Center for Strategic and International Studies
Arleigh A. Burke Chair in Strategy
1800 K Street, N.W. • Suite 400 • Washington, DC 20006
Phone: 1 (202) 775-7325 • Fax: 1 (202) 457-8746
Web: www.csis.org/burke

Iranian Nuclear Weapons?

Iran's Missiles and Possible Delivery Systems

Anthony H. Cordesman
Arleigh A. Burke Chair in Strategy
acordesman@aol.com

Khalid R. Al-Rodhan
Visiting Fellow
kalrodhan@csis.org

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Introduction

It is one thing to have nuclear weapons; it is another to deliver them. This depends on being able to build them small enough to fit current missile warheads or build new missile technology to carry such weapons. In the case of Iran, this depends on knowing the extent of its nuclear technology. For example, if its P-1 or P-2 designs were provided by AQ Khan—the same warhead that was sold to Libya—then it is the Chinese design with 500 kg and 1 m diameter, which can fit Iran's current Shahab-3 missile.[1]

While there is more information about Iran's missile program than there is about actual CBRN capabilities, many aspects of Iran's missile systems remain uncertain. Many experts do, however, believe that 1) Iran's missile technology is more advanced than it nuclear capabilities, 2) Iran's missiles are too inaccurate to be used for conventional attacks, and 3) Iran's missile technology is getting more advanced by the day.

Iran continues to work actively on its missile warhead designs, and US officials expressed their concerns regarding such developments. Former Secretary of State Colin Powell's offered a warning on November 17, 2004, "You don't have a weapon until you put it in something that can deliver a weapon."[2] Other officials have expressed similar sentiments. The former Director of the Nonproliferation Center at Central Intelligence Agency (CIA), Gordon Oehler, was quoted as saying that "If someone has a good idea for a missile program, and he has really good connections, he'll get the program through….But that doesn't mean there is a master plan for nuclear weapon."[3]

Some of these fears were exacerbated by the claims and threats of Iranian officials. For example, Yadollah Javani, head of the Islamic Revolutionary Guards' political bureau, stated in August 2004 that any Israeli attack on Iran would have "terrifying consequences," and that Israel would have to "permanently forget" about its nuclear research center and reactor at Dimona. He also warned that "The entire Zionist territory, including its nuclear facilities and atomic arsenal, are currently within range of Iran's advanced missiles."[4]

US Assessment of Iranian Missile Capabilities

A 2003 unclassified CIA report made the following judgments about Iran's ballistic missile program. While these comments do not take account of the developments in 2004 and 2005, they still seem to broadly reflect current US intelligence assessments:[5]

> Ballistic missile-related cooperation from entities in the former Soviet Union, North Korea, and China over the years has helped Iran move toward its goal of becoming self-sufficient in the production of ballistic missiles. Such assistance during 2003 continued to include equipment, technology, and expertise. Iran's ballistic missile inventory is among the largest in the Middle East and includes some 1,300-km-range Shahab-3 medium-range ballistic missiles (MRBMs) and a few hundred short-range ballistic missiles (SRBMs)-including the Shahab-1 (Scud-B), Shahab-2 (Scud C), and Tondar-69 (CSS-8)-as well as a variety of large unguided rockets. Already producing Scud SRBMs, Iran announced that it had begun production of the Shahab-3 MRBM and a new solid-propellant SRBM, the Fateh-110. In addition, Iran publicly acknowledged the development of follow-on versions of the Shahab-3. It originally said that another version, the Shahab-4, was a more capable ballistic missile than its predecessor but later characterized it as solely a space launch vehicle with no military applications. Iran is also pursuing longer-range ballistic missiles.

John R. Bolton presented a similar assessment in a testimony to the House International Relations Committee in June 2004:[6]

> Iran continues its extensive efforts to develop the means to deliver weapons of mass destruction. Thanks to assistance from entities -- including government-owned entities -- in North Korea, Russia, and China, Iran is developing a variety of liquid-propellant and solid-propellant ballistic missiles. Iran's ballistic missile inventory is among the largest in the Middle East and includes some 1,300-km-range Shahab-3 medium-range ballistic missiles (MRBMs) and a few hundred short-range ballistic missiles (SRBMs) -- including the Shahab-1 (Scud-B), Shahab-2 (Scud C), and Tondar-69 (CSS-8)--as well as a new solid-propellant SRBM, the Fateh-110. The 1,300-km range Shahab-3 missile is a direct threat to Israel, Turkey, U.S. forces in the region, and U.S. friends and allies.
>
> In addition, we believe Iran has programs to develop longer-range missiles that will be able to strike additional targets throughout the region or that will allow Iran to launch missiles against Israel from locations further within Iranian territory. Finally, Iran is likely to develop IRBMs or ICBMs capable of delivering payloads to Western Europe or the United States. I want to emphasize this point: Iran is acquiring the means to produce ever more sophisticated and longer-range missiles. If they are successful in this endeavor, our attempts to slow the missile trade will have little effect on Iran's already-developing indigenous missile capability.
>
> North Korea is one of the main suppliers of ballistic missiles, missile equipment, and production technology to Iran. North Korea provided Iran with the technology to produce the SCUD B (300 km range) and SCUD C (500 km range) missiles. In addition, the Shahab-3 medium-range ballistic missile is based on the North Korean No Dong missile.
>
> Foreign assistance has been key to the development of Iran's ballistic missile programs. Such assistance during the first half of 2003 included equipment, technology, and expertise and has helped Iran move toward its goal of becoming self-sufficient in the production of ballistic missiles. Although Iran is not a member of the Missile Technology Control Regime (MTCR), a multilateral arrangement aimed at stemming the proliferation of ballistic missiles or the International Code of Conduct Against Ballistic Missile Proliferation (ICOC), Iran has engaged in substantial trade in missile technology with countries that ought to know better.

A more recent estimate on Iran's missile program—by the Director of the Defense Intelligence Agency (DIA), Vice Admiral Lowell E. Jacoby, on March 17, 2005—stated that:[7]

> We judge Iran will have the technical capability to develop an ICBM by 2015. It is not clear whether Iran has decided to field such a missile. Iran continues to field 1300-km range Shahab III MRBMs capable of reaching Tel Aviv. Iranian officials have publicly claimed they are developing a new 2000-km-range variant of the Shahab III. Iranian engineers are also likely working to improve the accuracy of the country's SRBMs.

Iran's Missile Arsenal

Iran continues to deploy surface-to-surface missiles, and has its own systems in development. The number assigned to the army versus the Islamic Revolutionary Guards Corps (IRGC) is unclear, but the IRGC seems to hold and operate most long-range missiles rather than the Army. Iran seems to have some 12-18 SCUD-B/C launchers and 250-350 missiles, and 30 land-based CSS-8 launchers with 175 missiles. Iran refers to the SCUD-B as the Shahab-1 and the Scud C as the Shahab-2.

The Iranian government stated as early as 1999, that it was developing such a large missile body or launch vehicle for satellite launch purposes, however, and repeatedly denied that it is upgrading the Shahab series (especially the Shahab-3) for military purposes. Iran also continued to claim that the 'Shahab-4' program is aimed at developing a booster rocket for launching satellites into space. In January 2004, Iran's Defense minister claimed that Iran would launch a domestically built satellite within 18 months. This had still not taken place in January 2006.[8]

In December 2005, the US government announced its belief that Iran had built underground missile factories that were capable of producing Shahab-1, Shahab-2, and Shahab-3 as well as testing new missile designs. It was also believed that Karimi industries was housed at one of the secret bases, which is where they were working on perfecting Iran's nuclear warheads.[9]

US officials insisted that this information did not come from Iranian opposition sources like the MEK, and that it was reliable. They feel Iran has made significant strides in recent years using North Korean, Chinese, and Russian technology. If Iran begins work on the Shahab-5 and the Shahab-6 series, they may acquire delivery systems with the range to make them a global nuclear power, instead of merely a regional one.

