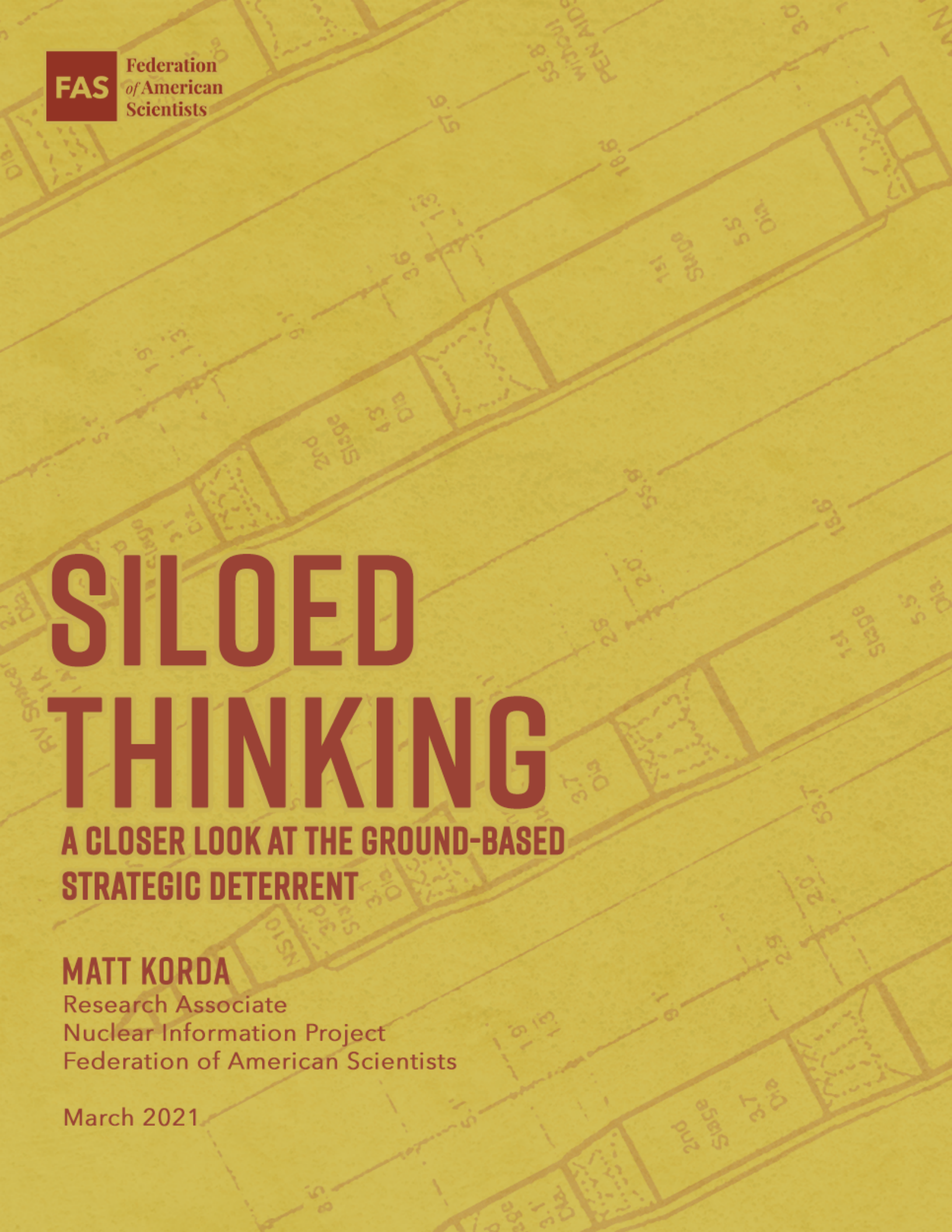

Federation of American Scientists

SILOED THINKING

A CLOSER LOOK AT THE GROUND-BASED STRATEGIC DETERRENT

MATT KORDA
Research Associate
Nuclear Information Project
Federation of American Scientists

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ABOUT FAS

The **Federation of American Scientists** (**FAS**) is an independent, nonpartisan think tank that brings together members of the science and policy communities to collaborate on mitigating global catastrophic threats. Founded in November 1945 as the Federation of Atomic Scientists by scientists who built the first atomic bombs during the Manhattan Project, FAS is devoted to the belief that scientists, engineers, and other technically trained people have the ethical obligation to ensure that the technological fruits of their intellect and labor are applied to the benefit of humankind. In 1946, FAS rebranded as the Federation of American Scientists to broaden its focus to prevent global catastrophes.

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FAS can be reached at 1112 16th St. NW. Suite 400, Washington, DC, 20036, fas@fas.org, or through fas.org.

Cover image: *ICBM Prime Team, "Minuteman Weapon System History and Description," 2001.*

AUTHOR

Matt Korda is a Research Associate for the Nuclear Information Project at the Federation of American Scientists, where he co-authors the Nuclear Notebook with Hans Kristensen. Previously, he worked for the Arms Control, Disarmament, and WMD Non-Proliferation Centre at NATO HQ in Brussels. Matt is also the co-director of Foreign Policy Generation—a group of young people working to develop a progressive foreign policy for the next generation. He received his MA in International Peace & Security from the Department of War Studies at King's College London.

Matt's research interests and recent publications focus on nuclear deterrence and disarmament, progressive foreign policy, and the nexus between nuclear weapons, climate change, and injustice. Matt's work has been widely published and quoted in The Washington Post, Forbes, CBC, Politico, The Nation, Bulletin of the Atomic Scientists, Defense One, Inkstick, 38 North, Arms Control Wonk, and others. Matt is Ploughshares Fund's 2020 Olum Fellow, a 2019 alumnus of the Wilson Center's Nuclear History Boot Camp, and a 2019 CSIS Nuclear Scholar.

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The statements made and views expressed are solely the responsibility of the author. Please direct all inquiries to Matt Korda, Research Associate for the Nuclear Information Project, Federation of American Scientists (mkorda@fas.org). Visit https://fas.org/issues/icbm-information-project/ for more information about the ICBM Information Project.

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INTRODUCTION

The Pentagon is planning to replace its current arsenal of intercontinental ballistic missiles (ICBMs) with a brand-new missile force, known as the **Ground-Based Strategic Deterrent**, or **GBSD**.

The GBSD program consists of a like-for-like replacement of all 400 Minuteman III missiles that are currently deployed across Colorado, Montana, Nebraska, North Dakota, and Wyoming, and will also include a full set of test-launch missiles, as well as upgrades to the launch facilities, launch control centers, and other supporting infrastructure. The GBSD program will keep ICBMs in the United States' nuclear arsenal until 2075, and is estimated to cost approximately $100 billion (in Then-Year dollars) in acquisition fees and $264 billion (in Then-Year dollars) throughout its life-cycle.

However, critics of the GBSD program—which include a chorus of former military commanders and Secretaries of Defense, top civilian officials, current congressional committee chairs, subject matter experts, and grassroots groups—are noting a growing number of concerns over the program's increasing costs, tight schedule, and lack of 21st century national security relevance. Many argue that the GBSD's price tag is too high amid a plethora of other budgetary pressures. Many also say that alternative deterrence options are available at a much lower cost, such as life-extending the current Minuteman III ICBM force.

Despite these concerns, the GBSD program has been accelerated in recent years, apparently in an effort to lock in the system before a new administration could consider reversing it. However, the Pentagon has not offered a convincing articulation of what role these Cold War-era weapons are supposed to play in a post-Cold War security environment. Attempts in Congress to scrutinize the program have been shot down, usually with the lobbying help of the major GBSD contractors.

As a result, key decisions during the most crucial years of GBSD have been made without being able to access the full scope of information and analysis about the program.

To that end, the Federation of American Scientists has conducted an external review of the GBSD program, in addition to reviewing the fundamental role of ICBMs in US nuclear strategy. After conducting open-source analysis, filing Freedom of Information Act requests, reviewing Air Force and program documents, examining primary and secondary sources, commissioning a comprehensive polling effort, and consulting with well-informed individuals, this review compiles a comprehensive, unclassified picture of the GBSD, while challenging many assumptions about the history, purpose, and utility of ICBMs.

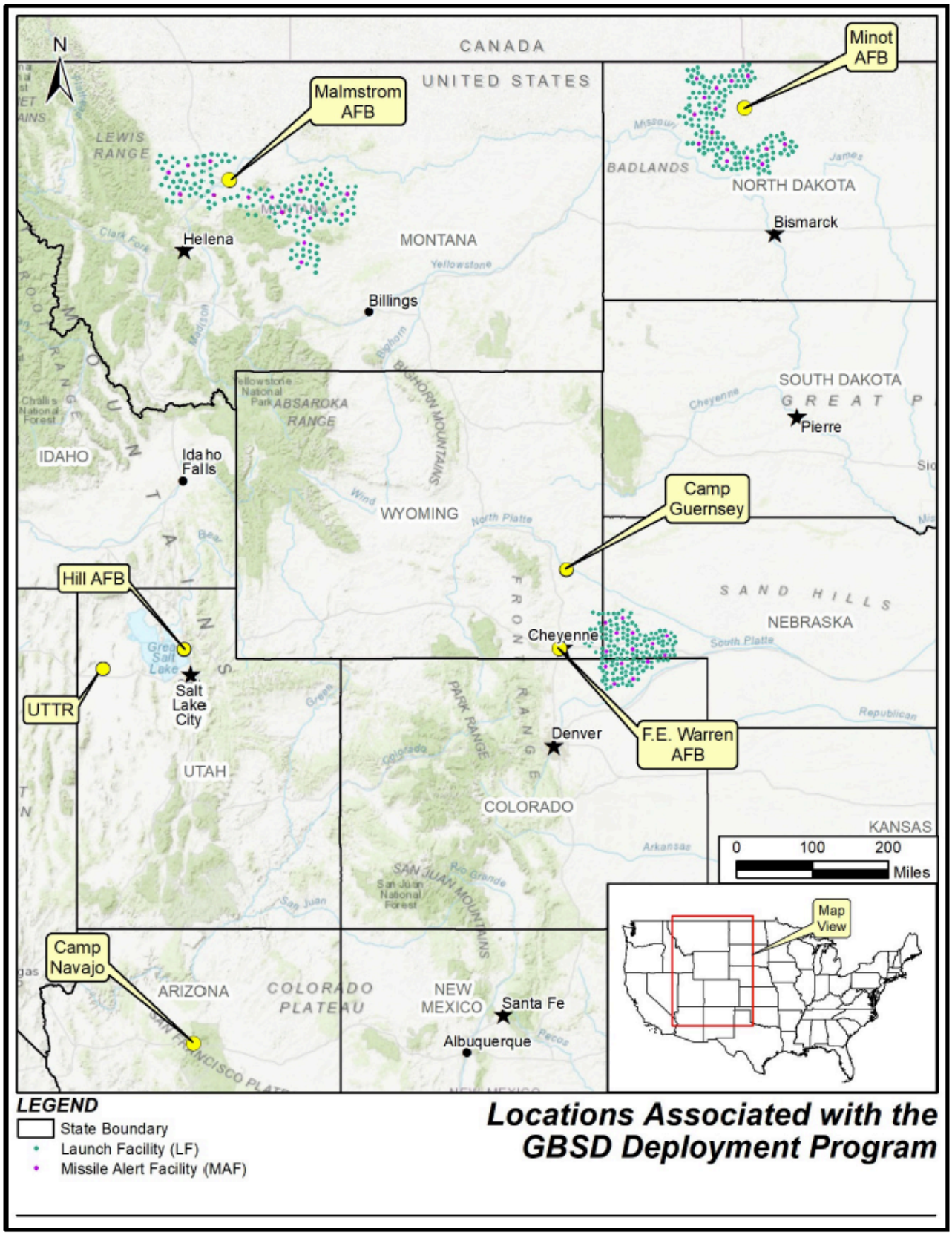

Image: Air Force Global Strike Command, "Map of GBSD EIS project locations," United States Air Force (2020).

EXECUTIVE SUMMARY

As sociologist Donald MacKenzie suggests, the United States developed long-range ballistic missiles "without any agreed understanding—even within élite circles, much less among the general population—of why it was doing so."[1] Only *after* the nuclear triad was built and deployed did US policymakers articulate how each leg could uniquely influence deterrence: somewhat counterintuitively, the weapons came first; the questions of how and when to use them came second.

Subsequently, the consolidation of the "nuclear triad" into a singular, unbreakable entity has proved to be an effective defensive measure against proposed reductions to the US nuclear force. Despite substantial cuts to the ICBM force over the past two decades, every post-Cold War administration has accepted that ICBMs would remain part of the US nuclear deterrent, despite the fact that the Pentagon has not offered a convincing articulation of what role these Cold War weapons are supposed to play in a post-Cold War security environment.

The "nuclear triad" is neither sacred nor immutable, however, as the United States faces imminent decisions that will affect the country's force posture until the end of the 21st century, a review of the ICBMs' role in US nuclear strategy is certainly warranted.

During the Cold War, the United States planned to use ICBMs primarily as damage-limitation tools as a means of reducing the Soviet Union's destructive potential, in the event of a nuclear war. Although the war plan has been revised and replaced several times since the end of the Cold War, it is believed that ICBMs currently play a similar role in US nuclear planning and targeting.[2]

The President can decide to change the United States' nuclear employment guidance anytime, however, and a shift towards a posture that foregoes preemptive, damage-limiting nuclear strikes would remove the requirement to maintain ICBMs in the US arsenal. There are several reasons why a President might choose to shift towards a posture that eliminates this particular targeting requirement: non-mobile ICBMs invite a devastating attack on the United States, they face significant limitations in addressing 21st century deterrence challenges, and they are uniquely destabilizing weapon systems that can bias a President towards launching quickly in a crisis.

Eliminating the requirement to pursue preemptive, damage-limiting nuclear strikes—the role that the ICBMs have historically fulfilled in US nuclear strategy– would prioritize the role of ballistic

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[1] Donald MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, Massachusetts: The MIT Press, 1993), p. 162.

[2] Hans Kristensen, "US Nuclear War Plan Updated Amidst Nuclear Policy Review," *FAS Strategic Security Blog* (4 April 2013), accessed 10 February 2021, <https://fas.org/blogs/security/2013/04/oplan8010-12/>.

missile submarines in ensuring that the United States is able to "ride out" a nuclear attack, accurately assess damage, and still maintain an assured retaliatory capability. Under this revised nuclear posture, the United States' deterrence credibility would largely be conferred by the survivability of its nuclear command, control, and communications (NC3) infrastructure, because a crippling attack on US NC3 could prevent the President from ordering retaliatory strikes from US SSBNs. Therefore, modernized NC3 systems, in conjunction with the adoption of NC3 safeguards and backstops, would help strengthen the conditions under which the United States could shift away from damage-limiting nuclear strikes.

Such investments would help strengthen the United States' deterrence credibility, because as long as an adversary lacked confidence in its ability to destroy every US nuclear submarine or cripple the US NC3 network, a stable deterrence relationship would theoretically hold. Under this revised posture, any attempted first strike on US strategic nuclear forces would likely still leave the majority of the US ballistic missile submarine force relatively unscathed and ready to launch.

The survivability of the SSBN force is unlikely to change, even decades into the future. As the 2018 Nuclear Posture Review states, "When on patrol, SSBNs are, at present, virtually undetectable, and there are no known, near-term credible threats to the survivability of the SSBN force."[3] The next generation of US SSBNs—the Columbia class—is expected to be even quieter and more survivable than the current Ohio-class fleet.[4] Given the United States' supremacy in submarine-quieting and submarine-detection capabilities, any meaningful technological developments are likely to be predictable and are unlikely to offer an advantage to US adversaries. Furthermore, such developments are unlikely to affect the United States' ability to conduct retaliatory nuclear strikes, given the significant logistical complications associated with destroying US submarines on patrol.

Despite the lack of security rationale for preserving ICBMs in a post-Cold War era, the Pentagon's flawed assessment metrics have continuously pushed the department towards upgrading and modernizing its missiles without taking into account whether particular requirements could be filled by other systems—or whether those requirements are indeed necessary at all. This process has been bolstered by the influence of the Senate ICBM Coalition—a group of senators from ICBM host states who have played an outsized role in dictating US nuclear force posture—occasionally even overriding the guidelines set by US military leaders—in order to prevent any significant ICBM force reductions from taking place.

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[3] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), pp. 44-45, <https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF>.

[4] "Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress," *Congressional Research Service* (31 July 2000), RL30622, p. 19, accessed 15 November 2020, <https://www.everycrsreport.com/files/20000731_RL30622_c288e8b1829d574fffb93ddf56d0891b36cff9fc.pdf>.

These lawmakers are generously funded by weapons contractors and other corporations that stand to materially benefit from the GBSD program, and have protested against proposed cuts to the ICBM force on the basis of losing jobs in their constituencies.[5] However, the ICBM force does not create nearly as many jobs as its advocates often claim: for the same amount of spending on defense, low-carbon industries like health care and education support 100% to 140% *more* jobs.[6]

Instead of reducing the ICBM force, however, the Air Force is pursuing a $264 billion replacement program—the Ground-Based Strategic Deterrent—that will keep ICBMs in the United States' nuclear arsenal until 2075. The Air Force's justification for the GBSD program rests upon several flawed assumptions about how GBSD would address capability gaps, maintain the health of the large solid rocket motor industrial base, share commonality with the Navy's missiles, and—most importantly—be cheaper than the cost of a Minuteman life-extension.[7] In hindsight, it appears that these factors were based on flawed assumptions, and many have since been been deprioritized.

Furthermore, it has become clear that the outcome favoring GBSD was largely predetermined by arbitrary force requirements and timelines that have little 21st century strategic rationale. The most consequential example of this was the Air Force's requirement to maintain current ICBM force levels until 2075, which had a significant knock-on effect on its associated cost analysis. If the Air Force had selected a different timeframe—2050, for example, or even 2100—the most cost-effective policy to meet those requirements would have been to pursue a life-extension of the current Minuteman III system, thus deferring a decision on GBSD for two decades and alleviating the overwhelming pressure on the current defense budget.

These conclusions suggest that the Air Force's case for GBSD needs to be reevaluated in light of cost escalation and surrounding budget pressures. This is especially true given that a Minuteman III life-extension program remains a cheaper and less risky option. The Minuteman III's critical subsystems continue to show high reliability with age, and new forms of nondestructive testing methodologies could allow the Air Force to monitor their reliability without sacrificing any test assets. The President could also revise nuclear employment guidance to accept a slightly higher

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[5] William Hartung, "Inside the ICBM Lobby: Special Interest or the National Interest?" *Center for International* Policy (9 March 2021), <https://3ba8a190-62da-4c98-86d2-893079d87083.usrfiles.com/ugd/3ba8a1_89fe183f8a164e22a2fa29d4d6381d7b.pdf>.

[6] Heidi Garrett-Peltier, "War Spending and Lost Opportunities," *Costs of War Project* (14 March 2019), accessed 20 September 2020, <https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/March%202019%20Job%20Opportunity%20Cost%20of%20War.pdf>.

