OPEN NUCLEAR NETWORK
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SEPTEMBER 2026

DPRK Comparison to Historical and Current Nuclear Programmes

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ACKNOWLEDGEMENTS

The authors would like to thank Andreas Persbo for his project conception and counsel, and the additional ONN staff members who have supported this work, including Elin Bergner and Jaewoo Shin. The authors also thank M.N. Fisher for lending invaluable copy-editing abilities, further ensuring the clarity of this document.

This work was funded as part of a joint project between VERTIC, the James Martin Center for Nonproliferation Studies (CNS) and the Royal United Services Institute (RUSI), which was funded by Global Affairs Canada.

The authors gratefully acknowledge the support of PAX *sapiens*.

Executive Summary

This report presents a systematic comparative analysis of the nuclear weapons programme of the Democratic People's Republic of Korea (DPRK) against those of nine historical and contemporary known or alleged nuclear-armed states: China, France, India, Israel, Pakistan, South Africa, the Soviet Union/Russia, the United Kingdom and the United States.

Drawing exclusively on open sources, the study examines four defining dimensions of nuclear weapons programmes (nuclear strategy and doctrine; fissile material production; nuclear testing and warhead design; and arsenal size and types of delivery systems) to identify potential analogues that may illuminate the DPRK's current capabilities and future trajectory. In doing so, the report seeks to ground its assessments of the DPRK's opaque programme in comparative evidence and historically informed analysis.

Nuclear strategy and doctrine

The DPRK's nuclear weapons appear to serve a broader operational role than the arsenals of most comparison states. Its doctrine extends beyond minimum deterrence or last-resort retaliation and incorporates battlefield-relevant and potentially pre-emptive nuclear use. In this respect, the closest analogy is Pakistan's full spectrum deterrence and earlier Soviet nuclear-use concepts. This reflects the DPRK's limited conventional options relative to its neighbours and concern that a future conflict could quickly threaten regime survival.

Fissile material production and constraints

Across the comparative cases, fissile material availability emerges as a key determinant of programme scale and pace. Importantly, the DPRK's limited access to fissile material remains an issue overall, especially when procuring it for each new mission set, whereas most of the other nuclear programmes solved this problem via early stockpiling or external assistance. As the DPRK expands its enrichment of fissile material, this issue could become less acute in the near term.

The analysis also highlights a cautionary lesson from the United States: fissile material production can outpace defence requirements, meaning that supply-side estimates alone may overstate the number of weapons a state intends to field. Applied to the DPRK, this insight underscores the need for care in inferring force structure or strategic intent directly from material estimates.

Nuclear testing and warhead development

Technologically, the DPRK benefits from a pronounced late-mover advantage. Its six-test series over eleven years shows a compressed progression from early implosion devices to a claimed thermonuclear capability, echoing targeted testing approaches seen in China, France and the United Kingdom rather than the extended, exploratory testing of early inventors such as the Soviet Union and the United States. Notably, reported features of the DPRK's test sequence (such as possible early use of composite pits and claims surrounding its thermonuclear capabilities) have historical precedents that lend technical plausibility, even where uncertainty remains. At the same time, the report finds that gas boosting remains a critical unknown, which parallels uncertainty in the programmes of India, Israel and Pakistan. China's decades-long struggle to master this technology illustrates that some capabilities may lag behind others, suggesting that the DPRK's arsenal could still exhibit significant variation in sophistication across capabilities.

Arsenal size and delivery systems

In terms of nuclear force size and delivery posture, the DPRK does not closely mirror any single comparison. While its arsenal remains far smaller than those of the major nuclear powers, it is likely more diversified than those programmes at similar stages, reflecting both late-mover efficiencies and acute, perceived security pressures. The DPRK's focus on land-based missile systems, with ongoing efforts to develop sea-based capabilities and the lack of an air leg, is one of the starkest differences found in this report. Most other states have focused on air-based delivery systems (often with land- and/or sea-based systems to complement), the sole exception being the United Kingdom with an all-submarine force. Pyongyang is seeking survivability, regional coercive leverage and the ability to hold US bases and the US homeland at risk, rather than replicating any established nuclear force structure.

Analytical implications

A cross-cutting insight of this report is that opacity itself is not unique to the DPRK. Several comparative cases, most notably China, India, Israel and Pakistan, have historically posed similar challenges to analysts due to limited disclosure, ambiguous doctrines and/or sparse testing records. The comparative frameworks applied here, and other methodologies developed throughout the larger project, demonstrate that meaningful assessment remains possible even under such constraints. The key methodological lesson is to separate declared intent, inferred capability and technical possibility, and to compare across doctrine, fissile material, test data, delivery systems and signalling.

Taken together, this research shows that while every nuclear programme is shaped by a unique context, they are rarely unprecedented nor completely analytically unknowable. Understanding the DPRK's programme development through a comparative lens is one essential analytical tool for avoiding inaccurate assumptions, sharpening policy responses and grounding international debate in evidence.

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Introduction and methodology

The Verification Research, Training and Information Centre (VERTIC), the James Martin Center for Nonproliferation Studies (CNS) and the Royal United Services Institute (RUSI), with funding from Global Affairs Canada, conducted a multi-year project to assess the weapons of mass destruction programme in the Democratic People's Republic of Korea (DPRK).

The initial phase focused on modelling the DPRK's nuclear fuel cycle (NFC), from uranium mining to weapons-grade material production.[1] VERTIC led the modelling, using software provided by the UK's National Nuclear Laboratory, supplemented with open-source information, including extensive satellite imagery analysis from CNS. The result of this work was a range of estimates of the DPRK's fissile material inventory, generating estimates based on plutonium reprocessing and uranium enrichment scenarios.[2]

Subsequently, the Open Nuclear Network (ONN), a programme of PAX sapiens, analysed DPRK nuclear force structure strategies and their impact on fissile material[3] demand, as well as how fissile material constraints – derived from VERTIC data – could shape the DPRK's nuclear arsenal.[4] These assessments yielded insights into the DPRK's possible fissile material demands, constraints and additional considerations, where a number of conclusions were drawn about the possible current structure of the DPRK's nuclear weapons arsenal.

As part of this comprehensive effort to assess open-source information regarding the DPRK's nuclear weapons programme, ONN sought unique data sources and analytical methods given the opacity of the subject area. This report presents the findings of one such initiative: a rigorous comparative analysis of the DPRK's nuclear programme against those of historical and contemporary known or alleged nuclear-armed states: China, France, India, Israel, Pakistan, South Africa, the Soviet Union/Russia, the United Kingdom (UK) and the United States (US).

The analysis for each state is structured around four aspects that uniquely define each nuclear weapons programme: nuclear strategy and doctrine; fissile material production; nuclear tests and warhead designs; and the number of warheads and types of delivery systems. For each of these aspects, a final determination regarding the country's similarity to the DPRK is made using one of the following definitions: Not analogous; weak analogue; partial analogue; and strong analogue.

The report is organised alphabetically by country, with a summary of key information at the start of each case study and key takeaways at the end of each case study. The report ends with summary tables (to synthesise and visually display the key comparisons) and an overarching conclusion.

1 Grant Christopher et al., Estimating North Korea's Nuclear Material Inventory (Verification Research, Training and Information Centre (VERTIC) and James Martin Center for Nonproliferation Studies (CNS), 2025), https://storymaps.arcgis.com/stories/f562dbf9a20b4717a505390358533a13.

2 VERTIC and Open Nuclear Network, 'Open-Source Assessments of the DPRK's Nuclear Programme', ArcGIS StoryMaps, 15 June 2026, https://storymaps.arcgis.com/collections/64ea53b6c76542fe814e1f51601dec5b.

3 For the purposes of this paper, 'fissile material' refers to weapons-grade plutonium (WGP) and highly enriched uranium (HEU).

4 Sarah Laderman et al., Fissile Material and Nuclear Force Structure in North Korea, Occasional Paper (Royal United Services Institute for Defence and Security Studies (RUSI), 2024), https://www.rusi.org/explore-our-research/publications/occasional-papers/fissile-material-and-nuclear-force-structure-north-korea.

For larger programmes with longer histories, such as the five Nuclear Weapons States, ONN primarily focused on the early- and mid-stages to allow for a more direct comparison with the current developmental stage of the DPRK's programme, while also providing brief overviews of their present-day capabilities to inform potential parallels in the DPRK's trajectory. In order to draw out parallels for countries at different stages of development, a set of terms is used throughout the report to categorise the case studies: early inventor or adopter (e.g. the US, Soviet Union), second mover (e.g. France, China) and late mover (e.g. Pakistan, the DPRK).

The description of the DPRK's nuclear programme upon which the comparative analyses rest can be found in the previously published reports discussed above,[5] and is not reproduced here in full. Where necessary in the comparisons, and in the summary tables at the end of this report, key facts and assessments are discussed in order to draw out the important findings.

All data comes from open sources, gathered based on their relevance to each of the four aspects analysed for each of the nine states. While research began in 2022, the information has been continuously updated up to the cut-off date of 19 June 2026.[6] Further research is recommended to expand, continue and update the information presented here, which should serve open-source researchers as a starting point for further comparative analysis. It is recommended that future workshops or discussions are conducted to update these assumptions and underlying information to make this global comparative analysis even more robust and supportive in future DPRK nuclear programme research and monitoring.

5 Christopher et al., Estimating North Korea's Nuclear Material Inventory; Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

6 Parts of this text were drafted using the AI tool ChatGPT. The work was edited, expanded upon or changed by the authors for accuracy, clarity and consistency.

China

Key Information

STATED NUCLEAR POLICY: NFU, minimum deterrent	
FISSILE MATERIAL IN ARSENAL: Initially HEU, later incorporation of WGP	
FIRST NUCLEAR TEST: 16 October 1964	
TOTAL NUMBER OF NUCLEAR TESTS: 45	
TWO-STAGE THERMONUCLEAR: Yes, 1966	
TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 2 years	
GAS BOOSTING: Yes, 1980s	
TIME FROM FIRST TEST TO GAS BOOSTING: ~20 years	
CURRENT NUMBER OF WARHEADS: 620 (external expert assessment)	
DELIVERY POSTURE: Triad	

Nuclear Strategy

Since the 1960s, China has maintained a declared "No First Use" (NFU) policy.[7] China has consistently articulated its commitment to a minimum deterrent for defence needs. The state has, however, refrained from providing a precise definition of "minimum deterrent", a deliberate ambiguity that allows Beijing to project continuity in its declaratory policy while still expanding the size and sophistication of its nuclear forces.[8]

At the same time, China appears to be undertaking a modernisation and expansion of its nuclear forces. The US Department of Defense (DoD) assesses that China has surpassed approximately 600 operational nuclear warheads and is continuing to expand its arsenal alongside investments in new silo fields, mobile systems and higher readiness postures.[9] The DoD further assesses that this expansion is intended to counterbalance US military advantages and to deter or constrain US military action.[10]

China's 2025 arms control white paper does not acknowledge or explain China's ongoing nuclear force expansion.[11] The document criticises a range of external developments that Beijing characterises as strategically destabilising, particularly actions by the United States, such as its withdrawal from key arms control treaties, expansion of missile defence capabilities and global/regional missile deployments.[12] Taken together, these elements suggest that China primarily frames its nuclear strategy in terms of preserving strategic stability in response to perceived external pressures.

Comparison with the DPRK

Similarity in this domain: Not analogous

China's NFU and self-defensive "minimum deterrent" approach contrasts sharply with the DPRK's doctrine. China's nuclear doctrine has traditionally sought to preserve deterrence through assured retaliation following an adversary's first strike. The DPRK, by contrast, creates more space for early or pre-emptive nuclear use in a crisis, including in response to perceived imminent threats.[13] Therefore, the DPRK's nuclear weapons are more operationally integrated into wartime planning than China's historical minimum-deterrence posture, making China a weak analogue for assessing DPRK nuclear doctrine, even though both states frame their arsenals as defensive responses to external threat.[14]

7 In the late 1970s, Chinese leadership judged that no world war was to be fought and that it needed to mend ties with the West. See: '邓小平与改革开放初期中国对外政策的调整 [Deng Xiaoping and China's Foreign Policy Adjustment during the Early Years of Reform and Opening Up]', Web of CPC History, 2018, http://www.zgdsw.com/article/698.html.

8 Hans M. Kristensen et al., 'Chinese Nuclear Weapons, 2025', Bulletin of the Atomic Scientists 81, no. 2 (2025): 135–60, https://doi.org/10.1080/00963402.2025.2467011.

9 U.S. Department of Defense, Report to Congress on Military and Security Developments Involving the People's Republic of China 2025 (U.S. Department of Defense, 2025), https://media.defense.gov/2025/Dec/23/2003849070/-1/-1/1/ANNUAL-REPORT-TO-CONGRESS-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2025.PDF.

10 U.S. Department of Defense, Report to Congress on Military and Security Developments Involving the People's Republic of China 2025.

11 'China's Arms Control, Disarmament, and Nonproliferation in the New Era', Ministry of Foreign Affairs of the People's Republic of China, 27 November 2025, https://www.fmprc.gov.cn/mfa_eng/xw/wjbxw/202511/t20251127_11761653.html.

12 Ministry of Foreign Affairs of the People's Republic of China, 'China's Arms Control, Disarmament, and Nonproliferation in the New Era'.

13 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

14 Mary Beth D. Nikitin, North Korea's Nuclear Weapons and Missile Programs, no. IF10472 (Congressional Research Service, 2025), https://www.congress.gov/crs-product/IF10472.

Fissile material production

China's first nuclear device, tested in 1964, utilised highly enriched uranium (HEU), as China began fissile material production with HEU in 1964.[15] China is widely assessed to have halted HEU production for weapons purposes around 1987; current estimates place its HEU stockpile at around 14±3 tonnes.[16]

Weapons-grade plutonium (WGP) production began in 1966,[17] but production reportedly ceased around 1990.[18] Estimates of China's current WGP stockpile range from 1.7 to 5.2 tonnes.[19] External experts have assessed that these stockpiles could provide China with a fissile material base sufficient to produce around 1,000 nuclear warheads, and that this fissile material base has supported China's nuclear arsenal in the past decades.[20]

Comparison with the DPRK

Similarity in this domain: Not analogous

China's WGP and HEU output, even in the early stages of its programme, was significantly higher than the DPRK. For China, early accumulation of fissile material allowed political and strategic choices, rather than material scarcity, to shape arsenal size. Its nuclear weapon production remained relatively small compared to its fissile material stockpile, suggesting that China's historical warhead production was driven more by strategic requirements than by supply constraints.

By contrast, the DPRK's nuclear programme remains more closely tied to its fissile material production capacity. Its more limited WGP and HEU stocks mean that fissile material scarcity shapes the number and types of weapons Pyongyang can plausibly produce.

15 For a detailed historical discussion of China's early weaponisation pathway, see: Hui Zhang and Tong Zhao, 'Miniaturization and Modernization: The Untold Story of China's Nuclear Weapons', 9 December 2025, https://carnegieendowment.org/events/2025/11/miniaturization-and-modernization-the-untold-story-of-chinas-nuclear-weapons?lang=en. The presentation indicates that China's first nuclear device ("596") employed a solid HEU core, while subsequent warhead designs incorporated WGP cores following later domestic production, consistent with assessments that China initially relied on HEU before transitioning to WGP-based weapons.

16 Hui Zhang, 'China's HEU and Plutonium Production and Stocks', Science & Global Security 19, no. 1 (2011): 68–89, world; 'Countries: China', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/china.html.

17 Zhang, 'China's HEU and Plutonium Production and Stocks'.

18 International Panel on Fissile Materials, 'Countries: China'.

19 'World Plutonium Inventories', Bulletin of the Atomic Scientists 55, no. 5 (1999): 71, https://doi.org/10.1080/00963402.1999.11460377 ; John Swegle and Christopher Yeaw, China's Historical Plutonium Production (National Strategic Research Institute at the University of Nebraska, 2021), https://nsri.nebraska.edu/-/media/projects/nsri/docs/academic-publications/2021/march/China-Historical-Plutonium-Production.pdf; International Panel on Fissile Materials, 'Countries: China'.

20 For a recent historical overview of China's fissile material production and early weaponisation pathway, see: Hui Zhang and Tong Zhao, 'Miniaturization and Modernization'. The presentation broadly reinforces existing open-source assessments regarding China's early reliance on HEU and the long-term sufficiency of China's fissile material stockpiles.

Nuclear tests and warhead designs

Between 1964 and 1996, China conducted 45 nuclear tests.[21] Its inaugural test on 16 October 1964 used a simple implosion device.[22] Early in its testing phase, China was primary focused on the development and weaponisation of relatively large, high-yield hydrogen bombs for strategic deterrence against the Soviet Union and the US.

- **16 October 1964:** [23] China conducted its first nuclear test, an HEU-based experimental implosion device with a yield of 22 kt (CHIC-1).[24]
- **4 May 1965:** [25] China tested an airdropped version of CHIC-1 (CHIC-2), with a yield over 30 kt.[26]
- **9 May 1966:** [27] China conducted a test to study fusion, featuring lithium deuteride in a layered cake design (CHIC-3), yielding 220 kt.[28]
- **27 October 1966:** [29] A reduced-size device (for a smaller-yield weapon) was tested to fit on top of DF-2A medium-range ballistic missile (CHIC-4), with a 12 kt yield.[30]
- **28 December 1966:** [31] China tested its first two-stage thermonuclear device (CHIC-5); a reduced yield of 122 kt was achieved by a reduction of lithium deuteride and fissile material.[32]
- **17 June 1967:** [33] An airdropped version of the CHIC-5 (CHIC-6) was tested at full yield (~3.3 Mt).[34]

These first six tests capture the core path of China's early nuclear development.

21 'Ending Nuclear Testing', United Nations, United Nations, accessed 1 October 2024, https://www.un.org/en/observances/end-nuclear-tests-day/history.

