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European Missile Defense: Assessing Iran's ICBM Capabilities

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In 1999 and 2001, the National Intelligence Council stated that Iran could develop an ICBM capable of reaching the United States by 2015. In recent years, U.S. government agencies have affirmed those estimates, arguing that "Iran could have long-range missiles capable of reaching the U.S. and Europe before 2015" and that "proposed U.S. missile defense assets in Europe would defend the U.S. and much of Europe against long-range ballistic missile threats launched from the Middle East."[1] Accordingly, Washington intends to build a missile defense system in Europe by around 2012.

Can Iran field an ICBM capable of striking the United States by 2012? Iran has more than a decade of experience with developing single-stage, short-range and medium-range missiles that can reach neighboring countries and Israel. It has yet to demonstrate a capability for a longer-range missile, although within a few years it may have the means to develop and deploy a 3,000-4,000-kilometer-range missile that can strike western Europe. Iran would find it difficult, though, to field a 10,000-kilometer-range ICBM that can strike the United States by 2012-2015 unless North Korea or another country successfully develops and tests such a system and transfers it to Iran. Even with such foreign assistance, it would likely take Tehran several additional years of development and testing before it could produce and deploy a modest number of such missiles.

Iran's Missile Programs

Iran initially sought ballistic missiles during its war with Iraq, when hundreds of Iraqi missiles struck Iranian cities. Tehran's missile program then developed in several phases. From the mid-1980s to mid-1990s, Iran purchased 300-kilometer-range Scud-B and 600-kilometer-range Scud-C missiles from North Korea, and it also indigenously assembled and built Scuds. Then Iran developed the single-stage, liquid-fuel Shahab-3 missile. This approximately 16-metric-ton missile has a range of 1,300 kilometers with a 750-kilogram payload and is derived from North Korea's Nodong missile. The Shahab-3 was first flight-tested in July 1998 and reportedly completed its development test series after its sixth flight in July 2003.[2]

Since the turn of the century, Iran has pursued a number of other missile projects, although it has not yet flight-tested a new medium-range or long-range ballistic missile. One project involves modifications to the Shahab-3. In August 2004, Iran tested a Shahab-3 with a bulbous nose cone reportedly capable of accommodating a nuclear warhead.[3] In August 2005, Iran stated that it had increased the range of the Shahab-3 to 2,000 kilometers. Iran again tested the Shahab-3 in January 2006 and May 2006, and the January 2006 test may have involved a more advanced North Korean Nodong-B missile.[4]

The Nodong-B reportedly uses technology from the Soviet-era SS-N-6 submarine-launched missile and has a range of 2,500-4,000 kilometers. It is reportedly shorter and wider than the original Nodong and has a dual-chamber control engine rather than the steering vanes of the original Nodong, which would make it more stable, more maneuverable, and more accurate than the original. Its Iranian derivative is sometimes called the Shahab-3B. Press reports in April 2006 noted that Iran had received this Nodong-B missile from North Korea, but it is unclear as to how many missiles

were supplied and whether Iran is also indigenously building this missile.[5]

Another Iranian rocket project is the Shahab-4, which has not been flight-tested and may well have been terminated. Press reports in 1999-2000 mentioned that this rocket was powered by an RD-214 engine used in Russia's liquid-fuel SS-4 missile and would be used to launch satellites. However, Iran has not launched satellites aboard such a rocket. Other reports noted that the Shahab-4 was based on the North Korean Taepo Dong-1 design. North Korea's Taepo Dong-1 has only been tested once, in August 1998, and is based on a Nodong-derived first stage and a Scud-derived second stage. Neither North Korea nor Iran are known to have deployed this system.

Iran has long-standing plans to build and launch satellites using its own rockets. In 1999, press reports noted that Iran planned to launch three satellites by 2002-2003,[6] and Iran's first two satellites were eventually launched aboard Russian rockets in 2005. In January 2007, *Aviation Week* quoted Iranian officials as saying that an Iranian satellite-launching rocket "has been assembled and will lift off soon."[7] It added that this rocket weighed 22-27 metric tons and used a Ghadr or Shahab-3 missile as its first stage, a configuration that would be similar to the Taepo Dong-1.[8] In general, any Iranian satellite launcher derived from the SS-4/RD-214, Ghadr, Shahab-3, or Taepo Dong-1 would only be capable of placing a satellite weighing a few hundred kilograms into low-Earth orbit and would be the equivalent of a missile with a range of approximately 2,000-4,000 kilometers. It would not be able to reach the continental United States.

