

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 may potentially have produced 10–20 nuclear weapons (see table 11.10). This is based on calculations of the amount of plutonium that North Korea may have separated from the spent fuel produced by its 5 megawatt-electric (MW(e)) graphite-moderated research reactor at the Yongbyon Nuclear Scientific Research Centre and assumptions about North Korean weapon design and fabrication skills.

North Korea is believed to be increasing its limited holdings of weapon-usable plutonium (see section X), although assessments differ about the scale and pace of the increase.¹ When fully operational, the 5-MW(e) reactor at Yongbyon has been estimated to produce approximately 6 kilograms of plutonium per year, enough for one nuclear weapon.² However, the operational status of the reactor since its announced restarting in 2013 has been unclear. Commercial satellite imagery and thermal imagery indicate that the reactor might be operating at low power or only intermittently.³ In August 2016 North Korea confirmed assessments made by the International Atomic Energy Agency (IAEA) and several non-governmental analysts earlier in the year that it was conducting a new spent fuel reprocessing campaign at the Yongbyon radiochemical laboratory.⁴

In 2016 North Korea publicly acknowledged that it was producing highly enriched uranium (HEU) for nuclear weapons.⁵ There has been considerable speculation that North Korea is seeking to build warheads using HEU as the fissile material in order to overcome the constraints imposed by its limited holding of separated plutonium. However, it is not known whether it has

¹ See e.g. Yonhap News Agency, 'North Korea has 50 kg of weapons-grade plutonium: Seoul's defense white paper', 11 Jan. 2017; and Albright, D. and Kelleher-Vergantini, S., 'Plutonium, tritium and highly enriched uranium production at the Yongbyon nuclear site', InSTITUTE for Science and International Security, Imagery Brief, 14 June 2016.

² Hansen, N. and Lewis, J., 'North Korea restarting its 5 MW reactor', 38 North, US–Korea Institute, Johns Hopkins University, 11 Sep. 2013. The 5-MW(e) reactor at Yongbyon operated between 1986 and 1994, and between 2003 and 2007. The reactor was then shut down and disabled pursuant to an agreement reached in the Six-Party Talks. It was restarted in 2013.

³ Bermudez, J. and Dinville, A., 'Checks and balances: thermal imagery analysis of Yongbyon', 38 North, US–Korea Institute, 25 Oct. 2016.

⁴ Kyodo News Agency, 'North Korea confirms restart of plutonium processing', *Japan Times*, 17 Aug. 2016; and Reuters, 'North Korea apparently reopened plant to produce plutonium: IAEA', 16 June 2016.

⁵ Kyodo News Agency (note 4).

Table 11.10. North Korean forces with potential nuclear capability, January 2017

Type ^a	Range (km)	Payload (kg)	Status	No. of warheads
<i>Land-based ballistic missiles</i>				..
Scud-ER (extended-range)/Hwasong-7	1 000	500–1 000	Scud missile variant, lengthened to carry additional fuel; possible nuclear role	
Nodong	1 250	1 000–1 250	Fewer than 50 launchers; first deployed in 1990; 5 missiles test launched in 2016, 3 of which were successful	
Hwasong-10 (BM-25, Musudan)	>3 000	(1 000)	Single-stage, liquid-fuel missile under development; 8 test launches conducted in 2016, 1 of which appeared to be partially successful	
Hwasong-13 (KN-08) ^b	>5 500	..	3-stage missile with potential intercontinental range under development; no test launch yet	
Taepodong-2 ^c	>5 500	..	Under development; 3-stage space launch vehicle variant placed satellite in orbit in Dec. 2012 and Feb. 2016	
<i>Submarine-launched ballistic missiles</i>				
Bukkeukseong-1 (KN-11) ^d	..	..	2-stage, solid propellant SLBM under development, replacing earlier liquid-fuel version; 5 test launches conducted in 2016, 1 of which was successful	
Total				(10–20)^e

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

^a There is no open-source evidence that North Korea has developed and tested a re-entry vehicle that is intended to carry a nuclear warhead on a ballistic missile, developed a warhead that is sufficiently compact for this purpose, or deployed warheads with operational forces. This table lists the ballistic missiles that could potentially have a nuclear delivery role.

^b A 2-stage variant, the KN-14, is under development but has yet to be test launched.

^c A 2-stage Taepodong-1 missile was unsuccessfully flight tested in 1998.

^d A land-based version, the KN-15, was flight tested in Feb. 2017.

