SUPPLEMENTAL SECOND-STRIKE: ROAD-MOBILE ICBMS IN THE TWO-PEER ENVIRONMENT

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Executive Summary

For the first time in more than three decades, there is discussion in senior U.S. national security circles about the need for a road-mobile intercontinental ballistic missile (ICBM) system to supplement the current nuclear triad with a versatile new capability. One of the recommendations from the recent report of the Congressional Strategic Posture Commission was to "pursue the feasibility of fielding some portion of the future ICBM force in a road-mobile configuration."[2] Given that this type of system has not been analyzed in depth since the Cold War, this publication seeks to ensure clarity and accessibility for both industry professionals and the general public in understanding the key aspects of this potential new asset.

The need for deeper analysis on a mobile land-based nuclear system is driven by three key factors. First, mobile ICBMs present their own technological, doctrinal, and operational benefits and challenges that have been insufficiently analyzed in recent academic and analytic literature. The United States has never fielded a true mobile ICBM system, and such a system cannot be designed, tested, acquired, and implemented overnight. On average, it will take an estimated 21 years from the decision-to-develop to achieving operational capability for systems in the modernized nuclear triad.[3] Second, while the decision to develop new weapon systems rests with senior U.S. leadership, enduring political support extends beyond a single presidential or congressional term and is greatly enhanced by broader public understanding. Third, in an era marked by rapid technological advancements and a deteriorating global security environment, there is a need for understanding why a mobile ICBM system is appealing for those looking at sustaining an effective U.S. nuclear deterrent.

This report begins by outlining the threats from nuclear-armed adversaries and examines their impacts on the future security environment. It then explores the composition of each leg of the current nuclear triad and provides an assessment of their strengths and weaknesses.

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[1] The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes.

[2] Madelyn R. Creedon, Jon L. Kyl, Marshall S. Billingslea, Gloria C. Duffy, Rose E. Gottenmoeller, Lisa E. Gordon-Hagerty, Rebeccah L. Heinrichs, et al. "The Final Report of the Congressional Commission on the Strategic Posture of the United States." House Armed Services Committee. 2023. https://armedservices.house.gov/sites/republicans.armedservices.house.gov/files/Strategic-Posture-Committee-Report-Final.pdf. Accessed May 9, 2024.

[3] The timeline from development decision to estimated initial operating capability spans 20 years for the B-21 bomber, 21 years for the Columbia-class SSBN, and 22 years for full operability of the Sentinel ICBM. CRS report R44463 *Air Force B-21 Raider Long-Range Strike Bomber*, IF11681 *Defense Primer: LGM-35A Sentinel Intercontinental Ballistic Missile*, and R41129 *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress.*

Additionally, it analyzes the need for a road-mobile ICBM and highlights five key advantages that this asset could bring to the triad. Furthermore, this research examines and dissects four primary concerns facing the development of a new road-mobile system. Finally, it concludes that a road-mobile ICBM could serve as a supplemental second-strike capability, improve responsiveness through advanced communication systems, minimize overflight concerns, and complicate adversary targeting. It could also serve as a critical asset in offering flexible options for decision-makers in a world in which Russia boasts of having developed a "nuclear scalpel" for every military problem, China is drastically increasing its nuclear forces, and North Korea can no longer be viewed as a lesser threat.

Introduction

Senior level experts have argued that the degradation of the global threat environment coupled with the rapid advancement of emerging technologies underscores the necessity for a system that enhances the guaranteed second-strike capability of the nuclear ballistic missile submarine (SSBN) fleet.[4] This concept is foundational to modern nuclear deterrence strategies because it ensures that a country can withstand a surprise nuclear attack from an adversary and still retain the ability to respond effectively. However, there is growing concern that adversary interest in advancing artificial intelligence (AI), quantum computing, advanced sensing, and autonomous systems could lead to breakthroughs in anti-submarine warfare (ASW), posing significant risks to Western SSBNs.[5]

For the first time since the development of the nuclear weapon, the United States faces multiple nuclear peer adversaries who are bound together in their hostility towards U.S. dominated global influence. The problems surrounding a security environment with several nuclear challengers have been discussed in great length but has recently come to a critical point with the full-scale Russian invasion of Ukraine, emergence of ICBM silo fields in China, and significant advancements in the North Korean nuclear program.[6] In 2020, the U.S. Department of Defense (DOD) estimated China's nuclear stockpile to be in the low 200s and would double within the decade. Since then, China has accelerated its nuclear development, likely expanding its arsenal to 700 warheads by 2027 and 1,000 by 2030.[7] This has led to a desire to effectively demonstrate the ability to adapt to these evolving threats and modernize current forces in order to assure allies and deter adversaries in an era of deteriorating global security.

[4] Creedon, "Report on the Strategic Posture of the United States."; According to official U.S. Navy reports, the abbreviation "SSBN" actually stands for Ship, Submersible, Ballistic, Nuclear, but is frequently referred to as Nuclear Ballistic Submarine.
[5] Greg Weaver, and Amy F. Woolf. "Requirements for nuclear deterrence and arms control in a two-nuclear-peer environment." Atlantic Council. 2024. https://www.atlanticcouncil.org/in-depth-research-reports/report/requirements-for-nuclear-deterrence-and-arms-control-in-a-two-peer-nuclear-peer-environment/. Accessed May 9, 2024.
[6] Deng Xiaoping. "2021 CMPR FINAL." Department of Defense. 2021. https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF. Accessed May 9, 2024.
[7] Brad Roberts, Michael Albertson, Paul Bernstein, Elaine Bunn, Brad Clark, Elbridge Colby, Jacek Durkalec, et al. "China's Emergence as a Second Nuclear Peer." Center for Global Security Research. 2023. https://cgsr.llnl.gov/content/assets/docs/CGSR_Two_Peer_230314.pdf. Accessed May 9, 2024.

