

IX. North Korea's military nuclear capabilities

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The Democratic People's Republic of Korea (DPRK, or North Korea) maintains an active but highly opaque nuclear weapon programme. It is estimated that North Korea possessed approximately 20–30 nuclear weapons as of January 2019 (see table 6.10). This is based on calculations of the amount of fissile material—plutonium and highly enriched uranium (HEU)—that North Korea is estimated to have produced for use in nuclear weapons and assumptions about its weapon design and fabrication capabilities.

Fissile material production

North Korea continued to produce both weapon-grade plutonium and HEU in 2018 (see section X).¹ North Korea's plutonium production and separation capabilities are located at the Yongbyon Nuclear Scientific Research Centre (YNSRC). In February 2018 commercial satellite imagery indicated that the ageing 5 megawatt-electric (MW(e)) graphite-moderated research reactor located at the YNSRC continued to operate despite ongoing maintenance work.² Moreover, the Radiochemical Laboratory located at Yongbyon appeared to be operating in May 2018 to separate plutonium from the 5-MW(e) reactor's spent fuel rods.³ In addition, satellite imagery indicated that the adjacent Experimental Light Water Reactor (ELWR), which is also capable of producing plutonium, was starting operation or was undergoing pre-operational testing in 2018.⁴

There is considerable uncertainty about North Korea's uranium enrichment capabilities and its stock of HEU. The country's leadership is widely believed to have prioritized the production of HEU for use in nuclear warheads to overcome its limited capacity to produce weapon-grade plutonium. In 2018 satellite imagery analysis indicated that North Korea continued to operate the gas centrifuge enrichment plant at the Yongbyon complex that it had declared in 2010.⁵ During the year, a group of non-governmental researchers from the United States identified a suspected covert uranium enrichment

¹ Brunnstrom, D., 'North Korea may have made more nuclear bombs, but threat reduced: Study', Reuters, 12 Feb. 2019.

² Pabian, F., Bermudez, J. and Liu, J., 'North Korea's Yongbyon nuclear complex: 5 MWe reactor is likely operating, new military encampment established', 38 North, 5 Mar. 2018.

³ Hecker, S. S., Carlin, R. L. and Serbin, E. A., 'A comprehensive history of North Korea's nuclear program: 2018 update', Center for International Security and Cooperation, 11 Feb. 2019, p. 3.

⁴ Albright, D. and Burkhard, S., 'North Korea continues expanding its reactor capability for making plutonium for nuclear weapons', Imagery Brief, Institute for Science and International Security, 5 Apr. 2018.

⁵ Pabian, F. V. and Liu, J., 'North Korea's Yongbyon nuclear facilities: Well-maintained but showing limited operations', 38 North, 9 Jan. 2019; and Hecker, Carlin and Serbin (note 3), pp. 3–4.

Table 6.10. North Korean forces with potential nuclear capability, January 2019

Type ^a	Range (km)	Payload (kg)	Status	No. of warheads
<i>Land-based ballistic missiles</i>				..
Hwasong-7 (Nodong)	>1 200	1 000	Single-stage, liquid-fuel missile. Fewer than 100 launchers; first deployed in 1990.	
Hwasong-9 (Scud-ER)	1 000	500	Scud missile variant, lengthened to carry additional fuel.	
Bukkeukseong-2 (KN-15)	1 000	..	Single-stage, solid-fuel missile under development launched from canister TEL. Land-based version of Bukkeukseong-1 SLBM; test launched in 2017.	
Hwasong-10 (BM-25, Musudan)	>3 000	(1 000)	Single-stage, liquid-fuel missile under development; several failed tests in 2017.	
Hwasong-12 (KN-17)	>3 000	1 000	Single-stage, liquid-fuel missile under development.	
Hwasong-13 (KN-08) ^b	>5 500	..	Three-stage, liquid-fuel missile with potential intercontinental range under development; no known test launches.	
Hwasong-14 (KN-20)	6 700– 10 400	500– 1 000	Two-stage, liquid-fuel missile under development; tested in 2017.	
Hwasong-15 (KN-22)	13 000	1 000– 1 500	Two-stage, liquid-fuel missile under development; two tests in 2017.	
Taepodong-2 ^c	12 000	..	Under development; three-stage space launch vehicle variant placed satellites in orbit in Dec. 2012 and Feb. 2016.	
<i>Submarine-launched ballistic missiles</i>				
Bukkeukseong-1 (KN-11)	Two-stage, solid-fuel SLBM under development, replacing earlier liquid-fuel version.	
Total				(20–30)^d

.. = not available or not applicable; () = uncertain figure; SLBM = submarine-launched ballistic missile; TEL = transporter-erector-launcher.