[7] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," Department of Defense (July 2016), p. 4.

threshold for risk; this would allow the Air Force to meet presidential guidance with a life-extended Minuteman III, without affecting strategic stability. At the point when the Minuteman III's subsystems would ultimately need to be replaced, the Air Force has a proven track record of conducting life-extension operations at low cost.

Ultimately, pursuing a Minuteman III life-extension is less risky than building a brand-new missile force from scratch. According to the Air Force, the GBSD already carries a "high-risk" schedule, likely due to the prospect of delays from a demanding military construction schedule, the inexperience of Air Force Global Strike Command in implementing simultaneous major acquisition program, and the likely delays to GBSD-adjacent programs like the W87-1 warhead. The Air Force is already anticipating that the W87-1 will not be completed on-time, and is therefore planning for the GBSD to reach Initial Operational Capability with legacy warheads.[8]

In 2017, the Congressional Budget Office estimated that the entire US nuclear modernization program would cost approximately $1.2 trillion, and these costs are highly likely to increase with inflation and customary programmatic overruns.[9] Given these significant budgetary pressures it would seem irresponsible to spend nearly $100 billion to acquire the GBSD today when such a decision could be deferred for several decades—thus allowing the United States to reallocate that money towards more pressing security priorities.

Recent polling conducted suggests that this form of reallocation would be widely popular on a bipartisan basis. An October 2020 poll conducted by the Federation of American Scientists and ReThink Media found that Americans overwhelmingly do not derive their sense of safety from investments in nuclear or conventional weapons. These results suggest that a legislative effort to reallocate funds from GBSD towards more proximate security priorities would be widely supported by Americans on both sides of the political spectrum. Additionally, the survey demonstrated very little bipartisan support for the GBSD program itself, and respondents overwhelmingly supported delaying the GBSD and continuing to refurbish the Minuteman III while the program undergoes a review.

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[8] Department of the Air Force, "Report on Development of Ground-Based Strategic Deterrent Weapon," Report to Congressional Committees (May 2020), p. 4.

[9] Congressional Budget Office, "Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046" (October 2017), <https://www.cbo.gov/system/files/115th-congress-2017-2018/reports/53211-nuclearforces.pdf>.

I. THE UNCERTAIN HISTORY OF THE NUCLEAR "TRIAD"

The "nuclear triad" of land-based missiles, submarine-launched missiles, and long-range bombers is often presented as a logical inevitability, as something that naturally arose from expanding the three existing domains of conventional warfare—land, sea, and air—into the nuclear realm. As the then-Commander of US Strategic Command testified to Congress in 2017, "If the adversary has capabilities to operate from the sea, from the land [and] from the air, we have to be able to deter all those elements. That's how the triad was developed and that's how we need to go."[1]

However, this characterization of the triad's development is both simplistic and ahistorical. It subscribes to a problematic notion of nuclear determinism by suggesting that a nation's nuclear posture should be a natural extension of its conventional military posture. In fact, characterizing the triad's development as an essential and inevitable feature of US nuclear policy overlooks the complexity of the personalities, decisions, and organizational politics that were required in order to bring it into existence. It also ignores the fact that the nuclear triad almost never existed at all. As sociologist Donald MacKenzie argues, "the United States built its missile arsenal without any agreed understanding—even within élite circles, much less among the general population—of why it was doing so."[2]

The organizational politics of ICBMs

The development of the nuclear triad was certainly not an inevitability; in fact, it came close to never existing at all. Until the early 1950s, there remained extreme skepticism about the utility—and even the technological possibility—of unmanned missiles taking the place of manned bombers. Even Vannevar Bush, the eminent scientist who directed all wartime research and development and played a principal role in the Manhattan Project, was not convinced. He famously told Theodore von Kármán—the father of supersonic flight—"I don't understand how a serious scientist can play around with rockets."[3]

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[1] Gen. John Hyten, testimony before the House Armed Services Committee, "Hearing on Military Assessment of Nuclear Deterrence Requirements," 115th Congress, 1st session (8 March 2017), <https://dod.defense.gov/Portals/1/features/2017/0917_nuclear-deterrence/docs/Transcript-HASC-Hearing-on-Nuclear-Deterrence-8-March-2017.pdf>.

[2] Donald MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, Massachusetts: The MIT Press, 1993), p. 162.

[3] Ann Markusen et al., *The Rise of the Gunbelt: The Military Remapping of Industrial America* (New York: Oxford University Press, 1991), p. 91.

Bush's skepticism was not unfounded. Early ballistic missiles like the V-2 were crude and inaccurate, and at the time there seemed to be little hope of transforming them into systems suitable for carrying heavy nuclear payloads to a specific target, thousands of kilometers away. In December 1945, Bush told the Senate Special Committee on Atomic Energy: "I say technically I don't think anybody in the world knows how to do such a thing, and I feel confident it will not be done for a long period of time to come."[4]

In addition to the associated technological challenges, the organizational culture of the US Air Force actively rejected unmanned flight, writ large. The unique role of strategic bombers during the Second World War had helped justify the Air Force's establishment as a separate branch of the armed forces in 1947, and for many pilots and military officers, flying symbolized a particularly 'American' way of life.[5] As a result, it was not unreasonable for an organization composed almost entirely of airmen to be inherently suspicious of unmanned systems, which posed an existential threat to both their career incentives and their service culture.

In the face of these technological, cultural, and organizational challenges, it is not surprising that during the 1940s and early 1950s, the Air Force's stance towards ballistic missiles could "best be characterized as a combination of skepticism, indecision, and indifference."[6] Colonel Edward Hall—the engineer in charge of designing the United States' first ICBM—reportedly even admitted that he had faked an intelligence report on Soviet rocket engines in the early 1950s, just so that his own work on long-range ballistic missiles would not be shut down.[7] When viewed through this lens, the development of ICBMs—much less the nuclear triad—was certainly not an inevitability.

However, by the final months of 1953 and the early months of 1954, these institutional barriers had eroded to the point where the "missile revolution" finally became possible. As the first Republican president to be elected in two decades, the newly-inaugurated Eisenhower administration effectively cleaned house, enacting a series of mid-level personnel changes that altered the fate of the missile revolution. Determined individuals like Trevor Gardner (Eisenhower's newly-appointed Air Force Assistant Secretary for Research and Development) and Bernard Schriever (Gardner's pick to lead the Air Force's first ICBM program) were instrumental

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[4] Vannevar Bush, testimony before the Special Senate Committee on Atomic Energy, 3 December 1945; "Inquiry into Satellite and Missile Programs," hearings before the Preparedness Investigating Subcommittee of the Senate Committee on Armed Services, 85th Congress, 1st and 2nd sessions, 1957-1958, p. 943.

[5] Robert L. Perry, *The Ballistic Missile Decisions* (Santa Monica, California: RAND Corporation, October 1967), p. 26.

[6] Kenneth P. Werrell, *The Evolution of the Cruise* Missile (Maxwell Air Force Base, Alabama: Air University Press, 1985), p. 103.

[7] Gretchen Heefner, *The Missile Next Door: The Minuteman in the American Heartland* (Cambridge, Massachusetts: Harvard University Press, 2012), p. 24.

in removing many of the major bureaucratic roadblocks, thus paving the way for political investment in a long-range ballistic missile program.[8]

The newly-empowered ICBM lobby was aided significantly by the invention of the hydrogen bomb in 1952, which prompted a pivotal RAND report to assess in early 1954 that "the development of small, high-yield warheads now makes possible a missile of more reasonable size, with every prospect of further improvement in the very near future."[9] The study concluded that "if given adequate funding and development effort, [an ICBM] can be operational by or before 1960."[10]

Two days after publication, the RAND study's conclusion was echoed by a highly influential civilian scientific advisory committee, which endorsed an accelerated ICBM program.[11] This committee, codenamed the "Teapot Committee," had been stood up by Trevor Gardner months earlier, and he had carefully staffed it entirely with ICBM supporters in order to ensure a pro-ICBM outcome. The Teapot Committee, which Robert L. Perry described as having "no purpose of being except to induce more widespread acceptance of the missile thesis," accomplished its mission.[12] A year later, the Killian Committee—the most important scientific advisory committee in the Eisenhower administration—echoed the Teapot Committee's recommendation to the president, urging him to give "highest priority" to the development of an Air Force ICBM program.[13]

Adding a sense of urgency to this shared recommendation, the Teapot Committee generated intelligence estimates suggesting that the "Soviets are significantly ahead of us in the strategic missile field."[14] Despite the subsequent revelation that the "missile gap" between the Soviet

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[8] For more detail on ICBM-related organizational theory, refer to Thomas P. Hughes, *Rescuing Prometheus* (New York: Vintage Books, 1998); Robert L. Perry, *The Ballistic Missile Decisions* (Santa Monica, California: RAND Corporation, October 1967); Donald MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, Massachusetts: The MIT Press, 1993); Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics* (New York: Columbia University Press, 1976).

[9] B.W. Augenstein, *A Revised Development Program for Ballistic Missiles of Intercontinental Range: Special Memorandum No. 21* (Santa Monica, California: U.S. Air Force Project RAND, 8 February 1954), p. 7.

[10] Ibid, p. 38.

[11] Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force* (Washington, DC: Office of Air Force History, United States Air Force, 1990), pp. 95-103.

[12] Perry, *The Ballistic Missile Decisions*, pp. 15-16.

[13] *Foreign Relations of the United States*, 1955-1957, Volume XIX, National Security Policy, eds. William Klingaman, David S. Patterson, and Ilana Stern (Washington, DC: Government Printing Office, 1990), Document 9. Original source: Department of State, S/S–RD Files: Lot 71 D 171. Top Secret; Restricted Data.

[14] MacKenzie, *Inventing Accuracy,* pp. 111-113; Hughes, *Rescuing Prometheus*, pp. 137-149.

Union and the United States was, in fact, a myth, this assumption proved to be a significant factor in persuading congressional allies to advocate aggressively in favor of an ICBM program.[15]

Having taken all of these factors into account, and facing significant pressure from Congress and several of his own political appointees, President Eisenhower finally assigned the highest national priority to the development of an ICBM in September 1955. This ultimate decision, however, was anything but inevitable, and it certainly did not resolve the underlying bureaucratic resistance to the program. One estimate suggests that institutional inertia alone delayed the start of ICBM development by up to six years, and once the Navy initiated its own ballistic missile program, the Air Force's ICBM once again faced a new round of potentially existential roadblocks.[16]

Competing missiles, competing doctrines

The Navy was quick to understand that an Air Force monopoly over ballistic missiles would be coupled with a dramatic cut to their already-shrinking service budget. For that reason—and largely for that reason alone—forceful individuals within the Navy advocated for the development of a "Fleet Ballistic Missile" to compete with the Air Force's ICBMs. The project found a welcome audience among the members of the Killian Committee, and was ultimately approved by Eisenhower in September 1955.[17]

This development sparked a bitter, long-lasting fight between the Navy and the Air Force, one which culminated in the articulation of two competing nuclear doctrines. Rather than being driven strictly by deterrence requirements, these doctrines—known today as "counterforce" and "countervalue"—were largely shaped by the characteristics and limitations of the delivery systems themselves.[18] Somewhat counterintuitively—and in a pattern that continues to plague US nuclear policy to this day—the weapons came first; the questions of how and when to use them came second.

Initially—and, as Donald MacKenzie notes, without much strategic thought—both services attempted to incorporate their new ballistic missiles into their existing targeting doctrines.[19] The Air Force's early ballistic missiles were explicitly intended for destroying cities, and were slated to be used in conjunction with Strategic Air Command bombers to preemptively deliver an all-

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[15] Hughes, *Rescuing Prometheus*, pp. 166-167.

[16] Beard, *Developing the ICBM*, p. 70; Hughes, *Rescuing Prometheus*, p. 125.

[17] Donald MacKenzie and Graham Spinardi, "The Shaping of Nuclear Weapon System Technology: US Fleet Ballistic Missile Guidance and Navigation, Part I: From Polaris to Poseidon," *Social Studies of Science* 18 (1988), DOI: 10.1177/030631288018003002, p. 425.

[18] A "counterforce" doctrine is used to target an adversary's strategic military forces and facilities, such as ICBM silos, as a form of damage limitation; a "countervalue" doctrine is used to target an adversary's cities and economic infrastructure.

[19] MacKenzie, *Inventing Accuracy*, p. 124.

encompassing "Sunday Punch" to the Soviet Union.[20] Having previously characterized the Air Force's targeting of urban-industrial centers as "immoral" and "unmilitary," the Navy's ballistic missile proponents initially conceived of its Fleet Ballistic Missile as a means of solely destroying "targets of naval opportunity" like ports and submarine pens.[21]

This early targeting differentiation was a convenient way for both the Air Force and the Navy to justify funding for their respective ballistic missile programs, and both services were initially careful to not upset this delicate balance.[22] However, this detente would not last long. Polaris—the Navy's first ballistic missile—was too inaccurate to be used for anything but a counter-city weapon, and so its proponents were forced to flip their previous doctrine upside-down, and articulate a countervalue doctrine that they had previously condemned as "immoral" and "ineffective." Under a new doctrine of "finite deterrence," as it was known, a relatively small number of invulnerable Navy submarines—armed with Polaris missiles—could hold Soviet cities at risk, even after a Soviet first strike.[23]

This shift in the Navy's preferred doctrine presented an obvious problem for the Air Force. If adopted, finite deterrence would mean that the Navy could effectively deter the Soviet Union all by itself, thus rendering the Air Force's ballistic missile force—not to mention its bombers and overseas bases—redundant. This fact was not lost on the Eisenhower administration, which recognized that adopting a retaliatory doctrine could be used to justify a new round of defense budget cuts.[24]

In an attempt to differentiate its ballistic missiles from those of the Navy, the Air Force coalesced around a competing nuclear doctrine that had been devised at the RAND Corporation, known as "counterforce." Recently enabled by improvements in accuracy, a counterforce doctrine emphasized preemptively striking the Soviet Union's nuclear forces as a means of damage-limitation, while eschewing attacks on cities and population centers.

Recognizing that Polaris represented an existential threat to its ICBMs, the Air Force attempted to claim jurisdiction over the Navy's weapon by proposing a Single Integrated Operational Plan (SIOP) for launching all US nuclear weapons, to be organized under the auspices of Strategic Air Command (SAC). It was presented as a means to better synchronize nuclear planning; however, in reality, as Fred Kaplan writes, "the strategy behind SIOP was to co-opt the Polaris, take it out

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[20] Augenstein, *A Revised Development Program for Ballistic Missiles of Intercontinental Range*, p. 11.

[21] MacKenzie and Spinardi, "The Shaping of Nuclear Weapon System Technology, Part I," p. 437.

[22] Ibid, p. 437.

[23] MacKenzie, *Inventing Accuracy*, pp. 149-150.

[24] MacKenzie and Spinardi, "The Shaping of Nuclear Weapon System Technology, Part I," p. 438.

of the hands of the Navy and place it firmly under the wings of SAC."[25] This move caused Polaris' most forceful advocate, Admiral Arleigh Burke, to characterize his Air Force counterparts as "smart and ruthless […] the same way as the Communists."[26]

Throughout the late 1950s and early 1960s, both the Air Force and the Navy lobbied heavily in favor of their respective weapons and doctrines; however, neither made an outright attempt to undermine the justification for the other's existence; MacKenzie and Spinardi even note that "there is no evidence of an attempt [by the Navy] to compete with the Air Force in the accuracy stakes."[27] Ultimately, the Air Force's preferred "counterforce" doctrine won the day. Although the Navy managed to retain control over Polaris when the SIOP came into effect, the majority of the war plan's targets were more suited to the Air Force's counterforce mission, and "finite deterrence" was explicitly rejected by Secretary of Defense Robert McNamara in 1961.[28] Counterforce dramatically expanded the United States' target list and thus enabled the establishment of "overkill" levels of US nuclear forces throughout the 1960s. This also included significant increases to the submarine-based nuclear forces, which McNamara believed could play a "role in a 'controlled response' strategy for later stages of a nuclear war."[29]

Thus, under the Kennedy administration the defense budget shifted from a sustained period of Air Force dominance to a relatively stable balance between the services—which has largely endured ever since.[30]

The "Triad" as strategic nomenclature

The development of the "nuclear triad" was not an inevitable outgrowth of the land, air, and sea domains of warfare, nor was it necessarily a response to corresponding developments in the Soviet nuclear arsenal. These claims ignore the organizational and bureaucratic politics which drove the majority of nuclear decision-making during the Cold War. As Donald MacKenzie

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[25] Fred Kaplan, *The Wizards of Armageddon* (Stanford, California: Stanford University Press, 1983), p. 263.

[26] Ibid, p. 265.

[27] MacKenzie and Spinardi, "The Shaping of Nuclear Weapon System Technology, Part I," p. 441.

[28] "War and Peace in the Nuclear Age; The Education of Robert McNamara; Interview with William Kaufmann, 1986," *GBH Archives* (5 March 1986), <http://openvault.wgbh.org/catalog/V_D1FA1FDE1AF4474A8C40165A496EEAEB>; Memorandum to President Kennedy from Secretary of Defense Robert S. McNamara, "Recommended Long Range Nuclear Delivery Forces, 1963-67" (23 September 1961), Top Secret, excised copy, accessed via William Burr, ed., "How Much is Enough?": The U.S. Navy and "Finite Deterrence," Electronic Briefing Book No. 275, *National Security Archive* (1 May 2009), <https://nsarchive2.gwu.edu/nukevault/ebb275/>.

[29] William Burr, ed., "How Much is Enough?": The U.S. Navy and "Finite Deterrence," Electronic Briefing Book No. 275, *National Security Archive* (1 May 2009), <https://nsarchive2.gwu.edu/nukevault/ebb275/>.

[30] David Wright, William D. Hartung, and Lisbeth Gronlund, "Rethinking Land-Based Nuclear Missiles," *Union of Concerned Scientists* (June 2020), p. 26, <https://www.ucsusa.org/sites/default/files/2020-06/rethinking-land-based-nuclear-missiles.pdf>.

writes, "With political leaders by no means simply in command, the Soviet Union a shadowy mirror reflecting American fears rather than a well-understood foe, and nuclear strategy often rationalization after the fact rather than genuine guiding principle, the initiative for new missile systems came largely from below."[31]

The post-facto rationalization for new nuclear systems is especially visible when considering the phrase "nuclear triad." References to the "triad" in nuclear discourse didn't appear until the 1970s—*after* the respective weapons systems had already been deployed at scale. Instead, as historian Alex Wellerstein suggests, "[t]he invocation of the 'triad' as a unitary strategic concept seems to have come about when people started to wonder whether we actually needed three major delivery systems for strategic weapons."[32]

In the 1970s, as the Navy's new ballistic missiles became more accurate, the Air Force's B-1 bomber and MX ICBM came under threat; as MacKenzie suggests, "if Trident could 'do anything MX could do,' then the case for the vulnerable MX was further undercut."[33] It is therefore no coincidence that the "nuclear triad" solidified as an unbreakable concept at precisely this moment. As Wellerstein argues, "When you give something abstract a name, you aid in the process of *reification*, making it seem tangible, real, un-abstract. The notion of the 'triad' is a concept, a unifying logic of three different technologies, one that asserts quite explicitly that you need all three of them."[34]

Today, as decision-makers consider whether to retire or recapitalize the Air Force's ICBMs, industry lobbyists, hawkish think tanks, and some military officials are once again touting the "unbreakable" nature of the nuclear triad: "The nuclear triad has kept the peace since nuclear weapons were introduced," stated the Chairman of the Joint Chiefs of Staff during congressional testimony in 2016;[35] "A safe, secure, reliable and effective nuclear triad is essential to deterring threats against the U.S. homeland and underpins every other military operation around the

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[31] MacKenzie, *Inventing Accuracy*, pp. 162-163.

