Iran's Ballistic Missile and Space Launch Programs

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December 6, 2012

Congressional Research Service
7-5700
www.crs.gov
R42849

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

Iran has long been a source of concern for the United States and other countries because its goals are at odds with core U.S. objectives in the Middle East. Although it is not certain that Iran has made the decision to develop a nuclear weapon, it is taking steps to drastically reduce the time needed to obtain nuclear weapons should a decision be made to do so. It is the prospect of an Iranian nuclear weapon mated to an effective missile delivery capability that is especially worrisome to most.

Congress has long been interested in these matters. Congress has held numerous hearings on Iran, passed various resolutions regarding Iran and approved a range of sanctions against Iran over the past several decades.

According to the U.S. government, Iran has the largest number of ballistic missiles in the Middle East; it is developing missiles and space launch vehicles for multiple purposes. Iran is pursuing its missile and space programs with development and testing facilities that are scattered throughout the country. Assessing Iran's ballistic missile programs is challenging for many reasons, including the lack of specificity in official public sources, the secretive nature of Iran's regime and the regime's frequent exaggerations of its ballistic missile capabilities, and the overwhelming amount of and often conflicting information found in non-official sources.

The vast majority of Iran's heavy artillery rockets and ballistic missiles are short-range of less than about 500 kilometers. Most of Iran's ballistic missiles in fact are Scud-B and Scud-Cs, with a majority likely being Scud Cs, which are 500 km range capable. Iran views its short-range ballistic missiles (SRBM) capability as necessary for battlefield and tactical military purposes. These missiles could not strike U.S. or allied bases in the region unless they were moved far from their operating base and launched from vulnerable positions along Iran's Persian Gulf coastline. This is not likely because of logistical and operational security reasons. Although these SRBMs are not very accurate, they could be fired against economic or civilian targets. Also, any such missile attacks against U.S. bases, while not militarily decisive, could disrupt or complicate (but not halt) base operations.

Iran has grown increasingly self-sufficient in the production of SRBMs, but it still probably relies on others for some key components. Gaining access to these kinds of critical components and materials has grown increasingly difficult for Iran. Stricter international enforcement of export controls and broadening sanctions have reportedly slowed down Iran's efforts and forced Iran to find less reliable alternative sources of rocket and missile technology.

Iran is developing and producing medium-range ballistic missile (MRBM) capabilities with ranges estimated up to about 2,000 kilometers (with some non-U.S. government sources citing slightly higher ranges), sufficient to strike targets throughout the Middle East. U.S. intelligence assessments state such missiles are inherently capable of carrying a nuclear warhead. Although the number of Iran's MRBMs is thought to be relatively small by official U.S. estimates, it is expected to continue to build more capable MRBMs. Iran views these missiles as an important deterrent and retaliatory force against U.S. and other forces in the region in the event of war. Iran has also constructed an underground network of bunkers and underground silo-like missile launch facilities, and is seeking improved air defenses presumably to enhance the survivability of their MRBMs against preemptive attack.

Currently Iran must rely on others for certain key missile components and materials in its MRBM program. Export controls and sanctions have made it increasingly difficult, but certainly not impossible, for Iran to acquire the best of such items. On the other hand, these export control measures and sanctions have forced Iran to try to exploit weaknesses in existing export and nonproliferation regimes, including by trying to find foreign sellers willing to circumvent those laws.

Iran also has a genuine and ambitious space launch program, which seeks to enhance Iran's national pride, and perhaps more importantly, its international reputation as a growing advanced industrial power. Iran also sees itself as a potential leader in the Middle East offering space launch and satellite services. Iran has stated it plans to use future launchers for placing intelligence gathering satellites into orbit, although such a capability is a decade or so in the future. Many believe Iran's space launch program could mask the development of an intercontinental ballistic missile (ICBM) – with ranges in excess of 5,500 km that could threaten targets throughout Europe, and even the United States if Iran achieved an ICBM capability of at least 10,000 km. ICBMs share many similar technologies and processes inherent in a space launch program, but it seems clear that Iran has a dedicated space launch effort and it is not simply a cover for ICBM development. Since 1999, the U.S. Intelligence Community (IC) has assessed that Iran could test an ICBM by 2015 with sufficient foreign assistance, especially from a country such as China or Russia (whose support has reportedly diminished over the past decade). It is increasingly uncertain whether Iran will be able to achieve an ICBM capability by 2015 for several reasons: Iran does not appear to be receiving the degree of foreign support many believe would be necessary, Iran has found it increasingly difficult to acquire certain critical components and materials because of sanctions, and Iran has not demonstrated the kind of flight test program many view as necessary to produce an ICBM.

This report will be updated regularly.

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Congressional Interest

Why does Iranian acquisition of ballistic missiles[1] or Iran's pursuit of a space launch capability matter, especially to the Congress? For decades, most in Congress have viewed Iran with concern because of its nuclear program and its support of anti-U.S. and anti-Israel militant movements in the region. Congress has held numerous hearings on Iran, passed various resolutions regarding Iran and approved a range of sanctions against Iran over the past several decades. Congress has established a broad number of reporting requirements of the Executive Branch that encompass the range of its concerns regarding Iranian WMD and ballistic missile programs. These reporting requirements are detailed in **Appendix B**, "Reporting Requirements Relevant to Iranian Ballistic Missile Programs." Congress has also supported funding BMD programs aimed at countering ballistic missiles especially those from Iran,[2] including cooperative programs with friendly and allied nations such as Israel. Iran's current and prospective capabilities challenge U.S. national security interests in many ways and are raised briefly below.

In response to the Iranian ballistic missile and space program, Congress is considering the deployment of an ballistic missile defense site on the East coast to defend against possible Iranian ICBMs. The House included a provision in the FY2013 defense authorization bill (H.R. 4310) providing $103 million to begin developing a plan and a supporting environmental impact statement to establish by the end of 2015 such a missile defense site on the East Coast to defend against a possible Iranian ICBM attack. That plan would evaluate the effectiveness, from an East Coast site, of various long-range BMD interceptor missiles.[3] The Senate version of the authorization bill does not include such a provision. The House FY2013 defense appropriations bill (H.R. 5856) did not include any such provision. Neither did the Senate defense appropriations bill.

Iran: A Source Global Political Concern

Iran is often a topic of discussion and a source of concern for many policymakers and experts in the national and international security community: "much of the debate over U.S. policy toward Iran has centered on the nature of the current regime; some believe that Iran … is a threat to U.S.

[1] After an initial powered phase of flight, a ballistic missile leaves the atmosphere and follows an unpowered trajectory or flight path before reentering the atmosphere toward a predetermined target. Ballistic missile ranges can vary from a hundred or so kilometers to more than 10,000 kilometers. The flight path may not be optimal if the trajectory is depressed or lofted relative to the optimal range trajectory. Differences in trajectories also depend on the type of missile (i.e., solid or liquid-fuel) and other factors. A space launch generally differs from a ballistic missile in that the launcher will fly a steeper trajectory and the burn time will be longer to get the satellite into orbit. At about 750 km from the launch site, these differences start to become apparent, thus allowing an assessment to be made about the purpose of a long-range ballistic missile test. There are also other factors that would allow determination of whether a launch is aimed at placing a satellite into orbit or delivering a warhead. Perhaps the quickest is to determine the direction of the launch vehicle. In Iran's case, a satellite launch would be in a south easterly direction to avoid overflight of other countries and to take advantage of the rotation of the earth.

[2] The Pentagon and the Missile Defense Agency (MDA) have long argued the value of BMD to provide for extended deterrence, devalue missile proliferation, dissuade ballistic missile investment, and enable international cooperation for regional defense.

[3] These would include the three-stage weapon currently deployed at the existing GMD (Ground-based Midcourse Defense) sites in Alaska and California, a two-stage version of the GMD missile first envisioned for deployment in Poland during the Bush Administration, and several versions of the Navy's SM-3 (Standard Missile-3).

interests because hardliners in Iran's regime dominate and set a policy direction intended to challenge U.S. influence and allies in the region."[4] In his 2002 State of the Union address, President George W. Bush labeled Iran as part of the "Axis of Evil" along with Iraq and North Korea. More recently, the Obama Administration expressed its view of Iran as "a major threat to U.S. national security interests, a perception generated not only by Iran's nuclear programs but also by its military assistance to armed groups in Iraq and Afghanistan, to Hamas and other Palestinian militant groups, and to Lebanese Hezbollah."[5] To varying degrees these views are shared by many across the political spectrum and around the world. Yet there are considerable differences as to how to respond to Iran.

U.S. decision makers largely agree that Iran represents a threat to U.S. regional security interests. The 2010 National Security Strategy states that "for decades, the Islamic Republic of Iran has endangered the security of the region and the United States and failed to live up to its international responsibilities."[6] The United States "has long seen a threat to U.S. interests posed by Iran's support for militant groups" throughout the Middle East, Iran's support of the Syrian regime against growing popular opposition, and especially Iran's nuclear program, which "has emerged as a top priority for the Obama Administration."[7] Thus, Iran has been subject to a wide range of U.S. and international sanctions.

When coupled with its nuclear program, Iran's ballistic missile programs are a focus of major concern for a number of countries around the world. While discussing the implications of a February 2, 2009 Iranian satellite launch and addressing growing concerns over the threat posed by Iran, a Pentagon spokesman said such concerns affect Russia, Israel, the Middle East, Europe and beyond:

> We have long recognized that the threat—that they pose a real threat, and it is a growing threat, and that they are determined to develop long-range ballistic missiles. And I think all of Europe has recognized that to be the case, and that is why they unanimously embraced a third site for missile defense in Europe. And the Russians have recognized it, telling the secretary that they view Iran to be a threat as well. Clearly everybody in the Middle East recognizes it. The Israelis in particular but also the Gulf States are very concerned about Iran's actions in this realm. So this development today is cause for concern, not just here in the United States but in Europe, throughout the Middle East and, I believe, the greater world.[8]

Similarly, Russian Deputy Foreign Minister, Aleksandr Losyukov, was quoted by news agencies after a failed Iranian space launch attempt in 2008 saying the test "adds to general suspicions of Iran regarding its potential desire to build nuclear weapons" and he noted that long-range missiles "are one of the components of such weapons. That causes concern."[9]

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[4] CRS Report RL32048, *Iran: U.S. Concerns and Policy Responses*, by Kenneth Katzman.

[5] Ibid. Generally speaking, one of Iran's primary objectives is to compel the United States and other outside powers to vacate the Gulf so that Tehran can exercise greater hegemony. Iran maintains the Gulf States, if left alone, could live in peace and security. The United States and many others disagree with this.

[6] The White House, *National Security Strategy*, Washington, DC, May 2010, p. 26.

[7] CRS Report RL32048, *Iran: U.S. Concerns and Policy Responses*, by Kenneth Katzman.

[8] Department of Defense, DOD News Briefing with Press Secretary Geoff Morrell from the Pentagon, February 3, 2009, http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4347.

[9] "Iran: Russia Says New Rocket Raises Nuclear 'Suspicions,'" *Associated Press*, February 7, 2008.

Iran: A Source of Military Concern

More specifically, Iran's ballistic missiles challenge U.S. military capabilities and U.S. influence in the Middle East. According to the U.S. Intelligence Community (IC), "Iran already has the largest inventory of ballistic missiles in the Middle East, and it is expanding the scale, reach, and sophistication of its ballistic missile forces, many of which are inherently capable of carrying a nuclear payload."[10] According to the Pentagon, ballistic missiles in countries such as Iran threaten "U.S. forces, allies, and partners in regions where the United States deploys forces and maintains security relationships."[11]

Because of the size and capabilities of Iran's ballistic missile force, some argue that in the event of a crisis or conflict the United States might be deterred from engaging Iran militarily or that the possibility of ballistic missile attacks might preclude certain U.S. force options. In fact, the U.S. IC believes that Iran views its missile forces "as an integral part of its strategy to deter—and if necessary retaliate against—forces in the region, including U.S. forces. Its ballistic missiles are inherently capable of delivering WMD, and, if so armed, would fit into this strategy."[12]

In addition, some observers have argued that because many of Iran's neighbors lack their own deterrent capabilities or effective ballistic missile defenses Iran could "blackmail such states into meeting demands, for example, to raise oil prices, cut oil production or even withhold cooperation with the U.S. on which their very survival depends."[13] In the event of a conflict, one expert wrote, "U.S. military action would be to forestall Iranian interference with Gulf oil exports, this would have to be near total in its effect on Iranian capabilities. This would be difficult if not impossible to achieve, leading to a fear of attack which alone would have a formidable impact on oil prices."[14] Iran thus is viewed as a challenge to U.S. national security interests in the region, even with superior U.S. conventional military power. A major trend in U.S. military sales to the Persian Gulf states today is for anti-missile systems intended precisely to address this threat.[15]

Congress has long been concerned over the proliferation of WMD and their delivery systems, especially ballistic missiles. Over the past few decades, Iran has progressed from relying entirely on the outright purchase of ballistic missile systems to becoming nearly self-sufficient in important ways. Many now see Iran as a potential supplier to other nations or actors. This point is elaborated upon elsewhere in this report. Finally, some Members are concerned that an Iran armed with a nuclear ballistic missile, by the nature of the regime itself and the prospect of even wider proliferation that may follow, will result in a deterrence dynamic that is less stable and less

[10] James. R. Clapper, *Unclassified Statement for the Record on the Worldwide Threat Assessment of the U.S. Intelligence Community for the Senate Select Committee on Intelligence*, Director of National Intelligence, Washington, DC, January 31, 2012, p. 6.

[11] Pentagon, *Ballistic Missile Defense Review Report*, Washington, DC, 2010, p. 5.

[12] See footnote 11.

[13] See, for instance, Nick Braveman, "Iranian Nukes are not Heading Toward Tel Aviv," *Military Technology*, vol. 36, no. 2 (February 2012), p. 5.

[14] Paul Rogers, *Iran: Consequences of a War*, Oxford Research Group, Briefing Paper, Oxford, England, February 2006, p. 10.

[15] CRS Report R42678, *Conventional Arms Transfers to Developing Nations, 2004-2011*, by Richard F. Grimmett and Paul K. Kerr, p. 14.

reliable compared to the one that existed between the United States and the Soviet Union during the Cold War.

Finally, Iran's ballistic missile and space launch programs are major drivers of the U.S. BMD program. In addition to an extensive number of short-range ballistic missiles (SRBMs) and a smaller number of medium-range ballistic missiles (MRBMs) in Iran, the United States remains concerned about the possibility of an intercontinental range ballistic missile (ICBM) program in Iran. Since 1999, the IC has assessed that Iran could test an ICBM capable of striking parts of the United States by 2015 with sufficient foreign assistance.[16] Interestingly, however, LTG Burgess, Director, Defense Intelligence Agency (DIA) testified in 2010 that DIA "assesses that, with sufficient foreign assistance, Iran could develop and test an intercontinental ballistic missile (ICBM) capable of reaching the United States,"[17] but he did not include any particular date by which this might be accomplished. More recently, however, the 2012 DOD *Annual Report on Military Power of Iran* stated "Iran may be technically capable of flight-testing an intercontinental ballistic missile by 2015."[18] The report added that "beyond steady growth in its missile and rocket inventories, Iran has boosted the lethality and effectiveness of existing systems by improving accuracy and developing new submunition payloads,"[19] repeating what the same report said in 2010.

Potential Iranian missile threats to U.S. allies and friends in Europe and to the United States itself in the future are the basis for the Pentagon's plan to deploy increasingly capable phases of BMD, called the European Phased Adaptive Approach (EPAA), over the next decade in Europe and perhaps in the Persian Gulf as well.[20] At the May 2012 NATO Summit in Chicago, the Alliance declared an interim territorial missile defense capability based on U.S. ballistic missile defense (BMD) assets placed under NATO (North Atlantic Treaty Organization) command and control to guard against possible missile attacks from Iran and other potential adversaries.[21] The EPAA, which seeks to develop and deploy increasingly capable BMD over four phases through 2020, would serve as the cornerstone of this new NATO capability. Phase 1 of the U.S. EPAA was completed in December 2011 as scheduled. Phase 2 is expected to be completed by 2015, although Defense Secretary Panetta has stated that the future of the EPAA could be called into question by the application of automatic defense spending limitations under the Budget Control Act of 2012. The U.S. EPAA will be integrated with other BMD systems already being developed, augmented and deployed by NATO individual member states under NATO command and control architecture.[22]

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[16] National Intelligence Council, *Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015*, Washington, DC, September 1999. The most recent public update is National Intelligence Council, *Foreign Missile Development and the Ballistic Missile Threat Through 2015*, Washington, DC, December 2001.

[17] "Iran's Military Power," Lieutenant General Ronald L. Burgess, Jr., United States Army, Director, Defense Intelligence Agency, Statement before the Committee on Armed Services, U.S. Senate, April 14, 2010.

[18] Annual Report on Military Power of Iran, Department of Defense, April 2012, p. 4.

[19] Annual Report on Military Power of Iran, Department of Defense, April 2012, p. 1.

[20] See CRS Report RL34051, *Long-Range Ballistic Missile Defense in Europe*, by Steven A. Hildreth and Carl Ek. CRS Report R42529, *NATO's Chicago Summit*, by Paul Belkin. Also, LTG Patrick J. O'Reilly, USA, *BMD Overview—Phased Adaptive Approach*, Missile Defense Agency, 11-MDA-6321, Washington, DC, August 15, 2011, http://www.mda.mil/global/documents/pdf/bmds_briefing12.pdf.

[21] Previously, at the November 2010 Lisbon Summit, NATO formally agreed to implement a territorial BMD capability designed to cover all Member states in Europe, as well as the United States and Canada.

[22] CRS Report R42529, *NATO's Chicago Summit*, by Paul Belkin.

Further, some analysts, including the 1998 Rumsfeld Commission on the evolving missile threat to the United States and its allies, suggest that countries could threaten U.S. territory by pursuing unconventional deployment modes.[23] Among these, it is argued, is to deploy shorter range missiles on surface ships. These analysts argue that such ships could be brought close to coastal areas of the United States, thus giving the shorter range missiles the ability to strike targets in the United States. Others discount the ease with which this could be accomplished.

Context

This report is limited to analyzing Iran's efforts to develop, test and field ballistic missiles and to develop a space launch capability. Iran has pursued these efforts with the assistance of other countries and entities operating in those countries with and without direct or indirect official government sanction. Assessing Iran's progress and capabilities in this area are challenging given the general difficulty in evaluating ballistic missile capabilities and projections in general, especially from the vagueness of official assessments and the numerous, but specific and conflicting analyses by experts and others in the public domain. Although Iran is transparent in many ways, it remains secretive and attempts to obfuscate intent and capabilities in others. The latter tendency frequently extends to matters related to advancing its military technologies. All these things contribute significantly to the difficulty inherent in such a report as this. These issues are addressed below.

Scope

In and of itself, the acquisition of ballistic missiles is not necessarily problematic to U.S. interests. Indeed, many U.S. friends and allies have such missiles and pursue missile modernization programs. But when a ballistic missile program is pursued by a state hostile to the national security interests of the United States and its friends and allies, such an effort becomes a source of concern. Such concerns are amplified considerably when that state might develop a weapon of mass destruction (WMD), particularly a nuclear weapon that could be carried by that ballistic missile force. In Iran's case, no major intelligence community has concluded that Iran has made the decision to develop a nuclear weapon. But Iran has taken steps in its civilian nuclear program that raise serious questions about future intent to develop or break out of its nonproliferation commitments and obtain nuclear weapons on short notice.

An effective nuclear weapons capability has three major elements, each of which presents its own unique technical and other challenges. Additionally, each of these elements must work together as part of an operational system. All this is required to make the case that a specific ballistic missile threat is grave and imminent.

First is the production of fissile or nuclear material in sufficient quantity and quality as the source of a nuclear device.[24] The second element concerns the design, weaponization, miniaturization, and survivability of the warhead and its physics package capable of being delivered to its

[23] Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States, July 15, 1998, pp. 21-22.

[24] For an assessment of Iran's nuclear program see CRS Report RL34544, *Iran's Nuclear Program: Status*, by Paul K. Kerr.

intended target, especially at long-range.[25] The third element is providing an effective means for delivery, such as a ballistic missile or, as some believe, a capability that could grow out of a space launch program.

This report focuses solely on Iran's ballistic missile and space programs. It is important to note that this report does *not* assess Iran's capabilities in the other two critical areas. Without a reliable, survivable nuclear warhead the proliferation of Iranian ballistic missiles is arguably not an imminent significant threat.

Finally, there are literally many thousands of articles, news accounts and other sources regarding Iran's ballistic missile and space programs. It is not possible to sort through the tremendously varied and often different accounts of events or capabilities. This report does not rely on those items or try to adjudicate any differences in them. As much as possible, this report instead emphasizes U.S. Government and other official sources. It is noted, however, that official sources are frustrating to rely on as they frequently do not provide much specificity. On the other hand, some of the best non-government open sources provide much more specificity yet those same sources can vary considerably from one to another on the very same elements of Iran's ballistic missile and space launch programs. There are, however, perhaps a dozen or so excellent analysts who write and publish on Iran's programs, but who may differ on their various facets. This report attempts to make clear where some of those key differences exist.

The Technological Challenge of Ballistic Missiles

This section very briefly touches on some of the challenges inherent in rocket science and missile engineering regarding the development, testing and production of ballistic missiles.

As enormously capable as the United States is regarding the development and acquisition of ballistic missiles, it too experiences challenges and even failures on occasion. For instance, several years ago when the Pentagon sought to develop the first variant of the Ground-based Interceptor for long-range BMD, it experienced significant technical problems in developing a new solid rocket motor. Eventually, the Pentagon chose to go forward with an interceptor based on existing launch vehicles (Minotaur and Pegasus). Other modern states with advanced missile and space launch programs will also run into problems while developing new missile systems despite their long-standing expertise and an extensive industrial base that is unencumbered with external trade constraints, such as sanctions or export controls. In contrast, Iran's expertise and industrial base is significantly challenged in this regard on a number of fronts and cannot be viewed as comparable to that of the United States or of the other major nuclear powers. Nevertheless, Iran has demonstrated persistence over decades in continuing to develop and improve its indigenous capabilities in spite of widespread international opposition and cooperation against Iran's ballistic missile programs. A significant advantage that Iran has had is that the basic technology of rocket science is established and reasonably well known around the world.

[25] Gen. Eugene Habiger, former Commander US Strategic Command, has said that "the miniaturization of a nuclear warhead is probably the most significant challenge any proliferant would have to face." See General Eugene Habiger – Carnegie Endowment for International Peace, September 20, 2004. Problems and Prospects of New Alaska Missile Interceptor Site. http://carnegieendowment.org/files/Habiger.pdf. See also Joe Cirincione and Elise Connor, How Iran Can Build a Bomb, Ploughshares Fund, July 2, 2010, http://www.ploughshares.org/blog/2010-07-02/how-iran-can-build-bomb.

Another comparative marker is to contrast the number of missile flight tests between modern missile countries such as the United States and Russia on one hand and Iran on the other. By the end of their development efforts, the United States had conducted perhaps a couple dozen or more flight tests of the Trident II submarine-launched ballistic missile and somewhat less than that number for the MX ICBM. The Soviet Union/Russian flight test record for their ICBMs (SS-24, SS-25, and SS-26) was comparable. Moreover these flight tests took advantage of decades of flight testing of older systems dating to the 1950s. This record entailed scores of space launch flight tests and over a hundred each of the earliest ICBMs (Atlas and Minuteman I) prior to their deployments. In contrast, Iran has conducted very few flight tests of its modern missiles. This has major implications for how much confidence Iranian decision makers and military leaders would have in the reliability and expected performance of their ballistic missile force to achieve its intended missions.

