

# US NUCLEAR WEAPONS MODERNISATION: A REALITY CHECK

JAVED ALAM

In March 2024, former US President Joe Biden affirmed a classified nuclear strategic plan.<sup>1</sup> The strategy, which is referred to as the Nuclear Employment Guidance, “included China’s rapid nuclear expansion while ‘updating’ the US deterrent strategy”. Though the actual content of the strategy remains classified, two senior officials, former Acting Assistant Secretary of Defence for Space Policy Vipin Narang, former Senior Director of the National Security Council Pranay Vaddi, highlighted the change at two different platforms. They mentioned a “significant increase in the size and diversity of China’s nuclear arsenal”<sup>2</sup> and “the need to deter Russia, the PRC and North Korea simultaneously.”<sup>3</sup> In this context, the ongoing US’ nuclear modernisation requires further examination since some recent

---

Dr **Javed Alam** is a Research Associate at the Centre for Air Power Studies, New Delhi.

1. David E. Sanger, “Biden Approved Secret Nuclear Strategy Refocusing on Chinese Threat,” *The New York Times*, <https://www.nytimes.com/2024/08/20/us/politics/biden-nuclear-china-russia.html>. Accessed on January 2, 2025.
2. U.S Department of Defence, “Nuclear Threats and the Role of Allies”, Remarks by Acting Assistant Secretary of Defence for Space Policy Dr. Vipin Narang at CSIS, <https://www.defense.gov/News/Speeches/Speech/Article/3858311/nuclear-threats-and-the-role-of-allies-remarks-by-acting-assistant-secretary-of/#:~:text=The%20President%20recently%20issued%20updated,of%20the%20PRC's%20nuclear%20arsenal>. Accessed on January 2, 2025.
3. Julian E. Barnes and David E. Sanger, “U.S. Considers Expanded Nuclear Arsenal a Reversal of Decades of Cuts,” *The New York Times*, June 7, 2024, <https://www.nytimes.com/2024/06/07/us/politics/us-nuclear-russia-china.html>. Accessed on January 2, 2025.

**The ongoing US' nuclear modernisation requires further examination since some recent developments in weapons acquisitions have raised doubts about the ongoing pace of modernisation.**

developments in weapons acquisitions have raised doubts about the ongoing pace of modernisation.

This paper examines the US nuclear modernisation programme and its current challenges. In the National Defence Authorisation Act (NDAA) for Fiscal Year (FY) 2024, the US Senate authorised the Government Accountability Office (GAO) to review the nuclear weapon acquisitions carried out by the National Nuclear Security Administration (NNSA). The NDAA for FY 2023 also included a provision for the GAO to report on the state of the NNSA's nuclear weapon acquisition programme biennially. On December 17, 2024, the GAO published a report titled "National Nuclear Security Administration: Assessments of Nuclear Weapon Acquisitions." The report is the first biennial assessment of the five major NNSA weapon modernisation programmes as of July 2024. The GAO report and other reports published in 2024 and the preceding years have provided an overview of where exactly the US nuclear modernisation currently stands. This article examines the context under which the US nuclear modernisation is being pursued. It looks into three key nuclear armament programmes: the Sentinel Intercontinental Ballistic Missiles (ICBMs), the Columbia-class nuclear-powered ballistic missile submarines (SSBNs), and the plutonium processing and pit-manufacturing capabilities. While studying the key nuclear armament programmes, this article also discusses various hurdles these programmes face. The second part of the article looks into the five nuclear weapon acquisition programmes that the NNSA is currently undertaking and the concerns expressed about them by the 2024 Accountability Report of the GAO. The article concludes with a summary of the findings and their implications for the arms race and nuclear modernisation in the US and at the global level.

## THE CONTEXT OF THE US NUCLEAR MODERNISATION

The 2022 US National Defence Strategy included a doctrine of integrated deterrence, which advocates tailored use of national power. The integrated deterrence seeks “combat-credible forces prepared to fight and win, as needed, and backstopped by a safe, secure, and effective nuclear deterrent.”<sup>4</sup>

The 2022 US Nuclear Posture Review (NPR) also argued for tailored nuclear deterrence

strategies backed by a “full-scope triad replacement and other nuclear modernization programs including NC3.”<sup>5</sup> The 2022 NPR also affirmed the retirement of the B83-1 nuclear gravity bomb and the cancellation of the nuclear-armed Sea-Launched Cruise Missile (SLCM-N) programme. In terms of nuclear modernisation and capabilities development, the 2022 NPR categorically mentioned, among others, the following points:

- The replacement of the Minuteman III by the Sentinel ICBM.
- The Sentinel will carry the W87-0/Mk21 and W87-1/Mk21 A warhead and aeroshells.
- Completing the W88 Alt 370 programme and continuing the W93 warhead programme.
- Investing in the long-range standoff weapon and its W80-4 warhead.
- Replacing the B61-3/4/7 nuclear gravity bombs with the B61-12 LEP.<sup>6</sup>

Besides developing the above capabilities, the 2022 NPR also referred to the notion of technology innovation for the nuclear enterprise. For this

---

4. <https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf>

5. U.S. Department of Defence, 2022 National Defense Strategy of the United States of America: Including the 2022 Nuclear Posture Review and the 2022 Missile Defense Review, October 27, 2022, <https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf>. Accessed on January 3, 2025.

