

## IX. North Korean nuclear forces

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The Democratic People's Republic of Korea (DPRK, or North Korea) maintains an active but highly opaque nuclear weapon programme. As of January 2021, it is estimated that North Korea possessed sufficient fissile material for approximately 40–50 nuclear weapons (see table 10.10). This is an increase of 10 from the previous year's estimate due to additional production of fissile material. The estimate 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 (see section X). It is unknown how much of this material has been used to produce warheads for North Korea's ballistic missiles.<sup>1</sup> Analysing the numbers and types of North Korean warheads and delivery vehicles is fraught with uncertainty due to limited official public data; some of the data presented here is derived from satellite imagery and North Korean media sources, which can be subject to manipulation or exaggeration.

In January 2020 North Korean diplomats stated that the country would no longer observe its self-imposed moratoriums on nuclear explosive tests and flight tests of long-range ballistic missiles.<sup>2</sup> These had been announced by the Supreme Leader of North Korea, Kim Jong Un, in April 2018.<sup>3</sup> Despite this announcement, North Korea did not conduct any such test in 2020. Instead, it conducted multiple tests of short-range ballistic missiles (SRBMs).

### **The role of nuclear weapons in North Korean military doctrine**

In a speech marking the 75th anniversary of the ruling Korean Workers' Party in October 2020, Kim Jong Un reiterated North Korea's pledge not to use nuclear weapons 'preemptively'.<sup>4</sup> This does not constitute a no-first-use policy, however, since Kim made it clear that he could turn to nuclear weapons if 'any forces infringe upon the security of our state'.<sup>5</sup> However, as with other nuclear-armed states, it seems unlikely that North Korea

<sup>1</sup> For a discussion of US intelligence and other assessments of North Korea's nuclear warhead status see Kile, S. N. and Kristensen, H. M., 'North Korea's military nuclear capabilities', *SIPRI Yearbook 2020*, pp. 343–44.

<sup>2</sup> Nebehay, S., 'North Korea abandons nuclear freeze pledge, blames "brutal" US sanctions', Reuters, 21 Jan. 2020.

<sup>3</sup> Korean Central News Agency, 'Third plenary meeting of seventh CC, WPK held in presence of Kim Jong Un', 21 Apr. 2018. On North Korea's 6 underground nuclear test explosions in 2006–17 see Fedchencko, V., 'Nuclear explosions, 1945–2017', *SIPRI Yearbook 2018*.

<sup>4</sup> 'Kim Jong Un's October speech: More than missiles', 38 North, 13 Oct. 2020.

<sup>5</sup> 38 North (note 4).

**Table 10.10.** North Korean forces with potential nuclear capability, January 2021

Type/designation <sup>a</sup>	Range (km)	Payload (kg)	Status	No. of warheads
<i>Land-based missiles</i>				
Hwasong-7 (Nodong)	>1 200	1 000	Single-stage, liquid-fuel ballistic missile. Fewer than 100 launchers; first deployed in 1990.	Some
Hwasong-9 (Scud-ER)	1 000	500	Scud ballistic missile variant, lengthened to carry additional fuel.	Some
Pukguksong-2 (KN15)	>1 000	..	Two-stage, solid-fuel ballistic missile under development. Launched from canister TEL. Land-based version of Pukguksong-1 SLBM. Test launched in 2017.	..
Hwasong-10 (BM-25, Musudan)	>3 000	[1 000]	Single-stage, liquid-fuel ballistic missile under development. Several failed tests in 2016.	..
Hwasong-12 (KN17)	>4 500	1 000	Single-stage, liquid-fuel ballistic missile under development. Tested several times in 2017 with mixed success.	..
Hwasong-13 (KN08) <sup>b</sup>	12 000	..	Three-stage, liquid-fuel ballistic missile with potential intercontinental range under development. No known test launches.	..
Hwasong-14 (KN20)	>10 000	500–1 000	Two-stage, liquid-fuel ballistic missile under development. Tested in 2017.	..
Hwasong-15 (KN22)	>12 000	1 000–1 500	Two-stage, liquid-fuel ballistic missile under development. Two tests in 2017.	..
Hwasong-16 (KN27)	..	..	Two-stage, liquid-fuel ballistic missile under development. First displayed at a parade in Oct. 2020. No known flight tests.	..
Taepodong-2 <sup>c</sup>	12 000	..	Under development. Three-stage ballistic space launch vehicle variant placed satellites in orbit in Dec. 2012 and Feb. 2016. ICBM status unclear.	..
<i>Sea-based missiles</i>				
Pukguksong-1 (KN11)	>1 000	..	Two-stage, solid-fuel ballistic missile. Tested several times in 2015 and 2016 with mixed success.	..
Pukguksong-3 (KN-26)	≤1 900	..	Two-stage, solid-fuel SLBM under development. Likely replacing earlier Pukguksong-1 version. First flight tested in Oct. 2019.	..
Pukguksong-4	..	..	Two-stage, solid-fuel SLBM. First displayed at a parade in Oct. 2020. No known flight tests.	..
<b>Total warhead potential</b>				<b>[40–50]<sup>d</sup></b>

