

## V. Chinese nuclear forces

HANS M. KRISTENSEN AND MATT KORDA

As of January 2022, China maintained an estimated total stockpile of about 350 nuclear warheads. This estimate is higher than the ‘low-200’ warheads reported in the United States Department of Defense (US DOD) 2020 report to the US Congress; however, the DOD’s estimate only referred to ‘operational’ nuclear warheads and therefore presumably excluded warheads assigned to the newer launchers that were in the process of being fielded.<sup>1</sup> As a result, even though SIPRI’s estimate of China’s total inventory is the same as for January 2021, the ratio of stockpiled and other stored warheads has changed because additional and new launchers became operational during 2021. These warheads have been assigned to China’s operational land- and sea-based ballistic missiles and to nuclear-configured aircraft (see table 10.6). Although it is expected to increase significantly in the next decade, China’s nuclear stockpile as at January 2022 remained much smaller than that of either Russia or the USA.

SIPRI’s estimate of 350 warheads relies on publicly available information on the Chinese nuclear arsenal.<sup>2</sup> China itself has never declared the size of its nuclear arsenal. Occasionally, Chinese officials reference open-source estimates as a means of discussing China’s nuclear weapon programme publicly or in diplomatic negotiations.<sup>3</sup> As a result, many of the assessments here rely on data from the US DOD and must therefore be treated with a degree of caution. For example, in 2021 the US DOD estimated that China ‘likely intends to have at least 1000 warheads by 2030’; however, this claim relies on several assumptions about China’s future force posture and plutonium production that have not yet been fully realized.<sup>4</sup>

### **The role of nuclear weapons in Chinese military doctrine**

The Chinese government’s declared aim is to maintain its nuclear capabilities at the minimum level required for safeguarding national security. The goal is ‘deterring other countries from using or threatening to use nuclear

<sup>1</sup> US Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2020*, Annual Report to Congress (Office of the Secretary of Defense: Arlington, VA, 1 Sep. 2020), p. 85.

<sup>2</sup> Kristensen, H. M. and Korda, M., ‘Estimating world nuclear forces: An overview and assessment of sources’, SIPRI Topical Backgrounder, 14 June 2021.

<sup>3</sup> See e.g. Chinese Ministry of National Defense, ‘China reiterates it will not join so-called China–US–Russia arms control negotiations’, 9 July 2020.

<sup>4</sup> US Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2021*, Annual Report to Congress (Office of the Secretary of Defense: Arlington, VA, 3 Nov. 2021), p. 90; and Sokolski, H. D. (ed.), *China’s Civil Nuclear Sector: Plowshares to Swords?*, Nonproliferation Policy Education Center (NPEC), Occasional Paper no. 2102 (NPEC: Arlington, VA, Mar. 2021).

weapons against China'.<sup>5</sup> For decades, China did so with an arsenal of mainly liquid-fuelled land-based ballistic missiles and a few sea-based ballistic missiles, with a small stockpile of gravity bombs available for bombers as a semi-dormant back-up capacity. Since around 2017, China has started to put in place a triad of nuclear forces—solid-fuelled mobile and siloed land-based missiles, nuclear-powered ballistic missile submarines (SSBNs), and bombers with a full, re-established nuclear mission—in order to strengthen its nuclear deterrence and counterstrike capabilities in response to what it sees as a growing threat from other countries.<sup>6</sup>

Despite the continuing growth in the sophistication and size of its nuclear arsenal, there is no official public evidence that the Chinese government has deviated from its long-standing core nuclear policies, including its no-first-use (NFU) policy.<sup>7</sup> Although US officials have publicly and increasingly questioned China's NFU policy in recent years, the US DOD's 2021 report to the US Congress on China's military power acknowledged that 'there has also been no indication that national leaders are willing to publicly attach such additions, nuances, or caveats [to the NFU policy]'.<sup>8</sup>

In April 2021 the commander of US Strategic Command stated before the US Congress that 'increasing evidence suggests China has moved a portion of its nuclear force to a Launch on Warning (LOW) posture and . . . [is] adopting a limited "high alert duty" strategy'.<sup>9</sup> Additionally, in July 2021 an official from the US Department of State noted that 'Since 2017 PLA [the People's Liberation Army] has also conducted exercises involving launch-on-warning, and now has deployed at least one satellite into orbit for its [LOW] posture'.<sup>10</sup>

The Chinese posture has always involved procedures for loading warheads onto launchers in a crisis, but with warheads kept in central storage, separate from their delivery vehicles, during peacetime.<sup>11</sup> The US DOD's 2021 report

<sup>5</sup> Chinese State Council, *China's National Defense in the New Era* (Information Office of the State Council: Beijing, July 2019), chapter 2.

