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A Roadmap to Pragmatic Dialogue on the Iranian Missile Program

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A Roadmap to Pragmatic Dialogue on the Iranian Missile Program

As Europeans push for negotiations to restrain Iran's missile program, the question arises over what such a deal could look like. To address this question, it is necessary to assess which capabilities Iran considers vital to its national security and which it would be willing to limit. That requires a closer look at how Iran intends to use its missiles and how particular Iranian capabilities fit into the larger security picture.

Iran's missile force and doctrinal foundations emerged during the Iran-Iraq War. Iranian decision-makers were convinced that even imprecise ballistic missiles armed with conventional warheads could offset enemy air superiority and deter. With the post-war threat environment featuring enemies with superior aerial warfighting capabilities, these core beliefs persisted and were strengthened and expanded by technological advances in missile development.

Today, Iranian ballistic missiles are considered both battlefield weapons and political-military tools used to establish general and intra-war deterrence. Missiles have also become a potent political symbol, as well as a source of legitimacy and prestige.

This paper's review of Iran's capabilities points to a dilemma for European negotiators. Most types of missiles at ranges below 2000km are technically mature, mass-produced and deployed in large numbers. Most importantly, they are crucial to general deterrence and precision-strike, two concepts that Iran deems as vital for preserving its national security. Missile capabilities beyond 2000km, while able to be developed and deployed much more rapidly than often assumed, are still latent and currently not critical to Iranian national security. A consideration often overlooked is that verification of potential limits on these long-range capabilities would be substantially easier than for Iran's existing missile arsenal below 2000km.

With this in mind, and given their security concerns and limited leverage, European negotiators should focus their efforts on achieving two goals:

- Preventing Iran from extending its missile range to strike Europe;
- Blocking Iran from developing intercontinental ballistic missile (ICBM) technology, potentially under the guise of its space program.

Such an agreement could incorporate the following elements:

- Codifying Iran's self-imposed 2000km range limit;
- Restricting the Iranian space program to the use of fuel combinations with low military utility;
- Capping the capability of Iranian Space Launched Vehicles (SLVs) at the current level of the Simorgh
- Halting flight-testing of the Khorramshahr missile.

While not addressing many regional missile-related issues, such an agreement is achievable and capable of blocking destabilizing developments in the future. It could serve as the basis for follow-up negotiations should the US adopt a more pragmatic approach again, or protect core European security interests if the situation deteriorates. Although Iran's leaders are adamant that they will not negotiate on the country's force of deployed missile systems, an agreement aimed at codifying the Supreme Leader's 2000km range limit in order to halt future developments could be acceptable to them. Of course, the pre-condition to any deal, no matter how limited its goals, would be a minimum level of trust between Europeans and Iranians. With tensions on the rise, this currently seems far from guaranteed.

Introduction

Barely a week passes without a newsworthy mention of Iran's missiles, regularly described as threatening, destabilizing and needing to be urgently tackled. Yet little consideration is given to clarifying what is actually meant when discussing Iran's missiles. A closer assessment reveals that Iran's missile force consists of a diverse range of capabilities that play multiple roles in Iranian military planning. Iran uses ballistic missiles in its military strategy in a fundamentally different way from Western countries.

Unpacking this black box is important to understanding which capabilities are considered vital to national security and which could be subject to limitations.

The first part of this paper will examine the emergence of the Iranian missile force in the Iran-Iraq War and how it formed core beliefs that continue to influence the country's missile program to this day. The second part will discuss the roles of ballistic missiles in current Iranian military planning. The third part will discuss Iran's self-imposed 2000km range limit, how it has restricted

Iranian missile development, how Iran is attempting to circumvent the limit and how it is hedging for longer range systems. The fourth part will provide a short overview of Iranian capabilities, both deployed and under development evaluating their relative importance to the various roles described before. In the final section, the evaluation of Iranian capabilities will be used to offer recommendations for European priorities in future negotiations.

The Emergence of Iran's Missile Force

Iran's heavy reliance on ballistic missiles for defence is considered common knowledge. Yet it would have puzzled military analysts only three decades ago. At a time when Iran decided to heavily invest in a ballistic missile program, many if not most Western analysts assumed that conventionally armed ballistic missiles with their high inaccuracy (measured in hundreds of meters) were not viable weapon systems. To understand this decision one has to revisit the Iran-Iraq War (1980-1988) when the Iranian Islamic Revolutionary Guard Corps (IRGC) missile force was established.

During the first four years of the Iran-Iraq War, Iraqi forces targeted cities close to the border with artillery rockets, ballistic missiles



Iranian crew preparing a Libyan-supplied Scud B missile for launch against Iraq

and aircraft. While these attacks terrorized the local civilian population, their impact on the overall military balance and the Iranian political situation was limited. This changed rapidly in 1984 when Iraq, desperate to stop what had turned into an Iranian invasion, began targeting Iranian population centres deep inside the country, including cities such as Tehran, Esfahan and Shiraz using its formidable Soviet and French equipped air force.¹ Iran's limited ability to defend itself and stage retaliatory strikes using aerial power² (it lacked spares for its American-built combat aircraft and was cut off from major arms suppliers) meant that it took the decision to use ballistic missiles in response.