^a There is no publicly available evidence that North Korea has produced a nuclear warhead that is sufficiently compact to be delivered by a ballistic missile, developed and tested a missile re-entry vehicle to carry such a warhead, or deployed nuclear warheads with operational forces. This table lists the ballistic missiles that could have a nuclear delivery role.

^b A two-stage variant, the KN-14, is under development but has yet to be test launched.

^c A two-stage Taepodong-1 missile was unsuccessfully flight tested in 1998.

^d SIPRI's estimate is that North Korea may have enough fissile material to build between 20 and 30 nuclear warheads.

Sources: US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, July 2017); *IHS Jane's Strategic Weapon Systems*, various issues; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

plant located at Kangsong near Pyongyang.⁶ The site reportedly had been monitored by US intelligence agencies for more than a decade. However, analysts cautioned that, without access to the plant, it was not possible to confirm the nature and purpose of the activities being conducted there.⁷ According to media reports, a US intelligence assessment in June 2018 concluded that North Korea probably had more than one covert uranium enrichment plant and that the country was seeking to conceal the types and number of production facilities in its nuclear weapon programme.⁸

Nuclear warheads

In his annual New Year's Day speech on 1 January 2018, the North Korean leader, Kim Jong Un, declared that the country had successfully completed the development of its 'nuclear self-defence force'. He announced that it would begin to mass-produce and deploy nuclear warheads and ballistic missiles, 'the power and reliability' of which had been demonstrated.⁹

There is no publicly available evidence to confirm North Korea's claim that it has built a nuclear warhead that is sufficiently compact (or miniaturized) to be delivered by a ballistic missile. In 2017 the US Defense Intelligence Agency reportedly concluded that North Korea had successfully designed and produced such a warhead.¹⁰ In the 2018 edition of its biennial Defense White Paper, South Korea's Ministry of National Defense noted that North Korea appeared 'to have reached a considerable level of sophistication in its nuclear warhead miniaturization capability', but it did not state whether it believed that North Korea had produced or deployed a warhead for missile delivery.¹¹

North Korea has claimed since 2016 that it has developed and tested a thermonuclear weapon (hydrogen bomb).¹² The claim was initially dismissed by international experts as well as by Japanese, South Korean and US

⁶ Panda, A., 'Exclusive: Revealing Kangson, North Korea's first covert uranium enrichment site', *The Diplomat*, 13 July 2018.

⁷ Madden, M., 'Much ado about Kangson', 38 *North*, 3 Aug. 2018; and Albright, D., 'Kangsong: A suspect uranium enrichment plant', *Imagery Brief*, Institute for Science and International Security, 2 Oct. 2018.

⁸ Kube, C., Dilanian, K. and Lee, C. E., 'North Korea has increased nuclear production at secret sites, say US officials', *NBC News*, 1 July 2018; and Nakashima, E. and Warrick, J., 'North Korea working to conceal key aspects of its nuclear program, US officials say', *Washington Post*, 30 June 2018.

⁹ Korean Central News Agency, 'Kim Jong Un makes New Year address', 1 Jan. 2018. See also chapter 7, section I, in this volume.

¹⁰ Warrick, J. et al., 'North Korea now making missile-ready nuclear weapons, US analysts say', *Washington Post*, 8 Aug. 2017.

¹¹ Yoo, K. M., 'Defense Ministry's latest white paper omits language describing N. Korea as "the enemy"', *The Hankyoreh*, 16 Jan. 2019.

¹² Korean Central News Agency, 'DPRK proves successful in H-bomb test', 6 Jan. 2016.

intelligence agencies.¹³ However, in September 2017 North Korea conducted a test explosion that had a significantly larger yield (explosive energy)—some revised estimates put it in the range of 200–300 kilotons—than any of its five previous test explosions.¹⁴ The North Korean Nuclear Weapons Institute announced that the event was a successful test of a hydrogen bomb that could be delivered by an intercontinental ballistic missile (ICBM).¹⁵ In 2018 some non-governmental analysts concluded, based on an analysis of North Korean open-source scientific research work on nuclear materials, that North Korea probably had the capability to produce a boosted-fission device and possibly a two-stage thermonuclear device.¹⁶