22 'Statement of the Government of the People's Republic of China', Wilson Center Digital Archive, 16 October 1964, https://digitalarchive.wilsoncenter.org/document/statement-government-peoples-republic-china; '首颗原子弹核心部件铀球操刀人原公浦逝世 [Yuan Gongpu, the Worker Who Machined the Uranium Ball for the First Atomic Bomb, Passed Away]', Jiemian, 23 August 2021, https://finance.sina.com.cn/chanjing/cyxw/2021-08-23/doc-ikqciyzm3058036.shtml; '何祚庥忆于敏：当之无愧的氢弹构型最主要发明者 [In Memory of Yu Min: Yu Is the Main Inventor of China's Hydrogen Bomb]', The Paper, 19 January 2019, https://www.thepaper.cn/newsDetail_forward_2876128; 'Depleted Uranium', Text, IAEA, 8 November 2016, https://www.iaea.org/topics/spent-fuel-management/depleted-uranium; David E. Sanger and William J. Broad, 'Officials Fear Design of Nuclear Bomb Went to Others', The New York Times, 16 June 2008, https://www.nytimes.com/2008/06/16/world/asia/16iht-16nuke.13728852.html.

23 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland), 1st edn (湖南教育出版社, 2018); Arms Control Association, 'The Nuclear Testing Tally', Arms Control Association, October 2025, https://www.armscontrol.org/factsheets/nuclear-testing-tally.

24 中国军事百科全书 核武器分册 [Book of Nuclear Weapons, China Military Encyclopaedia] (Military Science Publishing House, 1990), 157–58.

25 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland); Arms Control Association, 'The Nuclear Testing Tally', January 2024, https://www.armscontrol.org/factsheets/nuclear-testing-tally.

26 当代中国的国防科技事业 上册 [National Defense and Science Works of Contemporary China, Book 1] (Contemporary China Publishing House, 1999).

27 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland); Arms Control Association, 'The Nuclear Testing Tally', January 2024.

28 Hui Zhang, 'The Short March to China's Hydrogen Bomb', Bulletin of the Atomic Scientists, 11 April 2024, https://thebulletin.org/2024/04/the-short-march-to-chinas-hydrogen-bomb/.

29 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland); Arms Control Association, 'The Nuclear Testing Tally', January 2024.

30 中国军事百科全书 核武器分册 [Book of Nuclear Weapons, China Military Encyclopaedia], 163–64.

31 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland); Arms Control Association, 'The Nuclear Testing Tally', January 2024.

32 中国军事百科全书 核武器分册 [Book of Nuclear Weapons, China Military Encyclopaedia], 159–61.

33 任益民 et al., 20世纪中国科学口述史·亲历者说"金银滩传奇" (The Legend on Golden and Silvery Grassland); Arms Control Association, 'The Nuclear Testing Tally', January 2024.

34 中国军事百科全书 核武器分册 [Book of Nuclear Weapons, China Military Encyclopaedia], 161–62.

The country took a considerable amount of time to master gas boosting, a technology crucial for its miniaturised, second-generation nuclear weapons;[35] this capability was not fully realised until the 1980s.[36] This delay in mastering gas boosting did not materially weaken China's second-generation strategic deterrent, because the delivery systems that most depended on smaller, lighter boosted warheads (particularly the solid-propellant, road-mobile DF-31 intercontinental ballistic missile (ICBM)) were not deployed until the 2000s. In other words, China had largely solved its warhead-miniaturisation challenge by the time this capability became central to its deployed strategic force.[37]

Comparison with the DPRK

Similarity in this domain: Partial analogue

China benefitted from a second-mover advantage (and the DPRK as a late-mover), which allowed for fewer tests as less innovation was needed to develop a nuclear warhead that was nearly guaranteed to work.[38]

The DPRK, similar to China, may have acquired the knowledge to build a two-stage thermonuclear weapon within six nuclear tests. However, the DPRK's early focus on smaller bombs, optimised for smaller ballistic missiles, could explain the differences in yields and designs when compared to China's early testing series.[39] China conducted significantly more nuclear tests than the DPRK has to date.

China's prolonged difficulties with gas boosting underscore the technical complexity of the capability, which depends on sophisticated warhead design, materials handling and precise system integration. It therefore remains uncertain whether the DPRK has fully mastered boosting, even if its nuclear tests and design claims suggest movement toward more compact and efficient weapons.

35 The breakthrough in gas boosting was given the highest science and technology award in 1987. See: '于敏 [Yu Min]', Ministry of Science and Technology of the People's Republic of China, 9 January 2015, https://www.safea.gov.cn/ztzl/kjrw/201501/t20150114_117709.html.

36 '于敏 [Yu Min]'; The JL-1/DF-21 warhead is the smallest warhead among the first generation nuclear weapons of China and does not apply gas boosting. See: 当代中国的国防科技事业 上册 [National Defense and Science Works of Contemporary China, Book 1], 223.

37 Web of CPC History, '邓小平与改革开放初期中国对外政策的调整 [Deng Xiaoping and China's Foreign Policy Adjustment during the Early Years of Reform and Opening Up]'.

38 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

39 Tianran Xu, Backgrounder: Previous DPRK Nuclear Tests (Open Nuclear Network, 2022), https://platform.opennuclear.org/thoughtroom/quick-takes/backgrounder-previous-dprk-nuclear-tests; Tianran Xu, Size Estimates of DPRK's Nuclear Devices (Open Nuclear Network, 2023), https://platform.opennuclear.org/thoughtroom/research-reports/size-estimates-of-dprks-nuclear-devices.

Arsenal size and delivery systems

Experts suggest that China produced around 200 warheads between 1964 and 1980, maintaining 200–250 weapons until 2015.[40]

From 2015 to 2023, the arsenal dramatically increased, reaching an estimated 600 warheads.[41] Current external expert estimates put the Chinese arsenal at 620 warheads.[42] These warheads are intended for delivery by land-, sea- and air-based platforms.

Comparison with the DPRK

Similarity in this domain: Weak analogue

Both states moved from an initial nuclear test capability towards a more diversified deterrent, but the scale and pace of their arsenal growth diverged sharply. China is estimated to have produced around 200 weapons within roughly the first 15–20 years of its programme, whereas the DPRK is assessed to have possessed far fewer assembled warheads. This discrepancy reflects differences in production capacity, fissile-material availability and strategic requirements. However, both countries face a similar target set in trying to deter distant adversaries.

40 Military and Security Developments Involving the People's Republic of China (U.S. Department of Defense, 2024), https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF.

41 From 2015 to 2023, the arsenal dramatically increased, reaching an estimated 600 warheads today in response to geopolitical developments. Hans M. Kristensen et al., 'Nuclear Notebook', Bulletin of the Atomic Scientists, accessed 25 April 2025, https://thebulletin.org/nuclear-notebook/; U.S. Department of Defense, Report to Congress on Military and Security Developments Involving the People's Republic of China 2025.

42 Hans M. Kristensen and Matt Korda, '8. World Nuclear Forces', in SIPRI Yearbook 2026: Armaments, Disarmament and International Security, by Stockholm International Peace Research Institute (Oxford University Press, 2026), https://www.sipri.org/sites/default/files/YB26%2008%20World%20Nuclear%20Forces.pdf.

Key takeaways

Key parallels:

- China had a second-mover advantage, while the DPRK had a late-mover advantage. This allowed both to advance capabilities with fewer tests in contrast to early adopters like the Soviet Union and the US.
- The DPRK may have acquired a two-stage thermonuclear weapon within six tests, similar to China.
- China's decades-long gas boosting struggles underscore how hard it can be to master this technology. The DPRK's status in this area remains unclear in open sources.
- Both countries are attempting to deter distant adversaries and have developed diversified missile capabilities.
- Limited official disclosure creates analytical challenges comparable to the DPRK

Key differences:

- China's early programme shows how rapidly a nuclear-armed state can support high-yield strategic deterrence when it has comparatively abundant fissile material and larger missile delivery systems. The DPRK, by contrast, has had to prioritise smaller, missile-deliverable systems under tighter material constraints and a more expansive nuclear-use doctrine.
- China maintains a NFU and "minimum deterrent" posture. The DPRK's doctrine codifies broader first-use conditions (including for non-nuclear contingencies).
- China accumulated large HEU and WGP stocks early. The DPRK's fissile material stockpile growth remains dependent on its own production limits (especially WGP).
- China began with HEU-based weapons whereas it is assessed that the DPRK began with WGP.
- China's current triad is a mature major-power force, while the DPRK remains a missile-centred regional deterrent with aspirations for diversification. Survivability, readiness and escalation options between the two cases differ sharply because of this.

France

Key Information

STATED NUCLEAR POLICY: From defensive to forward deterrence

FISSILE MATERIAL IN ARSENAL: Initially WGP, later incorporation of HEU

FIRST NUCLEAR TEST: 13 February 1960

TOTAL NUMBER OF NUCLEAR TESTS: 210

TWO-STAGE THERMONUCLEAR: Yes, 1968

TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 8 years

GAS BOOSTING: Yes, 1966

TIME FROM FIRST TEST TO GAS BOOSTING: 6 years

CURRENT NUMBER OF WARHEADS: 290–300 (external expert assessment and French government statement)

DELIVERY POSTURE: Dyad (sea and air)

Nuclear strategy

France's nuclear arsenal was initially developed to ensure technological parity with its allies and to establish an independent deterrent, particularly given its perception of isolation from the UK-US alliance.[43] French strategic thinking emphasised deterring large nations by threatening to inflict enough damage to compel an aggressor to cease hostilities. France's strategic discourse continued to closely link deterrence and nuclear capabilities.[44]

Currently, France considers its nuclear policy to be purely defensive, with nuclear weapons serving as a deterrent against "any form of state actor aggression against" vital French interests.[45] While the definition of "vital interest" remains ambiguous, it is understood to encompass national sovereignty, territorial integrity and protection from nuclear or conventional attacks.[46] In the most serious cases, France aims to inflict "absolutely unacceptable damages upon that State's centres of power: its political, economic and military nerve centres."[47]

In March 2026, President Macron introduced France's new strategy, "forward deterrence", which promises more integration with European allies, including joint exercises and nuclear deployment to allied territory. This strategy still encompasses the "original foundations of French doctrine."[48]

France does not adhere to an NFU policy but asserts that it would not use nuclear weapons against non-nuclear-weapon states (NNWS) unless it is facing an invasion backed by or carried out together with a nuclear-armed country.[49]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Both programmes emerged from a perceived need for autonomous deterrence against stronger adversaries. France developed its nuclear arsenal to preserve strategic independence and deter existential threats without relying fully on allied security guarantees. Similarly, the DPRK first developed its nuclear arsenal as an independent deterrent against nuclear and conventional threats.

However, France's doctrine remains defensive, with some movement now towards forward deterrence. It preserves ambiguity around the meaning of "vital interests" and the circumstances of potential nuclear use, but does include potential nuclear-sharing. The DPRK's doctrine, by contrast, creates explicit pathways for nuclear use across a wider range of contingencies, including pre-emptive and battlefield-related scenarios.[50] Because of this, France offers a useful comparison for understanding the logic of independent deterrence, but a poor analogue for the DPRK's current nuclear employment doctrine.

43 'French Nuclear Program', Atomic Heritage Foundation, 14 February 2017, https://ahf.nuclearmuseum.org/ahf/history/french-nuclear-program/.

44 Bruno Tertrais, French Nuclear Deterrence Policy, Forces, And Future: A Handbook, no. 4/2020, Recherches & Documents (Fondation pour la Recherche Stratégique, 2020), 14, 16, https://www.frstrategie.org/sites/default/files/documents/publications/recherches-et-documents/2020/202004.pdf; 'Fact Sheet: France's Nuclear Inventory', Center for Arms Control and Non-Proliferation, 27 March 2020, https://armscontrolcenter.org/fact-sheet-frances-nuclear-arsenal/; Hans M. Kristensen and Matt Korda, '10. World Nuclear Forces', in SIPRI Yearbook 2021 (Stockholm International Peace Research Institute, 2021), https://www.sipri.org/yearbook/2021/10.

45 'France Nuclear Overview', The Nuclear Threat Initiative, 14 May 2016, https://www.nti.org/analysis/articles/france-nuclear/.

46 'France Nuclear Overview'.

47 Kristensen and Korda, '10. World Nuclear Forces'.

48 Emmanuel Macron, 'Statement by the President of the French Republic on the Nuclear Deterrent', 2 March 2026, https://in.diplomatie.gouv.fr/en/statement-president-french-republic-nuclear-deterrent.

49 'Arms Control and Proliferation Profile: France', Arms Control Association, August 2024, https://www.armscontrol.org/factsheets/arms-control-and-proliferation-profile-france.

50 For a more extensive analysis of the DPRK's current nuclear programme, see Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Fissile material production

France initiated large-scale production of plutonium for military purposes in 1956, followed by HEU in 1967. The country has produced around 7±1 tonnes of WGP (with about 1 tonne expended during nuclear tests) and 25±6 tonnes of military-related HEU.[51] Production of plutonium for weapons ceased in 1992, and HEU production ended in 1996. France's stockpile of WGP and HEU exceeds the requirements of its standing nuclear arsenal.[52] This means France's arsenal size has been shaped by strategic, budgetary and doctrinal decisions about what level of force is sufficient, not fissile-material scarcity.

Comparison with the DPRK

Similarity in this domain: Weak analogue

While both the DPRK and France began with WGP in their arsenals, the DPRK's WGP production capabilities likely remain constrained,[53] whereas France, with its extensive domestic NFC, has produced vast quantities of fissile material since the early days of its nuclear programme.

The DPRK's arsenal trajectory remains closely tied to how much WGP and HEU it can produce, allocate and weaponise. This makes France a weak comparison for DPRK arsenal growth, but a useful contrast case for showing how fissile-material access changes the choices available to a nuclear-armed state.

51 'Countries: France', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/france.html.

52 Alexander Glaser, 'Military Fissile Material Production and Stocks in France', paper presented at 52nd Annual INMM Meeting, 17 July 2011, https://www.princeton.edu/~aglaser/PU057-Glaser-2011.pdf.

53 For a more extensive analysis of the DPRK's current nuclear programme, see Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Nuclear tests and warhead designs

France conducted a total of 210 nuclear tests from 1960 to 1996 in Algeria and French Polynesia.[54] Its early testing series is presented here as a comparison to the DPRK testing series and to illustrate its gas-boosting and thermonuclear developments.

- **13 February 1960:** France conducted its first nuclear test, a WGP-based device with a yield of 60–70 kt, triple the yield of the first UK or US tests, demonstrating a second-mover advantage. A French delegation's visit to the then US Nevada Test Site in 1957–1958 was instrumental in preparing for this inaugural test.[55]
- **24 September 1966:** France conducted the first test of a reportedly gas-boosted experimental device, with a yield of 150 kt, following 22 total nuclear tests, two years before its first thermonuclear test.[56]
- **1967–early 1968:** France tested low-yield fission primaries, in preparation for thermonuclear weapon development.[57]
- **15 July 1968:** The first operational gas-boosted device was tested, with a yield of 450–500 kt.[58]
- **24 August 1968:** France tested its first two-stage thermonuclear device, 8.5 years after its initial test and after successfully testing gas-boosted devices. The test yielded 2.6 Mt, the highest yield in France's testing history.[59]

Approximately 67% of French nuclear tests had yields below 20 kt, indicating a sustained focus on fission primaries. Tests below 5 kt are believed to have been conducted to confirm the performance of unboosted and boosted primary designs, while tests between 5 and 20 kt likely served "to confirm fully boosted primaries" and the "radiation implosion of largely inert secondaries."[60] The remaining 33% of tests during this period ranged from 20 to 150 kt, likely involving both stages of a thermonuclear weapon at full or partial yield.[61]

Comparison with the DPRK

Similarity in this domain: Partial analogue

The French testing series provides valuable lessons for analysing the DPRK, as France benefitted from a second-mover advantage and conducted more advanced tests earlier in its programme. Further, France's mode of testing each piece of the thermonuclear device separately (primary, boosted primary with inert secondary, full-scale thermonuclear) to produce vastly different yields and to validate each piece of the warhead may help explain the DPRK's 2016–2017 testing series, which could reflect a similar developmental logic. If so, individual tests may have been designed

54 Robert S. Norris, 'French and Chinese Nuclear Weapon Testing', Security Dialogue 27, no. 1 (1996): 39–54.

55 Andrew S. Burrows et al., French Nuclear Testing, 1960-1988, Working Paper NWD 89-1, Nuclear Weapons Databook Project (Natural Resources Defense Council, 1989), 5, https://nuke.fas.org/cochran/nuc_89020001a_87.pdf.

56 Burrows et al., French Nuclear Testing, 1960-1988, 27–28.

57 Burrows et al., French Nuclear Testing, 1960-1988.

58 Burrows et al., French Nuclear Testing, 1960-1988, 27–28.

59 Burrows et al., French Nuclear Testing, 1960-1988.

60 Norris, 'French and Chinese Nuclear Weapon Testing', 45.

61 Norris, 'French and Chinese Nuclear Weapon Testing'.

to generate data on primary performance, secondary coupling and overall yield, providing a framework for interpreting future DPRK tests as well. This is also similar to the UK programme.

However, the comparison should remain cautious. France conducted far more tests and left a much larger technical record, whereas the DPRK's smaller test series leaves greater uncertainty about reliability, weaponisation and deployment status.