Figure 1: Estimated Iranian Missile Profiles: 2006

Designation	**Stages**	**Progenitor Missiles**	**Propellant**	**Range** (Kilometers)	**Payload** (Kilograms)	**IOC** (Year)	**Inventory**
Mushak-120	1	CSS-8, SA-2	Solid	130	500	2001	200
Mushak-160	1	CSS-8, SA-2	Liquid	160	500	2002	?
Mushak-200	1	SA-2	Liquid	200	500	NA	0
Shahab-1	1	Soviet SSN-4, N Korean SCUD B	Liquid	300	987-1,000	1995	250-300
Shahab-2	1	Soviet SSN-4, N Korean SCUD C	Liquid	500	750-989	?	200-450
Shahab-3	1	N Korea Nodong-1	Liquid	1,300	760-1,158	2002	25-100
Shahab-4	2	N Korea Taep'o-dong-1	Liquid	3,000	1,040-1,500	NA	0
Ghadr 101	multi	Pakistan Shaheen-1	Solid	2,500	NA	NA	0
Ghadr 110	multi	Pakistan Shaheen-2	Solid	3,000	NA	NA	0
IRIS	1	China M-18	Solid	3,000	760-1,158	2005	NA
Kh-55	1	Soviet AS-15 Kent, Ukraine	jet engine	2,900-3,000	200 kt nuclear	2001	12
Shahab-5	3	N Korea Taep'o-dong-2	Liquid	5,500	390-1,000	NA	0
Shahab-6	3	N Korea Taep'o-dong-2	Liquid	10,000	270-1,220	NA	0

Source: Adapted from GlobalSecurity.org, available at: http://www.globalsecurity.org/wmd/world/iran/missile.htm; and the Federation of American Scientists, available at: http://www.fas.org/nuke/guide/iran/missile

Shahab-1/SCUD-B

The Soviet-designed SCUD-B (17E) guided missile currently forms the core of Iran's ballistic missile forces. The missile was used heavily in the latter years of the Iran-Iraq war. In 2006, it was estimated that Iran had between 50 and 300 Shahab-1's in its inventory.[10]

The SCUD-B missile is a tactical missile Iran first acquired in 1985. It has an approximate range between 280-330 miles, and carries a 987-1,000 kg warhead. It has a diameter of 0.885 meter, a height of 11 meters, a launch weight 5,860 kg, a stage mass of 4,873 kg, a dry mass of 1,100 kg, and a propellant mass of 3,760-3,671 kg.[11]

Iran acquired its Scuds in response to Iraq's invasion. It obtained a limited number from Libya and then obtained larger numbers from North Korea. It deployed these units with a special Khatam ol-Anbya force attached to the air element of the Pasdaran. Iran fired its first Scuds in March 1985. It fired as many as 14 Scuds in 1985, 8 in 1986, 18 in 1987, and 77 in 1988. Iran fired 77 Scud missiles during a 52 day period in 1988, during what came to be known as the "war of the cities." Sixty-one were fired at Baghdad, nine at Mosul, five at Kirkuk, one at Tikrit, and one at Kuwait. Iran fired as many as five missiles on a single day, and once fired three missiles within 30 minutes. This still, however, worked out to an average of only about one missile a day and Iran was down to only 10-20 Scuds when the war of the cities ended.

Iran's missile attacks were initially more effective than Iraq's attacks. This was largely a matter of geography. Many of Iraq's major cities were comparatively close to its border with Iran, but Tehran and most of Iran's major cities that had not already been targets in the war were outside the range of Iraqi Scud attacks. Iran's missiles, in contrast, could hit key Iraqi cities like Baghdad. This advantage ended when Iraq deployed extended range Scuds.

The SCUD-B is a relatively old Soviet design that first became operational in 1967, designated as the R-17E or R-300E. Its thrust is 13,160 Kg f, and its burn time is between 62-64 seconds, and it has an Isp 62-Sl due to vanes steering drag loss of 4-5 seconds. The SCUD-B possesses 1 thrust chamber and is a one stage rocket (it does not break into smaller pieces). Its fuel is TM-185, and its oxidizer is the AK-27I.[12]

The SCUD-B has a range of 290-300 kilometers with its normal conventional payload. The export version of the missile is about 11 meters long, 85-90 centimeters in diameter and weighs 6,300 kilograms. It has a nominal CEP of 1,000 meters. The Russian versions can be equipped with conventional high explosive, fuel air explosive, runway penetrating, sub-munitions, chemical, and nuclear warheads. Its basic design comes from the old German V-2 rocket design of WWII. It has moveable fins and is guided only during powered flight.

The SCUD-B was introduced on the JS-3 tracked chassis in 1961 and appeared on the MAZ-543 wheeled chassis in 1965. The "SCUD-B" missile later appeared on the transporter-erector-launcher based on the MAZ-543 (8x8) truck. The introduction of this new cross-country wheeled vehicle gave this missile system greater road mobility and reduces the number of support vehicles required.

The export version of the SCUD-B comes with a conventional high explosive warhead weighing about 1,000 kilograms, of which 800 kilograms are the high explosive payload and 200 are the warhead structure and fusing system. It has a single stage storable liquid rocket engine and is usually deployed on the MAZ-543--an eight-wheel transporter-erector-launcher (TEL). It has a strap-down inertial guidance, using three gyros to correct its ballistic trajectory, and uses internal graphite jet vane steering. The warhead hits at a velocity above Mach 1.5.

The following timeline tracks the history of the Shahab-1 (SCUD-B) after it was first introduced in Iran in 1985:

- **1985:** Iran began acquiring SCUD-B (Shahab-1) missiles from Libya for use in the Iraq war.[13]
- **1986:** Iran turned to Libya as a supplier of SCUD-B's.[14]
- **1987:** A watershed year. Iran attempted to produce its own SCUD-B missiles, but failed. Over the next 5 years, they purchased 200-300 SCUD-B missiles from North Korea.[15]
- **1988:** Iran began producing its own SCUD-B's, though not in large quantities.[16]
- **1991:** It is estimated that at approximately the time of the Gulf War, Iran stopped producing its own SCUD-B's, and began purchasing the more advanced SCUD-C's (Shahab-2).[17]
- **1993:** Iran sent 21 missile specialists, led by Birg. Gen. Manteghi, to North Korea for training.[18]

Experts estimate Iran bought 200-300 SCUD-Bs from North Korea between 1987 and 1992, and may have continued to buy such missiles after that time. Israeli experts estimated that Iran had at least 250-300 Scud-B missiles and at least 8-15 launchers on hand in 1997. Most current estimates indicate that Iran now has 6-12 SCUD launchers and up to 200 SCUD-B (R-17E) missiles with 230-310 kilometer range. Some estimates give higher figures. The IISS estimated in 2005-2006 that Tehran had 18 launchers, and 300 SCUD missiles.[19] It is, however, uncertain how many of those are SCUD-B and how many are SCUD-C's.

US experts also believe that Iran can now manufacture virtually all of the SCUD-B, with the possible exception of the most sophisticated components of its guidance system and rocket motors. This makes it difficult to estimate how many missiles Iran has in inventory and can acquire over time, as well as to estimate the precise performance characteristics of Iran's missiles, since it can alter the weight of the warhead and adjust the burn time and improve the efficiency of the rocket motors

Shahab-2/SCUD-C

Iran served as a transshipment point for North Korean missile deliveries during 1992 and 1993. Some of this transshipment took place using the same Iranian B-747s that brought missile parts to Iran.

Others moved by sea. For example, a North Korean vessel called the Des Hung Ho, bringing missile parts for Syria, docked at Bandar Abbas in May, 1992. Iran then flew these parts to Syria. An Iranian ship coming from North Korea and a second North Korean ship followed, carrying missiles and machine tools for both Syria and Iran. At least 20 of the North Korean missiles have gone to Syria from Iran, and production equipment seems to have been transferred to Iran and to Syrian plants near Hama and Aleppo.