Iran may also have difficulties in developing rocket motors for various reasons some of which might include the effect of sanctions and export control regimes. The U.S. IC has touched on this on many occasions. Although many principles of rocket science are much better known and more widely shared today, missile engineering remains a challenging skill acquired only through direct experience—it cannot simply be studied and applied without much trial and error. For instance, there is tremendous complexity in finding the right formulation of solid propellants for a specific missile system. Although the underlying rocket science has been reasonably well understood and publicly available for decades the predictability of how a solid rocket motor will perform depends on very subtle factors. This means that even after a propellant is formulated, the manufacturing of solid rocket motors still requires extreme reliability controls.[26]

Additional factors necessary for developing an effective ballistic missile include a guidance system that directs the missile and its payload to its intended target. This requires testing of missiles and their reentry vehicles, which produces data from which mathematical models can be developed, further tested and fine-tuned. From the time a ballistic missile lies dormant in its silo or launch vehicle to its actual launch, various errors can begin to accumulate. A systematic and rigorous testing regimen of all the component parts can help reduce as much as possible such structural or inherent errors even in proven systems, but such errors cannot be eliminated entirely. Operational tests of the system are generally necessary to know whether the entire system will work as intended, and the degree to which further testing may be required to ensure such missiles will launch successfully and operate as planned.

Management and Organization

Many experts would argue that strong management and organization are considered critical to a good ballistic missile program. Iran is generally assessed to have such an organizational and managerial program, although it too cannot be compared to similar programs in the major nuclear weapons states—the United States, Russia, China, the UK and France. Michael Elleman, for

[26] The Annex Handbook of the Missile Technology Control Regime (MTCR) contains among other things considerable information about solid rocket propellants and their complexity. Additionally, a classic textbook for aerospace engineers similarly demonstrates the complexity associated with formulating and implementing a propellant for a given rocket motor. See George P. Sutton and Donald M. Ross, "Solid Propellant Rocket Fundamentals," in *Rocket Propulsion Elements: An Introduction to the Engineering of Rockets*, 5th ed. (New York, NY: John Wiley & Sons, Inc., 1986).

instance, among others, has said "Iran's record in the area of overall systems management and engineering involving a range of technologies and industries is impressive."[27] He has further said

> their approach to missile development and modification is disciplined and well structured. This is unique in the proliferation world. They are not up to Western standards, but they are far more sophisticated than the DPRK, Iraq or even Pakistan. This capability empowers Iran to develop and produce whatever missile range it decides the country needs. It may take a decade or more, and they will still rely on foreign sources for some key items, but there appears to be little the West can do to stop (as opposed to impede) progress.[28]

Aaron Karp, one of the first experts to write about this, said

> There is much more to any major R&D project than just assembling metal and plastic. Easily overlooked are the necessary skills, experience and judgment required of engineers and programme managers. Also, behind every missile programme are conceptual, organizational, financial, and command and control factors, each imposing its own problems for ballistic missile development.[29]

Karp also said that, although countries may receive considerable amounts of foreign assistance in their missile programs, "would-be rocket makers are almost entirely on their own" in the area of program management: "foreign companies and governments can offer advice and their own example, but little else."

For instance, both appropriate organization and managerial choices have proven critical to successful ballistic missile programs when governments are choosing their development strategies. An incremental development strategy, which Iran appears to have pursued, in which a missile program moves in sequence through progressively larger designs, improving the performance of major components, and gradually introducing new ones is the most effective according to Karp. He cites the experience of the French as the best example of this. By contrast, states that have begun their missile programs by taking huge leaps tend to face greater difficulties. For instance, the UK began by developing an IRBM using this approach and that program eventually collapsed. Similarly, India began its space launch program in the early 1970s enduring many false starts and serious delays.

Missile Proliferation: Challenges with Estimates and Projections

Assessing ballistic missile proliferation capabilities in general has proven to be challenging. Further, projecting those capabilities over some near- or long-term future has proven unreliable. As a result, efforts to time responsive measures precisely according to program advancements in select countries are likely to fail by projecting such advancements coming later or earlier than will turn out to be the case. In the first instance, the United States was surprised by the advancement of the Soviet Union's space rocket capability, and by implication its ballistic missile program, with the launch of the Sputnik satellite. At the other end of the spectrum, in 1990 the U.S. IC projection for MRBMs and ICBMs by 2000 did not transpire:

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[27] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 100.

[28] E-mail correspondence with author, September 12, 2012.

[29] Aaron Karp was one of the first to write of this in *Ballistic Missile Proliferation: The Politics and Technics* (London: SIPRI/Oxford University Press, 1996), pp. 51-98.

> Most missiles likely to be fielded in the Third World over the next 5 years will have ranges of less than 1,000 kilometers, but by the year 2000 at least six countries probably will have missiles with range of up to 3,000 kilometers. At least three of them may develop missiles with ranges of up to 5,500 kilometers.[30]

Instead, intelligence assessments in 2000 showed that no country in the developing world had acquired such capabilities.[31] And the 1990 forecast has not been borne out through today.

For a variety of reasons, projections of ballistic missile trends in countries over time may not materialize as expected, instead slowing significantly, apparently halting, or even reversing from earlier assessments.[32] In some cases, missile proliferation estimates might show significant projected increases from year to year only later to show that same effort apparently halting entirely.[33]

In particular, few countries have successfully developed and deployed operational, nuclear-armed ICBMs. The developmental record of those who were successful indicates how challenging that effort was.[34] The fact that more nations have not achieved this capability is perhaps witness in part to the extraordinary technical effort it took. The long history of acquiring ICBM capability

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[30] U.S. Congress, Senate Committee on Armed Services, *Threat Assessment; Military Strategy; and Operational Requirements*, 101st Cong., 2nd sess., December 12, 1989; January 23-26, 30; February 2, 6-8, 21-22; March 7, 1990, S.Hrg. 101-780 (Washington: GPO, 1990), Statement of Hon. William H. Webster, Dir., Central Intelligence, p. 61.

[31] *Ballistic and Cruise Missile Threat*, National Air Intelligence Center, Wright-Patterson Air Force Base, Ohio, September 2000. The 2000 report identified several countries that were developing medium-range ballistic missiles but none were of that range and none had been deployed. These included North Korea (1,300-2,000 km.), India (2,000-3,200 km.), Pakistan (1,300-1,900 km.), and Iran (1,300-2,400 km.). Two other countries, generally not considered Third World, had some number of medium-range ballistic missiles with max ranges of 2,400 km (Saudi Arabia, which received some number of Chinese CSS-2 missiles) and 2,800 km. (China). North Korea's Taepo-Dong 2, estimated by some with a max range of more than 5,470 km was the one Third World country considered developing a long-range ballistic missile at the time.

[32] For instance, in 2002, the Department of Defense assessed that China would deploy the DF-31 by mid-decade. This did not occur, although DOD assessed the DF-31 in 2007 as having an "initial threat availability" and assessed that less than 10 were deployed in 2008; that number has not changed. DOD also assessed in 2002 that the follow-on extended ICBM version of the DF-31 (DF-31A) would be deployed by mid-to-late decade, which occurred in 2008. In 2003, DOD correctly assessed that China could have up to 60 ICBMs by the end of the decade. Similarly, the Chinese SLBM program shows such problems. Since 2000, NASIC has assessed that China may be developing a medium-range submarine-launched ballistic missile, but NASIC never considered it actually deployed. In contrast, the Department of Defense reported that China had one XIA class submarine for those missiles (referred to variously as the JL-1 or CSS-NX-3) as early as 2001. In 2002, DOD reassessed that China would deploy the JL-1 before the end of the year and moved its estimated date for deployment into 2003 the following year. DOD then stated from 2005-2007 that the XIA had deployed SLBMs, but then in 2008 and 2009 questioned whether the submarine was operational. In its latest report (2010), DOD questioned whether either the submarine or its associated ballistic missiles were operational. In 2002, the Department of Defense assessed that China would deploy the follow-on SLBM version of the DF-31 (JL-2 SLBM) by mid-to-late decade, which DOD indicated occurred in 2008-2009. But, in 2010, DOD assessed the JL-2 SLBM as still developmental. A flight test failure of the JL-2 SLBM in summer 2004 reportedly delayed its initial deployment[32] and the 2010 DOD report said the JL-2 failed several of its final rounds of tests. DOD currently believes the JL-2 SLBM and associated submarine combination renders uncertain when it will become operational at all.

[33] Initial growth estimates made by the Department of Defense in 2002 were that China would add about 50 SRBMs each year, but by 2003 DOD revised this estimate upward to over 75 missiles each year and in 2006 increased this further to about 100 per year. This trend appears to have slowed considerably or even halted in 2009-2010.

[34] This is taken from congressional testimony by the author, "Some Thoughts on ICBM Development and ICBM Threats." See U.S. Congress, House Committee on Oversight and Government Reform, Subcommittee on National Security and Foreign Affairs, *Oversight of Ballistic Missile Defense (Part 1): Threats, Realities and Tradeoffs*, 110th Cong., 2nd sess., March 5, 2008, Serial No. 110–148 (Washington: GPO, 2009), pp. 55-72.

among the five nuclear-armed ICBM states (U.S., Russia, China, UK[35] and France) demonstrates that such success required considerable resources in time, funding, knowledge, infrastructure, organization and national commitment. After 50 years of commitment and experience, these nations still experience developmental or even operational failures in their missile or space launch programs on occasion. Although there are frequent charges of the ease in which a country might develop an intercontinental ballistic missile from a space launch program, this has not in fact occurred under missile programs by emerging missile and rocket powers, despite the fact that so many of the technologies are comparable. Perhaps the closest example is that of India, which may have used a few elements of its more than 30-year old space program to develop and test an ICBM-range missile for the first time in April 2012.[36]

Some argue, however, that the small number of ICBM programs to date may result from the small number of countries who perceive the need for ICBMs rather than it being so difficult. Five countries make ICBMs, but nine countries have made successful SLVs, which are close to ICBMs. Additionally, it is argued, that countries such as the United States, the Soviet Union and France took considerable time and money to build their ICBMs is not necessarily an indication for other ICBM contenders. The superpowers and France adhere to high quality and reliability standards, which may or may not be present in Iran. Iran also may be satisfied with an ICBM capability of lesser quality and reliability, it is argued.

Contributing further to understanding missile proliferation in Iran is the difference in names often given to various Iranian missiles by Iran, the United States, U.S. friends and allies, and other good open sources, even when it appears specific missile capabilities seem to suggest the same missile is being described. This report does not attempt to reconcile those differences, but rather retains the missile designations in the sources cited.

Iran: A Special Case in Opacity

In many respects, a strong argument can be made that Iran is somewhat transparent in its ballistic missile activities. Iran regularly televises and talks about its operational missile exercises, publicly showcases many of its ballistic missile and space launch tests, and even holds televised interviews with Iranian officials and leaders in some of its missile and nuclear plants. By comparison, some countries considered allies or friends of the United States do not demonstrate this much openness themselves. In the absence of a diplomatic relationship or any kind of verifiable arms control regime between the countries, a few observers have suggested that Iran may be signaling a certain level of transparency to the United States and others regarding its ballistic missile and space launch programs.

Iran readily acknowledges that U.S. and other countries "possess satellite systems, especially the countries which control the space above Iran, [who] can see our missiles quite clearly. That is, their satellite systems, and not their radars, pick up the movement of our radars, including the firing platform and even the landing site. It is quite clear to them" when maneuvers are real and when Iran exercises with live weapons and are not simply exhibitions.[37] After two MRBM tests in

[35] Technically, the UK did not develop their strategic missiles; Trident II is purchased from the United States.

[36] One might argue that India did not need an ICBM 30 years ago, rather than striving for that long to develop and test an ICBM.

[37] "Iran's Guard Commander comments on Tehran's missile power," *BBC Monitoring Middle East - Political*, November 13, 2006, source: *Vision of the Islamic Republic of Iran Network 2*, Tehran, in Persian, November 12 2006.

February 2011 that Iran said were observed by the U.S. military, Iran expressed surprise that the United States chose not to disclose those launches publicly. Uzi Rubin, an Israeli missile engineer, former head of Israel's BMD program, and who is also a critic of Iran's ballistic missile programs, said the Iranians are transparent in these types of tests, openly wishing for "U.S. satellites to take pictures of their weapons sites and to see their capability."[38]

On the other hand, Iran has proven itself capable of misleading and deceitful statements regarding its ballistic missile and space launch programs. It is useful to briefly point this out as it casts serious doubt on relying heavily on Iranian statements about their ballistic missile and space launch programs. Although some U.S. agencies do that, this report takes exception to that practice. Although this report sources many Iranian statements about their missile programs and tests, it does not assume those statements are accurate without further corroboration or notes that Iranian claims are not confirmed. Although some examples of Iranian misinformation are scattered throughout this report, some of the more notable deceits include

- a photo-shopped "successful" test of a failed Iranian SRBM launch in 2008;[39]
- a "successful" launch of a "long-range radar-evading" ballistic missile in 2006,[40] which was actually video of a missile launch from a Chinese submarine;[41] and
- the "successful" launch of an Iranian satellite into orbit in 2008,[42] which actually exploded shortly after launch.[43]

It is possible that the Iranian media, rather than Iranian officials account for some of the distortions reported. Some have also raised questions over the accuracy of translations from the Persian language, which could then be read after translation as deliberate misinformation or misleading reporting from official sources.

[38] William Branigin, Thomas Erdbrink, and Walter Pincus, "Iran Test Fires Its Most Advanced Missiles," *The Washington Post*, September 28, 2009, On-line edition.

[39] "Iran doctored missile test-firing photo: defence analyst," *Agence France Presse - English*, July 9, 2008, and Al Kamen, "Iran Apparently in Possession of Photoshop," *The Washington Post*, July 11, 2008, p. A15, Suburban Edition.

[40] "Iran test-fires 'long-range' naval missile," *Agence France Press - English*, August 27, 2006, newswire. Iranian Navy Commander Admiral Koochaki was quoted as saying "the highly destructive Sagheb was successfully shot from a submarine but it can be carried on any other (naval) vessel."

[41] "World in Brief," *The Washington Post*, September 10, 2006, p. A23. Pentagon officials confirmed the test was "bogus" and U.S. intelligence determined the video matched a video of an earlier Chinese test.

[42] Siavosh Ghazi, "Iran launches home-built satellite rocket," *Agence France Presse - English*, August 17, 2008, newswire. Both the head of Iran's space agency and Iran's Defense Ministry said the Safir rocket carrying the Omid satellite launched successfully. Iranian officials later admitted that Iranian state media mistakenly claimed the satellite entered orbit.

[43] Nazila Fathi and Thom Shanker, "Iran sees itself assisting allies with satellites," *The New York Times*, August 19, 2008, p. A11. The article cited Pentagon and U.S. military officials who said the first stage of the missile performed successfully, but the second stage failed causing the missile to fly off wildly and destroying the top of the missile and its nose cone. Another source said advance notice of the test allowed the USS Russell, an Arleigh Burke-class destroyer operating in the Persian Gulf to monitor and radar track the launch. Infrared data from the U.S. Air Force Defense Support Program (DSP) missile warning satellite provided additional intelligence. Craig Covault, "U.S. radar and satellite data indicate Iran launch failed," *Aerospace Daily & Defense Report*, vol. 227, no. 6 2008, p. 1.

Iran's Ballistic Missile and Space Launch Programs

Iran has been acquiring, developing and testing its ballistic missile capabilities for decades. This section examines the long-term investment Iran has made in developing ballistic missiles and in building an extensive network of facilities. It further examines Iran's interest in and capabilities for a space launch capacity as well.

What is striking is the degree to which there is an overwhelming amount of information written about Iran's ballistic missile capabilities, performance parameters, testing results, infrastructure and Iran's cooperation with others compared to the paucity of public detail about how many missiles Iran actually has.

Context and Historical Background

Iran's interest in developing ballistic missiles can be traced back to the 1960s and can be tied to its regional security interests even before the Islamic Revolution in 1979. In general, the U.S. intelligence community has publicly stated that it believes Iran's overall approach to its international affairs "will remain relatively constant and will continue to be driven by longstanding priorities of preserving the Islamic regime, safeguarding Iran's sovereignty, defending its nuclear ambitions, and expanding its influence in the region and the Islamic world."[44] Similarly, the Defense Intelligence Agency (DIA) stated the strategic objectives of Iran's leadership are "first and foremost, regime survival; making Iran the preeminent regional power; and turning Iran into an economic, scientific, and technological powerhouse."[45]

Currently, the U.S. intelligence community believes Iran's growing inventory of ballistic missiles, as well as its production of anti-ship cruise missiles, provide capabilities to enhance its power projection. Dennis Blair, then Director of National Intelligence, said in his 2010 annual threat assessment report to Congress that

> Iran already has the largest inventory of ballistic missiles in the Middle East and it continues to expand the scale, reach and sophistication of its ballistic missile forces – many of which are inherently capable of carrying a nuclear payload….Tehran views its conventionally armed missiles as an integral part of its strategy to deter – and if necessary retaliate against – forces in the region. Its ballistic missiles are inherently capable of delivering WMD (Weapons of Mass Destruction), and if so armed, would fit into this same strategy.[46]

Similarly, the DIA said in 2010 that Iran

> continues to develop ballistic missiles capable of targeting Arab adversaries, Israel, and central Europe, including Iranian claims of an extended-range variant of the Shahab-3 and a 2,000-km medium range ballistic missile (MRBM), the Ashura. Beyond the steady growth in

[44] Dennis C. Blair, Dir., National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community for the Senate Select Committee on Intelligence*, February 2, 2010, p. 25.

[45] Lt. Gen. Ronald L. Burgess, Jr., Dir., Defense Intelligence Agency, *Iran's Military Power, Statement before the Senate Committee on Armed Services*, April 14, 2010, p. 1.

[46] Dennis C. Blair, Dir., National Intelligence, *Annual Threat Assessment of the U.S. Intelligence Community for the Senate Select Committee on Intelligence*, February 2, 2010, pp. 13-14.

> its missile and rocket inventories, Iran has boosted the lethality and effectiveness of existing systems with accuracy improvements and sub-munition payloads.[47]

There is no reliable open-source assessment as to how much Iran spends to develop, test, and field its ballistic missile capabilities, nor how much it spends relative to other nations that develop, test, and field ballistic missiles. There is limited open-source data, however, regarding Iran's military expenditures in general. Over the period 1997-2009, Iran reportedly spent about $6.2 billion annually (U.S. constant dollars).[48] Iran's military expenditures placed it fourth among the other Gulf States and the GCC.[49] As a function of GDP, Iran's military expenditures placed it sixth among those same states[50] and 60th in the world according to the CIA.[51]

Iran's Ballistic Missile and Space Launch Complex

Unclassified government and other open-source materials indicate that Iran has an extensive ballistic missile and space launch complex scattered throughout the country.[52] This section highlights only some of those reports. **Figure 1**, "Iran's Ballistic Missile and Space Launch Complex," illustrates where some of these facilities are apparently located. These include various short- and medium-range missile sites, missile test and space launch sites, and a number of sites suspected to be involved in the production, assembly and storage of ballistic missiles and missile-related infrastructure.

[47] Lt. Gen. Ronald L. Burgess, Jr., Dir., Defense Intelligence Agency, *Iran's Military Power, Statement before the Senate Committee on Armed Services*, April 14, 2010, p. 13.

[48] Anthony H. Cordesman and Aram Nerguizian, *The Gulf Military Balance in 2010: An Overview*, Center for Strategic & International Studies, Washington, DC, April 2010, p. 36. Data for military expenditures was taken from the annual Military Balance, published by the International Institute for Strategic Studies (London).

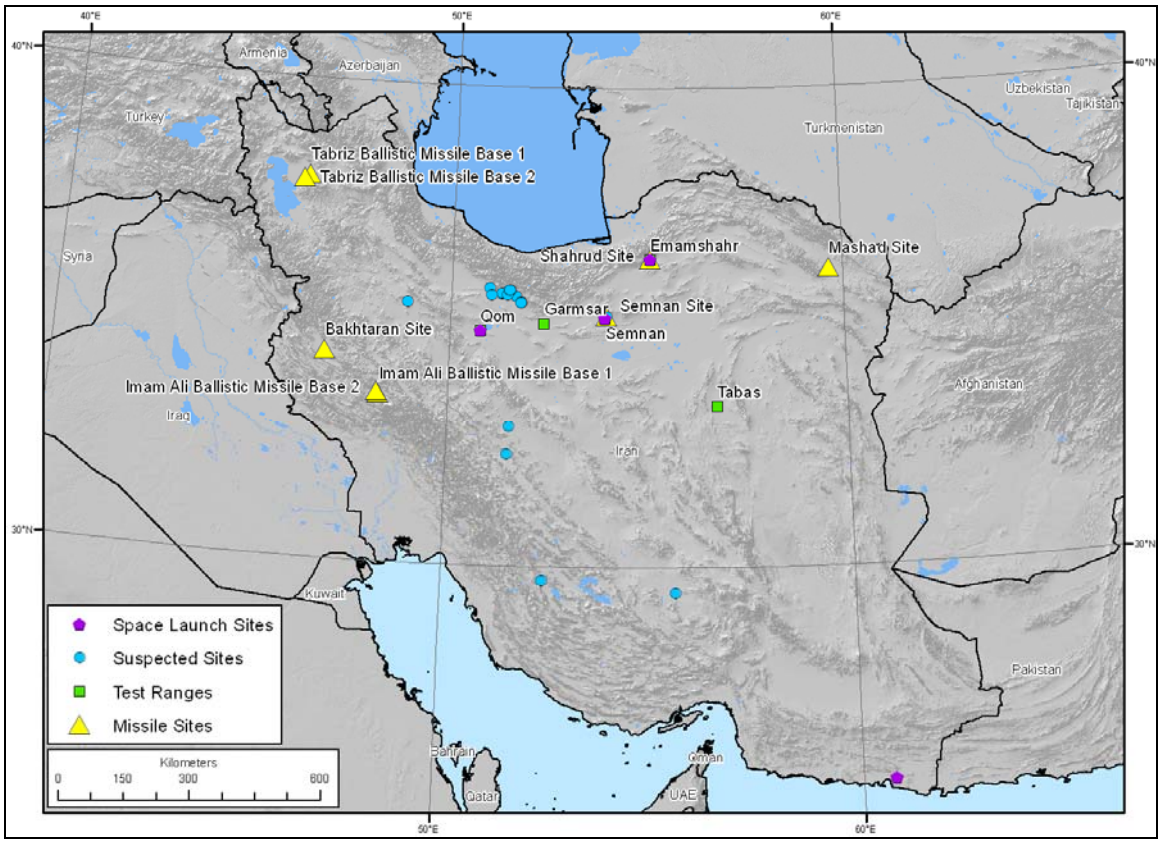
[49] Ibid., Figure 24: Southern Gulf Military Expenditures by Country: 1997-2009, p. 36.

[50] Ibid., Figure 25: Comparative Military Expenditures of the Gulf Powers as a Percent of GDP – 1989-2009.

[51] The World Fact book, CIA: https://www.cia.gov/library/publications/the-world-factbook/index.html

[52] Some of this information has been gathered over the years from what little information is published in the *Federal Record* regarding U.S. sanctions against specific Iranian entities. Additionally, UN sanctions reports and other UN reports can also provide information about Iranian businesses and other entities involved with Iran's ballistic missile and space launch infrastructure.

Figure 1. Iran's Ballistic Missile and Space Launch Complex



Some of Iran's ballistic missiles have reportedly been deployed at some time or another near Tehran, Tabriz, Kermanshah, Khorramabad, Semnan, Sharud, Shiraz and Mashad. Iran is known to have flight tested ballistic missiles of varying ranges and at different times in many locations; some of these locations may lie dormant, while others are more active. They include sites near Qom, Qeshm Island, Garmshar, Sharud, Semnan, and Tabas for instance. Although Iran currently relies primarily on the Semnan Space Launch complex in north central Iran,[53] it also has reportedly conducted some space launch activities near Qom and perhaps elsewhere.[54]

The Islamic Revolutionary Guard Corps (IRGC) is part of the duly constituted armed forces, but its primary role is to protect the Islamic regime.[55] It is the IRGC Air Force that operates Iran's ballistic missile forces.

[53] Orbital launches are conducted from Semnan, though some sub-orbital sounding rocket launches may have taken place elsewhere.

