

III. British nuclear forces

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As of January 2024 the United Kingdom's nuclear weapon stockpile consisted of approximately 225 warheads (see table 7.4, end of section)—an unchanged estimate from the previous year. SIPRI assesses that around 120 of these are operationally available for delivery by Trident II D5 submarine-launched ballistic missiles (SLBMs), with about 40 being carried on a nuclear-powered ballistic missile submarine (SSBN) that is on patrol at all times. The UK is expected to increase the number of warheads it possesses in the coming years.

These estimates are based on open-source information on the British nuclear arsenal and conversations with British officials. The UK has generally been more transparent about its nuclear activities than many other nuclear-armed states. However, it has never declassified the history of its stockpile or the actual number of warheads it possesses, and in 2021 it declared that it will no longer publicly disclose figures for the country's operational stockpile, deployed warheads or deployed missiles.¹

This section briefly outlines the role played by nuclear weapons in the UK's military doctrine and then describes its sea-based missiles and its nuclear weapon modernization programme.

The role of nuclear weapons in British military doctrine

In 2023 the British government published a 'refresh' of its Integrated Review of Security, Defence, Development and Foreign Policy that it had previously published in 2021. The document included much of the same nuclear-related language as its predecessor, noting that the UK's negative security assurance 'remains unchanged', and that the UK 'would consider using . . . nuclear weapons only in extreme circumstances of self-defence, including the defence of [North Atlantic Treaty Organization (NATO)] Allies'.² Despite this language, the UK has also stated that it remains 'deliberately ambiguous about precisely when, how and at what scale [it] would contemplate the

¹ British Government, *Global Britain in a Competitive Age: The Integrated Review of Security, Defence, Development and Foreign Policy*, CP 403 (Her Majesty's Stationery Office: London, Mar. 2021), pp. 76–77. On the challenges of collecting information on world nuclear forces more generally see Kristensen, H. M. and Korda, M., 'Estimating world nuclear forces: An overview and assessment of sources', SIPRI Commentary, 14 June 2021.

² British Government, CP 403 (note 1), p. 76; and British Government, *Integrated Review Refresh 2023: Responding to a More Contested and Volatile World*, CP 811 (His Majesty's Stationery Office: London, Mar. 2023), p. 33.

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use of nuclear weapons'.³ A promised Defence Nuclear Strategy to further flesh out a recapitalization strategy for the UK's 'defence nuclear enterprise', which is 'collectively responsible for the development, build, maintenance and . . . delivery' of the UK's nuclear deterrent, had not been published by the end of 2023.⁴

Like the United States, the UK operates its submarines with detargeted missiles, although it would take only moments to load the targeting coordinates. Unlike US SSBNs, which can launch in minutes, the UK says that its submarines 'are at several days' notice to fire'.⁵

Sea-based missiles

The UK is the only nuclear-armed state that operates a single type of nuclear weapon: the country's nuclear deterrent is entirely sea-based. The UK possesses four Vanguard-class SSBNs, based at Faslane on the west coast of Scotland, each of which can carry up to 16 Trident II D5 submarine-launched ballistic missiles. In a posture known as continuous at-sea deterrence (CASD), which began in 1969, one British SSBN carrying approximately 40 warheads is on patrol at all times.⁶ The second and third SSBNs remain in port but could be put to sea in a crisis. The fourth is in overhaul at any given time and is unable to deploy.

In the 2021 Integrated Review of Security, Defence, Development and Foreign Policy, the British government announced a significant increase to the upper limit of its nuclear weapon stockpile, to a maximum of 260 warheads.⁷ Previously, the goal had been to reach 180 warheads by the mid 2020s, as described in the UK's strategic defence and security reviews (SDSRs) of 2010 and 2015.⁸ British officials clarified in 2021 that the target of 180 warheads stated in the SDSRs 'was indeed a goal, but it was never reached'.⁹ Instead, in its statement submitted to the 10th Review Conference of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons, held in 2022, the British

³ 10th NPT Review Conference, National report of the United Kingdom, NPT/CONF.2020/33, 5 Nov. 2021, para. 13.

⁴ British Government, CP 811 (note 2), p. 34.

⁵ British Ministry of Defence, 'The UK's nuclear deterrent: What you need to know', 17 Feb. 2022.

⁶ British Ministry of Defence, 'UK's nuclear deterrent (CASD)', 17 Mar. 2021.

⁷ British Government, CP 403 (note 1), p. 76. For further detail see Kristensen, H. M. and Korda, M., 'British nuclear forces', *SIPRI Yearbook 2022*, pp. 371–72.

⁸ British Government, *Securing Britain in an Age of Uncertainty: The Strategic Defence and Security Review*, Cm 7948 (Her Majesty's Stationery Office: London, Oct. 2010), p. 38; and British Government, *National Security Strategy and Strategic Defence and Security Review 2015: A Secure and Prosperous United Kingdom*, Cm 9161 (Her Majesty's Stationery Office: London, 2015), p. 34. See also Kristensen, H. M. and Korda, M., 'United Kingdom nuclear weapons, 2021', *Nuclear notebook, Bulletin of the Atomic Scientists*, vol. 77, no. 3 (May 2021).