The SCUD-C is an improved version of the SCUD-B. With superior range and payload, it is another tactical missile first acquired by Iran in 1990. It has an approximate range between 500-700 miles, a CEP of 50m, and it carries a 700-989kg warhead. It has a diameter of .885m, a height of 11-12m, a launch weight 6,370-6,500kg, an unknown stage mass, an unknown dry mass, and an unknown propellant mass. In terms of propelling ability, its thrust is unknown, its burn time is unknown, and it has an effective Isp of 231. The SCUD-C possesses one thrust chamber and is a one-stage rocket (it does not break into smaller pieces). Its fuel is Tonka-250, and its oxidizer is the AK 20P.[20]

SCUD-C missile was successfully completed and ready for production by 1987 (mainly by North Korea), and then distributed to Iran several years later. According to some reports, Iran has created shelters and tunnels in its coastal areas that it could use to store Scuds and other missiles in hardened sites to reduce their vulnerability to air attack.

The missile is more advanced than the SCUD-B, although many aspects of its performance are unclear. North Korea seems to have completed development of the missile in 1987, after obtaining technical support from the China. While it is often called a "SCUD-C," it seems to differ substantially in detail from the original Soviet SCUD-B. It seems to be based more on the Chinese-made DF-61 than on a direct copy of the Soviet weapon.

Experts estimate that the North Korean missiles have a range of around 310 miles (500 kilometers), a conventional warhead with a high explosive payload of 700 kilograms, and relatively good accuracy and reliability. While some experts feel the payload of its conventional warhead may be limited for the effective delivery of chemical agents, Iran might modify the warhead to increase payload at the expense of range and restrict the using of chemical munitions to the most lethal agents such as persistent nerve gas. It might also concentrate its development efforts on arming its SCUD-C forces with more lethal biological agents.

It is currently estimated that Iran has 50-150 SCUD-C's in its inventory.[21] The following timelines tracks the development of Iranian SCUD-C missiles since the Gulf war:

- **1990:** It is estimated that at approximately the time of the Persian Gulf War, Iran stopped producing large quantities of SCUD-B's, and began purchasing the more advanced SCUD-C's (Shahab 2).[22]
- **1993:** Iran sent 21 missile specialists, led by Birg. Gen. Manteghi, to North Korea for training in missile technology.[23]
- **1994:** By this year, Iran had purchased 150-200 SCUD-C's from North Korea.[24]
- **1997:** Iran began production of its own SCUD-C missiles. This is generally considered a technological leap for Iran, and it is believed that a large portion of their production capability and technology came from North Korea.[25]

In spite of the revelations during the 1990s about North Korean missile technology transfers to Tehran, Iran formally denied the fact it had such systems long after the transfer of these missiles became a fact. Hassan Taherian, an Iranian foreign ministry official, stated in February 1995, "There is no missile cooperation between Iran and North Korea whatsoever. We deny this."[26]

A senior North Korean delegation did, however, traveled to Tehran to close the deal on November 29, 1990, and met with Mohsen Rezaei, the former commander of the IRGC. Iran either bought the missile then, or placed its order shortly thereafter. North Korea then exported the missile through its Lyongaksan Import Corporation. Iran imported some of these North Korean missile assemblies using its B-747s, and seems to have used ships to import others.

Iran probably had more than 60 of the longer range North Korean missiles by 1998, although other sources report 100, and one source reports 170. Iran may have 5-10 SCUD-C launchers, each with several missiles. This total seems likely to include four North Korean TELs received in 1995.

Iran is seeking to deploy enough missiles and launchers to make its missile force highly dispersed and difficult to attack. Iran began to test its new North Korean missiles. There are reports it fired them from mobile launchers at a test site near Qom about 310 miles (500 kilometers) to a target area south of Shahroud. There are also reports that units equipped with such missiles have been deployed as part of Iranian exercises like the Saeqer-3 (Thunderbolt 3) exercise in late October 1993.

In any case, such missiles are likely to have enough range-payload to give Iran the ability to strike all targets on the southern coast of the Gulf and all of the populated areas in Iraq, although not the West. Iran could also reach targets in part of eastern Syria, the eastern third of Turkey, and cover targets in the border area of the former Soviet Union, western Afghanistan, and western Pakistan.

Accuracy and reliability do remain major uncertainties, as does the missile's operational CEP. Much would depend on the precise level of technology Iran deployed in the warhead. Neither Russia nor the People's Republic of China seems to have transferred the warhead technology for biological and chemical weapons to Iran or Iraq when they sold them the SCUD-B missile and CSS-8. However, North Korea may have sold Iran such technology as part of the Scud-C sale. If it did so, such a technology transfer would save Iran years of development and testing in obtaining highly lethal biological and chemical warheads. In fact, Iran would probably be able to deploy far more effective biological and chemical warheads than Iraq had at the time of the Gulf War.

Iran can now assemble SCUD-C missiles using foreign-made components. It may soon be able to make entire missile system and warhead packages in Iran. Iran may be working with Syria in such development efforts, although Middle Eastern nations rarely cooperate in such sensitive areas.

Shahab-3

Iran appears to have entered into a technological partnership with North Korea after years of trading with the North Koreans for SCUD-C's throughout the 1990's. The visit to North Korea in 1993 by General Manteghi and his 21 specialists seems a possible date when Iran shifted from procurement to development.

Iran did not have the strike capability to attack Israel with their limited range Scuds. As a result, the Iranians seem to have begun using some of the designs for the North Korean No Dong MRBM in attempt to manufacture their own version of the missile, the Shahab-3. Between 1997 and 1998, Iran began testing the Shahab-3. While Iran claimed Shahab-3's purpose was to carry payloads of sub-munitions, it is more likely that Iran would use the Shahab-3's superior range to carry a chemical, nuclear, or biological weapon.

Missile Development

Iran's new Shahab-3 series is a larger missile that seems to be based on the design of the North Korean No Dong 1/A, and No Dong B missiles, which some analysts claim were developed with Iranian financial support. It also has strong similarities to the Ghauri. It is based on North Korean designs and technology, but being developed and produced in Iran. This development effort is controlled and operated by the IRGC. Iranian officials, however, claimed that the production of the Shahab-3 missiles was entirely domestic. The Iranian Defense Minister, Ali Shamkhani, argued in May 2005 that the production was compromised of locally made parts, and that the production was continuing.[27]

As the following timeline shows, the Shahab-3 is a relatively young and constantly evolving system, but it has been tested several times:

- **October 1997:** Russia began training Iranian engineers on missile production for the Shahab-3.[28]
- **1998:** Iran began testing its own Shahab-3s. Problems with finding or making an advanced guidance system hindered many of their tests, however. Meanwhile, Iran begins experimenting with the Shahab-4.[29]
- **July 23, 1998:** Iran launched its first test flight of the Shahab-3. The missile flew for approximately 100 seconds, after which time it was detonated. It is not known if it malfunctioned, or because the Iranians did not want to risk discovery.[30]
- **July 15, 2000:** Iran had its first successful test of a Shahab-3.[31]
- **Summer, 2001:** Iran began production of the Shahab-3.[32]
- **July 7, 2003:** Iran completes final test of Shahab-3. Allegations emerged that Chinese companies like Tai'an Foreign Trade General Corporation and China North industries Corporation had been aiding the Iranian's in overcoming the missile's final technical glitches.[33] The missile is seen in Iranian military parades and displayed openly.
- **August 11, 2004:** Iran decreases the size of the Shahab-3 warhead, making a move towards being able to mount a nuclear warhead to a Shahab-3. At this point, the modified Shahab-3 is often referred to as the Shahab-3M.[34] The missile had a new, smaller, and "bottle neck" warhead. This kind of warhead has a slower reentry than a cone shaped warhead and has advantages using warheads containing chemical and biological agents.
- **September 19, 2004**: Another test took place and the missile was paraded on the 21st covered in banners saying "we will crush America under our feet" and "wipe Israel off the map."[35]
- **May 31, 2005:** Iranian Defense Minister, Ali Shamkhani, claimed that Iran successful tested a new missile motor using solid-fuel technology with a range of 2000 km. Shamkhani was quoted as saying "Using solid fuel would be more durable and increase the range of the missile."[36] It remains uncertain if this referred to the Shahab-3 or the modified Shahab-3, the IRIS missile.