[54] The Nuclear Threat Initiative (www.nti.org) maintains a highly useful accounting of these and a wide variety of other facilities and suspect sites not just in Iran, but elsewhere too. Additionally, Iran Watch (part of the Wisconsin Project on Arms Control) maintains a large database of suspect ballistic missile facilities in Iran (www.iranwatch.org).

[55] Kenneth Katzman, *The Warriors of Islam: Iran's Revolutionary Guard* (Boulder, CO: Westview Press, 1993).

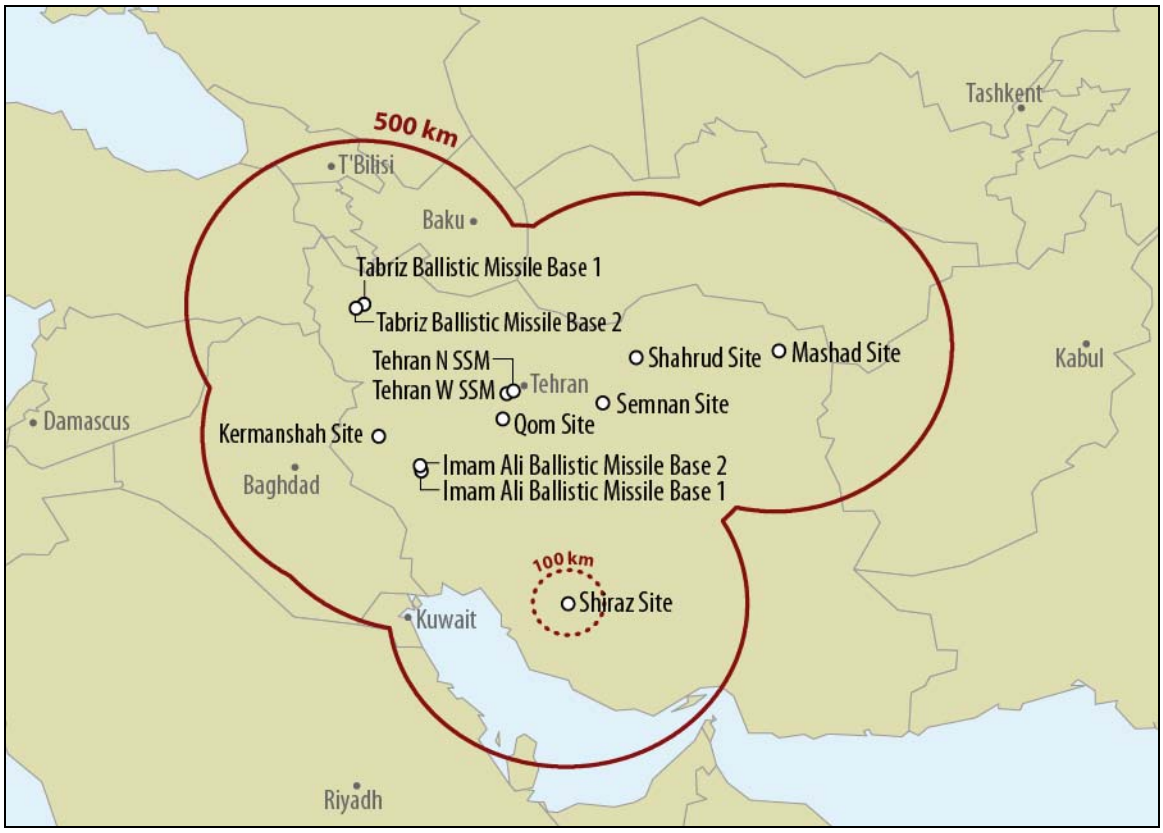
Short-Range Ballistic Missiles (SRBMs)

Short-range ballistic missiles (SRBMs) are generally defined as those ballistic missiles with ranges of less than 1,000 km. Some analysts further differentiate tactical ballistic missiles as those with ranges between 10-300 km. Iran views its SRBMs as an important part of its conventional military capability. The DIA said in 2010 that SRBMs provide Iran "with an effective mobile capability to strike coalition forces in the region. Iran continues to improve the survivability of these systems through technological advances, such as solid-propellant and the use of anti-missile defense tactics."[56]

A precise, public accounting of Iran's SRBM force is not available. Official U.S. sources often cite the figure of "hundreds of SRBMs" with perhaps 50-100 launchers (a launcher can be reused to fire additional missiles). There is no further breakdown of these numbers. See **Table 1**, "Iranian SRBMs (U.S. Government)." **Table 1** does not include an estimate for some years as nothing was noted in that particular year. **Figure 2**, "SRBM Sites and Ranges," illustrates the locations and the estimated operational SRBM ranges from those sites. The dotted ring around Shiraz roughly illustrates the operational range at a typical SRBM site.

[56] Lt. Gen. Ronald L. Burgess, Jr., Dir., Defense Intelligence Agency, *Iran's Military Power, Statement before the Senate Committee on Armed Services*, April 14, 2010, p. 13.

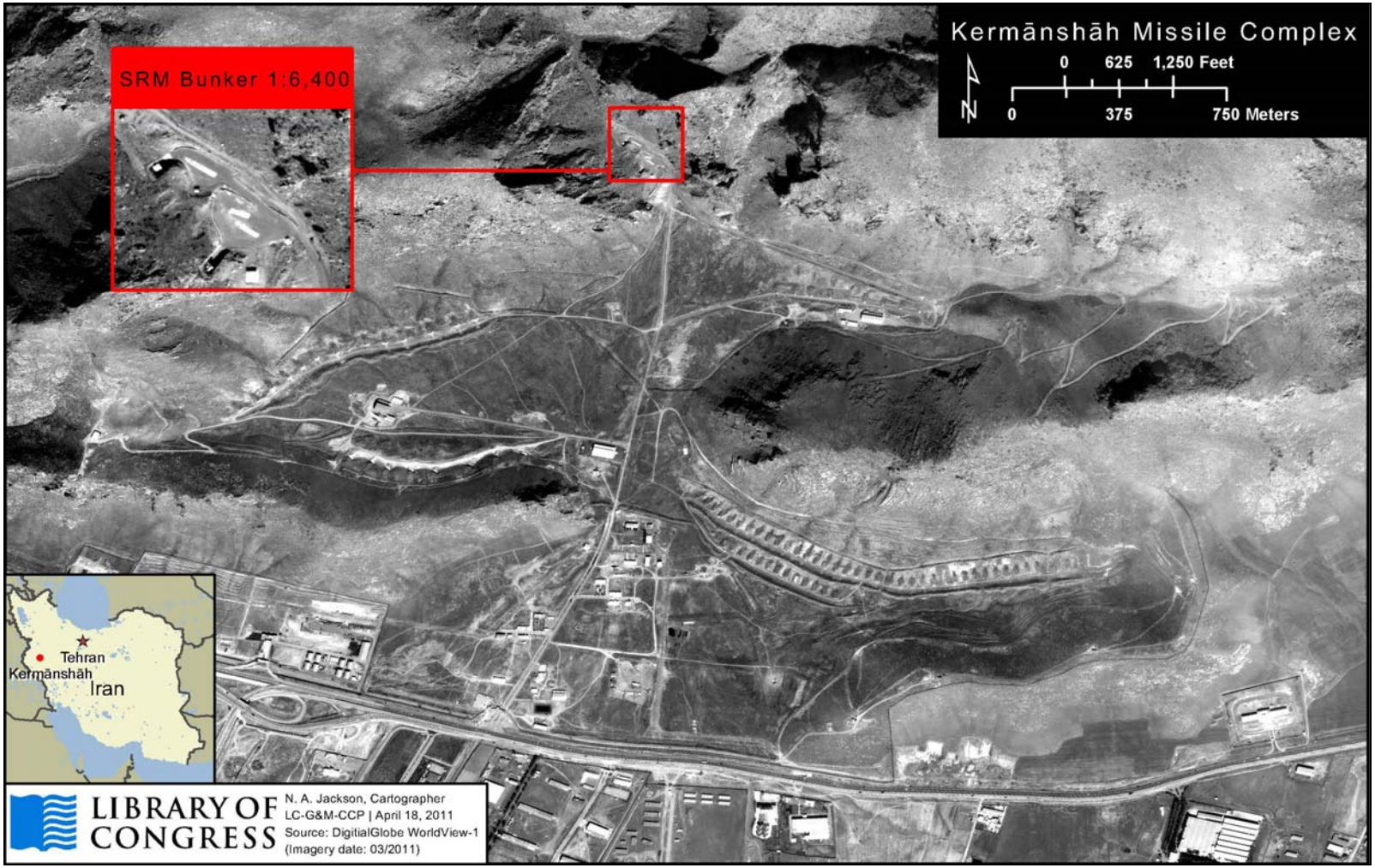
Figure 2. SRBM Sites and Ranges



Other good public sources cite figures of perhaps 200-300 Shahab-1 and Shahab-2 SRBMs (with as few as 18-20 launchers or up to around 50 launchers). See **Table C-1**, "Iranian SRBMs (Other Sources)." These latter sources cite additional, different named SRBMs in Iran's inventory, which this report does not attempt to deconflict. This section provides a brief overview of Iran's SRBM missiles and programs.

Finally, imagery obtained through the Library of Congress shows what appear to be a number of short-range missile bunkers in western Iran around Kermanshah and what a SRBM missile base might look like. See **Figure 3**, "Kermanshah SRBM Base."

Figure 3. Kermanshah SRBM Base



Source: CRS.

Shahab 1 and Shahab-2

Iran's initial, limited purchases of SRBMs came from Libya and Syria during the Iran-Iraq War (1980-1988). These missiles were used to strike targets deeper in Iraq from points further removed from the war's battlefront.[57] Later in the war, Iran acquired large numbers of Soviet Scud B and Scud C SRBMs primarily from North Korea. Iran began calling these missiles Shahab-1 and Shahab-2. Both are liquid-fueled ballistic missiles now produced by Iran, which developed an indigenous infrastructure with the help of the DPRK after the Iran-Iraq War to assemble these missiles. Iran likely continues to rely on some foreign-produced components to produce the Shahab-1 and Shahab-2 missiles:[58] "Uncertainty remains over Iran's ability to produce the Shahab-1 indigenously," and although it can "reliably produce the Shahab-2 missile," Iran continues to rely on foreign sources.[59]

Both the Shahab-1 and the Shahab-2 are road-mobile systems that can be moved to any number of pre-surveyed launch sites. Wartime experiences, such as in Iraq, show these missiles tend to operate within a radius of about 100 km or less from their bases because of the need to ensure operational security and to be able to maintain key logistics support. A notional operating area of these missiles is shown in **Figure 2** around Shiraz in southwestern Iran. The Shahab-1 has a range estimated of about 300 km, while the Shahab-2, which carries a lighter conventional warhead, has a range estimated at about 500 km. Iran has an unspecified number of Shahab-1 and Shahab-2 SRBMs, but they likely number on the order of a few hundred.

Qiam

The only reported test of this ballistic missile in the media was in August 2010. A UN Report said a Member State "assessed the Qiam to be based on the Shahab-2, with a range between 500 and 1,000 kilometers. Some experts have raised questions about the missile's lack of apparent testing. Missiles are known to require extensive flight testing before they can be fully operational."[60]

The status of the Qiam is unclear. According to a Hezbollah (Lebanese) media source, the Qiam 1 was delivered to the Aerospace Force of the IRGC in late May 2010.[61] Iran's Islamic Republic News Agency quoted Defense Minister BG Vahdi as saying the Qiam is harder to detect than older models and that mass production of the Qiam missile, the country's first missile without stabilizer fins, demonstrates Iran's self-sufficiency in producing various types of missiles. Gen. Vahdi added that the Qiam's design reduces the possibility of being detected by enemy anti-

[57] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 13.

[58] Ibid. Elleman points out, however, that open-source literature provides conflicting accounts of Iran's indigenous capabilities in this regard. Some analysts argue Iran has made significant strides in their own ability to produce the Shahab-1 and Shahab-2 missiles, and others argue that Iran must still import key components if not entire missiles from countries such as North Korea. See Elleman, *Iran's Ballistic Missile Capabilities*, p. 36.

[59] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 32.

[60] United Nations, Security Council Committee established pursuant to resolution 1737 (2006, *Final Report of the Panel of Experts submitted in accordance with resolution 1984 (2011)*, S/2012/395, June 12, 2012. The Panel of Experts report was issued under UN Security Council Resolution 1929, which mandated the Panel of Experts. UN Security Council Resolution 1984 renewed the 1929 Panel of Experts mandate.

[61] *Iran's Guards Get Qiam Missiles, Israel Claims are Bound to Hezbollah,* Al-Manar TV Lebanon, May 23, 2011.

missile systems and the omission of its fins increases the missile's speed enabling it to hit its targets with high precision. According to the same Hezbollah source, IRGC Commander Mohammed Ali Jafari, told reporters earlier in 2010 "these new missiles enjoy supersonic speed and cannot be tracked or intercepted by the enemy."

Before Syria's civil war, some in Israel thought the Qiam might be exported to Iranian clients, such as Hezbollah in Syria.[62] This appears less likely today, however, given conditions within Syria.

Fateh-110

The Fateh-110 is a solid-fuel, road-mobile battlefield or tactical ballistic missile with a range of about 200 km. Its development probably started around 1995 and its first test flight reported in 2001. There may be three versions of the Fateh-110 in service; one is apparently called the Khalij-Fasr.

An upgraded version of the Fateh-110 reportedly was tested in early August 2012. Iran claimed it was the fourth generation of the Fateh, and equipped with a new guidance system capable of striking targets up to 300 km away with high accuracy.[63] Experts such as Elleman find the Iranian assertion dubious; the missile has a maximum range of only 200-250 km, and claims of high accuracy are questionable.

[62] Katz, Yaakov, *Israel; New Missile Like Bound for Hezbollah*, Jerusalem Post, May 23, 2011.

[63] "Iran test fires short-range missile," *Aljazeera*, August 4, 2012, online edition.

Table 1. Iranian SRBMs (U.S. Government)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
U.S. Intelligence Community Assessments*													
CSS-8 Scud B Scud C	Several hundred SRBMs		Several hundred SRBMs		A few hundred SRBMs	A few hundred SRBMs		Hundreds of SRBMs	Hundreds of SRBMs				
Fateh-110				In production									
National Air and Space Intelligence Center (U.S. Air Force), Reports on Ballistic and Cruise Missile Threats**													
CSS-8	< 50 launchers			< 50 launchers			< 50 launchers			< 100 launchers			
SCUD B	< 50 launchers			< 50 launchers			< 50 launchers						
SCUD C	< 50 launchers			< 50 launchers			< 50 launchers						
Fateh-110				not yet deployed			< 50 launchers						

Sources: *Annual Threat Assessments, 721 Reports. **NASIC (U.S. Air Force), Reports on Ballistic and Cruise Missile Threat. Missile designations as used by the source.

Notes: Where launcher numbers only are noted, actual missile inventory may be larger because launchers can be reused to fire additional missiles.

Medium-Range Ballistic Missiles (MRBMs)

Iran has invested for several decades in an organized and well-planned effort to acquire, develop, test and deploy MRBMs capable of striking targets throughout the Middle East. Iran views these missiles as a deterrent to any military action that might be taken against it and has said that it can now target about three dozen U.S. bases throughout the region. Some number of these missiles may be housed or deployed in underground bunkers or silo-like structures. The United States and others have long maintained that Iranian MRBMs are inherently capable of carrying nuclear warheads.

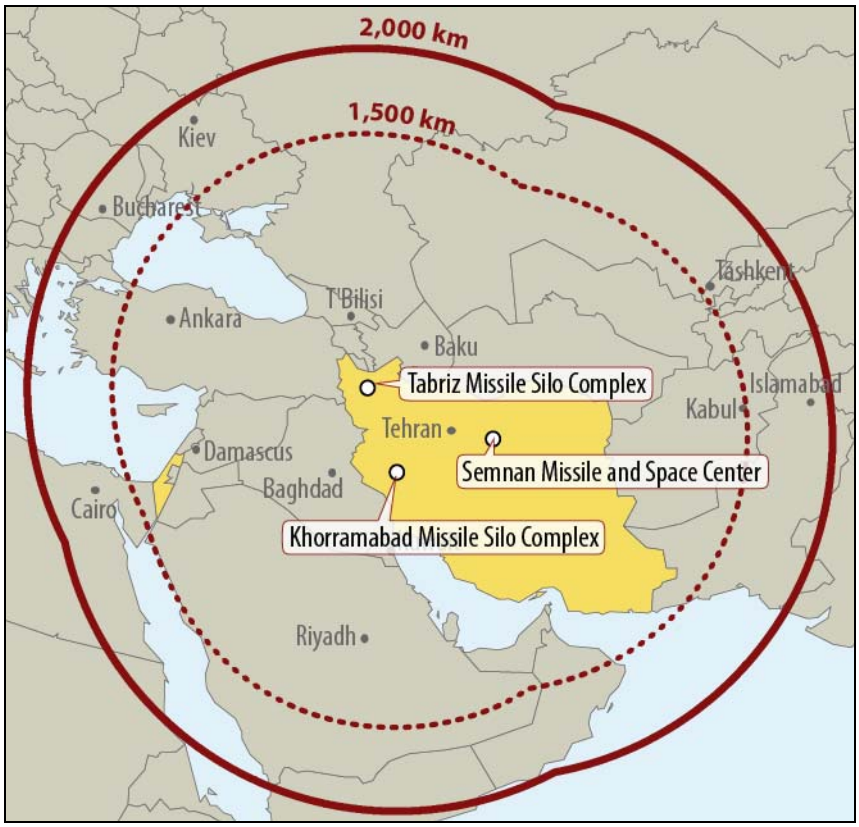
No official numbers of MRBMs operationally deployed are provided by official U.S. government sources. Those numbers that do exist show growth from less than 20 MRBM launchers to less than 50 MRBM launchers by 2009. Actual numbers of the missiles are not publicly provided by the U.S. government. **Table 2**, "Iranian MRBMs (U.S. Government)," shows that neither the annual U.S. threat assessment nor the annual 721 proliferation reports[64] provide any numbers of MRBMs or launchers. Only the U.S. Air Force has provided an official, public number of launchers, albeit not detailed. **Table C-2**, "Iranian MRBMs (Other Sources)," provides additional information, but it too illustrates the lack of preciseness as to how many MRBMs Iran has deployed. Other countries, such as Israel, have reported large numbers of MRBMs (i.e., 450) that could not verified by others.[65]

Figure 4, "MRBM Sites and Ranges," illustrates possible ranges of Iranian MRBMs from two apparent missile silo launch complexes in western Iran and from Iran's ballistic missile and space launch complex in central Iran. This gives one an idea of the area potentially covered by Iranian MRBMs.

[64] Congress established that a bi-annual (now annual) report from the Director, Central Intelligence, be submitted to identify acquisition and trends by foreign countries technology related to WMD and advanced conventional weapons. The 721 Report derives its name from Section 721 (which requires this report) of the Combating Proliferation of Weapons of Mass Destruction Act of 1996. P.L. 104-293; 50 U.S.C. 2301 note.

[65] "Israel 'highly sceptical' of IAEA deal with Iran," *Space Daily*, May 22, 2012, on line.

Figure 4. MRBM Sites and Ranges



Source: CRS.

In 2010, the DIA provided about as much specificity as has been seen about Iranian MRBMs, stating that Iran has "developed medium-range ballistic missiles, and continues to increase the range, lethality, and accuracy of these systems. The Shahab 3, based on the North Korean No Dong, can reach all of Israel. The Ashura or "Sejil" is an indigenous, two-stage missile under development, which uses solid-propellant technology, reducing the launch preparation and footprint."[66]

Iran faces geographical constraints in testing its ballistic and space launch systems. In a lengthy 2006 interview about Iran's ballistic missile programs, then IRGC Commander Gen. Rahim-Safavi made this point. He said, "the longest distance from the northwestern region of Maku to Chabahar is about 2,250 km. We usually fire towards Iran's central desert [and] because Iran is shaped like a trapezoid, we can fire along the longest diameter of the trapezoid. We also watch very carefully to make certain that there are no villages or other inhabited areas along the firing range of these missiles, lest they should be hit."[67]

[66] Lt. Gen. Ronald L. Burgess, Jr., Dir., Defense Intelligence Agency, *Iran's Military Power, Statement before the Senate Committee on Armed Services*, April 14, 2010, p. 13.

[67] BG Itai Brun, head of Israel's intelligence service research division, testified before Israel's parliamentary committee on foreign affairs and defence, that Iran "currently had 450 missiles capable of hitting the Jewish state. See "Iran's Guard Commander comments on Tehran's missile power," *BBC Monitoring Middle East - Political*, November 13, 2006, source: *Vision of the Islamic Republic of Iran Network 2*, Tehran, in Persian, November 12, 2006.

Therefore, estimates of some of Iran's MRBM tests may be based on observing missiles fired non-optimally, such as in a lofted trajectory that sends missiles higher than they would be relative to an optimal ballistic trajectory. Or these missiles might be flight-tested on nominal or minimum energy trajectories. There is no public information available on this.

It is unclear if Iran possesses adequate telemetry gathering capabilities needed to determine flight test results in a true ballistic trajectory over the ocean. On one hand, if Iran's MRBM tests have been lofted or on nominal trajectories, landing over land, this might suggest they lack that capability. Additionally, various technical assessments, such as the UN Panel of Experts reports cited earlier, indicate Iran lacks many things in its ballistic missile programs, including telemetry and instrumentation devices.

Uzi Rubin, however, claims that Iran's recent missile tests landed in the mouth of the Indian Ocean and thus argues that Iran has some capability to deploy instrumented ships or aircraft near the missile's impact points. Iran would do this "to obtain data on the behavior of the missile toward the end of its flight" and that such instrumented platforms could be deployed increasingly down range in the Indian Ocean "to test ballistic missiles to any range it wants."[68] Rubin believes the speed of Iranian recovery from failures is such that it implies plentiful telemetry data. Further, he argues, a successful space program would necessitate a full suite of telemetry and ground support equipment.

This section provides a brief overview of Iran's MRBMs.

The Shahab 3 and Its Variants

The Shahab-3 is a ballistic missile imported from the DPRK and based on the No-dong 1. Iran may have "purchased a production line for these missiles in the early 1990s and is now manufacturing them rapidly," according to one expert.[69] The Shahab-3 has been given various names by Iran and others over time. There reportedly have been several different versions of this liquid-fueled missile flight tested with various other modifications made to it, perhaps providing the Shahab-3 with ranges varying from about 800 – 1,000 km.

Modified Shahab-3/Ghadr-1/Kadr

Because the range of the Shahab-3 lies at the low end of an MRBM, Iran has sought to develop, test and deploy a much longer range ballistic missile.[70] It has sought to do this with both liquid-fueled missile programs based off the Shahab-3, such as the Ghadr-1 or Kadr (or Kadr F), and a separate solid-fuel missile such as the Sejil or Ashura.

Iran first pursued a number of efforts to extend the range of the Shahab-3 with mixed test results. One expert wrote that "there are indications that perhaps as many as one-half of them [Shahab-3

[68] Uzi Rubin, "Showcase of Missile Proliferation: Iran's Missile and Space Program," *Arms Control Today*, January/February 2012.

[69] Uzi Rubin, "The Global Range of Iran's Ballistic Missiles."

[70] Portions of Israel and other targets in the region remained out of reach of the Shahab-3. In addition, Iran apparently did not want to deploy its MRBMs on the borders of Iraq where it could be more vulnerable to attack than if moved further inland. Iranian efforts to develop a 2,000 km or more MRBM, therefore, perhaps in underground bunkers or silos further into the interior of Iran, seemingly are important drivers of Iran's program.

tests] failed."[71] Some have variously referred to this as an extended range or modified Shahab-3 or Ghadar-1. Range estimates for this missile vary widely, from 1,000 km to 2,000 km. Such range differences could in large part be explained in terms of ranges associated with payloads of different weights.