.. = not available or not applicable; [] = uncertain figure; ICBM = intercontinental ballistic missile; SLBM = submarine-launched ballistic missile; TEL = transporter-erector-launcher.

<sup>a</sup> This table lists the ballistic missiles that could potentially have a nuclear capability. There is no publicly available evidence that North Korea has produced an operational nuclear warhead for delivery by an ICBM. The first name of each system is the North Korean designation; the second name, in parentheses, is the designation used by the United States Department of Defense.

<sup>b</sup> A two-stage variant, the KN14, may be under development but had not been test launched as of Jan. 2021. It is possible that both the KN08 and KN14 have been abandoned in favour of newer, more advanced ICBM systems.

<sup>c</sup> A two-stage Taepodong-1 missile was unsuccessfully flight tested in 1998.

<sup>d</sup> SIPRI's estimate is that North Korea may have produced enough fissile material to build between 40 and 50 nuclear warheads. It is unknown how many warheads may have been assembled. SIPRI estimates that only a few of these would be hydrogen warheads and nearly all would be lower-yield single-stage fission warheads. See also Hecker, S., 'What do we know about North Korea's nuclear program?', Presentation, Dialogue on DPRK Denuclearization Roadmaps and Verification, Kyung Hee University, Global America Business Institute (GABI) and Natural Resources Defense Council (NRDC), 20 Oct. 2020.

Sources: US Department of Defense (DOD), *2019 Missile Defense Review* (DOD: Arlington, VA, 2019); US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat*, various years; *IHS Jane's Strategic Weapon Systems*, various editions; Hecker, S., Stanford University, Personal communication, 2020; *Bulletin of the Atomic Scientists*, 'Nuclear notebook', various issues; and authors' estimates.

would use its nuclear weapons outside of extreme circumstances when the continued existence of the state and its leadership was in question.

## **Fissile material and warhead production**

North Korea's plutonium production and separation capabilities for manufacturing nuclear weapons are located at the Yongbyon Nuclear Scientific Research Centre (YNSRC) in North Pyongan province.<sup>6</sup> In 2020 some of the nuclear facilities located there appeared not to be operating. In September 2020 the International Atomic Energy Agency (IAEA) reported that there had been no indications of steam or cooling water discharge from the ageing 5-megawatt-electric (MW(e)) graphite-moderated research reactor located at the YNSRC. It therefore concluded, 'it is almost certain that the reactor has remained shut down since early December 2018'.<sup>7</sup> The IAEA also reported that there were no indications that reprocessing activities were under way at the adjacent Radiochemical Laboratory used to separate plutonium from the 5-MW(e) reactor's spent fuel rods, which can be used for

<sup>6</sup> For an assessment of North Korea's nuclear weapon production facilities and infrastructure see Hecker, S. S., Carlin, R. L. and Serbin, E. A., 'A comprehensive history of North Korea's nuclear program: 2018 update', Stanford University, Center for International Security and Cooperation (CISAC), 11 Feb. 2019, p. 3.

<sup>7</sup> International Atomic Energy Agency (IAEA), Board of Governors and General Conference, 'Application of safeguards in the Democratic People's Republic of Korea', Report by the Director General, GOV/2020/42-GC(64)/18, 3 Sep. 2020, para. 12.

the production of nuclear weapons.<sup>8</sup> In October 2020 commercial satellite imagery indicated that activity was increasing at a building used to produce uranium dioxide (UO<sub>2</sub>); however, it is unclear whether the observed smoke or vapour emissions are an indication of UO<sub>2</sub> production or a different operation.<sup>9</sup> The IAEA report noted that North Korea may have conducted an infrastructure test at the experimental light water reactor that is under construction at Yongbyon, which is also capable of producing plutonium for nuclear weapons; however, the reactor had not yet commenced operation.<sup>10</sup>