<sup>6</sup> Fabey, M., 'China on faster pace to develop nuclear triad, according to Pentagon, analysts', *Jane's*, 3 May 2019; and 'Chinese military paper urges increase in nuclear deterrence capabilities', *Reuters*, 30 Jan. 2018.

<sup>7</sup> Santoro, D. and Gromoll, R., 'On the value of nuclear dialogue with China', *Pacific Forum, Issues & Insights* (special report), vol. 20, no. 1 (Nov. 2020); and Kulacki, G., 'Would China use nuclear weapons first in a war with the United States?', *The Diplomat*, 27 Apr. 2020.

<sup>8</sup> Zhou, L., 'China should "fine-tune" nuclear weapons policy amid US pressure, ex-diplomat says', *South China Morning Post*, 22 Sep. 2021; and US Department of Defense (note 4), pp. 90–91.

<sup>9</sup> Richard, C. A., Commander, United States Strategic Command, Statement before the US Senate Armed Services Committee, 20 Apr. 2021.

<sup>10</sup> Shashank Joshi (@shashj), '... PRC is building nuclear reactors and [ENR] facilities, while seeking to portray them as having only civilian purposes. Since 2017 PLA has also conducted exercises involving launch-on-warning, and now has deployed at least one satellite into orbit for its [LoW] posture', *Twitter*, 29 July 2021.

<sup>11</sup> Stokes, M. A., *China's Nuclear Warhead Storage and Handling System* (Project 2049 Institute: Arlington, VA, 12 Mar. 2010), p. 8; Li, B., 'China's potential to contribute to multilateral nuclear disarmament', *Arms Control Today*, vol. 41, no. 2 (Mar. 2011); and US Department of Defense (note 4), p. 91.

**Table 10.6.** Chinese nuclear forces, January 2022

All figures are approximate and some are based on assessments by the authors.

Type/Chinese designation (US designation)	No. of launchers	Year first deployed	Range (km) <sup>a</sup>	Warheads x yield <sup>b</sup>	No. of warheads <sup>c</sup>
<i>Aircraft</i>	20 <sup>d</sup>				20
H-6K (B-6)	20	2009	3 100	1 x bomb	20
H-6N (B-6N)	–	2021	..	1 x ALBM	–
H-20 (B-20)	–	[2025]	.. ..	.. ..	–
<i>Land-based missiles<sup>e</sup></i>	398				258
DF-4 (CSS-3)	6 <sup>f</sup>	1980	5 500	1 x 3 300 kt	6
DF-5A (CSS-4 Mod 2)	10	1981	12 000	1 x 4 000–5 000 kt	10
DF-5B (CSS-4 Mod 3)	10	2015	13 000	5 x 200–300 kt	50
DF-5C (CSS-4 Mod 4)	..	[2020s]	13 000	[MIRV]	..
DF-15 (CSS-6)	..	1990	600	1 x .. <sup>g</sup>	..
DF-17 (CSS-22)	36 <sup>h</sup>	2020	>1 800	1 x HGV <sup>i</sup>	..
DF-21A/E (CSS-5 Mod 2/6)	40 <sup>j</sup>	2000/2016	>2 100 <sup>k</sup>	1 x 200–300 kt	40 <sup>l</sup>
DF-26 (CSS-18)	200	2016	4 000	1 x 200–300 kt	20 <sup>m</sup>
DF-31 (CSS-10 Mod 1)	6	2006	7 200	1 x 200–300 kt	6
DF-31A/AG (CSS-10 Mod 2) <sup>n</sup>	72	2007/2018	11 200	1 x 200–300 kt	72
DF-41 (mobile version) (CSS-20)	18 <sup>o</sup>	2020	12 000	3 x 200–300 kt	54
<i>Sea-based missiles (SLBMs)</i>	6/72 <sup>p</sup>				72
JL-2 (CSS-N-14)	72	2016	>7 000	1 x 200–300 kt	72
JL-3 (CSS-N-X-..)	..	[2020s] <sup>q</sup>	>10 000	[MIRV]	..
<b>Total stockpile</b>	<b>490</b>				<b>350<sup>r</sup></b>

.. = not available or not applicable; – = nil or a negligible value; [ ] = uncertain SIPRI estimate; ALBM = air-launched ballistic missile; HGV = hypersonic glide vehicle; kt = kiloton; MIRV = multiple independently targetable re-entry vehicle; SLBM = submarine-launched ballistic missile.