6. Ibid.

purpose, the 2022 NPR argued in favour of an “increase[d] focus on research, development, test, and evaluation efforts ... and faster development of technologies and system concepts through the digital engineering approach and open architecture designs.”<sup>7</sup> The 2022 NPR also gave a three-point direction to the NNSA and Department of Defence (DoD) to effectively maintain the ongoing nuclear modernisation process and deliver on a timely basis. The three-point direction included the following pillars:

- Development and implementation of Nuclear Deterrent Risk Management.
- Institution of a Production-based Resilience Programme.
- Establishment of a Science and Technology Innovation Initiative.<sup>8</sup>

Similarly, the US International Security Advisory Board (ISAB) released a report titled “Report on Deterrence in a World of Nuclear Multipolarity” in October 2023. The report by ISAB, while arguing for advances in conventional weapons capabilities, stated that “in the near term, nuclear deterrence will remain a more immediate priority.”<sup>9</sup> The 2023 Strategic Posture Commission (SPC) report was even more vocal in arguing for a more robust nuclear security enterprise infrastructure and organisation. The SPC argued in favour of an infrastructure recapitalisation to execute the nuclear modernisation programme. The SPC outlined the following challenges within the DoD and NNSA:

- The infrastructure required to sustain weapon systems is ageing rapidly. This could severely impact the maintenance of legacy weapon systems.

---

7. Ibid.

8. U.S. Department of Energy, NNSA Administrator Jill Hruby’s remarks for the 17th Annual Symposium on Strategic Weapons in the 21st Century, “Nuclear Deterrence at the Inflection Point”, April 27, 2023, <https://www.energy.gov/nnsa/articles/nnsa-administrator-jill-hrubys-remarks-17th-annual-symposium-strategic-weapons-21st>. Accessed on January 3, 2025.

9. Department of State, International Security Advisory Board, “Report on Deterrence in a World of Nuclear Multipolarity,” October 2023, p. 16, [https://www.state.gov/wp-content/uploads/2023/11/ISAB-Report-on-Deterrence-in-a-World-of-Nuclear-Multipolarity\\_Final-Accessible.pdf](https://www.state.gov/wp-content/uploads/2023/11/ISAB-Report-on-Deterrence-in-a-World-of-Nuclear-Multipolarity_Final-Accessible.pdf). Accessed on January 3, 2025.

- Manufacturing/supply chain issues that have further complicated the transition from legacy to new weapon systems.
- The workforce challenges regarding recruitment and retention of personnel meant to facilitate the transition to the modernisation era.<sup>10</sup>

To overcome these challenges, the SPC recommended timely addressing of the two-peer threat by hedging against the four forms of risk: “technical failure of a warhead or delivery system, programmatic delays, operational loss of delivery systems, and further worsening of the geopolitical environment.”<sup>11</sup> These reports have come at a time when the US is implementing three key nuclear armament programmes:

1. The New Sentinel ICBMs.
2. The Columbia-class SSBN submarines programme.
3. Increase in plutonium processing and pit-manufacturing capabilities for nuclear deterrence.

### *Sentinel ICBM*

The US Air Force is looking to develop the LGM-35A Sentinel ICBMs (initially called the ground-based strategic deterrent) to effectively replace the current Minuteman III ICBMs. The Minuteman III ICBMs are currently the land-based arm of the US nuclear triad. The air force plans to procure 634 Sentinel missiles with an additional 25 missiles for development and testing support. While developing the Sentinel, the air force is also following the programme of modernising 450 silos and more than 600 facilities in the US.<sup>12</sup> In its FY2023 budget, the Biden Administration included \$3.6 billion for the

---

10. “America’s Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States,” October 20, <https://www.ida.org/-/media/feature/publications/a/am/americas-strategic-posture/strategic-posture-commission-report.ashx>. Accessed on January 4, 2025.

11. Ibid., <https://www.ida.org/-/media/feature/publications/a/am/americas-strategic-posture/strategic-posture-commission-report.ashx>, p. 60.

12. “Defense Primer: LGM-35A Sentinel Intercontinental Ballistic Missile,” *In Focus*, November 8, 2024, <https://sgp.fas.org/crs/natsec/IF11681.pdf>. Accessed on January 5, 2025.

