

An Overview of North Korea's Ballistic Missile Program

Summary

North Korea's development and international sales of ballistic missiles have long been seen by the United States and its allies in East Asia as a major security threat and source of regional instability, and developments in North Korea since Kim Jong-un's assumption of power demonstrate a renewed focus on advancing its missile capabilities. The DPRK has deployed an estimated 600 short-range ballistic missiles capable of striking parts or all of South Korea, and perhaps 150-200 medium-range Nodong missiles which could potentially reach Japan. North Korea has also developed several intermediate-range or intercontinental ballistic missiles, although it is not certain if any of these missiles are currently deployed or operational. These missiles include the Taepodong-1 and -2, tests of which have triggered strong international reaction, as well as the Musudan and road-mobile KN-08 missiles, which have not been flight-tested by the DPRK.

Much of the open-source information about North Korea's missile program – including its capabilities, historical development, and underlying strategic doctrine – remains inconclusive. One key question is the level of reliability and accuracy of some of the missiles North Korea has deployed; the DPRK has not tested many of its missiles to the same rigorous extent that most countries with ballistic missile programs have.¹ A further question is the extent and nature of foreign involvement in North Korea's development of ballistic missile capabilities, and by implication the extent to which the DPRK has been able to develop and reproduce these capabilities autonomously. Finally, the two most crucial unanswered questions from the U.S. perspective are whether North Korea has the technical capacity to miniaturize its nuclear weapons to fit on a missile warhead, and how far it is from being able to deploy an ICBM capable of striking the continental United States.

The U.S. and the international community have responded to developments in North Korea's missile program through sanctions, direct negotiations with the DPRK, and interdictions of its missile exports. While these efforts may have constrained the growth of North Korea's missile program, they ultimately have not prevented the DPRK from gradually improving and expanding its ballistic missile capabilities. North Korea appears to have placed a renewed emphasis on developing these capabilities since Kim Jong-un's rise to power, attempting two satellite launches using ballistic missile technology in 2012 and promising "a variety of satellites and long-range rockets which will be launched by the DPRK one after another" in the future.²

The Early Development of North Korea's Missile Program

As with its nuclear program, Pyongyang's drive to acquire long-range missiles has a history that reaches back into the early decades of the Democratic People's Republic of Korea, even though it only became a matter of major international concern in the post-Cold War era.³ In 1965, Kim Il-sung reportedly said that "if a war breaks out, the U.S. and Japan will also be involved. In order to prevent their involvement, we have to be able to produce rockets which fly as far as Japan."⁴ During the 1960s, the DPRK acquired surface-to-air missiles and FROG-5 artillery rockets from the Soviet Union; following a downturn in Soviet-DPRK relations, North Korea turned to China for missile cooperation during the 1970s, possibly collaborating on the development of the DF-61 SRBM prior to the project's cancellation by China for domestic reasons in 1978.⁵

According to most open source literature, North Korea received its first ballistic missile system, the Soviet Scud-B, from Egypt sometime in the late 1970s or early 1980s.⁶ By the mid-1980s, North Korea had reverse-engineered this missile and began the indigenous production (and export) of its Hwasong-5 missile. By the end of the decade, North Korea was also beginning to produce the longer-range Hwasong-6 missile – a variant of the Scud-C – and in 1990 first tested the Nodong, a medium-range ballistic missile based on Scud technology. The Nodong is believed to be the basis of Iran's Shahab-3 missile and Pakistan's Ghauri missile, with Iran assisting in its development and Pakistan purchasing the missile in the early 1990s; other parties, such as Soviet/Russian scientists (possibly without the approval of their government), may also have assisted with the development of the Nodong, explaining its relatively short development period.⁷ Additionally, North Korea may have begun the development of its longer-range Taepodong -1 and -2 missiles in this period – the initial design work for these multi-stage missiles may have begun in the late 1980s or early 1990s, and they were first identified by Western analysts in 1994.⁸

