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. North Korea is believed to have the capability to build a rudimentary nuclear weapon, but it is not known whether it has done so. Estimates of the possible size of North Korea's nuclear arsenal vary considerably. They are based primarily 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, prior to its 'disablement' in 2007 as part of the Six-Party Talks, and assumptions about North Korean weapon design and fabrication skills.[1] It is estimated that North Korea has produced enough weapon-grade plutonium to be able to construct up to eight rudimentary nuclear weapons, assuming that each weapon used 5 kilograms of plutonium.[2]

North Korea has conducted three nuclear test explosions to date: in October 2006, May 2009 and February 2013.[3] In 2014 commercial satellite imagery showed renewed excavation work at North Korea's underground test site located near Punggye-ri in the north-east of the country.[4] The activity was seen against the background of threats from the North Korean leadership to carry out a fourth nuclear test.[5] As the year ended, however, there were no indications that another test explosion was imminent.[6]

In 2014 North Korea's General Department of Atomic Energy continued the renovation and new construction activities at the Yongbyon nuclear complex announced in April 2013.[7] According to the International Atomic Energy Agency's (IAEA) annual report on North Korea, satellite imagery

[1] See Albright, D. and Waldron, C., *North Korea's Estimated Stocks of Plutonium and Weapon Grade Uranium* (Institute for Science and International Security: Washington, DC, 16 Aug. 2012).

[2] For details about this estimate see Kile, S. N., et al., 'World nuclear forces', *SIPRI Yearbook 2013*, p. 324.

[3] On the most recent test explosion see Fedchenko, V., 'Nuclear explosions, 1945–2009', *SIPRI Yearbook 2014*, pp. 346–48.

[4] Liu, J. and Hansen, N., 'Update on Punggye-ri: stepped up activity at west portal, drawdown at the south portal', 38 North, US–Korea Institute, Johns Hopkins University, 2 May 2015, <http://38north.org/2014/05/punggye050214/>.

[5] 'North Korea renews threat to conduct nuclear test', *The Guardian*, 10 May 2014.

[6] Liu, J., and Hansen, N., 'North Korea's Punggye-ri nuclear test site: no sign of test preparations', 38 North, US–Korea Institute, Johns Hopkins University, 16 Jan. 2015, <http://38north.org/2015/01/punggye0101615/>.

[7] Korean Central News Agency (KCNA), 'DPRK to adjust uses of existing nuclear facilities', 2 Apr. 2013. The KCNA is North Korea's state news agency; its statements are available on the website of the Korean News Service in Tokyo, <http://www.kcna.co.jp/>.

Table 11.10. North Korean forces with potential nuclear capability, January 2015

There is no public evidence that North Korea has developed and tested a sufficiently compact nuclear warhead and associated re-entry vehicle to be carried on a ballistic missile. This table lists the ballistic missiles that could potentially have this role.

Type	Range (km)	Payload (kg)	Status
Nodong	1 250	750–1 000	Fewer than 50 launchers;[a] first deployed in 1990; most recent test launch on 26 Mar. 2014
Musudan (BM-25)	>3 000	~1 000	Under development; no test launch yet
Hwasong-13 (KN-08)	>5 500	. .	Under development; no test launch yet
Taepodong-2	>5 500	. .	Under development; failed test launch in 2006; 3-stage space launch vehicle variant, the Unha-3, placed satellite in orbit in Dec. 2012

. . = not available or not applicable.

[a] The total missile inventory may be larger than the number of launchers, which can be reused to fire additional missiles.

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.

indicated that the 5-MW(e) plutonium production reactor at Yongbyon had resumed operation in August 2013.[8] A US research institute subsequently reported that the reactor appeared to have been shut down from late August until mid-December 2014. The reason for the extended halt in operations was unclear.[9] When operational, the reactor has been estimated to be capable of producing approximately 6 kilograms of plutonium per year, enough for one nuclear weapon.[10]

North Korea is building an indigenously designed experimental light water reactor (ELWR) at Yongbyon. Few details are known about the design of the 25–30 MW(e) reactor, which is believed to have features similar to standard Western pressurized water reactors.[11] One US analyst has estimated that the reactor could be used to produce up to 30–40 kg of

[8] International Atomic Energy Agency, Board of Governors General Conference, 'Application of Safeguards in the Democratic People's Republic of Korea', Report by the Director General, GOV/2014/42-GC(58)/21, 3 Sep. 2014, p. 3.