Sentinel programme.<sup>13</sup> However, in January 2024, the air force informed the US Congress that the Sentinel programme had exceeded its initial cost projections by at least 37 per cent. The increase in the cost essentially meant that from \$118 million, which was the baseline, it exceeded to \$162 million in the cost per unit. The increase in cost triggered what is known as the Nunn-McCurdy Act. Under this Act, two kinds of breach, significant and critical, require the US secretary of defence to certify that the programme is essential to national security, has no cheaper alternatives, and cannot be terminated. The Sentinel programme's cost increase breach is a 'critical' breach. The primary reasons the air force gave for the Sentinel's cost breach were supporting ground infrastructure updates, including launch control facilities and below-ground communications cables. The programme's cost has also been under the scanner because of the integration of immature technologies, cyber security, staffing, and supply chain issues.<sup>14</sup>

### ***Columbia Class Nuclear-Powered Ballistic Missile Submarines (SSBNs)***

The US Navy plans to replace its current strength of 14 Trident (Ohio class) SSBNs with the new Columbia class submarines [initially termed the Ohio replacement programme or SSBN (X)]. The navy plans to begin the retirement of the Ohio class in 2027 and bring in the Columbia class fleet in 2031. The total cost of the 12 new submarines will be \$139 billion. The US Navy FY2025 budget submission requested about \$3.3 billion for the procurement funding for the procurement cost of the second Columbia class submarine and about \$6.2 billion for the advance procurement funding for submarines in the subsequent years. The Columbia class submarine programme is one of the most important nuclear modernisation programmes the US is currently undertaking. The rise of China as a naval superpower now resonates more than ever in the US strategic circles. While the US still leads the race regarding submarine capabilities, China has outrun the US in ship-building capacities. Even in delivering the first Columbia class submarine,

---

13. "Defense Primer: Strategic Nuclear Forces," *In Focus*, May 19, 2023, <https://crsreports.congress.gov/product/pdf/IF/IF10519/18>. Accessed on January 5, 2025.

14. n. 12.

the US faces many hurdles. On April 2, 2024, it was reported that there were significant delays in the ongoing shipbuilding programmes in the US. A press report on the first Columbia class boat stated,

The vessel's new projected delay can't be attributed to one factor or a new technical issue, Navy officials told reporters Tuesday [April 2]. Instead, the delays are "related to the whole of the ship," in terms of assembling its modules correctly, "getting them all buttoned up," said Navy Assistant Secretary for Acquisition Nickolas Guertin.<sup>15</sup>

Subsequently, news agencies reported numerous delays related to the delivery of steam turbines, the bow section, and power generators.<sup>16</sup> The delay concerns the delivery of hardware and the projection cost of the whole programme. While the Sentinel programme has already hopped a critical breach, the Columbia class programme is also moving in the same direction. According to the Congressional Budget Office (CBO) October 2023 report, there is already uncertainty in the navy's and CBO's analyses of future shipbuilding costs of the 11 Columbia class submarines.<sup>17</sup> While considering the current industry conditions, the CBO report stated that the Columbia class programme would cost 19 per cent more than the navy's cost projection.<sup>18</sup> Besides the cost projections, the GAO report on the Columbia class programme has also noted major issues within the following parameters:

1. **Technology Maturity:** Integrating critical technologies has become a major hurdle for various US nuclear modernisation programmes. While the DoD has considered all of Columbia's 826 critical technologies to be mature, the GAO report of 2023 has reported three important systems technologies below the level of their definition of maturity.<sup>19</sup> The GAO

---

15. "Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress," Congressional Research Service, September 30, 2024, <https://crsreports.congress.gov/product/pdf/R/R41129>. Accessed on January 6, 2025.

16. Ibid.

17. Ibid.

18. Ibid.

19. Ibid.

believes that at least one critical technology will remain immature even after the delivery of the first Columbia class submarine.

2. **Design Stability:** Another important issue that the GAO reported in June 2023 was related to the risk associated with the design stability of the SSBNs, even after the formal construction of the lead ship. The risk, as reported by the GAO, entails shortcomings incurred during the testing or production of critical technologies and also because of the “ongoing challenges [based on] using a software-based design tool.”<sup>20</sup>

### *Plutonium Pits*

In 2019, the then US undersecretary of defence for acquisition and sustainment, while referring to the upgradation of nuclear capabilities, mentioned the urgent need for a new facility to develop the nuclear pits. A plutonium pit is an essential part of the US nuclear warheads. In simpler language, “a pit is a hollow sphere of plutonium ... when uniformly compressed by explosives inside a warhead or bomb, causes a nuclear explosion.”<sup>21</sup> At the height of the Cold War in 1967, the US nuclear stockpile had 31,225 weapons, each with a plutonium pit inside. The US stopped the large-scale production of the pits in 1989. However, due to the radioactivity decay over time, a plutonium pit might pose a risk to the nuclear stockpile. More importantly, because of the nuclear test moratorium followed by the US, the effects of ageing on plutonium pits cannot be studied by detonating a warhead. This is where the concern for developing new plutonium pits has been raised in the US.<sup>22</sup> The NNSA, in May 2020, submitted a report to the US Congress and urged that “reestablishing a pit production capability is

---

20. Ibid.

21. “Pit Production Explained,” Los Alamos National Laboratory, December 13, 2021, <https://www.lanl.gov/media/publications/national-security-science/2021-winter/pit-production-explained>. Accessed on January 6, 2025.