Arsenal size and delivery systems

France's nuclear arsenal grew incrementally, reaching a size of around 250 weapons by 1980.[62] By 1984, France's arsenal had grown to about 300 warheads. During the 1980s, the arsenal size nearly doubled to a peak of 540 in 1991–1992, likely in response to Soviet missile defence developments around Moscow.[63] Since this peak, France has gradually reduced its arsenal to its current size of 290 according to external experts. The most recent public declaration of arsenal size was in 2015 when the French President stated that the country had 300 weapons.[64] In March 2026, the President called for an increase in the size of the French arsenal, but did not specify the amount.[65]

External experts assess that France maintains 50 warheads for its air-based delivery systems, and 240 warheads for its submarine-launched ballistic missiles.[66]

Comparison with the DPRK

Similarity in this domain: Not analogous

France combines survivability through ballistic missile submarines (SSBNs) with political signalling through aircraft. The DPRK, remains land-missile based. This limits the DPRK's ability to signal nuclear readiness in the same way as France, while potentially increasing its reliance on missile tests, deployments and declaratory threats. Moreover, the DPRK's stockpile is likely smaller than the size of France's arsenal at a comparable stage of its programme.[67]

62 Hans M. Kristensen and Matt Korda, 'French Nuclear Forces, 2019', Bulletin of the Atomic Scientists 75, no. 1 (2019): 51–55, https://doi.org/10.1080/00963402.2019.1556003.

63 Center for Arms Control and Non-Proliferation, 'Fact Sheet: France's Nuclear Inventory'.

64 Kristensen and Korda, 'French Nuclear Forces, 2019'.

65 Macron, 'Statement by the President of the French Republic on the Nuclear Deterrent'.

66 Hans M. Kristensen et al., 'French Nuclear Weapons, 2025', Bulletin of the Atomic Scientists 81, no. 4 (2025): 313–26, https://doi.org/10.1080/00963402.2025.2524251.

67 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Key takeaways

Key parallels:

- France's main comparative value lies in its example of how a second-mover nuclear state used varied-yield tests to validate different elements of warhead design, including boosted primaries and thermonuclear configurations.
- This provides a useful framework for interpreting the DPRK's 2016–2017 tests as a possible staged developmental sequence, rather than simply as isolated demonstrations of increasing explosive yield.
- France's early pursuit of an independent deterrent also partially echoes the DPRK's original justification for an autonomous nuclear capability against stronger adversaries, although now France is looking to potentially provide a nuclear umbrella for European allies.

Key differences:

- The DPRK has pursued nuclear weapons under tighter fissile-material constraints, with fewer tests, a more permissive doctrine and a force structure centred on land-based missiles.
- France conducted far more tests and built a much larger technical record, which makes its warhead development pathway easier to assess. The DPRK's smaller test series leaves greater uncertainty about reliability, weaponisation and deployment status.
- France relies on sea- and air-based nuclear forces, whereas the DPRK only has confirmed land-based nuclear delivery capabilities, with sea-based systems still under development.

India

Key Information

STATED NUCLEAR POLICY: NFU, credible minimal deterrent

FISSILE MATERIAL IN ARSENAL: WGP

FIRST NUCLEAR TEST: 18 May 1974 (“peaceful nuclear explosion”), 11 May 1998 (military)

TOTAL NUMBER OF NUCLEAR TESTS: 6

TWO-STAGE THERMONUCLEAR: Yes, 1998 (although not confirmed from independent sources)

TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 24 years

GAS BOOSTING: Unknown

TIME FROM FIRST TEST TO GAS BOOSTING: Not applicable

CURRENT NUMBER OF WARHEADS: 190 (external expert assessment)

DELIVERY POSTURE: Triad

Nuclear strategy

When India conducted its first nuclear test in 1974, it was not in the midst of an urgent international security crisis, nor did it face an immediate existential or conventional military threat comparable to those confronting other emerging nuclear powers at the time. The test, described by India as a "peaceful nuclear explosion", was framed domestically as a scientific and technological achievement rather than an explicit step towards weaponisation, reflecting both normative sensitivities and India's desire to preserve its international standing. In response, the international community condemned the "peaceful nuclear explosion" as a false pretext, but the absence of rapid follow-on weaponisation and the lack of an overt nuclear posture directed at other states resulted in a relatively muted response.[68]

Since conducting its nuclear tests in 1998, India has maintained a policy of NFU and "credible minimum deterrence", which has been officially reaffirmed despite comments from officials that introduced some ambiguity.[69] The impetus for India's original nuclear and missile programmes was not just to fulfil urgent military requirements; India also aimed to demonstrate its technological prowess and pursue great power status.[70]

India's expanding nuclear arsenal, its development of new warhead technologies such as multiple independently-targetable reentry vehicles (MIRVs)[71] and its efforts to extend the range of its strategic delivery vehicles demonstrate its commitment to nuclear deterrence. These efforts are aimed at deterring both China, which has a larger and more advanced nuclear arsenal, and Pakistan, which poses a more immediate regional threat.[72]

Comparison with the DPRK

Similarity in this domain: Partial analogue

The primary distinguishing factor between India's and the DPRK's doctrines lies in their initial strategic environments.[73] The DPRK's programme developed under more explicitly adversarial conditions, whereas India's began with a declared "peaceful" test and only later moved towards overt weaponisation.

India's dual-deterrence posture (facing a larger nuclear-armed adversary in China and a geographically closer rival in Pakistan) offers a partial comparison to the DPRK. However, the analogy is limited. India must deter two neighbouring nuclear-armed rivals with different escalation dynamics, while the DPRK must deter a nearby US-allied conventional threat and a distant US strategic threat within the same alliance framework.

68 Matt Korda and Hans Kristensen, India's Nuclear Arsenal Takes a Big Step Forward, Global Risk (Federation of American Scientists, 2021), https://fas.org/publication/indias-nuclear-arsenal-takes-a-big-step-forward/; 'Fact Sheet: India's Nuclear Inventory', Center for Arms Control and Non-Proliferation, January 2023, https://armscontrolcenter.org/indias-nuclear-capabilities/; 'India Nuclear Overview', The Nuclear Threat Initiative, 4 November 2019, http://www.nti.org/analysis/articles/india-nuclear/; 'India Missile Overview', The Nuclear Threat Initiative, 4 November 2019, https://www.nti.org/analysis/articles/india-missile/.

69 Korda and Kristensen, India's Nuclear Arsenal Takes a Big Step Forward.

70 'India Missile Overview'.

71 Huma Rehman, 'What India's MIRV Test Adds to the "Strategic Trilemma" in South Asia', Bulletin of the Atomic Scientists, 3 May 2024, https://thebulletin.org/2024/05/what-indias-mirv-test-adds-to-the-strategic-trilemma-in-south-asia/.

72 'India Nuclear Overview'.

73 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Because of this, India demonstrates how a state can maintain a relatively restrained nuclear doctrine while gradually developing more advanced capabilities, including longer-range missiles, MIRVs and sea-based systems.

Fissile material production

India's arsenal to date is primarily plutonium-based. It has produced WGP in two reactors situated at the Bhabha Atomic Research Centre complex near Mumbai, only one of which remains operational.[74] Plutonium is reprocessed at the Plutonium Reprocessing Plant in Trombay, which has a capacity of approximately 50 tonnes of spent nuclear fuel per year.[75] India reportedly possesses 0.73±0.17 tonnes of WGP in weapons or available for use in weapons.[76]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Both the DPRK[77] and India have integrated WGP into their arsenals, although India does not seem to be integrating HEU. India has enough WGP to support a modest arsenal and is building delivery systems that may require more warheads over time. The DPRK appears more tightly constrained by how much fissile material it can produce.

India has historically maintained a steady plutonium production rate, suggesting that its weapons programme is less acutely constrained by fissile material availability than the DPRK's.[78]

74 'Countries: India', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/india.html.

75 'India Nuclear Overview'.

76 International Panel on Fissile Materials, 'Countries: India'.

77 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

78 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Nuclear tests and warhead designs

India's nuclear testing programme has followed a unique trajectory with a single test conducted in 1974, followed by five tests in three days in 1998. India subsequently declared itself a nuclear-armed state and has since observed a nuclear testing moratorium.

- **18 May 1974:** India conducted its first nuclear test, "Smiling Buddha", with an estimated yield of 12 kt.[79] Following this test, India did not weaponise the tested device and conducted no further nuclear tests for more than two decades.
- **11 May 1998:** According to Indian officials, three tests of the following devices were conducted:[80]
  - thermonuclear device (45 kt)
  - fission device (15 kt)
  - sub-kiloton device (0.2 kt)
- **13 May 1998:** Two sub-kiloton devices, with yields of 0.5 kt and 0.3 kt.[81]

India's nuclear warheads are generally assessed to be single-stage, plutonium-based implosion designs as external analysts have found no open-source evidence to independently verify claims of a thermonuclear device. Further, there is no information in open sources indicating India's gas boosting capabilities.[82]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Like the DPRK,[83] India benefited from a late-mover advantage. However, unlike the DPRK, India focused solely on plutonium designs and pursued a different testing strategy, conducting the majority of its tests over a short, three-day period. This approach, which lacked time for design improvements between tests, contrasts sharply to the DPRK's strategy of conducting six tests over 11 years.

The DPRK has less room for ambiguity because it needs to convince the US and its allies that it can successfully deliver nuclear attacks across multiple ranges and scenarios. Therefore, Pyongyang has likely felt stronger incentives to keep testing delivery systems and warhead designs. India shows that a

79 India Nuclear Overview

80 'Press Statement by Dr. Anil Kakodkar and Dr. R. Chidambaram on Pokhran-II Tests', Press Information Bureau, Department of Atomic Energy, Government of India, 24 September 2009, https://pib.gov.in/newsite/PrintRelease.aspx?relid=52814; Some experts believe the official yields are exaggerated. See, for example: 'India's Nuclear Forces, 2002', Bulletin of the Atomic Scientists 58, no. 2 (2002): 70–72, https://doi.org/10.1080/00963402.2002.11460559.

81 Press Information Bureau, Department of Atomic Energy, Government of India, 'Press Statement by Dr. Anil Kakodkar and Dr. R. Chidambaram on Pokhran-II Tests'.

82 Hans M. Kristensen et al., 'Indian Nuclear Weapons, 2024', Bulletin of the Atomic Scientists 80, no. 5 (2024): 326–42, https://doi.org/10.1080/00963402.2024.2388470; Shannon N. Kile and Hans M. Kristensen, '10. World Nuclear Forces', in SIPRI Yearbook 2020 (Stockholm International Peace Research Institute, 2020), https://www.sipri.org/yearbook/2020/10.

83 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

low number of tests can create significant uncertainty, especially when tests are clustered too closely to permit design learning. The DPRK's longer sequence almost certainly allowed data from earlier tests to inform later designs. Therefore, India's and the DPRK's tests are not analytically equivalent.

Arsenal size and delivery systems

Expert estimates place India's nuclear warhead count at approximately 190,[84] though calculations of its WGP stockpile suggest it has enough material for up to 210 warheads.[85] The Indian government does not publicly declare its arsenal size.

India has developed and maintains a strategic triad, with missile ranges estimated from 400 km to over 6,000 km.[86] In March 2024, India demonstrated MIRV technology, which could reportedly carry 3–4 nuclear warheads per ICBM.[87]

Much of the technology used in India's strategic delivery vehicles was initially acquired internationally. For example, India was provided French-manufactured and British-/French-designed fighter-bombers. India received a French research rocket in 1964 and, after decades of experience with the design, developed its own domestic rocket programme in the 1980s. Further, India's first indigenous nuclear-powered SSBN, the INS Arihant, commissioned in 2016, is structurally similar to the Russian-built Kilo-class attack submarines operated by the Indian Navy, with the addition of a missile compartment for India's submarine-launched ballistic missiles (SLBMs).[88]

Comparison with the DPRK

Similarity in this domain: Partial analogue

Leveraging its late-mover status, India has a history of acquiring foreign technologies, equipment and facilities, then adapting them into domestic programmes after gaining experience with them. A similar pattern may be relevant to the DPRK, given its past links to proliferation networks and its relationships with China, Iran, Pakistan and Russia. India's introduction of MIRV technology and nuclear-powered submarines also mirrors capabilities the DPRK appears to be pursuing.[89]

84 Kristensen and Korda, '8. World Nuclear Forces'.

85 Kristensen et al., 'Indian Nuclear Weapons, 2024'.

86 Kristensen et al., 'Indian Nuclear Weapons, 2024'.

87 Rehman, 'What India's MIRV Test Adds to the "Strategic Trilemma" in South Asia'.

88 Kristensen et al., 'Indian Nuclear Weapons, 2024'.

89 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Key takeaways

Key parallels:

- India's dual-deterrence problem involves two neighbouring nuclear-armed rivals. The DPRK must deter a nearby US-allied conventional threat and a distant US homeland target set within the same alliance framework.
- India's use of foreign technology followed by indigenous development may offer a useful reference point for the DPRK's delivery-system evolution, although the DPRK's pathway is more constrained by sanctions and secrecy.
- India's development of MIRV technology and nuclear-powered submarines mirrors capabilities the DPRK appears to be pursuing.

Key differences:

- India's early nuclear development was marked by strategic ambiguity and delayed weaponisation, whereas the DPRK's programme has been overtly military, coercive and central to regime survival.
- Today, India maintains a declared NFU policy and credible minimum deterrence, while the DPRK rejects NFU and legally codifies broader nuclear-use conditions.
- While both states' two-front posture is a similarity, the distance between China and India is significantly shorter than the distance between the continental United States and the DPRK impacting warhead design and missile development.
- India's arsenal is primarily plutonium-based and less acutely constrained by fissile-material availability than the DPRK's. The DPRK's growth remains more tightly linked to lower WGP production rates and likely increasing reliance on HEU.
- India's compressed 1998 test series left greater uncertainty about advanced warhead designs, while the DPRK's more iterative testing sequence may have supported incremental technical learning.
- India has a developing triad, although its sea-based leg remains relatively immature. The DPRK currently has confirmed land-based nuclear delivery capabilities, with sea-based systems still under development.

Israel

Key information

STATED NUCLEAR POLICY: Deliberate ambiguity

FISSILE MATERIAL IN ARSENAL: Likely WGP

FIRST NUCLEAR TEST: Unconfirmed, possibly 22 September 1979

TOTAL NUMBER OF NUCLEAR TESTS: 0 or 1

TWO-STAGE THERMONUCLEAR: Unknown

TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: Not applicable

GAS BOOSTING: Unknown

TIME FROM FIRST TEST TO GAS BOOSTING: Not applicable

CURRENT NUMBER OF WARHEADS: 90 (external expert assessment)

DELIVERY POSTURE: Likely land and air

Nuclear strategy

Israel's alleged nuclear weapons programme began in the 1950s to guarantee its survival in a hostile regional environment where it faced "the combined conventional superiority" of its neighbours, repeated wars and threats to its existence.[90] This has since shifted for Israel which now maintains significant conventional capabilities in relation to its neighbours.

Since the late 1960s, Israel has maintained a policy of deliberate ambiguity, known as "amimut", defined by the recurring official statement that it "won't be the first to introduce nuclear weapons into the Middle East."[91] This posture is based on a narrow Israeli interpretation that "introducing" a weapon requires public acknowledgment or a nuclear test. Consequently, by avoiding official confirmation and testing, Israel has maintained a policy that allows for the probable possession of a nuclear arsenal while technically adhering to its public pledge of non-introduction.[92] Despite rumours of a "Samson Option" (an alleged nuclear last resort doctrine allowing for nuclear use in conventional conflict if Israel is existentially threatened), it is unknown if Israel has an NFU policy.[93]

Comparison with the DPRK

Similarity in this domain: Not analogous

The DPRK and Israel are almost inverse cases in terms of nuclear signalling. The DPRK, facing a qualitative conventional disadvantage against the US–Republic of Korea (ROK) alliance, relies on explicit nuclear messaging and a nuclear warfighting doctrine to strengthen deterrence on the Korean Peninsula.[94] Israel, by contrast, now maintains substantial conventional advantages over its regional adversaries and relies on deliberate nuclear ambiguity rather than public nuclear threats; however, at the outset of Israel's programme, there was a partial parallel with the DPRK as both states viewed nuclear weapons as a hedge against conventional asymmetry and potential existential defeat.

As a result, the two arsenals now play fundamentally different roles in deterrence and escalation. Israel uses ambiguity to keep the nuclear threshold undefined and avoids being "the first to introduce nuclear weapons into the Middle East."[95] The DPRK uses explicit legal doctrine, public claims and weapons demonstrations to make potential nuclear-use scenarios more visible and credible.

90 Hans M. Kristensen and Matt Korda, 'Israeli Nuclear Weapons, 2021', Bulletin of the Atomic Scientists 78, no. 1 (2022): 38–50, https://doi.org/10.1080/00963402.2021.2014239.

91 Kristensen and Korda, 'Israeli Nuclear Weapons, 2021'.

92 Kristensen and Korda, 'Israeli Nuclear Weapons, 2021'.

93 Sherif Amin, 'The Samson Option: Implications for the Nuclear Taboo and Fatalism', Al Habtoor Research Centre, 8 April 2026, https://www.habtoorresearch.com/programmes/samson-option-nuclear-fatalism/; Sharad Joshi, 'Israel's Nuclear Policy: A Cost-Benefit Analysis', Strategic Analysis XXIII, no. 12 (2000), https://ciaotest.cc.columbia.edu/olj/sa/sa_00jos01.html.

94 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

95 Kristensen and Korda, 'Israeli Nuclear Weapons, 2021'.

Fissile material production

Israel is believed to possess approximately 300 kg of HEU reportedly "diverted from the NUMEC plant in the US in the 1960s."[96]

In 1957, Israel procured a research reactor and plutonium separation technology from France. Construction began at the Negev Nuclear Research Center near Dimona in 1958, where the programme's purpose was obscured, claiming that the site was a textile factory or a civilian research centre. This effort allowed the construction of a six-story underground chemical reprocessing plant to proceed largely undetected by visiting scientists, with plutonium production reportedly beginning in 1966. The reactor may now be used to primarily produce tritium, as Israel has a surplus of plutonium due to low demand in its alleged nuclear weapons programme. The country has reportedly produced around 0.9±0.1 tonnes of plutonium.[97]

Comparison with the DPRK

Similarity in this domain: Not analogous

Unlike Israel, the DPRK[98] faces stronger incentives to demonstrate production, testing and deployment progress because its adversaries scrutinise whether it has enough fissile material for tactical weapons, longer-range systems and survivable reserve forces. Further, Israel does not appear to face constraints on fissile material supply as its demand is not particularly high.