^e SIPRI's estimate is that North Korea may have fissile material for between 10 and 20 warheads, although there is no open-source evidence that North Korea has produced or deployed operational 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, May 2013); *Jane's Strategic Weapon Systems*, various issues; 'Nuclear notebook', *Bulletin of the Atomic Scientists*, various issues; and authors' estimates.

done so. Furthermore, little is known about North Korea's stock of HEU or its uranium enrichment capacity.⁶

⁶ Albright and Kelleher-Vergantini (note 1); and Hecker, S. et al., *North Korean Nuclear Facilities After the Agreed Framework*, Working Paper (Freeman Spogli Institute for International Studies, Stanford University: Stanford, CA, 2016).

On 6 January and 9 September 2016, North Korea carried out its fourth and fifth underground nuclear test explosions at the Punggye-ri underground test site in the north-east of the country (see section XI). North Korea had previously conducted three nuclear tests at the site in October 2006, May 2009 and February 2013. The estimated yields (explosive energy) of the tests have progressively increased.⁷

Ballistic missiles

North Korea is expanding and modernizing its ballistic missile force, which consists of 10 types of indigenously produced short-, medium- and intermediate-range systems that are either deployed or under development. It is also believed to be developing a road-mobile intercontinental-range ballistic missile (ICBM). In 2016 North Korea conducted missile tests at an unprecedented rate, carrying out 24 flight tests of different missile systems. In March and September, it also conducted ground tests of a 'high-power' solid-fuel rocket engine, ostensibly for use in a satellite launch vehicle.⁸ A large, liquid-fuelled rocket engine was tested in April.⁹

There is no publicly available evidence to confirm North Korea's claim that it has built a nuclear warhead that is sufficiently compact to be delivered by a ballistic missile. Following its fifth nuclear test explosion in September 2016, North Korea stated that it could build 'smaller, lighter ... nuclear warheads' that have been 'standardized' to be mounted on its ballistic missiles.¹⁰ A growing number of non-governmental analysts assess that North Korea is probably able to build a 'miniaturized' warhead that can be delivered by short- and medium-range missiles.¹¹ However, in the 2016 edition of its biannual Defense White Paper, South Korea's Ministry of National Defense noted that North Korea had 'reached a significant level' of technical progress towards building a miniaturized warhead, but did not state whether it believed that North Korea had done so.¹² In 2016 officials from the United

⁷ For a technical assessment of the tests and an overview of global nuclear weapon tests since 1945 see section XI of this chapter.

⁸ Korean Central News Agency, 'Kim Jong Un guides ground test of jet of high-power solid-fuel rocket engine and its cascade separation', 24 Mar. 2016; and Korean Central News Agency, 'Kim Jong Un guides ground jet test of new-type high-power engine of carrier rocket for geo-stationary satellite', 19 Sep. 2016.

⁹ Schilling, J., 'North Korea's large rocket engine test: a significant step forward for Pyongyang's ICBM program', 38 North, US–Korea Institute, 9 Apr. 2016.

¹⁰ Korean Central News Agency, 'DPRK succeeds in nuclear warhead explosion test', 9 Sep. 2016.

¹¹ See e.g. Lewis, J., 'North Korea's nuclear weapons: the great miniaturization debate', 38 North, US–Korea Institute, 5 Feb. 2015.

¹² Park, B., '2016 Defense White Paper estimates North Korea has 50kg of plutonium', *The Hankyoreh*, 12 Jan. 2017.

States emphasized that North Korea had not demonstrated a capability to build an operational nuclear weapon and fit it on to a ballistic missile.¹³

Assuming that North Korea is able to produce a sufficiently compact war-head, some observers assess that the size, range and operational status of the Nodong medium-range missile make it the system most likely to be given a nuclear delivery role.¹⁴ Based on a Soviet-era Scud missile design, the Nodong is a single-stage, liquid-fuelled ballistic missile with an estimated maximum range of 1000–1250 kilometres. The North Korean Army's Strategic Rocket Force Command carried out five test launches of Nodong missiles in March, July and August 2016, three of which were successful.¹⁵

On 5 September 2016 North Korea conducted three consecutive missile launches of what were initially identified as Nodong missiles. However, subsequent analysis showed that two of the missiles were a new Scud-ER (extended-range) system, which has an estimated range of 1000 km.¹⁶ There had been speculation that North Korea was developing an extended-range Scud missile, but no confirmation of its existence prior to the test.