As of early 2006, there had been some 10 launches at a rate of only 1-2 per year. Roughly 30% had fully malfunctioned, and six launches had had some malfunction. Iran had also tested two major payload configurations. [37]

Uncertain Performance[38]

Discussions of the Shahab-3's range-payload, accuracy and reliability are uncertain will remain speculative until the system is far more mature. A long-range ballistic missile requires at least 10-30 tests in its final configuration to establish its true payload and warhead type, actual range-payload, and accuracy. While highly detailed estimates of the Shahab 3's performance are available, they at best are rough engineering estimates and are sometimes speculative to the point of being sheer guesswork using rounded numbers.

Its real-world range will depend on both the final configuration of the missile and the weight of its warhead. Various sources now guess that the Shahab-3 has range between 1,300 and 2,000 kilometers but the longer range estimate seems to be based on Iranian claims and assumptions about an improved version, not full-scale operational tests.[39]

US experts believe that the Shahab-3 missile still has a nominal range of 1,300 kilometers. Iran, however, has claimed that the Shahab-3 had a range of 2,000 kilometers. Nasser Maleki, the head of Iran's aerospace industry, stated on October 7, 2004 that, "Very certainly we are going to improve our Shahab-3 and all of our other missiles." Tehran then claimed in September that the Shahab-3 could now reach targets up to 2,000 km away, presumably allowing the missiles to be deployed a greater distance away from Israel's air force and Jericho-2 ballistic missiles.[40]

IRGC political bureau chief, Yadollah Javani, stated in September 2004 that the modified Shahab –sometimes called the Shahab 3A or Shahab-3M -- could be used to attack Israel's Dimona nuclear reactor.[41] Iran performed another test on October 20, 2004, and Iran's Defense Minister, Ali Shamkani, claimed it was part of an operational exercise. Iran's Defense Minister also claimed that Iran was now capable of mass-producing the Shahab-3 on November 9, 2004 and that Iran reserved the option of pre-emptive strikes in defense of its nuclear sites. Shamkani claimed shortly afterwards that the Shahab-3 now had a range of more than 2,000 kilometers (1,250 miles).[42]

One leading German expert stresses the uncertainty of any current estimates and notes that range payload trade-offs would be critical. He puts the range for the regular Shahab 3 at 820 kilometers with a 1.3 ton payload and 1,100 kilometers with a 0.7 ton payload. (An analysis by John Pike of Global Security also points out that missiles–like combat aircraft–can make trade-offs between range and payload. For example, the No Dong B has a range of 1,560 kilometers with a 760 kilogram warhead and 1,350 kilometers with a 1,158 kilogram warhead.[43]

He feels that an improved Shahab could use a combination of a lighter aluminum airframe, light weight guidance, reduced payload, increased propellant load, and increased burn time to increase range. He notes that little is really known about the improved Shahab 3, but estimates the maximum range of an improved Shahab 3 as still being 2,000 kilometers, that a 0.7-0.8 ton warhead would limit its range to 1,500 kilometers and that a 0.8-0.9-1.0 ton warhead would reduce it to 1,200 kilometers. A1.2-ton warhead would limited it to around 850 kilometers. He feels Iran may have drawn on Russian technology from the R-21 and R-27. Photos of the system also show progressive changes in cable duct position, fins, and length in 2004 and 2005.[44]

The difference in range estimates may be a matter of Iranian propaganda, but a number of experts believe that Iranian claims refer to the modified Shahab-3D or the Shahab-3M and not the regular Shahab 3. There are reports that such modified versions use solid fuel, and could have a range of up to 2,000 kilometer. They also indicate that the standard Shahab-3 remains in production, but the improved Shahab was now called the Shahab-3M.[45]

Much also depends on the missile warhead. In 2004, then Secretary of State Collin Powell accused Iran of modifying its Shahab-3 to carry a nuclear warhead based on documents the US government had received from a "walk-in" source. While experts argued that this information was yet to be confirmed, others claimed that Iran obtained "a new nosecone" for its Shahab-3 missile.[46] In addition, other US officials claimed that the source of the information provided "tens of thousands of pages of Farsi-language computer files" on Iranian attempts to modify their Shahab-3 missile to deliver a "black box," which US officials believed to "almost certainly" referred to a nuclear warhead. These documents were said to include diagrams and test results, weight, detonation height, and shape, but did not include warhead designs.[47]

Media reporting indicates that the US, was able to examine drawings on a stolen laptop from Iran, and found that Iran had developed 18 different ways to adapt the size, weight, and diameter of the new nosecone on it Shahab-3 missile. It was also reported, however, that Iran's effort to expand the nosecone would not work and that Iran did not have the technological capabilities to adapt nuclear weapons into its Shahab-3 missile. US nuclear experts claimed that one reason for this failure was that the project "wasn't done by the A-team of Iran's program."[48]

Some experts believe that new "bottle neck" warhead tested in 2004 was for the Shahab-3M, and makes it more accurate and capable of air-burst detonations, which could be used to more effectively spread chemical weapons. Others believe a smaller warhead has increased its range.

As for other aspects of performance, it is again easy to be precise, but difficult to be correct. One source s, for example reports that the Shahab 3 has a CEP of 190 meters and carries a 750-989-1,158kg warhead). The same source reports that the Shahab 3 has a height of 16m, a stage mass of 15,092, a dry mass of 1,780-2,180, and a propellant mass of 12,912. In terms of propelling ability, its thrust is between 26,760-26,600, its burn time is 110 seconds, and it has an effective Isp of 226 and a drag loss of 45 seconds. According to this source, the Shahab-3 possesses one thrust chamber. Its fuel is TM-185, and its oxidizer is the AK 27I.[49]

High levels of accuracy are possible, but this remains to be seen. If the system uses older guidance technology and warhead separation methods, its CEP could be anywhere from 1,000 to 4,000 meters. If it uses newer technology, such as some of the most advanced Chinese technology, it could have a CEP as low as 190-800 meters. In any case, such CEP data are engineering estimates based on the ratios from a perfectly located target.

This means real-world missile accuracy and reliability cannot be measured using technical terms like circular error of probability (CEP) even if they apply to a fully mature and deployed missile. The definition of the term is based on the assumption the missile can be perfectly targeted at launch and performs perfectly through its final guidance phase, and then somewhat arbitrarily define CEP as the accuracy of 50% of the systems launched in terms of distance from a central point on the target. True performance can only be derived from observing reliability under operational conditions, and correlating actual point of impact to a known aim point.

A German expert notes, for example, that the operational CEP of the improved Shahab 3 is likely to be around three kilometers, but the maximum deviation could be 11 kilometers.[50] In short, unclassified, estimates of the Shahab 3's accuracy and reliability available from public sources are matters of speculation, and no unclassified source has credibility in describing its performance in real-world, war-fighting terms.

This is not a casual problem, since actual weaponization of a warhead requires extraordinarily sophisticated systems to detonate a warhead at the desired height of burst and to reliably disseminate the munitions or agent. Even the most sophisticated conventional sub-munitions are little more than area weapons if the missile accuracy and target location has errors in excess of 250-500 meters, and a unitary conventional explosive warhead without terminal guidance is little more that a psychological or terror weapon almost regardless of its accuracy.

The effective delivery of chemical agents by either spreading the agent or the use of sub-munitions generally requires accuracies less than 1,000 meters to achieve lethality against even large point targets. Systems with biological weapons are inherently area weapons, but a 1,000-kilogram nominal warhead can carry so little agent that accuracies less than 1,000 meters again become undesirable. Nuclear weapons require far less accuracy, particularly if a "dirty" ground burst can be targeted within a reliable fall out area. There are, however, limits. For example, a regular fission weapon of some 20 kilotons requires accuracies under 2,500-3,000 meters for some kinds of targets like sheltered airfields or large energy facilities.