[9] Hansen, N., 'North Korea's Yongbyon nuclear facility: restart of the 5 MWe reactor?', 38 North, US–Korea Institute, Johns Hopkins University, 28 Jan. 2015, <http://38north.org/2015/01/yongbyon012815/>.

[10] Hansen, N. and Lewis, J., 'North Korea restarting its 5 MW reactor', 38 North, US–Korea Institute, Johns Hopkins University, 11 Sep. 2013, <http://38north.org/2013/09/yongbyon091113/>.

[11] Milonopoulos, N. and Blandford, E., '"Safety first: not one accident can occur:" nuclear safety and North Korea's quest to build a light water reactor', 38 North, US–Korea Institute, Johns Hopkins University, 3 Apr. 2014, <http://38north.org/2014/04/milonbland040314/>.

plutonium annually for nuclear weapons.[12] In early 2015 commercial satellite imagery appeared to indicate that construction work on the reactor building has been completed, but there were no indications that the reactor has commenced operation. North Korea may have encountered technical problems that are delaying the start-up.[13]

There has been considerable speculation that North Korea is seeking to build nuclear weapons using highly enriched uranium (HEU) as the fissile material in order overcome the constraints posed by its limited stock of weapon-grade plutonium. In October 2014 South Korean Defence Minister Han Min-koo testified before the National Assembly that North Korea was believed to have the technical capability to build a nuclear weapon using HEU.[14] There has also been speculation that North Korea may attempt to build a fusion-boosted fission device or possibly even a thermonuclear weapon, but this is believed to be beyond North Korea's current capabilities.[15]

North Korea is known to have at least one uranium centrifuge enrichment plant, located in a former metal fuel rod fabrication building at Yongbyon. The plant was shown to a group of visiting US scientists in 2010, who were told that it was equipped with 2000 centrifuges.[16] In November 2014 a South Korean news report cited government officials as stating that North Korea had built a new enrichment facility adjacent to the known plant at Yongbyon. The facility was believed to be in operation. If so, it could double North Korea's capacity to produce HEU for nuclear weapons.[17]

Ballistic missiles

The main goal of North Korea's nuclear weapon and ballistic missile programmes is widely believed to be to develop a nuclear warhead that can be delivered by a long-range missile. There is considerable uncertainty about the extent to which North Korea has yet managed to miniaturize its

[12] Yonhap News Agency, 'NK's nuclear stockpile could rise sharply if light water reactor goes into operation: US expert', 7 July 2014, <http://english.yonhapnews.co.kr/northkorea/2014/07/07/26/0401000000AEN20140707000200315F.html>.

[13] Hansen (note 9).

[14] Jeong, Y. and Ser, M., 'North operates new uranium plant', *Joongang Daily*, 5 Nov. 2014.

[15] Lewis, J, 'Setting expectations for a DPRK test', Arms Control Wonk, 29 Jan. 2013, <http://lewis.armscontrolwonk.com/archive/6200/setting-expectations-for-a-dprk-test#more-3155>; and Makino, Y., 'N. Korea likely to test fusion-boosted fission bomb able to reach US', *Asahi Shimbun*, 25 Jan. 2013.

[16] Hecker, S., 'A return trip to North Korea's Yongbyon nuclear complex', Center for International Security and Cooperation, Stanford University, 20 Nov. 2010, <http://iis-db.stanford.edu/pubs/23035/HeckerYongbyon.pdf>.