Defining the Problem

With more attention now being paid to the emerging security environment, the consensus is that the United States has failed to strategically hedge against multiple peer adversaries and emerging technologies.[8] The U.S. nuclear posture has been deemed unfit for purpose due to its aging infrastructure, delayed modernization programs, and inadequate strategic investments.[9] These shortcomings undermine the credibility and reliability of the U.S. deterrent in the face of evolving threats. Hedging refers to a state pursuing development of capabilities in order to mitigate future risks and respond in a timely manner to new requirements. This necessity to hedge is prompted by advances in science and technology that result in game-changing impacts on national security.[10] Interest in a road-mobile ICBM system is partially driven by the belief that the antiquated U.S. nuclear posture has led to failed risk diversification surrounding the secure second-strike capability and lacks necessary flexibility amongst the land based strategic assets. The public taboo in the United States surrounding nuclear-capable systems, as well as the underestimation of regional conflicts with adversaries capable of all-domain escalation, likewise has led to outdated and constrained strategic rhetoric in the defense community.[11] It is posited that a failure to promptly adapt to this changing security environment will degrade the confidence of U.S. allies and will confirm adversarial beliefs of American decline.

While the U.S. does not necessarily need to match the quantity of nuclear capabilities of other countries, Table 1 underscores a significant disparity in nuclear weapon development since the Cold War. Although the nuclear capabilities of some systems have not been officially confirmed by their respective countries, available information suggests that Russia likely has 30 different nuclear systems currently deployed or under development, China has 19, and North Korea has 17. In stark contrast, the U.S. relies on just four aging delivery methods, all developed around three decades ago. The three strategic systems that the U.S. is currently developing were approved in 2014, before the full-scale Russian invasion of Ukraine and the expansion of China's nuclear arsenal. Many experts argue that while the U.S.'s nuclear modernization program is necessary, it alone may not sufficiently address the evolving threats of today's world. In this context, a road-mobile nuclear system could address some of the shortcomings identified in the existing modernization efforts.

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[8] Creedon, "Report on the Strategic Posture of the United States."

[9] Ibid.

[10] Zachary Davis, Frank Gac, Christopher Rager, Philip Reiner, and Jennifer Snow. "Strategic Latency and World Power: How Technology is Changing our Concepts of Security." CGSR, LLNL. 2021. https://cgsr.llnl.gov/content/assets/docs/Strategic_Latency.pdf. Accessed May 9, 2024.

[11] Brad Roberts. "On the Need for a Blue Theory of Victory." War on the Rocks. 2020. https://warontherocks.com/2020/09/on-the-need-for-a-blue-theory-of-victory/. Accessed May 9, 2024.

Table 1. Nuclear Weapons Systems by State

Russia	China	North Korea	United States	France	United Kingdom
ICBM **R-36M2/SS-18 Mod 5/6**[i] **RS-18/SS-19 Mod 3**[O] **RS-18/SS-19 Mod 4***[ii] **RT-2PM2/SS-27***[n] **RS-24/SS-29***[ii] **RS-28/SS-X-30***[i] RS-26/SS-X-31*[h] IRBM None MRBM None SRBM **9K720/SS-26†**[oo] **OTR-21/SS-21†**[x] SLBM **R-29/SS-N-18**[bb, y] **R-29RM/SS-N-23**[bb, k] **RSM-56/SS-N-32***[bb] R-29RMU2/SS-N-23 Mod 2*[pp, ddd] SLCM **P-120/SS-N-9†**[bbb] **P-700/SS-N-19†**[kk] **RK-55/SS-N-21**[m, 1] **P-270/SS-N-22†**[jj] **P-800/SS-N-26*†**[t, 2] **3M14/SS-N-30A*†**[eee,7,10] Torpedo **Status-6/KANYON***[dd] ALBM None ALCM **KH-55/AS-15**[t] **Kh-102/AS-23***[a] **9M728/SSC-7*†**[xx] **9M729/SSC-8*†**[w, xx] **P-800/SS-N-26*†**[t, 2] **Kh-22/AS-4A†**[yy] HGV **Kh-47M2/AS-24***[u] **Yu-74***[d] Gravity Bombs **Likely similar to B61†**[4] **Likely similar to B83**[4]	ICBM **DF-5A/CSS-4 Mod 2**[ccc] **DF-5B/CSS-4 Mod 3***[ccc] **DF-31A/CSS-10 Mod 2***[s] **DF-31AG/CSS-10 Mod 2***[s] **DF-41/CSS-20***[tt] DF-27/CSS-X-24*[ss, 5] IRBM **DF-4/CSS-3**[f] **DF-26/CSS-18***[r] MRBM **DF-21A/CSS-5 Mod 2***[v] **DF-21E/CSS-5 Mod 6***[v] **DF-17/CSS-22***[j] SRBM **DF-15A/CSS-6 Mod 1**[q] **DF-11/CSS-7***[p] SLBM **JL-2/CSS-N-14***[b] **JL-3/CSS-N-20***[b] SLCM None Torpedo None ALBM **DF-21 Variant/CH-AS-X-13***[uu] ALCM None HGV **DF-ZF/WU-14***[nn] Gravity Bombs **Estimated 15-40Kt bomb†**[qq] **Estimated 3Mt bomb**[qq]	ICBM **Hwasong-14/KN-20***[aa, 6] **Hwasong-15/KN-22***[aa, 6] Hwasong-17*[aa] Hwasong-18*[aa] IRBM Hwasong-8*[zz] Hwasong-10/BM-25*[aaa, 7] Hwasong-12/KN-17*[g] MRBM Pukguksong-2/KN-15*[aa] SRBM **KN-02***[gg] **Hwasong-5***[c, 8] **Hwasong-6***[c] KN-18*[vv] KN-23*[aa, 9] SLBM **Pukguksong-1/KN-11***[e] Pukguksong-3*[aa] Pukguksong-4*[aa] Pukguksong-5*[aa] SLCM None Torpedo None ALBM None ALCM None HGV None Gravity Bombs None	ICBM **LGM-30G *Minuteman III***[rr] LGM-35A *Sentinel**[rr] IRBM None MRBM None SRBM None SLBM **UGM-133A *Trident II D5 LE***[rr] UGM-133A *Trident II D5 LE2* *[cc] SLCM None Torpedo None ALBM None ALCM **AGM-86 †**[rr] LRSO*†[rr] HGV None Gravity Bombs **B61-3/4†**[rr] **B61-7/11**[rr] **B83-1**[rr] B61-12[rr]	ICBM None IRBM None MRBM None SRBM None SLBM **M51.1***[hh] **M51.2***[hh] M51.3*[hh] SLCM None Torpedo None ALBM None ALCM **ASMPA*†**[hh] ASN4G*†[hh] HGV None Gravity Bombs None	ICBM None IRBM None MRBM None SRBM None SLBM **UGM-133A *Trident II D5 LE***[rr] UGM-133A *Trident II D5 LE2* *[cc] SLCM None Torpedo None ALBM None ALCM None HGV None Gravity Bombs None