Although the acquisition of ballistic missiles proved difficult, Iran managed to assemble a tiny Scud force using an eclectic mix of Syrian training, Libyan Scuds and, later on, North Korean Hwasong missiles. Acutely aware of its limitations, Iran began a project early on to reverse-engineer the Scud and launched parallel development projects for solid-fuel artillery rockets.³

While the so-called "War of the Cities" is sometimes characterized as a crude exchange of aerial attacks and missile strikes to terrorize the enemy population, Iranian commanders viewed their missile strikes as an attempt to deter Iraqi aerial attacks on their population centres.⁴ The careful escalatory steps taken by the Iranian leadership supports this view. A first ultimatum to stop aerial attacks was followed by an artillery strike against Basra. As this showed no sign of working, it was followed by another ultimatum and a Scud fired against Kirkuk. As a last step and preceded by a final ultimatum, Baghdad was then targeted. Iranian commanders are convinced that this approach worked, noting that the various rounds of Iraqi attacks against Iranian cities between 1984 and 1988 correlated with the existence or absence of Iran's capability to retaliate against Baghdad. They are quick to point out that as soon as the Libyan launch team had left and Iran was assumed to be incapable of staging further missile strikes, Iraqi aerial attacks immediately resumed.⁵

Thus, the Islamic Republic ended the war with three core beliefs:

- **First, ballistic missiles could offset enemy air superiority.**
- **Second, conventional deterrence using ballistic missiles is feasible.**
- **Third, ballistic missiles must be produced domestically.**

These beliefs survived into the post-war period for two reasons. The first was the institutional and personal support for missile armament. The founder of the IRGC's missile corps Brigadier General Hassan Tehrani Moghaddam, a single-minded commander with deep political connections, would continue to lead Iran's missile development program until his death in 2011. The then President and today's Supreme Leader, Ali Khamenei, had shown a strong personal interest in ballistic missile use and development from very early on. Both were crucial to turning the IRGC's embryonic missile force into a major branch of service.⁶

The second reason these beliefs survived is that the threat environment that Iran faced after the end of the war, and still faces today, broadly resembles that of the Iran-Iraq war, albeit on much larger scale. Iran still has enemies with vastly superior aerial capabilities. Officials admit that the inability of Iranian air power and air defences to neutralize this threat remains the prime reason for continuous missile development.⁷ With the Iraqi military nearly crushed during the Gulf War, it is not surprising that the Iranian missile program was strategically reoriented towards the perceived threats from Israel and the US shortly afterwards.⁸

The Role of Missiles in Iran's Current Military Thinking

For analytical clarity, the roles of Iran's missiles are divided into two categories, battlefield weapons and political-military tools. Like most conventional weapons systems, Iranian missiles used as regular weapons are intended to degrade enemy fighting capabilities. When used as a political-

military tool the aim is to achieve a certain political and psychological effect. While in this role they may also degrade enemy fighting capabilities to an extent, the main purpose remains political and psychological.

Politico-Military Tools

GENERAL DETERRENCE

Iranian missiles are used today mainly for deterrence. In order to counter aggression by a foreign power and deter the initiation of an attack, Iran will illicit an immediate missile counter-strike and a protracted missile campaign.

As a concept, this is an outgrowth extension of conventional deterrence practiced during the Iran-Iraq War. The difference is that with its large inventory of missiles Iran is now able to deter the outbreak of hostilities and not only hostile acts during a conflict. There are clear parallels to nuclear deterrence reflected not only in the widespread use of the term deterrence (*bazdarandegi*) when referring to missiles but also in concrete modes of deployment, command and control structures as well as signalling. According to IRGC-ASF Commander Hajizadeh, a percentage of Iranian missiles is on continuous alert and ready to launch at any given moment. Launch authority for this contingent is delegated to local commanders who act according to pre-planned scenarios in case a military attack on Iran takes place.⁹ A member of the Iranian parliament called the potential response to any outside attack a “second strike.”¹⁰ On the ground, these theoretical considerations and contingency plans are backed up by a considerable number of large underground missile bases designed to survive an initial aerial attack, several of which are equipped with missile silos.

As with nuclear deterrence, signalling is a central element of the strategy. This is achieved by showcasing Iran’s underground missile bases to the world, conducting high-profile missile exercises but also by statements from Iran’s highest office. In 2013, Supreme Leader Ali Khamenei declared:



A Qiam missile ready to be launched from an underground position

“Sometimes the leaders of the Zionist regime threaten us. They threaten us with a military attack. But I think they know, and if they don’t know they should know, that if they make a mistake (attack Iran), the Islamic Republic will flatten Tel Aviv and Haifa.”¹¹

And in June 2018 while delivering remarks on the country’s missile program, Khamenei proclaimed: “The enemy knows that if he fires one, he will be hit by ten.”¹² While these statements have been criticized for their anti-Israeli content, they should not be discarded as mere propaganda. They should be understood as a deliberate attempt to signal Iran’s capacity and willingness to conduct a substantial second-strike.

INTRA-WAR DETERRENCE

A second mode of deterrence is intra-war deterrence, meaning the use or non-use of missiles to curtail certain acts by the enemy during existing hostilities. This was the original way Iran employed its tiny Scud force during the Iran-Iraq War to deter Iraqi aerial attacks and achieve what former IRGC commander Rezaee called a “missile ceasefire” within the war.¹³ Recent patterns of Houthi ballistic missile use seem to indicate the Iranian-trained and equipped Houthi missile force is emulating this by linking its strikes to aerial attacks against its leadership and the Yemeni capital Sana’a. A spokesman for the Houthi-controlled army stated that ballistic missiles launched against Riyadh in May 2018 was revenge for a Saudi airstrike that killed the



Students taking a selfie with a Zolfaghar missile on display at Tehran's Amirkabir University

Houthi's civilian leader in Sana'a, stating: "There will be more salvos until this enemy is deterred, understands the meaning of the Yemeni threat and ceases its crimes."¹⁴ The Houthi-controlled missile command reported that the strikes would "strengthen the growing deterrence equation."¹⁵

While it is difficult to imagine how a carefully managed escalation ladder intended for intra-war deterrence could be upheld after a massive second strike, this *modus operandi* could become more relevant again if Iran acquires a limited number of longer-range missiles, capable of reaching targets outside the Middle East, or in the case of a protracted regional war.