<sup>a</sup> For aircraft, the listed range is for illustrative purposes only; actual mission range will vary according to flight profile, weapon payload and in-flight refuelling.

<sup>b</sup> Warhead yields are listed for illustrative purposes. Actual yields are not known, except that older and less accurate missiles were equipped with megaton-yield warheads. Newer long-range missile warheads probably have yields of a few hundred kilotons, and it is possible that some warheads have even lower yield options.

<sup>c</sup> Figures are based on estimates of one warhead per nuclear-capable launcher, except for the MIRV-capable DF-5B, which can carry up to five warheads, and the MIRV-capable DF-41, which is estimated to carry three warheads. China's warheads are not thought to be deployed on launchers under normal circumstances but kept in storage facilities. All estimates are approximate.

<sup>d</sup> The number of bombers only counts those estimated to be assigned a nuclear role. H-6 bombers were used to deliver nuclear weapons during China's nuclear weapon testing programme (one test used a fighter-bomber) and models of nuclear bombs are exhibited in military museums. It is thought (but not certain) that a small number of H-6 bombers previously had a secondary contingency mission with nuclear bombs. The United States Department of Defense (US DOD) reported in 2018 that the People's Liberation Army Air Force was reassigned a nuclear mission.

<sup>e</sup> China defines missile ranges as short-range, <1000 kilometres; medium-range, 1000–3000 km; long-range, 3000–8000 km; and intercontinental range, >8000 km.

<sup>f</sup>The US DOD's 2021 report to the US Congress still listed the old liquid-fuelled DF-4 as an element of China's fixed intercontinental ballistic missile (ICBM) force, but the DF-4 is generally believed to be in the process of being retired.

<sup>g</sup>The US Central Intelligence Agency concluded in 1993 that China 'almost certainly' had developed a warhead for the DF-15, but it is unclear whether the capability was fielded.

<sup>h</sup>This number is based on the assumption that two DF-17 brigades were operational and up to two more were under preparation as of Jan. 2022.

<sup>i</sup>The DF-17 carries an HGV with an unknown payload. The US DOD's 2021 report to the US Congress noted that the DF-17 is 'primarily a conventional platform' but that it could 'be equipped with nuclear warheads'.

<sup>j</sup>In 2017 the US Air Force's (USAF) National Air and Space Intelligence Center reported that China had 'fewer than 50' Mod 2 launchers. The Mod 6 is thought to be a replacement for the Mod 2.

<sup>k</sup>The range of the nuclear-armed DF-21 variants (CSS-5 Mod 2 and Mod 6) is thought to be greater than the 1750 km reported for the original (CSS-5 Mod 1), which has been retired. The USAF has reported the range as 2150 km.

<sup>l</sup>It is assumed that nuclear launchers do not have any reloads, unlike conventional versions (DF-21C and DF-21D) that are assumed to have one reload.

<sup>m</sup>The DF-26 is a dual-capable launcher. It is thought that its mission is primarily conventional and that only a few launchers are assigned nuclear warheads. Only one nuclear warhead is assumed for each of the DF-26's missiles that have been assigned a nuclear mission, with any reloads assumed to be conventional.

<sup>n</sup>The DF-31AG is thought to carry the same missile as the DF-31A.

<sup>o</sup>This number assumes two brigades were operational as of Jan. 2022. It is possible that the number of launchers is closer to 24.

<sup>p</sup>The first figure is the total number of operational nuclear-powered ballistic missile submarines (SSBNs) in the Chinese fleet; the second is the maximum number of missiles that they can carry. Two additional Jin-class (Type 094) SSBNs joined the fleet in 2021 to give a total of six SSBNs.

<sup>q</sup>US officials have suggested that the JL-3 might have already become operational; however, it is thought that the system is intended to arm the future Type 096 SSBN, which will not be ready for several years.

<sup>r</sup>The US DOD's 2021 report to the US Congress stated that the 'operational' stockpile was in the low 200s and increasing. Since then, the DF-41 and two additional submarines have become operational (see notes o and p). Consequently, SIPRI estimates that the total stockpile is larger and includes approximately 350 warheads.