[32] Alex Wellerstein, "A brief history of the nuclear triad," *Restricted Data: The Nuclear Secrecy Blog* (15 July 2016), <http://blog.nuclearsecrecy.com/2016/07/15/brief-history-nuclear-triad/>.

[33] MacKenzie, *Inventing Accuracy*, p. 289.

[34] Wellerstein, "A brief history of the nuclear triad," <http://blog.nuclearsecrecy.com/2016/07/15/brief-history-nuclear-triad/>.

[35] Gen. Mark Milley, as quoted in *The Fiscal Year 2017 National Defense Authorization Budget Request from the Military Department* (Washington, D.C.: Government Publishing Office, March 16, 2016), testimony before the House Armed Services Committee. No. 114-111, p. 33, <https://www.govinfo.gov/content/pkg/CHRG-114hhrg20063/pdf/CHRG-114hhrg20063.pdf>.

world," noted the Air Force's Chief of Staff in 2020;[36] "We have to make sure that we are always ready to respond to any threat," testified the then-Commander of US Strategic Command to Congress in 2019, "I can do that today because I have the most powerful triad in the world."[37]

These platitudinal defenses of the nuclear triad are all listed prominently on the website of Northrop Grumman—the sole bidder and awardee for the contract to build the next generation of ICBMs—along with a series of articles on why the ICBM leg of the triad must be modernized "without delay."[38] However, the history of long-range ballistic missiles demonstrates that weapons are often built, as Donald MacKenzie notes, "without any agreed understanding" of whether they are actually necessary, nor of why and how they would be used.[39] Instead, they typically require a post-facto rationalization campaign in order to defend the procurement decision after the fact. And in the particular case of the ICBM leg of the triad, history shows that these weapons are not sacrosanct: they are not a product of strategic necessity, but of bureaucratic politics.

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[36] "Advance Policy Questions for General Charles Q. Brown, Jr., U.S. Air Force Nominee for Appointment to be Chief of Staff of the Air Force," Senate Armed Services Committee PAIRS CASE 2020-C-0296, <https://www.armed-services.senate.gov/imo/media/doc/Brown_APQs_05-07-20.pdf>.

[37] Gen. John Hyten, testimony before the Senate Armed Services Committee, 116th Congress, 1st session (26 February 2019), <https://www.armed-services.senate.gov/imo/media/doc/19-14_02-26-19.pdf>.

[38] "Nuclear Triad: Supporting Voices," *Northrop Grumman*, <https://www.northropgrumman.com/cyber/gbsd-icbm/nuclear-triad-supporting-voices/>.

[39] MacKenzie, *Inventing Accuracy*, p. 162.

II. CHALLENGING THE STRATEGIC REQUIREMENT FOR ICBMS

Only *after* the nuclear triad was built and deployed did US policymakers articulate how each leg could uniquely influence deterrence. Eventually, these arguments coalesced into a now-familiar refrain, which has been continuously reflected in various iterations of the Nuclear Posture Review: ballistic missile submarines (SSBNs) are "the most survivable" leg of the nuclear triad, heavy bombers are "the most flexible and visible," and ICBMs are "the most responsive."[1]

This primary requirement for ICBM responsiveness is rooted in a Cold War-era strategic environment when the United States and the Soviet Union alike feared a "bolt-from-the-blue" nuclear attack; however, this type of attack is an improbable possibility today. In 2012, the Secretary of Defense and the Director of National Intelligence jointly concluded in a report to Congress that "the only Russian shift in its nuclear forces that could undermine the basic framework of mutual deterrence […] is a scenario that enables Russia to deny the United States the assured ability to respond against a substantial number of highly valued Russian targets following a Russian attempt at a disarming first strike—a scenario that the Department of Defense judges will most likely not occur."[2]

Despite the fact that the possibility of a "bolt-from-the-blue" attack is, in the words of former Secretary of Defense William Perry and Ploughshares Fund's Tom Collina, "vanishingly small," ICBM proponents often claim that ICBMs are just as necessary—if not *more* necessary—than they were during the Cold War.[3] A survey of the arguments in favor of maintaining ICBMs yields several related assumptions about the purpose of these weapons, largely relating to their uniquely "responsive" nature, their intended role as a cost-imposition tool for US adversaries,

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[1] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), pp. 44-46, <https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF>; US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (April 2010), p. 22, <https://dod.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf>.

[2] Department of Defense, "Report on the Strategic Nuclear Forces of the Russian Federation Pursuant to Section 1240 of the National Defense Authorization Act for Fiscal Year 2012 (U)," *Office of the Under Secretary of Defense for Policy* (May 2012), <https://fas.org/programs/ssp/nukes/nuclearweapons/DOD2012_RussianNukes.pdf>, accessed via Hans Kristensen, "DOD: Strategic Stability Not Threatened Even by Greater Russian Nuclear Forces," *Federation of American Scientists* (10 October 2012), <https://fas.org/blogs/security/2012/10/strategicstability/>.

[3] For further discussion on the improbability of a modern-day "bolt-from-the-blue" attack, see William J. Perry and Tom Z. Collina, *The Button: The New Nuclear Arms Race and Presidential Power from Truman to Trump* (Dallas, TX: BenBella Books, Inc., 2020); for discussion on the perceived additional importance of ICBMs today, see Gen. (ret.) C. Robert Kehler, "The U.S. Needs a New ICBM Now," *National Institute for Public Policy*, Information Series No. 444 (16 August 2019), <https://www.nipp.org/wp-content/uploads/2019/08/IS-444.pdf>.

and their presumptive utility as deterrence and hedging tools. These assumptions are driven by the United States' longstanding nuclear employment guidance, which directs US planners to utilize ICBMs primarily as damage-limitation tools in the event of a nuclear war.

In response, this chapter assesses the relative values of "responsiveness" and "survivability," and suggests that by prioritizing the former over the latter, the ICBM force contributes to instability. To mitigate this risk, the United States could change its nuclear employment guidance to emphasize deterrence without pursuing preemptive, damage-limiting nuclear strikes. Under this posture, ICBMs would not be necessary. Instead, this revised posture would prioritize the modernization of the United States' nuclear command, control, and communications (NC3) infrastructure, as well as the retaliatory role of the ballistic missile submarine force—whose survivability is unlikely to be meaningfully challenged in the foreseeable future.

The role of ICBMs in US nuclear strategy

The US nuclear war plan—now known as OPLAN 8010-12—has gone through several iterations since the end of the Cold War; however, it has its roots in the Cold War-era Single Integrated Operations Plan, or SIOP. Within each of the SIOP's Major Attack Options, ICBMs played a significant targeting role in conjunction with other elements of the US nuclear arsenal, and in some cases multiple delivery systems would be employed to "cross target" a single facility, bunker, or ICBM silo in order to increase confidence that the target would be destroyed.[4]

These targeting requirements were drawn from the Policy Guidance for the Employment of Nuclear Weapons (NUWEP)—a document issued by the Secretary of Defense to guide the SIOP targeting process. In its 1974 iteration, as the United States embraced more flexible counterforce targeting options, the NUWEP indicated that the US objective in the event of uncontrolled nuclear war would be to "preclude enemy domination" in the "post-war period," "(i) by destruction of those political, economic, and military resources critical to the enemy's post-war power and influence and national and military recovery; (ii) by limitation of damage to the United States and its allies through counterforce operations; and (iii) by retaining a strategic force in reserve for protection and coercion during and after the war."[5]

In order to fulfill these objectives, the NUWEP indicated that "in a U.S. attack planned with fully generated undamaged forces on the Soviet nuclear threat to the United States and its allies, not less than one warhead should be applied to each ICBM site, each IRBM and MRBM site, each base for heavy, medium, and light bombers, and each base for missile-launching submarines, even

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[4] Office of the Secretary of Defense, "Policy Guidance for the Employment of Nuclear Weapons" (3 April 1974), Top Secret, p. 17, accessed via National Security Archive Electronic Briefing Book No. 705, "Overkill, Assured Destruction, and the Search for Nuclear Alternatives: U.S. Nuclear Forces During the Cold War," William Burr, ed., *National Security Archive* (22 May 2020), <https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2020-05-22/us-nuclear-weapons-posture-during-cold-war-compilation-core-primary-sources>.

[5] Ibid, pp. 1-2.

if a high damage expectancy cannot be achieved or only short-term damage can be realized."[6] This multiple-warhead requirement suggests that ICBMs would be used in conjunction with strategic bombers or submarine-launched ballistic missiles to strike a common target set as a damage-limitation measure.

In the post-Cold War period, the SIOP was replaced and revised several times to accommodate various updates to nuclear policy guidance, and its current iteration is OPLAN 8010-12—the 18th major plan update since the end of the Cold War. However, as Hans Kristensen suggests, "although very different from the SIOP, OPLAN 8010-12 is still thought to be focused on nuclear warfighting scenarios using a Cold War-like Triad of nuclear forces on high alert to hold at risk and, if necessary, hunt down and destroy nuclear (and to a smaller extent chemical and biological) forces, command and control facilities, military and national leadership, and war supporting infrastructure in a myriad of tailored strike scenarios."[7]

If this is true, then it can be assumed that ICBMs currently hold a relatively similar targeting role in US nuclear strategy than they did during the Cold War. It is important to note, however, that these targeting responsibilities are based upon high-level military guidance, which itself is derived from the guidance of the highest civilian authorities in the country. The President can decide to change the United States' nuclear employment guidance anytime, and a shift towards a posture that eschews preemptive nuclear strikes would remove the requirement to maintain ICBMs in the US arsenal.

There are several reasons why a President might choose to shift towards a posture that eliminates this particular targeting requirement. As the remainder of this chapter suggests, non-mobile ICBMs invite a devastating attack on the United States, ICBMs face significant limitations in addressing 21st century deterrence challenges, and ICBMs are uniquely destabilizing weapon systems that can bias a President towards launching quickly in a crisis. Each of these will be explored in depth below, as a means to suggest that shifting away from damage-limiting nuclear strikes would reduce these dangers while continuing to ensure the survivability of the US nuclear arsenal.

ICBMs invite a devastating attack on the United States

The abstract nature of deterrence theory can obscure what a counterforce attack on the United States would really mean: the sudden disintegration of the United States' health care system, its agricultural and industrial sectors, and the ability of the government to care for its citizens. In short—the complete collapse of American society.

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[6] Ibid, p. 18.

[7] Hans Kristensen, "US Nuclear War Plan Updated Amidst Nuclear Policy Review," *FAS Strategic Security Blog* (4 April 2013), accessed 10 February 2021, <https://fas.org/blogs/security/2013/04/oplan8010-12/>.

Although these are unpleasant subjects on which to dwell, they are necessary considerations when discussing the role of ICBMs—because if US-Russia deterrence fails, the non-mobile US ICBM force could invite the detonation of several hundred warheads across the Great Plains.[8]

Some ICBM advocates suggest that this could actually save lives, because without the ICBMs to direct those warheads towards sparsely-populated regions of the United States, Russia could re-target them towards US cities—thus triggering additional casualties.[9] There is no reason to believe, however, that Russia would use its extra warheads to target US cities, rather than holding them in reserve. It is also possible that Russia might simply decide it needed fewer warheads in its nuclear arsenal if the United States did not have ICBMs.

Moreover, it is insufficient to contrast population densities without additionally examining the social, economic, and environmental consequences of nuclear war. Without considering these crucial factors, one might be tempted to conclude that targeting a less-populated region would allow the United States to somehow weather the effects of a large-scale nuclear war. In reality, as several theoretical studies on the effects of nuclear war demonstrate, if hundreds of nuclear weapons were to detonate on US soil, the consequences would be dire—regardless of where the aimpoints were located.

Notwithstanding the tens of millions of individuals that would be killed by the blasts themselves—one 2002 study projected that a Russian counterforce attack on the US ICBM force could cause approximately 100 million immediate deaths—the United States' already-strained and privatized health care system would rapidly disintegrate.[10] For a picture of what that would look like in reality, the following passage is a cable sent to the International Committee of the Red Cross from one of its delegates on the ground in Hiroshima in August 1945:

> *Conditions appalling. City wiped out. Eighty percent of all hospitals destroyed or seriously damaged. Inspected two emergency hospitals, conditions beyond description. Effect of bomb mysteriously serious.*

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[8] The idea of mobile intercontinental ballistic missiles has been considered throughout several generations of US ICBM development, including with the Ground-Based Strategic Deterrent; however, these mobile options have always been discarded due to a combination of security concerns, significant expenses, and local resistance to the idea. For further discussion of the obstacles facing mobile US-based missiles, see Jeffrey Lewis, "Return of the Hard Mobile Launcher," *Arms Control Wonk* (14 June 2012), accessed 18 November 2020, <https://www.armscontrolwonk.com/archive/205381/return-of-the-hard-mobile-launcher/>; Antonia Handler Chayes, "Managing the Politics of Mobility," *International Security* 12:2 (Fall 1987), pp. 154-162, <https://www.jstor.org/stable/2538817>.

[9] Matthew Kroenig, "The Case for the US ICBM Force," *Strategic Studies Quarterly* 12:3 (Fall 2018), pp. 60-61, <https://www.jstor.org/stable/26481909>.

[10] Ira Helfand, Lachlan Forrow, Michael McCally, and Robert K. Musil, "Projected US Casualties and Destruction of US Medical Services From Attacks by Russian Nuclear Forces," *Medicine & Global Survival* 7:2 (February 2002), pp. 68-76, <https://www.psr.org/wp-content/uploads/2018/05/projected-us-casualties-russian-attack.pdf>; William Daugherty, Barbara Levi, and Frank Von Hippel, "The Consequences of 'Limited' Nuclear Attacks on the United States," *International Security* 10:4 (1986), pp. 3-45, DOI: 10.2307/2538949.

Many victims apparently recovering suddenly suffer fatal relapse due to decomposition of white blood cells and other internal injuries, now dying in great numbers. Estimated still over one hundred thousand wounded in emergency hospitals located surroundings. Sadly lacking bandaging materials, medicines.[11]

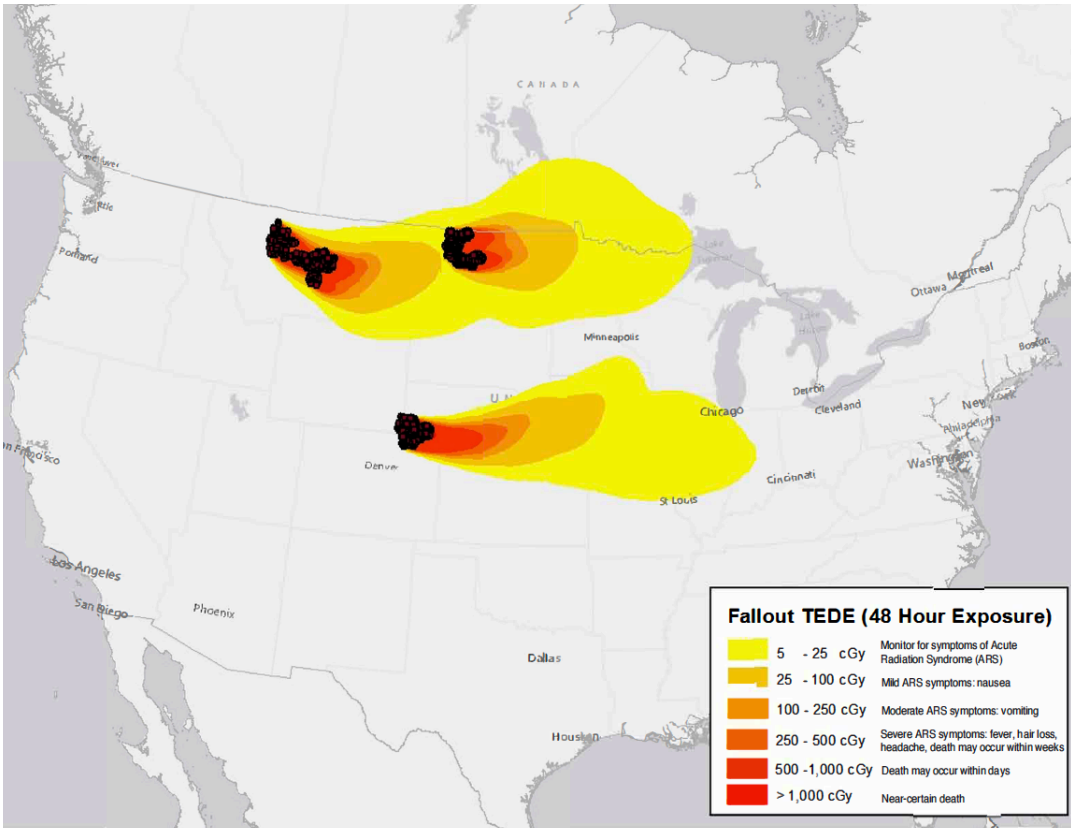

Image adapted from Hans M. Kristensen and Matthew McKinzie, "Nuclear Deterrence, Nuclear War Planning, and Scenarios of Nuclear Conflict," briefing to Vienna Conference on Humanitarian Impact of Nuclear Weapons, 2014; Medical data from US Department of Health and Human Services.

As a 1982 Cato Institute study estimated, even if—impossibly—no doctors or hospitals were affected by the detonations, "there would be one doctor for every 50 or 100 injured, and between 10 and 30 patients per available hospital bed."[12] Any pre-admitted hospital patient would no longer be able to receive proper treatment, and the millions of individuals exposed to harmful levels of radiation would not be able to receive the transplants, transfusions, antibiotics, or professional care necessary to keep them healthy. Medical and insurance records would largely be

[11] Peter Maurer, "Who will assist the victims of nuclear weapons?," prepared remarks of the President of the International Committee of the Red Cross, *International Conference on the Humanitarian Impact of Nuclear Weapons*, Oslo (4-5 March 2013), <https://www.icrc.org/en/doc/resources/documents/statement/2013/13-03-04-nuclear-weapons.htm>.

