the United States. Iran's new foreign policy approach fostered the spread of revolutionary ideology, supported anti-Western movements, and promoted confrontation with the West and Western allies in the Middle East.⁴ The United States imposed its first sanctions on post-revolution Iran in response to the 1980 U.S. embassy siege in Tehran. These sanctions were the first of many in a chain aimed at curbing Iran's actions against the West. Military-related sanctions prohibited Iran from exporting arms, importing arms, or engaging in arms deals, which had previously been a strong source of Iran's military prowess.⁵

The Iran-Iraq War (1980–88) saw the most influential and effective conflict application of ballistic missiles since World War II. Due to the use of ballistic missiles by both Iran and Iraq to target cities, the conflict became known as the "War of Cities" and was a milestone in Iran's ballistic missile program.⁶ In seeking to retaliate against Iraqi strikes on its cities, Iran succeeded in acquiring several Scud-B missiles from Libya and North Korea.⁷ In the following decades, Iran made improvements in its ballistic missile arsenal in both qualitative and quantitative dimensions such as range, guidance, launch systems, and variants.⁸

Today, despite Western sanctions and limitations, Iran's ballistic missile program still improves on its development processes and has become a cost-benefit weapons system for the Islamic Republic and its current and probable future clients.⁹ This has led to Iran being hailed as the possessor of the most significant ballistic missile arsenal in the Middle East, aside from Israel, consisting of short- and medium-range ballistic missiles.¹⁰ Currently, Iran's ballistic missile arsenal sits at the heart of its deterrence doctrine.¹¹ Iranian officials have repeatedly emphasized the development of this arsenal and refuse any negotiations that will limit the country's missile program.¹²

Detection and Warning

The establishment of Iran's air defense units goes back to 1933, when some ground forces of the Imperial Iranian Army were equipped with 75-millimeter antiaircraft weapons. Thereafter, as part of Mohammad Reza Shah Pahlavi's efforts to modernize the Iranian military, officers were sent to the United States and United Kingdom for training. Returning officers went on to establish Iran's first radar site at the Doshan Tappeh Air Base in 1958.¹³ Iran's air defense forces continued to improve in subsequent decades due to Pahlavi's significant financial investment as well as support from the United States that was in line with the Nixon Doctrine's focus on countering the Soviet Union.¹⁴ After the termination of Western training and other support for the Iranian military following the 1979 Revolution, the Islamic Republic shifted to acquiring air defense systems from other countries, such as the People's Republic of China.¹⁵ At present, the Islamic Republic of Iran Army and the Islamic Revolutionary Guard Corps' (IRGC) Aerospace Forces (IRGCASF) possess air defense capabilities, which they coordinate at the Khatam al-Anbiya air defense base.¹⁶ Iran tries to meet its current air defense needs by sourcing equipment and armaments from Russia and other foreign countries, successfully obtaining strategic systems such as the Russian-made S-300 and Tor M-1 surface-to-air missile (SAM) systems, to secure airspace over its strategic positions. It also continues to develop an air defense network by upgrading and modifying older systems and manufacturing its own long-range systems, such as the mobile Bavar-373 and 3rd Khordad SAM systems, which successfully targeted an advanced U.S. drone in June 2019.¹⁷

Mobility

Iran acquired and operated mobile missile launchers during the Iran-Iraq War, first acquiring two MAZ-543P transporter-erector-launcher (TEL) vehicles and as many as 20 Scud-B missiles from Libya. When Libya refused to supply more, Iran turned to North Korea, from whom it received four TEL vehicles in 1994.¹⁸

Iran's attempts to improve the mobility of its ballistic missile systems were not limited to importing related technologies from North Korea and other allies. Based on available evidence, Iran has tried to import and develop domestic production capabilities to manufacture heavy-duty trucks to improve its mobile launcher fleet by signing deals with European companies such as Mercedes-Benz and seeking to develop the production capabilities of state-owned automakers such as Iran Khodro.¹⁹ In recent years, by introducing 8 x 8 tactical trucks, 10 x 10 tactical trucks, and TELs, Iran has sought to manufacture heavy-duty tactical trucks at home for its military sector, thereby improving the mobility of its land-based missile delivery systems.

Iran's Use of Deception, Camouflage, and Concealment for Missile Protection *Using Commercial Trucks*

Iran is seeking new ways to conceal its ballistic missile systems, including by camouflaging them as civilian rather than military vehicles and locations. During the 43d anniversary of the Islamic Revolution in 2022, Iran unveiled the Kheibarshékan medium-range ballistic missile, which mounts on a 10-wheel commercial truck.²⁰ The employment of commercial trucks as TELs, in addition to other measures such as installing rail curtains on TELs and painting support vehicles to look like civilian and commercial vehicles, demonstrates Iran's goal of reducing the risk of its ballistic missile systems being detected by an enemy's intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) systems.²¹

Missile Farms

In July 2020, during the Great Prophet XIV military exercise, Iran unveiled a new launch platform called the “Missile Farm” that maintained missiles in a ready-to-launch state while being buried to decrease the threat of enemy preemptive strikes, similar to the United States’ LGM-118A Peacekeeper platform.²² This new platform also increased cost effectiveness by maintaining launch sites that can function without additional storage facilities and locations for other equipment and personnel.²³ Employing this platform reduces the risk of detection by an enemy’s ISTAR systems, again demonstrating the priority that Iran gives to enhancing its air defenses and strike capabilities through camouflage measures.