96 Roger J. Mattson, The NUMEC Affair: Did Highly Enriched Uranium from the U.S. Aid Israel's Nuclear Weapons Program?, ed. Roger J. Mattson et al., vol. 565, Israeli Nuclear History Series (National Security Archive, 2016), https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2016-11-02/numec-affair-did-highly-enriched-uranium-us-aid-israels-nuclear-weapons-program; 'Countries: Israel', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/israel.html.

97 Kristensen and Korda, 'Israeli Nuclear Weapons, 2021'; International Panel on Fissile Materials, 'Countries: Israel', 22 May 2026.

98 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Nuclear tests and warhead design

A US reconnaissance satellite detected a double flash of light off the eastern coast of South Africa on 22 September 1979, dubbed the Vela incident. The “double flash” is considered a key signature of a nuclear detonation, but the incident is still not fully understood, as most information remains classified.[99] Some analysts suggest that Israel had strong motivation to test in 1979 as development of a two-stage nuclear device typically requires testing in order to ensure the functioning of the trigger (or primary). Others suggest South Africa or another collaborator could have been responsible, while a non-nuclear origin is also possible due to the lack of supporting data.[100] Therefore, it is unclear if this incident was a nuclear test conducted by Israel or not.

To date, it is unknown what warhead designs Israel may have incorporated into its arsenal, but assessments range from single-stage, boosted fission warheads to two-stage thermonuclear warheads and neutron bombs.[101] Estimates generally treat WGP as the primary fissile material in Israel’s arsenal because the Dimona complex was built around plutonium production and separation.[102]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Given the lack of a documented testing series (or at most a singular test), the specifics about Israel’s weapons programme remains largely unknown. The Vela incident marks the outer boundary of what open sources can responsibly say about Israel’s test history. If it was a nuclear test, Israel may have validated at least one design without abandoning ambiguity. If it was not, Israel’s deterrent rests on a striking absence of explosive test data.

Either way, Israel’s case shows that a state can sustain nuclear deterrence through assumed capability rather than public demonstration. For Israel, ambiguity strengthens deterrence because adversaries already assume it possesses a survivable last-resort capability. For the DPRK, too much ambiguity could weaken deterrence because its doctrine depends on convincing adversaries that it can impose unacceptable costs across multiple scenarios.[103] This helps explain why the DPRK has relied on testing, public claims and delivery-system demonstrations in ways that Israel has avoided.

99 ‘Israel Nuclear Overview’, The Nuclear Threat Initiative, 14 May 2014, https://www.nti.org/analysis/articles/israel-nuclear/.

100 ‘Israel Nuclear Overview’; Avner Cohen and William Burr, ‘Revisiting the 1979 VELA Mystery: A Report on a Critical Oral History Conference’, Sources and Methods, Wilson Center History and Public Policy Program, 31 August 2020, https://www.wilsoncenter.org/blog-post/revisiting-1979-vela-mystery-report-critical-oral-history-conference; William Burr et al., ‘Blast from the Past’, Foreign Policy, 22 September 2019, https://foreignpolicy.com/2019/09/22/blast-from-the-past-vela-satellite-israel-nuclear-double-flash-1979-ptbt-south-atlantic-south-africa/.

101 Kristensen and Korda, ‘Israeli Nuclear Weapons, 2021’.

102 ‘Countries: Israel’, International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/israel.html; Kristensen and Korda, ‘Israeli Nuclear Weapons, 2021’.

103 For a more extensive analysis of the DPRK’s current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Arsenal size and delivery systems

The most recent open-source estimates place the number of Israeli warheads at approximately 90.[104] While information on their payload and deployment remains limited, Israel likely uses the following delivery systems: F-16I and F15I aircraft; Jericho II and Jericho III land-based missiles; and Popeye sea-launch cruise missiles (SLCMs).[105] The Jericho III missile possibly has MIRV capabilities.[106]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Although the two arsenals may be broadly similar in size, this does not mean they serve equivalent deterrence requirements. Israel's geography and target set allow a relatively small arsenal to function as a last-resort regional deterrent, supported by substantial conventional capabilities.

The DPRK's arsenal must serve a wider and more operationally demanding set of missions. It is intended to deter US-ROK conventional operations, threaten regional targets and US bases, and increasingly demonstrate an ability to hold the US homeland at risk. As a result, similar arsenal size does not imply similar deterrent sufficiency.[107]

104 Kristensen and Korda, '8. World Nuclear Forces'.

105 Kristensen and Korda, 'Israeli Nuclear Weapons, 2021'.

106 Missile Defense Project, 'Jericho 3', Center for Strategic and International Studies: Missile Threat, 23 April 2024, https://missilethreat.csis.org/missile/jericho-3/.

107 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

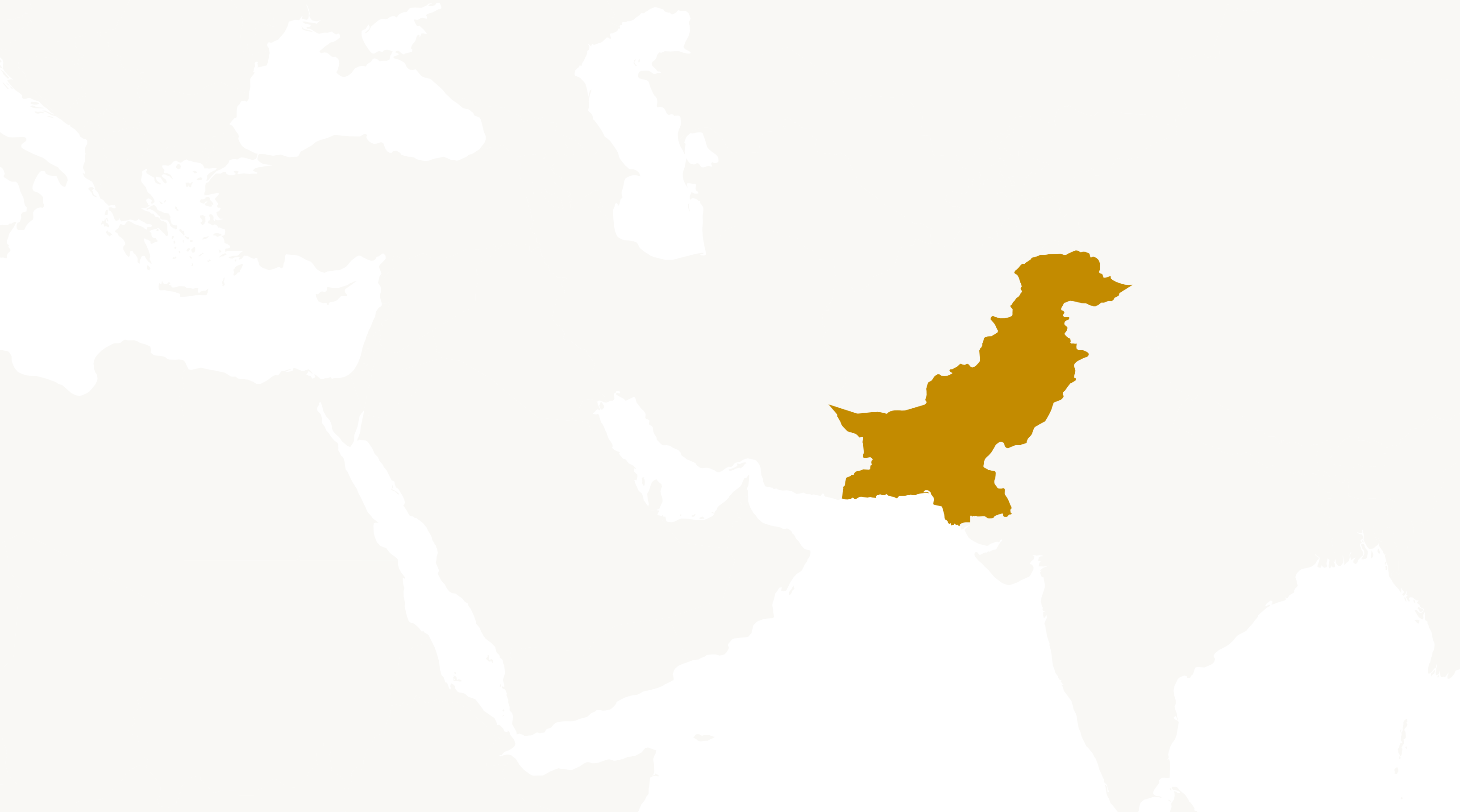
Key takeaways

Key parallels:

- Israel shows that nuclear deterrence can rest on assumed capability rather than public demonstration when adversaries already believe the threat is credible.
- Israel's possible advancement without a sustained test series offers a limited analogue for the DPRK as Israel does not need to develop its arsenal for distant adversaries. If the DPRK were to forego future nuclear explosive testing, it would need to rely more heavily on modelling, conservative designs, external knowledge or missile testing to maintain confidence and credibility.

Key differences:

- Both programmes are rooted in perceived existential threats, but they responded to those threats in opposite ways. Israel built deterrence through deliberate ambiguity, while the DPRK has built deterrence through explicit claims, legal codification, nuclear testing and repeated missile demonstrations.
- Israel retains substantial conventional superiority over its regional adversaries, while the DPRK's conventional vulnerability against the US-ROK alliance increases the role of nuclear weapons in warfighting and escalation planning.
- Israel does not appear to face the same fissile-material constraints as the DPRK, and its presumed arsenal can remain relatively small without advanced missile development because its deterrent is regionally focused. The DPRK's broader target set creates stronger incentives for arsenal growth, delivery-system diversification and continued signalling.



Pakistan

Key information

STATED NUCLEAR POLICY: Credible minimum, full spectrum deterrence	
FISSILE MATERIAL IN ARSENAL: HEU	
FIRST NUCLEAR TEST: 28 May 1998	
TOTAL NUMBER OF NUCLEAR TESTS: 6	
TWO-STAGE THERMONUCLEAR: Unknown	
TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: Not applicable	
GAS BOOSTING: Unknown	
TIME FROM FIRST TEST TO GAS BOOSTING: Not applicable	
CURRENT NUMBER OF WARHEADS: 170 (external expert assessment)	
DELIVERY POSTURE: Dyad (land and air), moving towards triad	

Nuclear strategy

Pakistan's nuclear posture is defined by "credible minimum deterrence,"[108] further operationalised through "full spectrum deterrence."[109] The latter incorporates a range of capabilities, including long-range missile systems and strategic aircraft, alongside various short-range, lower-yield nuclear-capable weapons. This posture is designed to address Indian military threats across the entire Indian territory, to include countervalue, counterforce and battlefield targets. Pakistan's use of non-strategic nuclear weapons has been shaped by its interpretation of India's "cold start" strategy, which involves large-scale non-nuclear attacks or territorial intrusions, just under the nuclear threshold. In contrast to India, Pakistan has not adopted a blanket NFU policy; it does however maintain a NFU policy towards NNWS.[110]

Comparison with the DPRK

Similarity in this domain: Partial analogue

Both Pakistan and the DPRK use nuclear weapons to compensate for conventional military disadvantage and to deny an adversary confidence in fighting a limited conventional war.[111] In both cases, non-strategic nuclear options are intended to close perceived gaps below the strategic level and complicate adversary planning.[112]

However, Pakistan's posture is designed almost entirely around India. Its nuclear strategy seeks to deter Indian conventional incursions, counterforce options and escalation dominance within a geographically proximate rivalry. The DPRK's posture must deter conflict on the Korean Peninsula while also threatening US regional bases and the US homeland in order to weaken Washington's confidence in extended deterrence. This means the DPRK requires both short-range systems for peninsula contingencies and credible long-range systems to hold US territory and overseas forces at risk.

108 Dr. Zafar Iqbal Cheema, 'Pakistan's Posture of Credible Minimum Deterrence: Current Challenges and Future Efficacy', Margalla Papers 12, no. 2 (2008): 43–78.

109 Hans M. Kristensen et al., 'Pakistan Nuclear Weapons, 2025', Bulletin of the Atomic Scientists 81, no. 5 (2025): 386–408, https://doi.org/10.1080/00963402.2025.2543685.

110 Kristensen et al., 'Pakistan Nuclear Weapons, 2025'.

111 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

112 Rajeswari (Raji) Pillai Rajagopalan and Linus Cohen, Mapping India-Pakistan Military Power (Australian Strategic Policy Institute, 2025), https://www.aspi.org.au/report/mapping-india-pakistan-military-power/; Arzan Tarapore, 'Almost Parity: Understanding the India–Pakistan Conventional Military Balance', in Routledge Handbook on South Asian Foreign Policy (Routledge, 2021), https://www.taylorfrancis.com/chapters/edit/10.4324/9780429054808-32/almost-parity-arzan-tarapore.

Fissile material production

Pakistan began producing WGP in 1998, with an initial production capacity of 11 kg per year.[113] Pakistan's accumulated stockpile is presumed to be 0.62±0.21 tonnes of WGP, produced at four reactors in Khushab.[114]

With the orchestration of A.Q. Khan (the architect of Pakistan's nuclear weapons programme) and technology from China, Pakistan began enriching uranium via centrifuge technology in the 1980s.[115] Pakistan currently has an estimated 5.5±1.6 tonnes of HEU. There is limited reliability of this estimate due to uncertainties surrounding Pakistan's uranium resources, the capabilities of its centrifuge facility in Kahuta and the possibility of a second facility in Gadwal.[116]

Comparison with the DPRK

Similarity in this domain: Partial analogue

The DPRK's centrifuges are based on Pakistani designs proliferated by the A.Q. Khan network, although they have likely since been modified from the original designs.[117] However, larger amounts of both HEU and WGP give Pakistan more freedom to develop different warhead types for different missions.

The DPRK also appears to be pursuing both HEU and WGP pathways, but from a more constrained material base.[118] Pakistan's large base allows for a broader full-spectrum posture without forcing the same degree of trade-off between tactical, regional and long-range systems.

Nuclear tests and warhead design

Pakistan's nuclear weapons programme allegedly began under the auspices of assistance and mentorship from China.[119] During the international investigation into the A.Q. Khan proliferation network beginning in 2004, two Chinese fission bomb blueprints were discovered. Similar to India's testing series, Pakistan conducted its six tests over three days in 1998.

- **28 May 1998:** Pakistani officials state that Pakistan conducted five nuclear explosions with a combined yield of up to 40 kt. According to official statements, the series included one boosted fission device (it is unclear if this meant gas- or solid-boosted) and four sub-kiloton devices; the tested designs were HEU-based.[120]

113 'Pakistan Nuclear Overview', The Nuclear Threat Initiative, 5 November 2019, http://www.nti.org/analysis/articles/pakistan-nuclear/.

114 'Countries: Pakistan', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/pakistan.html.

115 'Pakistan Nuclear Overview'.

116 International Panel on Fissile Materials, 'Countries: Pakistan'.

117 'Pakistan Nuclear Overview'.

118 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

119 William Burr, China, Pakistan, and the Bomb: The Declassified File on U.S. Policy, 1977-1997, National Security Archive Electronic Briefing Book no. 114 (The National Security Archive, n.d.), accessed 15 October 2024, https://nsarchive2.gwu.edu/NSAEBB/NSAEBB114/index.htm; Thomas C. Reed, 'The Chinese Nuclear Tests, 1964–1996', Physics Today 61, no. 9 (2008): 47–53, https://doi.org/10.1063/1.2982122; R. Jeffery Smith and Joby Warrick, 'Scientist: China Gave Pakistan Nuke Blueprint', NBC News, 13 November 2009, https://www.nbcnews.com/id/wbna33904300.

120 'Pakistan Nuclear Weapons', Federation of American Scientists, 12 November 2002, https://nuke.fas.org/guide/pakistan/nuke/; 'Pakistan Nuclear Overview'.

    - Some analysts dispute the official test count and assess that only two or three tests occurred with a combined yield of roughly 9–12 kt.[121]
    - Some analysts assess that two distinct designs may have been tested, a boosted HEU device and a plutonium device.[122]
- **30 May 1998:** Pakistani officials state that one additional nuclear test was conducted, with a yield of approximately 12 kt.[123] Some sources estimate the yield at around 4–6 kt.[124]

The fact that Pakistan conducted its tests within weeks of India's 1998 tests suggests that technical preparations were likely underway in advance, with execution contingent on political authorisation.[125] Separate reporting suggests that Pakistan detonated a miniaturised device during its 1998 test series. If accurate, this would be consistent with the possibility of external assistance, though the claim remains insufficiently substantiated in open sources.[126]

With no nuclear tests since 1998, the subsequent evolution of Pakistani weapon designs remains unclear, and uncertainty persists regarding gas-boosting and thermonuclear capabilities, particularly given the relatively low yields observed in the test series.

Comparison with the DPRK

Similarity in this domain: Partial analogue

As the DPRK is known to have acquired centrifuge technology through similar proliferation networks, it could have similarly acquired certain nuclear weapon designs, although open-source evidence for this is inconclusive.[127] Both the DPRK and Pakistani weapon designs likely started from a relatively compact device, highlighting their late-mover advantages.[128]

However, Pakistan and the DPRK used nuclear testing for different purposes. Pakistan's 1998 tests were politically tied to India's tests and served primarily to demonstrate nuclear status and restore deterrence symmetry with India. The DPRK's tests were spaced over 11 years, allowing each test to support claims of improving yield, miniaturisation and delivery relevance. The primary design distinction is that Pakistan officially claimed to have tested HEU devices, whereas the DPRK's early tests are generally assessed to have used WGP. In both cases, ambiguity remains over gas boosting, and Pakistan's thermonuclear capability remains unconfirmed.[129]

121 Federation of American Scientists, 'Pakistan Nuclear Weapons'.

122 Hans M. Kristensen and Matt Korda, 'Pakistani Nuclear Weapons, 2021', Bulletin of the Atomic Scientists 77, no. 5 (2021): 265–78, https://doi.org/10.1080/00963402.2021.1964258.