What is clear is that the Shahab could carry a well-designed nuclear weapon well over 1,000 kilometers, and Iran may have access to such designs. As noted earlier, the Shahab-3 missile tested in its final stages in 2003, and in ways that indicate it has a range of 2,000 km, which is enough to reach the Gulf and Israel. AQ Khan sold a Chinese nuclear warhead design to Libya with a mass of as little as 500 kg and 1 meter diameter. It is highly probable such designs were sold to Iran as well.

Mobility and Deployment

The Shahab-3 is mobile, but requires numerous launching support vehicles for propellant transport and loading and power besides its Transport Erector Launcher (TEL).[51] It is also slow in setting up, taking several hours to prepare for launch.[52] Its deployment status is highly uncertain.

Some reports have claimed that the Shahab-3 was operational as early as 1999. Reports surfaced that development of the Shahab-3 was completed in June 2003, and that it underwent "final" tests on July 7, 2003. However, the Shahab-3 underwent a total of only nine tests from inception through late 2003, and only four of them could be considered successful in terms of basic system performance. The missile's design characteristics also continued to evolve during these tests. A CIA report to Congress, dated November 10, 2003, indicated that upgrading of the Shahab-3 was still underway, and some sources indicated that Iran was now seeking a range of 1,600 kilometers.

There is an argument among experts as to whether the system has been tested often enough to be truly operational. The CIA reported in 2004 that Iran had "some" operational Shahab 3s with a range of 1,300 kilometers. Some experts feel the missile has since become fully operational and Iran already possesses 25-100 Shahab-3's in their inventory.[53] Iranian opposition sources have claimed that Iran has 300 such missiles., According to other sources, the IRGC operated six batteries in the spring of 2006, and was redeploying them within a 35 kilometer radius of their main command and control center every 24 hours because of the risk of US or Israeli attack. The main operating forces were deployed in the West in Kermanshah and Hamadan provinces with reserve batteries further east in Fars and Isfahan provinces.[54]

A substantial number of experts, however, believe the Shahab-3 may be in deployment, but only in "showpiece" or "test-bed" units using conventional warheads and with performance Iran cannot accurately predict.

Shahab-3A/3M/3D/IRIS

In October 2004, the Mujahedin-e Khalq (MEK) claimed that Iran was developing an improved version of the Shahab with a 2,400-kilometer range (1,500 miles). The MEK has an uncertain record of accuracy in making such claims, and such claims could not be confirmed. Mortezar Ramandi, an official in the Iranian delegation to the UN denied that Iran was developing a missile with a range of more than 1,250 miles (2,000 kilometers).[55]

This new range for the Shahab-3 may have marked a significant move in Iranian technological capability, as some experts believe Iran switched the fuel source from liquid fuel to solid. The possible existence of a Shahab-3 with a solid fuel source created yet another variant of the Shahab-3 series, the Shahab-3D, or IRIS missile.

Such a development of a solid fuel source might enable the Shahab-3D to enter into space, and serve as a potential satellite launch vehicle. Perfecting solid fuel technology would also move Iran's missile systems a long way towards the successful creation of an LRICBM, which is what the Shahab-5 and Shahab-6 are intended to accomplish.[56]

If there is an IRIS launch vehicle, it apparently consist of the No-dong/Shahab-3 first stage with a bulbous front section ultimately designed to carry the IRIS second stage solid motor, as well as a communications satellite or scientific payload.[57] The IRIS solid fuel missile itself may be the 3rd stage portion of the North Korean Taep'o-dong 1.[58]

The Shahab-3D alone is not capable of launching a large satellite probe into space by itself, and it is possible that it is a test for the second and third stage portions of the upcoming IRBM Ghadr designs and the LRICBM Shahab-5 and Shahab-6.[59]

No test flights of the Shahab-3D have been recorded on video, but it is believed that they have taken place at a space launch facility.[60] The following timeline shows the reported tests of the Shahab-3D/IRIS:

- **July 22, 1998:** First test flight (explodes 100 seconds after takeoff)
- **July 15, 2000:** First successful test flight (range of 850km).
- **September 21, 2000:** Unsuccessful test flight (explodes shortly after take off).
- **May 23, 2002:** Successful test flight.
- **July 2002:** Unsuccessful test flight (missile did not function properly).
- **June 2003:** Successful test flight. Iran declares this was the final test flight before deployment.
- **August 11, 2004:** Successful test flight of Shahab-3M. Missile now has bottleneck warhead
- **October 20, 2004:** Another Successful test flight of Shahab-3M. Iran now claims the modified missile has a range of 2,000 km.[61]

Shahab-4

Iran seems to be developing much larger designs with greater range-payload using a variety of local, North Korean, Chinese, and Russian technical inputs. These missiles have been called the Sahab-4, Sahab-5, and Sahab-6. As of January 2006, none of these missiles were being produced, and the exact nature of such programs remained speculative.

Some experts believe the "Shahab-4" has an approximate range between 2,200 and 2,800 kilometers. Various experts have claimed that the Shahab-4 is based on the North Korean No Dong 2, three stage Taepodong-1 missile, Russian SS-N-6 SERB, or even some aspects of the Russian SS-4, but has a modern digital guidance package rather than the 2,000-3,000 meter CEP of early missiles like the SS-4.

Russian firms are believed to have sold Iran special steels for missile development, test equipment, shielding for guidance packages, and other technology. Iran's Shahid Hemmet Industrial Group is reported to have contracts with the Russian Central Aerohydrodynamic Institute, Rosvoorouzhenie, the Bauman Institute, and Polyus. It is also possible that Iran has obtained some technology from Pakistan.

One source has provided a precise estimate of some performance characteristics. This estimate of "Shahab-4 gives it an estimated height of 25 meters, a diameter of 1.3 meter, and a launch weight of 22,000 kilograms. In terms of propelling ability, its thrust is estimated to around 26,000 kg f and its burn time around 293 seconds. It is said to be a 2/3 stage rocket that possesses 3 thrust chambers, one for each stage. Its fuel for the first stage is Heptyl, and its oxidizer is the IRFNA.[62]

Iran has sent mixed signals. In October, 2003, Iran claimed it was abandoning its Shahab-4 program, citing that the expected increase in range (2,200 to 3,000km) would cause too much global tension.[63] Some speculate that Iran may scraped its Shahab-4 program, because it either was not innovative and large enough and/or to avoid controversy. The reason some Iranians have announced for creating a missile like the Shahab-4 was for satellite launches. The IRIS/Shahab-3D, with its solid fuel source, however, has shown potential in for space launch. The improved range and bottleneck warhead design offered by the Shahab-3M (which began testing in August of 2004) may make the Shahab-4 simply not worth the effort or controversy.[64]

According to German press reports, however, Iran is moving ahead in its development of the Shahab-4. In February 2006, the German news agency cited "Western intelligence services" as saying that Iran successfully tested the Shahab-4 missile with a range of 2,200 kilometers on January 17, 2006, and the test was announced on Iranian television several days later by the commander of the Islamic Revolutionary Guards Corps (IRGC).[65] These reports remain unverifiable.

Shahab-5 and Shahab-6

Israeli intelligence has reported that Iran is attempting to create a Shahab-5 and a Shahab-6, with a 3,000-5,000 kilometer range. These missiles would be based on the North Korean Taep'o-dong-2, and would be three-stage rockets. If completed, the Shahab-5 and the Shahab-6 would take Iran into the realm of limited range ICBM's, and enable Iran to target the US eastern seaboard. The Shahab-5 and Shahab-6 would possess a solid fuel 3rd stage for space entry and liquid fuel for the first stage take units.