Key
Fielded
In Development
Developed/Fielded After Cold War*
Non-Strategic Weapon†

Sourcing found under "Table 1 References"

The Current Triad

To effectively understand the need for a potentially new nuclear capable system, it is crucial to first assess the strengths and weaknesses of the existing U.S. nuclear triad. Composed of ballistic missile submarines, bombers, and ICBMs, the triad embodies an essential element of national military strength by providing the President with strategic flexibility in decision making processes. Each leg of the triad offers specialized capabilities in responsiveness, flexibility, or survivability, while also partially compensating for the vulnerabilities of the other legs. The nuclear triad stands as a pivotal element of U.S. military power, but also offers significant value for the investment. Averaging $52 billion annually and constituting just 5.5% of the U.S. defense budget, the sustainment and modernization of the triad is cost effective in bolstering national security.[12]

Submarines

The sea-launched leg of the triad consists of 14 Ohio-class nuclear ballistic missile submarines equipped with up to 24 Trident II D5 Life Extension Submarine Launched Ballistic Missiles (SLBM).[13] These ships, which deploy from ports on both the Atlantic and Pacific coasts, are considered the most ***survivable*** component of the triad due to their advanced stealth capabilities. A number of SSBNs are on continuous patrol, covering target areas of over one million square miles and providing worldwide launch capability.[14] The SSBN fleet is crucial to ensuring a secure second-strike capability, which is the backbone of modern U.S. nuclear deterrence. Even in the event of a massive attack targeting ICBM silo fields and bomber bases, the covert features of the SSBNs provide them protection while at sea. Additionally, the mobility of these submarines allows them to mitigate overflight issues and increase operational flexibility. In rare cases, SSBNs can even signal political intent and reinforce strategic assurances by making port calls to U.S. allies.[15] Similar to ICBMs, the Trident II SLBM utilizes the Multiple Independently-targetable Reentry Vehicle (MIRV) system which enables it to carry up to 12 warheads per missile, further enhancing its deterrent value.[16]

However, there are multiple complications that undermine the reliability of the sea-launched leg of the triad. Advances in anti-submarine warfare technology, including artificial intelligence, advanced sensors, autonomous drones, and quantum computing, pose significant threats to this cornerstone of Western nuclear deterrence by potentially degrading the guaranteed second-strike capability. Financially, SSBNs represent one of the most expensive components of the military arsenal due to the advanced technologies and rigorous safety standards required for undersea operations. Cost projections from 2023 to 2032 show that SSBNs will account for

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[12] Michael Bennett. "Projected Costs of U.S. Nuclear Forces, 2023 to 2032." Congressional Budget Office. 2023. https://www.cbo.gov/system/files/2023-07/59054-nuclear-forces.pdf. Accessed May 9, 2024.
[13] Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, "Nuclear Matters Handbook"
[14] Ibid.
[15] Hyonhee Shin. "Second US submarine arrives in South Korea amid North Korea tensions." Reuters. July 23, 2023. https://www.reuters.com/world/asia-pacific/second-us-submarine-arrives-south-korea-amid-north-korea-tensions-2023-07-24/. Accessed May 9, 2024.
[16] Center for Strategic & International Studies. "Trident D5." Missile Threat. 2023. https://missilethreat.csis.org/missile/trident/. Accessed May 9, 2024.

48% of total expenditures on U.S. nuclear systems.[17] Furthermore, attributing an attack on an SSBN to a specific nation could be challenging, particularly when considering the potential for operational accidents. Operating in the ocean depths also imposes inherent limitations on the SSBN force, including slower communications and longer preparation times required for launch compared to their ICBM counterparts, which could impact their responsiveness.[18]

Bombers

The airborne component of the triad includes the B-52H Stratofortress heavy bomber, outfitted with nuclear air-launched cruise missiles (ALCM), and the B-2 Spirit stealth bomber, equipped with nuclear gravity bombs. In addition to the strategic capabilities, the F-15E Strike Eagle and F-35A Lightning II dual-capable aircraft can be outfitted with tactile, low-yield nuclear bombs and forward deployed to extend nuclear deterrence to U.S. allies.[19] Multiple air-refueling aircraft also bring a vital capability to the bomber force and are critical to its support and survivability.