SYMBOLIC AND POLITICAL VALUE

There is little doubt that Iran's missile program serves to foster the internal and external prestige of the Iranian regime. The IRGC and civilian officials claim that Iran's missile force strengthens their hand in any negotiation with hostile foreign powers. In the words of former IRGC commander Rezaee:

"What brought them to their senses and made them negotiate with us was Iran's missile and defensive power. They say with such a powerful capacity we have no other way but negotiating. There is no other way of doing it. If we attack they will strike us. It was exactly this idea 'they will strike us' that made them come to the table."¹⁶

International concern about the program is interpreted as confirmation that the missile strategy is working.¹⁷

Iran's technological progress and military advances are used to appeal to domestic nationalist sentiment.

Missile development is now the subject of countless murals, TV documentaries, books, exhibitions, congresses and even songs. Paying lip service to the country's achievements in missiles and space technology is necessary for every Iranian public figure, even though the Supreme Leader has alleged that at least privately some hold a more sceptical view of the program.¹⁸

The missile program is also increasingly used by hardliners as a political tool in domestic politics. Portrayed as an example of successful self-sufficient development, it represents the model of an autarkic Resistance Economy, as advocated by the faction. It is then often contrasted with the dismal state of Iran's car industry, which hardliners associate with a more open economic and political space advocated by less hardline factions.

Battlefield Weapons

During the Iran-Iraq War, Iran used a small number of missiles that had limited accuracy as a political-military tool. Iran's concepts of deterrence could be interpreted as designed to accommodate the limited accuracy of its missiles and in the case of intra-war deterrence, their limited numbers. The advent of missile mass production in the 1990s changed this. Iran acquired the capability to launch salvos of missile akin to artillery barrages that could compensate limited accuracy with high numbers of projectiles. This capability was first demonstrated in April 2001 when Iran launched over 70 ballistic missiles and artillery rockets against bases of the Mojahedin-e Khalq (MEK) in neighbouring Iraq.¹⁹ More recently, Iran has exercised firing missiles against mock-ups of American bases²⁰ and developed cluster



Drone footage of a precision-guided Iranian ballistic missile strike against a meeting of Democratic Party of Iranian Kurdistan commanders in Northern Iraq, September 2018

warheads for some of its ballistic missiles to maximize their effect as battlefield weapons.²¹ Using ballistic missiles as a form of long-range artillery will be a feature of any potential protracted military conflict between Iran and regional powers or with the West. In the medium term, this capability is quickly being made obsolete by the development of precision guidance systems.

PRECISION GUIDANCE

The introduction of precision-guided ballistic missiles in the 2010s has brought a dramatic change to the way Iranian decision-makers consider their ballistic missiles. Instead of viewing them as an equivalent to artillery barrages, Iranian officials are now beginning to view them as equivalent to precision airstrikes.²² Iran not only has developed systems to attack point targets but also developed specialized missile variants to target aircraft carriers and radar installations.²³ The development of precision-guided missiles originally focused on the shorter-range solid-fuel Fateh class of missiles. More recently, Iran has begun retrofitting its longer-range liquid fuel missiles with precision-guided warheads, including the Emad with a range of 1650km and the Khorramshahr 2 with an official range of 2000km (potentially much longer). Although there are some doubts about their reliability, precision-guided missiles have already been used three times in combat, twice against Islamic State targets in Eastern Syria^{24,25} and

once against a meeting of Democratic Party of Iranian Kurdistan commanders in Northern Iraq.²⁶

Judging by the issue's prominence in IRGC discourse and the deployment rate of these new systems, precision seems to be the main focus of Iran's missile program today. This priority is a direct result of the importance attached to it by Khamenei. IRGC-ASF commander Hajizadeh gave a detailed account of his first private meeting with the Supreme Leader in late 2009. Having prepared a detailed report outlining his proposals for future developments, Khamenei discarded it with a single sentence. "The things that you want to do are not my priority. I want precision from you."²⁷ In a 2013 interview, Hajizadeh recounted how Khamenei personally followed the progress of the project, congratulating his commanders for achieving an accuracy of 30 meters but imploring them to now aim for 15 meters.²⁸

One could argue that the advances in this technology might lessen the importance of deterrence as primary strategy for deploying Iranian ballistic missiles and move the country towards a more conventional doctrine of employing ballistic missiles mostly as battlefield weapons. It seems likely however that both concepts will eventually interlock and complement each other. A good example is the Hormoz missile, developed with the explicit aim of targeting missile defence sites and helping to maintain deterrence in

the face of rapidly evolving missile defence systems in the region.²⁹ Iran's ability to target specific sites with accuracy may also become more prominent in its deterrence signalling. A similar trend can already be seen with Hezbollah's new precision-guided capability. In late 2018, the group released a video titled 'Attack and you will regret' displaying satellite photos and coordinates of various potential high-profile targets inside Israel.³⁰

Regional Power Projection

The proliferation of missiles to Iranian clients and allied non-state regional actors is a fairly recent development in the Iranian missile program. This started in the early 2000s when Iran equipped Lebanese Hezbollah with artillery rockets. Encouraged by the results of the 2006 war between Israel and Hezbollah, Iran stepped up its activities both quantitatively and qualitatively. Today Iran not only supplies various non-state actors with ballistic missile with ranges up to 1000km, as in the case of Yemen, but also with precision-guided missiles and production technology which allows these groups to produce artillery rockets and ballistic missiles themselves. Iranian production facilities for shorter-range systems are partially designed to allow for their transfer to Iranian allies in the region.