It is alleged that Russian aerospace engineers are aiding the Iranians in their efforts. It is believed that the engineers will employ a version of Russia's storable liquid propellant RD-216 in the missile's first stage. The RD-216 is an Energomash engine originally used on the Skean/SS-5/R-14, IRBM, Saddler/SS-7/R-16, ICBM and Sasin/R-26 ICBM missiles used in the cold war. These reports remain uncertain, and Israeli media and official sources have repeatedly exaggerated the nature and speed of Iranian efforts.[66]

Neither the Shahab-5 nor the Shahab-6 have been tested or constructed. While no description of the Shahab-6 is yet available, extrapolations for the Shahab-5 have been made based on the North Korean Taep'o-dong 2. The Shahab-5 has an approximate range between 4,000 km and 4,300km. The Shahab-5 has an unknown CEP, and its warhead capacity is between 700-1,000kg. It has a height of 32m, a diameter of 2.2m, and a launch weight of 80,000-85,000.

In terms of propelling ability, some experts estimate its thrust to be 31,260 Kg f and its burn time is 330 seconds. The Shahab-5 is a three-stage rocket that possesses 6 thrust chambers, 4 for stage one, and one for the two remaining stages. The Shahab-5 and Shahab-6 would be considered long-range ICBM's.[67]

As of January 2006, Iran had not completed its plans for these missiles, and it had none in its inventory. In February 2006, German press reports, however, claimed that the Federal German Intelligence Service (BND) estimated that it was possible for Iran to acquire the Shahab-5 as early as 2007 with a range of 3,000-5,000 kilometers.[68] These estimates, however, are speculative and remain unconfirmed.

Ghadr 101 and Ghadr 110

The uncertainties surrounding Iran's solid fuel problem and the existence or non-existence of the Shahab 3 are compounded by reports of a separate missile development program. The Iranian exile group, National Council of Resistance in Iran (NCRI), claimed in December 2004, that the Ghadr 101 and Ghadr 110 were new missile types that used solid fuel and were, in fact, IRBMs. Their existence has never been confirmed, and conflicting reports make an exact description difficult.

At the time, US experts indicated that the Ghadr is actually the same as the Shahab-3A/Shahab M/Shahab 4, which seemed to track with some Israel experts who felt that Iran was extending the range/payload of Shahab 3, and that reports of both the Gadr and Shahab 4 were actually decribing the Shahab 3A/3M. [69]

In May 2005, Iran tested a solid fuel motor for what some experts came to call the Shahab-3D, possibly increasing the range to 2,500km, making space entry possible, and setting the stage for the Shahab-5 and Shahab-6, are 3 stage rockets resembling ICBMs.[70] This test showed that Iran had developed some aspects of a successful long-range, sold fuel missile design, but did not show how Iran intended to use such capabilities.

NCRI again claimed in March 2006, that Iran was moving forward with the Ghadr solid fuel IRBM. It also claimed that Iran and scrapped the Shahab 4 because of test failures and performance limitations. It reported that Iran had substantial North Korean technical support for the Ghadr, that it was 70% complete, and had a range of 3,000 kilometers. One Israel expert felt that NCRI was confusing a solid-state, second stage for the liquid-fueled Shahab 4 with a separate missile.[71]

Work by Dr. Robert Schmucker indicates that Iran is working on solid fueled systems, building on its experience with solid fuel artillery rockets like its Fateh 110A1 and with Chinese support in developing solid fuel propulsion and guidance. The Fateh, however, is a relatively primitive system with strap down gyro guidance that is not suited for a long-range ballistic missile.[72]

As is the case with longer-range variants of the Shahab, it is probably wise to assume that Iran is seeking to develop options for both solid and liquid fueled IRBMs, and will seek high range-payloads to ensure it can deliver effective CBRN payloads even if it cannot produce efficient nuclear weapons. It is equally wise to wait for systems to reach maturity before reacting to vague possibilities, rather than real-world Iranian capabilities.

Raduga KH-55 Granat/Kh-55/AS-15 Kent

The Raduga KH-55 Granat is a Ukrainian/Soviet-made armed nuclear cruise missile first tested in 1978 and completed in 1984.[73] The Russian missile carries a 200-kiloton nuclear warhead, it has a range of 2,500-3,000 kilometers. It has a theoretical CEP of about 150 meters, and a speed of Mach 0.48-0.77. It guidance system is reported to combine inertial-Doppler navigation and position correction based on in-flight comparison of terrain in the assigned regions with images stored in the memory of an on-board computer. It was designed to deliver a high yield nuclear weapon against fixed area targets, and has little value delivering conventional warheads. While it was originally designed to be carried by a large bomber, and its weight makes it a marginal payload for either Iran's Su-24s or F-14As, it has land and ship launch capability. It can also be adapted to use a much larger nuclear or other CBRN warhead by cutting its range, and may be a system that Iran can reverse engineer for production.[74]

Russian President Boris Yeltsin made further manufacture of the missile illegal in 1992.[75] Still, the Ukraine had 1,612 of these missiles in stock at the end of 1991, and it agreed to give 575 of them to Russia and scrap the rest.[76] The plans to give the missiles to Russia in the late 1990's proved troublesome, however, and an organization was able to forge the documents regarding 20 missiles and listed them as being sold to Russia, while in fact 12 seem to have been distributed to Iran and 6 to China (the other two are unaccounted for).[77] It was estimated that the missiles were smuggled to Iran in 2001.[78]

Ukrainian officials confirmed the illegal sale on March 18, 2005, but the Chinese and Iranian governments were silent regarding the matter. While some US officials downplayed the transaction, the US State Department expressed concern that the missiles could give each state a technological boost.[79] The missiles did not contain warheads at the time of their sale, and they had passed their service life in 1995, and were in need of maintenance.[80] It is, however, feared that Iran could learn from the cruise missiles technology to improve their own missile program and the missiles could be fitted to match Iran's Su-24 strike aircraft.[81]

Alternative Delivery Options and Counter-Threats

Iran has several alternatives to deliver its WMDs in addition to its missile program. First, Iran can use its existing air force assets to delivery CBRN. Second, Iran can use its asymmetric warfare capabilities and covert assets available to the IRGC and its intelligence services to carry WMD attacks against US assets in the region, neighboring states, or energy routes. Third, Iran can use proxy groups such as Hezbollah to attack targets in the Middle East and beyond. Fourth, Iran can smuggle CBRN devices into target cities, US forces, or neighboring states military and energy sites.

Air Force

The Iranian Air Force is still numerically strong, but most of its equipment is aging, worn, and has limited mission capability. It has some 52,000 men; 37,000 in the air force per se, and 15,000 in the Air Defense force, which operates Iran's land-based air defenses. It has over 300 combat aircraft in its inventory (The IISS estimates 306).

Many of these aircraft, are either not operational or cannot be sustained in extended air combat. This includes 50-60% of Iran's US and French supplied aircraft and some 20-30% of its Russian and Chinese supplied aircraft. It has nine fighter-ground attack squadrons with 162-186 aircraft; seven fighter squadrons, with 70-74 aircraft, a reconnaissance unit with 4-8 aircraft, and a number of transport aircraft, helicopters, and special purpose aircraft. It operates most of Iraq's land-based air defenses, including some 150 I Hawks, 45 HQ-21s, 10 SA-5s, 30 Rapiers, and additional forces equipped with light surface-to-air missiles.

The Iranian air force is headquartered in Teheran with training, administration, and logistics branches, as well as a major central Air Defense Operations Center. It has a political directorate and a small naval coordination staff. It has three major regional headquarters: Northern Zone (Badl Sar), Central Zone (Hamaden), and Southern Zone (Bushehr). Each regional zone seems to control a major air defense sector with subordinate air bases and facilities. The key air defense sub-zones and related bases in the Northern Zone are at Badl Sar, Mashhad, and Shahabad Kord. The sub-zones and bases in the Central Zone are at Hamadan and Dezful, and the sub-zones and bases in the Southern Zone are at Bushehr, Bandar Abbas, and Jask. Iran has large combat air bases at Mehrabad, Tabriz, Hamadan, Dezful, Bushehr, Shiraz, Isfahan, and Bandar Abbas. It has smaller bases at least at eleven other locations. Shiraz provides interceptor training and is the main base for transport aircraft.