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 but is not known to have been flight tested prior to 2016. During the year North Korea conducted eight flight tests of the Musudan system. Only one of the tests, conducted on 21 June, was judged to have been successful, when a missile flew approximately 400 km. In the other tests, the missiles exploded on launch or shortly thereafter.¹⁷

One of the main goals of North Korea's ballistic missile programmes is widely believed to be to develop a long-range ballistic missile that can deliver a nuclear warhead. The Hwasong-13 (also referred to by the US 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.¹⁸ At a 2015 parade, North Korea unveiled

¹³ Kim, J. and Pearson, J., 'North Korean leader says will soon test nuclear warhead', Reuters, 16 Mar. 2016.

¹⁴ See e.g. Fitzpatrick, M., 'North Korea nuclear test on hold?', Shangri-La Voices, International Institute for Strategic Studies, 27 May 2014.

¹⁵ Three of the missile flight tests were apparently successful, but 2 of the missiles exploded (1 in July 2016 and 1 in Aug. 2016) shortly after launch. Kim, J. and Park, J-M., 'Defiant North Korea fires ballistic missile into sea, Japan protests', Reuters, 19 Mar. 2016; and Kwon, K. et al., 'North Korea fires 2 ballistic missiles, South Korea and US say', CNN, 3 Aug. 2016.

¹⁶ Park (note 12).

¹⁷ Savelsberg, R. and Kiessling, J., 'North Korea's Musudan missile: a performance assessment', 38 North, US-Korea Institute, 20 Dec. 2016.

¹⁸ Richardson, D., 'North Korea developing mobile missile: US intelligence', *Jane's Missiles and Rockets*, Feb. 2014; and Schiller, M. and Kelley, R., 'Evolving threat: North Korea's quest for an ICBM', *Jane's Defence Weekly*, vol. 54, no. 3 (Jan 2017), p. 24.

what appeared to be a two-stage, long-range missile, subsequently identified as the KN-14.¹⁹ Estimates of the range and payload capabilities of the missiles are highly speculative. No test launches had been conducted as of the end of 2016.

North Korea appears to have made some technical progress towards building an ICBM using a satellite launch vehicle variant of its Taepodong-2 missile. On 6 February 2016 North Korea's National Aerospace Development Administration announced that a Kwangmyongsong-4 ('Bright Star') earth-observation satellite had been successfully placed in orbit.²⁰ The three-stage Unha-3 launch vehicle was the same rocket used to place a satellite in orbit in December 2012.²¹ However, analysts have noted that building a military version of the satellite launch rocket would involve formidable technical challenges, including developing and flight testing the guidance and re-entry capabilities required for an operational ICBM.²²

North Korea is developing a submarine-launched ballistic missile (SLBM) called the Bukkeukseong-1 ('Polaris-1', designated KN-11 by the US Department of Defense). The missile appears to be a new two-stage, solid fuel design after initial test failures using a liquid-fuelled missile.²³ In 2015 North Korea conducted three underwater ejection tests—that is, tests designed to evaluate stabilization systems and the process of ejecting the missile from a submerged launch tube—with mixed results.²⁴ In 2016 North Korea conducted five underwater test launches of the KN-11—on 8 January, 16 March, 23 April, 9 July and 24 August. Of these, only the last test was considered to have been fully successful, when a KN-11 flew 500 km on a lofted trajectory and fell into the Sea of Japan inside Japan's air defence identification zone.²⁵ While the test was widely seen as evidence that North Korea is making technical progress towards achieving an SLBM capability, many outside observers assess that North Korea still has numerous technical challenges to overcome before it is able to design, build and deploy an operational SLBM force.²⁶

¹⁹ Schiller and Kelley (note 18).

²⁰ Korean Central News Agency, 'DPRK National Aerospace Development Administration releases report on satellite launch', 7 Feb. 2017.

²¹ Kim, J. and Brunnstrom, D., 'North Korea turns to "old workhorse" rocket to repeat past success', Reuters, 7 Feb. 2016.

²² Elleman, M., 'Prelude to an ICBM? Putting North Korea's Unha-3 launch into context', *Arms Control Today*, vol. 43, no. 2 (Mar. 2013).

²³ Schilling, J., 'A new submarine-launched ballistic missile for North Korea', 38 North, US-Korea Institute, 25 Apr. 2016.

²⁴ See Kile, S. N. and Kristensen, H. M., 'World nuclear forces', *SIPRI Yearbook 2016*, pp. 659–60.

²⁵ Park, J.-M. and Kim, J., 'North Korea fires submarine-launched ballistic missile towards Japan', Reuters, 24 Aug. 2016.

²⁶ Park and Kim (note 25); and Yoshida, R. and Johnson, J., 'Japan condemns North Korea submarine missile; test shows advances', *Japan Times*, 24 Aug. 2016.