[12] Arthur Katz and Sima R. Osdoby, "The Social and Economic Effects of Nuclear War," *Cato Institute*, Policy Analysis No. 9 (21 April 1982), <https://www.cato.org/sites/cato.org/files/pubs/pdf/pa009.pdf>.

inaccessible, and individuals with radiation-weakened immune systems could easily become carriers for other infectious diseases.[13]

American agriculture and food production would be severely disrupted by even a small number of nuclear detonations. The same "breadbasket" states that would be most affected by a nuclear attack on US ICBMs also happen to produce the majority of the United States' wheat, corn, and animal products, and collectively they produce approximately half of the United States' total caloric intake.[14] In the context of a nuclear war, the land destruction and longstanding land denial that would be visited upon these states would have extreme consequences for the rest of the country for decades. National and regional food shortages—coupled with the likelihood of regional hoarding and national social disorganization—could additionally lead to conflict between food-producing states and states that have large populations but low levels of self-sufficiency.[15]

Additionally, several key industries would be similarly disrupted by nuclear detonations on American soil, including the critical banking, energy, and manufacturing sectors. Regional and federal governments would likely be forced to bail out entire industries, and, as the aforementioned Cato Institute study suggested, "since individual, industrial, and even regional economic stability would depend on which industries and plants were decontaminated and/or received needed financial support first, implementing these governmental policies would be politically explosive."[16]

Nuclear detonations within the continental United States would also trigger unprecedented population displacement. Tens of millions, possibly even hundreds of millions, would be forced to evacuate irradiated zones, which would place additional burdens on US infrastructure, transit pathways, and housing. The Cato Institute study estimated that "under a limited war scenario in the United States, to absorb the evacuated population, the number of people living in a single house or apartment in the host areas would have to increase six times (from three people to eighteen). It is not hard to imagine the conflict and stress that type of crowding would create."[17]

Even with the continued presence of land-based missiles, it is also highly unlikely that an adversarial nuclear attack would be limited to just ICBM targets. Additional targets would likely

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[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Ibid.

include high-level military command and control centers—many of which are in or near cities—nuclear bomber and submarine bases, leadership and military targets in Washington DC, and possibly early-warning systems and strategic refueling bases dotted across the country.[18] As a result, it is safe to suggest that a strategic nuclear attack on the United States would be absolutely devastating—with or without the presence of ICBMs.

The consequences of such an attack would not be limited to the United States. The smoke and soot generated from a large number of nuclear detonations could generate "continental scale smoke clouds" within just a few days, which could cause the global mean temperature to decline by several degrees and could cause significant precipitation decreases, for a period of almost a decade.[19] It is expected that this global cooling phenomenon would dramatically increase ocean acidification, which would in turn affect the global fishing industry and food security for millions of people.[20]

International assistance in the event of such an attack would face significant operating constraints. In 2013, the President of the International Committee of the Red Cross suggested that "an effective means of assisting a substantial portion of survivors of a nuclear detonation, while adequately protecting those delivering assistance, is not currently available at national level and not feasible at international level. It is highly unlikely that the immense investment required to develop such capacity will ever be made. If made, it would likely remain insufficient."[21]

Moreover, as Campbell Craig suggests, "the question is not only how many Americans would survive. It is also whether the United States as an identifiable political and social entity could withstand it. Could it remain a liberal and democratic order in the aftermath of such

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[18] Examples of such targets could include: Offutt Air Force Base near Omaha, Nebraska; Barksdale Air Force Base near Shreveport, Louisiana; Naval Submarine Base Kitsap near Seattle, Washington; Naval Submarine Base Kings Bay near St. Marys, Georgia; Tinker Air Force Base near Oklahoma City, Oklahoma; Clear Air Force Station near Anderson, Alaska; Beale Air Force Base near Marysville, California; and Cape Cod Air Force Station at Cape Cod, Massachusetts.

[19] Richard P. Turco, "Recent Assessments of the Environmental Consequences of Nuclear War," in *The Medical Implications of Nuclear War*, Fred Solomon and Robert Q. Marston, eds. (Washington, DC: National Academy Press, 1986), <https://www.ncbi.nlm.nih.gov/books/NBK219155/>; Owen B. Toon, Alan Robock, and Richard P. Turco, "Environmental Consequences of Nuclear War," *Physics Today* 61:12 (December 2008), DOI: 10.1063/1.3047679; Jonas Jägermeyr, et al, "A regional nuclear conflict would compromise global food security," *Proceedings of the National Academy of Sciences* 117:13 (31 March 2020), pp. 7071-7081, DOI: 10.1073/pnas.1919049117.

[20] Nicole S. Lovenduski, et al. "The Potential Impact of Nuclear Conflict on Ocean Acidification," *Geophysical Research Letters* 47:3 (16 February 2020), DOI: 10.1029/2019GL086246.

[21] Maurer, "Who will assist the victims of nuclear weapons?," *International Conference on the Humanitarian Impact of Nuclear Weapons*, Oslo (4-5 March 2013).

devastation? If not, then the war would, by definition, be an absurdity: it would destroy the objectives for which it was fought."[22]

This is only a cursory examination of the social, economic, and environmental consequences of nuclear war; however, these reflections demonstrate that individuals are, in fact, more vulnerable to the *indirect* effects of nuclear war than to the detonations themselves. This is critical to the broader examination of ICBMs, because if either Russia or the United States launched a counterforce first strike against the other, the degree of national and international devastation would be so intense that it would ultimately matter very little where the aimpoints were located—whether near cities or in sparsely-populated areas.

To that end, reducing the overall number of aimpoints located on US soil—and thus, the number of detonations that would be visited upon the United States in wartime—would ultimately prove to be a much more worthwhile pursuit than adjusting their locations. The best way to do this would be for the United States to pursue mutual ICBM force reductions with Russia. However, Nobel laureate Thomas Schelling—considered by many to be the father of nuclear arms control—suggests that the United States should not necessarily wait for Russia to come to the table. In a 1987 piece where he called land-based missiles "an embarrassment" that "give the entire deterrent force a bad name," Schelling argued: "If we unilaterally dismantled our land-based missiles, we would instantly deprive a large part of the Soviet land-based missile force for its raison d'être. […] So if we cannot dismantle their land-based missiles by negotiation, we may gain a lot by dismantling their targets instead."[23]

ICBMs have significant limitations in addressing 21st century deterrence challenges

Despite substantial reductions in the ICBM force over the past two decades, the Pentagon has not offered a convincing articulation of why ICBMs have ultimately been retained in the US arsenal, or what role these Cold War-era weapons are supposed to play in a post-Cold War security environment.

The Nuclear Posture Review accurately states that Russia is the only nuclear-armed state with an arsenal large enough to overwhelm the United States' ICBM force.[24] However, as the United States increasingly seeks to factor China into its post-Cold War deterrence calculations, the limitations of ICBMs relative to other elements of the US nuclear arsenal come into stark focus.

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[22] Campbell Craig, "Book Review: The logic of American nuclear strategy, by Matthew Kroenig," *Journal of Strategic Studies* (25 August 2020), DOI: 10.1080/01402390.2020.1798582.

[23] Thomas C. Schelling, "Abolition of Ballistic Missiles," *International Security* 12:1 (Summer 1987), pp. 179-180, DOI: 10.2307/2538923.

[24] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), p. 46.

On the whole, US ICBMs may not be particularly relevant to deterrence with either China or North Korea. This is because the range and deployment locations of the US ICBM force would force the missiles to fly over Russian territory, in the event that they were aimed at Chinese or North Korean targets. As Bruce Blair, Jessica Sleight, and Emma Clare Foley suggest in Global Zero's "Alternative U.S. Nuclear Posture Review," such an action "could too easily appear on Russian radar screens as an attack directed at it and trigger a mistaken Russian launch in response." "To avoid such confusion and respect Russian territorial integrity," they note, "U.S. strategic submarines and bombers, rather than ICBMs, are assigned the nuclear mission against China or North Korea in the absence of a simultaneous conflict with Russia."[25] This sentiment was echoed in a 2017 Johns Hopkins Applied Physics Laboratory study on the future role of ICBMs, where the authors noted that "ICBMs at the current bases are useful against Russia and have little role beyond that unless flying over Russia is allowed."[26]

Image courtesy of Global Zero.

It might be possible to pursue cooperative risk mitigation strategies with Russia to ensure that launches over Russian territory would not be misconstrued—for example, through the use of the Washington-Moscow hotline, which is reserved for secure communications at the highest level.

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[25] Bruce Blair, Jessica Sleight, and Emma Clare Foley, "An Alternative U.S. Nuclear Posture Review: The End of Nuclear Warfighting, Moving to a Deterrence-Only Posture," *Global Zero* (September 2018), p. 62, <https://www.globalzero.org/wp-content/uploads/2018/09/ANPR-Final.pdf>.

[26] Dennis Evans and Jonathan Schwalbe, "Intercontinental Ballistic Missiles and their Role in Future Nuclear Forces," *Johns Hopkins Applied Physics Laboratory,* NSAD-R-16-001 (2017), p. 17, <https://www.jhuapl.edu/Content/documents/ICBMsNuclearForces.pdf>.

However, even with such safeguards, overflying Russian territory would still be fraught with significant risks. Over the past several decades, analysts have noted several instances in which Russia's early warning system incorrectly detected—or, in some cases, completely failed to detect—North Korean missile launches.[27] Given these shortfalls, it is reasonable to be concerned with the prospect of US ICBMs flying over Russian airspace on their way to targets in China or North Korea—and how Russian leadership might mistakenly interpret those launches.

Concerns with ICBM overflight have long been recognized by the US Air Force. In 2014, an Air Force-sponsored RAND report described the issue in detail, and proposed three possible solutions for consideration: enable the missile to conduct plane changes during its flight path; dramatically increase missile mass in order to enable a "southern launch" strategy; and/or move the ICBM bases to the coasts.[28] However, none of these have been incorporated into the US ICBM program to-date, possibly because altering the current predictable ICBM trajectories could, in the words of the RAND authors, "turn any launch into a risky launch."[29] Additionally, the authors of the 2017 Johns Hopkins Applied Physics Laboratory study noted that any of these options would only be available at considerable expense.[30]

ICBMs are uniquely destabilizing weapon systems

ICBMs are often characterized as the most responsive leg of the triad in the event of a nuclear crisis: "Unlike other legs of the triad, ICBMs are always on alert, and they can promptly strike any target on Earth in 30 minutes or less," writes one ICBM advocate. "Bombers and nuclear-capable fighter aircraft require hours to reach an intended target. SLBMs also generally take more time, depending on their position."[31] Similarly, the 2018 Nuclear Posture Review suggested that "ICBMs are the most responsive leg of the triad because they are in constant readiness and communication can be achieved most expeditiously."[32]

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[27] Pavel Podvig, "Did Russian early-warning radars see North Korean missiles?" *Russian Strategic Nuclear Forces* (5 July 2006), accessed 2 August 2020, <http://russianforces.org/blog/2006/07/did_russian_earlywarning_radar.shtml>; Joshua Pollack, "Russia Eyes North Korea," *Arms Control Wonk* (7 April 2009), accessed 2 August 2020, <https://www.armscontrolwonk.com/archive/502248/russia-eyes-north-korea/>; Joshua Pollack, "Nuclear Deterrence and the Revenge of Geography," *Arms Control Wonk* (24 September 2017), accessed 3 August 2020, <https://www.armscontrolwonk.com/archive/1204122/nuclear-deterrence-the-revenge-of-geography/>.

[28] Lauren Caston, Robert S. Leonard, Christopher A. Mouton, Chad J.R. Ohlandt, Craig Moore, Raymond E. Conley, and Glenn Buchan, "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Project Air Force* (2014), pp. 55-67, <https://www.rand.org/pubs/monographs/MG1210.html>.

[29] Ibid, p. 56.

[30] Evans and Schwalbe, "Intercontinental Ballistic Missiles and their Role in Future Nuclear Forces," *Johns Hopkins Applied Physics Laboratory* (2017), p. 17.

[31] Kroenig, "The Case for the US ICBM Force," *Strategic Studies Quarterly* (Fall 2018), p. 59.

[32] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), pp. 44-45.

Responsiveness was not unanimously considered to be a requirement for a stable deterrence relationship, however. In fact, in the late 1950s, as the Air Force and the Navy battled over who would exert more influence over US nuclear doctrine, the responsive nature of the vulnerable ICBMs was specifically condemned by Navy leaders as dangerously escalatory. In the late 1950s, Chief of Naval Operations Admiral Arleigh Burke—the most prominent voice in favor of adopting a minimum deterrence, or "finite deterrence" posture—drafted a set of Navy talking points about the Polaris SLBM which implicitly portrayed it in opposition to the Air Force's ICBM; one note in particular stated that "POLARIS will not lead to the build-up of psychological 'pressures' to push the button first in fear that our reprisal capability might be knocked out by surprise. This is important to permit stability during periods of international tension which come and go."[33] Navy leaders had parochial interests for deriding the Air Force's ICBMs, as they sought to carve out piece of the nuclear budget for themselves; however, it is notable that they specifically characterized the ICBMs as a destabilizing weapon system in order to make their case.

At the time, however, institutional and political pressures were pushing US nuclear doctrine in the opposite direction. In the wake of the USSR's Sputnik success and the subsequent "missile gap" controversy—which Eisenhower accurately described in 1960 as a "useful piece of political demagoguery"—it was almost impossible to advocate successfully for fewer ICBMs.[34] Despite the incoming Kennedy administration's respect for Polaris, the newly-embraced "counterforce" doctrine of aiming at an adversary's strategic forces, rather than its cities, won the day.[35] This doctrine would ultimately require the United States to deploy many more nuclear weapons, in order to hold an increased number of targets at risk. In 1961, Secretary of Defense Robert McNamara explicitly rejected Arleigh Burke's concept of "finite deterrence," and Burke retired later that year.[36]

Particularly after the embrace of counterforce targeting, ICBM responsiveness was seen as the key to maintaining the United States' assured retaliatory capability: the missile's "Minuteman"

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[33] Office of the Chief of Naval Operations, "CNO Personal No. 35" (5 March 1958), to: Flag and General Officers, subj: Dope, Secret, excerpt: Item 5 on 'Polaris,' pp. 13-15, accessed via William Burr, ed., "How Much is Enough?": The U.S. Navy and "Finite Deterrence," Electronic Briefing Book No. 275, *National Security Archive* (1 May 2009), <https://nsarchive2.gwu.edu/nukevault/ebb275/>.

[34] William D. Hartung, "Nuclear Politics," in *Sleepwalking to Armageddon: The Threat of Nuclear Annihilation*, Helen Caldicott, ed. (New York, NY: The New Press, 2017), p. 111; Peter J. Roman, *Eisenhower and the Missile Gap* (Ithaca, NY: Cornell University Press, 1995).

[35] "War and Peace in the Nuclear Age; The Education of Robert McNamara; Interview with William Kaufmann, 1986," *GBH Archives* (5 March 1986), <http://openvault.wgbh.org/catalog/V_D1FA1FDE1AF4474A8C40165A496EEAEB>.

[36] Memorandum to President Kennedy from Secretary of Defense Robert S. McNamara, "Recommended Long Range Nuclear Delivery Forces, 1963-67" (23 September 1961), Top Secret, excised copy, accessed via William Burr, ed., "How Much is Enough?": The U.S. Navy and "Finite Deterrence," Electronic Briefing Book No. 275, *National Security Archive* (1 May 2009), <https://nsarchive2.gwu.edu/nukevault/ebb275/>.

nickname was no coincidence. Given that Soviet ICBMs could reach their American counterparts in 30 minutes or less, US military planners believed that the best course of action would be to launch their own ICBMs in response to a Soviet first strike—before the Soviet missiles hit their targets—in order not to *lose* them before they had a chance to *use* them.[37] This "launch-under-attack" posture, which Arleigh Burke had warned about decades previously, became an explicit feature of US nuclear warfighting strategy in the late 1970s, and has endured ever since.[38]

This posture was criticized by some administration insiders at the time. In a 1979 memorandum addressed to National Security Advisor Zbigniew Brzezinski, NSC staffer William E. Odom called launch-under-attack "unwise" and recommended removing it from the SIOP entirely, primarily because "it has no targeting rationale other than to ensure escalation." According to Odom, in the event of a Soviet first strike, US ICBMs would be used to target now-empty Soviet ICBM silos and conventional military targets. Therefore, concluded Odom, "[w]hat it would achieve beyond provoking a major Soviet response, I fail to see."[39]

Subsequent studies on the feasibility of launch-under-attack also noted that US command, control, and communications were simply not good enough "to complete the process of warning assessment, decision-making, and emergency action message dissemination in the time available […] between the first submarine-launched ballistic missile breakwater and attacks on command,

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[37] Report by Jerome Wiesner, President's Science Advisory Committee, "Warning and Defense in the Missile Age" (3 June 1959), Top Secret, accessed via William Burr, ed., "Launch on Warning: The Development of U.S. Capabilities, 1959-1979," Electronic Briefing Book No. 43, *National Security Archive* (April 2001), <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB43/>; Helmut Sonnenfeldt, NSC Staff, to Henry Kissinger, "Message' to You From Arbatov" (22 September 1969), Secret, Nodis, accessed via William Burr, ed., "Launch on Warning: The Development of U.S. Capabilities, 1959-1979," Electronic Briefing Book No. 43, *National Security Archive* (April 2001), <https://nsarchive2.gwu.edu/NSAEBB/NSAEBB43/>

[38] George C. Wilson, "'Counterforce' Arms Attract U.S., Soviets," *The Washington Post* (1 June 1979), <https://www.washingtonpost.com/archive/politics/1979/06/01/counterforce-arms-attract-us-soviets/235d8d05-2fbd-43ba-9912-6f3c949c6fa6/>; "Launch-under-attack" and "launch-on-warning" are often used interchangeably, and, according to the National Security Archive, the Joint Chiefs of Staff historically defined them identically: "as a launch of forces between the detection of an attack and the arrival of the first warhead." Some analysts have identified potential distinctions between the two—Bruce Blair, for example, suggested that "launch-under-attack" would require military commanders to delay their retaliation until receiving confirmation of an adversarial attack—however, the basic principle of both policies remains the same: that pre-delegated instructions were in place "to ensure that ICBMs would be launched rapidly enough to destroy time urgent targets specified in war plans." For more information, see William Burr, ed., "The 'Launch on Warning' Nuclear Strategy and Its Insider Critics," Electronic Briefing Book No. 674, *National Security Archive* (11 June 2019), <https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2019-06-11/launch-warning-nuclear-strategy-its-insider-critics>.