Not party to any international agreements or organizations aimed at restricting the spread of ballistic missiles, such as the Missile Technology Control Regime, North Korea rose to prominence in the global arms market in conjunction with its development of missile technology during the 1980s. In addition to collaborating with Egypt in reverse-engineering the Scud-B, North Korea also began selling missile technology to Iran – then in the midst of its "war of the cities" with Iraq – after 1985. In the late 1980s and early 90s, according to one analyst, North Korea appears to have hit the peak of its foreign missile sales, primarily exporting to countries in the Middle East.⁹ Numerous factors, including a drop in foreign demand, increasing indigenous missile-production capabilities among former buyers of its ballistic missile systems, and international pressure on recipient countries, may have contributed to a subsequent decline in missile sales abroad. However, even as the breadth of North Korean missile sales narrowed during this period, its depth of technical collaboration with countries including Iran, Syria, and Pakistan increased. North Korean missile collaboration with Iran is believed by many analysts to be robust and ongoing.¹⁰

U.S.-DPRK Missile Negotiations in the Agreed Framework Period

Until its launch of a long-range missile in 1998, U.S. concern over North Korea's missile program and activities was far outweighed by concern over its nuclear activities. During the negotiations that led to the Agreed Framework, the U.S. warned North Korea that continued missile sales to Iran could undermine the possibility of improving U.S.-DPRK relations, but the final agreement did not directly mention ballistic missiles. Bilateral U.S.-DPRK missile negotiations that began in April 1996 collapsed the following year without making progress.¹¹

In August 1998, North Korea launched a Taepodong-1 missile modified as a space launch vehicle, its first test of a multi-stage missile. Beginning a pattern that would continue with its 2009 and 2012 launches, the DPRK stated that the purpose of the launch was to put a small satellite, the Kwangmyongsong, into orbit. Much of the international community saw this explanation as a veil for a long-range missile test. The DPRK launched the missile from its Musudan-ri launch facility in the country's northeast, with its third stage apparently failing. The launch evoked swift criticism, especially since the missile overflew Japan.¹²

Several months after the launch, the U.S. resumed missile talks with North Korea. Although the initial rounds of these talks did not produce the outlines of a comprehensive settlement, by September 1999 the DPRK had agreed to a moratorium on long-range ballistic missile testing (but not foreign missile sales) as long as diplomatic talks continued.¹³ The United States responded by partially lifting economic sanctions. Amid progress on missile negotiations in the waning days of the Clinton administration, Vice Marshal Jo Myong Rok visited the U.S. in October 2000, followed by a reciprocal visit by U.S. Secretary of State Madeleine Albright to Pyongyang.

The outline of the deal under consideration would have had the DPRK freeze the development, production, testing, and deployment of missiles with a range of over 500km; halt North Korea's missile exports in exchange for "in-kind" compensation; provide North Korea with a few launches of civilian satellites annually; and take steps to improve U.S.-DPRK diplomatic relations. Several key issues remained unresolved in these negotiations, including the extension of the freeze to North Korea's scud-type Hwasong missiles, the elimination of existing missiles, and verification and monitoring procedures. A contemplated visit from President Clinton to Pyongyang to finalize the agreement during the final months of his presidency did not move forward, owing to the lack of progress on these issues as well as a focus on concurrent priorities such as the ongoing Middle East peace negotiations.¹⁴

The incoming Bush administration, skeptical of the Agreed Framework and the verifiability of a missile agreement, delayed the resumption of missile talks with the DPRK while it undertook a comprehensive policy review.¹⁵ In response the North Korean government warned that it would be difficult for it to maintain the unilateral testing moratorium "indefinitely."¹⁶ However, following Japanese Prime Minister Junichiro Koizumi's 2002 visit to Pyongyang, North Korea agreed to keep the moratorium in place.¹⁷ Nonetheless, North Korea continued to export missiles during this period. A 2002 shipment of North Korean scud missiles to Yemen – which was interdicted by the Spanish navy, but allowed to proceed due to the lack of international treaties governing the missile trade – prompted the creation of the Proliferation Security Initiative, a multilateral cooperative project aimed at interdicting the transfer of WMD.¹⁸