U.S. nuclear bombers are considered the most ***flexible*** strategic asset as they are able to counter a wide variety of threats through a number of different weapon yields and delivery platforms. They serve not only as a potent military tool but also as a visible sign of U.S. extended deterrence efforts to reinforce allies. The deployment of these nuclear bombers conveys a clear political message and intent to adversaries, with a single B-52 bomber capable of using ALCMs to target up to 20 separate locations.[20] These missiles allow a B-52 to strike from a distance of over 1,500 miles without entering enemy airspace, while the B-2's stealth capabilities enable it to penetrate airspace undetected.[21] The upcoming replacement of the ALCM with the more advanced Long Range Stand-Off (LRSO) cruise missile further challenges adversaries and compels them to heavily invest in more advanced air defense systems to counter these sophisticated threats.[22]

However, the airborne leg of the nuclear triad faces significant challenges. On a day-to-day basis, the U.S. nuclear bomber force is effectively not operational, and lacks the survivability and responsiveness of other triad components as stationed bombers are vulnerable to surprise attacks.[23] Although bombers are more survivable during heightened alert levels in extreme crises, these periods are brief and rare. Additionally, transitioning the bomber force back to a constant alert posture presents a significant challenge as it diverts bombers from their conventional missions and strains already limited resources. The dual-capability of U.S.

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[17] Bennet, "Projected Costs of U.S. Nuclear Forces, 2023 to 2032."
[18] Blair, "The U.S. Nuclear Launch Decision Process."
[19] Office of the Deputy Assistant Secretary of Defense for Nuclear Matters. 2020. "Nuclear Matters Handbook 2020 [Revised]." NMHB 2020 [Revised]. https://www.acq.osd.mil/ncbdp/nm//NMHB2020rev/. Accessed May 9, 2024.
[20] Ibid.
[21] Center for Strategic and International Studies. "AGM-86 Air-Launched Cruise Missile (ALCM)" Missile Threat. 2024. https://missilethreat.csis.org/missile/alcm/. Accessed May 9, 2024.
[22] Office of the Deputy Assistant Secretary of Defense for Nuclear Matters. "Nuclear Matters Handbook"
[23] Dennis Evans, and Jonathan Schwalbe. "Intercontinental Ballistic Missiles and Their Role in Future Nuclear Forces." Air & Space Power Journal. 2018. https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Volme-32_Issue-2/F-Evans_Schwalbe.pdf. Accessed May 9, 2024.

bombers to carry both conventional and nuclear weapons could also heighten tensions in a crisis, particularly if adversaries suspect a conventionally armed bomber may be equipped with nuclear weapons.[24] Furthermore, despite the long-range and stealth capabilities designed to reduce their vulnerability, U.S. bombers may still risk engagement by enemy aircraft and integrated air defense systems.

ICBMs

The land-based leg of the triad is comprised of 400 LGM-30G Minuteman III ICBMs spread out over thousands of miles in Nebraska, Colorado, Wyoming, North Dakota, and Montana. These highly accurate ICBMs are on continuous alert and capable of launch from deeply buried, hardened silos, hitting their designated targets in 30 minutes or less.[25]

The U.S. ICBM force is considered the most ***responsive*** leg of the triad due to their ability to launch within minutes of presidential authorization. This quick response is integrated with the dual-phenomenology concept from strategic early warning systems, combining satellite and radar for adversary missile launch detection, ultimately deterring adversaries from a first-strike against U.S. nuclear missiles prior to them being launched.[26] The Minuteman III is operated with the Rapid Execution and Combat Targeting (REACT) console and advanced nuclear command, control, and communication (NC3) systems which grant the ICBM force with the fastest retargeting capability in the triad.[27] Moreover, ICBMs represent the most cost-effective nuclear weapon system, costing roughly one quarter of their bomber and SSBN counterparts.[28] Additionally, the trajectory of ballistic missiles is relatively straightforward to calculate, suggesting that anti-ballistic missile (ABM) systems should be simple to implement. However, the reality is that ABM systems must be highly sophisticated, capable of detecting, tracking, and intercepting objects traveling at speeds up to Mach 23.[29] To further counteract ABM threats, penetration aids and the MIRV system has been implemented to increase the chances of breaching adversary defenses.[30] Finally, the ground-based leg of the triad imposes a significant "price-to-attack", a theory highlighting the challenges posed by the widespread and dispersed

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[24] Evans, "Intercontinental Ballistic Missiles and Their Role in Future Nuclear Forces."
[25] Ibid.
[26] Adam Lowther, and Derek Williams. "Why America Has a Launch on Attack Option." War on the Rocks. 2023. https://warontherocks.com/2023/07/why-america-has-a-launch-on-attack-option/. Accessed May 9, 2024.
[27] Paul Dent. "Rapid Execution and Combat Targeting (REACT): Armageddon with a Floppy disk and trackball!" Nuclear Companion. 2019. https://nuclearcompanion.com/rapid-execution-and-combat-targeting-react-armageddon-with-a-floppy-disk-and-trackball/. Accessed May 9, 2024.
[28] Kingston Reif, Travis Sharp, and Usha Sahay. "Pruning the Nuclear Triad? Pros and Cons of Submarines, Bombers, and Missiles." Center for Arms Control and Non-Proliferation. 2013. https://armscontrolcenter.org/pruning-the-nuclear-triad-pros-and-cons-of-submarines-bombers-and-missiles/. Accessed May 9, 2024.
[29] Air Force Global Strike Command, Public Affairs Office. "LGM-30G Minuteman III." Air Force. 2019. https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104466/lgm-30g-minuteman-iii/. Accessed May 9, 2024.
[30] National Museum of the U.S. Air Force. n.d. "Boeing LGM-30G Minuteman III" National Museum of the USAF. https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196676/boeing-lgm-30g-minuteman-iii/ Accessed October 10, 2023; and Center for Arms Control and Non-Proliferation. "Fact Sheet: Multiple Independently-targetable Reentry Vehicle (MIRV)." Center for Arms Control and Non-Proliferation. 2017. https://armscontrolcenter.org/multiple-independently-targetable-reentry-vehicle-mirv/. Accessed May 9, 2024.