[39] William E. Odom, National Security Council Staff, to National Security Adviser Zbigniew Brzezinski, "Launch from Under Attack" (8 October 1979), Top Secret, accessed via William Burr, ed., "The 'Launch on Warning' Nuclear Strategy and Its Insider Critics," Electronic Briefing Book No. 674, *National Security Archive* (11 June 2019), <https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2019-06-11/launch-warning-nuclear-strategy-its-insider-critics>.

control, and communications systems."[40] Although US nuclear command, control, and communications (NC3) has significantly improved since the 1980s, the compressed decision-time required to execute a launch-under-attack posture is the same as it has always been, and therefore remains a cause for concern in contemporary nuclear policy debates. Although it would take approximately thirty minutes for an ICBM to reach its target, much of that time would be lost to threat detection, confidence assessments, and the launch procedures themselves—including retargeting the ICBMs from the open ocean to their eventual aimpoints. This could leave the US president with only a few minutes to make a launch decision, and once launched, ICBMs can neither be recalled nor retargeted.[41]

Deciding to launch US ICBMs under these conditions would be the most impactful decision in human history—it might very well decide the fate of civilization as we know it. No matter how competent the president is, it is unfathomable that a single individual would be able to make a rational decision under these extraordinary circumstances, especially given the irrationality of the system itself and likelihood of a false alarm. Potentially catastrophic false alarms are more common than one might think—between 1977 and 1984, the Department of Defense acknowledged the occurrence of 1,152 "moderately serious" false alarms, averaging *almost three false alarms per week*.[42] In his autobiography, *An American Life*, Ronald Reagan wrote about how a potential false alarm could intersect with the President's compressed decision time to create a nuclear crisis out of thin air: "*Six minutes* to decide how to respond to a blip on a radar scope and decide whether to unleash Armageddon!" he wrote, "How could anyone apply reason at a time like that?[43]

As President Reagan's comments suggest, the United States' Cold War-era guidance for nuclear retaliation biased—or "jammed"—the President towards quickly authorizing a nuclear strike. As General Lee Butler, former commander of US Strategic Command, suggests, "Our policy was premised on being able to accept the first wave of attacks… Yet at the operational level it was never accepted… They built a construct that powerfully biased the president's decision process

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[40] Joint Chiefs of Staff, Joint Secretariat, Historical Division, Joint Chiefs of Staff Special Historical Study, "A Historical Study of Strategic Connectivity, 1950-1981" (July 1982), Top Secret, p. 67, accessed via William Burr, ed., "The 'Launch on Warning' Nuclear Strategy and Its Insider Critics," Electronic Briefing Book No. 674, *National Security Archive* (11 June 2019), <https://nsarchive.gwu.edu/briefing-book/nuclear-vault/2019-06-11/launch-warning-nuclear-strategy-its-insider-critics>.

[41] Jeffrey Lewis, "Is Launch Under Attack Feasible?" *Nuclear Threat Initiative* (24 August 2017), <https://www.nti.org/analysis/articles/launch-under-attack-feasible/>; In peacetime, US ICBMs are aimed at the open ocean in case of accidental launch, for more information on US nuclear launch procedures, see Bruce G. Blair, "Protocol for a U.S. Nuclear Strike," *Public Books* (26 February 2018), <http://www.publicbooks.org/virtual-roundtable-on-presidential-first-use-of-nuclear-weapons/#blair>.

[42] Linn I. Sennott, "Overlapping False Alarms: Reason for Concern?" pp. 39-44, in *Breakthrough: Emerging New Thinking,* Martin E. Hellman and Anatoly A. Gromyko, eds. (New York, NY: Walker and Company, 1988), <https://ee.stanford.edu/~hellman/Breakthrough/book/pdfs/sennott.pdf>.

[43] Ronald Reagan, *An American Life* (New York, NY: Simon and Schuster, 1990), p. 257.

toward launch before the arrival of the first enemy warhead… a move in practice to a system structured to drive the president invariably toward a decision to launch under attack."[44]

One strand of deterrence theory suggests that a compressed decision timeline is *precisely* what keeps the nuclear peace. As the thinking goes, if an adversary knows that launching its missiles will immediately trigger nuclear retaliation, then it will be deterred from launching in the first place.[45] This argument implies that deterrence rests upon the *immediacy* of the retaliation—rather than the prospect of retaliation itself.

This line of thinking, however, can be challenged by a competing strand of deterrence theory, which suggests that the simple assurance of a nuclear second strike—regardless of whether it arrived minutes, hours, or days later—would be enough to deter a pre-emptive nuclear strike. As Soviet Premier Nikita Khrushchev once said, "Missiles are not cucumbers; one cannot eat them, and one does not require more than a certain number in order to ward off an attack."[46]

To that end, in 2013 President Obama directed the Pentagon to reduce the number of circumstances under which the United States would rely on launch-under-attack, with the full support of US Strategic Command and the Joint Chiefs of Staff.[47] Jon Wolfsthal, former senior director at the National Security Council for arms control and nonproliferation, subsequently described the implications of this decision as follows: "By openly stating that the United States could, and would, sacrifice its ICBMs in a conflict and still fulfill its missions, the country signaled the reliability and strength of its retaliatory forces."[48]

ICBMs would not be necessary under a revised nuclear posture

Given the inherently destabilizing nature of the ICBM force, the United States should consider shifting its nuclear posture to further reduce the pressure on the President to launch promptly in a crisis. Such a shift would amount to a global security imperative.

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[44] Jonathan Schell, *The Gift of Time* (New York: Metropolitan Books, 1998), pp. 191-194, referenced in Bruce Blair, "Strengthening Checks on Presidential Nuclear Launch Authority," *Arms Control Today* (January/February 2018), <https://www.armscontrol.org/act/2018-01/features/strengthening-checks-presidential-nuclear-launch-authority>.

[45] One example of this argument can be found in Kevin P. Chilton, "Defending the Record on Nuclear Deterrence," *Strategic Studies Quarterly* 12:1 (Spring 2018), pp. 15, <https://www.jstor.org/stable/26333874>.

[46] Jeffrey Lewis, "Minimum Deterrence," *Bulletin of the Atomic Scientists* 64:3 (July/August 2008), pp. 38-41, DOI: 10.2968/064003008.

[47] Bruce Blair, "Strengthening Checks on Presidential Nuclear Launch Authority," *Arms Control Today* (January/February 2018), <https://www.armscontrol.org/act/2018-01/features/strengthening-checks-presidential-nuclear-launch-authority>.

[48] Jon Wolfsthal, "The political and military vulnerability of America's land-based nuclear missiles," *Bulletin of the Atomic Scientists* 73:3 (18 April 2017), pp. 150-153, DOI: 10.1080/00963402.2017.1314996.

This could be done by eliminating the requirement to pursue preemptive, damage-limiting nuclear strikes—the role that the ICBMs have historically fulfilled in US nuclear strategy. This would prioritize the role of ballistic missile submarines—the most "survivable" leg of the triad—in ensuring that the United States is able to "ride out" a nuclear attack, accurately assess damage, and still maintain an assured retaliatory capability.

Under this revised nuclear posture, the United States' deterrence credibility would largely be conferred by the survivability of its nuclear command, control, and communications (NC3) infrastructure, because a crippling attack on US NC3 could prevent the President from ordering retaliatory strikes from US SSBNs. Therefore, as George Perkovich and Pranay Vaddi suggested in a 2021 report for the Carnegie Endowment for International Peace, adopting such a posture would require significant investments to establish an adequately hardened and redundant NC3 infrastructure, in order to ensure that the United States' SSBNs would still be able to retaliate if an adversary attempted to strike first.[49]

In a 1993 report, the Government Accountability Office found that "C3 to SSBNs is **about** as prompt and as reliable as to ICBMs, under a range of conditions," indicating a high level of confidence in the durability and effectiveness of the sea-based nuclear force.[50] Additionally, the authors of a 2012 Global Zero report—which included a former NATO Supreme Allied Commander Atlantic, a former Secretary of Defense, two former US ambassadors, and a former Commander of US Strategic Command—additionally noted that due to technological advances in higher-frequency communications modes, "[t]he past clear-cut superiority of ICBM over SSBN communications for wartime dissemination of emergency action messages no longer exists."[51]

That being said, a modernized NC3 infrastructure—which the Pentagon plans to build for approximately $77 billion over the next decade—would help strengthen the conditions under which the United States could shift away from damage-limiting nuclear strikes.[52] In a 2018 study, Bruce Blair, Jessica Sleight, and Emma Clare Foley suggested that in this regard, specific attention

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[49] George Perkovich and Pranay Vaddi, "Proportionate Deterrence: A Model Nuclear Posture Review," *Carnegie Endowment for International Peace* (21 February 2021), pp. 45-49, <https://carnegieendowment.org/files/Perkovich_Vaddi_NPR_full1.pdf>.

[50] Eleanor Chelimsky, "GAO's Evaluation of the Strategic Modernization Program," Testimony before the Senate Committee on Governmental Affairs, *US General Accounting Office* (10 June 1993), p. 14, <https://www.gao.gov/assets/110/105080.pdf>; Original emphasis included in quotation.

[51] Gen. (ret.) James Cartwright, Amb. Richard Burt, Sen. Chuck Hagel, Amb. Thomas Pickering, Gen. (ret.) Jack Sheehan, Bruce Blair., "Global Zero U.S. Nuclear Policy Commission Report: Modernizing U.S. Nuclear Strategy, Force Structure and Posture," *Global Zero* (May 2012), p. 8, <https://www.globalzero.org/wp-content/uploads/2018/09/gz_us_nuclear_policy_commission_report.pdf>.

[52] Congressional Budget Office, "Projected Costs of U.S. Nuclear Forces, 2019 to 2028" (January 2019), p. 2, <https://www.cbo.gov/system/files/2019-01/54914-NuclearForces.pdf>.

should be paid to improving the very-low-frequency trailing wire antennas attached to airborne command posts like E-6B Mercury aircraft, as well as extremely-high-frequency satellite links—both of which enable secure communications between high-level military and civilian authorities and the submarines at sea.[53]

Such investments would help strengthen the United States' deterrence credibility, because as long as an adversary lacked confidence in its ability to destroy every US nuclear submarine or cripple the US NC3 network, a stable deterrence relationship would theoretically hold. Under such a posture, any attempted first strike on US strategic nuclear forces would likely still leave the majority of the US ballistic missile submarine force relatively unscathed and ready to launch. Being generous to the attacker, one could surmise that a surprise attack on the United States' strategic submarine ports could disable up to six boats. This scenario would still leave at least eight Ohio-class submarines ready to launch approximately 720 nuclear warheads in retaliation—more than double that of China's entire nuclear arsenal.[54]

The aforementioned DOD/DNI 2012 report to Congress arrived at a similar conclusion when assessing the effects of Russia deploying additional warheads above New START limits: "The Russian Federation […] would not be able to achieve a militarily significant advantage by any plausible expansion of its strategic nuclear forces, even in a cheating or breakout scenario under the New START Treaty, primarily because of the inherent survivability of the planned U.S. strategic force structure, particularly the OHIO-class ballistic missile submarines, a number of which are at sea at any given time."[55]

Eschewing preemptive, damage-limiting nuclear strikes would also expand presidential decision-time from just a couple minutes to several hours, or even days. This is effectively the nuclear doctrine of the United Kingdom, which possesses only four nuclear-armed ballistic missile submarines and ordinarily deploys only one at sea.[56] To safeguard against the degradation of its NC3 in wartime, the United Kingdom uses a system of handwritten letters to command its

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[53] Blair, Sleight, and Foley, "An Alternative U.S. Nuclear Posture Review," *Global Zero* (September 2018), pp. 75-76.

[54] Each Trident submarine-launched ballistic missile can carry up to eight nuclear warheads, but in peacetime normally carries an average of four or five warheads, for an average load-out of approximately 90 warheads per submarine. If each submarine was fully loaded, then eight Ohio-class submarines would be capable of launching a maximum of 1,280 warheads, while eight Columbia-class submarines would be capable of launching a maximum of 1,024 warheads. For more information, see Hans M. Kristensen and Matt Korda, "United States nuclear weapons, 2021," *Bulletin of the Atomic Scientists* 77:1 (26 January 2021), pp. 43-63, DOI: 10.1080/00963402.2020.1859865.

[55] Department of Defense, "Report on the Strategic Nuclear Forces of the Russian Federation Pursuant to Section 1240 of the National Defense Authorization Act for Fiscal Year 2012 (U)," *Office of the Under Secretary of Defense for Policy* (May 2012), accessed via Kristensen, "DOD: Strategic Stability Not Threatened Even by Greater Russian Nuclear Forces," *Federation of American Scientists* (10 October 2012).

[56] "UK Nuclear Deterrence (CASD)," *UK Ministry of Defence* (3 May 2019), accessed 2 February 2021, <https://www.gov.uk/government/collections/uk-nuclear-deterrence-the-facts>.

submarines in the event of an adversarial first strike that incapacitates the country's leadership. On their first day in office, the Prime Minister is expected to offer preplanned instructions regarding the United Kingdom's nuclear response, which are said to include options like "Put yourself under the command of the US, if it is still there," "Go to Australia," "Retaliate," or "Use your own judgment."[57] Although the United Kingdom's deterrence environment is markedly different than that of the United States, this is a useful example of how NC3 safeguards can be implemented to strengthen a deterrence posture without ICBMs.

Another example of such a safeguard could involve implementing a system of "decide-under-attack," proposed by former Vice Chairman of the Joint Chiefs of Staff Admiral James A. Winnefeld. Under this option, the President could order a preplanned, *delayed* retaliation in response to an adversarial first strike. This would still allow retaliatory forces to carry out the President's orders if they were not recalled by a pre-specified time, but it would also allow the President some additional time to revise or cancel those orders in the event of a false alarm or an exaggerated initial attack assessment.[58]

Eschewing damage-limiting nuclear strikes would not sacrifice the United States' ability to launch nuclear weapons quickly in a crisis, if the President chose to do so. Despite the Nuclear Posture Review's characterization of ICBMs as "the most responsive leg of the triad," submarine-launched ballistic missiles can reach their targets on approximately the same timelines.[59] In 1993, a Government Accountability Office report on the US nuclear triad stated that "compared to ICBMs, no operationally meaningful difference in time to target was found," further noting that "SSBNs are in essentially constant communication with national command authorities and, depending on the scenario, SLBMs from submarine platforms would be almost as prompt as ICBMs in hitting enemy targets."[60]

This finding has been echoed by the aforementioned Global Zero report's authorship of high-ranking former defense officials, who collectively noted in a 2012 study that there is only a ten-minute difference between ICBM and SLBM launch times.[61] Moreover, the authors of a 2021 Institute for Defense Analyses study suggested that under certain circumstances, it is possible that

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[57] Richard Norton-Taylor, "Theresa May's first job: decide on UK's nuclear response," *The Guardian* (12 July 2016), accessed 9 February 2021, <https://www.theguardian.com/politics/2016/jul/12/theresa-mays-first-job-decide-on-uks-nuclear-response>.

[58] James A. Winnefeld, Jr., "A Commonsense Policy for Avoiding a Disastrous Nuclear Decision," *Carnegie Endowment for International Peace* (10 September 2019), accessed 9 February 2021, <https://carnegieendowment.org/2019/09/10/commonsense-policy-for-avoiding-disastrous-nuclear-decision-pub-79799>.

[59] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), pp. 44-45.

[60] Chelimsky, "GAO's Evaluation of the Strategic Modernization Program," *US General Accounting Office* (10 June 1993), pp. 6-7, 14.

[61] Cartwright, et al., "Global Zero U.S. Nuclear Policy Commission Report," *Global Zero* (May 2012), p. 8.

SLBMs could have shorter flight times than ICBMs, due to the proximity between their "hard alert" patrol areas and their targets.[62] An example of how this could manifest in a wartime scenario took place in March 2005, when the USS Tennessee (SSBN-734) test launched a Trident II D5 SLBM on a heavily compressed trajectory, with impact occurring only 12 to 13 minutes after launch.[63]

As such, it appears that the targeting requirements for prompt launch capabilities could be satisfied by the ballistic missile submarine force, which has a distinct advantage over the ICBM force given that its survivability is not in question. Furthermore, the responsiveness of the sea-based forces appears to satisfy several former officials who were once responsible for the US strategic deterrent.

Additionally, it is important to note that the accuracy disparities between ICBMs and SLBMs that were apparent during the Cold War have not existed for several decades. In 1983, Richard Garwin suggested that "it is true that ICBM-range SLBMs […] can now be given accuracy equivalent to that specified for the land-based MX."[64] Given that the destructive potential of the SSBN force has dramatically improved with the introduction of the new hard-target kill "super-fuze," it is difficult to identify a wartime scenario—including a hard-target kill scenario—where the ballistic missile submarine force, operating in conjunction with other US conventional and nuclear deterrence systems, would be unable to accomplish the mission of the ICBM force.[65] It is worth noting here that throughout the development of Trident, the Pentagon explicitly pushed the Navy to increase the accuracy and throw weight of its SLBM force as a means of "hedging against dependence on ICBMs;" in a May 1976 memorandum to the Secretary of the Navy, the Deputy Secretary of Defense, W. P. Clements, Jr., noted that such improvements would "[encourage] consideration of options to expand our SLBM capability against the full spectrum of the target system."[66]

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[62] William A. Chambers, Caroline R. Milne, Rhiannon T. Hutton, and Heather W. Williams, "No-First Use of Nuclear Weapons: A Policy Assessment," P-20513, *Institute for Defense Analyses* (January 2021), p. 17, <https://www.ida.org/-/media/feature/publications/n/no/no-first-use-of-nuclear-weapons-a-policy-assessment/p-20513.ashx>.

[63] Hans M. Kristensen, "Global Strike A Chronology of the Pentagon's New Offensive Strike Plan," *Federation of American Scientists* (15 March 2006), pp. 39-40, <https://www.nukestrat.com/pubs/GlobalStrikeReport.pdf>.

[64] Richard L. Garwin, "Will Strategic Submarines Be Vulnerable?" *International Security* 8:2 (Autumn 1983), p. 53, DOI: 10.2307/2538595.

[65] For further discussion on these new "super-fuzes," see Chapter III or Hans M. Kristensen, Matthew McKinzie, and Theodore A. Postol, "How US nuclear force modernization is undermining strategic stability: The burst-height compensating super-fuze," *Bulletin of the Atomic Scientists* (1 March 2017), accessed 19 April 2020, <https://thebulletin.org/2017/03/how-us-nuclear-force-modernization-is-undermining-strategic-stability-the-burst-height-compensating-super-fuze/>.

[66] Graham Spinardi, *From Polaris to Trident: The Development of US Fleet Ballistic Missile Technology* (Cambridge: Cambridge University Press, September 2009), pp. 147-148.

If the United States achieved an acceptable level of confidence in its ability to assure retaliation—which would be conferred through a modernized NC3 architecture and the potential adaptation of NC3 safeguards like the United Kingdom's "letters of last resort" or "decide-under-attack"—then launch-under-attack would no longer be required to assure retaliation. This would allow the United States to forego damage-limiting nuclear strikes and reduce or eliminate the ICBM force entirely, without sacrificing its retaliatory capability.

ICBM advocates note that advances in anti-submarine warfare or ballistic missile defenses could bolster an adversary's confidence in weathering a reduced US retaliation; however, at present neither technology is remotely advanced enough to meaningfully change this calculus.[67] One longstanding concern—that the survivability of the SSBN force could be challenged in the future, thus requiring the maintenance of the ICBM force as a "hedge"—is considered in greater detail below.