This missile reportedly carries a smaller payload than the Shahab-3, includes a lighter airframe for greater distances, and has "an improved guidance system and uses a triconic aeroshell geometry that provides greater aerodynamic stability."[72] The Ghadar-1 design, "almost certainly includes a separating warhead," could provide the capacity "to carry airburst warheads, or warheads containing submunition packages."[73] It was reported in 2006 that some Western intelligence experts believed Iran had been able to modify the nose cone or reentry vehicle (RV) of the Shahab-3 with Russian and Chinese assistance. An identical RV was twice displayed on No Dong missiles in North Korean parades, so it may have been designed by North Korea. One source says that "instead of the single cone normally attached to this type of missile, the new Shahab has three cones, or a triconic, warhead. A triconic warhead allows the missile to accommodate a nuclear device and this type of warhead is normally found only in nuclear weapons."[74] But others have suggested the triconic RV may be less suitable for a nuclear payload than the previous conical RV associated with the older Shahab 3, and may instead be designed for higher accuracy which may indicate a nonnuclear mission. But none of this has been officially confirmed in Iran. U.S. and other intelligence reports indicate that Iran apparently has not made the decision to develop a nuclear weapon, but developments such as these cause concern among many decision makers and observers.

What of the Shahab-4, Shahab-5 and Shahab-6?

Various reports of a Shahab-4 surfaced in the 1990s and those missile designations are still used or mentioned on occasion. It appears, however, that whatever was intended originally, any "Shahab-4"missile effort likely led to the development of the extended-range Shahab-3 MRBMs or the Ghadr-1.

In the late 1990s and early 2000s, other reports said Iran was developing a solid- or liquid-fueled, two- or three-stage MRBM or space launch vehicle. It is possible they once had a designation of Shahab-5 and Shahab-6, which continues to cause some confusion today. But, more likely these programs led to other ballistic missile and space launch programs in Iran today. One may have become or led to the Ashura/Sejil and the other may have become or led to the Safir space launch vehicle.

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[71] Uzi Rubin, "The Global Reach of Iran's Ballistic Missile Program," *Jerusalem Issue Brief (Jerusalem Center for Public Affairs)*, vol. 5, no. 26 (June 20, 2006).

[72] This unreleased UN report is identified as: United Nations, *Final Report*, Panel of Experts Established Pursuant to resolution 1929 (2010), May 2010. The only online copy that could be found is: http://www.scribd.com/doc/55737041/Leaked-UN-Panel-of-Experts-Report-on-Iran-Sanctions-May-2011.

[73] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 20.

[74] The article further said "the Iranian warhead is designed to carry a spherical nuclear weapon that would be detonated 2,000 feet above the ground.... Although U.S. officials believe Iran is several years away from acquiring nuclear weapons, they point out that the warhead could hold a version of the nuclear bomb Pakistan is known to have developed. Iran has acquired a detailed breakdown of Pakistan's nuclear weapons." Con Coughlin, "Iran has missiles to carry nuclear warheads. Updated Scud puts Israel in Teheran's sights," *The Daily telegraph (London)*, April 7, 2006, p. 19.

When asked in a lengthy and seemingly rather open interview in 2006 about Iranian military exercises ('Great Prophet' IV) and Iranian ballistic missiles, then IRGC Commander Gen. Safavi said, "I'd prefer not to answer," whether there were Shahab-4 and Shahab-5 missiles.[75]

Sejil/Sejjil 2/Ashura

The Sejil is a solid-fueled ground-mobile ballistic missile that Iran says has a range about 2,000 km according to official U.S. sources. Both Postol and Elleman state a 2,200 km range. Some in Israel and elsewhere believe the missile might have a range up to 2,500 km.

The Ashura was announced by Iran in November 2007. This announcement was accompanied either by an unsuccessful test of the solid propellant motors or the Ashura missile itself depending on whether an Israeli or Russian account, respectively, was accurate.

Subsequently renamed the Sejil, it was flight tested successfully in November 2008, reportedly at about 800 km. Additional tests of the Sejil or a modified and apparently more capable version of it (Sejil 2) took place in May, September and December 2009. From the progress shown in the Sejil solid-fuel rocket program, Elleman concludes that "Iran is at a minimum in the process of mastering the technology."[76] Many consider the Sejil 2 a nuclear capable ballistic missile as its payload capacity could accommodate a first generation nuclear warhead. Some have suggested that the MRBM silos near Tabriz and Khorramabad might be intended for the Sejil 2. Many believe the missile is the same regardless of the naming designation (i.e., Sejil, Sejjil 2, or Ashura).

The R-27/BM-25/Musadan Controversy

The issue of whether Iran received at some point some number of Soviet-era R-27 SLBMs (submarine launched ballistic missiles) or components remains unsettled, controversial and persistent. Early on, the German press named this missile the BM-25 when they referred to the Iranian version, and others have referred to this as the Musadan when used in the context of North Korean involvement. The pedigree of this system is far from trivial and its reported design or redesign remains obscure. No official public U.S. assessment or word of this was found.

This issue, therefore, has been largely been a debate among technical experts and observers who track Iranian missile programs. Whether Iran acquired these missiles or their rocket motors in whole or part, or received other technical assistance regarding these missiles or their component parts is important. If accurate, acquiring this capability or technical knowledge might enable Iran to build more powerful and longer range ballistic missiles.

Some experts lend credence to assessments that Iran may have some number of these missiles or their components. Uzi Rubin stated that "Iran has acquired eighteen BM25 land-mobile missiles with launchers from North Korea, which can strike targets in Europe. In the past, the BM-25 has been produced in two models: one with a range of 2,500 km and the second with a range of 3,500

[75] "Iran's Guard Commander comments on Tehran's missile power," *BBC Monitoring Middle East - Political*, November 13, 2006, source: *Vision of the Islamic Republic of Iran Network 2*, Tehran, in Persian, November 12, 2006.

[76] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 110.

km."[77] Similarly, according to an unpublished May 2011 UN Panel of Experts Report, two Member States shared the assessment that "Iran received a shipment of 19 BM-25 missiles from the DPRK in semi-knock down and complete knock down kits.[78] German missile scientists Schmucker and Schiller acknowledge that the BM-25 is "seen as an operational part of the North Korean and Iranian missile arsenals, though it was never actually launched," but that its display in a 2007 DPRK military parade turned out to be a different, very short-range missile.[79]

The *Washington Post* reported in 2010,[80] citing U.S. cables, that Iran had obtained 19 of the BM-25 or Musadan missiles from North Korea. The document reportedly summarized a meeting of U.S. and Russian technical experts and officials, where the Russians claim the BM-25 might not even exist and U.S. officials acknowledge never seeing the missile in Iran. It turns out that the U.S. delegation reportedly relied heavily on a 2005 article from a conservative leaning German tabloid called *Bild Zeitung* quoting German intelligence sources that Iran had purchased 18 (not 19) BM-25 kits made up of missile components for the BM-25 from North Korea. One technical expert was quoted in the *Post* article as saying "the U.S. side does not firmly say we have evidence that the BM-25 is in Iran."

This missile has not been seen publicly in Iran and has not been tested. Some were reportedly shown in North Korea, but subsequently discounted as mock-ups. Some analysts have reported the BM-25 might be capable of reaching 3,500 km. It is reputedly based on a Soviet-era submarine launched ballistic missile known as the R-27 in Russia and the SS-N-6 in the West.

Experts such as Michael Elleman believe that although it is "highly improbable that complete or disassembled R-27 missiles were exported by Russia, it is possible that individual components of the missile may have been smuggled out of the country."[81] Other missile experts such as Ted Postol of MIT argue that the evidence suggests that an unknown quantity of Soviet-era naval ballistic missile parts were shipped to North Korea without the approval or knowledge of the central government during the collapse of the 1990s. Russia never acknowledged this transfer, Postol and Elleman said, because it would tarnish Russia's reputation as a country that claims to have never sold technology that could be used in an intercontinental ballistic missile.[82]

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[77] Uzi Rubin, "The Global Reach of Iran's Ballistic Missile Program," *Jerusalem Issue Brief (Jerusalem Center for Public Affairs)*, vol. 5, no. 26 (June 20, 2006).

[78] These terms are generally used within industry. Usually, a knock-down kit includes all the parts for a system, but is shipped unassembled. Semi-knock-down can mean that some of the harder parts—engine installation, hydraulic plumbing, electronics wiring—have been put together in advance, with only the minimal-skill items left for assembly by the recipient.

[79] Robert H. Schmucker and Markus Schiller, "The DPRK Missile Show: A Comedy in (Currently) Eight Acts," Draft report, Schmucker Technologies, Report XX/10, Germany, May 5, 2010, p. 12-13. The authors cite media reports that North Korea had sold to Iran a reverse engineered and improved version of the Soviet R-27/SSN-6 now named BM-25. Schmucker's earlier assessment of Iran's missiles includes the modified R-27/SSN-6 as procured via North Korea without any DPRK modification, further describing its status as unknown and that there was no production of or modification of the missile in Iran. See Robert H. Schmucker, "Iran and its Regional Environment," Second Transatlantic Conference, Berlin, Germany, March 27, 2006, pp. 4, 37-39.

[80] John Pomfret and Walter Pincus, "Experts question North Korea-Iran missile link from WikiLeaks document release," *The Washington Post*, December 1, 2010, online edition.

[81] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 32.

[82] John Pomfret and Walter Pincus, "Experts question North Korea-Iran missile link from WikiLeaks document release," *The Washington Post*, December 1, 2010, online edition.

Over time, it appears that some of these missile parts and components, or at least their design features, seem to have made their way into North Korean and Iranian missile and space launch programs. Postol has made this argument in assessing the Iranian Safir space launch missile, which has a second stage that appears to use the two vernier thrust chambers and common turbopump from the R-27. In addition, the unusual spatial arrangement of the two thrust chambers, their hydraulic mounts and the conical shape of the stage's back-end are essentially the same as that on the R-27.[83] Some of this is touched on briefly in the section on Iran's space launch program.

MRBM Silo-like Launch Facilities

During the June 2011 "Great Prophet" military exercises, Iranian military leaders publicly revealed for the first time the existence of a secret network of what they characterized as 'underground missile silos'. These structures are distinctly different that those that have been built by the United States, Russia and China. The Shahab-3 is housed in a chamber that has a vertical tunnel that the missile flies through. Both the chamber and the tunnel are large relative to the missile diameter. This creates a very large volume that the rocket exhaust gases can expand into, greatly reducing the challenges associated with flying out of the types of ballistic missile silos built by the United States, Russia and China.

Iran's IRGC Aerospace Forces Commander BG Amir Ali Hajizadeh told state media that the Guard had the capability to "attack all American facilities in the region by these [Shahab 3] missiles."[84] In a televised segment another military official said that Iran had been building this network for the past 15 years. The *New York Times* reported Iranian State TV as saying these silos held medium and long-range missiles.[85] In June 2012, the UN said these missile silos, "which have been reported for a number of years, have not been confirmed to be operational."[86] **Figure 5** shows pictures from Iranian television of what is reported as a ballistic missile in one of these underground facilities as well as a partially opened launch door.

[83] Theodore Postol, *A Technical Assessment of Iran's Ballistic Missile Program. Technical Addendum to the Joint Threat Assessment on Iran's Nuclear and Missile Potential*, EastWest Institute, Iran's Nuclear and Missile Potential: A Joint Threat Assessment by U.S. and Russian Technical Experts, by Siegfried Hecker and David Holloway, Stanford University, Stanford, CA, May 2009, pp. 20-24.

[84] "Iran Test Fires Missiles, Unveils Secret Silos," *The Frontrunner - English*, June 29, 2011, newswire.

[85] William J. Broad, "Iran shows off strengthened underground silos for missiles," *The New York Times*, June 29, 2011, p. 5.

[86] United Nations, Security Council Committee established pursuant to resolution 1737 (2006, *Final Report of the Panel of Experts submitted in accordance with resolution 1984 (2011)*, S/2012/395, June 12, 2012, p. 22.

Figure 5. Iranian Launch Silo

If the Iranian military official was quoted correctly, it would mean that work would have started on these silos around 1996. In fact, perhaps the first public account of Iranian interest in such came in 1993 when then Iranian Defense Minister Foruzandeh led an economic delegation to the DPRK and may have discussed the possibility of joint production of the Nodong missile and construction of underground missile shelters at 18 sites across Iran.[87] Construction may have been underway by 1998 when Israeli Prime Minister Netanyahu said Iran is "building an enormous infrastructure [including] hardened missiles silos," which can house Iranian ballistic missiles and protect them against U.S. or Israeli preemptive strikes.[88]

The next time there was any apparent mention of Iranian missile silos came in 2006. Former head of Israel's missile defense agency and missile engineer Uzi Rubin wrote that "there are indications they [Iranians] are now constructing fixed silo-like hardened sites to make their missiles even more survivable."[89] Rubin mentioned this in the context of Iran's MRBMs.

[87] Various secondary sources cite Hiroshi Kano, "Tehran, Pyongyang Push Arms," *International Review*, Autumn 1994 for this account, but CRS was unable to find this article in any journal. After an exhaustive search of media and journal articles, CRS was able to find only one report at the time that said anything about such shelters. According to *The Jerusalem Post*, "sources say they believe Foruzandeh and North Korea discussed the possibility of joint production of the [Nodong], along with underground shelters for the missiles." See David Makovsky, in Israel said not pushing U.S. to stop N. Korean missile sales to Iran," *The Jerusalem Post*, December 24, 1993. Although the news account demonstrates a relatively weak case, the report is worth mentioning as it fits the general time frame for when Iran may have first begun its efforts to build such shelters, which were then under construction not long thereafter.

[88] Martin Sieff and Bill Gertz, "Iran's long-range missile plans worry Netanyahu; Says U.S. cities may be targeted," *The Washington Times*, October 1, 1998, p. A13.

[89] Uzi Rubin, "The Global Reach of Iran's Ballistic Missile Program," p. 65, http://jcpa.org/text/iran_page_62-67.pdf.

It was not until 2008, however, that more specific claims about silo construction, hardened sites, locations, and imagery, began to surface in public.[90] Two different blogs, gemint.com and armscontrolwonk.com, wrote about the same time in early 2008 of a possible silo missile base near Tabriz, Iran. O'Connor (gemint.com) later wrote that:

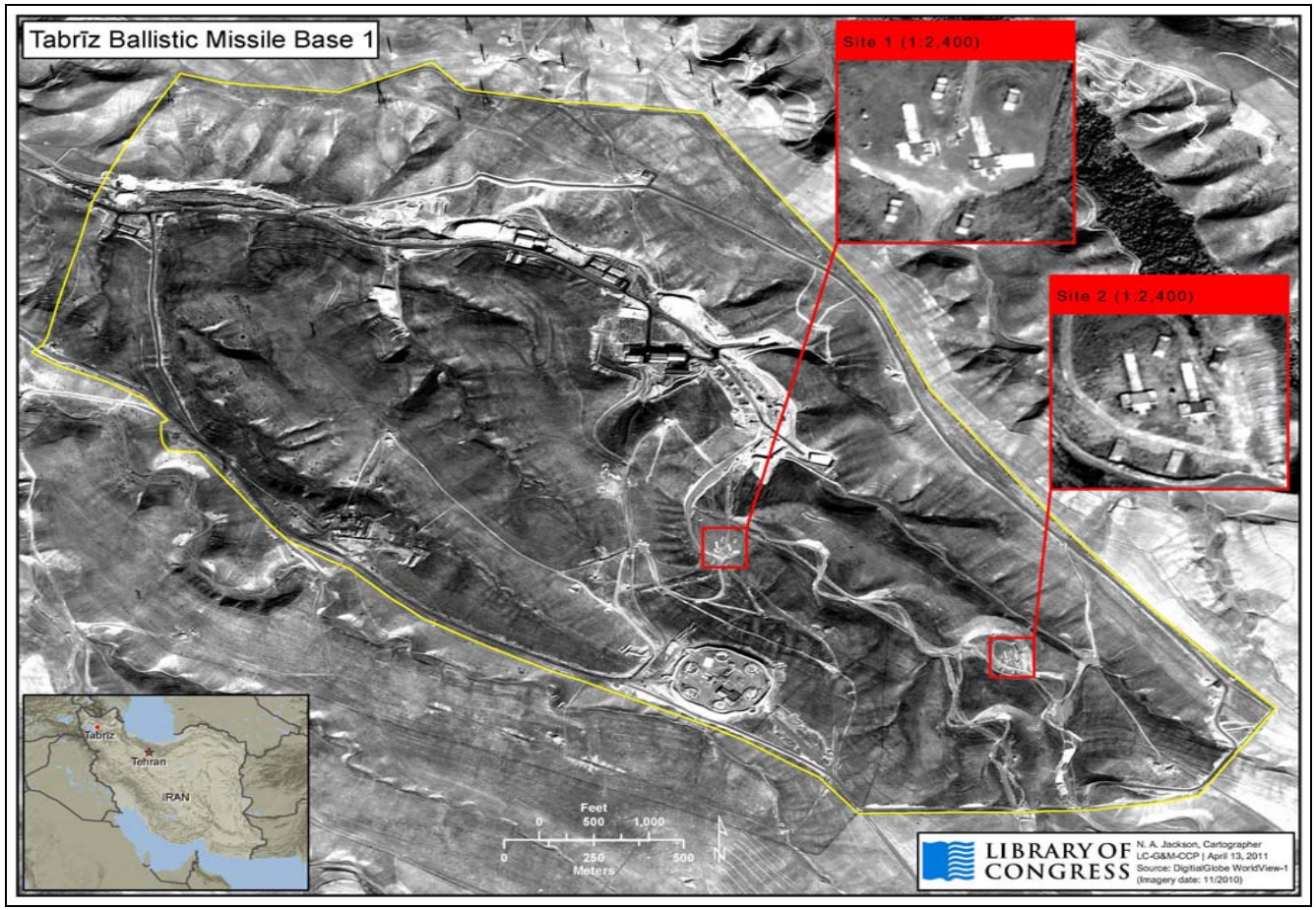
> between 2003 and 2005, a silo complex was constructed on the grounds of an existing SSM [surface-to-surface missile] facility south of Tabriz in northwestern Iran. The complex consisted of two missile silos, likely intended to house Shahab-3 series IRBMs (sic) based on the existing facility. Between 2007 and 2008 a second pair of silos appeared roughly 700 meters SE of the initial pair. A third pair of silos appeared approximately 14 kilometers to the west near the town of Khosro Shahr.[91]

Based on these previous assessments and using imagery obtained through the Library of Congress, this report locates what appear to be those missile silos in northwest Iran near Tabriz. See **Figure 6**, "Tabriz Ballistic Missile Silo Base 1," and **Figure 7**, "Tabriz Ballistic Missile Silo Base 2." Imagery obtained through the Library of Congress dated around 2000 and examining additional imagery dated about once every year or two at this location shows what appears to be gradual construction of the second silo site referenced by O'Connor. This second silo pair may have been completed by 2011 from looking at that imagery and is labeled 'Site 2' in **Figure 6**, "Tabriz Ballistic Missile Base 1."

[90] Sean O'Connor, who runs gemint.com, told the author in March 2011 that he thought he did "the first open-source look at Iran's silos in February of 2008." This particular blog is no longer available on his website, but the copy he sent to the author said there had been "a great deal of recent open-source reporting dealing with a purported missile site near Tabriz in northwestern Iran. While these reports may or may not be true, they have all failed to note the presence of another missile facility in the region [about 10 kilometers southwest of Tabriz]. The difference is that this facility can be identified with much greater certainty: this facility houses Iran's first missile silos." A copy of this specific blog can be found elsewhere, however, at http://www.irandefence.net/showthread.php?t=29952. O'Connor did not indicate where the open-source reporting came from and the author was not able find any reports about Iranian silos during this time. O'Connor has blogged many times since about the missile silos at Tabriz and Khorramabad, providing details and satellite imagery. Jeffrey Lewis at armscontrolwonk.com wrote of a suspect missile facility near Tabriz in February 2008 as well, based on rough translations of a German newspaper *(Bild)* article that might have been published as early as 2005 but was apparently no longer available. Although blog contributors provided various and somewhat different translations, it appears the original source was the BND (German intelligence agency), which said Iran had bought 18 unassembled mobile BM-25 rockets (range of 2,500 km), which Iran remodeled to obtain a 3,500 km range, and that "German intelligence had located a stationary starting system for the test of silo-supported rockets [as translated]." Lewis' blog too has written about the silos at Tabriz and Khorramabad at various times since.

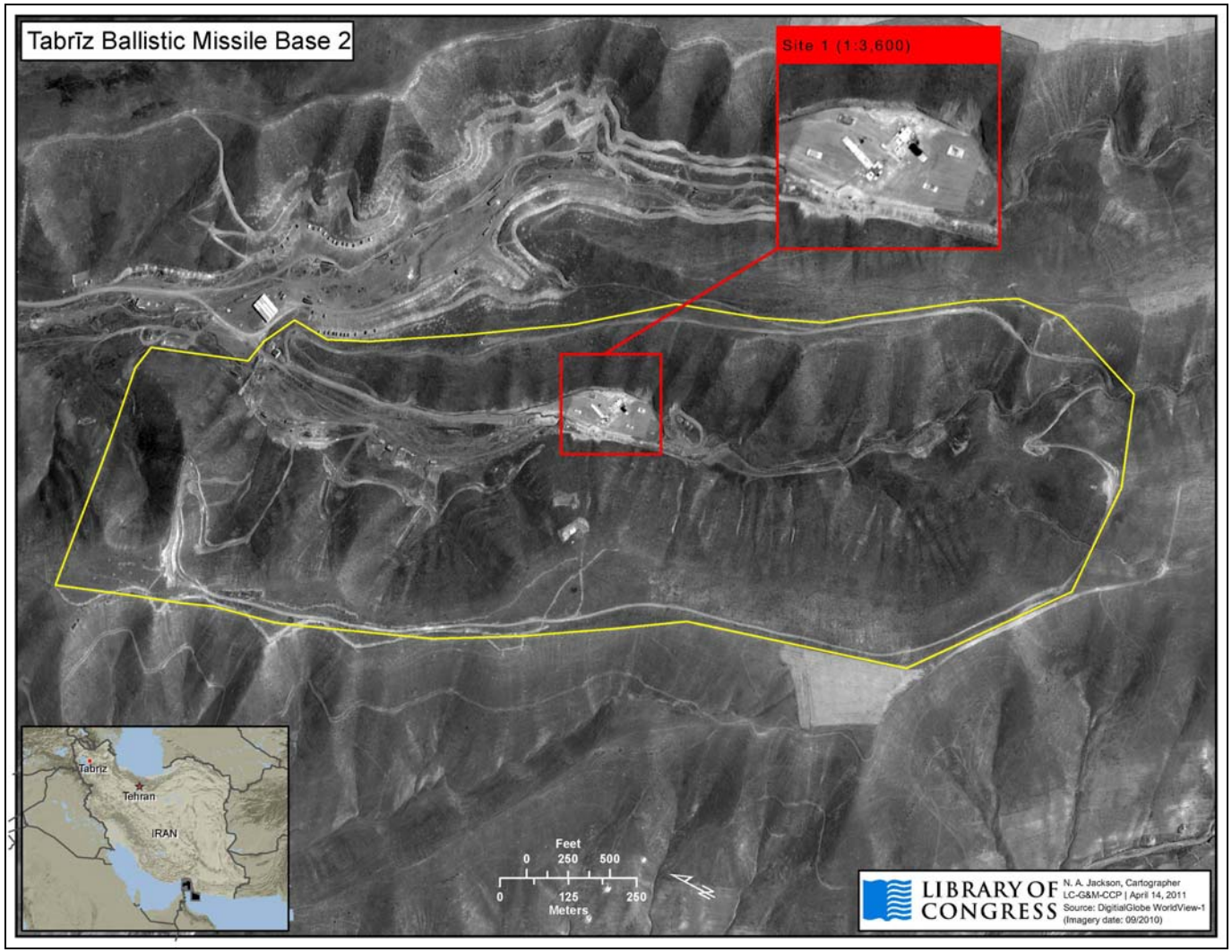
[91] Sean O'Connor, "Iranian SSM Facilities," *I&A (Imagery and Analysis)*, vol. 1, no. 2 (March 20, 2011), p. 11, self-published, http://www.gemint.com.

Figure 6. Tabriz Ballistic Missile Silo Base 1



Source: CRS, Library of Congress.