As is the case with most aspects of Iranian military forces, estimates of Iran's exact air strength differ by source. The IISS estimates the air force has 18 main combat squadrons. These include nine fighter ground-attack squadrons, with 4/55-65 US-supplied F-4D/E and 4/55-65 F-5E/FII, and 1/27-30 Soviet-supplied Su-24. Iran had 7 Su-25K and 24 Mirage F-1 Iraqi aircraft it seized during the Gulf War, and some may be operational. Some reports indicate that Iran has ordered an unknown number of TU-22M-3 'Backfire C' long-range strategic bombers from either Russia or the Ukraine.[82] While such discussions do seem to have taken place, no purchases or deliveries can be confirmed.

Iran had seven air defense squadrons, with 2/20-25 F-5B, 60 US-supplied F-14, 2/25-30 Russian/Iraqi-supplied MiG-29, and 1/25-35 Chinese supplied F-7M.[83] The Iranian air force had a small reconnaissance squadron with 3-8 RF-4E. It has 5 C-130H MP maritime reconnaissance aircraft, 1 RC-130 and other intelligence/reconnaissance aircraft, together with large numbers of transports and helicopters.

Most Iranian squadrons can perform both air defense and attack missions, regardless of their principal mission -- although this is not true of Iran's F-14 (air defense) and Su-24s (strike/attack) units. Iran's F-14s were, however, designed as dual-capable aircraft, and have not been able to use their Phoenix air-to-air missiles since the early 1980s. Iran has claimed that it is modernizing its F-14s by equipping them with I-Hawk missiles adapted to the air-to-air role, but it is far from clear that this is the case or that such adaptations can have more than limited effectiveness. In practice, this means that Iran might well use the F-14s in nuclear strike missions. They are capable of long range, high payload missions, and would require minimal adaptation to carry and release a nuclear weapon.[84]

As a result, Iran has a large number of attack and air defense aircraft that could carry a small to medium sized nuclear weapon long distances, particularly since most such strikes are likely to be low-altitude one-way missions. (These were the mission profiles in both NATO and Warsaw Pact theater nuclear strike plans.) Several might conceivably be modified as drones or the equivalent of "cruise missiles" using autopilots, on-board computers, and add-on GPS.

Iran also has some indigenous capability to make combat aircraft and drones. Iran has been developing three new attack aircraft. The indigenous design and specifics of one of the fighters in development, the Shafagh, were unveiled at the Iran Airshow in 2002. Engineers hope to have a prototype by 2008, though it is unclear what the production numbers will be and what the real-world timetable for deployment may be.[85] Only limited data are available on the other two fighters in development, the Saeghe and the Azarakhsh, other than they have been reportedly derived from the F-5F. Claims have been made that the Azarakhsh is in low rate production, and has had operational weapons tests. There are also some indications that Iran is experimenting with composites in the Azarakhsh, and is seeking to give it locally modified beyond-visual-range radar for air-to-air combat.[86]

The Islamic Revolutionary Guards Corps (Pasdaran)

The Islamic Revolutionary Guards contribute some 120,000 men to Iran's forces, and have substantial capability for asymmetric warfare and covert operations. It operates most of Iran's surface-to-surface missiles, and would probably have custody over deployed nuclear weapons, most or all other CBRN weapons, and operate Iran's nuclear-armed missile forces if they are deployed.

The Air Branch

The air branch of the IRGC is believed to operate Iran's three Shahab-3 IRBM units, and may have had custody of its chemical weapons and any biological weapons. While the actual operational status of the Shahab-3 remains uncertain; Iran's supreme leader, Ayatollah Ali Khamenei, announced in 2003 that Shahab-3 missiles had been delivered to the Islamic Revolutionary Guards Corps (IRGC). In addition, six Shahab-3s were displayed in Tehran during a military parade in September 2003.[87]

The IRGC also has some air elements. It is not clear what combat formations exist within the IRGC, but the IRGC may operate Iran's 10 EMB-312 Tucanos.[88] It seems to operate many of

Iran's 45 PC-7 trainers, as well as some Pakistani-made trainers at a training school near Mushhak, but this school may be run by the regular air force. It has also claimed to manufacture gliders for use in unconventional warfare. These are unlikely delivery platforms but could carry small number weapons.[89]

The Naval Branch

The IRGC also has a naval branch with some 20,000 men. According to the IISS, this total includes Iran's marine of some 5,000 men, and a combat strength of one brigade. Other sources show this force subordinated to the Navy. Such a force could deliver small nuclear weapons or other CBRN weapons into ports, oil and desalination facilities, and felt operational areas in the Gulf and Gulf of Oman.

The naval branch has bases in the Gulf, many near key shipping channels and some near the Strait of Hormuz. These include facilities at Al-Farsiyah, Halul (an oil platform), Sirri, Abu Musa, Bandaer-e Abbas, Khorramshahr, and Larak. It also controls Iran's coastal defense forces, including naval guns and an HY-3 Seersucker land-based anti-ship missile unit deployed in 5-7 sites along the Gulf coast.

Its forces can carry out extensive raids against Gulf shipping, carry out regular amphibious exercises with the land branch of the IRGC against objectives like Islands in the Gulf, and could conduct raids against Saudi Arabia or other countries on the Southern Gulf coast. They give Iran a major capability for asymmetric warfare. The Guards also seem to work closely with Iranian intelligence, and to be represented unofficially in some embassies, Iranian businesses and purchasing offices, and other foreign fronts.

They have at least 40 light patrol boats, 10 Houdong guided missile patrol boats armed with C-802 anti-ship missiles, and a battery of HY-2 Seersucker land-based anti-ship missiles. Some of these systems could be modified to carry a small CBRN weapon, but are scarcely optimal delivery platforms because of their limited-range payload and sensor/guidance platforms unsuited for the mission.

Proxy and Covert CBRN Operations

Other elements of the IRGC could support proxy or covert use of CBRN weapons. They run some training camps inside Iran for outside "volunteeers." Some IRGC still seem to be deployed in Lebanon and actively involved in training and arming Hezbollah, other anti-Israeli groups, and other elements.[90] The IRGC has been responsible for major arms shipments to Hezbollah, including large numbers of AT-3 anti-tank guided missiles, long-range rockets and some Iranian-made Mohajer UAVs.[91]

Some reports indicate Iran has sent thousands of 122mm rockets and Fajr 4 and Fajr 5 long-range rockets, including the ARASH with a range of 21-29 kilometers. These reports give the Fajr 5 a range of 75 kilometers with a payload of 200 kilograms. Iran seems to have sent arms to various Palestinian movements, including some shiploads of arms to the Palestinian Authority.[92]

The IRGC has a complex structure that is both political and military. It has separate organizational elements for its land, naval, and air units, which include both military and paramilitary units. The Basij and the tribal units of the Pasdaran are subordinated to its land unit command, although the commander of the Basij often seems to report directly to the commander-in-chief and Minister of the Pasdaran and through him to the Leader of the Islamic Revolution.

The IRGC has close ties to the foreign operations branch of the Iranian Ministry of Intelligence and Security (MOIS), particularly through the IRGC's Qods force. The Ministry of Intelligence and Security was established in 1983, and has an extensive network of offices in Iranian embassies. It is often difficult to separate the activities of the IRGC, VEVAK, and Foreign Ministry, and many seem to be integrated operations managed by a ministerial committee called the "Special Operations Council" that includes the Leader of the Islamic Revolution, President, Minister of Intelligence and Security, and other members of the Supreme Council for National Defense.[93]

The Quds Forces

The IRGC has a large intelligence operations and unconventional warfare component. Roughly 5,000 of the men in the IRGC are assigned to the unconventional warfare mission. The IRGC has the equivalent of one Special Forces "division," plus additional smaller formations, and these forces are given special priority in terms of training and equipment. In addition, the IRGC has a special Quds force which plays a major role in giving Iran the ability to conduct unconventional warfare overseas using various foreign movements as proxies.[94]

The budget for the Quds forces is a classified budget directly controlled by Khamenei, and is not reflected in the Iranian general budget. It operates primarily outside Iran's borders, although it has bases inside and outside of Iran. The Quds troops are divided into specific groups or "corps" for each country or area in which they operate. There are Directorates for Iraq; Lebanon, Palestine, and Jordan; Afghanistan, Pakistan, and India; Turkey, the Arabian Peninsula; the Asiatic republics of the FSU, Western Nations (Europe and North America) and North Africa (Egypt, Tunisia, Algeria, Sudan, and Morocco).