ICBMs are not needed to hedge against submarine vulnerability

Both the 2010 and 2018 Nuclear Posture Reviews suggested that an ICBM force is needed "as a hedge against any future vulnerability of US SSBNs," and that "[r]etaining sufficient force structure in each leg [offers] the ability to hedge effectively by shifting weight from one Triad leg to another if necessary due to unexpected technological problems or operational vulnerabilities."[68] As the argument goes, if technological innovation suddenly renders US SSBNs vulnerable to a first-strike, or if unanticipated technical defects temporarily ground part or all of the SSBN fleet, then the ICBM force is the only thing preventing an adversary from disabling the United States' entire retaliatory capability.

Given the unlikelihood of a modern-day "bolt-from-the-blue" first strike, the grounding of the SSBN force in peacetime would be an unlikely precursor to nuclear war. However, as Bruce Blair, Jessica Sleight, and Emma Clare Foley suggested in Global Zero's 2018 "Alternative U.S. Nuclear Posture Review," the maintenance of strategic bombers could provide a useful hedge against these unanticipated technical challenges:

> *[A] capable hedge might consist of a mixed fleet of 40 to 70 heavy bombers (B-52H, B-2A, and B-21 Raider, which is still in development) armed with ALCMs, B61 gravity bombs, conventional cruise missiles and, optionally, the new air-launched long-range standoff (long-range standoff, or "LRSO")*

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[67] Examples of this argument can be found in Kroenig, "The Case for the US ICBM Force," *Strategic Studies Quarterly* (Fall 2018), p. 57-58; Loren Thompson, "Why Getting Rid Of U.S. ICBMs Could Make Nuclear War More Likely," *Forbes* (5 January 2021), accessed 5 January 2021, <https://www.forbes.com/sites/lorenthompson/2021/01/05/why-getting-rid-of-us-icbms-could-make-nuclear-war-more-likely/?sh=3ed2a32c4a4f>.

[68] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (April 2010), pp. 20, 23; US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), p. 45.

> *cruise missile. The fleet size would vary from a low of 40 aircraft for a deterrence-only hedge to 70 for a deterrence-plus-warfighting hedge.*[69]

Additionally, a 2017 analysis from the Johns Hopkins Applied Physics Laboratory noted that "if on maximum nuclear alert, it is likely that most, or perhaps all, US nuclear bombers would get airborne in time to survive."[70] Although the United States does not currently keep its bombers on maximum nuclear alert in peacetime, this status would likely shift in the event of a prolonged nuclear crisis. Therefore, unless an adversary launched a truly surprising "bolt-from-the-blue" massive attack—an unthinkable prospect in the post-Cold War era, as today's nuclear crises are much more likely to stem from protracted periods of rising tensions and possible conventional military action—it is likely that a sizable portion of the US nuclear bomber force would be capable of conducting a retaliatory strike in a crisis.

Turning to the second argument in favor of using ICBMs as a hedge—that adversarial technological innovation could challenge the survivability of the US SSBN force—it is important to note that fears of a "transparent ocean" are not new, and have often been explicitly employed to defend against any proposed reduction to the ICBM force. Despite the United States' unrivaled superiority in anti-submarine warfare (ASW), Richard Garwin noted in 1983 that "in the course of arguing in support of a land-based MX deployment, the Secretary and other Defense officials have suggested that there might be an ASW breakthrough which would result in the 'oceans becoming transparent.'"[71]

Today, these same fears are being employed once again in defense of the Ground-Based Strategic Deterrent—the replacement system for the current Minuteman III ICBM force. Despite the United States' unrivaled primacy in submarine stealth, there is much hype surrounding the notion that technological advances—some uncertain combination of big data, artificial intelligence, quantum computing, and unmanned underwater vehicles—could suddenly render the oceans "transparent," thus eroding the survivability of the US SSBN force.[72] The only reasonable defense against this, suggest many ICBM advocates, is the ICBM force—now and forever—just in case.

These fears, however, appear to be exaggerated in several key respects.

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[69] Blair, Sleight, and Foley, "An Alternative U.S. Nuclear Posture Review," *Global Zero* (September 2018), pp. 73-74.

[70] Evans and Schwalbe, "Intercontinental Ballistic Missiles and their Role in Future Nuclear Forces," *Johns Hopkins Applied Physics Laboratory* (2017), p. 11.

[71] Garwin, "Will Strategic Submarines Be Vulnerable?" *International Security* (Autumn 1983), p. 63.

[72] One example of this argument can be found in Loren Thompson, "Why Getting Rid Of U.S. ICBMs Could Make Nuclear War More Likely," *Forbes* (5 January 2021).

First, the United States' Ohio-class SSBNs are among the quietest ballistic missile submarines on the planet. As the 2018 Nuclear Posture Review states, "When on patrol, SSBNs are, at present, virtually undetectable, and there are no known, near-term credible threats to the survivability of the SSBN force."[73] The same cannot be said for other nuclear-armed states' SSBNs; Russia's legacy SSBN fleet is noisier than its American counterpart, and China's Type 094 boomers remain noisy enough that analysts have questioned their survivability writ large.[74]

The next generation of US SSBNs—the Columbia class—is expected to be even quieter than the current Ohio fleet. As opposed to the mechanical-drive propulsion trains deployed on current Ohio class submarines, the Columbia class will include an electric-drive propulsion train, which turns the boat's jet pump using an electric motor, rather than a set of gears.[75] In contrast to a mechanical drive system, this electric motor can also be used to generate power that can be diverted from the propulsion system to a non-propulsion system. As the Congressional Research Service puts it, this is "roughly analogous to the arrangement in the 'Star Trek' science fiction television series, in which the captain of the star ship can order the ship's engineer to divert power from the ship's engines to its weapons or other systems."[76] These electric motors are substantially quieter than the mechanical process used to turn older ships' propellers. As a result, the CRS assesses that "the significantly improved quieting promised by electric drive may be the single most important benefit of electric drive to the Navy's submarine community."[77]

Not only will electric drive make the Navy's Columbia-class submarines quieter, but they will also make them more survivable in the event of an attack. As the Congressional Research Service notes, "Electric drive makes it possible to more widely distribute elements of the propulsion system around the ship, making it less likely that a single weapon might disable the entire drive system."[78] Additionally, the decentralized and redundant nature of an electric drive system

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[73] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (February 2018), pp. 44-45.

[74] Eugene Miasnikov, "Appendix 1: What is known about the character of noise created by submarines?" in *The Future of Russia's Strategic Nuclear Forces*, Brian Finn and Renee Friedman, trans. (Center for Arms Control, Energy and Environmental Studies at MIPT, 1996), <https://www.armscontrol.ru/subs/snf/snf03221.htm>; Tong Zhao, "Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability," *Carnegie Endowment for International Peace* (2018), pp. 25-34, <https://carnegieendowment.org/files/Zhao_SSBN_final.pdf>.

[75] Ronald O'Rourke, "Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress," *Congressional Research Service* (15 January 2021), R41129, p. 41, accessed 2 February 2021, <https://fas.org/sgp/crs/weapons/R41129.pdf>; "Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress," *Congressional Research Service* (31 July 2000), RL30622, pp. 11-12, accessed 15 November 2020, <https://www.everycrsreport.com/files/20000731_RL30622_c288e8b1829d574fffb93ddf56d0891b36cff9fc.pdf>.

[76] "Electric-Drive Propulsion for U.S. Navy Ships: Background and Issues for Congress," *Congressional Research Service* (31 July 2000), p. 12.

[77] Ibid, p. 19.

[78] Ibid, p. 20.

means that "distributed power sources can be rapidly reconfigured in the event of damage to the ship to ensure a continued supply of electricity to vital systems."[79]

Second, technology development is slow and does not occur in a vacuum. Due to long development timelines and the intertwined nature of submarine-quieting and submarine-detection technologies, it is highly unlikely that the United States will be surprised by a new detection technology without having already taken steps to mitigate its presumed effect.

This is precisely how the US Navy maintained such a tremendous advantage over its Soviet counterpart during the Cold War: by specifically taking care, in the words of Owen R. Cote, Jr., to "solve the [anti-submarine warfare] problem against its own submarines."[80] For example, as the United States' Sound Surveillance System (SOSUS) underwater listening network came online and underwent significant improvements in the early 1960s, these listening stations discovered unwanted mechanical tonals during the *USS Thresher*'s early sea trials. This prompted the Navy to eliminate these tonals for all of its future submarines, whereas the Soviets—who did not try to create a Soviet version of SOSUS and therefore utilized submarine designs that were not informed by ASW development—did not manage to eliminate them until the early 1980s.[81]

This continuous game of technological chess between US acoustic engineers has always been a mainstay of US submarine and anti-submarine development. "Thus," as Owen R. Cote, Jr. writes, "when USS Columbia first deploys, it will represent one-half of the legacy of more than 50 years of intense, essentially continuous competition between American submarine designers and American antisubmarine warfare sensors."[82]

Third, the United States is actually more likely to achieve breakthroughs in these emerging technologies than its competitors. In this respect, it is important to remember that not all countries benefit equally from technology development. The development of underwater passive acoustic surveillance systems, for example, was a game-changer in submarine warfare: it is the closest historical example to the oceans becoming "transparent" that exists today; however, for decades this technology was exclusively pursued by the United States, who therefore singularly reaped the benefits. The oceans did not become universally "transparent" upon this technology's

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[79] Ibid, p. 20.

[80] Owen R. Cote, Jr., "The Third Battle: Innovation in the U.S. Navy's Silent Cold War Struggle With Soviet Submarines," *Naval War College*, Newport Paper #16 (2003), pp. 45-48, <https://www.usni.org/sites/default/files/inline-files/newportpaper16.pdf>.

[81] Ibid, pp. 45-48.

[82] Owen R. Cote, Jr., "Invisible nuclear-armed submarines, or transparent oceans? Are ballistic missile submarines still the best deterrent for the United States?" *Bulletin of the Atomic Scientists* 75:1 (7 January 2019), p. 32, DOI: 10.1080/00963402.2019.1555998.

development; instead, they became clearer for one country, while still remaining opaque for its geopolitical rival.

At this current moment, given the United States' significant and long-standing technological edge in quieting and ASW technology, it is fair to suggest, as Cote does, that "no countries other than the United States have the global presence and the full spectrum of anti-submarine warfare capabilities needed to make even very quiet submarines potentially vulnerable."[83] Therefore, if the oceans are going to be "transparent" for a particular country, that country will—once again—probably be the United States. "With that in mind," writes Cote, "it is not the United States that should be cautious about the viability of a new generation of SSBNs, but China."[84]

Fourth, fears of a "transparent" ocean often fail to consider the United States' uniquely favorable geographical position relative to that of its nuclear-armed rivals. When Pacific-based US submarines leave their port in Washington state, they are able to operate in a relatively uncontested patrol area stretching from the west coast of the United States to New Zealand. Within this area, there are no choke points that would draw US submarines into easily-targetable patrol lanes, and all nearby land masses are either American territories or allies. As a result, writes Cote, "For deployed *Columbia*-class submarines to become vulnerable, a means of initially finding them in this vast space would need to be developed and deployed without the aid of local land-based facilities for processing data from underwater sensor arrays, or any kind of persistent surveillance by airborne sensor platforms given the vast distances involved. The prospects of such a capability are vanishingly small."[85] Therefore, the long ranges of the United States' Trident submarine-launched ballistic missiles allow US SSBNs to patrol with a very high degree of survivability, while being able to hold significant portions of China—possibly including Beijing—at risk.

The same is not true for the current class of Chinese submarines, which is seriously hampered by geographic limitations and cannot bring themselves within range of the continental United States (except possibly Seattle or Portland, with the development of China's JL-3 SLBM) without sailing through dangerous choke points currently controlled by the US Navy.[86] As a result of these geographical inequalities, any advanced detection technology eventually deployed by a US nuclear rival is unlikely to have much—if any—impact on US SSBNs; they are much more likely to affect forward-operating US attack submarines, which do not carry nuclear weapons.

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[83] Ibid, p. 33.

[84] Ibid, p. 33.

[85] Ibid, pp. 34-35.

[86] Hans M. Kristensen and Matt Korda, "Chinese nuclear forces, 2020," *Bulletin of the Atomic Scientists* 76:6 (10 December 2020), pp. 443-457, DOI: 10.1080/00963402.2020.1846432.

Lastly—and most crucially—finding a submarine is easier than destroying one. Even if an adversary were able to detect, track, and target a US ballistic missile submarine, destroying it is another matter entirely. There are only two places where a submarine's precise location could be reasonably identified in a crisis: in port, or immediately following the launch of one of its missiles. At any given time, twelve of the Navy's fourteen Ohio-class SSBNs are considered "deployable:" an average of eight or nine boats are normally at sea, four or five of which are believed to be on "'hard alert' within range and position of their priority target strike package," with most of the remaining boats in port and able to deploy on relatively short notice.[87]

In the event of a conflict, all deployable US submarines are likely to leave port immediately and travel to their "hard alert" positions. As Austin Long notes in an article for Lawfare, "At the official cruising speed of 20 knots, the submarine can travel six miles in any direction in about 15 minutes."[88] Therefore, if an adversary intended to strike US submarine bases as the opening salvo of a war, they would have only a few minutes to do so—and could potentially leave eight or nine SSBNs at sea with anywhere between 720 and 1,440 warheads onboard, depending on their load-out.

In a 1983 study, Richard Garwin dismissed the likelihood that an adversary would be able to continuously track US strategic submarines, given the available countermeasures and "the acute interest of an SSBN in knowing whether it (and its whole fleet of siblings) is held in trail." Garwin concluded that "it is inconceivable that a fleet-wide covert trailing operation could be long maintained."[89] Although adversarial anti-submarine warfare capabilities have improved since the 1980s, the complexities associated with a fleet-wide tracking operation remain highly prohibitive. Even if an attacker were able to pinpoint the locations of every single one of these submarines, the requisite patrol aircraft, surface combatants, and attack submarines needed to destroy them would face significant logistical challenges. Maritime patrol aircraft would take hours to reach their targets and would likely have to pass through contested airspace (including air defense systems), while more proximate sea-based platforms would face attackers of their own during wartime. Additionally, due to the similarities in speed between US and adversary

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[87] Hans M. Kristensen, "US SSBN Patrols Steady, But Mysterious Reduction In Pacific In 2017," *FAS Strategic Security Blog* (24 May 2018), <https://fas.org/blogs/security/2018/05/ssbnpatrols1960-2017/>; The two remaining submarines are typically refueling and are therefore not deployable in a crisis. Additionally, only 12 submarines will be built under the future Columbia-class, as opposed to the current Ohio-class' 14 submarines.

[88] Austin Long, "Location, Location, Location: Evaluating Risks to Submarines from Low-Yield Warhead and Submarine Missile Launch Detection," *Lawfare* (11 March 2018), accessed 20 November 2020, <https://www.lawfareblog.com/location-location-location-evaluating-risks-submarines-low-yield-warhead-and-submarine-missile>.

[89] Garwin, "Will Strategic Submarines Be Vulnerable?" *International Security* (Autumn 1983), p. 55.

submarines, attacking submarines would have to already be very close to US SSBNs in order to fire upon them, which is "statistically quite unlikely," notes Long.[90]

In addition to the deficiencies of these conventional platforms, any attempt to disable US SSBNs using nuclear weapons is also likely to be unsuccessful. Firstly, as Long notes, an adversary would have to fuze its own missiles to survive contact with the ocean and penetrate at a depth of at least 100 feet; given the tremendous speeds at which ballistic missiles re-enter the atmosphere, this is not as simple as it sounds.[91] Secondly, an adversary would have to fire enough missiles to cover all of the possible locations that a US SSBN could travel during the time it would take for the missiles to reach their target. In his 1983 study, Richard Garwin suggested that it would require "23 single megaton warheads to destroy a single undecoyed SSBN detected at 5,000 km range on a perfectly accurate acoustic surveillance system."[92] In a more recent study, Austin Long paints a similar picture of just how demanding it would be for an adversary to disable a single US SSBN using nuclear weapons, even if it could pinpoint its location after a US SLBM launch:

> *Assuming there is roughly a 10-minute delay from the time of U.S. SLBM launch to the time of Russian missile launch, due to the challenge of detecting the launch (e.g. if there is cloud cover over the launch point) and then a lag for retargeting, the U.S. submarine would have thirty minutes before Russian missiles arrived and could move 12 miles in any direction. This expands the area Russian warheads would have to cover to about 450 square miles. It would then require about 29 warheads to cover the area with 1500 psi. If the delay is 20 minutes, the requirement increases to about 50 warheads.*[93]

As a result, it seems highly unlikely that—even if it could locate every American SSBN—an adversary would gamble its continued existence on its ability to destroy every single one, given that each individual SSBN carries an average load-out of approximately 90 nuclear warheads in peacetime.[94]

In a 1993 report, the Government Accountability Office specifically addressed the everlasting fears of "transparent oceans," offering a damning interpretation for how they were being weaponized by the Pentagon in order to justify continued investment in ICBMs:

> *We found that the Soviet threat to the weapon systems of the land and sea legs had also been overstated. For the sea leg, this was reflected in unsubstantiated allegations about likely future breakthroughs in Soviet submarine detection technologies, along with underestimation of the performance and capabilities of our own nuclear-powered ballistic missile submarines. The projected threat to the sea leg was, however, used*

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[90] Long, "Location, Location, Location," *Lawfare* (11 March 2018).

[91] Ibid.

[92] Garwin, "Will Strategic Submarines Be Vulnerable?" *International Security* (Autumn 1983), p. 58.

[93] Long, "Location, Location, Location," *Lawfare* (11 March 2018).

[94] Kristensen and Korda, "United States nuclear weapons, 2021," *Bulletin of the Atomic Scientists* (26 January 2021), pp. 43-63.

> *frequently as a justification for costly modernizations in the other legs to "hedge" against SSBN vulnerability. Our specific finding, based on operational test results, was that submerged SSBNs are even less detectable than is generally understood, and that there appear to be no current or long-term technologies that would change this. Moreover, even if such technologies did exist, test and operational data show that the survivability of the SSBN fleet would not be in question.*[95]

In this regard, very little has changed between 1993 and the present day; despite the dubious nature of the "transparent oceans" fears, these fears are currently being employed in service of the Ground-Based Strategic Deterrent.[96] However, as this chapter suggests, the Nuclear Posture Review's argument in favor of retaining ICBMs "as a hedge against any future vulnerability of US SSBNs" does not hold much water.[97]

Abstaining from damage-limiting nuclear strikes is possible

Ultimately, the decision to revise nuclear employment guidance lies in the hands of the President. If they sought to shift away from the United States' longstanding doctrine to utilize ICBMs as a damage-limiting measure, the military requirement to maintain ICBMs as a discrete targeting option would shift along with it.