Sources: US Air Force (USAF), National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, various years; USAF Global Strike Command, various documents; US Central Intelligence Agency, various documents; US Defense Intelligence Agency, various documents; US Department of Defense, *Military and Security Developments Involving the People's Republic of China*, Annual Report to Congress, various years; Kristensen, H. M., Norris, R. S. and McKinzie, M. G., *Chinese Nuclear Forces and US Nuclear War Planning* (Federation of American Scientists/Natural Resources Defense Council: Washington, DC, Nov. 2006); *Bulletin of the Atomic Scientists*, 'Nuclear notebook', various issues; Google Earth satellite imagery; and authors' estimates.

reaffirmed that China 'almost certainly keeps the majority of its nuclear force on a peacetime status—with separated launchers, missiles, and warheads'.<sup>12</sup> A transition to a LOW posture, where space-based sensors could detect an incoming attack before impact, does not necessarily require China to keep

<sup>12</sup> US Department of Defense (note 4), pp. 90–91.

warheads on delivery vehicles under normal circumstances, and doing so would constitute a significant change to the country's long-held nuclear custodial practices. But missile brigades need training to be ready to load the warheads. The US DOD's 2021 report stated that the PLA Rocket Force (PLARF) brigades conduct 'combat readiness duty' and 'high alert duty' drills, which 'apparently includes assigning a missile battalion to be ready to launch and rotating to standby positions as much as monthly for unspecified periods of time'.<sup>13</sup>

### **Aircraft and air-delivered weapons**

Chinese medium-range bombers have long had a capability of delivering nuclear weapons and were used to conduct more than 12 atmospheric nuclear tests in the 1960s and 1970s. Until 2018, the capability was not fully operational and was probably a back-up contingency mission. As a result, until 2018, SIPRI continued to assess that China maintained a small inventory of gravity bombs for secondary contingency use by Hong-6, or H-6 (B-6) bombers.<sup>14</sup>

In 2018, however, the US DOD reported that the PLA Air Force (PLAAF) was 'newly re-assigned a nuclear mission'.<sup>15</sup> In its 2021 report, the US DOD concluded that China in 2019 had 'signaled the return of the airborne leg of its nuclear triad after the PLAAF publicly revealed the H-6N (B-6N) as its first nuclear-capable air-to-air refuelable bomber', and noted that as of 2020, the H-6N had been operationally fielded.<sup>16</sup> Legacy H-6 bombers did not include an air-to-air refuelling probe, which significantly limited their long-range targeting capability.

Since at least 2015, China has been developing two new air-launched ballistic missiles (ALBMs), one of which is assessed by the USA to be potentially nuclear-capable.<sup>17</sup> This missile, which can be carried by the H-6N bomber and is designated as CH-AS-X-13 by the USA, may be a variant of the Dong Feng-21, or DF-21 (CSS-5), medium-range ballistic missile (MRBM), or

<sup>13</sup> US Department of Defense (note 4), pp. 90–91.

<sup>14</sup> For the aircraft, missiles and submarines discussed here, a designation in parentheses (in this case B-6) following the Chinese designation (in this case H-6) is that assigned by the USA.

<sup>15</sup> US Department of Defense, *Military and Security Developments Involving the People's Republic of China 2018*, Annual Report to Congress (Office of the Secretary of Defense: Arlington, VA, 16 May 2018), p. 75.

<sup>16</sup> US Department of Defense (note 4), pp. 55–56.

<sup>17</sup> US Department of Defense (note 4), pp. 55–56; Ashley, R., Director, US Defense Intelligence Agency, 'Worldwide threat assessment', Statement for the record, US Senate Armed Services Committee, 6 Mar. 2018, p. 8; 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), p. 37; and Stewart, V. R., Director, US Defense Intelligence Agency, 'Worldwide threat assessment', Statement for the record, US Senate Armed Services Committee, 9 Feb. 2016.

possibly the DF-15.<sup>18</sup> The first base to be equipped with this capability might be Neixiang, Henan province, where an H-6N bomber was observed flying with the possible new ALBM in October 2020.<sup>19</sup> In its 2021 report, the US DOD stated that ‘The PRC has possibly already established a nascent “nuclear triad” with the development of a nuclear-capable air-launched ballistic missile . . . and improvement of its ground and sea-based nuclear capabilities’, potentially indicating that it assessed the ALBM to be operational.<sup>20</sup> Even so, the ‘viability’ of the triad would depend on the survivability and capability of each leg.