ICBM fields. Due to their vast geographic area, an adversary would be forced to employ roughly 900 nuclear weapons to effectively neutralize this segment of the triad.[31]

Despite these advantages, the silo-based nuclear deterrent also faces several significant challenges, with the most obvious being the inherent vulnerability of these ICBMs. Their fixed locations are easily identifiable and can be found with a simple internet search which makes them prime targets for adversaries.[32] Although they are housed in hardened, underground facilities to enhance their survivability, they remain susceptible to conventional ground penetrators and direct nuclear strikes. Additionally, unlike bombers, fixed ICBMs lack the capability to serve as a visible show of force or play a role in extended deterrence efforts because they are stationary, and their retargeting options are not observable by allies or adversaries. Another issue is the ballistic nature of the ICBMs, which necessitates overflight of other countries and could be perceived as a legitimate threat, especially in an emerging era of maneuverable hypersonic vehicles.[33] Finally, the "use or lose" concept of launch-on-warning has been researched and debated heavily in the defense community, but still poses a significant strategic dilemma.[34] This theory dictates that upon detection of an incoming strike, the President has approximately eight minutes to decide whether to launch ICBMs immediately in retaliation or risk destruction of one third of the nuclear triad.[35]

Each of the legs of the nuclear triad face unique challenges that may be exploited as technology continues to advance. The U.S. SSBN fleet is vulnerable to cutting-edge detection technologies, nuclear bombers are not operational on a day-to-day basis, and the ICBM force is constrained by the launch-on-warning protocol. To enhance the deterrent strength and survivability of these forces, the Strategic Posture Commission has put forth several recommendations. One key suggestion to address some of these strategic problems is the development of a road-mobile ICBM.

The Need for Supplemental Second-Strike

The guaranteed second-strike capability that SSBNs supply to the U.S. nuclear deterrent is immensely stabilizing. It is arguably the backbone of modern nuclear deterrence amongst major nuclear powers because it guarantees nuclear response options against an adversary, regardless of their first-strike, and ensures decision space for U.S. leaders. However, the longstanding fear is that a breakthrough in anti-submarine technology will undermine this assured capability for a retaliatory strike. Rapid technological developments in advanced computing and sensing, big data analytics, artificial intelligence, and robotic autonomy will

[31] Matthew Kroenig. "The Case for the US ICBM Force." Air University. 2018. https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-12_Issue-3/Kroenig.pdf. Accessed May 9, 2024.
[32] "90th Missile Wing LGM-30 Minuteman Missile Launch Sites." 2024. Wikipedia. https://en.wikipedia.org/wiki/90th_Missile_Wing_LGM-30_Minuteman_Missile_Launch_Sites. Accessed October 10, 2023.
[33] Toby Dalton, Megan Dubois, Natalie Montoya, Ankit Panda, and George Perkovich. "Assessing U.S. Options for the Future of the ICBM Force." Carnegie Endowment for International Peace. 2022. https://carnegieendowment.org/2022/09/07/assessing-u.s.-options-for-future-of-icbm-force-pub-87808. Accessed May 9, 2024.
[34] Lowther, "Launch on Attack Option."
[35] Bruce G. Blair. "The U.S. Nuclear Launch Decision Process." Global Zero. 2019. https://www.globalzero.org/wp-content/uploads/2020/11/Full-LOWTimeline.pdf. Accessed May 9, 2024.

continue at breakneck speeds, potentially removing the word "guaranteed" from "guaranteed second-strike". Therefore, policymakers should consider whether the current and future U.S. nuclear triad needs to be enhanced with the flexible, survivable, and responsive features of a road-mobile ICBM system. Such a system could focus on adaptability and serve as the most ***versatile*** strategic asset. As previously mentioned, each leg of the current triad specializes in a given capability. However, a mobile ICBM system would not specialize in one area; it would instead ideally be a culmination of all aspects. The supplemental second-strike capability from the mobile ICBM force could offer more flexible strike options than silo-based ICBMs, faster deployment than SSBNs, and greater survivability than bombers, thereby reinforcing the second-strike capability essential for effective modern deterrence.

This report identifies five key advantages that could enhance the versatility of the nuclear triad with the incorporation of a mobile ICBM force:

1. This strategic system would serve as a "supplemental second-strike" capability, hedging against breakthroughs in anti-submarine technology and diversifying risks associated with the sea-based second-strike capability.
2. It would introduce more flexible options for senior decision makers by leveraging its mobility to circumvent the constraints of silo-based, launch-on-warning scenarios. By enhancing ICBM force survivability, the need for substantial expansion of U.S. strategic forces to manage the challenge posed by two peer adversaries is also reduced.
3. By integrating NC3 systems similar to those utilized in the Airborne Command Post and Airborne Launch Control System, mobile ICBMs would overcome the current challenges faced by SSBNs and bombers regarding limited responsive options. This integration would enable mobile ICBMs to achieve response times similar to their silo-based counterparts.[36]
4. This asset would minimize the overflight concerns experienced by the silo-based ICBMs. The importance of this concept has grown considerably with advancements in maneuverable reentry vehicles and hypersonic glide vehicles.
5. The dispersion of mobile systems would complicate adversary targeting and planning processes. This complexity could force U.S. adversaries to invest in costly and highly technical tracking capabilities or face a significant "price-to-attack" due to the necessity of deploying a large number of weapons across an expansive geographic area.

Although not as prominent as Russia, China, and North Korea, as all three countries currently utilize road-mobile nuclear systems, the U.S has had some historical experience with land-based mobile nuclear systems. The Hard-Mobile Launcher, developed in the late 1980s, was designed to launch the Midgetman missile and engineered to withstand the radiation and overpressure effects of a near-miss detonation.[37] It was later canceled due to the drawdown of nuclear forces at the end of the Cold War. Over the years, U.S. nuclear strategy has evolved in

[36] A1C Armstrong, J. T. "Looking Glass: USSTRATCOM's Airborne Command Post." U.S. Strategic Command. 2016. https://www.stratcom.mil/Media/News/News-Article-View/Article/984308/looking-glass-usstratcoms-airborne-command-post/. Accessed May 9, 2024.