There is considerable uncertainty about North Korea's uranium enrichment capabilities and its stock of HEU. It is widely believed that North Korea has focused on the production of HEU for use in nuclear warheads to overcome its limited capacity to produce weapon-grade plutonium. In 2020 the IAEA assessed that North Korea continued to operate the gas centrifuge enrichment plant located at the Yongbyon complex that it had declared in 2010.<sup>11</sup> Using commercial satellite imagery, several non-governmental researchers have identified a suspected covert uranium enrichment plant located at Kangsong, to the south-west of Pyongyang.<sup>12</sup> However, analysts cautioned that, without access to the plant, it was not possible to confirm the nature and purpose of the activities being conducted on-site.<sup>13</sup> A classified intelligence assessment by the United States in 2018 reportedly concluded that North Korea probably had more than one covert uranium enrichment plant and that the country was seeking to conceal the types and numbers of production facilities in its nuclear weapon programme.<sup>14</sup>

It is unclear how many nuclear weapons North Korea has produced with its fissile material, how many have been deployed on missiles, and what the military characteristics of the weapons are. North Korea has only demonstrated a thermonuclear capability (or a capability with demonstrated thermonuclear yield) once, in 2017.<sup>15</sup> US intelligence sources have not yet confirmed North Korea's capability to deliver a functioning warhead on an intercontinental ballistic missile (ICBM). Moreover, most of North Korea's nuclear tests demonstrated yields in the range 5–15 kilotons. As a result,

<sup>8</sup> International Atomic Energy Agency, GOV/2020/42-GC(64)/18 (note 7).

<sup>9</sup> Pabian, F. V., Makowsky, P. and Liu, J., 'North Korea's Yongbyon complex: Activity picks up', 38 North, 30 Oct. 2020.

<sup>10</sup> International Atomic Energy Agency, GOV/2020/42-GC(64)/18 (note 7).

<sup>11</sup> International Atomic Energy Agency, GOV/2020/42-GC(64)/18 (note 7). See also Hecker et al. (note 6), pp. 3–4.

<sup>12</sup> Panda, A., 'Exclusive: Revealing Kangsong, North Korea's first covert uranium enrichment site', *The Diplomat*, 13 July 2018; and Albright, D. with Burkhard, S., 'Revisiting Kangsong: A suspect uranium enrichment plant', *Imagery Brief*, Institute for Science and International Security, 2 Oct. 2018.

<sup>13</sup> Hecker et al. (note 6), p. 4; and Madden, M., 'Much ado about Kangsong', 38 North, 3 Aug. 2018.

<sup>14</sup> 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*, 1 July 2018.

<sup>15</sup> Fedchenko (note 3).

SIPRI estimates that North Korea has used only a small portion of its HEU for thermonuclear weapons and has probably used the majority for a larger number of fission-only or boosted single-stage weapons deliverable by medium-range ballistic missile (MRBM) or possibly by intermediate-range ballistic missile (IRBM). For this reason, SIPRI estimates that North Korea could potentially produce 40–50 nuclear weapons with its current inventory of fissile materials.<sup>16</sup>

### Land-based missiles

North Korea is increasing both the size and capability of its ballistic missile force, which consists of indigenously produced missile systems with ranges from a few hundred kilometres to more than 12 000 km.<sup>17</sup> In recent years it has pursued the serial production of several missile systems with progressively longer ranges and increasingly sophisticated delivery capabilities.<sup>18</sup> There is considerable uncertainty about the operational capability of North Korea's long-range ballistic missiles. According to an independent analysis, North Korea has deployed long-range missiles at several missile bases.<sup>19</sup> However, in 2019 the US Department of Defense (DOD) indicated that many of North Korea's newer ballistic missiles (Hwasong-10/12/13/14/15 or Puk-guksong-1/2) had not yet been 'fielded'.<sup>20</sup>

It is unclear which of North Korea's missiles would carry nuclear weapons. The available evidence suggests that the longer-range missiles in particular are being developed to fulfil a nuclear role in North Korea's military doctrine. However, North Korea has not yet publicly demonstrated a reliable atmospheric re-entry vehicle or a capability for terminal-stage guidance and warhead activation.<sup>21</sup> As such, it remains unclear whether its missiles would be able to reliably deliver a nuclear warhead to an inter-continental-range target without further development.<sup>22</sup>

<sup>16</sup> For a recent assessment see also Hecker, S., 'What do we know about North Korea's nuclear program?', Presentation, Dialogue on DPRK Denuclearization Roadmaps and Verification, Kyung Hee University, Global America Business Institute (GABI) and Natural Resources Defense Council (NRDC), 20 Oct. 2020, slide 5.