Figure 7. Tabriz Ballistic Missile Silo Base 2



Source: CRS, Library of Congress.

Since then, only a few other experts have mentioned these silos until the Iranian videos and interviews in June 2011. To date, there does not appear to have been any official U.S. public assessment or acknowledgment of these silos. It is unclear what the absence of any such assessment might mean.

"Secret" MRBM Tests (2010-2011)

In comments to the British parliament in June 2011, British Foreign Minister William Hague said Iran had conducted three secret tests of ballistic missiles capable of carrying nuclear weapons in contravention of UN Security Council Resolution 1929.[92] An Iranian spokesman denied the British allegations, saying that none of the missiles tested by Iran has a nuclear capability.[93]

Britain apparently reported these tests to the UN, but had not previously made them public.[94] Although it received little media attention at the time, a report by a Panel of Experts at the UN became public the month before Hague's speech in London. According to *AP* the UN report said Iran launched a liquid-fueled Shahab-3 missile with a range of about 800 kilometers, and one or two solid-fueled Sejil 1 missiles with a range of about 2,000 kilometers.[95] *AP* further said the UK believe these missile tests showed that Iran's leaders wanted to avoid scrutiny over "the real extent of their weapons programs."

This unpublished May 2011 report[96] was not circulated because it had not been approved by its parent UN Security Council, apparently for political reasons—China and Russia opposed its release according to UN sources. Nonetheless, the news it shed on previously undisclosed Iranian MRBM tests was highly significant. Specifically, the report mentioned the launch of the Sejil/Ashura in October 2010 and a Sejil and Shahab-3 test in February 2011.[97] By early July 2011, Iran conceded the two February tests. *Reuters* reported that Iran state television admitted test-firing two long-range missiles from the "Semnan province into the mouth of the Indian Ocean" about 1,900 kilometers away sometime between January 21 and February 19, 2011.[98] BG Hajizadeh, head of the IRGC's Aerospace Division, said U.S. spy planes were operating in the area where the missiles hit, but it was "interesting that they [the United States] did not report it."[99] *Jane's* said these medium-range missile tests were likely the Sejil-2 or the Shahab-3.[100]

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[92] James Kirkup, "Iran accused of secret missile tests," *The Daily Telegraph (London)*, June 30, 2011, p. 22. UNSCR 1929 prohibits Iran from any activities related to ballistic missiles capable of delivering nuclear weapons, including launches using ballistic missile technology, and provides that UN Member States are to take all measures necessary to prevent the transfer of technology or technical assistance to Iran related to such activities. Hague said these tests were conducted from October 2010 to some point before his speech in June 2011.

[93] "Britain accuses Iran of secretly testing nuclear-capable missiles," *States News Services*, June 29, 2011, newswire.

[94] Ibid.

[95] David Stringer, "UK: Iran conducting secret ballistic missile tests," *The Associated Press*, June 29, 2011, newswire.

[96] This unreleased UN report is identified as: United Nations, *Final Report*, Panel of Experts Established Pursuant to resolution 1929 (2010), May 2010. The only online copy that could be found is available at http://www.scribd.com/doc/55737041/Leaked-UN-Panel-of-Experts-Report-on-Iran-Sanctions-May-2011.

[97] The report said, "The Panel was informed of [these two Sejil launches] by a Member State." Ibid., p. 26.

[98] "Iran says fires missiles to Indian Ocean for first time," *Reuters*, July 9, 2011, newswire.

[99] Ibid.

[100] "Iran claims to have tested missiles in Indian Ocean," *Jane's Intelligence Weekly*, July 11, 2011.

The fact that there was neither public announcement by Iran at the time of these launches, nor any public condemnation from the United States or from any other any other nation represented a notable departure from the past. Three key questions are thus raised. First, what might account for this change in Iranian policy that normally publicizes or televises missile tests? There are several conceivable explanations:

- One or more of the tests might have failed and Iran did not want that known. This could explain what happened with the first launch, but evidence is that the February flights were successful, or
- Iran may have tested to a new, untried range for which it did not want international attention. Only after media reports and the leaked UN draft report did Iran concede the longer range tests into the Indian Ocean; or
- Iran may have decided for whatever reason that it no longer wanted to publicly demonstrate its MRBM capabilities, perhaps over concern regarding UNSCR 1929. But in "Great Prophet" 7 Iran said it had flown a 2,000 kilometer missile, which should be noted was not independently verified. And Iran had declared two other Sejil launches and a Shahab-3 test in 2009, after UNSCR 1929 passed earlier that year. Also, just because Iran did not publicly announce or show these tests does not mean they cannot be verified by others.

A second key question is why neither the United States nor any other nation at the time chose to criticize Iran for those tests, which to many seemingly violates UNSCR 1929. Possible reasons might include:

- The United States might have wanted to forge a consensus behind closed doors for additional sanctions and worried that public attention to the tests might make it harder to bring in Russian or Chinese support, or both. U.S. Permanent Representative to the UN Susan Rice complained about Iran's noncompliance with UNSCR 1929 in June 2011 and referred to the draft Panel of Experts as containing "troubling findings, including significant evidence about several reported violations" of UN sanctions related to Iran, but implied some Member States were holding up public release.[101] Some have noted that the Final Report released in June 2012[102] did not mention the three tests from the unpublished earlier Final Report in May 2011. This was for no other reason than the missile launches occurred in a different mandated reporting period.
- Due to the sensitive, ongoing talks with Russia over the U.S. European Phased Adaptive Approach (EPAA), there may have been some reticence within parts of the U.S. Government to "shove this" into the Russian face. Keeping any announcement of these Iranian tests out of the public debate may have been seen as having a greater policy priority in order to facilitate an agreement with Moscow.

[101] Remarks by Ambassador Susan E. Rice, U.S. Permanent Representative to the United Nations, at a Security Council Briefing on Iran and Resolution 1737, New York, NY, June 23, 2011.

[102] United Nations, Security Council Committee established pursuant to resolution 1737 (2006, *Final Report of the Panel of Experts submitted in accordance with resolution 1984 (2011)*, S/2012/395, June 12, 2012.

Table 2. Iranian MRBMs (U.S. Government)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
U.S. Intelligence Community Assessments*													
National Air and Space Intelligence Center (U.S. Air Force), Reports on Ballistic and Cruise Missile Threats**													
Shahab 3	Not yet deployed			< 20 launchers			< 20 launchers			< 50 launchers (all variants)			
Shahab 3 variant							Not yet deployed						
Shahab 4	Not yet deployed/ not flight tested												
New MRBM/ Shahab4?				Not yet deployed									
New MRBM							Not yet deployed			Not yet deployed			
Shahab 5	Not yet deployed/not flight tested												
New MRBM/ Shahab5?				Not yet deployed									
IRBM/ ICBM							Not yet deployed			Undeter-mined			

Sources: *Annual Threat Assessments, 721 Reports. **NASIC (U.S. Air Force), Reports on Ballistic and Cruise Missile Threat. Missile designations as used by the source.

Notes: Where launcher numbers only are noted, actual missile inventory may be larger because launchers can be reused to fire additional missiles.

Intercontinental-Range Ballistic Missiles (ICBMs)

Traditionally, the United States has defined ICBMs as those ballistic missiles capable of achieving ranges greater than 5,500 kilometers (about 3,400 miles). To date, only five countries have deployed operational ICBMs (all with nuclear weapons): the United States, Russia, China, France, and the UK.[103] Only the United States and the Soviet Union achieved those capabilities entirely indigenously; to some degree China, France and the UK received significant assistance. Some countries, such as Iran, are believed by some observers to have ICBM programs in varying stages of development.

ICBMs, fitted with nuclear warheads, pose significantly greater challenges to U.S. national security than nuclear weapons alone. Director of Central Intelligence George Tenet testified in 2000, "these countries calculate that possession of ICBMs would enable them to complicate and increase the cost of US planning and intervention, enhance deterrence, build prestige, and improve their abilities to engage in coercive diplomacy."[104]

Since the late 1990s, the U.S. intelligence community has repeatedly stated, with a number of caveats, that Iran would be able to test an ICBM capable of reaching the United States by 2015, which is at least 10,000 km away. Other countries do not necessarily share this assessment and Iran has long denied that it is developing an ICBM capable of reaching the United States. Open-source analyses of ballistic missile tests in both Iran and North Korea raise questions about whether Iran may be developing a ballistic missile capable of reaching the United States or seeking to develop a space launch capability that could provide the technological basis for conversion to an ICBM. This section examines these issues.

Intelligence Estimates: U.S. and Others

The United States

In 1999, the U.S. intelligence community assessed that at some point the United States would probably face ICBM threats from Iran.[105] This remains the official U.S. position. More specifically, the 1999 assessment warned that "Iran *could test* an ICBM in the last half of the next decade using Russian technology and assistance" (emphasis in the original). A similar report was issued in 2001.[106] Such a test did not occur in this time frame, but in 2010 the DIA assessed that, by 2015:

[103] India recently successfully tested a long-range ballistic missile just under what is defined as ICBM range (around 5,000 km), but it will still be several years before that missile class is considered operational and it is further unknown whether it will carry a nuclear warhead.

[104] U.S. Congress, Senate Select Committee on Intelligence, *Current and Projected National Security Threats to the United States*, 106th Cong., 2nd sess., February 2, 2000, S.Hrg. 106-580 (Washington: GPO, 2000), p. 11.

[105] National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat to the United States through 2015," September 1999. This unclassified National Intelligence Estimate was provided in open testimony to the Senate Foreign Relations Committee on September 16, 1999, by Robert D. Walpole, National Intelligence Officer for Strategic and Nuclear Programs, Central Intelligence Agency.

[106] National Intelligence Council, "Foreign Ballistic Missile Threat Through 2015," December 2001, Unclassified Summary of a National Intelligence Estimate.

> with sufficient foreign assistance, Iran could develop and test an intercontinental ballistic missile (ICBM) capable of reaching the United States. In late 2008 and early 2009, Iran launched the Safir, a multi-stage space launch vehicle (SLV), demonstrating progress in some technologies relevant to ICBMs. Iran displayed its next generation SLV, the Simorgh, in February 2010. The Simorgh is much larger than the Safir and shows progress in booster design that could be applicable to an ICBM design.[107]

The 2012 annual report on Iran's military power to Congress (April 2012) restated that "Iran has launched multistage space launch vehicles that could serve as a test bed for developing long-range ballistic missile technologies."

These assessments are often interpreted as stating that Iran will have nuclear-tipped ICBMs capable of striking the United States by 2015, but the unclassified intelligence statements continue to place various caveats on potential capability to test at some date. These assessments focus only on the ability to test an ICBM and do not make any judgments about the ability of Iran to successfully deliver a nuclear warhead at ICBM range.

These intelligence statements serve as the official U.S. basis for assessing the Iranian ICBM threat to the United States and to its friends and allies. These assessments drive U.S. military efforts designed to respond to such threats, such as the U.S. BMD program in general and the U.S. missile defense system in Europe specifically, as well as U.S. diplomatic and other efforts such as sanctions to dissuade or slow down Iranian long-range ballistic missile programs.[108] However, they do not offer a probability assessment for such technological assistance being available.

These assessments do not mean that currently universal agreement exists within the U.S. intelligence community on the issue of an Iranian ICBM. According to these same unclassified statements, some within the intelligence community argued that an Iranian ICBM test was likely before 2010 (which did not happen), and very likely before 2015. Other U.S. officials believed, however, that there is "less than an even chance" for such a test before 2015. Furthermore, U.S. assessments are also conditional in that an Iranian ICBM capability would have to rely on access to foreign technology, from, for example, North Korea or Russia.[109] Finally, some argue that an Iranian ICBM could be developed out of the Iranian space program under which a space-launch vehicle might be converted into an ICBM program. In the 1990s, some argued that Iran could have developed and tested such a space launch vehicle by 2010. Iran successfully demonstrated a space launch capability in 2009 with the launch of a low-earth orbit satellite, but the IC has not assessed that Iran has conducted an ICBM test or acquired an ICBM capability.

Regarding the relation between ICBMs and space launch capability, a UN Security Council Panel of Experts "reached a consensus" in 2012 that

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[107] Lt. Gen. Ronald L. Burgess, Jr., Dir., Defense Intelligence Agency, *Iran's Military Power, Statement before the Senate Committee on Armed Services*, April 14, 2010, pp. 13-14.

[108] See CRS Report RL34051, *Long-Range Ballistic Missile Defense in Europe*, by Steven A. Hildreth and Carl Ek, and CRS Report CRS Report RL32048, *Iran: U.S. Concerns and Policy Responses*, by Kenneth Katzman.

[109] See National Intelligence Council, "Foreign Missile Developments, 1999," and Robert D. Walpole, "The Ballistic Missile Threat to the United States," Statement Before the Senate Subcommittee on International Security, Proliferation and Federal Services, February 9, 2000.

> both ballistic missile and space launch programmes shared a great deal of similar materials and technology, including systems for propulsion, control and navigation. The Panel also noted that, although some examples existed of ballistic missile programmes developed from space launch programs, in general there were more examples of the reverse – space launch programmes developed on the basis of ballistic missile programmes.[110]

Some observers argue that although the U.S. position may be based upon a realistic assessment, it is also a worst-case analysis of the potential threat from Iran. They argue that "with rare exception this level of threat has rarely turned out to be the historical reality."[111]

Other Governments and the UN

Some governments support the contention that Iran will be capable soon of developing ICBM capabilities, while others do not share that assessment. In 2008, a UK House of Commons, Foreign Affairs Committee report noted that Iran made no secret of its space launch aspirations, which "technology has some value for longer-range and intercontinental ballistic missiles. We believe Iran could test such systems by the end of the decade [presumably meaning 2010]. If it acquired a complete long-range ballistic missile system, it could achieve such a capability more quickly."[112] Although dated, it is worth mentioning here as indicative of a broader belief that Iran could develop an ICBM capability at some point.

In 2005, the conservative-leaning German tabloid newspaper *Bild* reported that, according to information obtained by the German Intelligence Service (BND), "Iran has bought from North Korea 18 assembly kits of the mobile BM-25 type [and that] Ahmadinejad has or had them upgraded on the basis of the Russian submarine missile SS-N-6."[113]

Russia, however, has long denied that any such transfer of R-27s or SSN-6s took place[114] and has indicated that an Iranian ICBM was not likely for the foreseeable future. In 2006, the Chief-of-Staff of Russia's Armed Forces said Iran did not have the technological potential to build ICBMs. Yury Baluyevsky said "according to our information, Iran possesses neither the technological nor technical resources to build a missile with an intercontinental range."[115] A few years later, U.S. and Russian technical experts and officials gathered to discuss Iranian programs. The Russians indicated they believed Iran

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[110] United Nations, Security Council Committee established pursuant to resolution 1737 (2006, *Final Report of the Panel of Experts submitted in accordance with resolution 1984 (2011)*, S/2012/395, June 12, 2012, p. 23.

[111] For instance, see Charles P. Vick, "North Korean, Iranian, and Pakistani Common Russian, Chinese Nuclear Weapons Heritage and Tests, What does it Reveal about the Missile Borne Warhead Development Status?" Part 1, March 20, 2007, at http://www.globalsecurity.org/wmd/world/dprk/nuke-warhead-dev1.htm.

[112] Global Security: Iran, Fifth Report of Session, 2007-08. Report together with formal minutes, oral and written evidence, House of Commons, Foreign Affairs Committee, Ordered by The House of Commons to be printed 20 February 2008. HC 142, Incorporating HC 496-i, ii, iii Session 2006-2007. Published on 2 March 2008, London, p. Ev.27.

[113] Einar Koch, "German Intelligence Service Sees Iran Upgrading Missiles to Reach Israel, Europe," *Bild (Hamburg)*, December 16, 2005, (Internet Version-WWW).

[114] Gareth Porter, "Russians Refuted U.S. Claim of Iranian Missile Threat to Europe," *IPSNews.net*, November 30, 2010, On-line edition.

[115] "Iran does not have technology to build ICBMs - Russian Chief of Staff (Part 2)," *Russia & CIS Military Newswire*, November 2, 2006. See also "Iran "not capable" of creating intercontinental missiles: Russia," *Agence France Presse - English*, November 2, 2006, newswire.

> was a long way from building intercontinental ballistic missiles that could hit the United States.... Iran lacks appropriate structural materials for long-range systems.... Iran can build prototypes, but in order to be a threat to the U.S. or Russia, Iran needs to produce missiles in mass quantities, and it lacks materials sufficient for the type of mass production needed to be a security threat. Russia further noted that the technology for longer-range missiles is sophisticated and difficult to master.[116]

Israel reportedly believes Iran will have ballistic missiles capable of striking the United States within two to three years. In recent remarks, Israeli Finance Minister Steinitz said the Israeli assessment was in line with a 2010 Pentagon assessment that Iran could build a U.S. missile with the range to strike the United States by 2015. He said, the Iranians "are working now and investing a lot of billions of dollars in order to develop ICBMs ... and we estimate that in two to three years they will have the first ICBMs that can reach the east coast of America. So their aim is to put a direct nuclear ballistic threat ... to Europe and to the United States."[117]

In 2012, a UN Security Council-approved Panel of Experts report that, among many other things, cast doubt on Iran's capacity to develop long-range ballistic missiles:

> While the Islamic Republic of Iran is actively producing its own missiles, it remains reliant on foreign suppliers for components, materials and equipment. According to some experts, there is no evidence that the Islamic Republic of Iran possesses the technology necessary to ... construct longer range missiles. It also appears that the Islamic Republic of Iran continues to import whole engines, or at least critical engine components, for its liquid-fueled missiles, and requires components for guidance systems.[118]

The View from Iran

Iran disputes that any of its ballistic missile programs under development would be capable of reaching the United States. Its most recent denial came when the Pentagon released its April 2010 report on Iran's Military Power. Among other things, that report reaffirmed previous intelligence assessments since the late 1990s that Iran could develop and test an ICBM capable of reaching the United States by 2015.[119] In response to this report, Iranian Defense Minister Ahmad Vahdi stated that "the Islamic Republic of Iran has no plans to build such a missile."[120]

Iran denies reports that it collaborates with other nations to develop ICBMs. In response to charges that Iran obtained ballistic missiles from North Korea based on the Russian R-27 SLBM design, Iranian Ambassador to Russia Mahmoud Sajjadi said in November 2010 that "Iran has

[116] David E. Hoffman, "In WikiLeaks: Russia's doubts about Iranian missiles," *Foreign Policy Journal—online blog*, November 29, 2010.

[117] Jeffrey Heller and Mark Heinrich, "Israel: Iran will have U.S.-range missile in 2-3 years," *Reuters*, February 22, 2012, U.S., online edition.

[118] United Nations, Security Council Committee established pursuant to resolution 1737 (2006, *Final Report of the Panel of Experts submitted in accordance with resolution 1984 (2011)*, S/2012/395, June 12, 2012, p. 20.

[119] "Unclassified Report on Military Power of Iran," Department of Defense, April 2010, p. 11.

[120] Ali Sheikholeslami, "Iran Say No Plan for Missile Able to Reach U.S.," *Bloomberg Business Week*, April 21, 2010, Online edition and "Iran has no Plan to Build Missiles Capable of Reaching U.S.," *Tehran Times*, April 22, 2010, Online edition.

received no [such] missile from North Korea … [and] we do not need such military services from any country at the present time."[121]

The Commander of the Aerospace Division of the IRGC, BG Amir Ali Hajizadeh, said in 2011 that Iran "possesses the technology," but has "no intention of producing" missiles with ranges greater than 2,000 kilometers.[122] Hajizadeh further said Iran was interested only in the ability to target U.S. and Israeli bases in the region.[123]

Space Launch Program

Organization

The Iranian Space Agency (ISA) coordinates Iran's space activities. Iran is also one of the 24 founding members of the UN Committee on the Peaceful Uses of Outer Space, established in 1958, well before the 1979 Islamic Revolution. The ISA was established in 2004 and given responsibility to support all of Iran's activities concerning the peaceful uses of space. ISA falls under the leadership of a Supreme Council of Space that is chaired by Iran's President. This Council has policy making responsibilities regarding Iran's use of outer space, for building, launching and using satellites, approving all government and private sector space programs, and identifying areas of potential regional and international cooperation. ISA is affiliated with Iran's Ministry of Communication and Information.

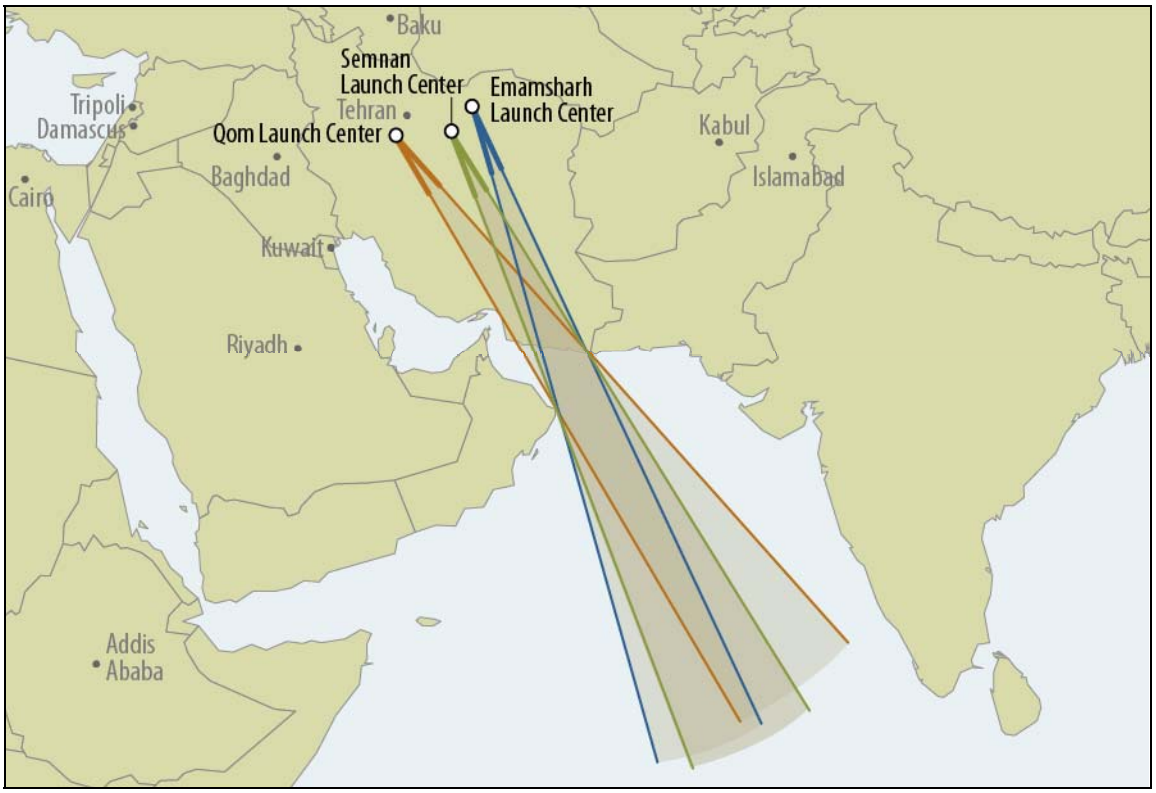
Iran conducts its space launch activities primarily out of the Semnan Launch Center in the north central part of the country. Iran has reportedly launched previously from an area near Qom and from Emamsharh as well. From these locations Iran is able to send its rockets in a southeastern direction over the entrance of the Persian Gulf and then over the Indian Ocean. **Figure 8**, "Space Launch Vectors (Current)," shows these launch corridors, which are somewhat constrained if Iran wants to avoid overflying other countries such as Oman and Pakistan. The slightly darker lines extending out a couple hundred kilometers show where the 1st stage rocket motors might be expected to fall to earth.

[121] "Iran Rejects Report on Transfer of N. Korean Missiles to Iran," *Fars News Agency (Tehran, Iran)*, November 29, 2010, On-line edition.

[122] "Guard Chief: Iran can build longer-range missiles," *The Associated Press*, June 28, 2011, newswire.