In addition to the intermediate-range H-6 bomber, the PLAAF has been developing its first long-range strategic bomber, known as the H-20 (B-20), with an anticipated range of at least 8500 kilometres and a stealthy design.<sup>21</sup> The aircraft might be in production within 10 years, according to the US DOD.<sup>22</sup> The US DOD has also suggested that the H-20 will be dual-capable—that is, able to deliver both conventional and nuclear weapons.<sup>23</sup>

### Land-based missiles

China’s nuclear-capable land-based ballistic missile arsenal has been undergoing significant modernization as China replaces its ageing silo-based, liquid-fuelled missiles with large numbers of new mobile and silo-based, solid-fuelled models.

#### *Intercontinental ballistic missiles*

In 2021 commercial satellite imagery revealed that China had started construction of what appeared to be more than 300 new missile silos across at least three distinct fields in northern China.<sup>24</sup> On several separate occasions, different elements of the US government appeared to validate the open-

<sup>18</sup> Wright, T., ‘Chinese PLAAF H-6N pictured carrying large missile’, International Institute for Strategic Studies, 23 Oct. 2020; and Panda, A., ‘Revealed: China’s nuclear-capable air-launched ballistic missile’, The Diplomat, 10 Apr. 2018.

<sup>19</sup> Lee, R., ‘China’s Air Force might be back in the nuclear business’, The Diplomat, 9 Sep. 2020; and Rod Lee (@roderick\_s\_lee), ‘The video footage of an H-6N with a possible air-launched ballistic missile appears to be taken at this location just outside Neixiang Afd. This corroborates my theory that the 106th bde operates H-6N’s and, per the CMPR suggesting nuclear-capable ALBMs, is a nuclear unit’, Twitter, 17 Oct. 2020.

<sup>20</sup> US Department of Defense (note 4), p. 90.

<sup>21</sup> US Department of Defense (note 4), p. 85.

<sup>22</sup> US Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, *Nuclear Matters Handbook 2020* (US Department of Defense: Arlington, VA, Mar. 2020), figure 1.1, p. 3.

<sup>23</sup> US Department of Defense (note 4), p. 85.

<sup>24</sup> Lewis, J. and Eveleth, D., ‘Chinese ICBM silos’, Arms Control Wonk, 2 July 2021; Korda, M. and Kristensen, H. M., ‘China is building a second nuclear missile silo field’, FAS Strategic Security Blog, Federation of American Scientists, 26 July 2021; and Lee, R., ‘PLA likely begins construction of an intercontinental ballistic missile silo site near Hanggin Banner’, China Aerospace Studies Institute, 12 Aug. 2021.

source assessment that the construction sites were associated with China's missile programme.<sup>25</sup> If China eventually fills each suspected silo site with a single-warhead missile, the number of warheads attributed to China's intercontinental ballistic missile (ICBM) force, estimated at January 2022 as around 190 warheads, could more than double to approximately 450 warheads. If each suspected silo were filled with a missile equipped with three multiple independently targetable re-entry vehicles (MIRVs), this number could rise to approximately 1000 warheads. However, as of January 2022 it was unclear how China plans to operate the new silos, whether they will all be filled, how many warheads each missile would carry, and whether a portion of them could potentially have conventional strike roles.<sup>26</sup>

Notably, China's new silo fields are located deeper inside China than any other known ICBM base and are beyond the reach of US conventional cruise missiles. This, combined with the large number of silos, could suggest that one of the main drivers of the construction effort is to reduce the vulnerability of China's nuclear arsenal from long-range conventional strikes.

In its 2021 report to the US Congress, the US DOD estimated that China's operational arsenal included 100 ICBMs, and that the number of warheads on Chinese ICBMs capable of reaching the USA was expected to grow to 200 by 2025.<sup>27</sup> Additionally, the report noted that China appeared to be doubling the number of launchers in some ICBM brigades, although this could be the result of redistributing existing launchers.<sup>28</sup>

The silo-based, liquid-fuelled, two-stage DF-5 (CSS-4) family of missiles—which first entered into service in the early 1980s—were believed to be China's longest-range ICBMs as at the end of 2021. Along with the road-mobile, solid-fuelled, three-stage DF-31A/AG (CSS-10 Mod 2) ICBM and the new solid-fuelled, three-stage DF-41 (CSS-20) ICBM, DF-5s are capable of targeting all of continental USA and Europe.