<sup>17</sup> US Air Force, National Air and Space Intelligence Center (NASIC), *Ballistic and Cruise Missile Threat 2020* (NASIC: Wright-Patterson Air Force Base, OH, July 2020).

<sup>18</sup> James Martin Center for Nonproliferation Studies (CNS), *The CNS North Korea Missile Test Database*, 31 Mar. 2021.

<sup>19</sup> Bermudez, J. and Cha, V., 'Undeclared North Korea: The Yusan-ni missile operating base', *Beyond Parallel*, Center for Strategic and International Studies (CSIS), 9 May 2019.

<sup>20</sup> US Department of Defense (DOD), *2019 Missile Defense Review* (DOD: Arlington, VA, 2019), p. 7.

<sup>21</sup> Ali, I., 'US general says North Korea not demonstrated all components of ICBM', Reuters, 30 Jan. 2018.

<sup>22</sup> Elleman, M., 'Does size matter? North Korea's newest ICBM', 38 North, 21 Oct. 2020.

*Short-range ballistic missiles*

North Korea has several types of SRBM, including older systems possibly based on Soviet R-17 Scud missiles and newer missiles with indigenous designs. In 2020 North Korea conducted several initial launches of at least two new types of solid-fuelled SRBM: the KN24 and the KN25.<sup>23</sup> These systems could be nearing or have possibly begun operational deployment.

While older, inaccurate SRBMs might have been developed with dual capability, there is no publicly available, authoritative information confirming a nuclear delivery role for the newer, more accurate SRBMs.<sup>24</sup> Independent assessments suggest that a nuclear device that North Korea displayed in 2017—if, indeed, it was a functional nuclear device—might be too large to fit into these newer SRBMs. However, as North Korea seeks to miniaturize its nuclear warheads, these types of missile could adopt a dual-capable role in the future.<sup>25</sup>

*Medium- and intermediate-range ballistic missiles*

Assuming that North Korea is able to produce a sufficiently compact warhead, independent assessments indicate that the size, range and operational status of the Hwasong-7 (Nodong or Rodong) MRBM make it the system most likely to be given a nuclear delivery role.<sup>26</sup> Possibly based on a Soviet-era R-17 (Scud) missile design, the Hwasong-7 is a single-stage, liquid-fuelled ballistic missile with an estimated range exceeding 1200 km. In addition, North Korea has developed the single-stage, liquid-fuelled Hwasong-9 (Scud-ER for extended-range), which has an estimated range of 1000 km and may also be a nuclear-capable delivery system. According to the 2020 ballistic and cruise missile report of the US Air Force's National Air and Space Intelligence Center (NASIC), the system has not yet been deployed.<sup>27</sup>

The Hwasong-10 (Musudan or BM-25) is a single-stage, liquid-fuelled missile with an estimated range exceeding 3000 km. It was first unveiled at a military parade in 2010. Flight testing began in 2016, with multiple failures.<sup>28</sup> No flight tests of the Hwasong-10 are known to have been con-

<sup>23</sup> Panda, A., 'What was behind North Korea's busy March 2020 missile launches?', *The Diplomat*, 8 Apr. 2020; and Dempsey, J., 'Assessment of the March 9 KN-25 test launch', 38 North, 10 Mar. 2020.

<sup>24</sup> James Martin Center for Nonproliferation Studies (note 18); and Panda (note 23).

<sup>25</sup> Elleman, M., 'Preliminary assessment of the KN-24 missile launches', 38 North, 25 Mar. 2020.

<sup>26</sup> See e.g. Fitzpatrick, M., 'North Korea nuclear test on hold?', *Shangri-La Voices*, International Institute for Strategic Studies (IISS), 27 May 2014; and Albright, D., 'North Korean miniaturization', 38 North, 13 Feb. 2013. For the missiles and submarines discussed here, a designation in parentheses (in this case Nodong or Rodong) following the North Korean designation (in this case Hwasong-7) is that assigned by the US Department of Defense (DOD).

<sup>27</sup> US Air Force (note 17), pp. 18, 21, 25.

<sup>28</sup> Savelsberg, R. and Kiessling, J., 'North Korea's Musudan missile: A performance assessment', 38 North, 20 Dec. 2016.

ducted since 2016–17, and the status of the missile’s development programme is unclear.