[123] "Iran not to make longer-range missiles," *Iran Government News*, June 28, 2011.

Figure 8. Space Launch Vectors (Current)



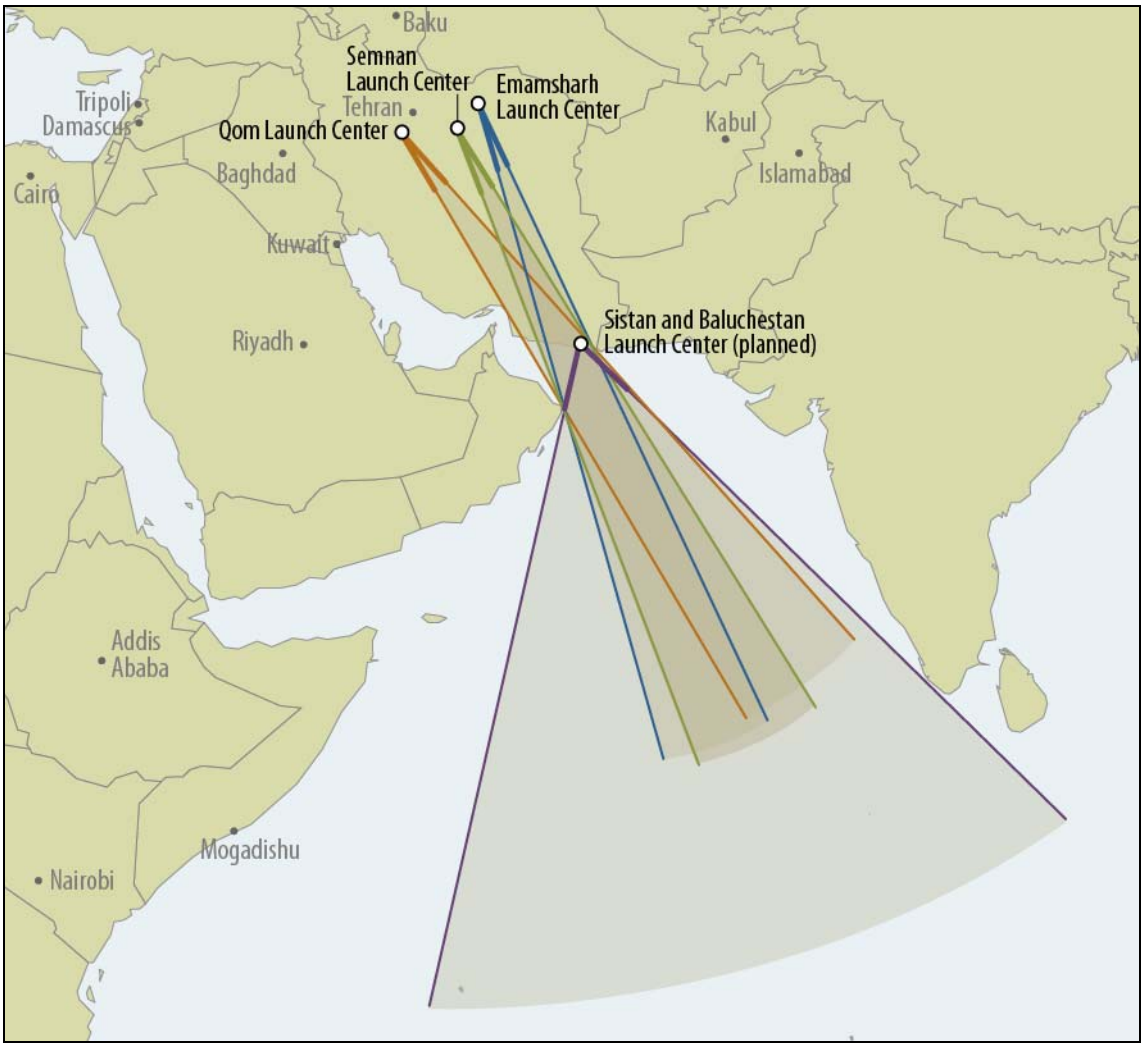
Source: CRS.

Iran announced in December 2010 that it would build a new space launch complex in the Sistan and Baluchistan Province, which is at the entrance of the Persian Gulf, and which Iran's Defense Minister Vahdi indicated in June 2012 was about 80% complete although Vahdi gave no clue as to the center's location. Some experts believe a new space complex, first mentioned in December 2010, is being built in southeastern Iran in the Sistan and Baluchistan Province.[124] The fact that such a complex is so close to the Gulf and highly vulnerable to attack suggests its purpose is for space launch activities. **Figure 9**, "Space Launch Vectors (Prospective)," illustrates how significantly enhanced and more flexible Iran's space launch endeavors would be increased over what they are currently with this new space complex. Range safety concerns would similarly be greatly alleviated by having rocket stages and possible failed launches occur over wide swaths of the ocean rather than land. From this southern launch location, a more southeastern trajectory also provides some advantage of the earth's rotation in achieving orbit.[125]

[124] "Iran's new space center boosts rocket plan," *UPI.com*, August 3, 2012, online edition.

[125] The more easterly the launch allows the launcher to gain maximum speed from the rotation of the earth.

Figure 9. Space Launch Vectors (Prospective)



Source: CRS.

Space Launch Vehicles

Iran used the Safir SLV to launch the Omid satellite into orbit in February 2009. The Safir SLV used a first stage based on the single stage Shahab 3 with a specially designed second stage. Iran continued to develop this liquid-fueled SLV. The Safir is designed to carry a light payload into low-earth orbit and as such is not considered to be capable of providing a long-range nuclear weapons capability. The Safir-2B is a second generation Safir SLV designed to put a 50 kilogram payload into low-earth orbit.

A more powerful rocket was displayed as a mockup in 2010 and named Simorgh. It appeared to be designed to carry heavier Iranian satellites into orbit using four main engines. Iran claims the Simorgh could put a 60 kilogram payload into low-earth orbit. Comments made by Iranian officials suggest the design has since undergone various modifications. Simorgh (which Iran now calls the Safir-2) was to have first flown in 2010, but is now expected to be launched at either a newer site at Semnan or the newly planned space complex in southeastern Iran.

Orbital Launches

Satellite Launch Effort to Date

Iran became the ninth country[126] to demonstrate an indigenous space launch capability on February 2, 2009 when it launched an Omid satellite from a Safir 2 rocket. The launch occurred at the Semnan Missile and Space Center east of Tehran and flew southeast over the Indian Ocean.[127] Space-track.org confirmed soon thereafter that two objects had entered low-earth orbit. The Omid satellite reentered the atmosphere on April 25, 2009 and fell into the south Atlantic. The Safir 2 rocket body reentered the atmosphere on May 31, 2009. Iran said that Omid was a communications satellite.[128]

U.S. officials, however, objected to the Iranian space launch. The Department of State said: "Iran's ongoing efforts to develop its missile capabilities remain a matter of deep concern. Recently, Iran's development of a space launch vehicle (SLV) capable of putting a satellite into orbit establishes the technical basis from which Iran could develop long-range ballistic missile systems."[129] A spokesman for the Department of Defense said the launch was

> certainly a reason for us to be concerned about Iran and its continued attempts to develop a ballistic missile program of increasingly long range. Although this would appear just to be the launch of a satellite, their first, obviously there are dual-use capabilities in the technology here which could be applied toward the development of a long-range ballistic missile. And this is a cause of concern to us, and I think to certainly everybody in the region – Israel and their Arab neighbors – as well as to our allies in the region.[130]

Various analysts have argued that to some degree Iranian missile experts have modified or reverse-engineered older Soviet-era rockets in Iran's space program. They point out how identical they look, how comparable their performance parameters are, and so on. Despite compelling evidence supporting their claims, others strongly disagree. German scientists Schmucker and Schiller maintain that "reverse engineering is so difficult that there is not one single proven example for successfully reverse engineered missiles and rockets."[131]

Iran has launched two additional satellites. The Rasad-1, reportedly an imaging satellite, was successfully launched on June 15, 2011. The Navid-e Elm-o Sanat was reportedly successfully

[126] In order of first orbital launch are: the Soviet Union, the United States, France, Japan, China, the United Kingdom, India, Israel and Iran. Russia and Ukraine are considered to have inherited their space launch capabilities as successor states to the former Soviet Union. The European Space Agency (ESA) is not included because it is a consortium of a number of European governments and commercial companies.

[127] Stephen Clark, "Iran puts Satellite into Earth Orbit," *Spaceflight Now*, February 3, 2009, http://spaceflightnow.com/news/n0902/03iran/.

[128] Iranian Space Agency, *In the Name of God the Compassionate the Merciful*, OMD Satellite Launch Report, 46th Meeting of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS), 9th-20th February 2009, February 9, 2009.

[129] Department of State, "Iranian Launch of Satellite," press release, February 3, 2009.

[130] Department of Defense, DOD News Briefing with Press Secretary Geoff Morrell from the Pentagon, February 3, 2009, http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4347.

[131] Robert H. Schmucker and Markus Schiller, "The DPRK Missile Show: A Comedy in (Currently) Eight Acts," Draft report, Schmucker Technologies, Report XX/10, Germany, May 5, 2010, p. 8.

launched on February 3, 2012; it remained in orbit for about two months. The Navid is an experimental student-built satellite designed to test camera and telecommunications equipment.

Planned Satellite Launches

In January 2011, Iranian Defense Minister Vahdi announced that two satellites were being readied, including the Fajr satellite and the Rasad satellite mentioned above, which were capable of capturing imagery with a resolution of more than 200 meters. He also said a space laboratory called Explorer-4 was being readied.[132] On February 7, 2011, President Ahmadinejad named four satellites to be launched: Fajr, Rasad, Amir-Kabir-1 and Zafar.[133] **Table 3**, "Iranian Satellites (Current and Planned)," provides an overview of current and planned Iranian satellite launches.

Table 3. Iranian Satellites (Current and Planned)

Name	Purpose	Date
Sinah-1 (Iranian design, Russian built)	Reconnaissance	Launched by Russia on Oct. 28, 2005
Environment-1 (Iran, China, Thailand)	Joint research; earth observation	Launched by China on Sept. 6, 2008
Omid	Research and Telecommunications	Launched by Iran on Feb. 2, 2009
Fajr	Imaging with experimental GPS system	Delayed, planned for fall 2012
Navid-Elmo-Sannat or Ya Mahdi (experimental student satellite)	Telecommunications and reconnaissance	Launched by Iran, February 3, 2012
Rasad	Imaging	Launched by Iran, June 15, 2011
Mesbah (Iranian-Italian collaboration)	Telecommunications	Satellite being held by Italy because of sanctions
Mesbah-2	Limited telecommunications	Planned for 2011-2012
AUT-SAT (experimental student satellite)	Remote Sensing	Planned for 2011-2012
Zafar-1	Imaging	Planned for 2012
Zohreh	Communications	Planned for 2014
Qaem	Communications	Planned for 2016
Toloo	Reconnaissance with SIGINT capabilities	Launch date not confirmed
Pars Sepehr	Remote sensing	Launch date not confirmed
Pars-2	Remote sensing	Launch date not announced
Iran-APSCO (Asia-Pacific Space Cooperation Organization)	Design, build and launch 10 research, remote-sensing and telecommunications satellites	Launch dates not confirmed
Besharat (Iran-Organization of the Islamic Conference)	Not announced	Not announced

Sources: Various Iranian and international news sources and *Jane's Intelligence Review*, April 4, 2011.

[132] *Defense Minister: New Space Projects to be Unveiled*, Islamic Republic News Agency (IRNA), January 30, 2011.

[133] *Iran President Unveils Four New Satellites*, Islamic Republic News Agency (IRNA), February 7, 2011.

Sub-orbital Launches

As part of a nation's space program, it is common to develop, test and launch a number of rockets into space for short durations to measure the effects of space and study its effects on animals in preparation for subsequent manned space flight. Iran has outlined such a plan and has moved forward with those plans. This is another indication that Iran intends to pursue advanced space flight in the future.

On February 25, 2007 Iran reportedly launched a rocket, but no information on what equipment or cargo it carried was provided. A year later on February 4, 2008 Iran said it launched a sub-orbital rocket named Kavoshgar-1, which reportedly transmitted various scientific data on the earth's atmosphere. Kavoshgar-2 launched in November 2008 carrying a small space laboratory. A third rocket, Kavoshgar-3 launched on February 3, 2010 with several animals (a rodent, several worms, and two turtles) and transmitted live video of the small environmental lab. Iran thus became the sixth nation or consortium to send animals into space.[134] Kavoshgar-4 launched on March 15, 2011. Although designed to carry a monkey, this particular launch did not include any animals. In September 2011, Kavoshgar-5 was launched with a monkey on board in a test capsule, but the rocket failed. Later in 2011, Iran suspended its sub-orbital flight program for further review, but in May 2012 Iran announced the program to send live animals into space would resume shortly. The Kavoshgar-1 was apparently a modified Ghadr-1; the other Kavoshgars likely were based on either Zelzal or Nazeat rocket motors.

Manned Space Flight

Iran first expressed interest in manned space flight during a Soviet-Iranian Summit on June 21, 1990. Both Presidents agreed in principle to conduct joint Soviet-Iranian manned flights to the Soviet Mir space station. This goal was not realized because of the break-up of the Soviet Union soon thereafter.

It was not until 2008 that Iran announced plans for its own manned space program, as well as plans for the development of its own spacecraft and a space laboratory. [135] The head of Iran's Aerospace Industries Organization added that Iran intended to launch a manned mission into space within a decade. He described this as Iran's top priority for the next decade in order to make Iran the leading space power of the region by 2021.[136]

In August 2010, Iranian President Ahmadinejad said Iran's first astronaut would be sent into space on an Iranian space craft no later than 2019. This would be preceded by an Iranian manned sub-orbital spaceflight by 2016 in preparation for the eventual orbital spaceflight. There has also been some unconfirmed news regarding Iranian participation in a Chinese space station.

The fact that Iran has signified a commitment to a public, manned space effort over the next decade is indicative of the kind of space launch program one would expect from a country pursuing a legitimate program. Although this does not mean Iran will not learn much from a space launch program that it could apply to long-range ballistic missiles, some might argue that

[134] Others are the United States, the Soviet Union, China, Japan and the European Space Agency.

[135] "Iran plans manned space mission in 10 years," *Reuters*, August 21, 2008, newswire.

[136] "Iran to send first astronaut into space within 10 years," RIA Novosti, August 20, 2008.

its use of personnel and resources in this way significantly weakens the case that Iran's space program is merely rhetorical masking of a covert ICBM program.

Foreign-Iranian Cooperation

Since the early 1980s, many thousands of articles and news stories have been written about Iran's efforts to procure ballistic missiles, components and materials, and to develop an indigenous missile and space launch infrastructure. A considerable number of these items provide details of interest. Although many of those articles are likely accurate, it is not entirely possible to sort them all out from those accounts that are not entirely accurate. On the other hand, official public U.S. and other government sources generally do not provide such specificity, but instead are very useful to track broader trends over time.

This section is included to provide an overview from such public official assessments because no such overview is found elsewhere probing the extent of foreign cooperation with Iran's ballistic missile and space launch programs. Furthermore, this section describes not only the degree to which Iran developed close working relationships with others on the way to developing its own indigenous capabilities, but also demonstrates that these relationships largely continue out of necessity for Iran.

Around 1982, Iran began to focus on developing an indigenous solid-propellant rocket industry, but turned subsequently to other countries in varying degrees to acquire whole systems, components and training to build up its own ballistic missile force and develop its own production capabilities. Iran's efforts in this regard evolved and perhaps even diminished over time with respect to specific countries. As a result of this decades long effort, Iran is now considered to have become self-sufficient in major parts of its own ballistic missile programs, yet it is still apparently reliant on outside sources for some key missile components, especially for further development of its longer range ballistic missile program.

The Libyan and Syrian Relationship

Perhaps the earliest evidence of direct foreign missile cooperation with The Islamic Republic of Iran began in the early 1980s.[137] Iran reportedly began secret negotiations with Libya in 1984 to acquire short-range Scud-B ballistic missiles and in the following year received 20 Scud-Bs and 2 TELs (transporter erector launcher).[138] In 1986, Iran apparently received about a dozen Scud-Bs from Syria. It does not appear that Iran acquired additional Scuds from Libya or Syria after those transfers.

[137] Prior to the 1979 Revolution, Iran had ties to Western countries such as the United States. Iran had some it inherited from under the rule of the Shah. These were older, short-range tactical and battlefield missiles it used in the Iran-Iraq War (1980-1988).

[138] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment*, The International Institute for Strategic Studies, London, England, May 2010, pp. 13-14.

North Korean-Iranian Cooperation

Iran's relationship with the DPRK in developing ballistic missiles has been of long-standing. Starting with acquisition of Scud missiles from the DPRK in the 1980s, Iran has developed a close working relationship with Pyongyang in many if not all of its ballistic missile programs that subsequently led to Iran becoming increasingly self-sufficient in those programs.

Currently, Iran has likely exceeded the DPRK in its technical capacity to develop, test and build ballistic missiles.[139] But Iran may, to some extent, remain reliant on others, perhaps including the DPRK itself, for certain materials in the production of its ballistic missiles.

Then-Director of Central Intelligence Robert Gates testified in 1992 that North Korea had sold other countries longer range missiles and the technology to produce them.[140] The following year, then-Director of Central Intelligence R. James Woolsey[141] added that North Korea has sold Syria and Iran extended range Scud Cs and apparently agreed to sell missile technology prohibited by the MTCR. The IC further expressed concern that the DPRK was developing and marketing a new 1,000 km range missile and apparently had no threshold governing its sales; it appeared willing to sell to any country with the cash to pay. Already, North Korea was selling two versions of ballistic missiles—the normal modified Scud (500 km range), which they sold to several countries in the Middle East. They also had a number of discussions and contract talks for the 1,000 km missile, Woolsey testified. In follow-up questions for the record, the IC later wrote that Iran, "one of North Korea's best customers for ballistic missiles and related technology, is likely to be one of the first recipients of the 1,000 km No Dong. By the end of this decade [1990s], Iran could be able to assemble short-range (Scud B and Scud C) and medium-range No Dong ballistic missiles."[142]

Woolsey also commented on a report by the Russian intelligence community: "the IC has reviewed the Russian report on nonproliferation and finds it to be a credible unclassified document that generally corresponds to Western appraisals."[143] That Russian report said Iran's missile potential was confined to Scud B SRBMs received from Syria and North Korea. Using technology obtained from Egypt, North Korea was upgrading the Scud-class missiles purchased earlier from the USSR and exporting them to countries such as Iran. The same Russian report noted that North Korea's "Nodong 1 IRBM," which the DPRK intends to offer on the world market, was at the testing stage.[144]

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[139] E-mail correspondence with Michael Elleman (IISS), September 2012.

[140] U.S. Congress, Senate Committee on Armed Services, *Threat Assessment, Military Strategy, and Defense Planning*, 102nd Cong., 2nd sess., January 22, 1992, S.Hrg. 102-755 (Washington: GPO, 1992), pp. 8-21.

[141] U.S. Congress, Senate Committee on Governmental Affairs, *Proliferation Threats of the 1990's*, 103rd Cong., 1st sess., February 24, 1993, S.Hrg. 103-208 (Washington: GPO, 1993), pp. 8-12

[142] U.S. Congress, Senate Committee on Governmental Affairs, *Proliferation Threats of the 1990's*, 103rd Cong., 1st sess., February 24, 1993, S.Hrg. 103-208 (Washington: GPO, 1993), p. 192.

[143] In response to hearing questions, the IC responded thusly some months later. See U.S. Congress, Senate Committee on Governmental Affairs, *Proliferation Threats of the 1990's*, 103rd Cong., 1st sess., February 24, 1993, S.Hrg. 103-208 (Washington: GPO, 1993), p. 172.

[144] Foreign Broadcast Information Service, *Proliferation Issues. Russian Federation Foreign Intelligence Service Report. A New Challenge After the Cold War: Proliferation of Weapons of Mass Destruction*, JPRS-TND-93-007, Washington, DC, March 5, 1993, p. 29-30.

The 1990s saw several recurring trends 1990s between Iran and North Korea as assessed by the IC in its annual threat assessments before Congress. First, North Korea's ongoing export of ballistic missiles provided a qualitative increase in capabilities to countries such as Iran. Second, Iran was using its relationship with North Korea, and the significant amount of ballistic missile goods and services it provided to Iran, as an important means by which Iran was achieving its goal of self-sufficiency in the production of MRBMs. Third, Iran could significantly shorten the acquisition time for an ICBM by purchasing key components or entire systems from potential sellers such as North Korea, including potentially significant inputs of space launch vehicle technology and support.

It was not until 2006 that Iran publicly acknowledged for the first time that it had obtained missiles from North Korea during its war with Iraq, but added that it no longer needed Pyongyang's assistance: "We received these [Scuds] from foreign countries like North Korea but 17 years after the war we were able to design all of these pieces and even their fuel," said the chief commander of the IRGC.[145] Some observers cast doubt on Iran's ability to produce even the Scud Bs and Scud Cs (Shahab-1 and Shahab-2 respectively) entirely indigenously without any foreign support for materials or components, or both, even through today.

In the latter 2000s, the IC continued to provide testimony on Iran's longstanding relationship with North Korea with respect to the purchase and development of ballistic missile technology. The IC continued to assess that North Korean cooperation was ongoing and significant to Iran's ballistic missile programs.

The Russian-Iranian Relationship

According to official public accounts, since the early 1990s, Russia's involvement with Iranian ballistic missile programs evolved slowly at first. But whether the Russian government itself was officially or indirectly involved with non-government Russian entities and Iran on these matters remains unclear. Whatever the case may be, the involvement of Russian individuals and entities expanded despite Russian government efforts to curb such involvement, leading to the acceleration of some Iranian missile programs. In the last few years, Russian involvement appears to have receded. From 2004-2007, Russian arms transfer agreements with Iran totaled about $1.6 billion (current U.S. dollars); from 2008-2011 total arms transfer agreements totaled about $100 million (current U.S. dollars).[146]

During the era of the Soviet Union, it does not appear that Iran acquired any ballistic missile systems, technology or training from that country. As the Soviet Union broke up, however, U.S. officials began warning that the former Soviet Union could become a source of proliferation concern. Then-Director of Central Intelligence Robert Gates testified in 1992 that specialized Soviet-era defense industries facing cuts in military funding might turn to the international marketplace where pursuit of hard currency could take precedence over proliferation concerns.[147]

[145] "Iran admits buying missiles from North Korea during Iraq war," *BBC Monitoring Asia Pacific—Political*, November 7, 2006, translated from *Nezavisimaya Gazeta*, November 3, 2006, p. 7.

[146] CRS Report R42678, *Conventional Arms Transfers to Developing Nations, 2004-2011*, by Richard F. Grimmett and Paul K. Kerr, p. 44.

[147] Gates also said tens of thousands of scientists and engineers are emigrating from the former Soviet Union, and "some have expertise applicable to special weapons and missiles… some may find a better market for their expertise in Third World countries trying to acquire or improve special weapons capabilities." U.S. Congress, House Committee on (continued...)