[17] Jeong and Ser (note 14); and Kim, J., 'New North Korea nuclear facility could boost weapons fuel: report', Reuters, 5 Nov. 2014, <http://uk.reuters.com/article/2014/11/05/uk-northkorea-nuclear-idUKKBN0IP0A420141105>.

warhead design sufficiently for use with a ballistic missile and demonstrated a capability to deliver such a warhead. In 2014 US and South Korean government sources assessed that North Korea had made technical progress towards building a sufficiently compact nuclear warhead for this purpose. The commander of US Forces Korea, General Curtis Scaparrotti, reportedly stated in October that he believed North Korea had most likely achieved the capability to build a so-called miniaturized nuclear warhead, although it had not yet tested such a device.[18] The 2014 edition of South Korea's biennial defence white paper assessed that North Korea appeared to have achieved 'a significant level' of technology for building miniaturized nuclear weapons that could be carried on long-range missiles.[19] However, a South Korean Defence Ministry spokesperson cautioned in February 2015 that '[d]espite its significant technology level, we do not think the North is capable of making such nuclear weapons'.[20]

North Korea's ballistic missile arsenal is known to include nine types of indigenously produced guided ballistic missile, which are believed to be derived from older Soviet missile designs and from technologies that were reverse engineered by North Korea (see table 11.10).[21] These nine types include five longer-range missiles: the Nodong, Musudan (also designated BM-25), Hwasong-13 (designated KN-08), Taepodong-1 and Taepodong-2. North Korea is frequently cited in the open-source literature as possessing a total of 800–1000 ballistic missiles of all types, but these estimates are highly uncertain.[22] There is also considerable uncertainty about the reliability and operational readiness of North Korea's ballistic missile force. Compared with the missile programmes of other countries, North Korea has carried out only a small number of test and training launches of its indigenously produced missiles before declaring them to be operational.[23]

Assuming that North Korea is able to produce a compact nuclear warhead, some observers assess that the size, range and operational status of the Nodong make it the missile system most likely to be given the nuclear delivery role.[24] The Nodong is a road-mobile, single-stage, medium-range

[18] Sanger, D., 'US commander sees key nuclear step by North Korea', *New York Times*, 24 Oct. 2014.

[19] Oh, S., 'N. Korea has "significant" technology for miniaturized nukes: Seoul', Yonhap News Agency, 6 Jan. 2015, <http://english.yonhapnews.co.kr/national/2015/01/06/38/0301000000AEN20150106002600315F.html>.

[20] Yonhap News Agency, 'N. Korea yet to miniaturize nukes: Seoul', *Korea Herald*, 26 Feb. 2015.

[21] For a detailed history of North Korea's missile programme see Pollack, J. D., *No Exit: North Korea, Nuclear Weapons and International Security* (Routledge: Abingdon, 2011); and Bermudez, J. S., *A History of Ballistic Missile Development in the DPRK*, Occasional Paper no. 2 (Monterey Institute of International Studies, Center for Nonproliferation Studies: Monterey, CA, 1999).

[22] Schiller, M., *Characterizing the North Korean Nuclear Missile Threat* (Rand Corporation: Santa Monica, CA, 2012), p. xv.

[23] Schiller (note 22), pp. 11–13, 34–36.

[24] See e.g. Fitzpatrick, M., 'North Korea nuclear test on hold?', Shangri-La Voices, International Institute for Strategic Studies, 27 May 2014, <http://www.iiss.org/en/shangri-la%20voices/blog sections/2014-363a/north-korea-nuclear-test-on-hold-8fec>.

ballistic missile (MRBM) with an estimated maximum range of 1000–1250 km.[25] North Korea flight-tested the missile first in 1993 and again in 2006 and 2009. The most recent test took place on 26 March 2014, when the North Korean Army's Strategic Rocket Force Command launched two Nodong missiles from mobile launchers. They travelled 650 km before falling into the Sea of Japan.[26]

The Musudan missile, sometimes designated the BM-25, is reportedly a road-mobile, single-stage, intermediate-range ballistic missile (IRBM). Most analyses in the open-source literature have concluded that its design is based on the Russian R-27 (SS-N-6) submarine-launched ballistic missile (SLBM). The Musudan was first unveiled during a military parade in 2010.[27] The missile has never been tested and is not believed to be operationally deployed.