Additional Tests and International Sanctions

In March 2005, a month after declaring its withdrawal from the six-party talks and declaring its production of nuclear weapons, North Korea announced that it had ended its missile test moratorium.¹⁹ On July 5, 2006, the DPRK flight-tested an array of ballistic missiles, including a long-range Taepodong-2. (Unlike its other long-range missile tests, Pyongyang did not claim that it was attempting to put a satellite into orbit; however, the missile failed after about 40 seconds of flight.) Ten days later the United Nations Security Council adopted Resolution 1695, demanding that member states prohibit the procurement to or from the DPRK of “missile and missile-related items, materials, goods and technology.” It also included a prohibition on the transfer of “financial resources in relation to the DPRK’s missile or WMD programmes.”²⁰

After the DPRK tested a nuclear device in October 2006, the UN adopted UNSCR 1718, which “Demands that the DPRK not conduct any further nuclear test or launch of a ballistic missile. . . Decides that the DPRK shall suspend all activities related to its ballistic missile programme and in this context re-establish its pre-existing commitments to a moratorium on missile launching. . . [and] Decides also that the DPRK shall abandon all other existing weapons of mass destruction and ballistic missile programme in a complete, verifiable and irreversible manner.”²¹ The resolution also introduced an array of sanctions intended to compel North Korea to return to the Six Party Talks and come into compliance with its denuclearization obligations.

In March 2009, the DPRK informed the International Maritime Organization and the International Civil Aviation Organization of its plan to launch a satellite into orbit, with KCNA reporting the following day that the DPRK had joined the International Space Treaty and Convention and the Convention on the Registration of Launched Objects into Outer Space.²² On April 5, 2009 the DPRK’s Korean Central News Agency issued a statement saying that the DPRK had sent a communications satellite into orbit using an Unha-2 launch vehicle. Western analysts identified the launch vehicle as a modified Taepodong-2, and cast doubt on the claims of the satellite reaching orbit.²³

While the DPRK maintained that the launch was “a legitimate right of a sovereign state... to use space for peaceful purposes,” the United Nations Security Council issued a Presidential Statement condemning the launch, calling it a “contravention” of UNSCR 1718 (2006) and applying sanctions to three additional North Korean entities. After North Korea conducted a second nuclear test in the following month, the UN Security Council adopted Resolution 1874, which reiterated the call for North Korea to abandon its nuclear and missile programs, tightened sanctions, and called for states to interdict vessels believed to be involved in the transfer of prohibited goods.

On February 29, 2012, the U.S. and DPRK issued separate statements indicating that North Korea would freeze uranium enrichment and halt its nuclear and missile tests, while the U.S. would provide North Korea with 240,000 tons of nutritional assistance. Only a fortnight after the agreement was announced, North Korea announced plans to launch a satellite into orbit, claiming that “the launch of the working satellite is an issue fundamentally different from that of a long-range missile” and did not violate the agreement.²⁴ (While U.S. diplomats, during the negotiation of this agreement, had apparently warned that a satellite launch would be considered a violation of its terms, the North Korean side did not appear to have agreed to this definition.)²⁵

In April 2012, the DPRK marked the 100th birthday of Kim Il-sung by attempting a satellite launch using the Unha-3, an SLV based on the Taepodong-2, from the new Sohae launch facility in the country's northwest. The launch rendered the "leap day understanding" moot, and the UN Security Council responded by issuing a Presidential Statement condemning it and applying sanctions to three additional North Korean entities. The Korean Central News Agency acknowledged that the launch was unsuccessful, and in response to the Presidential Statement stated that "many more satellites of the DPRK will be launched into space."²⁶