China is believed to have deployed at least two mobile DF-41 brigades—totalling around 18 launchers—and appeared to be preparing for the

<sup>25</sup> US Strategic Command (@US-Stratcom), 'This is the second time in two months the public has discovered what we have been saying all along about the growing threat the world faces and the veil of secrecy that surrounds it', Twitter, 27 July 2021; Shashank Joshi (@shashj), 'State Dept. told me: "This build-up is deeply concerning, raises questions about the PRC's intent, and reinforces the importance of pursuing practical measures to reduce nuclear risks"', Twitter, 29 July 2021; and US Department of Defense (note 4), pp. 60–62.

<sup>26</sup> Roderick Lee of the United States Air Force's China Aerospace Studies Institute—who disclosed the third Chinese silo complex at Hanggin Banner in Aug. 2021—suggests that circumstantial evidence could indicate that China might consider using some of its new ICBM silos in a conventional strike role. Lee, R., 'A case for China's pursuit of conventionally armed ICBMs', *The Diplomat*, 17 Nov. 2021.

<sup>27</sup> US Department of Defense (note 4), pp. 60–62.

<sup>28</sup> US Department of Defense (note 4), p. 61; and Decker Eveleth (@dex\_eve), 'Ok, this is a bit of an overstatement: TEL garages have doubled at 644, the DF-41 OT&E brigade, possibly indicating ~24 launchers. At other new ICBM units, number of garages has actually gone down, from 12 to 8. Possible the PLARF is redistributing existing DF-31AG launchers', Twitter, 3 Nov. 2021.

integration of additional DF-41 brigades.<sup>29</sup> The US DOD assessed in 2020 and 2021 that China might ultimately plan to deploy the DF-41 in both mobile and silo-based modes, in some or all of China's new missile silo fields, and potentially in a rail-based mode as well.<sup>30</sup> However, the new silo fields were still only in the early stages of construction in late 2021.<sup>31</sup>

The US DOD's 2021 report states that China has also begun developing a new missile called the DF-27, which could have a range of 5000–8000 km.<sup>32</sup> However, public information about this new missile is scarce and rife with unsubstantiated rumours.

After many years of research and development, China has modified a small number of ICBMs to deliver nuclear MIRVs, apparently to improve the penetration capabilities of its warheads in response to advances in US and, to a lesser extent, Russian and future Indian missile defences. The DF-5B (CSS-4 Mod 3) is a MIRV-capable variant of the DF-5 that can carry up to five warheads, two more than previously assumed.<sup>33</sup> A second variant under development, the DF-5C (CSS-4 Mod 4), can reportedly also deliver multiple warheads. Some US media reports have suggested that it might be capable of carrying up to 10 warheads, but it seems more likely that it will carry a number similar to that of the DF-5B version.<sup>34</sup> There has been speculation that the DF-41 is able to carry 6–10 warheads, but there is significant uncertainty about the actual capability, and it is likely to carry fewer than its maximum capacity in order to maximize range. SIPRI cautiously estimates that the DF-41 carried 3 warheads as at January 2022.

China reportedly conducted two tests of what appeared to be a hypersonic boost-glide system in July and August 2021.<sup>35</sup> According to the US Office of the Director of National Intelligence, at least one test 'flew completely around the world', indicating that the test might have been of an orbital bombardment system.<sup>36</sup> Additionally, the US DOD noted that at least one test fired a missile mid-flight over the South China Sea.<sup>37</sup> Other credible details

<sup>29</sup> US Department of Defense (note 4), p. 62; and Rod Lee (@roderick\_s\_lee), 'More evidence that 651 Bde has DF-41s: An officer assigned to 651 Bde inspecting a probable 41 TEL in garrison. Known 651 Bde personalities state that in the past few years, the brigade has been swapping out for a new missile that was featured in the 2019 parade', Twitter, 28 Dec. 2021.

<sup>30</sup> US Department of Defense (note 4), p. 62; and US Department of Defense (note 1), p. 56.

<sup>31</sup> Gertz, B., 'Exclusive: China building third missile field for hundreds of new ICBMs', *Washington Times*, 12 Aug. 2021.

<sup>32</sup> US Department of Defense (note 4), p. 62.

<sup>33</sup> US Department of Defense (note 4), p. 61; and Lewis, J. G., 'China's belated embrace of MIRVs', eds M. Krepon, T. Wheeler and S. Mason, *The Lure and Pitfalls of MIRVs: From the First to the Second Nuclear Age* (Stimson Center: Washington, DC, May 2016), pp. 95–99.