The use of these weapons by non-state actors resembles the way Iran uses its missiles from general deterrence relying on large numbers (Hezbollah), intra-war deterrence (Houthi strikes against Riyadh), and conventional weapons (Houthi precision-guided missile strikes against coalition forces).

Potential delivery systems for nuclear weapons

While Iranian sources have been silent on the issue, both IAEA reports about Possible Military Dimensions of the Iranian nuclear program and the recent Israeli revelations about Iran's nuclear ambitions, leave little doubt that Iran has worked on a nuclear warhead design for its Shahab 3 missile.^{31,32} While it remains impossible to assess potential new developments in this area with

certainty, the US intelligence community asserts that Iran is currently not undertaking any key activities associated with a nuclear weapons program.³³

In theory, all Iranian missile systems are technically capable of delivering a nuclear warhead. In practice, if one assumes the miniaturization level that Iran aimed for in its pre-2003 effort, only Iran's liquid-fuel missiles and the solid-fuel Sejil would be able to deliver a nuclear warhead. With Iran's pre-2003 plans centred on the Shahab 3, it seems highly likely that a potential renewed effort to develop a nuclear warhead would again focus on Iran's current longer-range systems i.e. the Shahab 3, the Ghadr, the Khorramshahr and if actually operational, the Sejil. While some of these systems currently use sleek warheads designs too small to accommodate the pre-2003 nuclear warhead design, these could easily be replaced. In fact, while the Ghadr's standard warhead is too small to fit the design, the Ghadr's precision-guided warhead introduced in 2015 would be large enough to accommodate it.

The relative importance of the various roles

Among all of these roles, general deterrence remains the most important and is widely credited by IRGC commanders as having prevented an outbreak of war in recent years. However, the precision strike role, aided by high level support, has been rapidly catching up and represents the main focus of Iranian missile development programs. While the deterrence model envisaged a strictly defensive role for Iranian missiles, both precision strike and regional proliferation are increasingly blurring the lines between the defensive and offensive roles of Iran's missiles.

The 2000km Range Limit and Beyond

Iran's missile activities are currently not regulated by any agreement. Iran claims to adhere to a self-imposed 2000km range limit ordered by the Supreme Leader. It is difficult to determine when exactly the range limit was

set. While it only entered public discourse in the 2010s, some remarks suggest it has been in place as early as the mid-2000s.³⁴ The 2000km range limit seems to be a trade-off, allowing just enough range for the IRGC to target Iran's regional enemies and US forces deployed in the region, while avoiding the political cost of longer-range missile development.

In general, the range limit has restrained the Iranian missile program. Despite being technically capable of doing so, Iran has not deployed any technically mature missile with a range above 2000km in substantial numbers, yet. However, there are also several worrisome trends. These include threats by high-ranking IRGC officials to remove the restriction, attempts to circumvent it and past and potentially present ICBM-technology hedging efforts under the guise of space activities.

IRGC commander Jafari,³⁵ his deputy Hossein Salami³⁶ and the secretary of the Supreme National Security Council Ali Shamkhani³⁷ have all threatened to end the voluntary range limit. Shamkhani's and Salami's remarks were made in the context of European efforts to restrict Iran's missile program. The framing of these threats, sometimes explicit, sometimes more subtle, has always been consistent. A

statement by Salami in 2018 illustrates this well:

"I want to make one point clear, especially to these European countries. Look, if we to this day have restricted our missile range to 2000km and for the time being have not exceeded it, it is not because of technological restrictions, not at all! From a technical point of view we face no limitations to increasing the range of our missiles. [...] But why haven't we done this? Because every action we take follows certain strategic criteria. Our missile range is subject to a strategic logic, meaning that we increase the range of our weapons to the edge of the area we feel threatened from. Beyond that, if there is no threat, we won't increase our missile range. The Europeans should know that if they want to enter the sanctum of our missiles, we might discard these limitations."³⁸

On a technical level, there is evidence Iran is trying to circumvent the range limitations through the development of the Khorramshahr missile, a design based on the North Korean Musudan missile. Officially, the Khorramshahr's range conforms to the 2000km limit. However, unlike other Iranian



Iran's Khorramshahr missile on parade in Tehran



Left: Hassan Moghaddam and the Supreme Leader during the latter's inspection visit to Project Ghaem at Imam Hossein University in May 2010. Right: Launch pad at the Shahroud solid-fuel development and testing facility.

missiles of the same range that carry warheads weighing between 500kg and 800kg, the Khorramshahr carries a super-heavy warhead of 1800kg. Iranian news sources have also mentioned the possibility of alternatively equipping it with several separate smaller warheads.³⁹ These extremely heavy payloads artificially restrain the missiles range and there is little doubt it would exceed 2000km if fitted with a single regular-weight warhead. In a way, Iran's Khorramshahr can be considered an inversion of Russia's strategy in regards to the Intermediate-Range Nuclear Forces (INF) Treaty compliance of the RS-26 Rubezh.