22. In 2019, the independent scientific advisory group Jason released a study that assessed plutonium pit lifetimes. The study, a follow up to the 2006 Jason report that concluded there wasn’t enough proof to support a plutonium ageing issue, stated that plutonium ageing might, in fact, eventually impact the reliability of U.S. nuclear weapons. In the unclassified summary, the authors “urge that pit manufacturing be re-established as expeditiously as possible in parallel with the focused program to understand Pu [plutonium] aging, to mitigate against potential risks posed by Pu aging on the stockpile.” “Pit production explained,” Los Alamos

considered critical to maintaining the nation's nuclear weapons stockpile to meet modern standards for safety and reliability."<sup>23</sup> It is to be noted that since 2012, the NNSA has not produced any war reserve pits. While considering the request, the DoD directed the US Department of Energy (DoE) to produce not less than 80 pits per year by 2030. Under this plan, the NNSA would annually produce 30 pits at the Los Alamos National Laboratory and 50 at the Savannah River Site. However, the GAO 2023 report highlighted several issues that can hamper the NNSA's 80 pits per year plan. The following are the issues:

1. The GAO report has noted that the NNSA lacks a comprehensive schedule or cost estimate. The Integrated Master Schedule, which the NNSA follows for the 80-pits plan, fails to assign resources to activities. This means that a non-comprehensive schedule has to be considered unreliable under the GAO schedule guide.
2. The GAO report has also emphasised that the NNSA pit plan has not developed a life-cycle cost estimate. The issue of cost estimates has already become an issue of concern since "the cost of producing plutonium pits at the 80-unit-per-year rate mandated by Congress is projected to rise to more than \$4 billion per year from fiscal years 2027 to 2029."<sup>24</sup>

## **GAO 2024**

The GAO 2024 report has come when the US' nuclear weapon modernisation programme is undergoing a major shift. The US is currently in the midst of a highly ambitious upgradation programme of its nuclear triad. The nuclear modernisation and maintenance programme is expected to continue

---

National Laboratory, December 13, 2021, <https://www.lanl.gov/media/publications/national-security-science/2021-winter/pit-production-explained>. Accessed on January 6, 2025.

23. "NUCLEAR WEAPONS: NNSA Does Not Have a Comprehensive Schedule or Cost Estimate for Pit Production Capability," United States Government Accountability Office: Report to Congressional Committees, January 2023, <https://www.gao.gov/assets/gao-23-104661.pdf>. Accessed on January 6, 2025.

24. "U.S. Nuclear Costs, Projections Continue to Rise," Arms Control Association, April 2024, <https://www.armscontrol.org/act/2024-04/news/us-nuclear-costs-projections-continue-rise>. Accessed on January 7, 2025.

beyond 2039 and cost the US taxpayer around \$1.2 trillion.<sup>25</sup> While various stakeholders in the US are advocating robust nuclear modernisation, the issue of cost overruns, particularly regarding the Sentinel ICBM, have been criticised. On July 8, 2024, the DoD had announced that the Sentinel ICBM programme would continue with a projected 81 per cent cost overrun.<sup>26</sup>

The GAO 2024 has mentioned various points that the NNSA must consider in order to develop and deliver its weapons programme. Currently, the NNSA is managing five nuclear weapon acquisition programmes. These programmes are given in Table 1 below.

**Table 1**

Warhead	Programme	Purpose
B-61-12	Life Extension Programme (LEP)	Airborne Deterrent
W88	Alteration 370 Programme	Sea-based Deterrent
W80-4	Life Extension Programme	Airborne Deterrent
W-87-1	Modification Programme	Land-based Deterrent
W-93	New Warhead Programme	Sea-based Deterrent

Besides these, the NNSA is also involved in two additional nuclear weapons acquisitions, the B-61-13 gravity nuclear weapon and sea-launched nuclear cruise missile.

According to the GAO report, the NNSA, while undertaking the development of various nuclear weapons acquisition programmes, “has not documented, formally and comprehensively, the process that its programs must follow to identify which technologies are critical technologies.”

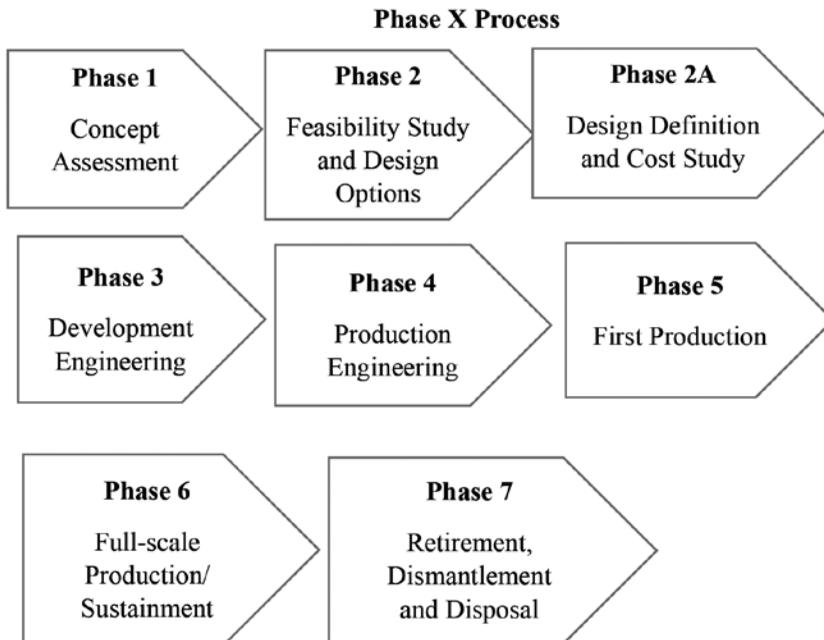
25. Hans M. Kristensen and Matt Korda, “Nuclear Notebook: United States Nuclear Weapons, 2023,” *Bulletin of the Atomic Scientists*, [https://thebulletin.org/premium/2023-01/nuclear-notebook-united-states-nuclear-weapons-2023/#:~:text=The%20complete%20nuclear%20modernization%20\(and,over%20the%20next%20three%20decades](https://thebulletin.org/premium/2023-01/nuclear-notebook-united-states-nuclear-weapons-2023/#:~:text=The%20complete%20nuclear%20modernization%20(and,over%20the%20next%20three%20decades).