<sup>34</sup> Gertz, B., 'China tests missile with 10 warheads', *Washington Free Beacon*, 31 Jan. 2017.

<sup>35</sup> Sevastopulo, D., 'China conducted two hypersonic weapons tests this summer', *Financial Times*, 20 Oct. 2021. See also chapter 13, section VI, in this volume.

<sup>36</sup> US Office of the Director of National Intelligence (ODNI), *Annual Threat Assessment of the US Intelligence Community* (ODNI: McLean, VA, 7 Feb. 2022), p. 7.

<sup>37</sup> Sevastopulo (note 35).



about this new system are scarce; however, if the initial reporting is accurate, then the system may be intended to counter advances in US missile defences.

*Intermediate- and medium-range ballistic missiles*

In 2016 the PLARF began the deployment of the dual-capable DF-26 (CSS-18) intermediate-range ballistic missile (IRBM). This missile has an estimated maximum range exceeding 4000 km and can therefore reach targets in India, the South China Sea, and the western Pacific Ocean, including the US strategic base on Guam.<sup>38</sup> The missile is equipped with a manoeuvrable re-entry vehicle (MaRV) that can be swapped with another warhead at a rapid pace, thus theoretically allowing the PLARF to switch the missile's mission between precision conventional strikes and nuclear strikes against ground targets—and even conventional strikes against naval targets—at the last minute.<sup>39</sup> The majority of the DF-26s are thought to serve a conventional mission with a smaller number assigned a nuclear role. In its 2021 report, the US DOD noted that: 'The DF-26 is the PRC's first nuclear-capable missile system that can conduct precision strikes, and therefore, is the most likely weapon system to field a lower-yield warhead in the near-term.'<sup>40</sup> It remains unclear, however, whether low-yield options have been produced for China's nuclear forces.

China appears to be producing the DF-26 in significant numbers, and in 2021 the US DOD estimated that China might have up to 200 launchers and 300 missiles in its inventory, although SIPRI estimates that only a small number of those have a nuclear role.<sup>41</sup> The launcher number might also be on the higher end of an estimated range and could also include launchers in production as of January 2022. There were sightings of the missile at several PLARF brigade bases during 2021, and PLARF brigades conducted several exercises that featured multiple waves of missile strikes, reloads and relocations.<sup>42</sup>

The US DOD's 2021 report indicated a sizable increase in China's MRBM force, from 150 launchers and 150-plus missiles in 2020 to 250 launchers and 600 missiles in 2021.<sup>43</sup> Most of these are conventional versions, and the numbers are probably on the higher end of an estimated range and could also include launchers and missiles in production. SIPRI estimates that, as of January 2022, around 40 of the PLARF's MRBMs were nuclear

<sup>38</sup> US Department of Defense (note 4), p. 61.

<sup>39</sup> Pollack, J. H. and LaFoy, S., 'China's DF-26: A hot-swappable missile?', Arms Control Wonk, 17 May 2020; Deng, X., 'China deploys Dongfeng-26 ballistic missile with PLA Rocket Force', *Global Times*, 26 Apr. 2018; and US Department of Defense (note 4), p. 61.

<sup>40</sup> US Department of Defense (note 4), p. 93.

<sup>41</sup> US Department of Defense (note 4), p. 163.

<sup>42</sup> Liu, X., 'PLA Rocket Force practices night DF-26 missile launch', *South China Morning Post*, 9 June 2021.

<sup>43</sup> US Department of Defense (note 4), p. 163; and US Department of Defense (note 1), p. 166.

DF-21s (CSS-5). The DF-21 is a two-stage, solid-fuelled mobile missile. The original DF-21 (CSS-5 Mod 1), which was first deployed in 1991, has been retired. An upgraded variant, the DF-21A (CSS-5 Mod 2), was first deployed in 1996 and an enhanced version, possibly known as the DF-21E (CSS-5 Mod 6), was fielded in 2017.<sup>44</sup> Two other versions of the DF-21 (DF-21C and DF-21D) are armed with conventional warheads.