Another Iranian missile project involves a one-to-two stage solid-fuel missile, reportedly called the Ghadr, that would represent an advance from Iran's prior liquid-fuel missiles. Solid-fuel missiles are better suited for military purposes because they can be launched instantly. Liquid fuels are often volatile, so they are stored separately from missiles and take hours to load onto a missile. In May 2005, Iranian officials announced that they were testing a solid-fuel engine for this missile and that it would have a range greater than 2,000 kilometers. Iran displayed a Ghadr missile at a September 2007 military parade and announced that it had a range of 1,800 kilometers; it is not known if this missile had a solid-fuel engine as was reported in May 2005.

Finally, Iran is believed to be seeking a longer-range Shahab-5 or Shahab-6 missile and satellite launch vehicle (SLV), which is reportedly based on North Korea's Taepo Dong-2 or Taepo Dong-2C/Taepo Dong-3. No Iranian flight tests of this system have been reported, and North Korea's single flight test of this system, in July 2006, failed.

In summary, as of mid-2007, Iran has only flight-tested one medium-range missile, the single-stage Shahab-3, having a range of 1,300-2,000 kilometers. Iran is reported to be developing or acquiring two more advanced missiles, a one-to-two stage solid-fuel missile and a 2,500-4,000 kilometer-range, liquid-fuel, Shahab-3B based on the North Korean Nodong-B. These would give Iran the capability to strike western Europe: a 3,000-kilometer-range Iranian missile could reach Rome and Berlin; a 4,000-kilometer-range missile could reach London and Paris.

An ICBM From North Korea

Iran has not yet tested an intercontinental-range missile capable of striking the United States. Major U.S. cities, such as New York and Washington, are 9,500-10,000 kilometers from Iran. But U.S. intelligence officials contend that Iran could quickly develop such missiles by acquiring Taepo Dong-2 technology from North Korea. They routinely note that "if Iran were to acquire complete [Taepo Dong-2] systems from North Korea, it could conduct a flight test within a year of delivery."[9] Yet, North Korea itself has not successfully tested the Taepo Dong-2, and its range is uncertain.

Initial reports in the late 1990s and early 2000s noted that the Taepo Dong-2 had a first stage derived from China's CSS-2 and a second stage derived from the Nodong, giving it a range of 4,000-6,000 kilometers.[10] Such a missile would not reach the continental United States from Iran, even with a third stage that adds 1,000-2,000 kilometers to its range. More recent reports suggest that North Korea may have developed an improved Taepo Dong-2C/Taepo Dong-3 missile with a more powerful propulsion system using UDMH fuel, which is superior to the kerosene-gasoline fuel used in the Taepo Dong-2. This missile reportedly has a first stage weighing more than 50 metric tons and a second stage weighing 15-20 metric tons.[11]

U.S. officials have stated that the two-stage version of this Taepo Dong-2C/Taepo Dong-3 missile has a range of 10,000 kilometers and a three-stage version can fly 15,000 kilometers, enabling it to cover all of the United States.[12] It is difficult, however, to verify the accuracy of the information in these reports. North Korea and Iran

would only have confidence in the Taepo Dong-2 or an improved Taepo Dong-2C/Taepo Dong-3 after a few successful tests of the system.

Further, even after regional powers test prototype ICBMs or equivalent SLVs, they only build one or two such systems each year, in part because international technology embargoes and economic constraints considerably limit their volume of missile production. Illustrating this, the historical record from the 1980s and 1990s shows that North Korea annually built 50-100 short-range, Scud-type missiles and 10-20 medium-range, Nodong-type missiles. Some reports note that Iran may have increased its production rate to perhaps five Shahab-3s each month.[13] Yet, regional powers have initially built only one or two long-range systems annually, such as the 130-metric-ton booster used on India's polar SLV that flew six times in the eight years after its first launch in 1993.