As this chapter suggests, such a decision—in conjunction with a modernized NC3 architecture to ensure SSBN survivability—would mitigate the dangers associated with the current deployed ICBM force. Ultimately, the risks associated with such a shift would be less consequential than the risks of maintaining the current force posture, and therefore this course of action should now be considered in light of significant budgetary pressures and the challenges associated with adapting these Cold War-era weapons into the post-Cold War security environment.

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[95] Chelimsky, "GAO's Evaluation of the Strategic Modernization Program," *US General Accounting Office* (10 June 1993), p. 5. Emphasis and underlines are present in original report.

[96] One example of this argument can be found in Loren Thompson, "Why Getting Rid Of U.S. ICBMs Could Make Nuclear War More Likely," *Forbes* (5 January 2021).

[97] US Department of Defense, "Nuclear Posture Review," *Office of the Secretary of Defense* (April 2010), p. 23.

III. THE ENHANCED CAPABILITIES OF THE POST-COLD WAR ICBM FORCE

Although the United States reduced its ICBM force by more than half of its launchers and over 80 percent of its attributed warheads after the Cold War ended, it was generally accepted that ICBMs would remain part of the US nuclear deterrent, despite the lack of a clearly-articulated strategic rationale for their sustainment in a post-Cold War era.

The Clinton administration's Nuclear Posture Review working groups, convened by future Secretary of Defense Ash Carter, considered several proposals that would have eliminated the ICBM force entirely—including Carter's suggestion to adopt a "monad" of 10 submarines carrying 24 Trident missiles with six warheads each—however, these proposals were quickly shot down.[1] In fact, it appears that STRATCOM even collected background information on Carter and expressed concern over his "less-than favorable long-term outlook for nuclear weapons" and long-term visions of "complete denuclearization."[2]

Things did not change under the George W. Bush administration, despite its emphasis on conventional weapons and its interest in nuclear weapons reductions. Indeed, as a Congressional Research Service report notes, while President Bush's Nuclear Posture Review sought the retention of all three "legs" of the nuclear force, the document "did not, however, offer a rationale for this traditional 'triad'"—despite the dramatic changes to the post-Cold War security environment.[3]

In truth, just as the United States created the ICBM force—in the words of sociologist Donald MacKenzie—"without any agreed understanding […] of why it was doing so," the ICBM force was sustained and upgraded after the Cold War ended with a similar absence of agreed logic.[4] As a result, although the United States did retire its Peacekeepers and Minuteman IIs during these decades, it simultaneously subjected the Minuteman III force to a series of incremental modernization programs in order to keep the aging weapon system operational until 2030.

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[1] Benjamin Friedman, Christopher Preble, and Matt Fay, "The End of Overkill? Reassessing U.S. Nuclear Weapons Policy," *Cato Institute* (2013), p. 9, <https://www.cato.org/sites/cato.org/files/pubs/pdf/the_end_of_overkill_wp_web.pdf>.

[2] Hans M. Kristensen, "The 1994 Nuclear Posture Review," *The Nuclear Information Project* (8 July 2005), accessed 21 December 2020, <https://www.nukestrat.com/us/reviews/npr1994.htm>.

[3] Amy F. Woolf, "U.S. Strategic Nuclear Forces: Background, Developments, and Issues," *Congressional Research Service* (10 December 2020), RL33640, p. 6, accessed 2 February 2021, <https://fas.org/sgp/crs/nuke/RL33640.pdf>.

[4] Donald MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, Massachusetts: The MIT Press, 1993), p. 162.

These were not simply life-extensions, however. A closer examination of the major post-Cold War Minuteman III modernization programs reveals that, in many cases, the Air Force sought to replace systems that did not necessarily need replacing, in order to significantly enhance the missiles' warfighting capabilities. These upgrades—which included improvements to the Minuteman III force's guidance systems, re-entry vehicles, fuzing, and rapid retargeting capabilities—were driven less by strategic requirements and more by an institutional desire to continuously improve the weapons in the US arsenal. As a result, many of these modernization programs were conducted despite criticisms from both internal governmental agencies and external analysts.

Guidance Replacement Program (GRP)

In the early 1990s, the Air Force sought to upgrade the Minuteman III's guidance system, specifically with an intent to replace both the electronic components of the missile guidance set control and the inertial measurement instruments contained within the gyro-stabilized platform.[5] At the time, Pentagon officials claimed that these upgrades were necessary in order to improve the Minuteman III's accuracy, and because "current electronics components continue to degrade and are projected to become unreliable as early as 1997 and unsupportable as early as 1998."[6]

A June 1993 study by the Government Accountability Office, however, stated the opposite. Specifically, the GAO noted that the Air Force's own assessments "are not identifying any Minuteman III missile guidance set system-level performance concerns. To the contrary, for the last several years the Minuteman III missile guidance set flight reliability has improved."[7] The study further assessed that "missile guidance set failure rates have remained at an acceptable level, with no adverse failure rate trends," and quoted a previous Air Force study which suggested that "there is no conclusive evidence of degradation within the Minuteman III missile guidance set that cannot be corrected on a case-by-case basis."[8]

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[5] The navigation systems for all three generations of Minuteman ICBMs have used inertial guidance, meaning that the Missile Guidance System can calculate the position of the missile through onboard sensors without relying on external references or communications. The lack of ground communication with the guidance system after launch means that once the missile is in the air, its planned trajectory cannot be altered and thus cannot be recalled. For more information, see "Minuteman Weapon System History and Description," *ICBM Prime Team* (July 2001), p. 49.

[6] Lt. Gen. John E. Jaquish, responses to questions for the record in the hearing on "Research, Development, Test and Evaluation of the Air Force" before the House Appropriations Subcommittee on Defense, *Hearings on Department of Defense Appropriations for 1994*, 103rd Congress, 1st Session (21 April 1993), pp. 313-314.

[7] Steven F. Kuhta et al., "ICBM Modernization: Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," *Government Accountability Office* (June 1993), GAO/NSIAD-93-181, p. 3, <https://www.gao.gov/assets/160/153500.pdf>.

[8] Ibid, pp. 3, 16-17.

In response to the Air Force's claim that the guidance system's electronic components would become unreliable by 1997, the GAO responded individually to each of the Air Force's concerns, concluding that "the most troublesome electronic problems are in the process of being corrected as units are returned to the guidance repair facility for maintenance or other reasons, and the seriousness of the remaining anomalies is not apparent."[9]

The GAO study additionally questioned the Air Force's desire to improve the Minuteman III's accuracy to match that of the Peacekeeper ICBM, which was scheduled to be retired beginning in 2003. Noting the new requirements of START I and II—of which the latter had been signed only months earlier—the GAO stated that the Pentagon had not adequately determined whether, or how many, US nuclear weapons still needed to have a hard-target kill capability.[10] And if so, could that requirement instead be satisfied by either the Peacekeeper ICBMs (which would soon be retired) or the Trident II SLBMs?[11] Absent an answer from the Pentagon, the GAO concluded that the "Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," titled its report as such, and recommended delaying the program altogether.[12]

Faced with two competing narratives—one, lacking evidence, suggesting that the guidance systems would completely fail in five years and required accuracy improvements, and the other, based upon a full year of technical assessments and interviews, suggesting the opposite—Congress chose to fully fund the $1.6 billion Minuteman III Guidance Replacement Program.[13] Initial production of the upgrade guidance systems began in 1998, and full-rate production of all 652 requested units began in 2000 and was completed in 2009.[14]

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[9] Ibid, pp. 17-19.

[10] "Hard-target kill" refers to the capability to destroy hardened facilities, such as missile silos and command silos reinforced with steel and concrete. This capability is usually a function of a missile's accuracy and the yield of its warhead.

[11] Ibid, pp. 24-25.

[12] Ibid, p. 5.

[13] Paul G. Kaminski, "Sustaining the U.S. Nuclear Deterrent in the 21st Century," prepared remarks of the Under Secretary of Defense for Acquisition and Strategy, *US Strategic Command Strategic Systems Industrial Symposium*, Offutt Air Force Base, Nebraska (30 August 1995), accessed 25 November 2020, <https://fas.org/nuke/guide/usa/doctrine/dod/di1099.htm>.

[14] "Boeing Delivers Final Upgraded Minuteman III Guidance Set," *Boeing* (10 February 2009), accessed 29 November 2020, <https://boeing.mediaroom.com/2009-02-10-Boeing-Delivers-Final-Upgraded-Minuteman-III-Guidance-Set>; David N. Spires, *On Alert: An Operational History of the United States Intercontinental Ballistic Missile Program, 1945-2011*, 2nd ed. (Barksdale Air Force Base, Louisiana: Air Force Global Strike Command, 2019), pp. 174-175; "Minuteman Weapon System History and Description," *ICBM Prime Team* (July 2001), p. 57; Kuhta et al., "ICBM Modernization: Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," *Government Accountability Office* (June 1993), pp. 28-29.

Safety Enhanced Reentry Vehicle (SERV)

In addition to the GRP upgrade, the Pentagon continued to pursue an enhanced hard-target kill capability for its Minuteman III ICBMs, despite the Government Accountability Office's 1993 conclusion that such a pursuit had not been adequately justified.[15]

At the time of the GAO report's 1993 publication, the START II agreement had just been signed, and the United States had recently declared its intention to retire its 50 deployed Peacekeeper ICBMs by the mid-2000s. The Peacekeeper, however, was the most accurate ballistic missile in the United States' arsenal; it was specifically designed to enhance the ICBM force's hard-target kill capability. Rather than retire this capability, as early as 1993 the Air Force was considering options to replace the Minuteman III's existing Mk12 reentry vehicles with the Peacekeeper ICBM's Mk21 reentry vehicle.[16] This would sustain the ICBM force's hard-target kill capability beyond the Peacekeeper's retirement—despite the GAO's unanswered questions about whether the Trident II SLBMs could satisfy this requirement instead, or whether a hard-target capability was even necessary at all.[17]

Despite the GAO's concerns, the Safety Enhanced Reentry Vehicle (SERV)/Mk21 RVs and W87 warheads were ultimately installed on 250 Minuteman III ICBMs across all three ICBM bases, and today approximately 200 of them remain in the deployed force.[18]

Although the SERV program was billed as a safety measure due to the new emphasis on configuring the missile fleet with insensitive high explosives, enhanced detonation systems, and other safety features, it also had the practical effect of dramatically improving the Minuteman III's hard-target kill capability.[19] The Peacekeeper—and its corresponding Mk21 reentry vehicle—was the United States' most accurate ICBM in its arsenal. To that end, the same concerns that critics had about the Peacekeeper at the time of its development—that its hard-target kill capability "is inconsistent with the U.S.-proclaimed policy of deterrence by threat of assured-destruction retaliation, because a hard-target counterforce capability is only necessary for

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[15] Kuhta et al., "ICBM Modernization: Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," *Government Accountability Office* (June 1993).

[16] Ibid, p. 21.

[17] Ibid, p. 25.

[18] Department of Defense, "RDT&E Budget Justification Sheet: 0604851F ICBM - EMD," *Department of the Air Force* (June 2001), accessed 12 February 2021, <https://www.globalsecurity.org/military/library/budget/fy2002/usaf-peds/0604851F.pdf>; Hans M. Kristensen and Matt Korda, "United States nuclear weapons, 2021," *Bulletin of the Atomic Scientists* 77:1 (26 January 2021), pp. 43-63, DOI: 10.1080/00963402.2020.1859865.

[19] Spires, *On Alert* (2019), pp. 176-178.

supporting preemptive-attack or first-strike postures"—were ultimately transplanted onto the Minuteman III force via the SERV program.[20]

As a result, it is worth considering: if the sole purpose of the United States' nuclear arsenal is, in the words of President Biden, "to deter—and if necessary, retaliate against—a nuclear attack," then why does the United States continue to sustain and modernize nuclear systems—such as the SERV—that are specifically designed for preemptive strikes?[21]

Rapid Execution and Combat Targeting (REACT) System

Until the mid-1970s, US missileers relied upon a highly laborious and time-consuming process in order to retarget their ICBMs. In order to retarget the fleet, new targeting tapes would first have to be cut at an offsite location away from the silos, then a three-person team would have to drive out to each silo and physically swap the tapes—a process that would take several weeks to complete.[22]

Between 1975 and 1977, the Air Force completed the installation of the Command Data Buffer (CDB) system within each of its operational Minuteman III squadrons, which enabled remote retargeting of the ICBMs from their respective Launch Control Centers for the first time.[23] A similar remote retargeting system—the Improved Launch Control System (ILCS)—was implemented within Minuteman II squadrons a few years later.[24] Despite these new systems, however, retargeting the entire fleet with either CDB or ILCS still took approximately 20 hours, and the process still relied upon pre-written war plans.[25]

This changed dramatically when the Rapid Execution and Combat Targeting (REACT) system came online in the mid-1990s. REACT made it possible to retarget the entire fleet in under ten hours, and—most critically—allowed missileers to continuously retarget individual missiles as necessary. Although the upgrade was painted at the time as primarily a means of reducing crew fatigue, it also further entrenched the idea of nuclear weapons as "flexible" tools that could be called upon in warfighting scenarios—a strain of thought that continues to dominate nuclear

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[20] Jonathan E. Medalia, "MX Intercontinental Ballistic Missile Program," Issue Brief No. IB77060, *Congressional Research Service* (14 December 1981), pp. 10-11, <https://apps.dtic.mil/dtic/tr/fulltext/u2/a478161.pdf>

[21] Joseph R. Biden, Jr. "Why America Must Lead Again," *Foreign Affairs* (March/April 2020), accessed 11 November 2020, <https://www.foreignaffairs.com/articles/united-states/2020-01-23/why-america-must-lead-again>.

[22] Gen. Jon D. Ryan, testimony before the Senate Appropriations Subcommittee on Defense, *Senate Hearings Before the Committee on Appropriations for Fiscal Year 1973,* 92nd Congress, 2nd Session (16 February 1972), p. 63; William M. Arkin, "The Six-Hundred Million Dollar Mouse," *Bulletin of the Atomic Scientists* 52:6 (Nov. 1996), p. 68.

[23] Col. William W. Woodruff, testimony before the House Appropriations Subcommittee on Military Construction, *Hearings Before the Committee on Appropriations for Fiscal Year 1975*, 93rd Congress, 2nd Session (1974), pp. 768-769.

[24] "Minuteman Weapon System History and Description," *ICBM Prime Team* (July 2001), p. 24.

[25] Arkin, "The Six-Hundred Million Dollar Mouse," *Bulletin of the Atomic Scientists* (Nov. 1996), p. 68.

deterrence thinking to this day. As William M. Arkin noted at the time, "the adaptability is so in excess of any real requirement of deterrence it is hard to decide whether the program is merely a humongous waste of money or whether it is a sinister undermining of 'detargeting' and other confidence-building measures created at the end of the Cold War."[26]

ICBM Fuze Modernization Program

Although a previously-considered plan to retrofit all Minuteman III ICBMs with the retired MX Peacekeeper's highly-accurate guidance systems did not come to pass, this has not prevented the Pentagon from steadily increasing the accuracy of its nuclear delivery systems through other methods, including the aforementioned SERV program, as well as through a planned upgrade to the warheads' fuzes.[27]

The ICBM Fuze Modernization Program is scheduled to produce a replacement for the Mk21 fuze for integration into the current Minuteman III force, as well as the GBSD follow-on force. Although the Pentagon's budget documents state that the new fuze will be "a form, fit and functionally equivalent replacement for the Mk21 fuze," in reality it is expected to significantly improve the accuracy of the delivery system. This is because the new ICBM warhead fuzing system will incorporate the same "super-fuze" technology that is being installed on Trident SLBM warheads.[28]

Each new "super-fuze"—which will eventually be installed on all US SLBM and ICBM systems—includes a new radar module and a path-length compensating module, which reportedly allows the Arming, Fuzing, and Firing (AF&F) System to adjust its height-of-burst point during its flight path. With previous "fixed" fuzes, the warhead would simply detonate once it reached its pre-programmed burst height, regardless of whether the missile had accurately delivered it to the target. With this new system, if the missile was going to fall short or long of an

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[26] Ibid, p. 68.

[27] Elaine M. Grossman, "Top Secret U.S. Nuke War Plans Thwarted," *The Daily Beast* (13 April 2017), accessed 12 February 2021, <https://www.thedailybeast.com/top-secret-us-nuke-war-plans-thwarted>.

[28] According to Air Force budget documents, "The ICBM Fuze Modernization program will leverage technologies, parts, components and development/production capabilities resulting from extensive fuze work performed by the US Navy (USN) and NNSA on the Mk5/W88 Alt 370 Fuze program. Common USN & USAF fuze components include the Radar Module, Thermal Battery Assembly and Path Length Module. USN & USAF fuze components that are partially common and use common technologies include the Missile Interface and Controller Module, Launch Safety Device, Firing Set Integration Module and Terminal Protection Device." Department of Defense, "RDT&E Budget Justification Sheet: 0604933F ICBM Fuze Modernization," Justification Book Vol. 2: Research, Development, Test & Evaluation, *Department of the Air Force* (February 2020), pp. 697-705, accessed 10 February 2021, <https://www.saffm.hq.af.mil/Portals/84/documents/FY21/RDTE_/FY21%20Air%20Force%20Research%20Development%20Test%20and%20Evaluation%20Vol%20II.pdf?ver=2020-02-12-145218-377>.

intended target, the AF&F would measure its own altitude 60 to 80 kilometers in advance of impact, and manually adjust its own height-of-burst in order to cause maximum damage.[29]

Although this may seem like a relatively minor technical adjustment, it amounts to a revolution in accuracy. Hans Kristensen, Matthew McKinzie, and Theodore Postol—the analysts who first documented the "super-fuze" system in 2017—estimate that with regards to the Navy's warheads, this flexible height-of-burst system is "boosting the overall killing power of existing US ballistic missile forces by a factor of roughly three."[30]

As Kristensen, McKinzie, and Postol write, "Eventually, super-fuze upgrades will make it possible for every SLBM and ICBM warhead in the US arsenal to perform the hard-target kill missions that were initially envisioned to be exclusively reserved to MX Peacekeeper ICBM warheads."[31] This finding has dramatic implications for the future of US-Russian first-strike stability; in the midst of a crisis or a misunderstanding, Russian leadership might rapidly assess that the United States has the means and motive to launch a decapitating first strike with its hard-target-kill ICBMs and SLBMs, and respond in kind.

The Pentagon initially intended to purchase 693 of these new super-fuzes to replace the legacy fuzes within the reentry vehicles of the existing Minuteman III fleet; however, now that these super-fuzes are also slated to be incorporated into the eventual GBSD force, it is clear that this procurement effort will grow substantially over the coming decade.[32] Two test launches of Minuteman III ICBMs equipped with the new super-fuzes have already taken place, with the final two tests planned for 2022 and 2024.[33]

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[29] Hans M. Kristensen, Matthew McKinzie, and Theodore A. Postol, "How US nuclear force modernization is undermining strategic stability: The burst-height compensating super-fuze," *Bulletin of the Atomic Scientists* (1 March 2017), accessed 19 April 2020, <https://thebulletin.org/2017/03/how-us-nuclear-force-modernization-is-undermining-strategic-stability-the-burst-height-compensating-super-fuze/>.