Gates repeated these concerns in 1993,[148] and his successor, R. James Woolsey testified that Russia and Ukraine were showing a growing willingness to sell missile technology prohibited by the MTCR (Missile Technology Control Regime) because of internal nationalist and economic pressures.[149] Woolsey added that most reports of any such transfers to that date were hoaxes, exaggerations or scams, but that a few transfers of sensitive technology had occurred to China. He warned further that China in turn could pass more advanced Russian or Ukrainian military technologies to others. Although the potential for Iranian-Russian ballistic missile cooperation existed, the U.S. IC made no mention of any such relationship in 1994[150] or 1995.[151]

The Iranian-Russian relationship had changed by 1996, however. Congress was notified in the annual 721 Report[152] that Russia had become a "primary source for missile related goods" and had "supplied a variety of ballistic missile goods during the reporting period to foreign countries, especially Iran."[153] The 1997 annual threat assessment from the Intelligence Community stated that Iran acquired Kilo-class submarines from Russia and was upgrading its anti-ship missile capabilities.[154] Additionally, the 721 Report stated "that entities in Russia and elsewhere continued to supply missile-related goods and technology to Iran. Iran is using these goods and technologies to achieve its goal of becoming self-sufficient in the production of MRBMs. The foreign equipment obtained in 1997 will be essential for achieving that goal."[155]

Russian officials, apparently concerned about these activities, issued a broad decree in January 1998 prohibiting Russian companies from exporting items known or believed to be used for developing WMD or their delivery systems, whether or not those items were on Russia's export control list.[156] Acknowledging that Russian efforts had shown some signs of slowing proliferation activities, the U.S. IC noted the difficulty in restricting technologies with dual civil and military applications, especially when countries such as Iran could take advantage of shortcomings in Russian export controls.[157] More specifically, the 1998 721 Report said that Iran's success in

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Armed Services, *Potential Threats to American Security in the Post-Cold War Era*, Hearings Before the Defense Policy Panel, 102nd Cong., 1st sess., December 10, 1991, H.A.S.C. No. 102-52 (Washington: GPO, 1992), p. 9.

[148] U.S. Congress, Senate Committee on Armed Services, *Threat Assessment, Military Strategy, and Defense Planning*, 102nd Cong., 2nd sess., January 22, 1992, S.Hrg. 102-755 (Washington: GPO, 1992), pp. 8-21.

[149] U.S. Congress, Senate Committee on Governmental Affairs, *Proliferation Threats of the 1990's*, 103rd Cong., 1st sess., February 24, 1993, S.Hrg. 103-208 (Washington: GPO, 1993), pp. 8-12.

[150] U.S. Congress, Senate Select Committee on Intelligence, *Current and Projected National Security Threats to the United States and its Interests Abroad*, 103rd Cong., 2nd sess., January 25, 1994, S.Hrg. 103-630 (Washington: GPO, 1994), pp. 4-78.

[151] Perhaps a key reason, according to Director, DIA, Lt. Gen. James R. Clapper was that Iran's military was rebuilding from its war with Iraq and that major economic constraints, such as hard currency shortages and a poor debt servicing record limited Tehran's ability to acquire weapon systems in the international marketplace. U.S. Congress, Senate Select Committee on Intelligence, *Worldwide Intelligence Review*, 104th Cong., 1st sess., January 10, 1995, S.Hrg. 104-15 (Washington: GPO, 1995), p. 34.

[152] This report is referred to as the 721 Report because it is a congressionally mandated under section 721 of the Intelligence Authorization Act for Fiscal Year 1997 (P.L. 104-293). Initially, it was a biannually-required report to Congress, but legislation changed that to an annual reporting requirement starting in 2004.

[153] Director of Central Intelligence, *The Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, July - December 1996*, Washington, DC, June 1997.

[154] 1997 Annual Threat Assessment.

[155] Director of Central Intelligence, *Report of Proliferation-Related Acquisition in 1997*, Washington, DC.

[156] Ibid.

[157] 1998 Annual Threat Assessment.

gaining technology and materials from Russian companies accelerated Iranian development of the Shahab-3 MRBM, which was flight tested in July 1998. The Report added that following intense and continuing engagement with the United States, "Russian officials have taken some positive steps in curtailing proliferation activities."[158]

Despite Russia announcing additional, new export controls, the IC reported in 1999 that "expertise and material from Russia continued to assist the Iranian missile effort in areas ranging from training, to testing, to components. There is no doubt this will play a crucial role in Iran's ability to develop more sophisticated and longer range missiles."[159] The first of two 721 Reports in 1999 stated that entities in Russia and elsewhere continued to supply considerable ballistic missile-related goods and technology to Iran, whose goal was to become self-sufficient. Despite steps taken to curtail proliferation activities, the Russian Government's "commitment, willingness, and ability to curb proliferation-related transfers remains uncertain. Moreover, economic conditions in Russia continued to deteriorate, putting more pressure on Russian entities to circumvent export controls."[160] The second of the two 721 Reports for 1999 reiterated much of the previous report and added that Russian entities provided substantial missile-related technology, training, and expertise to Iran that "almost certainly will continue to accelerate Iranian efforts to develop new ballistic missile systems, especially longer range ballistic missiles."[161] These assessments aligned with the 1999 National Intelligence Estimate (NIE) that stated Iran could test an ICBM that could deliver a several-hundred kilogram payload to many parts of the United States in the last half of the next decade (i.e., the late 2000s) using Russian technology and assistance.[162]

Russian entities continued to engage in transfers of missile related technology, goods and technical know-how throughout the 1990s until at least 2010. During this period, Iran moved increasingly toward self-sufficiency in the production of ballistic missiles. However, Iran certainly remains dependent on foreign suppliers for some key missile components," such as Russian suppliers (among others) according to the IC.[163]

A limited but significant level of ongoing cooperation is seen in each of the 721 Reports provided to Congress during the 1990s until the last several years. Also, a number of the IC's Annual Threat Assessments provided information about ongoing proliferation activities and concerns over the cooperation of some Russian entities with Iran. Through this period too, various Russian entities and individuals were sanctioned by the United States for their proliferation activities with Iran.

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[158] Director of Central Intelligence, *Unclassified Report to Congress, January – June 1998*, Washington, DC.

[159] 1999 Annual Threat Assessment.

[160] Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 30 June 1999*, Washington, DC.

[161] Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 July through 31 December 1999*, Washington, DC.

[162] National Intelligence Council (NIC), *Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015*, Washington, DC, September 1999

[163] Deputy Director of National Intelligence for Analysis, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 31 December 2010*, Washington, DC.

A change may have occurred in the last couple of years. Neither the 2011[164] nor the 2012[165] annual threat assessments to Congress indicated ongoing cooperation between Russian entities with Iranian ballistic missile programs. And the 2011[166] and 2012[167] 721 Reports say the same thing that "Iran continued to move toward self-sufficiency in the production of ballistic missiles, but almost certainly remains dependent on foreign suppliers for some key missile components. Entities in China and Russia along with North Korea are among likely suppliers." In other words, the specificity of earlier Russian cooperation is now more ambiguously described as collaboration with other countries and other foreign entities.

In the open-source literature, there are a significant number of reports, articles, news accounts and assessments that touch on Russia's involvement with Iran's ballistic missile programs. Although this body of literature can be speculative and misinformed, some of it appears well grounded, albeit based on unclassified technical or other assessments. Because of this, the public policy debate can be limited in terms of what can be considered informed and accurate, and what is inaccurate or misleading.

From some of the expert community, at least two slightly different schools of thought exist as to what Russian involvement in Iran's ballistic missile programs may have consisted of. The official, unclassified record discussed above does not necessarily rule out or definitively show that either view is represented accurately by the open-source literature.

One view suggests that Iran may actually have succeeded in gaining access to a licensed production line from Russian defense firms via North Korea. Noted German rocket scientists Robert Schmucker (who served as a weapons inspector in Iraq) and Markus Schiller have argued that North Korea did not indigenously develop its own ballistic missile capabilities, but rather procured Russian ballistic missiles that they then may have modified with technical assistance from entities elsewhere, principally Russia and perhaps China, with likely funding support from Iran. This licensed production arrangement, they argue, may continue today. Some of those systems in turn may then have made their way into Iran; these authors, like many others, believe many of Iran's ballistic missiles are of North Korean origin or manufacture.[168] Schmucker and Schiller assess that the Shahab-1 SRBM is identical to the DPRK Scud B, the Shahab-2 is almost identical to the North Korean Scud C, and the Shahab-3/No Dong is strongly related to the Scud B. Further Iranian adaptations of these missiles are evident, they argue.

[164] Director of National Intelligence, James R. Clapper. *Statement for the Record on the Worldwide Threat Assessment of the U.S. Intelligence Community for the Senate Armed Services*, March 10, 2011. Also, Director, Defense Intelligence Agency, Lt. Gen. Ronald L. Burgess. *World Wide Threat Assessment. Statement before the Committee on Armed Services*, March 10, 2011.

[165] Director of National Intelligence, James R. Clapper. *Unclassified Statement for the Record on the Worldwide Threat Assessment of the U.S. Intelligence Community for the Senate Select Committee on Intelligence*, January 31, 2012.

[166] Deputy Director of National Intelligence for Analysis, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 31 December 2010*, Washington, DC.

[167] Deputy Director of National Intelligence for Analysis, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 31 December 2011*, Washington, DC.

[168] Robert H. Schmucker and Markus Schiller, "The DPRK Missile Show: A Comedy in (Currently) Eight Acts," Draft report, Schmucker Technologies, Report XX/10, Germany, May 5, 2010.

A second school of thought largely posits that Iranian scientists and technicians have been able to reverse engineer variations of derivatives of Soviet-era ballistic missiles with varying degrees of Russian assistance. How Iran actually acquired such technology is further debated, but DPRK-Iranian collaboration on reverse engineering is often suggested, with varying levels of assistance from Chinese entities as well. Michael Elleman[169] for instance, argues there is no evidence to suggest that Iran itself succeeded in procuring a licensed production line for liquid-fueled engines. Instead, Elleman has said it is possible but uncertain that Iran received Russian assistance in attempting to reverse-engineer and manufacture the North Korean No Dong engine, which is widely believed to be an adaptation of the Soviet-era Scud missile.

MIT Professor Ted Postol wrote a detailed and significant contribution to the technical debate over Iranian ballistic missile programs.[170] He largely agrees that the Shahab series are of North Korean derivation and with some degree of reverse engineering they were adapted in Iran. Although Postol agrees there was likely Russian assistance, he argues that Iranian scientists and engineers have demonstrated their own significant expertise in their ballistic missile programs.

Again, neither view may be entirely correct or entirely wrong. Both may have some correspondence with classified technical assessments as to how precisely Iran acquired and developed its ballistic missile capabilities with respect to Russian involvement.

Chinese-Iranian Cooperation

China has been involved in proliferating WMD and ballistic missile programs to other countries for a long time, and has thus proven a major concern for the United States. Although many U.S. policymakers deem China's progress perhaps too slow to be acceptable, others would argue that progress toward U.S. nonproliferation objectives is being made. Where once China exported entire systems, production capabilities, and key components often with direct or tacit government approval, many believe today that China no longer does those things. Instead, China has adopted its own export controls modeled after those of the MTCR and works with the United States to help stop some proliferation activities within China. This has now forced countries such as Iran to find and exploit weaknesses in the Chinese system, looking for lax enforcement and shopping around for PRC entities willing to export perhaps out of view of the Chinese government. From 2004-2007, Chinese arms transfer agreements with Iran totaled about $300 million (current U.S. dollars); from 2008-2011 total arms transfer agreements dropped to less than $50 million (current U.S. dollars).[171]

The U.S. Intelligence Community expressed concern in the early 1990s over China selling other unnamed countries longer range missiles and the technology to produce them, especially those technologies that might grow out of China's preexisting military cooperation with countries such as Russia and Ukraine. The IC pointed out that although China had agreed to observe MTCR guidelines when the United States lifted sanctions, unless sales of such missiles were actually stopped, it was likely these delivery systems would be mated with WMD capabilities, especially

[169] Michael Elleman, *Iran's Ballistic Missile Capabilities: A Net Assessment* (London: The International Institute for Strategic Studies, 2010), p. 94.

[170] Theodore Postol, *Technical Addendum to the Joint Assessment on Iran's Nuclear and Missile Potential, A Technical Assessment of Iran's Ballistic Missile Program*, May 6, 2009.

[171] CRS Report R42678, *Conventional Arms Transfers to Developing Nations, 2004-2011*, by Richard F. Grimmett and Paul K. Kerr, p. 44.

in the Middle East.[172] During this period it was also clearly a source of concern that China might be cooperating on missile programs with North Korea who might in turn assist Iran in its ballistic missile programs.

Russian intelligence to this point in 1993, however, assessed that Iran's missile programs were restricted to Syrian and DPRK Scud purchases. According to Russia, available data confirmed there were "bottlenecks" throughout the whole of Iran's missile program, primarily a shortage of skilled personnel, science-intensive technology, scarce starting materials, and, possibly, the requisite amounts of financing.[173]

In 1996, the Intelligence Community began to testify openly that China was among several countries and private consortiums that were willing to sell missile systems and technologies to developing countries around the world.[174] Although Iran was not named specifically in the annual threat assessment, the IC reported to Congress a more specific role between China and Iran in the 721 Report that year, stating "China and Russia have been primary sources for missile-related goods" to Iran."[175] Iran's efforts to acquire foreign missile technology was characterized as "unrelenting," and the Chinese were described as having provided a tremendous variety of assistance to both Iran's and Pakistan's ballistic missile programs. This charge was stronger the following year when the IC reported that Iran was using these goods and technologies (from several countries including China) "to achieve its goal of becoming self-sufficient in the production of MRBMs. The foreign equipment obtained in 1997 will be essential for achieving that goal."[176] It was not clear how key China's participation was compared to the other countries named: Russian and the DPRK.

By 1998, the IC testified that PRC defense industries were under increasing pressure to become profit making organizations – an imperative that put them at odds with U.S. interests.[177] The IC added that conventional arms sales had lagged in recent years, encouraging Chinese defense industries to look to WMD technology, primarily to Pakistan and Iran, in order to recoup any losses. Further, there was no question that China contributed to WMD advances in these countries. Moreover, although China had passed comprehensive laws governing nuclear technology exports, China's relations with some proliferant countries were long-standing and deep.[178] The 721 Report added little more, other than that Chinese entities provided a variety of

[172] U.S. Congress, Senate Committee on Armed Services, *Threat Assessment, Military Strategy, and Defense Planning*, 102nd Cong., 2nd sess., January 22, 1992, S.Hrg. 102-755 (Washington: GPO, 1992), pp. 8-21, and also U.S. Congress, Senate Committee on Governmental Affairs, *Proliferation Threats of the 1990's*, 103rd Cong., 1st sess., February 24, 1993, S.Hrg. 103-208 (Washington: GPO, 1993), pp. 8-12.

[173] Foreign Broadcast Information Service, *Proliferation Issues. Russian Federation Foreign Intelligence Service Report. A New Challenge After the Cold War: Proliferation of Weapons of Mass Destruction*, JPRS-TND-93-007, Washington, DC, March 5, 1993, p. 29.

[174] 1996 Annual Threat Assessment.

[175] Director of Central Intelligence, *The Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, July - December 1996*, Washington, DC, June 1997.

[176] Director of Central Intelligence, *Report of Proliferation-Related Acquisition in 1997*, Washington, DC.

[177] 1998 Annual Threat Assessment.

[178] Ibid. The IC testified that China had agreed to abide by the "guidelines and parameters" of the Missile Technology Control Regime (MTCR) and had committed not to transfer ground-to-ground MTCR-class missiles. But China did not appear to interpret its responsibilities under the MTCR guidelines as strictly as the United States and other MTCR members the IC said. By all indications China had taken itself out of the business of exporting complete ballistic missiles, however. This, the IC assessed, was an important step—one that has slowed the process of military destabilization in South Asia and the Middle East. "But it is not enough, it argued. We would like to see China upgrade (continued...)

missile related items and assistance to several countries of proliferation concern, implying, but not naming, Iran.[179]

Since 1999 through today, in its annual worldwide threat assessments and through the 721 reports to Congress, the IC regularly discussed concern over ongoing Chinese or Chinese entity involvement with Iranian and other country missile programs,[180] despite some level of PRC government commitment to restricting such exports. From these assessments, China's role has apparently not changed significantly one way or the other.

In part, China has disagreed with the United States and others with interpretation of some of its MTCR commitments to restrict missile-related exports. The PRC might therefore argue that the types of exports its companies are selling to countries such as Iran are legitimate. The U.S. position has been otherwise. But there might also be another explanation: lax PRC enforcement of its commitments and its laws. In 2011, the IC reported that

> Chinese entities – including private and state-owned firms – continue to engage in WMD-related proliferation activities. The United States in recent years has imposed sanctions on several Chinese companies for sales of WMD- and ballistic missile-related technologies to states of concern. Although China has export control legislation that approximates MTCR controls, enforcement continues to fall short. Chinese entities continue to supply a variety of missile-related items to multiple customers, including Iran, Syria, and Pakistan.[181]

Missile proliferation or problematic missile-related exports from China was not mentioned in the most recent IC annual threat assessment (2012).[182]

Net Effects on Iranian Programs

Iran has become self-sufficient in many aspects of its ballistic missile and space launch programs. But as noted in the above section, the U.S. IC has said on several occasions that Iran almost certainly remains dependent on foreign suppliers for some key missile components. The United States has not identified what these components are. According to an unreleased report by a Panel of Experts at the UN,[183] however, a number of specific items that Iran continues to procure from

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its commitments to current MTCR levels and implement effective export controls."

[179] Director of Central Intelligence, *Unclassified Report to Congress, January – June 1998*, Washington, DC

[180] For example, U.S. Congress, Senate Committee on Armed Services, *Worldwide Threats*, 106th Cong., 1st sess., February 2, 1999, S.Hrg. 106-436 (Washington: GPO, 2000); U.S. Congress, Senate Select Committee on Intelligence, *Current and Projected National Security Threats to the United States*, 106th Cong., 2nd sess., February 2, 2000, S.Hrg. 106-580 (Washington: GPO, 2000); Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 July through 31 December 1999*, Washington, DC; and Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 30 June 2000*, Washington, DC.

[181] Deputy Director of National Intelligence for Analysis, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 31 December 2010*, Washington, DC.

[182] Director of National Intelligence, James R. Clapper. *Unclassified Statement for the Record on the Worldwide Threat Assessment of the U.S. Intelligence Community for the Senate Select Committee on Intelligence*, January 31, 2012.

[183] This unreleased UN report is identified as: United Nations, *Final Report*, Panel of Experts Established Pursuant to resolution 1929 (2010), May 2010, pp. 28-29. The only online copy that could be found is: http://www.scribd.com/doc/
(continued...)

foreign sources indicate a lack of indigenous capability. Iran continues to seek navigation guidance units, including gyroscopes and accelerometers, testing and satellite navigation equipment, control systems, tracking telemetry equipment, transmitters, receivers, on-board sensors and transducers. In addition to these missile components, Iran lacks access to some high quality production materials to improve the effectiveness and precision of their missiles. These dual-use materials include carbon-carbon materials,[184] structural materials,[185] polymeric substances,[186] ammonium percholorate[187] and aluminum powder.[188]

Perhaps the most consequential contribution has been from China, mostly in the provision of solid-propellant production facilities and equipment and likely training. What China has provided and the accumulated knowledge gained by Iran in operating these facilities has likely enabled Tehran to build whatever size and range solid fuel missile they want, although this will require time and money.

Today Iran is viewed increasingly as a rising proliferator. Perhaps the irony of a restrictive nonproliferation regime is that Iran became largely self-sufficient. This likely took longer than Iran had wanted, but with a considerable indigenous capability Iran may now be positioned to export some of its own ballistic missile systems, components or knowledge to others. It has been noted that Syria continued work on establishing a solid-propellant rocket motor development and production capability with help from outside countries such as Iran.[189] But civil war in Syria raises doubts as to whether this will result in anything of consequence.

Challenges Today

Iran has demonstrated its willingness over decades to pursue the development, testing, acquisition and deployment of ballistic missiles as an essential part of its regional war fighting, deterrent and retaliatory capability. A determined adversary such as Iran has not shown that it is deterred or dissuaded by U.S. conventional military superiority, or by U.S. and international sanctions, or by the deployment of U.S. BMD capabilities.

Iran has similarly demonstrated resolve and commitment to a genuine space launch program as a matter of national pride and self-sufficiency in space in the face of widespread international condemnation. Just as every other space faring nation, however, Iran too will use space for a range of military purposes, such as for reconnaissance and communications.

(...continued)

55737041/Leaked-UN-Panel-of-Experts-Report-on-Iran-Sanctions-May-2011.

[184] Used for the production of motor exit cones and nozzles, reentry vehicle nose tips, heat shields and leading edges of control surfaces.

[185] Used to produce solid motor cases, interstages, wings, inlets, nozzles, heat shields, nose tips, structural members and frames.

[186] Used for producing solid-propellant rocket fuel.

[187] An oxidizing agent used in most modern solid-propellant formulas.

[188] An important fuel component of composite propellants in solid rocket motors.

[189] Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January through 30 June 1999*, Washington, DC.

Is slowing down Iran's ballistic missile and space launch programs, making them more difficult and expensive, and forcing Iran to find less reliable and capable alternatives an adequate solution for dealing with Iran? On this point there are significant disagreements and no consensus on how to proceed. At the same time, is it realistic to believe that ending Iranian interest in acquiring ballistic missiles or pursuing a space launch capability is even possible? Some point out that other countries have given up their missile programs entirely, or forsworn ballistic missiles while developing an effective space launch program alone. But would Iran change its pattern of behavior short of a change in regime? Most are skeptical.

So this seemingly leaves the United States and its allies, many might reluctantly agree, with few better choices than the current apparent path. On the other hand, there are perhaps early indicators that Congress' attitudes regarding the reliability of the "assured destruction" deterrence policy of the Cold War era may be changing under the circumstance of both nuclear and missile delivery system proliferation. Among the pieces of evidence suggesting this change in attitude is Declaration 2 in the Resolution of Ratification accompanying New START.[190] Such a change in attitude might imply that defensive options will no longer be seen as 'destabilizing', as was the dominant view during the Cold War. Although the behavior of rogue states such as Iran may be catalyzing this change in attitude, the language of Declaration 2 also carries the strong implication that in the future Congress will gauge the missile threat more broadly than just focusing on the activities and progress of ballistic missile and nuclear programs in such rogue states. This is because Declaration 2 challenges even a mature missile power such as Russia to adopt a more defensive strategic posture in order to provide a political and policy basis for devaluing offensive missile and nuclear weapon programs in a broader grouping of threatening and potentially threatening states. In this case, the focus on assessing the progress of ballistic missile and nuclear weapons programs of rogue states might become less intense in Congress because responsive U.S. policies will become more broadly based. In short, specific actions by Iran may become a less powerful driver of U.S. strategic deterrence policy than is the case today. For the time being, however, Congress will likely continue to take a focused interest in Iran's role in the region and in its missile programs. Beyond efforts to impose increasingly stringent sanctions, it is unclear whether there is more Congress itself can do to affect Iran's commitment to its ballistic missile and space launch programs. But continuing to work with the Administration through cooperation and oversight, to stay prepared to take additional action as needed is a process many decision makers appear prepared to be committed to.

[190] *Congressional Record*, December 22, 2010, pp. S10984-S10985.

Appendix A. The "Great Prophet" Exercises (2006-2012)

Since 2006, Iran has conducted various military exercises that included some number of ballistic missile tests. These are called "Great Prophet" exercises by Iran and sometimes "Noble Prophet" or "Holy Prophet" by others. Iran tests missiles at other times as well, but these particular missile tests are held in conjunction with other conventional land, sea, and air military exercises. From open sources it is neither possible to identify with precision the number and type of all missiles launched during these exercises, nor to identify all other test launches by Iran at other times.

Nevertheless, these ballistic missile exercises provide considerable information to U.S. and other intelligence communities that assess Iran's ballistic missile programs. Additionally, these exercises serve several purposes for Iran, including testing and evaluating weapon system performance, providing operational training and evaluation of military personnel, broadcasting Iran's capabilities to the United States and others throughout the Middle East, and showcasing military prowess to Iran's own populace. Many of these missile launches are shown in photos and video on Iranian television and other media and can be found on such places as YouTube. There does not appear to be any single source that tracks or details the missile launch components of all these exercises. Therefore this appendix is added to this report. This appendix will be updated for future "Great Prophet" exercises.