26. John A. Tirpak, “Sentinel ICBM Survives Pentagon Review, But Cost Jumps 81%,” *Air & Space Forces Magazine*, July 8, 2024, <https://www.airandspaceforces.com/sentinel-icbm-pentagon-review-result-cost/>. Accessed on January 4, 2025.

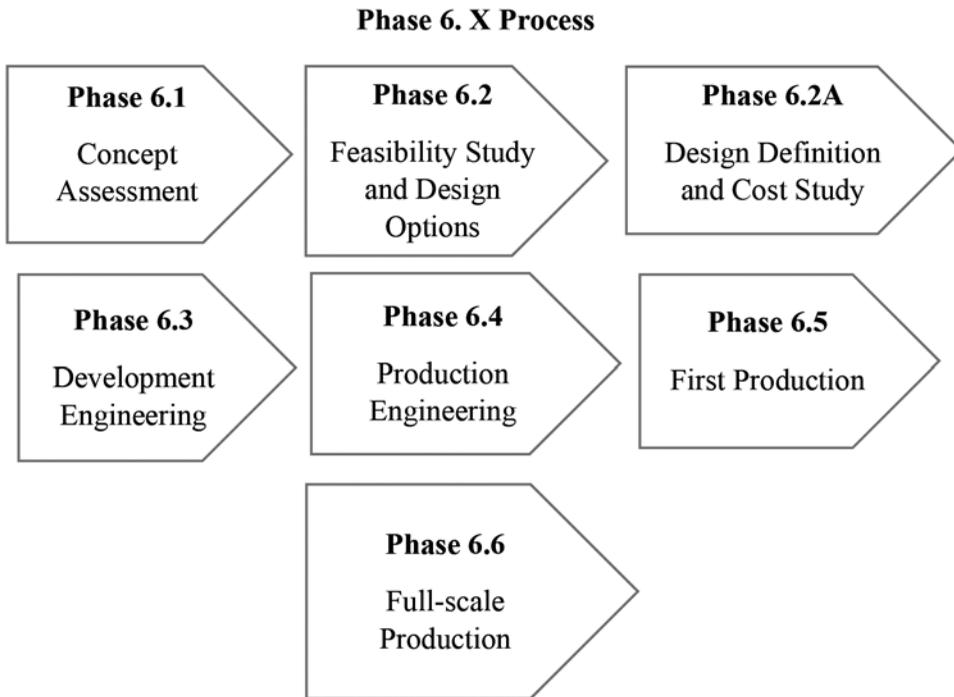
The following are the major challenges and issues that the GAO 2024 report has identified:

- The Issue of Identifying Critical Technologies:** The NNSA essentially follows an acquisition process known as ‘Phase X’ and ‘Phase 6.X.’ Phase X is a process meant for the development of new weapons, and this process has not been utilised fully since the end of the Cold War as it is meant for developing new nuclear weapons. Of the seven weapon acquisition programmes aforementioned, Phase X only looks after the W93 programme. It is Phase 6.X, which the NNSA, along with the DoD, has been utilising “to manage life extension programs and major nuclear weapon alterations and modifications.” Phase 6.X is utilised for the B-61-12 LEP, the W88 alteration, the W-87-1 modernisation and the W80-4 LEP.

**The Following Charts Explain Phase X and Phase 6.X**



Source: <https://www.gao.gov/assets/gao-25-106048.pdf>



Source: <https://www.gao.gov/assets/gao-25-106048.pdf>

The Phase X process essentially involves eight steps from Concept Assessment to Retirement, Dismantlement and Disposal of nuclear weapons. Phase 6.X, on the other hand, involves only seven steps, starting from Concept Assessment to Full-scale Production. There is no provision for Retirement, Dismantlement, or Disposal of nuclear weapons in the Phase 6.X process. This is where the GAO report has flagged the inconsistency. According to the GAO report, the NNSA’s Technology Readiness Assessment (TRA) fails to “specify a process that programs must follow for identifying which technologies are critical technologies.”<sup>27</sup> The GAO has recommended that the NNSA specify which technologies are critical based on principles that can

---

27. Ibid., p. 19.

be “consistently applied across programs.”<sup>28</sup> The rationale is that it seems to find a balanced list of critical technologies to prioritise resource allocation.