123 Federation of American Scientists, 'Pakistan Nuclear Weapons'; 'Pakistan Nuclear Overview'.

124 'Ten Years since India and Pakistan Conducted Nuclear Tests', CTBTO Preparatory Commission, 2008, https://www.ctbto.org/news-and-events/news/ten-years-india-and-pakistan-conducted-nuclear-tests; Federation of American Scientists, 'Pakistan Nuclear Weapons'.

125 Kristensen and Korda, 'Pakistani Nuclear Weapons, 2021'; Carey Sublette, 'Pakistan's Nuclear Weapons Program - 1998: The Year of Testing', Nuclear Weapon Archive, 11 October 2001, https://nuclearweaponarchive.org/Pakistan/PakTests.html.

126 Sanger and Broad, 'Officials Fear Design of Nuclear Bomb Went to Others'; Joby Warrick and Peter Slevin, 'Libyan Arms Designs Traced Back to China', The Washington Post, 14 February 2004, https://www.washingtonpost.com/archive/politics/2004/02/15/libyan-arms-designs-traced-back-to-china/2aacac24-4d49-4198-9aa0-7d68962fd8c2/.

127 Reportedly, Libya received a crude bomb design in addition to centrifuge equipment from A.Q. Khan's network. See: William J. Broad, 'Libya's Crude Bomb Design Eases Western Experts' Fear', World, The New York Times, 9 February 2004, https://www.nytimes.com/2004/02/09/world/libya-s-crude-bomb-design-eases-western-experts-fear.html.

128 This could also be deduced from the perspective of missile delivery systems. The DPRK's Hwasong-7 medium-range ballistic missile and its Pakistani version, the Ghauri, served as the main regional nuclear weapon delivery system for both states for decades. The missile has a body diameter of around 1.3 metres, limiting the size of nuclear payload it carries.

129 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Arsenal size and delivery systems

Pakistan is estimated to possess around 170 nuclear warheads, with the potential for growth to around 200 by the end of the 2020s.[130] The Pakistani government does not publicly declare its arsenal size.

Its delivery systems include air-launched cruise missiles (ALCMs), SLCMs and land-based ballistic and cruise missiles, with a range of 70–2,750 km.[131] Beyond its land and air systems, Pakistan is currently developing a sea-based leg of its nuclear triad through the Babur-3 cruise missile, which has an estimated range of 450 km. This expansion into the maritime domain, alongside the development of medium-range ballistic missiles reflects a continued effort to build up its nuclear forces.[132]

Pakistan reportedly maintains its nuclear warheads in a disassembled state during peacetime, keeping fissile cores separate from their warheads, which greatly increases the time required for deployment.[133]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Both countries aim to complicate adversary planning, but at different scales. Pakistan's delivery systems are designed to make India uncertain about escalation, while the DPRK's must do that on the Korean Peninsula and also threaten US bases/homeland.[134] This gives the DPRK a stronger incentive to pursue ICBMs and SLBMs. Whereas Pakistan's range requirements are primarily located in India.[135]

130 Kristensen et al., 'Pakistan Nuclear Weapons, 2025'; Kristensen and Korda, '8. World Nuclear Forces'.

131 Kristensen et al., 'Pakistan Nuclear Weapons, 2025'.

132 'Arms Control and Proliferation Profile: Pakistan', Arms Control Association, August 2023, https://www.armscontrol.org/factsheets/arms-control-and-proliferation-profile-pakistan.

133 'Arms Control and Proliferation Profile: Pakistan'.

134 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

135 We acknowledge recent claims suggesting that Pakistan may be pursuing longer-range, including ICBM, capabilities. For more information, see : Paul K. Kerr, Pakistan's New Long-Range Missile Development, In Focus no. IF13086 (Congressional Research Service, 2025), https://www.congress.gov/crs-product/IF13086. However, these indications are currently insufficient to confidently claim that Pakistan has changed its nuclear doctrine and is on the path towards acquiring ICBM capability.

Key takeaways

Key parallels:

- Pakistan is the strongest doctrinal comparison for the DPRK because both states use nuclear weapons to offset conventional disadvantage and deter limited conventional war. Pakistan's full spectrum deterrence shows how a state can use lower-threshold nuclear options to close perceived gaps below the strategic level and deny an adversary confidence in limited conventional operations.
- Both programmes have used similar centrifuge designs, and have pursued dual tracks of HEU and WGP production.
- Both states have developed multiple delivery options, but Pakistan's diversification is India-centred, while the DPRK's must support both peninsula-level deterrence and threats against US regional and homeland targets.
- Both benefited from late-mover advantage, allowing for capability development with comparatively few tests.

Key differences:

- Pakistan's conventional forces are not as outmatched as the DPRK's, giving Islamabad more viable conventional options before nuclear escalation.
- Pakistan's primary adversary is geographically proximate, while the DPRK has incentives to develop longer-range systems capable of holding US bases and the US homeland at risk. This creates stronger pressure for warhead miniaturisation and weight reduction for longer-range missile delivery.
- Pakistan is assessed to hold substantially larger fissile material inventories than the DPRK.
- Pakistan stated that its 1998 tests used only HEU in its devices, despite also stockpiling WGP, whereas the DPRK has declared that it has used both HEU and WGP in its warhead designs.

South Africa

Key information

STATED NUCLEAR POLICY: From strategic uncertainty to dismantlement	
FISSILE MATERIAL IN ARSENAL: HEU	
FIRST NUCLEAR TEST: Unconfirmed, possibly 22 September 1979	
TOTAL NUMBER OF NUCLEAR TESTS: 0 or 1	
TWO-STAGE THERMONUCLEAR: No	
TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: Not applicable	
GAS BOOSTING: No	
TIME FROM FIRST TEST TO GAS BOOSTING: Not applicable	
CURRENT NUMBER OF WARHEADS: 0 (6 operational before dismantlement, South African declaration)	
DELIVERY POSTURE: Air	

Nuclear strategy

On 24 March 1993, South African President de Klerk declared that the country had created and subsequently dismantled a "limited nuclear deterrent capability," consisting of several gun-type assembly devices.[136]

Initially, the nuclear programme had maintained an official focus on peaceful applications until approximately 1977, when the programme's official objective shifted towards establishing a strategic deterrent. The shift to acquire this capability was prompted by escalating security challenges along South Africa's borders and increasing international isolation in political and nuclear technology spheres.

South Africa's perceived threat came from regional conflicts in Angola and Namibia, Cuban military involvement, Soviet support for anti-apartheid and Marxist-aligned forces, and the possibility that South Africa could become isolated in a wider regional crisis. It retained significant conventional military capabilities relative to most neighbouring states.

In April 1978, a nuclear policy of "strategic uncertainty" was adopted, whereby its nuclear capability would only be acknowledged to the US or other international powers "should South African territory be threatened." This policy included a final clause threatening an underground nuclear test should any territorial threat persist after acknowledgement of the nuclear weapons programme.[137] South Africa never envisioned or intended offensive nuclear use, understanding such actions would provoke significant international retaliation. In reality, the strategy never progressed to the stage of international acknowledgement.[138] Due to this policy of strategic ambiguity, it is unclear if South Africa ever had an NFU policy.

By the late 1980s to early 1990s, following Namibia's independence, the withdrawal of Cuban troops from Angola, efforts to secure peace in Angola and the collapse of the Soviet Union, South Africa concluded that its nuclear deterrent was no longer necessary and voluntarily gave up its nuclear weapons programme.[139] While the security landscape is likely the main reason, other reasons contributed to the decision to abandon the nuclear weapons programme, such as the de Klerk apartheid government in its late stages harbouring concerns about "undeclared nuclear material and technology falling in the hands of a black-led government."[140]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Similar to the DPRK,[141] South Africa developed its nuclear arsenal in response to a sense of political isolation and regional security threats. Though its adversaries were largely non-nuclear,

136 Adolf von Baeckmann et al., 'Nuclear Verification in South Africa', IAEA Bulletin, Atoms for Peace, vol. 37, no. 1 (1995), https://www.iaea.org/sites/default/files/publications/magazines/bulletin/bull37-1/37105394248.pdf.

137 Waldo Stumpf, 'Birth and Death of the South African Nuclear Weapons Programme', 50 YEARS AFTER HIROSHIMA, Castiglioncello, Italy, 28 October 1995, https://nuke.fas.org/guide/rsa/nuke/stumpf.htm.

138 J. W. de Villiers et al., 'Why South Africa Gave Up the Bomb', Foreign Affairs, 1 December 1993, https://www.foreignaffairs.com/articles/south-africa/1993-12-01/why-south-africa-gave-bomb.

139 de Villiers et al., 'Why South Africa Gave Up the Bomb'.

140 Arunjana Das, 'Role of Moral Foundations in the Nuclear Disarmament of South Africa', Scientia Militaria - South African Journal of Military Studies 50, no. 1 (2022): 1, https://doi.org/10.5787/50-1-1331.

141 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

some were supported by nuclear-armed states. Unlike the DPRK, South Africa chose to keep its programme secret until its decision to dismantle.

With the threat landscape fundamentally changed, South Africa deemed its nuclear arsenal “superfluous” and dismantled its programme voluntarily.[142] South Africa’s nuclear rollback was made possible only by a fundamental transformation in the state’s security environment and domestic political order.

This means South Africa is not a model for DPRK denuclearisation unless both the DPRK’s external threat environment and internal political incentives change dramatically. South Africa gave up weapons that had never become central to military doctrine or regime identity. The DPRK, by contrast, has embedded nuclear weapons in law, military planning and regime legitimacy making a similar outcome highly unlikely under current geopolitical and domestic conditions.

Fissile material production

South Africa focused exclusively on HEU production and did not produce plutonium for nuclear weapons. From 1977 to 1990, it produced approximately 990 kg of HEU with an average enrichment level of 68%, of which 478 kg was enriched to approximately 87.4%.[143]

Comparison with the DPRK

Similarity in this domain: Not analogous

South Africa’s HEU pathway supported simple gun-type devices suitable for a small, recessed deterrent intended primarily for political signalling rather than for operational military use. The DPRK’s dual-track approach supports a more operationally diverse arsenal, including missile-deliverable warheads/tactical systems and potentially more compact designs.

Even though South Africa’s fissile-material constraint limited the pace and size of its programme, its narrow deterrence concept did not require large numbers of sophisticated warheads. Conversely, the DPRK faces continuing pressure to expand fissile-material production.

142 de Villiers et al., ‘Why South Africa Gave Up the Bomb’.

143 David Albright and Andrea Stricker, Revisiting South Africa’s Nuclear Weapons Program: Its History, Dismantlement, and Lessons for Today (Institute for Science and International Security; CreateSpace Independent Publishing Platform, 2016), https://isis-online.org/uploads/isis-reports/documents/RevisitingSouthAfricasNuclearWeaponsProgram.pdf.

Nuclear tests and warhead design

South Africa began warhead development in 1971, producing its first device in 1979 and the last in 1989.[144] One assessment suggests that South Africa's nuclear weapons had 50–60 kg of HEU each, with a yield of 10–18 kt.[145]

South Africa made several unique decisions regarding its weapons programme. First, it pursued only uranium weapons with no apparent plans for plutonium production. Second, South Africa only produced six active weapons (not accounting for the one device under development at the time of dismantlement), all of which were gun-type assemblies.[146] Additionally, advanced concepts like implosion devices and lithium-6 production (for use in boosting) were limited to theoretical exploration.[147]

South Africa's gun-type HEU device was inefficient in fissile-material terms but technically conservative and did not require a nuclear test to establish basic confidence. Because South Africa's weapons were not intended for flexible battlefield use or a large missile force, the state had less incentive to move quickly towards miniaturised implosion designs, boosted weapons or thermonuclear development. This strongly contrasts with other programmes, which generally move towards implosion and plutonium design development fairly quickly, as these features require less fissile material.

As discussed in the section on Israel, a US reconnaissance satellite detected a double flash of light off the eastern coast of South Africa on 22 September 1979. The "double flash" is considered a key signature of a nuclear detonation, but the Vela incident is still not fully understood, as most information remains classified.[148] Some analysts suggest that South Africa had a motive to conduct a test in 1979, given the advanced state of its nuclear programme at the time and the technical challenges associated with weapons development. Others suggest that Israel or another collaborator could have been involved, while a non-nuclear origin is also possible due to the lack of supporting data.[149]

Comparison with the DPRK

Similarity in this domain: Not analogous

South Africa's weapons designs and testing (or lack thereof) bear no similarities to those of the DPRK. South Africa's simple gun-type assembly design likely did not require testing, similar to the decision taken by the US in 1945 for its first weapon. In contrast, the DPRK's programme began with implosion devices, which necessitate testing.[150] The DPRK's testing pattern reflects its needs to validate warhead designs suitable for ballistic missiles, improve confidence in miniaturisation and demonstrate credibility to adversaries. South Africa never needed these things.

144 von Baeckmann et al., 'Nuclear Verification in South Africa', 42–48.

145 de Villiers et al., 'Why South Africa Gave Up the Bomb'.

146 Lt Col Roy E. Horton, OUT OF (SOUTH) AFRICA: PRETORIA'S NUCLEAR WEAPONS EXPERIENCE, Occasional Paper no. 27 (USAF Institute for National Security Studies, 1999), https://nuke.fas.org/guide/rsa/nuke/ocp27.htm.

147 Stumpf, 'Birth and Death of the South African Nuclear Weapons Programme'.

148 'Israel Nuclear Overview'.

149 'Israel Nuclear Overview'; Cohen and Burr, 'Revisiting the 1979 VELA Mystery'; Burr et al., 'Blast from the Past'.

150 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Arsenal size and delivery systems

The South African nuclear programme was characterised by its limited geographic footprint, constrained resources and small number of weapons. The country required domestic production of various components and, with limited availability of HEU, the production rate was severely limited. At the programme's conclusion, the inventory comprised eight weapons: six operational (including five suitable for use and one designated as a test device), one under construction for testing purposes and one additional training device without a fissile core.[151]

South Africa's weapons were designed for stand-off delivery on the Buccaneer bomber, using the Raptor glide bomb (with a range of 60 km).[152]

Comparison with the DPRK

Similarity in this domain: Not analogous

South Africa's likely target set was regional, and its nuclear concept relied on aircraft delivery as part of a political signalling strategy. It did not require survivable second-strike forces, long-range ballistic missiles, SLBMs, tactical nuclear weapons or systems capable of holding a distant homeland at risk.

The DPRK's target set is much broader. This wider target set explains why the DPRK has stronger incentives to develop multiple missile ranges, mobile launchers, sea-based systems and potentially MIRVs. Therefore, South Africa's delivery posture reflected a narrow regional deterrent designed for last-resort political leverage.

151 Horton, OUT OF (SOUTH) AFRICA: PRETORIA'S NUCLEAR WEAPONS EXPERIENCE.

152 Albright and Stricker, Revisiting South Africa's Nuclear Weapons Program.

Key takeaways

Key parallels:

- Both programmes emerged from political isolation and perceived external threat, but the adversary sets and military balances were fundamentally different. A deterrent primarily intended for nuclear signalling can remain very small. South Africa's arsenal was designed to create strategic uncertainty and potentially trigger Western intervention in an extreme crisis, not to support battlefield use or sustained nuclear warfighting.
- The South African case shows that dismantlement is possible when the threat environment and domestic political order change fundamentally. However, there is no obvious comparable pathway for the DPRK under current conditions, short of a dramatic transformation of the peninsula's security environment and the DPRK's domestic political system.

Key differences:

- South Africa faced regional, mostly non-nuclear adversaries while retaining significant conventional capabilities of its own. The DPRK faces a qualitatively superior US–ROK alliance backed by US nuclear capabilities.
- South Africa gave up weapons that had never become central to military doctrine or regime identity. The DPRK is expanding its arsenal and has embedded nuclear weapons in law, military planning and regime legitimacy.
- South Africa built HEU gun-type assembly devices and may not have tested. The DPRK began with WGP implosion designs and pursued a nuclear test series, reflecting more demanding warhead and delivery-system requirements.
- South Africa had no need for intercontinental reach or survivable second-strike forces. The DPRK does, because its deterrence problem includes both peninsula-level warfighting and strategic deterrence against the US.

Soviet Union/Russia

Key information

STATED NUCLEAR POLICY: From warfighting to defensive with broad use cases

FISSILE MATERIAL IN ARSENAL: HEU and WGP

FIRST NUCLEAR TEST: 29 August 1949

TOTAL NUMBER OF NUCLEAR TESTS: 715

TWO-STAGE THERMONUCLEAR: Yes, 1955

TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 6 years

GAS BOOSTING: Yes, 1957

TIME FROM FIRST TEST TO GAS BOOSTING: 8 years

CURRENT NUMBER OF WARHEADS: 5,420 (external expert assessment)

DELIVERY POSTURE: Triad

Nuclear strategy

Initially, nuclear weapons were viewed as a means of enhancing firepower and winning in general wars, as well as tools for striking both battlefield and strategic assets. From 1955, the concept of pre-emptive nuclear strikes entered strategic thinking.[153] Military thinkers moved away from the belief in victory in an all-out nuclear war with battlefield use of nuclear weapons and moved towards concepts of deterrence. By the end of the 1960s, it was understood that a truly disarming first strike was impossible, and deterrence became the primary strategic approach.[154]

The 1970s saw operational plans developed for conventional and nuclear forces, with conventional conflicts preceding nuclear use. Similarly, the pre-emptive strike scenario was still included in nuclear war planning due to the Soviet belief that US nuclear and anti-ballistic missile capabilities were preparation for a surprise nuclear attack against the Soviet Union.[155]

After the collapse of the Soviet Union, Russia's approach to nuclear weapons fluctuated, with their role diminishing in the 1990s.[156] The scope for the use of nuclear weapons slightly broadened during the 2000s, narrowed in the 2010s and once again broadened in the 2020s. Throughout this period, the fundamentally defensive nature of Russia's nuclear weapons policy has been consistently maintained and emphasised.[157] According to current official Russian policy on nuclear deterrence, which does not incorporate an NFU policy, there are five conditions under which Russia could use nuclear weapons:[158]

- "receipt of reliable data on the launch of ballistic missiles attacking the territories of the Russian Federation and (or) its allies;"
- "employment of nuclear or other types of weapons of mass destruction by an adversary against the territories of the Russian Federation and (or) its allies, against facilities and (or) military formations of the Russian Federation located outside its territory;"
- "actions by an adversary affecting elements of critically important state or military infrastructure of the Russian Federation, the disablement of which would disrupt response actions by nuclear forces;"
- "aggression against the Russian Federation and (or) the Republic of Belarus as participants in the Union State with the employment of conventional weapons, which creates a critical threat to their sovereignty and (or) territorial integrity;"
- "receipt of reliable data on the massive launch (take-off) of air and space attack means (strategic and tactical aircraft, cruise missiles, unmanned, hypersonic and other aerial vehicles) and their crossing of the state border of the Russian Federation."