Great Prophet 1 (March-April 2006)

Iran conducted military exercises in the Straits of Hormuz from March 31 to April 6, 2006. Most reports at the time were vague or conflicting about precisely what missile launches were involved. Various Iranian media reported launches of a medium-range radar-evading anti-ship missile, a different multi-warhead missile and a very fast torpedo. Most media reports at the time, however, reported these simply as missile launches. Various observers outside Iran greeted Iranian technical claims with some skepticism or believed that these were not Iranian weapons, but more likely Russian and Chinese in origin. A Pentagon spokesman responded to the launches saying while it is "possible they are increasing their capability.... Iranians have also been known to boast and exaggerate their statements about greater technical and tactical capabilities."[191] In one account, Iran reportedly claimed to have launched an improved "intermediate-range ballistic missile likely a Shahab-3 missile,"[192] but in another report a Pentagon official said Iran tested a Shahab-2 SRBM.[193]

Great Prophet 2 (November 2006)

Iran conducted military exercises throughout the country November 2-9, 2006. According to Iranian military leaders, "the first and main goal of this exercise is to demonstrate power and

[191] Alon Ben-David, "West Doubts Iran Missile Claims," *Jane's Defence Weekly*, April 12, 2006.

[192] Douglas Barrie, "Firing Away; Missile in Iranian exercises underscores extent of guided-weapons ties between Tehran and Beijing," *Aviation Week and Space Technology*, April 10, 2006, p. 33.

[193] Bill Gertz, "Pentagon calls Iran missile claim and exaggeration," *The Washington Times*, April 4, 2006, p. A03.

national determination to defend the country against any possible threat."[194] Iran military officials added that other objectives included enhancing and testing the IRGC's deterrence capability and effectiveness; testing sophisticated and advanced weapons, conducting operational tactics involving distances of more than 1,400 kilometers; and, finally, coordinating land, naval, and air operations and logistics forces covering an area of 1,730 kilometers.[195] The Commander of the IRGC added that Iran was ready to share its missile systems with political allies and neighboring countries.[196]

Iran claimed to have test-fired "dozens of Shahab-2 and -3, Zolfaghar-73 [unknown what this referred to], Scud B, Fateh-110 and Zelzal" missiles in a central area of Iran.[197] It was the first time Iran claimed to have launched an enhanced range Shahab-3 MRBM during military maneuvers and said that it was fired with cluster warheads;[198] it was also reported to have an extended range of about 1,900 kilometers.[199] Iran further claimed to have launched three new types of tactical naval warfare missiles named Noor, Kowsar and Nasr, "suitable for covering all the Strait of Hormuz, the Persian Gulf and the Sea of Oman."[200] Vice Admiral Walsh, commander of U.S. naval forces in the region, expressed "particular concern over the threat the missiles pose to vessels traveling through the Sea of Oman and the Strait of Hormuz."[201]

Great Prophet 3 (July 2008)

Iran conducted a series of missile tests during military exercises in the Strait of Hormuz and in the desert from July 8-10, 2008. The missiles were launched from the Semnan Missile Test Range with warheads impacting within Iran or its coastal waters.[202] Although there was some confusion over what precisely occurred, U.S. officials and others determined that no new capabilities were demonstrated.[203]

Iran reportedly launched some number of Shahab-1 and Shahab-2 SRBMs, a Shahab-3 MRBM, and Fateh, Zelzal, Nazeat, Fajr-3 and Oghab tactical missiles, but there is uncertainty over exactly how many. Iran and most early media accounts said nine missiles of varying ranges were launched.[204] But another report said that U.S. tracking systems detected only seven missile

[194] "Iran fires first long-range missiles in war games," *Agence France Presse—English*, November 2, 2006.

[195] "Iran ready to give missile systems to regional allies - army commander," *BBC monitoring Middle East - Political*, November 8, 2006, source: *Al-Alam TV*, Tehran (in Arabic), November 5, 2006.

[196] Reuters, "Iran Would Share Missiles," *The New York Times*, November 7, 2006, p. 6.

[197] Ibid.

[198] Iran claimed the Shahab-3 was fitted with a warhead containing 1,400 bomblets and that they landed at an intended target only a few meters away leaving a large crater larger than 20-30 meters. It would be used against large garrisons, large gatherings, aircraft carriers, etc. See "Iran's Guard Commander comments on Tehran's missile power," *BBC Monitoring Middle East - Political*, November 13, 2006, source: *Vision of the Islamic Republic of Iran Network 2*, Tehran, in Persian, November 12, 2006.

[199] Ed Blanche, "Iran stages display of missile firepower," *Jane's Missiles and Rockets*, January 1, 2007.

[200] "Report: Iran Test fires 3 New Missiles," *Associated Press Online*, November 3, 2006, on-line edition.

[201] David Shelby, "U.S. Admiral Condemns Iranian Missile Tests," *State Department Documents and Publications*, November 6, 2006. For Adm. Walsh, the concern expressed was not so much focused on this particular test, but the these missiles generally posed to the Gulf.

[202] David A. Fulghum, "Warhead Diplomacy," *Aviation Week & Space Technology*, July 14, 2008, p. 60.

[203] Pamela Hess, "Official: Iran missile tests used 'old equipment,'" *Associated Press*, July 12, 2008.

[204] See for instance, "Defiant Iran test-fires longer range missile," *Agence France Presse - English*, July 9, 2008.

launches.[205] Television footage showed at least six missiles firing simultaneously, including the Shahab-3.[206] The following day, U.S. officials reported that one of the missiles had apparently failed the day before and that although Iran reported a second round of missile launches it appeared there was only one missile launched and it was unclear whether it was the one that had failed the day before.[207] Adding to the confusion were various reports concluding Iran had doctored or "photo-shopped" one of the photographs to make it appear that one of the missiles fired simultaneously with the others had launched successfully, instead of actually failing.[208] And a U.S. intelligence official was quoted as saying "while I cannot comment one way or another on these particular photos, it would be wrong to assume that the U.S. intelligence community accepts at face value what the Iranians disclose about their missile tests."[209] The State Department responded to the debate over how many launches actually occurred by noting that it did not matter precisely how many, but rather that Iran was testing increasingly longer and more capable missiles in the region.[210]

Great Prophet 4 (September 2009)

Iran conducted military and missile exercises from September 27 - 28, 2009 in which it reportedly launched the Shahab-3 MRBM and the new solid-fueled Sejil-2 MRBM.[211] An Iranian military official, Abdullah Araqi, was quoted as saying "Iranian missiles are able to target any place that threatens Iran."[212] Another source said the "optimized Shahab-3" missile has a range of 1,300 – 2,000 kilometers and that the Sejil was launched for the first time in military maneuvers from the central province of Semnan where Iran's space program is located.[213] The IRGC's Air Force Commander said the main aim of the exercise was to evaluate the "technical developments recently achieved in surface-to-surface missiles ... including simultaneous ... and successive" missile launches.[214] Also reported were launches specifically of Shahab-1 and 2 SRBMs, and Fateh, Tondar, Zelzal, and various other tactical ballistic missiles.[215] Iran claimed to have also tested a "multiple missile launcher for the first time."[216]

[205] Pauline Jelinek, "Pentagon plumbing Iran's missile tests for clues," *The Associated Press*, July 9, 2008.

[206] Ali Akbar Dareini, "Iran tests long- and medium-range missiles in Strait of Hormuz," *Associated Press Worldstream*, July 9, 2008.

[207] "Iran fired only one missile on second day: U.S.," *Agence France Presse*, July 10, 2008.

[208] "Iran doctored missile test-firing photo: defence analyst," *Agence France Presse - English*, July 9, 2008, and Al Kamen, "Iran Apparently in Possession of Photoshop," *The Washington Post*, July 11, 2008, p. A15, Suburban Edition.

[209] Ibid.

[210] "The U.S. Department of State: Daily Press Briefing July 10, 2008," *States News Services*, July 10, 2008.

[211] Alan Crowell and Nazila Fathi, "Iran Test-Fires Missiles That Put Israel in Range," *The New York Times*, September 28, 2009, On-line edition.

[212] Ibid.

[213] William Branigin, Thomas Erdbrink, and Walter Pincus, "Iran Test Fires Its Most Advanced Missiles," *The Washington Post*, September 28, 2009, On-line edition.

[214] Jay Deshmukh and Hiedeh Farmani, "Iran launches missile war games," *Agence France Presse - English*, September 27, 2009.

[215] Iran Watch, Tracking Iran's Weapons of Mass Destruction Program, Wisconsin Project on Nuclear Arms Control, Iran Missile Milestones (for September 2009), http://www.iranwatch.org/wmd/wponac-missilemilestones.htm

[216] Jay Deshmukh and Hiedeh Farmani, "Iran launches missile war games," *Agence France Presse - English*, September 27, 2009.

Great Prophet 5 (April 2010)

Iran conducted war games on April 22 – 25, 2010, reportedly firing five tactical sea-to-sea and shore-to-sea missiles at a single target simultaneously from different locations.[217] The Deputy Head of Iran's Armed Forces Headquarters, BG Massoud Jazayeri, said Iran "is designing defense operations to strengthen deterrent power of its forces and give a crushing response to any aggression."[218] But it does not appear that any short or medium-range ballistic missiles were launched in this exercise.

Great Prophet 6 (June 2011)

Iran conducted military exercises June 27-July 6, 2011 and reportedly launched 14 ballistic missiles, including Shahab-1 and Shahab-2 SRBMs and Zelzal and Fateh-110 tactical ballistic missiles. At least one Qiam SRBM, or an upgraded Shahab-3 or Ghadr (or Kadr), or a Sejil MRBM[219] was reportedly launched, depending on which source is cited. Reports said some missiles were aimed at targets at sea and perhaps as many as nine of the missiles were fired simultaneously.[220] The Department of Defense subsequently confirmed that this exercise included a multiple missile salvo of some unspecified number.[221]

Iran also unveiled the existence of a network of underground missile silos for the first time, which IRGC spokesman Asghar Qelich-Khani said were "part of the swift reaction unit of [Iran's] missile brigade; missiles are stored vertically."[222] The *New York Times* added that Iranian officials showed an underground launching pad or silo for what they called the Shahab-3 MRBM.[223] The televised reports also showed a large metal roof opening atop the silo to allow the firing of the missile.[224] Iran claimed the silos were built indigenously, but Israel was reported as saying the silos were built with DPRK assistance.[225] One account of a tour of the silo complex also showed reported footage of a missile launch from a silo,[226] which at least one analyst said looked like the launch of a DPRK missile from its silo. Although Iran kept the location of the silos a secret, others, such as *Jane's Defence Weekly*, said Iran's hidden silos were near Tabriz and Khorramabad.[227]

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[217] "Iran Guards fire five missiles: TV," *Agence France Presse - English*, April 25, 2010, Newswire.

[218] "Iran test-fires powerful missiles in Persian Gulf drill: report," *Xinhua General News Service - English*, April 25, 2010, newswire.

[219] Various Iranian media and other reports provided differing designations.

[220] "Commander: All US, Israeli Bases within Iran's Missile Range," *FARS News Agency (Iran)*, June 28, 2011.

[221] Annual Report on Military Power of Iran, Department of Defense, April 2012, p. 4.

[222] "In 'Great Prophet VI' Maneuvers, Iran fires 14 ballistic missiles; IRGC Dep. Cmdr: Iran won't initiate attack – but response will be 'purely aggressive.'" MEMRI (Middle East Media Research Institute) Blog, June 28, 2011 http://www.thememriblog.org/blog_personal/en/38864.htm

[223] William J. Broad, "Iran Unveils Missile Silos as it Begins War Games," *The New York Times*, June 27, 2011, On-line edition.

[224] William J. Broad, "Iran shows off strengthened underground silos for missiles," *The International Herald Tribune*, June 29, 2011, p. 5.

[225] Ibid.

[226] "Iran TV shows footage of 'underground missile silo'—full text," *BBC Monitoring Middle East - Political*, June 28, 2011, source: Vision of the Islamic Republic Network 2, Tehran, in Persian, June 27, 2011.

[227] Lauren Gelfand, "Iran tests missiles amid suspicion of nuclear goals," *Jane's Defence Weekly*, June 30, 2011.

IRGC deputy commander BG Hossein Salami further added "our missiles have aggressive, tactical, strategically deterrent and defensive features, of course we will not initiate any operation but our responses will be purely aggressive."[228] The *Washington Post* reported a Shahab-3 was fired at targets at sea and added that Iranian television quoted Iranian military officials saying that Iran "began building a network of such silos across the nation 15 years ago."[229]

Great Prophet 7 (July 2012)

Iran held military exercises and missile launches July 1-3, 2012. Iran reported that it fired from different locations tens of Shahab-1 and Shahab-2 SRBMs, Shahab-3 MRBMs and Fateh, Qiam, Persian Gulf,[230] and Zelzal tactical ballistic missiles simultaneously at a mock air base in Iran's Lut desert in southeastern Iran.[231] IRGC Aerospace Force Commander BG Amir Ali Hajizadeh said "these maneuvers send a message to the adventurous nations that the IRGC is standing up to bullies alongside the determined and unified Iranian nation, and will decisively respond to any trouble they cause." Iran's FARS news agency further said these exercises "underline Tehran's threat to strike U.S. military bases in the neighboring countries—in Afghanistan, Bahrain, Kuwait and Saudi Arabia—if it comes under attack by Israel or the United States."[232]

The *Associated Press (AP)* reported from Iranian sources that the missile tests demonstrated improved accuracy where 90% of the missiles hit their targets. Additionally, *AP* reported that Iran said it fired a considerable number of missiles against a single target (mock air base) making it "impossible for anti-missile systems to intercept and destroy them." Iran warned that 35 U.S. military bases in the Middle East are within Iran's missile range and would "be destroyed within seconds after any attack on Iran."[233] Another source said Iran claimed it had launched a missile capable of reaching targets 2,000 km away, but only fired to a range of 1,300 km. and repeated many of the things said here of July 2012 test launches.[234]

There was no reported official U.S. response as to the accuracy of the claims made by Iran about their Great Prophet 7 exercises.

[228] See footnote 56.

[229] Thomas Erdbrink, "Iran test-fires missiles, shows secret silos," *The Washington Post*, June 28, 2011, on-line edition.

[230] The Persian Gulf missile is also known as the Khalije Fars Anti-Ship Ballistic Missile.

[231] "IRGC Starts Wargames by Firing Tens of Missiles," *FARS News Agency (Iran)*, July 3, 2012, English.

[232] Ibid. See also "Iranian Media Says Missile Able to Hit Israel Tested," *Radio Free Europe. Radio Liberty*, July 3, 2012, on-line edition.

[233] Associated Press, "Iranian reports: Military maneuvers display better accuracy, firing capability of missiles," *Washington Post*, July 13, 2012, On-line edition.

[234] Lt. Col (ret) Michael Segall (Israeli Defense Force), "Iran's Latest Missile Exercise: A Message of Force Projection," *Jerusalem Center for Public Affairs*, vol. 12, no. 16 (July 17, 2012), pp. on-line edition.

Appendix B. Reporting Requirements Relevant to Iranian Ballistic Missile Programs[235]

Title	721 Report		
Requirement	To identify acquisition by foreign countries over preceding six months of dual-use and other technology related to WMD and advanced conventional munitions, and trends of acquisition.		
Legislation	**From**	**To**	**Frequency/Duration**
Sec. 721, Combating Proliferation of Weapons of Mass Destruction Act of 1996 (P.L. 104-293; 50 U.S.C. 2301 note)	Director of Central Intelligence	Intelligence Committees Speaker and minority leader of the House, majority and minority leaders of the Senate	Annually, by February 1

Title	ACDA Compliance Report		
Requirement	To identify: arms control, nonproliferation, disarmament objectives for upcoming year, including assessment of ongoing negotiations, U.S. adherence to its obligations, other nations' adherence, and noncompliance by foreign governments.		
Legislation	**From**	**To**	**Frequency/Duration**
Sec. 403, Arms Control and Disarmament Act (P.L. 87-297; 22 U.S.C. 2593a	President (prepared by Secretary of State, with concurrence of Director of Central Intelligence, in consultation with Secretaries of Defense and Energy and Chairman of Joint Chiefs of Staff)	Speaker of the House, chairman of Senate Foreign Relations Committee	Annually, not later than April 15

Title	Annual Report on Proliferation of Missiles and Weapons of Mass Destruction		
Requirement	To identify information on the transfer in the preceding calendar year, by most countries, of "weapons, technology, components, or materials that can be used to deliver, manufacture, … or weaponize nuclear, biological, chemical or radiological weapons…."		
Legislation	**From**	**To**	**Frequency/Duration**
Sec. 1308, Security Assistance Act of 2002 (P.L. 107-228; 50 U.S.C. 2368)	President	Committees on Appropriations, Armed Services, Foreign Affairs of the House; Committees on Appropriations, Armed Services, Foreign Relations of the Senate	Annually, not later than March 1

Title	Annual Threat Report
Requirement	To identify: threats posed to the United States and its allies by weapons of mass destruction, ballistic missiles, and cruise missiles, and by their proliferation; states and non-state entities that have WMD and delivery systems, have related capability, or seek to develop such means and likely timelines for the development of the threat; relevant doctrines and control mechanisms.

[235] This section was drawn from previous work by the author and Dianne Rennack, Specialist in Foreign Policy Legislation, CRS.

Legislation	From	To	Frequency/Duration
Sec. 234, National Defense Authorization Act for Fiscal Year 1998 (P.L. 105-85; 50 U.S.C. 2367)	Secretary of Defense (in consultation with Director of Central Intelligence)	Congress	Annually, by January 30

Title	**Illicit Trade With Iran**
Requirement	To identify countries suspected of diverting certain goods, services, and technologies to or through Iran, including material contributions to Iran's development of nuclear, chemical, or biological weapons; ballistic missile or advanced conventional weapons capabilities; or support for international terrorism; and are Commerce Control List (CCL) items, United States Munitions List (USML) items, or prohibited under U.N. Security Council requirements.

Legislation	From	To	Frequency/Duration
Sec. 302, Comprehensive Iran Sanctions, Accountability, and Divestment Act of 2010 (P.L. 111-195; 22 U.S.C. 8542)	Director of National Intelligence, who reports within the Executive Branch to the President and Secretaries of Defense, State, Commerce, and Treasury	Committees on Finance; Banking, Housing, and Urban Affairs; and Foreign Relations of the Senate; and Committees on Ways and Means; Financial Services; and Foreign Affairs of the House	Annually, and when new information becomes available

Title	**Iraq Sanctions Act Report (later made to also apply to Iran)**
Requirement	To identify sanctions taken by other nations against Iraq and Iran.

Legislation	From	To	Frequency/Duration
Sec. 586J(c), Iraq Sanctions Act of 1990 (P.L. 101-513; 50 U.S.C. 1701 note)	President	Committees on Appropriations and Foreign Relations of the Senate; Committees on Appropriations and Foreign Affairs of the House	Semiannually, with first report not later than May 5, 1991

Title	**Non-State Entities Report**
Requirement	To identify: nuclear weapons and delivery system programs and related programs of non-nuclear-weapons states; nuclear weapons aspirations of non-state entities; and foreign persons who make a material contribution to such aspirations.

Legislation	From	To	Frequency/Duration
Sec. 1055, National Defense Authorization Act for Fiscal Year 2010 (P.L. 111-84; 50 U.S.C. 2371)	Director of National Intelligence	Committee on Armed Services and Select Committee on Intelligence of the Senate; Committee on Armed Services and Permanent Select Committee on Intelligence of the House	Biennially, with first report not later than September 1, 2010

Title	**Proliferation Relating to Iran, North Korea, and Syria (INKSA Report)**
Requirement	To identify every foreign person for whom there is credible information that the person has transferred to or acquired from Iran, Syria, or North Korea goods, services or technology controlled for WMD and missile-related proliferation concerns.

Legislation	From	To	Frequency/Duration

Sec. 2, Iran, North Korea, and Syria Nonproliferation Act (P.L. 106-178; 50 U.S.C. 1701 note)	President	Committee on Foreign Affairs of the House; Committee on Foreign Relations of the Senate	Semiannually, with the first report not later than September 14, 2000

Title	**Russian Proliferation to Iran and Other Countries**		
Requirement	To identify Russian proliferation of WMD and ballistic missile goods, technology, expertise, and information, and of dual-use items to Iran and to other countries identified by the Director of Central Intelligence as a proliferation concern during the year preceding the year.		
Legislation	**From**	**To**	**Frequency/Duration**
Sec. 1206, Bob Stump National Defense Authorization Act for Fiscal Year 2003 (P.L. 107-314; 22 U.S.C. 5952 note)	President	Congress	Not later than March 15 of 2003 through 2009

Title	**WMD Threat**		
Requirement	To assess the current threat of attack on the United States using ballistic missiles or cruise missiles; or chemical, biological, or nuclear weapon delivered by a system other than a ballistic missile or cruise missile.		
Legislation	**From**	**To**	**Frequency/Duration**
Sec. 114, National Security Act of 1947 (P.L. 80-253; 50 U.S.C. 404i)	Director of National Intelligence	Committees on Intelligence, Foreign Relations, and Armed Services of the Senate; Committees on Intelligence, Foreign Affairs, and Armed Services of the House	First report required not later than December 31, 1991; after that annually by February 1

Source: United States Code.

Appendix C. Other Estimates of Iran's Ballistic Missiles

Table C-1. Iranian SRBMs (Other Sources)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jane's Strategic Weapon Systems													
Shahab 1 and Shahab 2 (Scud B and Scud C)			some number have been acquired, assembled, produced and used to date				300 - 400 missiles			around 50 launchers; 200 - 300 missiles	around 50 launchers; 200 - 300 missiles	around 50 launchers; 200 - 300 missiles	around 50 launchers; 200 - 300 missiles
Tondar 69 (CSS-8)			some number exported from China in 1992							up to 30 launchers; up to 200 missiles	around 20 launchers; less than 100 missiles	around 20 launchers; less than 100 missiles	around 20 launchers; 200 missiles
Fateh A-110		tested	low-rate production		initial operational capability					3 versions may be in service	3 versions may be in service		
The Military Balance (The International Institute for Strategic Studies)													
Scud B / Scud C Shahab-1/2	est. 10 launchers; 300 missiles	est. 17 launchers; 300 missiles	est. 17 launchers; 300 missiles	est. 17 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles	12-18 launchers; 300 missiles
CSS-8	est. 25 launchers; 150 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	est. 30 launchers; 175 missiles	Est. 30 launchers; 175 missiles	Est. 30 launchers; 175 missiles	Est. 30 launchers; 175 missiles	Est. 30 launchers; 175 missiles	Est. 30 launchers; 175 missiles
Shaheen-1 Hatf-4 / Shaheen-2						some	some	some	some	some		some	some

Source: As noted. Missile designations as used by the source.

Notes: Where launcher numbers only are noted, actual missile inventory may be larger because launchers can be reused to fire additional missiles.

Table C-2. Iranian MRBMs (Other Sources)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jane's Strategic Weapon Systems													
Shahab 3 and variants			production underway	production underway					< 20 TELs				25
Sejil / Ashura									testing	testing		IOC	
Shahab-3/4 (Ghadr-1)				IOC	~20		30-50						
The Military Balance (The International Institute for Strategic Studies)													
Shahab-3	some	some (20 missiles)	some	at least 3	at least 6 launchers (Shahab 3 / Zelzal-3)	6 launchers; each with est. 4 missiles	est. 6 launchers; each with est. 4 missiles	est. 6 launchers; each with est. 4 missiles	est. 6 launchers; each with est. 4 missiles	est. 6 launchers; each with est. 4 missiles	up to 12 launchers, some Ghadr (or Kadr)	6 launchers, some Ghadr	12+ Shahab 3/ Ghadr
Sajjil													
Sajjil-2												in development	some (in development)

Source: As noted. Missile designations as used by the source.

Notes: Where launcher numbers only are noted, actual missile inventory may be larger because launchers can be reused to fire additional missiles.

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Acknowledgments

The author wishes to thank the following external reviewers for their substantive comments: Joe Cirincione (President, Ploughshares), Dr. Michael Elleman (IISS, former UN weapons inspector in Iraq), Ted Postol (MIT), Dr. Uzi Rubin (former head of Missile Defense Organization, Israel), Drs. Markus Schiller and Robert Schmucker (Schmucker Technologie, Germany), Dr. Rob Soofer (Office of Senator John Kyl, former official U.S. missile defense organization), Baker Spring (Heritage Foundation), and Greg Thielman (Arms Control Association, former senior intelligence analyst at Department of State). The author alone is responsible for the final version.