Just exactly how far it could fly is difficult to assess. In 2009 US officials estimated the original North Korean Musudan to have a 4000km range with a regular warhead.⁴⁰ More recently, David Wright, a well-known analyst, used data of the sole successful Musudan test flight (which had a lofted trajectory) to calculate it's range if used on a normal trajectory and arrived at only 3000km.⁴¹ Another layer of uncertainty is added by visible design differences between the Musudan and the Khorramshahr. Currently, this threat is somewhat mitigated by the missile's difficult development. As Lewis and LaFoy have pointed out, the first two test flights of the Khorramshahr have failed and the testing record of the original North Korean Musudan is abysmal.⁴² Nevertheless, a recently

announced precision-guided version of the Khorramshahr seems to indicate that despite these obstacles, Iran is still committed to developing the missile into a viable weapon system in the future.⁴³

Another worrisome aspect is ICBM-technology hedging under the guise of space activities. Today, Iran's official space program uses two types of satellite launch vehicles developed by the Aerospace Industries Organization, the Safir and the Simorgh. The Safir is an extremely light SLV only capable of launching micro-satellites to very low orbits and therefore has no utility in a potential ICBM development program. While the Simorgh's first stage could at least in theory form the basis for an ICBM, analysts such as Elleman and Schmerler have rightly pointed out that the Simorgh's reliance on Scud-technology,⁴⁴ with fuel that is low-energetic and not storable for longer periods of time, severely limits its utility as a weapons system. Furthermore the Simorgh's current configuration is clearly optimized for satellite launches. Any modification towards a military role would necessitate the exchange of its low thrust upper stage, requiring further flight tests. While Simorgh launches might help Iran might improve some militarily relevant technological skills such as staging and telemetry, it seems unlikely the Simorgh will ever be developed into a weapons system.^{45,46}

This is not the whole story however. In November 2011 a large explosion at the Shahid Modarres Garrison, the IRGC's Self-Sufficiency Jihad Organization's solid fuel motor development facility, killed Brigadier General Hassan Tehrani Moghaddam and over thirty of his co-workers. Comments made in reference to the incident revealed that Moghaddam had been leading a parallel development effort aimed at a solid-fuel SLV. According to IRGC commander Jafari: "The work that was done there was related to solid fuel for SLVs not to military missiles."⁴⁷ The fact that Moghaddam had been working on a large solid-fuel SLV aimed at launching satellites into geostationary orbit has been confirmed not only by IRGC commander Mohammad Ali Jafari,⁴⁸ but also IRGC-ASF deputy Seyyed Majid Musavi⁴⁹ as well as Professor Fathollah Omi the current president of Iran's Aerospace Research Center.⁵⁰ The project officially named Ghaem, but mostly euphemistically referred to as 'the last project of Martyr Moghaddam' was institutionally separate from Iran's official space program and conducted by both the Self-Sufficiency Jihad Organisation and the IRGC's Imam Hossein University. As IRG-ASF deputy Musavi notes: "It was different from the efforts of the Industries (AIO). The AIO had entered the area of space flight using liquid-fuel technology, but Moghaddam entered this area through the use of solid-fuel technology."⁵¹

The development of solid-fuel SLVs is of particular concern.

Unlike systems that rely on a large amount of low-energetic liquid fuel like the Simorgh, solid-fuel SLVs can be converted into viable ICBMs quite easily.

Statements made by IRGC officials imply that Project Ghaem indeed had a military dimension and was an ICBM-technology hedging effort under the guise of a space program. According to Majid Musavi, the 2000km range limit was the primary impetus for the solid-fuel space program: "When the range limit was set, Moghaddam chose the field of space flight, so that our path could still face forward and our connection to the

current scientific developments would not be cut."⁵² IRGC spokesman Ramazan Sharif commented that Moghaddam's last project "will without any doubt have a decisive place in our defensive power and the strengthening of deterrence."⁵³

The status of the program and whether it survived the death of its leader is difficult to assess using open sources. Iran's solid-fuel production, testing and launch facility at Shahroud was almost certainly built for the project. Recent geospatial analysis by Jeffrey Lewis, Dave Schmerler and the author show that the base is operational and has seen rapid expansion in recent years and months. However, the facility could have been repurposed for smaller solid-fuel missile development. Large test stands built to test ICBM-class solid motors have not yet been used.⁵⁴ Even if the program has been shut down, its technical legacy presents a challenge on its own. IRGC commander Jafari claims that the basic technological components needed for the project had been developed by the time of the explosion.⁵⁵

There is yet another data point indicating Iran's interest in longer-range systems. According to US intelligence assessments in 2013, the AIO and its liquid-fuel technology subsidiary the Shahid Hemmat Industrial Group began cooperation with the DPRK to develop an engine with 80 tons of thrust.^{56,57} It seems highly likely that the engine in question is the North Korean copy of the Soviet RD-250 which powers the country's Hwasong 15 ICBM.⁵⁸ Mehdi Farahi, who according to US intelligence assessments was critical to the development of the 80 ton booster and travelled to Pyongyang to negotiate the contract, mentioned in an interview in early 2013 that his organization was now planning a larger SLV called Sepehr to succeed the Simorgh.⁵⁹ While one cannot be sure of the connection to the 80 ton engine (the Sepehr could be technologically different altogether) the statement is nevertheless worrying.

Current Capabilities

Iran has developed a multitude of missile capabilities that seem confusing to outside observers. These Iranian missile capabilities can be grouped into eight categories.