153 David Holloway, Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939-1956 (Yale University Press, 1994), 328, 331–33, https://doi.org/10.2307/j.ctvf3w23z.

154 'Russian / Soviet Doctrine', Federation of American Scientists, 4 September 2000, https://nuke.fas.org/guide/russia/doctrine/intro.htm; Ilya Kramnik, 'Ракетное Продолжение: К Чему Пришла Концепция Ядерного Сдерживания [Missile Continuation: What the Concept of Nuclear Deterrence Came To]', Izvestia, 29 October 2018, https://iz.ru/805612/ilia-kramnik/raketnoe-prodolzhenie-k-chemu-prishla-kontceptciia-iadernogo-sderzhivaniia.

155 Federation of American Scientists, 'Russian / Soviet Doctrine'; Kramnik, 'Ракетное Продолжение: К Чему Пришла Концепция Ядерного Сдерживания [Missile Continuation: What the Concept of Nuclear Deterrence Came To]'.

156 'Russia Nuclear Overview', The Nuclear Threat Initiative, 11 October 2018, http://www.nti.org/analysis/articles/russia-nuclear/.

157 Nikita Degtyarev, 'Everything Old Is New Again: Evolution of Russia's Nuclear Doctrine', Open Nuclear Network, 29 October 2024, https://platform.opennuclear.org/thoughtroom/quick-takes/everything-old-is-new-again-evolution-of-russias-nuclear-doctrine.

158 'Fundamentals of State Policy of the Russian Federation on Nuclear Deterrence', Ministry of Foreign Affairs of the Russian Federation, 3 December 2024, https://www.mid.ru/ru/foreign_policy/international_safety/disarmament/1434131/?lang=en.

Comparison with the DPRK

Similarity in this domain: Partial analogue

For the Soviet Union, early fears of US strategic advantage and surprise attack encouraged pre-emption and warfighting concepts, but these ideas became less central as the Soviet Union developed a secure second-strike capability. For the DPRK, Pyongyang's conventional inferiority, fear of decapitation and exposure to US–ROK precision-strike capabilities may sustain a more permissive nuclear-use doctrine even as its strategic deterrent matures.[159]

Still, the Soviet case offers a possible long-term trajectory. The DPRK could gradually move towards a more deterrence-centred posture if it becomes confident in the survivability of its nuclear forces. Further, both states have had to develop missile capabilities to reach distant adversaries.

159 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Fissile material production

From 1950 to 1962, gaseous diffusion served as the primary uranium enrichment method, producing around 270 tonnes of HEU.[160] With the advent of industrial centrifuges, from 1963 to 1988, the Soviet Union produced approximately 1,200 tonnes of HEU.[161] HEU production for weapons ceased in the Soviet Union in 1988.[162] Russia reportedly continued HEU production for naval and research reactor fuel until the mid–2000s, before fully restarting production for research and breeder reactors in 2012.[163]

Plutonium production increased steadily from 1949 until the second half of the 1960s, then plateaued (with periodic jumps and drawdowns) until the late 1980s, when plutonium production declined.[164] By 1986, the Soviet Union held approximately 140 tonnes of WGP, while its nuclear arsenal peaked at around 45,000 warheads. As force levels declined through the 1990s and 2000s, large quantities of fissile material were removed from military nuclear programmes, including through presidential-level commitments to release up to 500 tonnes of HEU and up to 50 tonnes of plutonium from defence use. Russia downblended 500 tonnes of HEU and designated 34 tonnes of WGP for disposition as civilian fuel.[165] The last three plutonium-production reactors were shut down in 2010. Russia is currently estimated to hold around 194 tonnes of separated plutonium and 680 tonnes of HEU, not all of which is in weapons or directly available for weapons use.[166]

Comparison with the DPRK

Similarity in this domain: Not analogous

The Soviet Union initially faced technical and industrial challenges because it was building a large nuclear complex almost from scratch. Once that complex matured, fissile-material production enabled arsenal growth at a scale unavailable to the DPRK.

The DPRK is a late nuclear developer with access to more accumulated technical knowledge, but with a much smaller industrial base and a more constrained fissile-material pipeline.[167]

160 HEU in this section is assumed to be 90% U-235. Oleg Bukharin, 'Analysis of the Size and Quality of Uranium Inventories in Russia', Science & Global Security 6, no. 1 (1999): 68, https://doi.org/10.1080/08929889608426434.

161 Bukharin, 'Analysis of the Size and Quality of Uranium Inventories in Russia', 68.

162 Oleg Bukharin et al., New Perspectives on Russia's Ten Secret Cities (1999), 6, https://nuke.fas.org/norris/nuc_10019901a_208b.pdf.

163 'Countries: Russia', International Panel on Fissile Materials, 19 June 2026, https://fissilematerials.org/countries/russia.html.

164 See Figure 3 in Anatoli Diakov, 'The History of Plutonium Production in Russia', Science & Global Security 19, no. 1 (2011): 32, https://doi.org/10.1080/08929882.2011.566459; David Albright et al., Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies (Stockholm International Peace Research Institute, 1997), 52, https://www.sipri.org/publications/1997/plutonium-and-highly-enriched-uranium-1996-world-inventories-capabilities-and-policies.

165 Alexander Pavlov and Vladimir Rybachenkov, 'Looking Back: The U.S.-Russian Uranium Deal: Results and Lessons', Arms Control Today, n.d., accessed 17 June 2026, https://www.armscontrol.org/act/2013-12/looking-back-us-russian-uranium-deal-results-and-lessons.

166 International Panel on Fissile Materials, 'Countries: Russia'.

167 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Nuclear tests and warhead designs

- **29 August 1949:** The Soviet Union tested its first atomic bomb, RDS-1. The implosion-type weapon, highly similar to the US Fat Man bomb, had a yield of 22 kt, and a plutonium pit approximately 10 cm in diameter.[168]
- **24 September 1951:** A second nuclear test was conducted, with a yield of 38 kt. This test employed an external neutron initiator to increase power and efficiency. A new implosion method and design significantly reduced the size and weight of the bomb.[169]
- **18 October 1951:** The Soviet Union tested RDS-3, with a yield of 42 kt, using a composite plutonium–uranium pit (uranium enriched to 75%). The RDS-3 became the first mass-produced Soviet nuclear bomb, commissioned in 1954.[170]
- **12 August 1953:** During its fourth nuclear test, the Soviet Union tested RDS-6s, a “Layer Cake” design with a yield of 400 kt. The charge contained both lithium deuteride and tritium, and was intended for delivery by a Tu-16 bomber.[171]
- **22 November 1955:** The first Soviet two-stage thermonuclear weapon was tested, with a yield of 1.6 Mt. Prior to this test, designers focused on modifying the RDS-6s, but the limitations of the Layer Cake design necessitated a fundamentally new approach.[172]
- **Late 1957:** The Soviet Union successfully tested a device with deuterium-tritium gas boosting.[173]

Between 1949 and 1990, the Soviet Union conducted 715 nuclear tests, including 83 tests in the first decade of its programme.[174] The time from nuclear programme initiation to bomb production was approximately four years, or two years and eight months after achieving the first chain reaction, a timeline broadly comparable to that of the US nuclear programme.[175]

Comparison with the DPRK

Similarity in this domain: Partial analogue

The Soviet testing sequence shows rapid movement through several design families. But this

168 Ministry of the Russian Federation for Atomic Energy, ed., Испытания Ядерного Оружия и Ядерные Взрывы в Мирных Целях СССР: 1949 – 1990 гг. [Nuclear Weapon Tests and Nuclear Explosions for Peaceful Purposes of the USSR: 1949 – 1990] (Russian Federal Nuclear Center-VNIIEF, 1997); Thomas B. Cochran et al., Making the Russian Bomb: From Stalin to Yeltsin, 1st edn (Routledge, 2019), https://doi.org/10.4324/9780429039256.

169 ‘Летопись // Эволюция отрасли /// История Росатома 1951 [Chronicle // Evolution of the Industry /// History of Rosatom 1951]’, Росатом История [Rosatom History], accessed 16 October 2024, https://www.biblioatom.ru/timeline/; Holloway, Stalin and the Bomb.

170 Ministry of the Russian Federation for Atomic Energy, Испытания Ядерного Оружия и Ядерные Взрывы в Мирных Целях СССР: 1949 – 1990 гг. [Nuclear Weapon Tests and Nuclear Explosions for Peaceful Purposes of the USSR: 1949 – 1990]; ‘Летопись // Эволюция отрасли /// История Росатома 1949 [Chronicle // Evolution of the Industry /// History of Rosatom 1949]’, Росатом История [Rosatom History], accessed 16 October 2024, https://www.biblioatom.ru/timeline/; Pavel Podvig, ed., Russian Strategic Nuclear Forces (2004), https://mitpress.mit.edu/9780262661812/russian-strategic-nuclear-forces/.

171 ‘Летопись // Эволюция отрасли /// История Росатома 1953 [Chronicle // Evolution of the Industry /// History of Rosatom 1953]’, Росатом История [Rosatom History], accessed 16 October 2024, https://www.biblioatom.ru/timeline/; Holloway, Stalin and the Bomb.

172 Holloway, Stalin and the Bomb, 314–15; ‘Летопись // Эволюция отрасли /// История Росатома 1955 [Chronicle // Evolution of the Industry /// History of Rosatom 1955]’, Росатом История [Rosatom History], accessed 16 October 2024, https://www.biblioatom.ru/timeline/.

173 I. A. Andryushin et al., Укрощение ядра: страницы истории ядерного оружия и ядерной инфраструктуры СССР [Taming the Atom: Pages from the History of Nuclear Weapons and Nuclear Infrastructure in the USSR] (Kras. Oct., 2003), https://elib.biblioatom.ru/text/ukroshchenie-yadra_2003/; S. T. Brezkun and V. M. Voronov, Конструктор в Атомной проблеме: книга о Д. А. Фишмане [A Designer in the Atomic Problem: A Book about D. A. Fishman] (FSUE RFNC - VNIIEF, 2007), https://elib.biblioatom.ru/text/konstruktor-v-atomnoy-probleme_2007/.

174 United Nations, ‘Ending Nuclear Testing’; Cochran et al., Making the Russian Bomb; ‘Nuclear Testing Chronology’, Atomic Archive, accessed 1 October 2024, https://www.atomicarchive.com/almanac/test-sites/testing-chronology.html.

175 Holloway, Stalin and the Bomb, 220.

progression occurred inside a massive state-industrial programme with extensive testing, espionage-derived knowledge and intense great-power competition. That makes it a useful technical reference point, but not a direct model for the DPRK.

The Soviet Union's third test used a device with a composite plutonium-uranium pit, demonstrating that this technology was within its capabilities even at an early stage. This is a crucial data point, as it demonstrates that the use of composite pits in a third test would not be without historical precedent, supporting speculations that the third DPRK nuclear test could have involved uranium or a composite pit.[176]

The Soviet RDS-6s test was far larger than the DPRK's fourth test in 2016 and occurred within a much more extensive testing programme, so it should not be treated as a direct technical analogue. However, it shows that composite pits, boosted devices and thermonuclear-adjacent configurations can represent meaningful steps towards more advanced weapons, even when they fall short of a mature two-stage thermonuclear capability. Applied to the DPRK, this suggests that early or ambiguous "H-bomb" claims should not be dismissed outright nor should they be treated as proof of an operational two-stage warhead.

Arsenal size and delivery systems

According to some open-source expert assessments, the Soviet Union had 1,060 warheads by 1959, nearly 10,500 by 1969 and close to 30,000 by 1979. The nuclear arsenal peaked in 1986, reaching 45,000 warheads.[177]

Experts estimate that Russia currently has about 5,420 nuclear warheads in total, with 1,020 of those retired and awaiting dismantlement.[178] The most recent New Strategic Arms Reduction Treaty (New START) update (from 2023 and published by the US Department of State) reports 1,549 deployed warheads for strategic systems.[179] Russia's arsenal can be delivered by a wide variety of systems (of a myriad of ranges), including land-based ballistic and cruise missiles, SLBMs, ALCMs and SLCMs.[180]

Comparison with the DPRK

Similarity in this domain: Not analogous

Russia's mature triad gives Moscow multiple ways to survive attack, signal escalation and threaten distant targets. The DPRK is trying to acquire the survivability and penetration functions with a much smaller and less mature force.[181] This helps explain its interest in mobile ICBMs, solid-fuel missiles, SLBMs and potentially MIRVs, and the Soviet/Russian case could point to a future missile-development trajectory.

176 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

177 Kristensen et al., 'Nuclear Notebook'.

178 Hans M. Kristensen et al., 'Russian Nuclear Weapons, 2026', Bulletin of the Atomic Scientists 82, no. 3 (2026): 221–54, https://doi.org/10.1080/00963402.2026.2659527.

179 'New START Treaty Aggregate Numbers of Strategic Offensive Arms', United States Department of State, 1 September 2022, https://www.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-4/.

180 Kristensen et al., 'Russian Nuclear Weapons, 2026'.

181 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Key takeaways

Key parallels:

- Testing-sequence parallels (composite pit at an early stage and thermonuclear claim at a comparable fourth-test point) show that intermediate designs can represent meaningful steps towards more advanced weapons.
- Both cases show how perceived vulnerability can broaden nuclear-use concepts, even though the military balances are very different.
- The Soviet evolution from nuclear warfighting concepts towards deterrence illustrates a possible long-term doctrinal trajectory, especially in deterring distant adversaries. However, the DPRK would first likely need to develop enough confidence in force survivability to reduce reliance on early or battlefield nuclear options.

Key differences:

- Soviet/Russian fissile material production, quantity of nuclear weapons testing, variety of weapons designs and arsenal size are orders of magnitude beyond that of the DPRK, limiting direct comparability for quantities and force structure.
- The DPRK is not inventing the same technologies from scratch, but it also lacks the Soviet Union's industrial scale, testing volume and global military requirements.
- Russia's force structure reflects decades of triad development and arms-race competition with the US, a physically distant adversary. The DPRK's force structure reflects the narrower but still demanding problem of deterring peninsula-level conflict while holding US regional bases and the US homeland at risk. United Kingdom

United Kingdom

Key information

STATED NUCLEAR POLICY: Minimum, credible, independent nuclear deterrent	
FISSILE MATERIAL IN ARSENAL: Initially WGP, followed shortly by HEU	
FIRST NUCLEAR TEST: 3 October 1952	
TOTAL NUMBER OF NUCLEAR TESTS: 45	
TWO-STAGE THERMONUCLEAR: Yes, 1957	
TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 5 years	
GAS BOOSTING: Yes, 1956–1957	
TIME FROM FIRST TEST TO GAS BOOSTING: 5–6 years	
CURRENT NUMBER OF WARHEADS: 225 (external expert assessment)	
DELIVERY POSTURE: Sea	

Nuclear strategy

Similar to France, the British nuclear arsenal was established primarily to preserve great-power status, maintain technological parity with other major powers and reduce reliance on US security guarantees, rather than for use in conflict.[182]

Currently, the UK employs "a minimum, credible, independent nuclear deterrent" to "preserve peace, prevent coercion and deter aggression."[183] The use of nuclear weapons is reserved only for "extreme circumstances of self-defence, including the defence of NATO [North Atlantic Treaty Organization] allies."[184] The UK deliberately maintains ambiguity regarding the timing, method and extent of potential nuclear use in order to introduce uncertainty into the calculations of any adversary. The UK does not employ an NFU policy.[185]

The UK retains sovereign decision-making over nuclear use, but its arsenal depends on US-origin Trident missiles, shared missile infrastructure, warhead-design cooperation and wider nuclear collaboration. Because of this, the UK nuclear deterrent can be described as politically independent but technically interdependent. This distinguishes the UK from other nuclear-armed states that have pursued nuclear autonomy through solely domestic development.

Comparison with the DPRK

Similarity in this domain: Not analogous

The UK maintains a minimal deterrent not intended for battlefield use, which stands in stark contrast to the DPRK's policy of incorporating the use of nuclear weapons on the battlefield and in its warfighting doctrine. Further, the UK is vague regarding actual use cases, which contrasts with the more explicit declaratory approach seen in the DPRK.

Because of differences in arsenal autonomy, the UK offers a poor doctrinal analogue for the DPRK, but a useful contrast in how nuclear independence can be understood. For London, independence primarily means sovereign political control over use. For Pyongyang, independence also means domestic control over production, design, testing and delivery systems.

182 Jonathan Aylen, 'First Waltz: Development and Deployment of Blue Danube, Britain's Post-War Atomic Bomb', The International Journal for the History of Engineering & Technology 85, no. 1 (2015): 31–59, https://doi.org/10.1179/1758120614Z.00000000054.

183 UK Nuclear Deterrence Policy Booklet (HM Government Defence Nuclear Organisation, 2022), https://assets.publishing.service.gov.uk/media/61eea6848fa8f505893f1e03/UK_Nuclear_Deterrence_Policy_Booklet.pdf.