In December 2012, North Korea launched a second Unha-3 rocket from the same facility, this time successfully launching a satellite into orbit.²⁷ A multinational team of experts which examined parts of the Unha-3's first stage, salvaged by the South Korean Navy, concluded that most of its components were made within North Korea.²⁸ The December launch raised renewed fears in the United States of North Korea achieving an ICBM capability, with some analysts arguing that it represented a significant step forward in North Korea's ability to threaten the United States.²⁹ Other observers noted North Korea will still need to surpass significant technical hurdles before it could be considered to have a plausible nuclear ICBM capability, pointing to the DPRK's need to miniaturize a nuclear warhead, develop a re-entry vehicle and accurate guidance system for its long-range missiles, and improve their reliability through more frequent testing.³⁰

After the UN Security Council adopted a resolution condemning the launch and sanctioning additional entities, North Korea's National Defense Commission issued a statement pledging "a variety of satellites and long-range rockets which will be launched by the DPRK one after another and a nuclear test of higher level which will be carried out."³¹ In February 2013, North Korea followed through on the latter part of this statement by conducting its third nuclear test. The UN Security Council, in turn, adopted Resolution 2094, which further expanded the scope of sanctions, particularly in the financial sector. Following the test, some experts argued that North Korea could have succeeded in miniaturizing a nuclear weapon sufficiently to fit atop a medium-range Nodong missile; however, this point remains disputed among experts and the U.S. intelligence community.³²

In addition to the Taepodong-2, North Korea is developing several intermediate or intercontinental-range missiles that could threaten the United States or its bases in the Pacific. The DPRK's intermediate-range Musudan, possibly based on the Soviet SS-N-6 submarine-launched ballistic missile, has been publicly displayed on two occasions, though it has not been flight-tested. Information about this missile's capabilities and origins remains uncertain.³³ Even less is known about North Korea's KN-08, an untested missile displayed at a military parade in April 2012, which U.S. government officials have referred to as a mobile intercontinental ballistic missile.³⁴ Additionally, there is evidence that the DPRK may be planning a multistage missile or space launch vehicle considerably larger than the Taepodong-2: North Korea's Sohae and Tonghae missile sites appear to have been readied to accommodate rockets larger than any known to be in North Korea's arsenal, and Kim Jong-un has personally called for building "more powerful launch vehicles in greater numbers."³⁵

Profiles of Key North Korean Missiles

KN-02 (*Tested, possibly deployed*)

The KN-02 is a tactical short-range ballistic missile (SRBM) with a range estimated to be 100 to 120 km, allowing it to reach Seoul or military targets relatively close to the border.³⁶ The solid-fueled KN-02 is a mobile, accurate, truck-mounted missile capable of carrying a variety of warheads, possibly including submunitions and chemical warheads. (Mounting a nuclear warhead on this missile is believed to be well beyond North Korea's current capabilities.) The missile is believed to be the most accurate of North Korea's missile arsenal, and has been frequently tested.³⁷ According to one source, North Korea may have fifty KN-02s in service.³⁸

Hwasong (Scud) Missiles (*Tested, deployed, exported*)

The Hwasong -5 and -6, North Korean variants of Soviet Scud –B and –C ballistic missiles, are road-mobile, liquid-fueled SRBMs, and are believed to top the list of North Korea's missile exports.³⁹ Experts estimate that North Korea has deployed over 600 Hwasong missiles. The Hwasong-5 has an estimated range of about 300 km, carrying a payload of approximately 1,000 kg, while the Hwasong-6 can carry a smaller (700-750kg) warhead to a range of 500-600 km – potentially putting the entire southern half of the Korean peninsula in range.⁴⁰ The missiles are capable of carrying high explosives, submunitions, or chemical warheads, although they are hampered by poor accuracy. It is possible, though unlikely, that North Korea could mount miniaturized nuclear warheads on its Hwasong missiles.⁴¹

Nodong (*Tested, deployed, exported*)