⁹ Aidan Liddle (@AidanLiddle) Twitter, 16 Mar. 2021, <<https://twitter.com/aidanliddle/status/1371912132141445120>>. This information was also later confirmed by other officials. British officials, Interviews with the authors, May 2021.

government stated that the new and higher number of 260 warheads ‘is a ceiling, not a target, and it is not our current stockpile number’.¹⁰ While it is expected that the British nuclear stockpile will eventually increase in size, SIPRI assesses that there had been no change in the stockpile number as of January 2024.

Replacement of the submarines

The UK’s four Vanguard-class SSBNs entered service between December 1994 and February 2001, each with an expected service life of 25 years.¹¹ The 2015 SDSR stated the government’s intention to replace the Vanguard-class submarines with four new SSBNs, known as the Dreadnought class.¹² Construction of the third submarine, HMS *Warspite*, began in February 2023.¹³

The new submarines were originally expected to begin entering service by 2028, but this has been delayed until the early 2030s at the earliest. Reports from 2023 suggest that the production of key components, including the reactor cores, is several years behind schedule and significantly over-budget.¹⁴ The service life of the Vanguard-class SSBNs has been commensurately extended to an overall lifespan of about 37–38 years.¹⁵ The work to upgrade the ageing SSBNs has also been subject to significant delays and budget overruns. For example, the UK’s lead SSBN, HMS *Vanguard*, completed its refit in May 2023 and remained in sea trials at the end of the year.¹⁶ The cost of the *Vanguard* upgrade rose from an initial projection of about £200 million (US\$307 million) in 2015 to more than £500 million (\$688 million) in 2021, and the refit took 89 months, which was 6 months longer than it took to build the submarine.¹⁷ The next SSBN to begin a planned refit—HMS *Victorious*—arrived in port in June 2023.¹⁸

The delay in the *Vanguard* upgrade meant that the UK’s three other SSBNs had to extend their deterrence patrols. The length of time at sea for British nuclear submarines has reportedly increased from about 60–70 days in the

¹⁰ 10th NPT Review Conference, NPT/CONF.2020/33 (note 3), para. 22.

¹¹ Mills, C., *Replacing the UK’s Strategic Nuclear Deterrent: Progress of the Dreadnought Class*, Research Briefing no. 8010 (House of Commons Library: London, 3 May 2023), p. 10.

¹² British government, Cm 9161 (note 8), para. 4.73.

¹³ Mills (note 11), p. 5.

¹⁴ UK National Audit Office (NAO), *The Equipment Plan 2023-2033: Ministry of Defence* (NAO: London, 4 Dec. 2023), pp. 8, 17, 38; and Nuclear Information Service, ‘Increasing risk of problems in Derby delaying Dreadnought schedule’, 7 Aug. 2023.

¹⁵ Mills (note 11), p. 10.

¹⁶ Nuclear Information Service, ‘HMS Vanguard leaves Devonport after 7 years of maintenance’, 7 July 2023.

¹⁷ British Ministry of Defence, ‘British jobs secured through upgrade to nuclear deterrent’, 4 Dec. 2015; and ‘HMS Vanguard finally sails from Devonport after more than 7 years’, Navy Lookout, 10 May 2023.

¹⁸ Royal Navy, ‘HMS Victorious arrives in Plymouth for major refit in boost to 1,000 local jobs’, 26 June 2023.

1970s to 150–200 days in recent years; in September 2023 one of the UK's SSBNs reportedly returned from a 195-day patrol.¹⁹ These extended patrols were potentially factors contributing to several operating errors, accidents and personnel issues that have dogged the UK's nuclear forces in recent years.²⁰ In the latest incident in November 2023, a faulty depth gauge reportedly misled the SSBN's crew into thinking that the submarine was level when it was still diving, nearly triggering a catastrophic accident.²¹

The missiles and warhead

Given that the UK draws its SLBMs from a common pool shared with the USA, the UK is benefiting from the US Navy's programme to extend the service life of the Trident II D5 missile. The first and second life-extended versions are known as the D5LE and the D5LE2, respectively; the D5LE will function until the early 2060s and the D5LE2 until the mid 2080s (see section I of this chapter).²²

The warhead carried on the Trident II D5 is called the Holbrook, which is produced by the UK but thought to be based closely on the USA's W76 warhead design. It is being incorporated into the more effective USA-produced Mk4A re-entry body (aeroshell).²³ It is possible that sufficient Mk4A-upgraded warheads had been produced by the end of 2021 to arm the UK's Vanguard-class SSBNs; however, the full upgrade has not yet been completed.²⁴

In 2020 the British government announced its intention to replace the Holbrook with a new warhead that will use the Mk7 aeroshell being developed for the USA's new W93 warhead (see section I).²⁵ According to the British Ministry of Defence (MOD), the replacement warhead is 'not exactly

¹⁹ Sabbagh, D. and Edwards, R., 'Safety fears as UK Trident submarines are put to sea for longest-ever patrols', *The Guardian*, 6 Dec. 2022; and 'Royal Navy nuclear deterrent submarines conducting increasingly long patrols', *Navy Lookout*, 22 Sep. 2023.