The PLARF has also begun fielding the new DF-17 (CSS-22) MRBM equipped with a hypersonic glide vehicle (HGV).<sup>45</sup> The US DOD's 2021 report noted that the DF-17 is 'primarily a conventional platform', but that it could 'be equipped with nuclear warheads'.<sup>46</sup> As of January 2022, the DF-17 was operational in at least two brigades, with integration under way in several additional brigades.<sup>47</sup>

### Sea-based missiles

In 2021 China continued to pursue its long-standing strategic goal from the early 1980s of developing and deploying a sea-based nuclear deterrent. According to the US DOD's 2021 report, the PLA Navy (PLAN) has constructed six Type 094 SSBNs.<sup>48</sup> The two newest boats—Type 094A, believed to be variants of the original design—were handed over to the PLAN in April 2020 and one of them formally entered service in April 2021.<sup>49</sup> The US DOD's 2021 report assessed that these six operational Type 094 SSBNs constitute China's 'first credible, sea-based nuclear deterrent'.<sup>50</sup>

China's four original Type 094 submarines can each carry up to 12 three-stage, solid-fuelled Julang-2, or JL-2 (CSS-N-14), submarine-launched ballistic missiles (SLBMs). The JL-2 is a sea-based variant of the DF-31 ICBM. It has an estimated maximum range in excess of 7000 km and is believed to carry a single nuclear warhead.<sup>51</sup>

There has been considerable speculation about whether the missiles on China's SSBNs are mated with warheads under normal circumstances; there appear to be no credible public reports that China has commenced

<sup>44</sup> O'Halloran, J. C. (ed.), *IHS Jane's Weapons: Strategic, 2015-16* (IHS Jane's: Coulsdon, 2015), pp. 21-22; and US Department of Defense (note 4), p. 93.

<sup>45</sup> US Department of Defense (note 4), p. 61.

<sup>46</sup> US Department of Defense (note 4), p. 61.

<sup>47</sup> Rod Lee (@roderick\_s\_lee), 'The PLA appears to be fielding the (likely hypersonic) DF-17 at an operational unit, suggesting the DF-17 has achieved at least initial operational capability. PRC television footage from 29 December shows a probable DF-17 TEL at the PLARF's 627 Brigade in Jieyang', Twitter, 30 Dec. 2020; Chan, M., 'Chinese military beefs up coastal forces as it prepares for possible invasion of Taiwan', *South China Morning Post*, 18 Oct. 2020; and authors' estimates.

<sup>48</sup> US Department of Defense (note 4), p. 49.

<sup>49</sup> Chan, M., 'China's new nuclear submarine missiles expand range in US: Analysts', *South China Morning Post*, 2 May 2021.

<sup>50</sup> US Department of Defense (note 4), p. 49.

<sup>51</sup> US Air Force (note 17), p. 33.

nuclear-armed patrols. The routine deployment of nuclear weapons on China's SSBNs would constitute a significant change to the country's long-held practice of keeping nuclear warheads in central storage in peacetime and would pose operational challenges for its nuclear command-and-control arrangements. During a war, geographic choke points and advanced US anti-submarine warfare capabilities could force China to deploy its nuclear submarines in a protective bastion within the South China Sea, rather than sail them past Japan and out into the Pacific Ocean. These constraints significantly limit Chinese SSBNs from targeting continental USA.

The US DOD's 2021 report indicates that the PLAN has begun construction of its next-generation SSBN, Type 096, and a potential hull section was visible in commercial satellite imagery from February 2021.<sup>52</sup> Reports vary widely on the design parameters, but the new submarine is expected to be larger and quieter than the Type 094 and could possibly be equipped with more missile launch tubes. Given the expected lifespans of the current Type 094 and the next-generation Type 096 SSBNs, the PLAN is expected to operate both types concurrently. In 2021 the US DOD assessed that China could have up to eight SSBNs by 2030.<sup>53</sup>

The Type 096 SSBN will be armed with a successor to the JL-2: the JL-3 SLBM, which is thought to use technologies from the land-based DF-41 ICBM and have a longer range than the JL-2. The US Air Force's National Air and Space Intelligence Center has assessed that the JL-3 will be capable of carrying multiple warheads and have a range of more than 10 000 km.<sup>54</sup> According to the US DOD, the JL-3's longer range could enable the PLAN to deploy its SSBNs in bastions in the South China Sea and the Bohai Gulf, to enhance their survivability.<sup>55</sup>

<sup>52</sup> US Department of Defense (note 4), p. 49; and Sutton, H. I., 'First image of China's new nuclear submarine under construction', *Naval News*, 1 Feb. 2021.

<sup>53</sup> US Department of Defense (note 4), p. 49.

<sup>54</sup> US Air Force (note 17), p. 37.

<sup>55</sup> US Department of Defense (note 4), p. 91.