Thus, any meaningful assessment of an Iranian ICBM capability must await a successful test of the improved 10,000-kilometer-range Taepo Dong-2C/Taepo Dong-3 missile. If North Korea successfully tests such a missile during 2008-2010 and these missiles or their major subsystems such as engines and airframes are transferred to Iran, then Iran could plausibly have a few ICBMs by 2012-2015. Even so, Iran might not build or acquire more than just a few such missiles.

Iran's Indigenously Built ICBM

If Iran cannot acquire the Taepo Dong-2C or its major subsystems from North Korea, it would have to build this missile indigenously. Iran has an active missile research and development program based at the Shahid Hemmat Missile Industries Complex in Tehran. It also has considerable experience with missile development and production. It successfully developed the Shahab-3, albeit with initial North Korean and Russian assistance,[14] and is believed to have produced at least several tens of these missiles. This missile infrastructure could enable Iran to develop more powerful, intercontinental-range missiles, but it is unclear whether Iran could build and field many such missiles by 2012-2015 because missile development can take at least five years.

One missile study, the Rumsfeld Commission report of 1998, noted that "a nation with a well-developed, Scud-based ballistic missile infrastructure would be able to achieve first flight of a long-range missile, up to and including intercontinental ballistic missile (ICBM) range [greater than 5,500 kilometers], within about five years of deciding to do so."[15] This estimate has been true for some regional powers but not for others. India actively began working on the 48-metric-ton, 3,000-kilometer-range Agni-3 missile around 2001[16] and first unsuccessfully tested it in 2006, with a successful test in 2007. Thus, India built an advanced, medium-range missile after five to six years of actively working on, rather than of simply making a decision to pursue, this system. Despite a decade of work, Brazil has not yet successfully flown its approximately 49-metric-ton SLV launcher, which is built around a cluster of four eight- to nine-metric-ton boosters in the first stage. The first flight tests of this rocket in 1997 and 1999 failed, and the rocket exploded on its launch pad some days prior to launch in 2003.

If Iran is in fact working on other missiles, such as the Shahab-3B and Ghadr, it may not be able to allocate significant resources toward a 10,000-kilometer-range missile. Iran would presumably be able to devote more efforts toward an ICBM only after completing the development of the Shahab-3B and Ghadr missiles, which could take a few years. However, if Iran is not developing a Shahab-3B or Ghadr and is instead allocating most of its missile resources toward an ICBM, then it might be able to test such a missile within a few years.

Iran also would have to perfect many critical technologies for an ICBM, a delay in any one of which would delay the entire ICBM program. First, Iran would have to master stage-separation technology. Iran has developed the single-stage Shahab-3 missile but has yet to test a multiple-stage missile successfully. Its only reported test of a multiple-stage rocket, a Shahab-3D with a liquid-fuel first stage and solid-fuel second stage, failed in September 2000. Second, Iran would have to develop a powerful propulsion system for an ICBM. The propulsion systems for Iran's 1,300-2,000-kilometer-range Shahab-3 and the up to 2,500-4,000-kilometer-range Ghadr and Shahab-3B missiles are not powerful enough for an ICBM, and the option of stacking or clustering many of these systems to build an ICBM quickly is not generally viable for a missile. Therefore, Iran may have to develop entirely new, more powerful propulsion systems for an ICBM, which could take several years. Third, Iran would have to develop more sophisticated re-entry vehicles for ICBMs, because the re-entry vehicles on its intermediate-range missiles would be inadequate for the higher re-entry velocities and temperatures experienced by ICBMs. Fourth, Iran would have to develop advanced targeting and guidance systems for an ICBM and may be unable to do so without imports of critical

foreign technology. This would degrade the performance of any Iranian ICBM because missile inaccuracy increases with distance. ICBMs without good targeting and guidance may not be able to hit a target city when fired from halfway across the planet.