²⁰ For further detail see Kristensen, H. M. and Korda, M., 'British nuclear forces', *SIPRI Yearbook 2023*, p. 277.

²¹ Starkey, J., 'Deep trouble: Major malfunction on Royal Navy nuclear submarine plunges warship into "danger zone" almost crushing 140 crew to death', *The Sun*, 19 Nov. 2023; and Beale, J., 'Nuclear-armed submarine suffered malfunction', BBC, 20 Nov. 2023.

²² Mills (note 11), p. 11.

²³ For detail on how the upgrade improves the weapon's capability see Cullen, D., *Extreme Circumstances: The UK's New Nuclear Warhead in Context* (Nuclear Information Service: Reading, Aug. 2022).

²⁴ NukewatchUK, 'Warhead convoy movements summary 2021', 2021; and British Ministry of Defence, 'The United Kingdom's future nuclear deterrent: 2022 update to Parliament', 8 Mar. 2023.

²⁵ Wallace, B., British Secretary of State for Defence, 'Nuclear deterrent', Written statement HCWS125, British House of Commons, 25 Feb. 2020; and Wolfe, J., Director of US Strategic Systems Programs, 'FY2022 budget request for nuclear forces and atomic energy defense activities', Statement before the US Senate, Armed Forces Committee, Subcommittee on Strategic Forces, 12 May 2021, pp. 6–7. For further detail see Kristensen, H. M. and Korda, M., 'British nuclear forces', *SIPRI Yearbook 2021*, pp. 360–61.

the same warhead [as the W93] but . . . there is a very close connection, in design terms and production terms'.²⁶

Although the future of the W93 programme is being debated in the USA, British officials stated in 2021 that the UK's warhead-replacement programme would move forward regardless of the status of the USA's W93 programme.²⁷ In both the UK and the USA, the decision to introduce new warheads is thought to stem from strong internal political pressure to enhance nuclear infrastructure and capabilities.²⁸ In 2022 the warhead-replacement programme entered into the 'concept' stage of development—the first of six MOD acquisition stages.²⁹

The UK has not issued an official cost estimate or timeline for its programme, but it is likely that the new warhead will come into service sometime in the late 2030s or early 2040s.³⁰

²⁶ Lovegrove, S., Permanent Secretary, Ministry of Defence, Statement, British House of Commons, Defence Committee, Oral evidence: MOD annual report and accounts 2019–20, HC 1051, 8 Dec. 2020, Q31.

²⁷ Mehta, A., 'UK official: American warhead decision won't impact British nuclear plans', *Defense News*, 13 Apr. 2021.

²⁸ Cullen (note 23), p. 6.

²⁹ British Ministry of Defence (note 24).

³⁰ Cullen (note 23), p. 4.

Table 74. British nuclear forces, January 2024

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

Type/designation	No. of launchers	Year first deployed	Range (km)	Warheads x yield	No. of warheads
<i>Sea-based missiles (SLBMs)</i>	4/64 ^a				120
Trident II D5	48 ^b	1994	>10 000 ^c	1–8 x 100 kt ^d	120
Total operationally available warheads					120^e
<i>Other stored warheads</i>					105 ^f
Total stockpile					225^g

kt = kiloton; SLBM = submarine-launched ballistic missile.

^a The first figure is the total number of nuclear-powered ballistic missile submarines (SSBNs) in the British fleet; the second is the maximum number of missiles that they can carry. However, the total number of missiles carried is lower (see note b). Of the 4 SSBNs, 1 is in overhaul at any given time.

^b The 3 operational SSBNs can carry a total of 48 Trident SLBMs. The United Kingdom has purchased the right to 58 missiles from a pool shared with the United States Navy.

^c The Trident II D5 missiles on British SSBNs are identical to the Trident II D5 missiles on US Navy SSBNs, which have demonstrated a range of more than 10 000 kilometres in test flights.

^d The British warhead is called the Holbrook, a modified version of the USA's W76 warhead, with a potential lower-yield option.

^e Of the 120 operationally available warheads, c. 40 are deployed on the single SSBN that is at sea at any given time, with the remaining warheads assigned to the 2 other deployable SSBNs.

^f This figure includes retired warheads that have not yet been dismantled. It seems likely that they will be reconstituted to become part of the UK's total stockpile over the coming years (see note g). Many of the stored warheads that have not been retired are thought to be undergoing upgrade from the Mk4 re-entry body to the Mk4A.

^g The British government declared in 2010 that its inventory would not exceed 225 warheads, and that the UK would reduce the number of warheads in its overall nuclear stockpile to no more than 180. Despite these stated intentions, the UK's nuclear stockpile appears to have remained at c. 225 warheads. The UK's Integrated Review of Security, Defence, Development and Foreign Policy, published in 2021, introduced a new ceiling of 260 warheads.

Sources: British Ministry of Defence, white papers, press releases and website; British House of Commons, *Hansard*, various issues; *Bulletin of the Atomic Scientists*, 'Nuclear notebook', various issues; and authors' estimates.