[37] Department of the Air Force. "Hard Mobile Launcher in Random Movement Basing Mode." Defense Technical Information Center. 1986. https://apps.dtic.mil/sti/tr/pdf/ADA268472.pdf. Accessed May 9, 2024.

step with technological advancements, moving from long-range bombers, to missiles, to nuclear submarines, and these technological advancements continue to influence the international threat landscape. In the coming years, enduring bipartisan support will be essential for the development and acquisition of a road-mobile nuclear system to ensure it aligns with contemporary security needs, domestic politics, and technological capabilities.

Unlike Russia, China, and North Korea, the U.S. has never utilized a mobile ICBM system, and they cannot be designed, tested, acquired, and implemented overnight. This is particularly concerning given that the current nuclear modernization program, which decided in 2014 to upgrade the entire nuclear enterprise, including all three legs of the triad, will not see the new Sentinel ICBM system fully operational until 2036.[38] It will take an estimated 22 years to design and deploy this new ICBM system, one that will reuse much of the operational experience, infrastructure, and human resource already in use by the Minuteman III system. This highlights the extensive timeline for acquiring a new asset, like a road-mobile ICBM, and underscores the necessity to begin development before advanced technologies can expose operational weaknesses in U.S. nuclear capabilities. Therefore, failing to hedge against threats on the triad's most critical assets by assuming that the oceans will keep the submarine force protected throughout the extended future is short-sighted and dangerous.

Counterarguments

Four primary critiques are often raised against the development of a road-mobile system. First, and most frequently addressed, is the cost associated with developing a new system. While government contracts are often subject to change, RAND's 2014 report on the future of the ICBM force sheds some light by exploring different basing methods. The report estimated the 50-year life cycle cost of a new road-mobile system on existing federal land at an average of $4.55 billion, and after adjusting for inflation, this figure rises to roughly $6 billion.[39] When compared to the nearly $12 billion annually projected cost for current ICBM sustainment and modernization, this highlights a substantial cost benefit.[40] Additionally, plans for the new Sentinel ICBM involve a significant restructuring of operational infrastructure, including a 48% reduction in the number of required launch control centers.[41] This reduction likely translates to an equivalent decrease in missile operations officers, who could then be redeployed to support the new road-mobile system in order to optimize human resources and recoup costs.

The second potential challenge is how a new nuclear system could impact the arms control community, who may view the development of a new major nuclear capability as counterproductive. However, senior U.S. officials have argued that enhancing deterrent capabilities positions the United States to negotiate arms control from a position of strength

38 Amy F. Woolf, and Benji Johnson. "Defense Primer: LGM-35A Sentinel Intercontinental Ballistic Missile." Congressional Research Service. 2024. https://crsreports.congress.gov/product/pdf/IF/IF11681. Accessed May 9, 2024.

39 Lauren Caston, Robert S. Leonard, Christopher A. Mouton, Chad J. Ohlandt, S. Craig Moore, Raymond E. Conley, and Glenn Buchan. "The Future of the U.S. Intercontinental Ballistic Missile Force." RAND. 2014. https://www.rand.org/content/dam/rand/pubs/monographs/MG1200/MG1210/RAND_MG1210.pdf. Accessed May 9, 2024.

40 Bennett, "Projected Costs of U.S. Nuclear Forces, 2023 to 2032."

41 David Roza. "How the Air Force Will Guard its New Sentinel ICBMs, Part 3: Infrastructure and Training." Air & Space Forces Magazine. 2023. https://www.airandspaceforces.com/air-force-security-forces-sentinel-infrastructure/. Accessed May 9, 2024.

and confidence.[42] Effective arms control can help limit and shape the nuclear capability decisions of U.S. adversaries. Given China's recent expansion of its nuclear capabilities, a strategic recalibration is necessary. Introducing advanced systems like road-mobile ICBMs could allow the U.S. to prioritize the quality and attributes of its nuclear arsenal, rather than merely increasing the quantity of weapons. China currently has little incentive to engage in arms control discussions, but by reinforcing its strategic position, the U.S. could foster a more conducive environment for engaging both Russian and China in meaningful arms control agreements.

Third, there is strong sentiment within the defense community that the SSBN fleet will remain secure from emerging detection technologies throughout the near future, leading to the belief that the U.S. does not need to immediately prepare against such threats.[43] However, it is dangerous to assume that submarine stealth technology will forever outpace an adversary's desire to detect the U.S.'s most critical nuclear asset. While a breakthrough in anti-submarine warfare technology may not completely negate the strategic benefits that SSBNs contribute to the nuclear triad, it could significantly undermine the guaranteed second-strike capability and destabilize the global deterrence landscape. The United States is showcasing its strategic complacency by over-relying on the survivability of its SSBN fleet, despite rapid advancements in detection technologies that threaten to compromise their stealth capabilities.[44] This issue is particularly critical for the West, as adversaries like Russia, China, and North Korea all have road-mobile nuclear systems to bolster their second-strike capabilities. There are already a number of different detection threats posed against the SSBN force like magnetic sensors, endo- and exo-atmospheric imagery, and public information analysis.[45] Researchers from the Chinese Academy of Sciences Fujian Institute of Research on the Structure of Matter reportedly used computer modeling to explore the detection of nearly imperceptible bubbles produced by nuclear submarines.[46] Their research found that the extremely low frequency (ELF) signals produced from these bubbles could be significantly stronger than the sensitivity of advanced magnetic anomaly detectors. This finding challenges the long-held belief that submarines will remain hidden, underscoring that current technologies can be innovatively repurposed to develop new detection capabilities. Some may argue that a mobile ICBM force would face a similar challenge with advanced satellite tracking capabilities and large-scale data analysis. However, the strategic and diplomatic responses to a perceived attack on a stealth submarine compared to a mass strike against continental U.S. assets would be vastly different.