Regular liquid fuel missiles (300km to 2000km):

- Shahab 1 (300km); Shahab 2 (500km); Qiam (800km); Shahab 3 (1300km); Ghadr (2000km)

Precision-guided shorter range solid fuel missiles (300km to 1000km):

- Fateh al-Mobin (200km); Hormoz (250km); Khalij-e Fars (300km); Fateh 313 (500km); Zolfaghar (700km); Hormoz 2 (700km); Dezful (1000km)

Precision guided liquid-fuel missiles (500km to 2000km):

- Guided Shahab 2 (500km); Guided Qiam (800km); Emad (1650km); Khorramshahr 2 (officially 2000km, probably substantially longer)

Cruise missiles (700km to 2000km):

- Ya Ali (700km); Soumar (700km); Houweyzieh (1300km)

Longer range solid-fuel missiles (2000 or 2500km):

- Sejil (2000km sometimes given as 2500km)

Missile equipped with super-heavy/multiple warheads (unknown):

- Khorramshahr (officially 2000km, probably substantially longer)

Scud-technology Satellite Launch Vehicles:

- Safir; Simorgh

ICBM-hedging efforts:

- Solid-fuel SLV project Ghaem (at least until 2011); Potential system based on 80-ton engine co-developed with the DPRK

The overview in the matrix shows the relative importance of these categories to the various roles Iranian missiles play:

- Deterrence value (when the system is fully developed)
- Precision-strike value (when the system is fully developed)
- Value as nuclear delivery system (when the system is fully developed)
- Symbolic value (current)

Iranian Missile Matrix: Taking a More Nuanced Look

	Deterrence Value	Precision-Strike Value	Symbolic/Political Value	Value as Nuclear Delivery System	Technical Progress	Numbers Fielded	Difficulty of Potential Verification	Threat to Region	Threat to West
Regular Liquid-fuel missiles	high	low	high	high	high	high	high	high	low
Precision-guided shorter-range solid fuel missiles	high	high	high	low	high	high	high	high	low
Precision guided liquid-fuel missiles	high	high	high	high	medium	medium	high	high	low
Cruise missiles	medium	high	medium	high	medium	low	medium	high	low
Longer range solid-fuel missiles	high	low	high	high	medium	low	low	high	low
Missiles equipped with super-heavy/multiple warheads	medium	medium	medium	high	low	low	low	high	medium
Scud-technology Satellite Launch Vehicles	none	low	high	low	medium	low	low	low	low
ICBM-hedging efforts	high	low	low	high	low	low	low	low	high

Further criteria relevant to any future negotiations on restraining the Iranian program have been added. These include:

- Technical progress (current)
- Numbers fielded (current)
- Difficulty of potential verification (current)⁶⁰
- Threat to region (assuming a point in time the system is fully developed)
- Threat to West (assuming a point in time the system is fully developed)

Options for negotiations on Iran's missile program

Any potential negotiation on Iran's missile program faces an obvious dilemma. On the one hand, an agreement that focuses on a future missile threat to Europe and the US seems possible to attain. The capabilities, while in development, so far play no major role in Iran's defensive doctrine, have not become a vital part of Iranian state propaganda and, most importantly, have still not resulted in an operational missile or dual-use SLV. This lack of technical maturity requires a substantial amount of further flight testing for any system to become operational, which in turn means that verification could rely on non-intrusive monitoring of test flights.

On the other hand, any agreement that aims to address the regional dimension of Iran's missile program faces formidable obstacles.

The capabilities relevant to regional security are either part of a centre-piece of Iranian national security doctrine (deterrence) or are of special importance to the Iranian leadership and significantly increase the country's military capabilities (precision guidance).

Furthermore, many of these capabilities are already fielded in large numbers, doubtlessly increasing the reluctance of Iranian

decision makers to either give them up or substantially reduce their numbers. Many of the missile types in question have already proved their reliability eliminating the need for substantial flight testing, although some further flight testing would be preferential for keeping up production standards and further enhancements. Thus any limitation would require some form of intrusive verification regime that would be a hard sell to the IRGC.

The unrealistic option

There is very little hope for negotiating any qualitative limitations on the following capabilities.

- Regular liquid-fuel missiles (300km - 2000km)
- Precision-guided short-range solid fuel missiles
- Precision guided liquid-fuel missiles

Regular liquid-fuel missiles and precision-guided short-range solid fuel missiles are at the heart of Iran's strategic outlook. Missiles related to both categories are both mass-produced and deployed in large numbers, have been tested extensively and have been used in combat. While precision guided liquid-fuel missiles certainly need further testing to technically mature, the high priority attached to precision-strike capabilities and the large military advantages Iran would get from retrofitting its older missiles at little cost make it unlikely for Iran to give up this capability.

Quantitative limitations (capping the number of missiles) might in theory seem more realistic to attain, but in practice they would face major verification challenges. It seems out of the question that either the Supreme Leader or the IRGC would accept regular inspections of deployed ballistic missiles at sites like Iran's underground 'missile cities'. Quantitatively limiting future production might seem a little less unrealistic considering the existence of less intrusive verification measures, such as those used for verifying missile production under START. Still the chances Iran would agree to such measures seem slim at best. Adding to these

doubts, one could ask whether a substantial degradation of Iran's deterrent and precision strike capability is actually in the West's interest. As Jenkins points out, Iran's current capabilities in this regard provide Iran's leaders with a sense of security that might actually decrease incentives to go nuclear.⁶¹

Unfortunately, negotiations that address the potential role of Iran's missiles as nuclear delivery systems also seems like a non-starter. The same longer-range liquid-fuel systems that would be the focus of any potential future nuclear warhead development effort also form the backbone of Iran's capability to retaliate against Israel. Thus, Iranian leaders are extremely unlikely to eliminate these systems any time soon. Even if they did, it is hard to imagine a viable verification system given missiles like the Shahab 3 and the Ghadr have been produced and deployed in large numbers. Ensuring that Iran is not retaining a small number of them as potential delivery systems seems like an impossible challenge.