The Hwasong-12 (KN17) is a single-stage IRBM 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.<sup>29</sup> NASIC estimated in 2020 that it has a range of more than 4500 km.<sup>30</sup> Some analysts have speculated that the missile carries a small post-boost vehicle that, in addition to increasing its maximum range, can be used to improve warhead accuracy.<sup>31</sup> The missile was last test launched in 2017 but has not been deployed.<sup>32</sup>

North Korea is developing the Pukguksong-2 missile (KN15), which is a land-based variant of the Pukguksong-1 submarine-launched ballistic missile (SLBM). The two-stage, solid-fuelled missile has an estimated range of approximately 1000 km.<sup>33</sup> It was flight tested twice in 2017. Some analysts have noted that North Korea’s development of the Pukguksong-2 is 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. In addition, and uniquely for a North Korean missile, the Pukguksong-2 is coupled with a tracked transporter-erector-launcher (TEL). This would allow North Korea to launch it from hidden, off-road sites, whereas other systems use wheeled launchers and thus require paved or relatively smooth roads—a rarity in North Korea’s mountainous terrain.<sup>34</sup>

### *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, as mentioned above, there remains considerable uncertainty in assessments of North Korea’s current long-range missile capabilities, and NASIC does not list any of North Korea’s ICBMs as deployed.<sup>35</sup>

<sup>29</sup> 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.

<sup>30</sup> US Air Force (note 17), p. 25.

<sup>31</sup> Elleman, M., ‘North Korea’s Hwasong-12 launch: A disturbing development’, 38 North, 30 Aug. 2017.

<sup>32</sup> Panda, A., ‘North Korea shows increased operational confidence in the Hwasong-12 IRBM’, *The Diplomat*, 17 Sep. 2017.

<sup>33</sup> US Air Force (note 17), p. 25.

<sup>34</sup> 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.

<sup>35</sup> Albert, E., ‘North Korea’s military capabilities’, Council on Foreign Relations, 16 Nov. 2020; and US Air Force (note 17), p. 29.



The Hwasong-13 (KN08) was first presented by North Korea as a road-mobile, three-stage missile with intercontinental range at a military parade in April 2012. Some non-governmental analysts have suggested that the missiles displayed were only mock-ups.<sup>36</sup> Estimates of the range and payload capabilities of the missile are highly speculative. As of 2020, it had not been flight tested.

North Korea has twice tested the Hwasong-14 (KN20), a prototype ICBM that first appeared in 2015 at a military parade in Pyongyang.<sup>37</sup> The two-stage missile appears to use the same high-energy liquid-propellant booster engine as the single-stage Hwasong-12 IRBM.<sup>38</sup> In 2020 NASIC assessed that the range of the Hwasong-14 could exceed 10 000 km, putting it in range of most of the continental USA but not Washington, DC, or other targets on the east coast.<sup>39</sup>

North Korea is developing a new two-stage ICBM, the Hwasong-15 (KN22), which has a significantly larger second stage and more powerful booster engines than the Hwasong-14. The first flight test was conducted in 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.<sup>40</sup> In 2020 NASIC assessed that the range of the Hwasong-15 could exceed 12 000 km, putting it in range of Washington, DC, and other targets on the east coast of the USA.<sup>41</sup> The missile was assessed to be carrying a light payload, however, and the range would be significantly reduced if it were carrying an actual nuclear warhead.<sup>42</sup> Four Hwasong-15 ICBMs were displayed during North Korea's October 2020 military parade.<sup>43</sup>

During the October 2020 parade, North Korea also unveiled four units of a new liquid-fuelled type of ICBM, which has not yet been tested but appears to be the largest road-mobile, liquid-fuelled ICBM on the planet.<sup>44</sup> The new ICBM, which is presumably called the Hwasong-16 in line with North Korea's naming conventions (with likely US DOD designation KN27), would hypothetically be large enough to accommodate multiple warheads; however, such capabilities have not yet been demonstrated.

<sup>36</sup> Schiller, M. and Kelley, R., 'Evolving threat: North Korea's quest for an ICBM', *Jane's Defence Weekly*, 18 Jan. 2017, p. 24.

<sup>37</sup> James Martin Center for Nonproliferation Studies (note 18).

<sup>38</sup> According to one non-governmental analyst, North Korea probably acquired the engine through illicit channels operating in Russia, Ukraine or both. Elleman, M., 'The secret to North Korea's ICBM success', Analysis, International Institute for Strategic Studies (IISS), 14 Aug. 2017.

<sup>39</sup> US Air Force (note 17), pp. 27, 29.

<sup>40</sup> Wright, D., 'North Korea's longest missile test yet', All Things Nuclear, Union of Concerned Scientists, 28 Nov. 2017.