The fourth challenge concerning the feasibility of a road-mobile ICBM is U.S. domestic politics and the choice of basing location. For clarity, "road-mobile" may encompass systems capable of

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[42] Jake Sullivan. "Remarks by National Security Advisor Jake Sullivan for the Arms Control Association (ACA) Annual Forum." The White House. 2023. https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/06/02/remarks-by-national-security-advisor-jake-sullivan-for-the-arms-control-association-aca-annual-forum/. Accessed May 9, 2024.

[43] Matt Korda. "ICBM Advocates Say US Missile Subs Are Vulnerable. It Isn't True." Defense One. 2020. https://www.defenseone.com/ideas/2020/12/icbm-advocates-say-us-missile-subs-are-vulnerable-it-isnt-true/170677/. Accessed May 22, 2024.

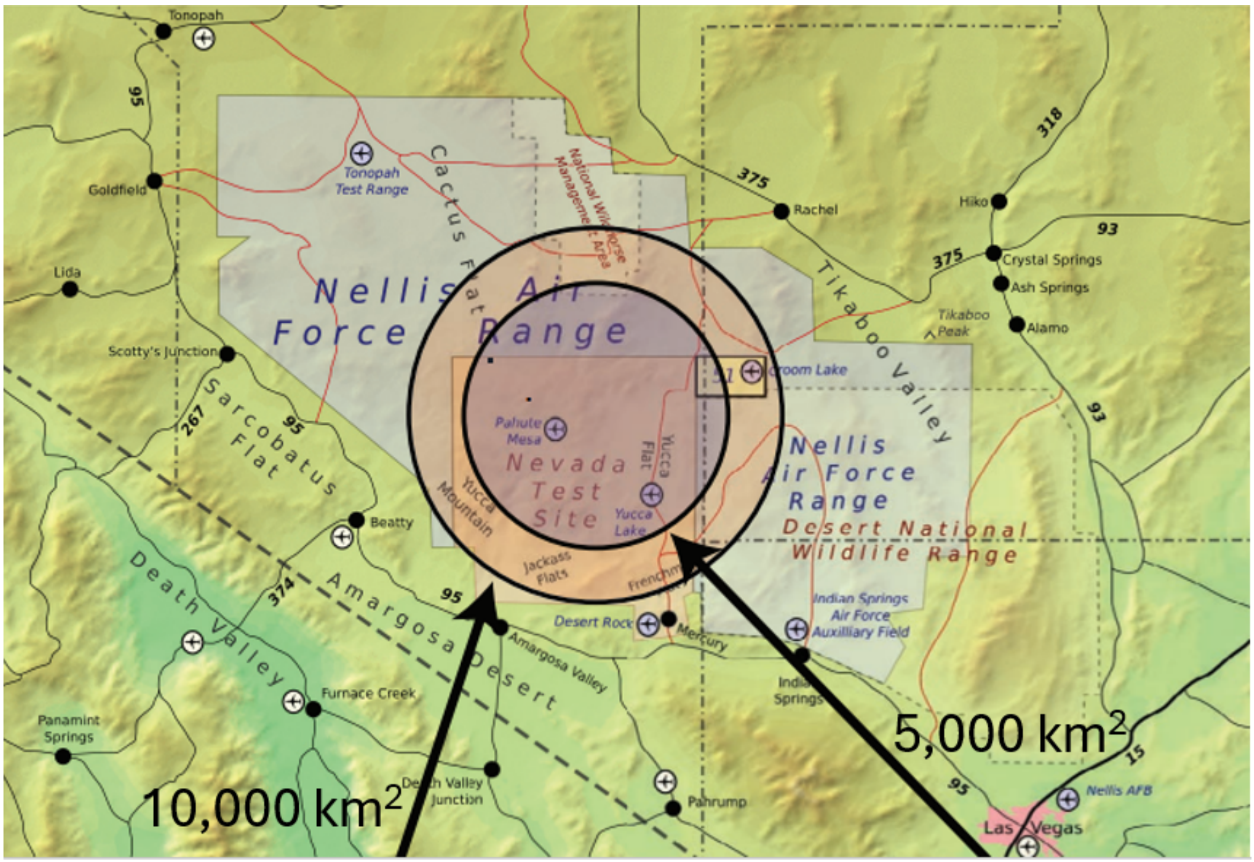
[44] Creedon, "Report on the Strategic Posture of the United States."

[45] Greg Weaver, "Requirements for nuclear deterrence and arms control in a two-nuclear-peer environment."

[46] Gabriel Honrada. "China claims breakthrough in US nuke sub detection." Asia Times. 2023. https://asiatimes.com/2023/08/china-claims-breakthrough-in-us-nuke-sub-detection/. Accessed May 9, 2024.

both paved-road and off-road movement, though the weight of these vehicles could impact their maneuverability. The general populace may oppose nuclear missiles being deployed on public highways, and these systems would likely exceed the weight limits for U.S. highways. For example, the previously proposed Hard-Mobile Launcher was three times heavier than the U.S. highway limit.[47] However, there are areas within the continental United States that are suitable. Figure 1 shows that the Nevada National Security Site, along with the Nellis Air Force Test Range, offers over 10,000 square kilometers of federally owned, relatively flat, and sparsely populated land which is ideal for dispersing mobile ICBMs.[48] This choice significantly reduces the need for additional funding for basing infrastructure and minimizes challenges related to cold-weather operations.