The Hwasong-13 (also referred to by the US designation, KN-08) was first presented by North Korea as a road-mobile missile with intercontinental range during a military parade in April 2012. Very little is publicly known about the missile, which has not been flight-tested to date. The US Director of National Intelligence, James R. Clapper, stated in 2014 that North Korea had taken 'initial steps' towards deploying the KN-08.[28] However, some non-governmental analysts have argued that the missiles displayed during military parades in 2012 and 2013 were only mock-ups that contained a number of design anomalies which called into question whether the system really existed.[29]

The Taepodong-2 is believed to be a two- or three-stage ballistic missile that may have an intercontinental range, although the estimates of its range vary considerably. The initial test launch in 2006 failed, as did two subsequent attempts, using space launch vehicle variants, in 2009 (Unha-2) and April 2012 (Unha-3).[30] North Korea successfully used a Unha-3 rocket to place a satellite into orbit in December 2012.[31] Despite the successful

[25] Fitzpatrick, M. (ed.), *North Korean Security Challenges: A Net Assessment* (International Institute for Strategic Studies: London, July 2011), pp. 134–35.

[26] Yonhap News Agency, 'N. Korea fires two ballistic missiles', 26 Mar. 2014, <http://english.yonhapnews.co.kr/national/2014/03/26/65/0301000000AEN20140326000500315F.html>.

[27] Lewis, J., 'Origins of the Musudan IRBM', Arms Control Wonk, 11 June 2012, <http://lewis.armscontrolwonk.com/archive/5337/origins-of-the-musudan-irbm>.

[28] Clapper, J. R., US Director of National Intelligence, 'Worldwide threat assessment of the US intelligence community for the Senate Select Committee on Intelligence', Unclassified statement for the record, 29 Jan. 2014, <http://www.dni.gov/files/documents/Unclassified_2015_ATA_SFR_-_SASC_FINAL.pdf>, p. 6.

[29] Richardson, D., 'North Korea Developing Mobile Missile: U.S. Intelligence', *Jane's Missiles and Rockets*, Feb. 2014; and Schiller, M. and Schmucker, R., 'The assumed KN–08 technology', Arms Control Wonk, 31 May 2012, <http://lewis.armscontrolwonk.com/files/2012/05/Addendum_KN-08_Analysis_Schiller_Schmucker.pdf>.

[30] Wright, D. and Postol, T., 'A post-launch examination of the Unha-2', *Bulletin of the Atomic Scientists*, Opinion, 29 June 2009, <http://thebulletin.org/post-launch-examination-unha-2>.

[31] Richardson, D., 'Unha-3 was largely of North Korean manufacture', *Jane's Missiles and Rockets*, vol. 17, no. 3, Mar. 2013, pp. 4–6.

application of three-stage separation technology demonstrated by the satellite launch, analysts note that North Korea has not demonstrated the guidance and re-entry capabilities required for a long-range ballistic missile.[32]

In 2014 US and South Korean defence officials disclosed that North Korea appeared to be seeking to enhance its nuclear deterrent by developing a capability to launch ballistic missiles from submarines.[33] They did not provide any details about the type of missile or submarine being used. Based on commercial satellite imagery, one analyst identified a recently constructed test stand at a North Korean shipyard that was the appropriate size and design for developing and testing a shipboard vertical missile launch tube system.[34] There is general agreement among non-governmental experts that while North Korea is making technical progress towards a submarine-launched missile capability it will likely need many years to design, build and deploy an operational SLBM force.

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

[33] Gertz, B., 'North Korea building submarine missile', Washington Free Beacon, 26 Aug. 2014, <http://freebeacon.com/national-security/north-korea-building-missile-submarine/>; and Fisher, R., 'US, S Korean sources suggest North has SLBM ambitions', IHS Jane's 360, 22 Sep. 2014, <http://www.janes.com/article/43551/us-s-korean-sources-suggest-north-has-slbm-ambitions>.

[34] Bermudez, J. S., 'North Korea: test stand for vertical launch of sea-based ballistic missiles spotted', 38 North, US–Korea Institute, Johns Hopkins University, 28 Oct. 2014, <http://38north.org/2014/10/jbermudez102814/>.