<sup>41</sup> US Air Force (note 17), pp. 27, 29.

<sup>42</sup> Elleman, M., 'North Korea's third ICBM launch', 38 North, 29 Nov. 2017.

<sup>43</sup> 'North Korea military parade 2020—Livestream & analysis', NK News, 10 Oct. 2020.

<sup>44</sup> NK News (note 43).



In 2019 the US DOD indicated that North Korea had deployed one ICBM, the Taepodong-2.<sup>45</sup> However, other official US sources list the missile as a space-launch vehicle that would need reconfiguration to be used as an ICBM.<sup>46</sup>

### Sea-based missiles

North Korea continues to pursue the development of a solid-fuelled SLBM system as part of an effort to improve the survivability of its nuclear-capable ballistic missile systems. North Korea's first SLBM, the Pukguksong-1 (KN11), was tested with mixed success throughout 2015 and 2016. A 'new type' of SLBM, called the Pukguksong-3 (KN-26), was tested in October 2019.<sup>47</sup> With an estimated maximum range of more than 1000 km—and perhaps as much as 1900 km—the Pukguksong-3 at that time was the longest-range, solid-fuelled missile that North Korea had displayed.<sup>48</sup> However, during the parade in October 2020, North Korea unveiled yet another new type of SLBM—the Pukguksong-4, that might have a longer range.<sup>49</sup> The two-stage, solid-fuelled missile—which is wider than the Pukguksong-1 and possibly a little shorter than the Pukguksong-3—has not yet been flight tested. Its larger diameter indicates that it could hypothetically carry multiple warheads or penetration aids to overcome US ballistic missile defences.

During 2020, there were indications that North Korea had made progress towards achieving its goal of designing, building and eventually deploying an operational ballistic missile submarine. Currently, North Korea has one Gorae-class (Sinpo) experimental submarine in service, which can hold and launch one SLBM. This is likely to be the Pukguksong-1 until it is replaced by the more advanced SLBMs under development. In November 2020 the National Intelligence Service of the Republic of Korea (South Korea) announced that North Korea was building a new ballistic missile

<sup>45</sup> US Department of Defense (note 20), p. 7.

<sup>46</sup> See e.g. US Defense Intelligence Agency (DIA), *Global Nuclear Landscape 2018* (DIA: Washington, DC, 2018), p. 22.

<sup>47</sup> Ji, D., 'Pukguksong-3 SLBM test-launch is "powerful blow" to hostile forces: Rodong Sinmun', NK News, 4 Oct. 2019.

<sup>48</sup> US Air Force (note 17), p. 33; Panda, A., 'North Korea finally unveils the Pukguksong-3 SLBM: First takeaways', *The Diplomat*, 3 Oct. 2019; Lee, J., 'North Korea says it successfully tested new submarine-launched ballistic missile', Reuters, 2 Oct. 2019; and Wright, D., 'North Korea's latest missile test', *All Things Nuclear*, Union of Concerned Scientists, 1 Oct. 2019.

<sup>49</sup> Kuhn, A., 'Kim Jong Un puts new missiles on display at military parade in North Korea', National Public Radio (NPR), 10 Oct. 2020; and Barrie, D. and Dempsey, J., 'What North Korea's latest missile parade tells us, and what it doesn't', *Analysis*, International Institute for Strategic Studies (IISS), 12 Oct. 2020.

submarine.<sup>50</sup> The vessel, designated Sinpo-C by the US DOD, appears to be based on a modified Project-633 (Romeo) diesel–electric submarine and to be fitted with three missile launch canisters.<sup>51</sup> According to a 2019 report by North Korea’s state-run Korean Central News Agency (KCNA), the submarine’s operational deployment was ‘near at hand’.<sup>52</sup>

<sup>50</sup> Bermudez, J. and Cha, V., ‘Sinpo South Shipyard: Construction of a new ballistic missile submarine?’, *Beyond Parallel*, Center for Strategic and International Studies (CSIS), 28 Aug. 2019; and Cha, S., ‘North Korea building two submarines, one capable of firing ballistic missiles—lawmaker’, *Reuters*, 3 Nov. 2020.

<sup>51</sup> Hotham, O., ‘New North Korean submarine capable of carrying three SLBMs: South Korean MND’, *NK News*, 31 July 2019; and Cha (note 50).

<sup>52</sup> ‘NK leader inspects new submarine to be deployed in East Sea: State media’, *Yonhap News Agency*, 23 July 2019.