The Nodong is a single-stage liquid-fueled medium-range ballistic missile (MRBM) with a range of 1,000-1,600 km, which could make Japan a potential target.⁴² Because of the missile's poor accuracy, if armed with conventional warheads it would likely be targeted at population centers rather than military targets.⁴³ North Korea has tested the Nodong on several occasions, and is estimated to have deployed approximately 200 of them.⁴⁴ North Korea has exported the missile or its components, and Iran's Shahab-3 and Pakistan's Ghauri-II missiles are believed to be based on its design.⁴⁵ Some analysts believe that North Korea's third nuclear test in February 2013 may have demonstrated its ability to miniaturize a nuclear weapon to fit atop a Nodong missile, or that North Korea is nearing such a capability.⁴⁶

Taepodong-1 (a/k/a Paektusan-1) (*Tested, possibly deployed*)

The Taepodong-1 is a two-stage liquid-fueled MRBM that is estimated to have a range of 1,500-2,500 km.⁴⁷ The missile, modified as a space launch vehicle, was tested in August 1998. During this test, the third stage failed to launch a satellite, although the two initial stages of the launch vehicle are believed to have worked successfully. Some sources suggest that the DPRK has deployed 10 Taepodong-1 missiles.⁴⁸ However, other analysts believe that the Taepodong-1 is "a transitory product for the development of the Taepodong-2."⁴⁹ Such analysts think it is unlikely that the Taepodong-1 has been deployed, since it does not offer significant strategic advantages over the Nodong.⁵⁰

Musudan (*Not tested, possibly deployed*)

The Musudan is a single-stage liquid-fueled intermediate-range ballistic missile (IRBM) with an estimated range of between 2,500 and 4,000 km, believed by some experts to be based on the Soviet SS-N-6 submarine-launched missile. Its range makes it potentially capable of striking some U.S. military bases in the Pacific, although some analysts doubt that it could reach as far as Guam.⁵¹ While North Korea has not flight-tested the missile, it may have conducted static tests of the missile's engine.⁵² North Korea publicly displayed the Musudan during military parades in 2007 and 2010, and there have been several reports of the missiles being deployed, although these may have been mock-ups.⁵³ In April 2013, amid high tensions on the Peninsula, one or more Musudan missiles were reportedly transferred to North Korea's east coast, possibly in preparation for a test launch timed near Kim Il-sung's birthday.⁵⁴

Taepodong-2 (a/k/a Unha-2 and Unha-3) (*Tested*)

The Taepodong-2 is a two- or three-stage liquid-fueled ballistic missile, first tested by North Korea in 2006, and – modified as an Unha space launch vehicle – further tested in 2009 and twice in 2012. Although estimates of the Taepodong's range vary greatly and are difficult to confirm, it is widely believed to be an intercontinental ballistic missile (ICBM), potentially capable of striking the west coast of the United States. While the most recent test of the Unha rocket largely succeeded in placing a satellite into orbit, several technical barriers likely remain before the Taepodong-2 could be considered an operational ICBM, particularly the development of a re-entry vehicle capable of returning a warhead from the atmosphere back to Earth. Overcoming these challenges, and increasing the operational reliability of the missile, would require further flight tests. Additionally, the complex and time-consuming logistics of transporting this missile to a fixed launch site, erecting it, and fueling it may significantly diminish its military utility during a conflict.⁵⁵

KN-08 (*Not tested, probably not deployed*)

In June 2011, Secretary of Defense Robert Gates warned that North Korea was developing a road-mobile ICBM.⁵⁶ During a military parade in Pyongyang the following April, this new missile, the KN-08, was first publicly displayed. Some analysts dismissed the missiles as aspirational mock-ups; others concluded that they were part of a development process for a three-stage liquid fueled mobile missile, possibly with intercontinental range.⁵⁷ The missile's origins are unknown, and although its rocket motors may have been tested, it has not been flight-tested.⁵⁸ At a March 2013 Pentagon press briefing, Joint Chiefs of Staff Vice Chairman Adm. James Winnefeld said that “we believe the KN-08 probably does have the range to reach the United States.”⁵⁹ Director of National Intelligence James Clapper testified earlier that month that the U.S. government believes North Korea “has already taken initial steps towards fielding this system.”⁶⁰

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