The Quds has offices or "sections" in many Iranian embassies, which are closed to most embassy staff. It is not clear whether these are integrated with Iranian intelligence operations, or that the ambassador in such embassies has control of, or detailed knowledge of, operations by the Quds staff. However, there are indications that most operations are coordinated between the IRGC and offices within the Iranian Foreign Ministry and Ministry of Intelligence and Security (MOIS). There are separate operational organizations in Lebanon, Turkey, Pakistan, and several North African countries. There also indications that such elements may have participated in the bombings of the Israeli Embassy in Argentina in 1992, and the Jewish Community Center in Buenos Aires in 1994 -- although Iran has strongly denied this.[95]

The Quds force seems to control many of Iran's training camps for unconventional warfare, extremists, and terrorists in Iran and countries like the Sudan and Lebanon. It has at least four major training facilities in Iran. The Quds forces have a main training center at Imam Ali University that is based in the Sa'dabad Palace in Northern Tehran. Troops are trained to carry out military and terrorist operations, and are indoctrinated in ideology. There are other training camps in the Qom, Tabriz, and Mashhad governates, and in Lebanon and the Sudan. These include the Al Nasr camp for training Iraqi Shi'ites and Iraqi and Turkish Kurds in northwest Iran, and a camp near Mashhad for training Afghan and Tajik revolutionaries. The Quds seems to help operate the Manzariyah training center near Qom, which recruits from foreign students in the religious seminary and which seems to have trained some Bahraini extremists. Some foreigners are reported to have received training in demolition and sabotage at an IRGC facility near Isfahan, in airport infiltration at a facility near Mashad and Shiraz, and in underwater warfare at an IRGC facility at Bandar Abbas.[96]

Role in Iran's Industries

The IRGC plays a major role in Iran's military industries. Its lead role in Iran's efforts to acquire surface-to-surface missiles and weapons of mass destruction, give it growing experience with advanced military technology. As a result, the IRGC is believed to be the branch of Iran's forces that plays the largest role in Iran's military industries.[97] It also operates all of Iran's Scuds, controls most its chemical and biological weapons, and provides the military leadership for missile production and the production of all weapons of mass destruction.

The Basij and Other Paramilitary Forces

The rest of Iran's paramilitary and internal security forces seem to have relatively little capability in such missions. The Basij (Mobilization of the Oppressed) is a popular reserve force of about 90,000 men with an active and reserve strength of up to 300,000 and a mobilization capacity of nearly 1,000,000 men. It is controlled by the Islamic Revolutionary Guards Corps, and consists largely of youths, men who have completed military service, and the elderly.

Iran also has 45,000-60,000 men in the Ministry of Interior serving as police and border guards, with light utility vehicles, light patrol aircraft (Cessna 185/310 and AB-205 and AB-206s), 90 coastal patrol craft, and 40 harbor patrol craft.

Assessing Iran's Delivery Options

There is no way to know Iran's plans relative to missiles, long-range aircraft, and covert/proxy use. Iran has, however, clearly made a major commitment to developing and deploying long-range surface-to-surface missiles. Iran may eventually have enough nuclear weapons to use them as shorter-range tactical weapons. This possibility is now so remote than it does not seem to merit detailed analysis.

Aside from the Scud, Iranian programs are too transitional, or too early in development, to allow any precise estimate of their nuclear capability. The ranges, payloads, and accuracies quoted for all missiles except the Scud are engineering estimates based on nominal performance criteria. This method of estimation has produced drastic and consistent errors for more than half a century. Hard data based on telemetry and actual tests are the only reliable source of such data, and these sources often never produce trustworthy data on operational accuracy and reliability unless tied to multiple tests and enough information to be sure of the aim point.

It is important to note that Iran faces much the same uncertainties in many aspects of developing testing, and designing missiles and warheads, and will continue to do so until it has a comprehensive set of operational test data based on its missiles and the behavior of its warheads. Even then, there will probably be a significant risk that any given missile launch will be at least a partial failure, and could impact far from its target. CEP is always nominal and based on a perfectly functioning system. Even then, it makes no effort to predict where the 50% of the missiles that impact outside the CEP actually go.

Warhead and bomb design are also major problems. It is one thing to create a nuclear device or even bomb, and other to create a reliable and effective nuclear warhead. Such a device would have to be safe, reliable, and -- for most uses that have predictable and controllable nuclear weapons effects -- have arming and detonation that allow precise control of the height of burst. Even making a small, efficient bomb is still a state of the art exercise in design, engineering and manufacturing. A missile warhead requires far more skill. The leak of Chinese designs may help, as may other technology transfers, but Iran would want great assurance that such designs would function as planned. This could, up to a point, be simulated by using non-fissile material, by testing specially configured conventional warheads, by static or even underground tests, and by testing bombs configured to give missile warhead design data. Concealment and non-fissile testing of nuclear missile warheads is possible, and could be highly effective in some ways, but would not be without risk

That said, ballistic and cruise missile systems offer the highest probability of successful penetration although Israel has deployed the Arrow anti-ballistic missile, and can use its Patriots for cruise missile defense. The US also has the Patriot, sea-based cruise missile and limited ABM defenses, and is developing much more advanced theater ABMs. The presence of such defense might, however, be partially countered by firing a volley of missiles at the same time because of the limited footprint and coverage in any given area. Only one would need to be nuclear armed, and Iran could first unarmed missiles first to determine how effective such defenses were.

The use of aircraft is often ignored, but presents complex trade-offs. Such systems may be easier to detect and defend against but they also offer more reliability and control. While Iran has a limited number of aircraft with high range payloads, it has a large number of aircraft in could launch on one-way ferry missions. Iran practiced such multiple attack or swarming techniques to suppress US Navy defenses in exercises during the time of the Shah. They have limited effectiveness against today's more capable defenses, but could still have some value.

The risk of any mix of such attacks would still be high and be compounded by the near certainty of retaliation. US, Saudi, Israeli, and other regional sensors would also detect any Iranian ballistic missile launch, and an alert force might well track a cruise missile at least back to Iranian territory. Delivering CBRN with missiles or aircraft may not be easy to defend against, but clearly implicates Iran in the attacks. If such a system were nuclear armed, it would be more than a license to escalate; it would be a license for massive retaliation with nuclear weapons.

It is unclear how the US would retaliate under such conditions. The minimal demand would probably be for unconditional surrender and one reinforced by immediate US military action. The Israeli reaction is more speculative, but it seems doubtful that Israel would take any chances in such an existential war. From an Israeli perspective, such Iranian action might well be seen as total war and one in which Israel could not afford not to send the most drastic possible signal to other nations in the region. The end result might well be thermonuclear ground bursts on all of Iran's major cities. If so, the damage would be far greater than the damage done by the smaller weapons and be compounded by the long-term killing effects of massive amounts of fall out.

As has been discussed earlier, this might make the use of covert, remote, or proxy options seem more desirable. Iran's role would be far harder to detect and this would complicate the exercise of retaliatory options. The problem would be, however, that it would take far more than mere "plausible deniability" to deter nations like the US or Israel, or America's regional allies from demanding an immediate response. A total "black" operation is always difficult, and the lack of a clear trace back to Iran would probably be irrelevant in a war or serious crisis. The threshold of any nuclear attack is simply too high for further risk taking or restraint. Even an attack that did initially seem to succeed in obfuscating Iran as a source, or succeed in using a "false flag" would also create the risk of future discovery. Memories, to put it mildly, would be long, and the response would probably be equally grim.

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