The difficult option

Though standing low chances of success in the current situation, any attempt to address the regional dimension of Iran's missile programs would be advised to focus on the following capabilities.

- Longer range solid-fuel missiles
- Cruise missiles

From available evidence, it appears that both capabilities are still under development or at least have not resulted in mass production or a large number of deployed missiles. This not only means that Iran might be more willing to give them up but also that verification could rely on non-intrusive measures such as the monitoring of test flights. At the same time, the short reaction time of solid-fuel missiles which don't require lengthy fuelling prior to launch as well as the effectiveness of cruise missiles make them a particular concern to states in the region. It must be noted however, that the monitoring of cruise missile tests would pose much more of a challenge than ballistic missile test flights.

Potential demands related to these capabilities could take the following shape:

- Capping solid-fuel missile range at 1000km (current range of the Dezful)
- Capping cruise missile range at 700km (current range of the Ya Ali)
- Ceasing the development of KH-55 derivatives

In terms of longer-range solid-fuel missiles, Iran so far has only introduced the Sejil with a 2000km range. This missile was last flight tested in 2011 and has not been observed being operationally deployed, which makes it seem unlikely that the missile is actually being mass produced or fielded in significant numbers.⁶² At the same time, Iran's new solid-fuel missiles (the latest being the Dezful with a 1000km range) show that Iran has made significant technological advances in the field of solid-fuel technology. There is no doubt Iran would be capable of either reviving the Sejil program or developing a new solid-fuel missile of this range. However, even if it is not mass-produced or deployed in numbers, the Sejil still features prominently in Iranian propaganda and giving it up would result in substantial loss of face.

When it comes to cruise missiles, Iran has developed and tested three different models, a shorter-range indigenously developed cruise missile called Ya Ali (700km) and two types derived from Soviet KH-55 technology called Soumar (700km) and Howeyzyeh (1300km). Iran has admitted that it faced substantial development problems related to the Soumar and that the Howeyzyeh, introduced only in 2019, was an attempt to address these issues.⁶³ A single cruise missile fired by the Houthis and almost certainly provided by Iran, failed to hit its target in the UAE in 2017.⁶⁴

The feasible option

While, at least in the current situation, limits on the regional dimensions of Iran's missile program seem out of reach, there is a reasonable chance of success for limiting the following capabilities:

- ICBM hedging efforts;
- Missiles equipped with super-heavy/multiple warhead.

Such limitations should focus on the following elements:

- Turning the 2000km range limit into a formal treaty between Iran and the EU;
- Limiting Iran's space program to SLVs using Scud-type technology or other propulsion technologies of little military value for ICBM development (such as engines using liquid oxygen as oxidizer);
- Ending flight-testing of the Khorramshahr missile.

Additional features that would strengthen confidence in such a deal could include the following conditions:

- Freezing heavy SLV development at the current configuration of the Simorgh
- Adopting certain transparency measures included in the Hague Code of Conduct such as pre-launch notifications for ballistic missiles and SLVs

For several reasons it seems likely that Iran's leaders would be inclined to compromise on these capabilities. First, none of these capabilities are at this point crucial to the two main pillars of Iranian missile strategy, general deterrence and precision-strike. If deployed in a regional role, the Khorramshahr offers only a limited advantage over Iran's existing Ghadr missiles, while still being plagued by technical difficulties. In addition, ICBM hedging efforts have not resulted in a long-range missile or a dual-use SLV yet. As has been mentioned before, experts are doubtful that the Simorgh will be developed into a weapons system. However, with the SLV's current configuration not being technically capable of serving as an ICBM, freezing heavy SLV development could

help decrease international tension related to future space launches. Second, it can be argued that Iranian decision-makers already consider themselves adhering to an informal deal in which Iran does not test ballistic missile systems at a range beyond 2000km in exchange for Europe not applying major pressure on Iran's missile program. An official agreement could build on this perception and at the same time tackle the issues of circumvention and hedging under the guise of space activities.

On a symbolic and political level, agreeing to restrictions on ICBM hedging efforts would come at very low cost to Iranian decision-makers. After all, Iran's official line has always been that it is neither interested in missiles with ranges beyond 2000km nor currently developing such systems. While some information about longer range hedging efforts and new SLVs beyond the Simorgh has come out, these developments play next to no role in Iran's public discourse. Putting limits on the Khorramshahr might be a more difficult sell as the missile is slowly gaining importance in domestic public relations efforts.

Verifying Iran's adherence to the 2000km range limit poses few challenges. Western militaries and intelligence services are closely monitoring Iranian ballistic missile tests and space launches. Any flight test of a potential ICBM prototype or a dual-use SLV would immediately be detected. The objective nature of radar-data would also make it exceptionally hard for Iran to refute allegations of non-compliance. As an additional measure Iran could agree to issue pre-launch notifications, as included in the Hague Code of Contact, which could serve as basis to discuss potential allegations of non-compliance.