A Concluding Word

As long as Iran remains in the nuclear Nonproliferation Treaty (NPT) and does not have nuclear weapons or the capacity for a quick nuclear breakout, its missile programs will be a less serious security threat. Iran's medium-range and long-range missiles or equivalent SLVs would be most threatening if Iran is outside the NPT and has acquired nuclear weapons. Still, although Iran could develop a medium-range missile capable of striking western Europe by the end of this decade, it would take longer to develop a missile capable of reaching the United States. Iran could develop a 10,000-kilometer-range ICBM capable of striking the United States by 2012-2015 if North Korea successfully tests such a system and then transfers the technology to Iran. If North Korea cannot successfully test such a system or if it does not transfer much of the technology to Iran because of, say, improved political relations and a nuclear and missile agreement with the United States, then Iran's ICBM program will be considerably hindered.

Iran has a well-developed technological and industrial capability to build short-range and medium-range missiles on a large scale, but it must still cross a number of technological thresholds concerning stage separation, propulsion systems, re-entry vehicles, and guidance systems before it could successfully test an ICBM. The development of these technologies and of a new long-range missile may take at least five years, as it took India for its Agni-3, but could possibly take longer. Assuming that Iran begins allocating significant resources toward an ICBM around 2010, after it has completed the development of its current medium-range Ghadr and Shahab-3B projects, it could possibly test its first ICBM by 2015. Iran would still have to flight-test any new ICBM at least a few times, over perhaps two to three years, before having confidence in this system. In addition, it would initially build only a small number of such missiles. Thus, although Iran might be able to test a rudimentary prototype 10,000-kilometer-range ICBM by 2015, it would still take a few additional years after its first test to perfect and deploy a modest number of such missiles that would be a more significant threat to the United States.

Corrected online August 29, 2008. See explanation.

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ENDNOTES

1. Office of the Press Secretary, U.S. Department of State, "Fact Sheet: Missile Defense Assets to Provide Protection in Central Europe," April 16, 2007.

2. Andrew Feickert, "Missile Survey: Ballistic and Cruise Missiles of Selected Foreign Countries," *CRS Report for Congress*, RL30427, July 26, 2005.

3. Craig Covault, "Iran's 'Sputnik,'" *Aviation Week & Space Technology*, November 29, 2004.

4. Charles Vick, "The Operational Shahab-4/No-dong-B Flight Tested in Iran for Iran & North Korea Confirmed" GlobalSecurity.org, April 10, 2007.

5. Zeev Schiff, "Iran Buys Surface-to-surface Missiles Capable of Hitting Europe," *Haaretz*, April 27, 2006.

6. "Iran to Launch Three Birds in Two Years," *Space Business News*, August 18, 1999, p. 7.

7. Craig Covault, "Iran Appears Poised To Try Satellite Launch," *Aviation Week and Space Technology*, January 27, 2007.

8. In February 2007, Iran announced that it launched a suborbital rocket to an altitude of just higher than 100 kilometers. Such a rocket would be much less powerful than one derived from the Shahab-3 or Ghadr missiles.

9. National Intelligence Council, "Foreign Missile Developments and the Ballistic Missile Threat Through 2015," p. 9.

10. The liquid-fuel CSS-2 weighed 54 metric tons and had a range of approximately 3,000 kilometers with a two-metric-ton warhead or 4,000 kilometers with a one-metric-ton warhead.

11. Charles Vick, "Taep'o Dong 2," found at www.globalsecurity.org.

12. Bill Gertz, "How the Axis Seeks the Killer Missile," *The Washington Times*, January 30, 2007.

13. Louis Charbonneau, "Iran Said to Step Up Plans for Shahab Missiles," Reuters, March 6, 2006. This claim has not been independently verified.

14. For example, press reports note that North Korea supplied 12 Shahab-3/Nodong engines to Iran in November 1999. Bill Gertz, "N. Korea Sells Iran Missile Engines," *The Washington Times*, February 9, 2000.

15. See "Report of the Commission to Assess the Ballistic Missile Threat to the United States: Executive Summary," July 15, 1998, sec. II.C.4.

16. The Agni-3 project was given the go-ahead around 1999, but Indian missile scientists were then working on another missile, the Agni-1. They began actively working on the Agni-3 around 2001.

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