North Korean moratoria on nuclear explosive and ballistic tests

On 20 April 2018, in a speech to the Central Committee of the ruling Korean Workers' Party, Kim announced that North Korea would impose an immediate halt to further tests of nuclear weapons and long-range ballistic missiles.¹⁷ He also announced that the underground nuclear weapon test site at Punggye-ri in the north-east of the country would be shut down and dismantled.¹⁸ On 24 May North Korea carried out the explosive demolition of the tunnels and buildings at the site in the presence of a group of international journalists.¹⁹ There had been speculation that the test site had become geologically unstable, and hence potentially unusable, because of aftershocks resulting from the large test explosion conducted there in September 2017.²⁰

Ballistic missiles

North Korea is expanding and modernizing its ballistic missile force, which consists of 10 types of indigenously produced short-, medium- and long-range missile systems that are either deployed or under development. It is also developing a submarine-launched ballistic missile (SLBM). In recent years,

¹³ Keller, J., Fessenden, F. and Wallace, T., 'Why experts doubt that North Korea tested a hydrogen bomb', *New York Times*, 6 Jan. 2016; and Japanese Ministry of Defense (MOD), *Defense of Japan 2018*, White Paper (MOD: Tokyo, 2018), p. 68.

¹⁴ NORSAR, 'The nuclear explosion in North Korea on 3 September 2017: A revised magnitude assessment', 12 Sep. 2017.

¹⁵ Korean Central News Agency, 'DPRK Nuclear Weapons Institute on successful test of H-bomb for ICBM', 3 Sep. 2017.

¹⁶ Hastings, J., Lee, H. and Kelley, R., 'North Korea's lithium research networks and its quest for a hydrogen bomb', *Korean Journal of Defense Analysis*, vol. 30, no. 3 (Sep. 2018), pp. 337–52.

¹⁷ Korean Central News Agency, 'Third plenary meeting of seventh CC, WPK held in presence of Kim Jong Un', 21 Apr. 2018.

¹⁸ North Korea conducted nuclear test explosions at the site in Oct. 2006, May 2009, Feb. 2013, Jan. and Sep. 2016, and Sep. 2017. The estimated yields of the tests have progressively increased.

¹⁹ Yonhap News Service, 'North Korea reports destruction of Punggye-ri nuclear test site', 24 May 2018.

²⁰ BBC News, 'North Korea test site could be unusable after collapse—Chinese scientists', 25 Apr. 2018.

it has pursued the serial development of several missile systems with progressively longer ranges and increasingly sophisticated delivery capabilities.

North Korea is not known to have conducted any flight tests of medium- and long-range missiles during 2018.²¹ In announcing the moratorium on the testing of such missiles, Kim stated that no further tests were required, 'given that the nuclear warheads were on the ballistic rockets in a scientific way and in sequence' and that the 'development of delivery and strike means was also made scientifically'.²²

Medium- and intermediate-range ballistic missiles

Assuming that North Korea is able to produce a sufficiently compact warhead, some observers assess that the size, range and operational status of the Hwasong-7, also known as Nodong (sometimes transliterated as Rodong), medium-range missile make it the system most likely to be given a nuclear delivery role.²³ Based on a Soviet-era Scud missile design, the Nodong is a single-stage, liquid-fuelled ballistic missile with an estimated range exceeding 1200 kilometres. In addition, North Korea has developed the single-stage, liquid-fuelled Hwasong-9, also known as the Scud-ER (extended-range), which may also be a nuclear-capable delivery system. Based on the Hwasong-6 (Scud C variant) missile with a lengthened fuselage to carry additional fuel, the Scud-ER has an estimated range of 1000 km.²⁴

The Hwasong-10 missile, also designated the Musudan or BM-25, is a single-stage, liquid-fuelled missile with an estimated range exceeding 3000 km. The Musudan was first unveiled at a military parade in 2010. Flight testing began in 2016, with multiple failures.²⁵ No flight tests of the Musudan are known to have been conducted since 2016, and the status of the missile development programme is unclear.

The Hwasong-12 (also referred to by the US Department of Defense, DOD, designation KN-17) is a single-stage, intermediate-range missile that is believed to have a new liquid-propellant booster engine as well as design features that may serve as a technology test bed for a future ICBM.²⁶ Some analysts have speculated that the missile carries a small post-boost vehicle

²¹ James Martin Center for Nonproliferation Studies, North Korea Missile Test Database, accessed Dec. 2018. North Korea conducted 20 known tests of such missiles in 2017.