Unit Security

Since the 1979 Revolution, Iran’s security and intelligence community has expanded in size with the establishment of new agencies and other institutions that operate under different military branches and ministries. The multilayered security system that controls Iran’s ballistic missile forces is run by the IRGCASF in cooperation with the IRGC’s Intelligence Organization and other intelligence bodies including the General Office of Counter Intelligence.²⁴ These agencies are tasked with preventing enemy sabotage efforts targeting the country’s ballistic missile programs and systems.

In August 2023, the Iranian Ministry of Defense and Armed Forces Logistics’ Counterintelligence Organization claimed that it foiled an Israeli plan to sabotage Iran’s ballistic missile production by selling defective parts for use in its missile industry.²⁵ Iran also maintains protected military sites near Kermanshah in the west of the country, which include tunnels to protect missile launchers and related equipment as well as extensive security measures to prevent enemy infiltration and surveillance.²⁶

Night Support Operations

Since 2017, Iran has launched as many as 12 ballistic missile strike waves against targets in Iraq, Syria, Pakistan, Saudi Arabia, and Israel.²⁷ Some of these missile strikes were launched alongside unmanned aerial vehicles (UAVs). Despite differences among the operations in terms of the number of missiles fired, all were launched at night, suggesting that Iranian decision makers see nighttime missile operations as the most strategically appropriate.

Hardening and Redundancy

Initial attempts by Iran to construct underground and mountain complexes for its ballistic missile program date back to 1993, following an agreement with North Korea that resulted in the building of up to 18 ballistic missile bunkers.²⁸ In recent decades, with the foundation of government-owned companies such as the Khatam al-Anbiya Construction Headquarters (which is owned by the IRGC), these companies have taken the lead in both military and civil-sector building projects, including the construction of underground nuclear and military facilities.²⁹

In 2015, Iran unveiled a secret underground missile site that can maintain ballistic missiles, their launchers, and related equipment. This demonstrates the benefit of Iran’s ballistic missile program from the construction of underground facilities, tunnels, and complexes by domestic companies and illustrates Iran’s capability in fulfilling its needs in constructing hardened facilities as a measure to reduce the risk of destruction by enemy strikes.³⁰ In February 2019, Brigadier General Amir Ali Hajizadeh, the commander of IRGCASF, emphasized the securing of Iran’s missile production through passive defense measures including the con-

Table 1. Iranian nighttime missile operations, 2017–24

| Operation name | Type | Location | Date | Time |
|------------------|-----------------|----------------|-------------------|-------|
| Laylat al-Qadr | Missile | Syria | 18 June 2017 | Night |
| Muharram | Missile | Syria | 1 October 2018 | Night |
| N/A | Missile and UAV | Saudi Arabia | 14 September 2019 | Night |
| Martyr Soleimani | Missile | Iraq | 8 January 2020 | Night |
| N/A | Missile | Iraq | 13 March 2022 | Night |
| N/A | Missile and UAV | Iraq and Syria | 15 January 2024 | Night |
| N/A | Missile | Pakistan | 16 January 2024 | Night |
| True Promise | Missile and UAV | Israel | 13 April 2024 | Night |

Source: compiled by the author based on the following data: Babak Dehghanpisheh, “Iran Fires Missiles at Militant Groups in Eastern Syria,” Reuters, 18 June 2017; “For a Second Time, Iran Fires Missiles at IS Targets in Syria,” Washington Institute For Near East Policy, 1 October 2018; “A Strike on Saudi Arabia Moves a Shadowy Conflict Closer to Open War,” Economist, 19 September 2019; Alissa J. Rubin, “‘It Was Like a Scene From an Action Movie,’” New York Times, 13 January 2020; Namo Abdulla, “Iraqis Widely Condemn Iran Missile Attack on Irbil,” Voice of America, 13 March 2022; “Iran Launches Missile Strikes in Iraq and Syria Citing Security Threats,” Al Jazeera, 15 January 2024; Jonny Hallam, “Pakistan Condemns Deadly Iranian Missile Strike on Its Territory as Tensions Spike across Region,” CNN, 17 January 2024; and Sune Engel Rasmussen et al., “Iran Launches Drone and Missile Attack at Israel,” Wall Street Journal, 14 April 2024.

struction of missile production lines, silos, and storage in underground facilities.³¹

Dispersal

The *Summary of the 2018 National Defense Strategy of the United States* highlighted the importance of the dispersal of infrastructure, emphasizing the transition from large and centralized infrastructure to smaller, dispersed forms.³²

In this regard, Iran, as the nineteenth largest country in the world, benefits from its large amount of territory, including many mountain ranges, that enables it to adopt passive defense measures to secure its military and nuclear facilities from enemy strikes.³³ The combination of dispersal measures and the development of mobile launchers enable Iran to reduce the vulnerability of its ballistic missile arsenal to detection and destruction by ISR systems and preemptive strikes.

Conclusion

The available evidence indicates that Iran continues to actively apply several passive defense measures to protect its ballistic missile arsenal and launch sites. These measures include developing an in-

creasingly capable air defense network and mobile missile launch capabilities; employing deception and concealment tactics, including missile farms and disguising military missile vehicles as civilian vehicles; establishing intelligence and security protocols for its multilayered security structure; launching missile attacks under the cover of night to reduce enemy visibility and counter-missile efforts; expanding its underground facilities where ballistic missiles can be stored and launched in case its surface facilities are damaged or destroyed by enemy strikes; and dispersing its storage of ballistic missiles. As a result of these strategies, Iran's increasingly large and varied ballistic missile arsenal has become much harder to detect, track, and target, posing a major challenge to the United States and its partners and allies in the event of an open conflict with Iran.

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