- 1. Challenge of Maturing of Technologies:** The GAO report also highlighted two important challenges that the NNSA faces regarding maturing of technologies. According to the report, the first challenge is of “accurately estimating the time it takes to mature technologies fully”<sup>29</sup> and the second is to “be dependent on DoD acquisition programs for testing assets.”<sup>30</sup> According to the GAO, these two challenges have made it difficult for the NNSA to reach the technology maturity milestones before the weapons development phase starts. The report has further noted that because of the challenges in the maturing of technologies, the NNSA has not been able to adopt and integrate new technologies and has relied on older existing alternatives. The report has mentioned that due to the delays in adopting new technologies, safety features such as optical initiators, which are essentially for the safety and security of the nuclear weapons detonation sequence, have not been used. As GAO noted, the issue with the old technology has led NNSA to “forego the potential safety and security benefits of the newer technology.”<sup>31</sup>
- 2. Issues Concerning Components Production:** The GAO report has also noted issues related to the production of components for developing existing and new weapons. According to the report, since the timelines for technology maturation have not been “realistic”, providing component certification and acceptance standards has created hurdles for manufacturing. The report has explained how issues with the production of the components, particularly with the legacy technology, which is almost 30 years old, have been creating issues with the

---

28. Ibid., p. 20.

29. Ibid., p. 23.

30. Ibid.

31. Ibid., p. 25.

estimates of manufacturing timelines. This issue has compounded the challenges for the W80-4, W87-1 and W93 programmes.

**3. Challenges Associated with Producing or Procuring Components:**

The report has noted that the NNSA principally faces two related challenges in producing and procuring components. One is related to all the components meeting the strict design requirements, and the second is that the components manufactured through a new or newly reconstituted production process do not create interference in weapon performance.

**4. Challenges Related to Plutonium Pits and Uranium Components:**

While the challenges associated with the plutonium pits have already been mentioned, the issues concerning uranium components have also been referred to in the GAO 2024 report. Currently, the Y-12 National Security Complex, which dates back to the 1940s and 1950s, provides the uranium components. Because of the continuous engagement with the Y-12, the NNSA has been modernising the project site under the Uranium Processing Facility project. However, according to the NNSA, the project will not be completed until FY 2030 and will cost over \$9 billion.<sup>32</sup>

Given below are further details of the state of individual programmes undertaken by the NNSA.

- **B61-12 LEP:** The B61-12 programme is being developed to replace and extend the self-life of three variants of the original B61 bomb, which was first produced in 1961. According to the NNSA estimates, the B61-12 programme will cost \$8.4 billion (the baseline is \$8.0 billion) and will be completed in September 2026 (the baseline is September 2025).<sup>33</sup>

---

32. "National Nuclear Security Administration: Assessments of Nuclear Weapon Acquisitions," United States Government Accountability Office: Report to Congressional Committees, December 2024, p. 29, <https://www.gao.gov/assets/gao-25-106048.pdf>. Accessed on December 28, 2024.

33. "B61-12 NUCLEAR BOMB: Cost Estimate for Life Extension Incorporated Best Practices, and Steps Being Taken to Manage Remaining Program Risks," United States Government Accountability Office: Report to the Committee on Armed Services, U.S. Senate, May 2018, <https://www.gao.gov/assets/gao-18-456.pdf>. Accessed on January 1, 2025. "NATIONAL

- **W88 Alteration 370 Programme:** This programme seeks to modify the W88 warhead, which was first added to the US nuclear stockpile in 1988. According to the NNSA, the W88 Alteration 370 programme will cost \$2.9 billion (the baseline is \$2.6 billion) and will be completed in September 2026 (the baseline is March 2025).<sup>34</sup>
- **W80-4 LEP:** This programme seeks to replace and extend the service life of the W80-1 warhead, which was first added to the US nuclear stockpile in 1982. The programme will cost \$13 billion and be completed by September 2033 (the baseline is September 2032).<sup>35</sup>
- **W87-1 Modification Programme:** This programme seeks to replace the existing W78 warhead, which first appeared in 1979. According to the NNSA, the programme’s estimated cost would be between \$15.2 billion and \$16.3 billion. The programme’s estimated completion date is from December 2030 to 2032.<sup>36</sup>
- **W93 Programme:** The NNSA is undertaking a new warhead programme to provide a flexible and adaptable warhead. The warhead will cost between \$20.9 billion and \$24.8 billion, and the estimated delivery time would be around the mid-2030s.<sup>37</sup>

---

NUCLEAR SECURITY ADMINISTRATION Assessments of Nuclear Weapon Acquisitions,” United States Government Accountability Office: Report to Congressional Committees, December 2024, p. 38, <https://www.gao.gov/assets/gao-25-106048.pdf>. Accessed on December 28, 2024.