Figure 1: Nevada National Security Site Basing



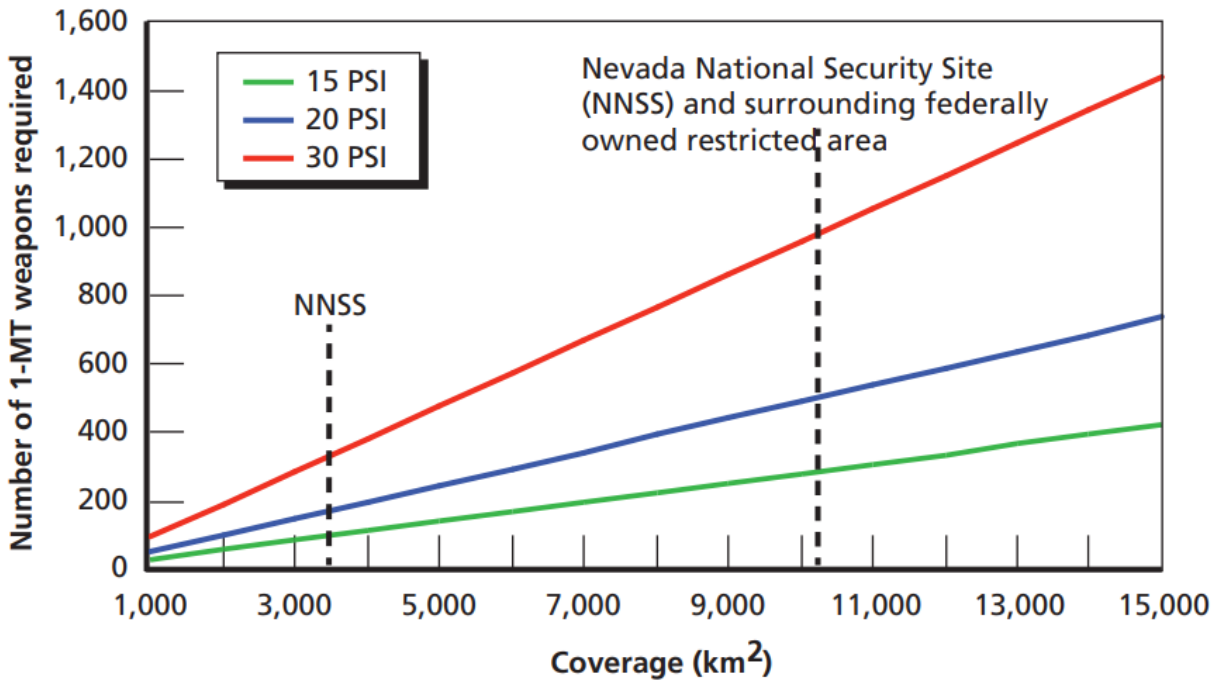
Source: Caston, "The Future of the U.S. Intercontinental Ballistic Missile Force."

The 2014 RAND report on the future of ICBMs also explored the feasibility of road-mobile systems being capable of handling rough terrain or constructing a paved network throughout the site to facilitate movement. While both of these deployment methods have their advantages and disadvantages, the results of the best methodology were inconclusive. Deploying mobile ICBM systems across such a vast area enhances their survivability as the cost and complexity of an attack to neutralize them would be prohibitive. It is improbable that an

[47] Department of the Air Force, "Hard Mobile Launcher"
[48] Caston, "The Future of the U.S. Intercontinental Ballistic Missile Force"

adversary would develop a tracking and targeting system precise and robust enough to threaten all mobile units effectively. Figure 2 outlines that without such a system, an adversary would need to expend over 1,000 one-megaton nuclear weapons to attempt a comprehensive strike on the dispersed ICBM forces across the Nevada National Security Site and surrounding federal land.[49]

Figure 2: Required Weapon Area Coverage for Overpressure Damage



Source: Caston, "The Future of the U.S. Intercontinental Ballistic Missile Force."

Conclusion

China's nuclear breakout and continuation of Russian aggression shows that the strategic environment is rapidly changing, and the consensus findings of documents like the Strategic Posture Commission report argue that the West must come to terms with this new reality to begin the initial stages of dealing with these new threats. The recommendation regarding the immediate development of a land-based mobile nuclear system is underscored by the fact that these systems introduce unique technological, doctrinal, and operational complexities. The U.S. lacks experience with this type of delivery platform and they cannot be hastily designed and deployed. Additionally, the decision to develop a road-mobile system, while ultimately lying with senior U.S. leadership, depends on sustained political support and public endorsement across multiple administrations. This continuity would be vital for the long-term success and acceptance of new strategic capabilities. Given the rapid pace of technological advances and the increasingly volatile global security landscape, a mobile ICBM system is one potentially useful avenue to explore. This capability would not only supplement the U.S. nuclear deterrent

[49] Caston, "The Future of the U.S. Intercontinental Ballistic Missile Force"

but also address vulnerabilities exposed by potential adversaries' advancements in fields like AI and advanced sensors, which threaten the survivability of the SSBN fleet in the coming years. The Strategic Posture Commission's report concludes that America's defense strategy and strategic posture must change in order to properly defend its vital interests and improve stability with China and Russia, and that decisions need to be made now in order for the nation to be prepared to address the threats from these two nuclear armed adversaries arising during the next decade.[50] The emergence of formidable advanced capabilities from peer adversaries accentuates the desire for a versatile, comprehensive response mechanism. When held up close to scrutiny, many now believe that the current U.S. nuclear triad likely will not suffice in managing emerging global threats and maintaining confidence among Western allies. Thus, the development of a mobile ICBM capability represents a strategic imperative to adapt to and navigate the complexities of a rapidly changing security environment.

[50] Creedon, "Report on the Strategic Posture of the United States."

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Table 1. Notes

1. Sea or ground launched.
2. Air, sea, or ground launched.
3. The AS-15 is the air-launched version of the SS-N-21.
4. Russia does not release public information regarding its nuclear gravity bombs.
5. Official Chinese publications indicate a range of 5,000-8,000km
6. There is ongoing debate as to whether this system has been fielded.
7. Unconfirmed but likely nuclear capability.
8. The short range of the Hwasong-5 design makes it unlikely to be paired with a nuclear warhead, but the system may be capable of accommodating one.
9. The short range of the KN-23, KN-24, and KN-25 design makes it unlikely to be paired with a nuclear warhead, but the system may be capable of accommodating one.
10. Submarine or ship launched.

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