184 UK Nuclear Deterrence Policy Booklet.

185 UK Nuclear Deterrence Policy Booklet.

Fissile material production

The UK initially selected plutonium as its fissile material, producing it in graphite reactors using reprocessing which began in 1952.[186] Over 11 years of collective reactor operation, these two reactors generated approximately 385 kg of WGP.[187] The UK expanded its plutonium capacity until 2004, when all military-related plutonium production ceased. As of 1998, the UK declared a stockpile of 3.2 tonnes of separated WGP, including materials in weapons and excess stockpile.[188]

In parallel with its plutonium production, the UK developed its HEU capabilities, and a gaseous diffusion plant began operation in 1953. By the end of 1957, it was able to produce 125 kg of HEU per year.[189] Despite this, the country primarily acquired HEU from the US, receiving 6,700 kg of HEU by 1970,[190] with a reported total of 13 tonnes acquired from the US over the course of the British programme.[191] The UK's military HEU programme ended in 1982, and its stockpile of military HEU was reported at 21.86 tonnes as of 2002.[192] It is unclear how much remains in military stockpiles, but the UK reported 637 kg of civilian HEU as of 2024.[193]

Comparison with the DPRK

Similarity in this domain: Weak analogue

Like the DPRK,[194] the UK embarked on its nuclear programme with plutonium, demonstrating how fissile-material access shapes the strategic choices available to each state. However, unlike the DPRK, the UK rapidly progressed to producing an excess of both WGP and HEU. It also received external HEU shipments specifically intended for weapons purposes, which has not been possible for the DPRK to date due to the development of contemporary legal frameworks, non-proliferation norms and extensive nuclear safeguards and export control regimes.

The US-UK material transfers allowed London to avoid the type of production bottleneck that continues to shape the DPRK's arsenal development. Therefore, the UK case demonstrates how shared access and resources can accelerate and stabilise a weapons programme in ways that are unavailable to isolated proliferators.

186 Carey Sublette, 'Britain's Nuclear Weapons: From MAUD to Hurricane', Nuclear Weapon Archive, 4 July 2007, https://nuclearweaponarchive.org/Uk/UKOrigin.html.

187 Carey Sublette, 'Britain's Nuclear Weapons: British Nuclear Facilities', Nuclear Weapon Archive, accessed 21 October 2024, https://nuclearweaponarchive.org/Uk/UKFacility.html.

188 'Countries: United Kingdom', International Panel on Fissile Materials, 22 May 2026, https://fissilematerials.org/countries/united_kingdom.html.

189 Sublette, 'Britain's Nuclear Weapons: From MAUD to Hurricane'.

190 Carey Sublette, 'Britain's Nuclear Weapons: The Current British Arsenal', Nuclear Weapon Archive, 30 April 2001, https://nuclearweaponarchive.org/Uk/UKArsenalRecent.html.

191 International Panel on Fissile Materials, 'Countries: United Kingdom'.

192 International Panel on Fissile Materials, 'Countries: United Kingdom'.

193 International Panel on Fissile Materials, 'Countries: United Kingdom'.

194 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Nuclear tests and warhead designs

The British nuclear weapons programme began during the Manhattan Project, with numerous British nuclear scientists assisting in the US development and initial testing programme. In 1946, the US passed the McMahon Act, which prohibited continued foreign participation in its nuclear weapons programme. The UK, determined to maintain technological parity, thus decided to develop its own programme.[195]

- **3 October 1952**: The first British nuclear test involved a plutonium implosion device, technically similar to Fat Man, but utilising an improved levitated pit to achieve a higher yield of 25 kt.[196]
- **November 1953:** Deployment of the first weapon, the “Blue Danube” plutonium bomb, which was technically similar to the US Mk 4.[197]
- **19 June 1956:** There is speculation among external experts that this 98 kt test included gas boosting, although some argue it may have been solid boosted, as gas boosting was not incorporated until the 1957 test series.[198]
- **15 May 1957:** The first attempt to test an independent thermonuclear device was not fully successful, resulting in a yield of 200–300 kt.[199]
- **8 November 1957:** A second thermonuclear test was successful, achieving a yield of 1.8 Mt and concluding the final series of independent British testing.[200]
- **1958:** The UK and the US signed the Agreement for Cooperation in the Uses of Atomic Energy for Mutual Defence Purposes, facilitating the exchange of nuclear materials, technology and information.[201]

After the Mutual Defence Agreement, the UK programme became less a purely independent design effort and more a closely integrated allied nuclear enterprise. Since 1958, all subsequent UK nuclear weapons have been based on US designs.[202] In total, the UK conducted 45 nuclear tests, with the last nuclear test in 1991 at the then US Nevada Test Site (now the National Nuclear Security Site).[203]

195 Aylen, ‘First Waltz’.

196 Sublette, ‘Britain’s Nuclear Weapons: From MAUD to Hurricane’.

197 Sublette, ‘Britain’s Nuclear Weapons: From MAUD to Hurricane’.

198 Steve Weintz, ‘The Story of How Britain Got Nuclear Weapons’, The National Interest, 10 June 2018, https://nationalinterest.org/blog/buzz/the-story-how-britain-got-nuclear-weapons-26203/; Carey Sublette, ‘Britain’s Nuclear Weapons: British Nuclear Testing’, Nuclear Weapon Archive, 23 August 2007, https://nuclearweaponarchive.org/Uk/UKTesting.html.

199 Sublette, ‘Britain’s Nuclear Weapons: British Nuclear Testing’.

200 Sublette, ‘Britain’s Nuclear Weapons: British Nuclear Testing’.

201 Claire Mills, UK-USA Mutual Defence Agreement, Research Briefing (UK Parliament House of Commons Library, 2014), https://commonslibrary.parliament.uk/research-briefings/sn03147/.

202 Sublette, ‘Britain’s Nuclear Weapons: British Nuclear Testing’.

203 ‘United Kingdom’s Nuclear Tests’, Atomic Archive, accessed 21 October 2024, https://www.atomicarchive.com/almanac/test-sites/uk-testing.html.

Comparison with the DPRK

Similarity in this domain: Partial analogue

The UK innovated new designs or relied on shared designs from the US, while the DPRK has benefitted from a late-mover advantage, and likely had some assistance.[204]

One relevant technological parallel is that the UK's testing programme appears to have progressed from tests of thermonuclear primaries, through secondary-stage validation and culminated in full-yield detonations. This sequencing may help explain the DPRK's 2016–2017 testing series, which could reflect a similar developmental logic. If so, individual tests may have been designed to generate data on primary performance, secondary coupling and overall yield, providing a framework for interpreting future DPRK tests. This is also similar to the French programme.

However, similar test sequencing does not imply similar strategic purpose. The UK used testing partly to prove itself worthy of renewed nuclear cooperation with the US. The DPRK uses testing to demonstrate deterrent credibility, domestic achievement and operational progress.

204 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Arsenal size and delivery systems

The UK has approximately 225 nuclear warheads for SLBMs,[205] with 120 ready for deployment on the UK's deployed or available SSBNs. One SSBN is continuously deployed at sea, two are available for rapid deployment and a fourth is in overhaul and might not be available for deployment (thus not carrying nuclear weapons). The remaining 105 warheads are assumed to be in storage. In 2021, the UK established a nuclear stockpile ceiling of no more than 260 warheads.[206]

The UK's arsenal grew rapidly, reaching a peak of 500 weapons in 1973, about 20 years after establishing its programme and its first test, and maintaining this number until 1981. From that point, the UK gradually reduced its warhead count before reaching its current size of 225 in 2010.[207]

The UK's current posture is distinctive because it has concentrated its entire nuclear deterrent in a single sea-based system. This is a deliberate trade-off, with the UK accepting limited delivery diversity in exchange for survivability, alliance integration and continuous at-sea deterrence.

Comparison with the DPRK

Similarity in this domain: Not analogous

The trajectory of the DPRK's weapons production has not followed the same rapid growth as the early UK programme, which reached 500 weapons in 20 years.[208] The UK reached force sufficiency by narrowing the diversity of its arsenal, while the DPRK is seeking sufficiency through diversification. The UK could reduce to a submarine-based deterrent because it had a reliable SSBN force, US-supported missile infrastructure and NATO backing. In contrast, the DPRK is developing mobile missiles, solid-fuel systems, sea-based concepts and potentially MIRVs as an attempt to build survivability and penetration through multiple pathways.

The UK reduced its arsenal from 1981 to 2010 after achieving both numerical sufficiency and a survivable, sea-based deterrence posture. The DPRK is assessed to possess only 10–20% of the UK's historical peak meaning a near-term reduction in the DPRK arsenal is unlikely, as Pyongyang has not yet achieved what it would likely regard as a fully credible deterrent, particularly given ongoing constraints on delivery range and survivability. Therefore, the UK trajectory of decreasing arsenal size departs from the DPRK's likely pathway.

205 Kristensen and Korda, '8. World Nuclear Forces'.

206 Hans M. Kristensen et al., 'United Kingdom Nuclear Weapons, 2024', Bulletin of the Atomic Scientists 80, no. 6 (2024): 394–407, https://doi.org/10.1080/00963402.2024.2420550; Claire Mills, Nuclear Weapons at a Glance: United Kingdom, Research Briefing CBP-9077 (UK Parliament House of Commons Library, 2024), https://researchbriefings.files.parliament.uk/documents/CBP-9077/CBP-9077.pdf.

207 Kristensen et al., 'United Kingdom Nuclear Weapons, 2024'.

208 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

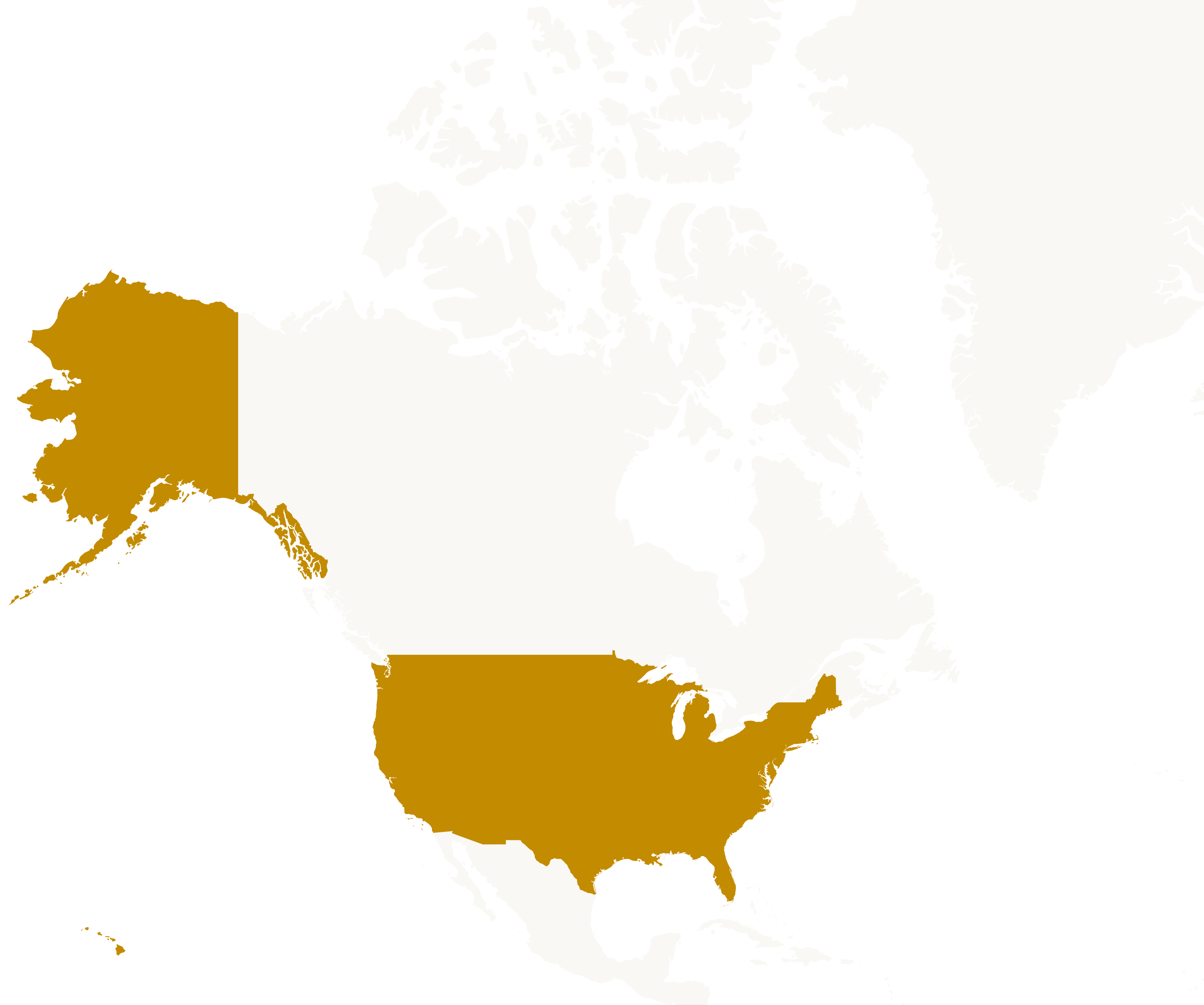
Key takeaways

Key parallels:

- The UK's early reliance on WGP offers a limited technical parallel to the DPRK's initial pursuit of WGP-based weapons.
- The UK's testing programme appears to have progressed from tests of thermonuclear primaries, through secondary-stage validation and culminated in full-yield detonations. The DPRK's 2016–2017 testing series, or future testing series, could reflect a similar developmental logic, and might provide an interesting technical parallel.
- The UK case shows how external assistance can accelerate nuclear development. After 1958, UK warhead design, material access and delivery systems became deeply linked to US cooperation.

Key differences:

- The UK maintains a minimum, sea-based deterrent for strategic retaliation, not battlefield nuclear use. The DPRK's doctrine includes first-use and battlefield-relevant provisions. The UK accumulated substantial fissile material stockpiles early in its programme (including HEU from the US). The DPRK remains more production constrained, with no open-source evidence of HEU or WGP acquisition from other nuclear-armed states.
- UK nuclear weapons development quickly became intertwined with US cooperation, designs and material supply. The DPRK has had to build clandestinely with limited external access
- The UK reduced its arsenal after achieving a survivable, alliance-supported deterrent. The DPRK has not reached comparable confidence in survivability or reach, making near-term reductions unlikely.



United States

Key information

STATED NUCLEAR POLICY: Robust, credible, modern deterrent	
FISSILE MATERIAL IN ARSENAL: HEU and WGP	
FIRST NUCLEAR TEST: 16 July 1945	
TOTAL NUMBER OF NUCLEAR TESTS: 1,054	
TWO-STAGE THERMONUCLEAR: Yes, 1952	
TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR: 7 years	
GAS BOOSTING: Yes, likely 1951	
TIME FROM FIRST TEST TO GAS BOOSTING: 6 years	
CURRENT NUMBER OF WARHEADS: 5,042 (external expert assessment)	
DELIVERY POSTURE: Triad	

Nuclear strategy

Early growth in the US nuclear arsenal was primarily intended to deter the Soviet Union/Russia. The additional challenges of deterring China, the DPRK and possibly a future nuclear-armed Iran have only become significant considerations in deterrence strategy in recent decades. The US programme was driven to maintain technical superiority and to keep its adversary from establishing a first-strike advantage. US nuclear doctrine was largely developed anew and has undergone dramatic shifts over time, from warfighting strategies, massive retaliation, flexible response, mutually assured destruction, limited nuclear war and finally to strategic stability and arms control.[209]

These doctrinal changes were tied not only to external situational shifts but also to trends in internal US military strategic thinking (including deployment strategies and arsenal sizes). Rivalries and resource competition among military branches also exacerbated vertical proliferation, contributing significantly to the large number and variety of delivery systems developed; before a unified nuclear war plan was created in 1960, each military branch had developed its own target maps and attack plans.[210] This shows how nuclear arsenal growth can be driven by more than direct deterrence requirements. Industrial capacity, technological ambition, alliance commitments and arms-race dynamics all contributed to an arsenal much larger and more diverse than any single defence requirement would have required.

Under the 2025 National Security Strategy, the US has explicitly prioritised maintaining the world's most “robust, credible, and modern nuclear deterrent” to ensure “no adversary or danger can hold America at risk.”[211] This strategy reflects a doctrine of “peace through strength,” asserting that sufficiently powerful forces and strength are the best deterrents.[212]

Comparison with the DPRK

Similarity in this domain: Not analogous

The strategic situation of the DPRK[213] bears little resemblance to that of the US. The US began its nuclear programme as the sole possessor of nuclear technology and then spent decades focusing its nuclear mission on deterring one distant adversary, the Soviet Union, which quickly achieved a similar level of technological capability.

The US case cautions against assuming that arsenal size follows directly from a state’s stated defence needs. In the US case, arsenal growth reflected peer competition, alliance commitments, bureaucratic incentives and technical ambition. In the DPRK case, arsenal growth is more tightly linked to regime survival, conventional inferiority and the need to hold regional and distant targets at risk.

209 ‘United States Nuclear Overview’, The Nuclear Threat Initiative, 6 July 2017, https://www.nti.org/analysis/articles/united-states-nuclear/.

210 ‘United States Nuclear Overview’.