34. “Nuclear Enterprise: DoD and NNSA Could Further Enhance How They Manage Risk and Prioritize Efforts,” U.S. Government Accountability Office, January 20, 2022, <https://www.gao.gov/products/gao-22-104061>. Accessed on January 1, 2025. “National Nuclear Security Administration: Assessments of Nuclear Weapon Acquisitions,” United States Government Accountability Office: Report to Congressional Committees, December 2024, p. 36, <https://www.gao.gov/assets/gao-25-106048.pdf>. Accessed on December 28, 2024.

35. Ibid.

36. “National Nuclear Security Administration: Actions Needed to Improve Integration of Production Modernization Programs and Projects,” U.S. Government Accountability Office, July 9, 2024, <https://www.gao.gov/products/gao-24-106342>. Accessed on January 1, 2024. “National Nuclear Security Administration: Assessments of Nuclear Weapon Acquisitions,” United States Government Accountability Office: Report to Congressional Committees, December 2024, pp. 42-3, <https://www.gao.gov/assets/gao-25-106048.pdf>. Accessed on December 28, 2024.

37. Ibid.

## ISSUES HIGHLIGHTED BY THE GAO 2024 REPORT ON INDIVIDUAL PROJECTS

Besides the baseline and the actual cost in the development of the above five programmes, the GAO report has also highlighted the additional cost that some of these programmes have incurred over the years. The W88 Alteration 370 programme has already incurred approximately \$170 million in addition to the total cost of the programme. The same is the case with the B61-12 LEP and W80-4 LEP. These programmes have incurred \$648 million and \$245 million, respectively, in addition to the actual cost. Besides the additional cost, some of these programmes face project-specific cost increases. The NNSA has noted that the W88 Alteration 370 programme will require \$72 million more to achieve full-scale production. This additional cost is due to underestimation of the cost during the programme's initial phase. The GAO has also noted that the technical issues of components have created hurdles for programmes like the W80-4 LEP. More importantly, the GAO has noted that programmes such as the W80-4 LEP may face delays because these programmes rely on the US Air Force's Long Range Standoff (LRSO) missile programme "for test assets and qualification testing."<sup>38</sup> The same is the case with the W87-1 modification programme, as it relies on the Sentinel missile programme and the Mk 21A reentry vehicle programme to "conduct flight testing and other qualification testing."<sup>39</sup> Besides these issues, there are other hurdles that the GAO notes regarding the lack of adequate testing facilities, particularly for new warheads like the W93. The lack of capabilities within the NNSA to manufacture components using new materials is also a concern that the GAO has noted. As noted in the report, the issue of priority-driven projects such as the Mk7 reentry body programme also creates "mechanical stress"<sup>40</sup> for new warhead projects.

---

38. "National Nuclear Security Administration: Assessments of Nuclear Weapon Acquisitions," United States Government Accountability Office: Report to Congressional Committees, December 2024, p. 41, <https://www.gao.gov/assets/gao-25-106048.pdf>. Accessed on December 28, 2024.

39. *Ibid.*, p. 43.

40. *Ibid.*, p. 45.

## **COST OF NUCLEAR MODERNISATION**

When it comes to spending on nuclear weapons, the US has always followed the sky being the limit approach. Historically, the agencies involved in cost projection have always underestimated the final programme costs, often by significant amounts. According to the CBO report *Projected Costs of U.S. Nuclear Forces, 2023 to 2032*, under the DoD and DoE's current plans for nuclear forces, the cost will be 756 billion.<sup>41</sup> However, this cost is 19 per cent or \$75 billion annually, higher than the projected cost between 2021 and 2030. While cost overruns and delays in the completion of the projects might seem like a part of the process in the history of the US nuclear weapons programme, it now seems to be becoming a norm. The Savannah River Pits production project is a glaring example. The NNSA initially planned the Mixed Oxide Fuel Fabrication Facility at the Savannah river, but later, the programme was abandoned due to cost overruns and delays. However, at the time of its abandonment, the project had already cost \$8 billion.<sup>42</sup> Delays, cost overruns, and the entanglement of nuclear programmes in their utility bring in more fiscal risks. Here, the evident example is of the tactical nuclear delivery systems such as the Sea-Launched Nuclear Cruise Missile (SLCM-N).<sup>43</sup> While the 2022 NPR recommended that the SLCM-N should be cancelled, in fact, the President's FY 2023 budget request also did not include any funding for the programme. However, the CBO 2023 report highlighted that the US Congress in 2022 included \$25 million for the DoD to start the work on the cruise missile and \$20 million for the NNSA to start the work on the nuclear warhead, W80-4 ALT. The same issue was carried forward in the FY24 budget request. While the US president's budget did not allot any money to the programme, the Senate and House included the bill, which included \$190 million for the missile and \$75 million for the

---

41. "Projected Costs of U.S. Nuclear Forces, 2023 to 2032," CBO, July 14, 2023, <https://www.cbo.gov/publication/59054#:~:text=CBO%20estimates%20that%20plans%20for,for%20the%202021%E2%80%932030%20period>. Accessed on January 10, 2025.

42. Eryn MacDonald, "The Sky's the Limit on Nuclear Weapons Spending, But What Does It Really Get Us?," Union of Concerned Scientists, August 2, 2023, <https://blog.ucsusa.org/emacdonald/the-skys-the-limit-on-nuclear-weapons-spending-but-what-does-it-really-get-us/>. Accessed on January 11, 2025.