The Khorramshahr's lack of technical maturity, as shown by the large number of failed tests of both the Musudan and the Khorramshahr, means that further flight-testing is essential for turning the missile into an operational system. Even though a complete elimination of the Khorramshahr would be preferable from a European perspective, such a demand

would face enormous verification challenges and would lead to considerable loss of face for the Iranian side. Ending the missile's flight-testing would have a comparable effect at substantially reduced political and diplomatic cost. Nevertheless, it might make sense for European negotiators to insist on the Khorramshahr's elimination as an initial negotiating position.

With Iran's economy in decline, both negative and positive financial incentives in the form of potential further sanctions or sanctions relief seem like the most promising way to gain leverage in negotiations with Iran.

As an additional quid pro quo for Iranian concessions, Europe could offer to launch domestically developed Iranian satellites. Currently, even Iran's heaviest SLV, the Simorgh is still not powerful enough to launch many types of commercial satellites, such as geostationary communication satellites. Therefore, European launch assistance would not only be in line with the Rouhani's government's focus on making Iran's space program more economically viable but would also decrease incentives for the development of more powerful domestic launchers. Unlike the country's SLVs, Iranian satellites themselves are developed by institutions under civilian control, such as the Space Research Agency subordinated to the Ministry of Information and Communications Technology as well as various Iranian Universities. Cooperation in this field could therefore avoid direct interaction with Iran's military.

Iran's lack of willingness to talk about missiles might seem like a formidable obstacle to an agreement. IRGC leaders have been adamant that there will be no negotiations on Iran's missile program. Former defense minister and current adviser to the Supreme Leader Hossein Dehghan stated that "Our missile capability is not up for negotiation, because this issue is a question of to be or

not to be."⁶⁵ Only recently, IRGC commander Hajizadeh sent a clear warning to Rouhani stating "The missile key is not in the hands of the government."⁶⁶ The narrative advanced by both the IRGC and Khamenei describes attempts to negotiate missiles as yet another Western pretext for weakening Iran with the eventual long-term goal of overthrowing the regime. While one cannot be entirely sure whether these statements are honest or simply a way of playing hardball, their consistency implies that resistance to missile negotiations is substantial.

Nevertheless, there is reason for optimism that an agreement addressing capabilities beyond 2000km could be reached. When talking about potential negotiations, Iranian officials operate under the assumption that such a deal would mean a substantial reduction of Iran's current deterrence capabilities, something which, as shown above, is unlikely to be accepted by Iran. A more narrow deal focusing on range restriction would likely be treated differently. Here, framing is important, especially in the light of Iran's increasingly polarized and toxic factional politics. 'Missile negotiations' and even the word 'negotiations' itself have become loaded terms in internal Iranian political discourse. Any actor advocating 'missile negotiations' would almost certainly face a massive and coordinated political attack by hardline factions. Suggesting an effort that is framed as a discussion of Iran's space program and potential ways to codify the Supreme Leader's 2000km limit would carry much less political risk for Iranian decision-makers, even if in the end it includes restraints on certain missile-related activities. In fact, it would be tricky to criticise an effort that aims at turning an order of the Supreme Leader into an international agreement.

Of course, even an agreement as limited in its goals as the one described above requires a certain amount of trust and a solid working relationship between Iranians and Europeans.

Whether these prerequisites can be upheld in the face of Europe's sluggish reply to America's JCPOA violation, the hardening of European attitudes towards Iran and the emboldenment of hardliners in Tehran remains to be seen.

Conclusion

In conclusion, it seems most prudent for Europeans to focus on addressing Iran's latent capabilities beyond the 2000km range limit, i.e. limiting the space program to certain propulsion technologies, formalizing the 2000km range limit and halting the Khorramshahr development. Such an agreement would not only stand a realistic chance of success, but also prevent Iran from posing a direct military threat to all EU countries, something that could happen very quickly.⁶⁷ The benefits of such an agreement go beyond narrow European self-interest, as any Iranian effort to openly move towards an ICBM capability would have serious destabilizing consequences on a global level.

Beyond immediate gains, such an agreement would also perform a dual function. It would build trust and could serve as a basis for future negotiations on the regional dimensions of Iran's missile program. With a more pragmatic US administration in place, more ambitious goals such as curtailing the development of 2000km solid-fuel missiles and cruise missiles might be attainable. At the same time, it would also serve as an insurance policy in case Iran's relationship with the US deteriorates to a crisis level.

There is no need to gloss over the fact that for the European side such an agreement would look deeply unsatisfactory on many levels. It would not address most local security concerns, would come at a political cost to relations with partners and allies and would not tackle Iran's possession of potential nuclear delivery systems. But that might be a price worth paying to prevent worse developments. As with many agreements focusing on potential future threats instead of existing current ones, it is a deal that no one is keen on making today and that everyone wishes they had made in ten years from now.

North Korea's recent history should serve as a warning. In 2009, North Korea launched the Unha, a large SLV relying on the very same technology as the Simorgh and conducted several provocative short-range missile tests. While North Korea was boasting about its achievements and the international community was busy condemning the launches, North Korean engineers were already secretly working on much more advanced capabilities. The short window of opportunity that could have been used to address these latent capabilities and negotiate a freeze of North Korean long-range missile development was lost. Eight years later, as relations with the US entered free fall, the country, seemingly out of nowhere, successfully tested two advanced new types of ICBMs. The global community was left with the worst of both worlds, a North Korea that possesses both short-range missiles and clumsy SLVs as well as ICBMs. As relations between Iran and the US continue to deteriorate and Iranian hardliners are emboldened by the US withdrawal from the JCPOA, we should not repeat the same mistake.

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