²² Korean Central News Agency (note 17).

²³ See e.g. Fitzpatrick, M., 'North Korea nuclear test on hold?', *Shangri-La Voices*, International Institute for Strategic Studies, 27 May 2014.

²⁴ US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat* (NASIC: Wright-Patterson Air Force Base, OH, July 2017), pp. 18, 25.

²⁵ Savelsberg, R. and Kiessling, J., 'North Korea's Musudan missile: A performance assessment', 38 North, 20 Dec. 2016. In 2016 North Korea conducted 8 flight tests of the Musudan system. Only 1 of the tests was judged to have been successful. In the other tests, the missiles exploded on launch or shortly thereafter.

²⁶ Yi, Y., 'Hwasong-12 a stepping stone in North Korea's ICBM development', *The Hankyoreh*, 16 May 2017; and Savelsberg, R., 'A quick technical analysis of the Hwasong-12 missile', 38 North, 19 May 2017.

(PBV) that, in addition to increasing its maximum range, can be used to improve warhead accuracy.²⁷ The missile has an estimated range of more than 3000 km, which would be sufficient to strike US military bases in the western Pacific Ocean, including potentially on the island of Guam. A Hwasong-12 missile was test launched in September 2017 from a transporter-erector-launcher vehicle rather than from a concrete platform, which could indicate a higher level of operational readiness.²⁸

North Korea is developing the Bukkeukseong-2 missile (US DOD designation, KN-15), which is a land-based variant of the Bukkeukseong-1 SLBM. The two-stage, solid-fuelled missile has an estimated range of approximately 1000 km.²⁹ It was flight tested twice in 2017. Some analysts have noted that North Korea's development of the Bukkeukseong-2 was probably part of an effort to improve the survivability of its nuclear-capable ballistic missile systems. Solid-fuelled missiles can be fired more quickly than liquid-fuelled systems and require fewer support vehicles that might give away their position to overhead surveillance.³⁰ In 2018 satellite imagery indicated that North Korea was completing a major expansion of a factory for producing solid fuel rocket motors.³¹

Intercontinental-range ballistic missiles

North Korea is widely believed to have prioritized building and deploying an ICBM that could potentially deliver a nuclear warhead to targets in the continental USA. However, North Korea has not yet demonstrated that it has developed an ICBM capable of delivering a nuclear warhead.³²

The Hwasong-13 (US DOD designation, KN-08) was first presented by North Korea as a road-mobile, three-stage missile with intercontinental range at a military parade in April 2012, although some non-governmental analysts have argued that the missiles displayed were only mock-ups.³³ Estimates of the range and payload capabilities of the missile are highly speculative, and as of the end of 2018 it had yet to be flight tested.

²⁷ Elleman, M., 'North Korea's Hwasong-12 launch: A disturbing development', 38 North, 30 Aug. 2017.

²⁸ Panda, A., 'North Korea shows increased operational confidence in the Hwasong-12 IRBM', The Diplomat, 17 Sep. 2017.

²⁹ US Air Force, National Air and Space Intelligence Center (note 24), p. 25.

³⁰ Panda, A., 'It wasn't an ICBM, but North Korea's first missile test of 2017 is a big deal', The Diplomat, 14 Feb. 2017.

³¹ Schmeler, D. and Lewis, J., 'North Korea expanding key missile site', Arms Control Wonk, 2 July 2018.

³² Ali, I., 'US general says North Korea not demonstrated all components of ICBM', Reuters, 30 Jan. 2018; and Acton, J., 'Assessing North Korea's progress in developing a nuclear-armed ICBM', Carnegie Endowment for International Peace, 4 May 2018.

³³ Schiller, M. and Kelley, R., 'Evolving threat: North Korea's quest for an ICBM', *Jane's Defence Weekly*, 18 Jan. 2017, p. 24.