43. Ibid.

**Joe Biden Administration did not include the SLCM-N in the FY2023, FY2024, or FY2025 budget requests, but Congress ensured that this programme was being funded for both missiles and warheads.**

warhead. In its estimates, the CBO stated that if the SLCM-N programme continues in 2024, it will cost about \$10 billion over the 2023-32 period.

### **CONCLUSION: ARMS RACE AND NUCLEAR MODERNISATION**

The US is now under the Presidency of Donald Trump, who, in his first tenure, made sure that nuclear modernisation would remain a steadfast priority. More importantly, Donald Trump, during his first tenure, had also argued in favour of hot nuclear testing. The issue of nuclear testing might become important again for the second Donald Trump Administration, as the GAO report has mentioned, since “aged infrastructure makes the use of new facilities and equipment inevitable, but, because the United States has observed a moratorium on nuclear explosive testing since the early 1990s, NNSA cannot fully test all newly manufactured parts in their operating environments.” The second issue that will probably become important for the second Donald Trump Administration is the development of a the SLCM-N, with either a new variant of the W80-4 warhead or a new warhead altogether. The SLCM-N was first proposed during the first Donald Trump Administration in 2018. The subsequent Joe Biden Administration did not include the SLCM-N in the FY2023, FY2024, or FY2025 budget requests, but Congress ensured that this programme was being funded for both missiles and warheads. Not only offensive systems but also defensive systems, which can further exacerbate an arms race, are now being considered vital for US national security. The Iron Dome for America, an executive order promulgated under the direction of Donald Trump, is a case in point. On January 27, 2025, President Donald Trump, under the vision of the “...goal of peace through strength,” ordered the US to build a “next-generation missile

defence shield.”<sup>44</sup> The executive order further proposed a plan which included:

1. Acceleration of the deployment of the hypersonic and ballistic tracking space sensor layer.
2. Development and deployment of proliferated space-based interceptors capable of boost-phase intercept.
3. Deployment of underlayer and terminal-phase intercept capabilities postured to defeat a counter-value attack.
4. Development and deployment of a custody layer of the proliferated war-fighter space architecture.
5. Development and deployment of capabilities to defeat missile attacks prior to launch and in the boost phase.
6. Development and deployment of a secure supply chain for all components with next-generation security and resilience features.
7. Development and deployment of non-kinetic capabilities to augment the kinetic defeat of ballistic, hypersonic, advanced cruise missiles, and other next-generation aerial attacks.<sup>45</sup>

**While developing the space sensor layer and terminal-phase interceptions to track ballistic and hypersonic missiles may seem defensive, a combination of these capabilities, along with space-based interceptors capable of boost-phase interception, certainly gives the impression of preemptive offensive capabilities.**

While developing the space sensor layer and terminal-phase interceptions to track ballistic and hypersonic missiles may seem defensive, a combination of these capabilities, along with space-based interceptors capable of boost-phase interception, certainly gives the impression of preemptive offensive capabilities. The US now seems to be moving toward developing

---

44. Ibid.

45. Ibid.

conventional capabilities, which can play strategic roles during heightened periods of conflict.

While the US seeks to modernise its nuclear triad, and the justification comes from various sources, the arms race scenario can further exacerbate the US nuclear spending. Currently, only the New Strategic Arms Reduction Treaty (New START) stops the US and Russia from engaging in any strategic arms race. The New START limits the US and Russia to 800 deployed and non-deployed strategic delivery vehicles. The number of deployed ICBMs, Sea Launched Ballistic Missiles (SLBMs), and heavy bombers within this limit cannot exceed 700. More importantly, the treaty forbids more than 1,550 deployed strategic warheads.<sup>46</sup> However, the New START will expire in 2026. Currently, there seems to be no scope for the extension of the New START, and, hence, there will be an impact on the US nuclear arsenal, in both numbers and cost. In 2020, the CBO studied the likely impact of the New START expiration on the costs of US nuclear expansion. According to the CBO estimates, if the US expands its arsenal to deploy 6,000 total warheads on up to 1,600 strategic delivery systems, it will cost approximately \$439 billion for acquisition and around \$24 to \$28 billion per year in acquisition and sustainment costs.<sup>47</sup>

The GAO report, however, is also an eye-opener. It has provided insights into major issues concerning the US nuclear modernisation. While the US will eventually modernise its nuclear triad, many issues will impact the overall modernisation process and have implications beyond the US.

---

46. "New START Treaty," NTI, <https://www.nti.org/education-center/treaties-and-regimes/treaty-between-the-united-states-of-america-and-the-russian-federation-on-measures-for-the-further-reduction-and-limitation-of-strategic-offensive-arms/#:~:text=New%20START%20is%20an%20agreement,on%20deployed%20strategic%20nuclear%20warheads>. Accessed on January 7, 2025.

47. "The Potential Costs of Expanding U.S. Strategic Nuclear Forces If the New START Treaty Expires," CBO, <https://www.cbo.gov/system/files/2020-08/56475-START.pdf>. Accessed on January 7, 2025.