211 The White House, National Security Strategy of the United States of America (The White House, 2025).

212 The White House, 2025 US National Security Strategy.

213 For a more extensive analysis of the DPRK’s current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Fissile material production

WGP for the first nuclear weapons was produced in a large complex comprising fourteen reactors in eastern Washington and in South Carolina. Military plutonium production ceased in 1987, and, as of 2009, the US had 81.3 tonnes of WGP in its inventory.[214]

Uranium enrichment for the first nuclear weapons was undertaken at the Oak Ridge site in Tennessee. Until 1964, the K-25 Plant at Oak Ridge and the Portsmouth facility in Ohio produced HEU for weapons using gaseous diffusion techniques. In total, the US produced 103.5 tonnes of HEU before military production of HEU was ceased in 1987.[215]

The production of both HEU and WGP may not have been strictly tied to any specific defence need and therefore significantly outpaced demand.[216] In the 1990s, the US DoD and Department of Energy reviewed fissile material requirements and found 38 tonnes of WGP and 174 tonnes of HEU to be in excess to defence needs. On that basis, an order was issued to withdraw approximately 200 tonnes of fissile material from the US stockpile for permanent disposal.[217] Additional declarations have followed in 1995, 2005 and 2007, with 14 tonnes Pu, 200 tonnes HEU and 9 tonnes WGP deemed excess and removed from further weapons use.

Comparison with the DPRK

Similarity in this domain: Weak analogue

Like the US, DPRK fissile-material production may not always be closely linked to defence requirements. Therefore, assessments that infer the DPRK's perceived defence needs directly from estimates of its fissile material stockpile risk overstating both the proportion of material intended for weaponisation, and the number of nuclear weapons Pyongyang considers necessary for deterrence.

214 US National Nuclear Security Administration, The United States Plutonium Balance, 1944 - 2009, DOE/DP-0137 Update (US National Nuclear Security Administration, 2012), https://www.osti.gov/includes/opennet/document/06-29-12%20FINAL%20PU%20Report%20(unclass).pdf.

215 'United States Nuclear Overview'.

216 'United States Nuclear Overview'.

217 Office of Fissile Materials Disposition Strategic Plan 2000 (US National Nuclear Security Administration, 2000), https://www.governmentattic.org/40docs/NNSAfmdStratPlan_2000.pdf.

Nuclear tests and warhead designs

The US initiated its nuclear programme under the auspices of the Manhattan Project, establishing a foundation for several decades of atmospheric and underground testing that shaped its warhead design evolution:

- **16 July 1945:** The US conducted the first ever nuclear test, "Trinity," involving the above-ground detonation of a plutonium implosion device with a yield of 21 kt. An HEU-based gun-type assembly device (Little Boy) was developed concurrently; however, it was never subject to full-scale testing as the design was deemed sufficiently reliable without it.[218]
- **8 May 1951:** Testing of the first fusion-boosted nuclear device, with an approximate yield of 225 kt. It is not clear if this was solid-boosted or gas-boosted, but likely contained gaseous tritium.[219]
- **1 November 1952:** Testing of the first thermonuclear device, with an approximate yield of 10.4 Mt.[220]
- **1 March 1954:** Testing of the first deliverable thermonuclear bomb at Bikini Atoll, yielding approximately 15 Mt.[221]

The US performed its last nuclear test in 1992, having conducted 1,054 tests in the atmosphere, above the atmosphere, underground and underwater.[222]

The US, during its over 80-year-long programme, has developed nearly every type of nuclear weapons design, and even experimented with how to incorporate nuclear weapons into peaceful uses.

Comparison with the DPRK

Similarity in this domain: Not analogous

Technological comparisons on nuclear designs and testing are difficult to make between the DPRK and the US. The US used extensive testing to create and expand the design space for nuclear weapons. The DPRK can draw on accumulated global knowledge, but has far fewer tests, less infrastructure and less access to full-scale validation. This makes the US a poor technical analogue, but a useful reminder that confidence in advanced warhead designs usually depends on a large base of test, modelling and engineering data.[223]

218 'United States Nuclear Overview'.

219 Defense Threat Reduction Agency, Operation Greenhouse, Fact Sheet (Defense Threat Reduction Agency, 2021), https://www.dtra.mil/Portals/125/Documents/NTPR/newDocs/5-GREENHOUSE%20-%202021.pdf; Carey Sublette, 'Operation Greenhouse', Nuclear Weapon Archive, 2 August 2003, https://nuclearweaponarchive.org/Usa/Tests/Grnhouse.html.

220 'United States Nuclear Overview'.

221 'United States Nuclear Overview'.

222 'United States Nuclear Overview'.

223 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Arsenal size and delivery systems

By the early 1950s, the US had a stockpile of more than 200 nuclear weapons. At peak production in 1959 and 1960, the country was building more than 7,000 new warheads annually.[224] The US nuclear stockpile reached its peak in 1967 with 31,255 nuclear warheads. Production of new nuclear weapons ceased in 1990, with only modifications and life-extension work continuing. Since the start of its nuclear programme, it is estimated that the US has built a total of 66,500 weapons.[225]

External experts estimate that the US currently possesses approximately 5,042 warheads, with 1,342 of them retired and awaiting dismantlement.[226] The most recent New START update from the US Department of State in May 2023 declared 1,419 deployed warheads for strategic systems (no declarations have been made since).[227]

The US inventory of non-strategic nuclear weapons is approximately 200 B61 gravity bombs, with 100 allegedly deployed at six NATO bases located in Belgium, Germany, Italy, the Netherlands and Turkey, with plans for basing in the UK by the 2030s.[228]

The US has developed a variety of missiles to carry nuclear payloads, and first deployed MIRV technology on ICBMs in 1970 and SLBMs in 1971, which destabilised established deterrence with the Soviet Union.[229] All branches of the US military, with the exception of the Coast Guard and the new US Space Force, have at some point had or maintained nuclear weapons.

Comparison with the DPRK

Similarity in this domain: Not analogous

Technological comparisons are difficult between the DPRK and the US as the latter had to design from scratch while the DPRK benefitted from existing technologies and its late-mover advantage, although with significantly fewer resources.

US delivery diversity reflects global reach, alliance commitments and peer competition.
DPRK delivery diversification reflects the narrower but still demanding problem of improving survivability, penetrating missile defences, threatening regional US assets and holding the US homeland at risk.[230]

224 'United States Nuclear Overview'.

225 Norris, Robert S., 'The History of the U.S. Nuclear Stockpile 1945-2013', Federation of American Scientists, 15 August 2013, https://fas.org/publication/the-history-of-the-u-s-nuclear-stockpile-1945-2013/.

226 Hans M. Kristensen et al., 'United States Nuclear Weapons, 2026', Bulletin of the Atomic Scientists 82, no. 2 (2026): 119–50, https://doi.org/10.1080/00963402.2026.2633029.

227 'New START Treaty Aggregate Numbers of Strategic Offensive Arms', United States Department of State, 12 May 2023, https://www.state.gov/new-start-treaty-aggregate-numbers-of-strategic-offensive-arms-5/.

228 Kristensen et al., 'United States Nuclear Weapons, 2026'.

229 'United States Missile Overview', The Nuclear Threat Initiative, 10 June 2015, https://www.nti.org/analysis/articles/united-states-missile/.

230 For a more extensive analysis of the DPRK's current nuclear programme, see: Laderman et al., Fissile Material and Nuclear Force Structure in North Korea.

Key takeaways

Key parallels:

- The US case shows that fissile-material production can outpace immediate defence requirements. This cautions against projecting DPRK arsenal size directly from fissile-material stockpile estimates alone.
- US testing history demonstrates that confidence in advanced warhead designs usually rests on extensive testing, modelling and engineering data.

Key differences:

- US deterrence requirements and alliance dynamics differ fundamentally from the DPRK's threat environment, especially when compared to the start of the US programme.
- The US pioneered designs and testing as an early inventor, while the DPRK benefitted from a late-mover advantage with global knowledge and technology diffusion, albeit with significantly fewer resources.
- US fissile material production, fissile material stockpiles, nuclear testing history, arsenal size and delivery platforms are far larger in number and capability than any plausible DPRK trajectory.
- The US arsenal later declined after reaching massive Cold War overcapacity and entering arms-control processes. The DPRK has not reached a comparable point of perceived sufficiency, making a similar reduction pathway unlikely.

Summary Tables

This section provides three tables that summarise the cross-programme comparisons made in the preceding country sections. Following this section is the conclusion in which the high-level findings are drawn out and discussed.

CASE	NUCLEAR STRATEGY	FISSILE MATERIAL PRODUCTION	NUCLEAR TESTS & WARHEAD DESIGNS	ARSENAL SIZE & DELIVERY
CHINA	Not analogous	Not analogous	Partial	Weak
FRANCE	Weak	Weak	Partial	Not analogous
INDIA	Partial	Weak	Weak	Partial
ISRAEL	Not analogous	Not analogous	Weak	Weak
PAKISTAN	Partial	Partial	Partial	Weak
SOUTH AFRICA	Weak	Not analogous	Not analogous	Not analogous
SOVIET UNION/ RUSSIA	Partial	Not analogous	Partial	Not analogous
UNITED KINGDOM	Not analogous	Weak	Partial	Not analogous
UNITED STATES	Not analogous	Weak	Not analogous	Not analogous

Table 1. Summary of historical and current nuclear programmes' analytical relevance as an analogue to the DPRK, grouped by research topic area. Definitions of terms can be found in the "Introduction and methodology" section.

CASE	STATED NUCLEAR POLICY	1ST NUCLEAR TEST	TOTAL NO. OF NUCLEAR TESTS	CURRENT NO. OF WARHEADS	DELIVERY POSTURE
DPRK	Deterrence, battlefield use	9 October 2006	6	~75	Land (some sea)
CHINA	NFU, minimum deterrent	16 October 1964	45	620	Triad
FRANCE	From defensive to forward deterrence	13 February 1960	210	290–300	Sea & air
INDIA	NFU, credible minimal deterrent	18 May 1974 (“peaceful nuclear explosion”), 11 May 1998 (military)	6	190	Triad
ISRAEL	Deliberate ambiguity	Unconfirmed, possibly 22 Sep 1979	0 or 1	90	Land & air
PAKISTAN	Credible minimum, full spectrum deterrence	28 May 1998	6	170	Land & air
SOUTH AFRICA	From strategic uncertainty to dismantlement	Unconfirmed, possibly 22 Sep 1979	0 or 1	0 (6 built)	Air
SOVIET UNION/ RUSSIA	From warfighting to defensive with broad use cases	29 August 1949	715	5,420	Triad
UNITED KINGDOM	Minimum, credible, independent nuclear deterrent	3 October 1952	45	225	Sea
UNITED STATES	Robust, credible, modern deterrent	16 July 1945	1,054	5,042	Triad

Table 2. Summary of key information on nuclear policy, testing and general arsenal structure for each case presented in the preceding sections. Citations for this data can be found in each country section. Data for the DPRK comes from Sarah Laderman et al., Fissile Material and Nuclear Force Structure in North Korea, Occasional Paper (Royal United Services Institute for Defence and Security Studies (RUSI), 2024), https://www.rusi.org/explore-our-research/publications/occasional-papers/fissile-material-and-nuclear-force-structure-north-korea.

CASE	FISSILE MATERIAL IN ARSENAL	TWO-STAGE THERMONUCLEAR	TIME FROM FIRST TEST TO TWO-STAGE THERMONUCLEAR	GAS BOOSTING	TIME FROM FIRST TEST TO GAS BOOSTING
DPRK	Initially WGP, later incorporation of HEU	Yes, 2016–7	10–11 years	Unknown	N/A
CHINA	Initially HEU, later incorporation of WGP	Yes, 1966	2 years	Yes, 1980s	~20 years
FRANCE	Initially WGP, later incorporation of HEU	Yes, 1968	8 years	Yes, 1966	6 years
INDIA	WGP	Yes, 1998	24 years	Unknown	N/A
ISRAEL	Likely WGP	Unknown	N/A	Unknown	N/A
PAKISTAN	HEU	Unknown	N/A	Unknown	N/A
SOUTH AFRICA	HEU	No	N/A	No	N/A
SOVIET UNION/ RUSSIA	HEU and WGP	Yes, 1955	6 years	Yes, 1957	8 years
UNITED KINGDOM	Initially WGP, followed shortly by HEU	Yes, 1957	5 years	Yes, 1956–7	5–6 years
UNITED STATES	HEU and WGP	Yes, 1952	7 years	Yes, 1951	6 years

Table 3. Summary of key information on technical progression for each case presented in the preceding sections. Citations for this data can be found in each country section. Data for the DPRK comes from Sarah Laderman et al., Fissile Material and Nuclear Force Structure in North Korea, Occasional Paper (Royal United Services Institute for Defence and Security Studies (RUSI), 2024), https://www.rusi.org/explore-our-research/publications/occasional-papers/fissile-material-and-nuclear-force-structure-north-korea. Conclusion

Conclusion

This comparative analysis of the DPRK's nuclear programme against nine current, former or allegedly nuclear-armed states provides useful insight into its strategic and technological trajectory.

By examining nuclear strategy, fissile material production, nuclear testing, warhead design, arsenal size and types of delivery systems, this paper shows that the DPRK's programme is not without historical or technical precedent. However, the DPRK is not a direct analogue for any single case, nor were any cases found to be a strong analogue for the DPRK. Its distinctiveness lies in its combination of features: acute conventional vulnerability, regional and intercontinental targeting requirements, limited fissile material production (especially WGP), public nuclear signalling and a nuclear doctrine that increasingly links declaratory policy to battlefield use, pre-emptive employment, and integration with conventional military planning.

The DPRK's nuclear weapons appear to serve a broader operational role than the arsenals of most comparison states. Its doctrine extends beyond minimum deterrence or last-resort retaliation and incorporates battlefield-relevant and potentially pre-emptive nuclear use. In this respect, the closest analogy is Pakistan's full spectrum deterrence and earlier Soviet nuclear-use concepts. This reflects the DPRK's limited conventional options relative to the US–ROK alliance and its concern that a future conflict could quickly threaten regime survival. India's dual-deterrence posture also offers a partial comparison, with two neighbouring nuclear-armed rivals. However, since the DPRK must deter a nearby US-allied conventional threat and a distant US homeland target set, this creates stronger incentives for the DPRK to develop a mixed force from short to intercontinental-range systems.

The fissile material comparison shows that the DPRK's trajectory is constrained by allocation pressure. Its programme initially relied on WGP due to reactor availability before later incorporating HEU as enrichment capabilities matured. This differs from states that either accumulated large fissile stocks early, such as the US, Soviet Union/Russia, China, France and the UK, or pursued narrower material pathways, such as South Africa's HEU-based gun-type devices. The DPRK's dual-track production resembles Pakistan in broad terms, but Pakistan appears to possess a larger and more flexible fissile material base. For the DPRK, each new mission set (tactical weapons, longer-range missiles, possible MIRVs or sea-based systems) competes for limited fissile material, although with its enrichment expansion, this could become less acute in the near term. The US experience does caution against equating fissile material estimates directly with intended arsenal size, since production capacity can exceed immediate defence requirements.

Technologically, the DPRK benefits from a late-mover advantage that may have compressed some developmental pathways. Its testing sequence shows potential parallels with other states that used varied-yield tests to validate different design elements, including primaries, boosted or composite designs and higher-yield configurations. For example, the Soviet Union demonstrated composite-pit technology early in its own testing series. This shows that the concept has historical precedent and is not beyond the reach of a determined late-mover programme. Similarly, comparisons with the Soviet, French and UK testing sequences suggest that intermediate or thermonuclear-adjacent tests can generate useful design data even before a mature two-stage capability is fully established. This gives some historic precedent to the DPRK's 2016 "H-bomb" claim.

Uncertainty remains around gas boosting, miniaturisation and warhead reliability. China's long struggle to master gas boosting demonstrates that this technology can be difficult even for a large and technically capable programme. For the DPRK, gas boosting would support smaller, lighter and more efficient warheads suitable for a wider range of missile systems, including tactical weapons, longer-range missiles and potentially MIRVed payloads. If the DPRK has not yet mastered gas boosting, this may constrain the reliability and diversity of its warhead options. If it has, or if it does so in the near term, its ability to field a more flexible and survivable arsenal would increase significantly.

The comparison also highlights different models of nuclear opacity and signalling. Israel demonstrates how a state can build deterrence through deliberate ambiguity and possible non-testing, while the DPRK has chosen the opposite path: explicit legal codification, public claims, missile demonstrations and periodic nuclear testing. Therefore, a key lesson is that analysis should separate declared intent, inferred capability and technical possibility, and should compare across doctrine, fissile material production, test data, delivery systems and political signalling rather than relying on any single indicator.

Finally, these comparisons suggest that future work would benefit from more focused expert engagement. A workshop format could test specific analytical questions raised in this paper, such as whether the DPRK's test sequence resembles French, UK or Soviet staged design validation; whether Pakistan's full spectrum deterrence provides the closest doctrinal comparison; whether South Africa offers any realistic lessons for rollback; and how Israel's opacity contrasts with the DPRK's visibility as a deterrence strategy. Bringing together DPRK specialists, nuclear weapons experts and country specialists would help refine these comparisons and identify where analogies clarify, and where they mislead.

In conclusion, this paper provides a comparative framework for assessing what is technically plausible, strategically likely and analytically uncertain. The DPRK's programme is historically unusual, but not wholly unprecedented. Its future trajectory will likely be shaped by the same variables highlighted across the comparison cases: threat perception, fissile material availability, confidence in warhead design, delivery-system survivability, alliance dynamics and the regime's judgement of what level of nuclear capability is sufficient for deterrence, coercion and survival. The findings are intended not as a definitive statement or forecast, but as a foundation for informed policy dialogue and strategic assessment as compared to other current or previously allegedly nuclear-armed states.

List of abbreviations

ALCM air-launched cruise missile

DoD US Department of Defense

DPRK Democratic People's Republic of Korea

HEU highly enriched uranium

ICBM intercontinental ballistic missile

kg kilogram

km kilometres

kt kiloton of TNT-equivalent

MIRV multiple independently-targetable reentry vehicle

Mt megaton of TNT-equivalent

NATO North Atlantic Treaty Organization

New START New Strategic Arms Reduction Treaty

NFC nuclear fuel cycle

NFU No First Use

NNWS non-nuclear-weapon states

ROK Republic of Korea

SLBM submarine-launched ballistic missile

SLCM sea-launch cruise missile

SSBN ballistic missile submarine

UK United Kingdom

US United States

WGP weapons-grade plutonium

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