North Korea has developed the Hwasong-14 (US DOD designation, KN-20), a prototype ICBM that first appeared in 2015 at a military parade in Pyongyang.³⁴ The two-stage missile appears to use the same high-energy liquid-propellant booster engine as the single-stage Hwasong-12.³⁵ Based on a flight test conducted in July 2017, one analyst estimated that the Hwasong-14 had a range of up to 10 400 km, depending on the payload and flight trajectory.³⁶ However, other analysts subsequently estimated that the missile's range was unlikely to exceed 8000 km when carrying a 500-kilogram payload, which is roughly the weight of a nuclear warhead. This meant that the missile could not reach targets in the USA beyond the West Coast when launched from North Korea.³⁷

North Korea is developing a new two-stage ICBM, the Hwasong-15 (US DOD designation, KN-22) that has a significantly larger second stage and more powerful booster engines than the Hwasong-14. The first flight test was conducted on 28 November 2017, when a Hwasong-15 was launched on an elevated trajectory and flew higher and for a longer duration than any previous North Korean missile. One estimate put the theoretical maximum range of the Hwasong-15 on a normal trajectory at up to 13 000 km—sufficient to reach Washington, DC, and other targets on the East Coast of the USA.³⁸ The missile was assessed to be carrying a light payload, however, and the range would be significantly reduced if it were carrying a heavier payload such as a nuclear warhead.³⁹ According to a North Korean statement issued after the test, the Hwasong-15 is 'an intercontinental ballistic rocket tipped with super-large heavy warhead which is capable of striking the whole mainland of the US' that 'meets the goal of the completion of the rocket weaponry system'.⁴⁰

While North Korea has made important progress towards building a nuclear-armed ICBM capable of credibly threatening the USA, it has yet to validate the performance and reliability of the missile systems under development.⁴¹ In particular, analysts have pointed out that North Korea has not demonstrated a mastery of the technology for building a reliable atmospheric

³⁴ Schiller and Kelley (note 33).

³⁵ According to one non-governmental analyst, North Korea probably acquired the engine through illicit channels operating in Russia or Ukraine. Elleman, M., 'The secret to North Korea's ICBM success', IISS Voices blog, International Institute for Strategic Studies, 14 Aug. 2017.

³⁶ Wright, D., 'North Korean ICBM appears able to reach major US cities', All Things Nuclear blog, Union of Concerned Scientists, 28 July 2017.

³⁷ Elleman, M., 'North Korea's Hwasong-14 ICBM: New data indicates shorter range than many thought', 38 North, 29 Nov. 2018.

³⁸ Wright, D., 'Re-entry of North Korea's Hwasong-15 missile', All Things Nuclear blog, Union of Concerned Scientists, 7 Dec. 2017.

³⁹ Elleman, M., 'North Korea's third ICBM launch', 38 North, 29 Nov. 2017.

⁴⁰ Korean Central News Agency, 'DPRK Gov't statement on successful test-fire of new-type ICBM', 29 Nov. 2017.

⁴¹ Acton (note 32).

re-entry vehicle.⁴² According to South Korea's Deputy Minister of Defense Policy, Yeo Suk-joo, North Korea still needed to prove the capability of other technologies, including those for terminal stage guidance and warhead activation.⁴³

Submarine-launched ballistic missiles

North Korea is developing an SLBM called the Bukkeukseong-1 (US DOD designation KN-11). The missile is now a two-stage, solid-fuelled design after initial test failures using a liquid-fuelled missile.⁴⁴ In 2017 North Korea conducted a series of successful underwater ejection tests—that is, tests designed to evaluate stabilization systems and the process of ejecting the missile from a submerged launch tube, but it did not conduct any flight tests of the missile.⁴⁵

Most observers assess that North Korea still has numerous technical challenges to overcome before it will be able to design, build and deploy an operational SLBM force. Currently, North Korea has one Sinpo class experimental submarine in service, which can hold and launch one SLBM. However, commercial satellite imagery of the Sinpo Shipyard from November 2017 revealed that North Korea appeared to be building a new, larger diesel-electric submarine capable of carrying and launching multiple SLBMs.⁴⁶

⁴² Wright (note 36); and Elleman (note 37).

⁴³ Kim, C. and Solovyov, D., 'Seoul says North Korea puts Washington in range, but needs to prove critical technology', Reuters, 1 Dec. 2017.

⁴⁴ Schilling, J., 'A new submarine-launched ballistic missile for North Korea', 38 North, 25 Apr. 2016.

⁴⁵ Ryall, J., 'North Korea carries out "unprecedented" test of submarine missile system', *Daily Telegraph*, 1 Aug. 2017.

⁴⁶ Bermudez, J., 'North Korea's submarine ballistic missile program moves ahead: Indications of shipbuilding and missile ejection testing', 38 North, 16 Nov. 2017.