[30] Ibid.

[31] Ibid.

[32] Department of Defense, "Selected Acquisition Report: Air Force Intercontinental Ballistic Missile Fuze Modernization (ICBM Fuze Mod)," *Defense Acquisition Management Information Retrieval* (December 2018), accessed 19 April 2020, <https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Selected_Acquisition_Reports/FY_2018_SARS/19-F-1098_DOC_41_ICBM_Fuze_Mod_SAR_Dec_2018.pdf>; Woolf, "U.S. Strategic Nuclear Forces," *Congressional Research Service* (10 December 2020), pp. 15-16.

[33] Theresa Hitchens, "New Warhead Fuze Gets Tested in 1st 2020 Minuteman III Launch," *Breaking Defense* (3 February 2020), accessed 20 April 2020, <https://breakingdefense.com/2020/02/first-2020-minuteman-iii-icbm-test-launch-focused-on-new-warhead-fuze/>.

The Pentagon's flawed assessment metrics

As a result of these upgrades, Air Force analysts have described these 50-year old Minuteman IIIs as "basically new missiles except for the shell."[34] However, this chapter posits that some of these modernization programs may not have been necessary, suggesting that the Pentagon has demonstrated a pattern of seeking out unnecessary upgrades to its weapon systems—even when, in the words of the Government Accountability Office, such upgrades had "not been adequately justified."[35]

Given these underlying concerns, why did these upgrades take place, and—in the case of the ICBM Fuze Modernization Program—why do they continue to take place? The Government Accountability Office's 1993 evaluation of the nuclear modernization program suggests that the main driver might be the Pentagon's flawed assessment mechanisms. To illustrate this point, the following statement by the GAO's then-Assistant Comptroller General Eleanor Chelimsky is quoted at length:

> *In comparing performance and cost across the legs and weapon systems of the triad, we were concerned to find little or no prior recent effort by DOD to do what we were doing—that is, evaluate comprehensively the relative effectiveness of similar weapon systems. Yet such agency evaluation is critical if limited budget dollars are to be concentrated on programs that are both needed and effective.*
>
> *With regard to proposed upgrades, we found many instances of dubious support for claims of their high performance; insufficient and often unrealistic testing; understated cost; incomplete or unrepresentative reporting; lack of systematic comparison against the systems they were to replace; and unconvincing rationales for their development in the first place. Where mature programs were concerned, on the other hand, we often found that their performance was understated and that inappropriate claims of obsolescence had been made. […]*
>
> *Perhaps the most important point here is that comparative evaluation across the three legs of the triad--and between individual weapon systems and their proposed upgrades--has been signally lacking. This is unfortunate because it deprives policymakers in both the executive branch and the Congress of information they need for making decisions involving hundreds of billions of dollars.*[36]

Chelimsky's statement further noted that the Pentagon tends to evaluate specific weapon systems in vacuums: "But examining whether a weapon system meets its specifications cannot get at

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[34] Carla Pampe, "Life Extension Programs Modernize ICBMs," *Air Force Global Strike Command* (25 October 2012), accessed 12 February 2021, <https://www.af.mil/News/Article-Display/Article/110241/life-extension-programs-modernize-icbms/>.

[35] Kuhta et al., "ICBM Modernization: Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," *Government Accountability Office* (June 1993).

[36] Eleanor Chelimsky, "GAO's Evaluation of the Strategic Modernization Program," Testimony before the Senate Committee on Governmental Affairs, *US General Accounting Office* (10 June 1993), pp. 7-8, <https://www.gao.gov/assets/110/105080.pdf>.

larger evaluative questions like (1) whether the mission to be addressed by a proposed new system is already adequately handled by capabilities existing elsewhere in the triad, or (2) whether that new system has the capability to improve significantly on existing performance, and at what relative cost."[37]

The Pentagon's own assessment of its ICBM fleet is no exception. Examining the history of post-Cold War ICBM modernization programs, it appears that the Department of Defense has often chosen to upgrade its missiles without taking into account whether particular requirements could be filled by other systems—or whether those requirements were indeed necessary at all. As Chelimsky's statement noted, in the case of evaluating the vulnerability of its ICBMs, the Pentagon "did not recognize the existence of sea and air-leg deterrence—that is, the likelihood that the Soviets would hesitate to launch an all-out attack on the ICBM silos, given their inability to target submerged U.S. SSBNs or on-alert bombers and their thousands of warheads that could be expected to retaliate."[38]

Today, this same kind of siloed thinking permeates the discourse over the Ground-Based Strategic Deterrent—the Pentagon's replacement program for the Minuteman III ICBM. When considering the ICBM leg with blinders on, expensive and unnecessary upgrades and replacements *ad infinitum* can seem like the obvious course of action. However, as the previous chapter of this report explores at length, adopting a systems analysis approach to nuclear deterrence suggests that certain capabilities of the proposed GBSD fleet can be filled by other weapon systems—and might not even be necessary at all.

These blinders are not simply conferred by Pentagon bureaucracy, however. It is also the result of close economic ties between US lawmakers, military contractors, and the Pentagon—a system which generally rewards ever-increasing and often redundant military investment. The following chapter explores this system—exemplified by the influence of the Senate ICBM Coalition—in depth.

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[37] Ibid, pp. 7-8.

[38] Ibid, p. 6.

IV. "PORK AND BUTTER:" THE INFLUENCE OF THE SENATE ICBM COALITION

Although the causal relationship between military investment and economic growth had long been understood prior to the development of intercontinental ballistic missiles, their deployment was a game-changer for the missiles' host communities—and especially for the politicians that represented them.

In the 1960s, Strategic Air Command realized that technological and logistical limitations would force them to deploy their new Minuteman ICBMs at existing Air Force bases in the Midwest—areas of the United States that had received significantly less government investment than their coastal counterparts.[1] At the time, Air Force bases across the country were losing their WWII-era bomber missions in favor of a new emphasis on land-based missiles, and most of these bases were tightly enmeshed with the local economies of their host communities. As Gretchen Heefner writes in *The Missile Next Door, t*hese communities began to see ICBM deployment as "an insurance of a sort, a policy taken out on the local Air Force base […] If missiles were the future of the Air Force, then a base with missiles had a future."[2]

As the missiles were deployed, residents of the missile fields began to see first-hand how an ICBM base could transform previously-underfunded communities. As Heefner writes, "The needs of the missile facilities were years—if not decades—ahead of local capabilities."[3] The missiles could not travel to and from their bases on unpaved roads, so the Pentagon would subsidize the costs of paving them. In similar fashion, crumbling bridges were rebuilt, telephone lines were repaired, and power stations were constructed on the government's dime.[4] It is worth reflecting on the fact that many of these Midwestern communities had lived without these basic necessities for decades, and it was the demands of the missiles—not the residents—that ultimately triggered government intervention. "As many Americans were coming to understand," writes Heefner, "national security dollars could make the difference between the haves and have-nots; between those regions that advanced and those that remained mired in the agrarian past."[5] As a result, it is easy to empathize with residents like Rapid City's Almon "Hoadley" Dean, who wrote to his

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[1] Gretchen Heefner, *The Missile Next Door: The Minuteman in the American Heartland* (Cambridge, MA: Harvard University Press, 2012), pp. 56-59.

[2] Ibid, p. 69.

[3] Ibid, p. 128.

[4] Ibid, pp. 128-130.

[5] Ibid, p. 113.

Senator in 1966 to ask for "'50 more missiles' […] 'possibly aimed at Peking'" to be deployed at his local Air Force base, specifically because "'our Rapid City community needs this shot in the arm.'"[6] In many ways, military investment was the only way to get the government to pay attention to a local community's needs.

No one understood this reality better than politicians, who recognized that if they could secure ICBM bases in their districts and bring the defense "pork" home, they would be subsequently rewarded at the polls. To that end, lawmakers did everything they could to bring these new missiles to their constituencies. In one particularly infamous case, Missouri Senator Stuart Symington wrote to General Thomas Power, head of Strategic Air Command to ask, "Dear Tommy, why can't we have one of the missile bases in Missouri?"[7] Symington, previously the first Secretary of the Air Force, was heavily tied to weapons contractors, and his exemplification of the then-unique links between business, politics, and the military was one of the factors that prompted President Eisenhower to issue his prescient warning about the dangers of the "military-industrial complex."[8]

After the Cold War, when the Soviet threat finally evaporated—and with it, much of the strategic rationale for maintaining ICBMs—the role of politicians became particularly crucial in preserving their ICBM bases *ad infinitum*. During the Clinton administration's Nuclear Posture Review process—the only time when the elimination of ICBMs was seriously, although briefly, considered—a collection of US senators successfully lobbied President Clinton to drop the issue entirely.[9] For decades afterwards—until very recently, in fact—the prospect of phasing out the ICBM force was, politically-speaking, off the table.

Although the ICBM leg was not in danger of being eliminated immediately after the Cold War, individual ICBM bases certainly were, especially since the United States was in the process of retiring its Minuteman II and Peacekeeper ICBMs. Many of these bases—such as Ellsworth Air Force Base (South Dakota) and Grand Forks Air Force Base (North Dakota)—were losing their ICBM missions and were therefore in danger of being closed down during the Base Realignment and Closure (BRAC) process.

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[6] Ibid, p. 113.

[7] Ibid, pp. 64-65.

[8] US National Archives, "Eisenhower's 'Military-Industrial Complex' Speech Origins and Significance," *YouTube* (19 January 2011), accessed 15 February 2021, <https://www.youtube.com/watch?v=Gg-jvHynP9Y&ab_channel=USNationalArchives>.

[9] Benjamin Friedman, Christopher Preble, and Matt Fay, "The End of Overkill? Reassessing U.S. Nuclear Weapons Policy," *Cato Institute* (2013), p. 9, <https://www.cato.org/sites/cato.org/files/pubs/pdf/the_end_of_overkill_wp_web.pdf>.

Being placed on the BRAC list was an existentially frightening prospect for residents and politicians alike. Large numbers of jobs were at stake—not just at the bases themselves, but also in the surrounding communities. Heefner quotes one ICBM community's Chamber of Commerce president on the indirect impacts of base closures: "A lot of people probably won't realize the impact until their soccer coach is gone and their Bible teacher is not here or their teacher's aide is gone."[10]

Politicians' jobs were at stake, too. It was no secret that the political futures of ICBM-state politicians were largely dependent on their success in keeping their missiles in the ground. In a huge upset in 2004, South Dakotans actually voted out their incumbent Democratic senator—Tom Daschle, who was also Senate Minority Leader at the time—"largely because they thought a Republican could better ensure a continued military presence in the state."[11] Political attack ads specifically made connections between the fate of South Dakota's Ellsworth Air Force Base—which had recently lost its ICBM mission when the Minuteman IIs were retired—and the upcoming election; one ad even went so far as to suggest that "A vote for Daschle is a vote against Ellsworth."[12] When Ellsworth Air Force Base was eventually removed from the BRAC list in 2005, Senator John Thune—Daschle's Republican replacement—and other South Dakota politicians were treated "like rock stars."[13] In his next Senate race, Thune won re-election with 100% of the vote, with the Democrats declining to even run a candidate against the immensely popular Senator.[14]

In subsequent decades, the ICBM issue has been used as a political cudgel for opposing politicians to claim that they are best positioned to protect their bases. In 2012, in the middle of a tight Senate race, Republican candidate Denny Rehburg sent out a mailer to Montanans hammering his opponent, Democrat Jon Tester, for supporting the New START treaty, falsely claiming that "The Obama START Treaty seeks to eliminate 150 missiles at Malmstrom."[15]

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[10] Heefner, *The Missile Next Door*, p. 194.

[11] Ibid, p. 193.

[12] Ibid, p. 193.

[13] Ibid, p. 197.

[14] Chet Brokaw, "S.D. Dems Skip Senate Race Against GOP's Thune," *Yankton Daily Press & Dakotan* (2 April 2010, accessed 15 November 2020, <https://www.yankton.net/news/article_b4d23452-c312-5ea3-be85-dad99ee04e4b.html>.

[15] "Rehberg claims START treaty guts Malmstrom nukes," *Billings Gazette* (21 March 2012), accessed 13 December 2020, <https://billingsgazette.com/news/state-and-regional/montana/rehberg-claims-start-treaty-guts-malmstrom-nukes/article_ccc6239f-174a-51d0-9d69-9d271c86105d.html>.

The success of the Senate ICBM Coalition

Today, the politicians that represent the missile fields work together on a bipartisan basis to advocate for the indefinite sustainment of their ICBM bases. This group of lawmakers, known as the "Senate ICBM Coalition," consists of senators from the three ICBM host states—Wyoming, Montana, and North Dakota—plus Utah, where ICBM sustainment and replacement activities are headquartered at Hill Air Force Base. Occasionally, senators from Louisiana—the home state of Air Force Global Strike Command—have also participated in the Coalition's activities.[16]

Over the past 15 years in particular, the members of the Senate ICBM Coalition have played an outsized role in dictating US nuclear force posture—occasionally even overriding the guidelines set by US military leaders—in order to prevent any significant ICBM force reductions from taking place.

Immediately after the George W. Bush administration announced its intention to deactivate Malmstrom Air Force Base's 564th Missile Squadron in 2006—thereby reducing the United States' ICBM force from 500 to 450—the Senate ICBM Coalition helped inject several measures into the FY2007 National Defense Authorization Act that temporarily stalled the reduction. Most immediately, they required the Department of Defense to draft a "detailed strategic justification" for the proposed reduction, "including an analysis of the effects of the reduction on the ability of the United States to assure allies and dissuade potential competitors."[17]

Additionally, the Senate ICBM Coalition also inserted an amendment into the FY2007 NDAA which continues to have ramifications to this day: Section 139 directs the Secretary of the Air Force to "modernize Minuteman III intercontinental ballistic missiles in the United States inventory as required to maintain a sufficient supply of launch test assets and spares to sustain the deployed force of such missiles through 2030."[18] This amendment proved to be incredibly consequential because, as Air Force historian David N. Spires describes, "Although Air Force leaders had asserted that incremental upgrades, as prescribed in the analysis of land-based strategic deterrent alternatives, could extend the Minuteman's life span to 2040, the congressionally mandated target year of 2030 became the new standard."[19]

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[16] Along with the regular eight Senate ICBM Caucus signatories from Montana, North Dakota, Utah, and Wyoming, former Louisiana Senators Mary Landrieu and David Vitter also co-signed a 2009 white paper "on the Criticality of the Intercontinental Ballistic Missile to United States Security," available here: "The Long Pole of the Nuclear Umbrella," *Senate ICBM Coalition* (November 2009), <https://www.airforcemag.com/PDF/SiteCollectionDocuments/Reports/2009/November%202009/Day10/Senate_ICBMcoalition_Nov2009.pdf>.

[17] Public Law 109-364: John Warner National Defense Authorization Act for Fiscal Year 2007," H.R. 5122 (17 October 2006), 120 Stat. 2115, <https://www.congress.gov/109/plaws/publ364/PLAW-109publ364.pdf>.

[18] Public Law 109-364: John Warner National Defense Authorization Act for Fiscal Year 2007," H.R. 5122 (17 October 2006), 120 Stat. 2114, <https://www.congress.gov/109/plaws/publ364/PLAW-109publ364.pdf>.

[19] David N. Spires, *On Alert: An Operational History of the United States Intercontinental Ballistic Missile Program, 1945-2011*, 2nd ed. (Barksdale Air Force Base, Louisiana: Air Force Global Strike Command, 2019), pp. 184-185.

In other words, Congress—with the help of the Senate ICBM Coalition—overruled the Air Force. This move likely accelerated the development of the Ground-Based Strategic Deterrent—the Minuteman III's replacement program—because, through a single amendment, Congress effectively shortened the ICBM's modernization timeline by a decade.

In subsequent years, the Coalition increasingly went on the offensive. In 2009, as US-Russia New START negotiations were drawing to a close, the Senate ICBM Coalition recognized that the treaty could threaten the ICBM force. The proposed New START agreement would not dictate the respective parties' force postures, it simply created ceilings for warheads and strategic delivery systems. This meant that the Obama administration would theoretically have the leeway to dramatically re-balance US nuclear forces, reducing certain delivery systems more than others if desired.

In anticipation of the Senate vote on New START, the ICBM Coalition published a white paper in November 2009 that clearly communicated their position to the Obama administration: they would support the Treaty, but only if the United States committed to maintaining 450 ICBMs equipped with one warhead each.[20] The Coalition also lobbied the Obama administration to spread any future ICBM cuts evenly among their states, a move which Jon Wolfsthal—who supported the negotiation and ratification process for New START as then-Vice President Joe Biden's special advisor for Nonproliferation and Nuclear Security—subsequently described as demonstrating "that these officials were concerned mainly with the economic impacts that ICBM reductions, or even base closing, would have on their states—and not with the strategic or military implications of reductions required under [New START]." "While it is not a surprise that senators are protective of their states' economic interests," Wolfsthal wrote in 2017, "nuclear strategy should not be sacrificed at such an altar."[21]

On 13 May 2010, the day of the ratification vote in the Senate, the Obama administration delivered its rebuttal to Congress: the United States would eliminate 30 ICBMs, ultimately retaining a force level of 420 ICBMs with one warhead each.[22] Most members of the ICBM Coalition found this to be acceptable, and later that day, the Senate ratified New START with 71

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[20] "The Long Pole of the Nuclear Umbrella," *Senate ICBM Coalition* (November 2009).

[21] Jon Wolfsthal, "The political and military vulnerability of America's land-based nuclear missiles," *Bulletin of the Atomic Scientists* 73:3 (18 April 2017), pp. 150-153, DOI: 10.1080/00963402.2017.1314996.

[22] "The New START Treaty – Maintaining a Strong Nuclear Deterrent," White House Fact Sheet (13 May 2010), accessed 4 January 2021, <https://www.airforcemag.com/PDF/SiteCollectionDocuments/Reports/2010/May%202010/Day18/NewSTARTsection1251factsheet.pdf>; Amy F. Woolf, "The New START Treaty: Central Limits and Key Provisions," *Congressional Research Service* (3 February 2021), R41219, p. 25.

Senators—and six members of the Coalition—voting in favor.[23] Given that the ratification would have failed if only five of these six senators had declined to support it, securing those votes was ultimately necessary for the Obama administration.

In 2013, as it became clear that the Obama administration intended to further reduce the ICBM force to 400, the Senate ICBM Coalition sprung into action once again. That year, Coalition members sent incoming Secretary of Defense Chuck Hagel several letters. The first letter, sent in January, criticized Hagel's participation in Global Zero's 2012 Nuclear Policy Commission Report—which specifically recommended eliminating US ICBMs—and demanded further clarification of his position on ICBMs in advance of his hotly-contested confirmation vote.[24]

Subsequent letters to Hagel, sent in September and December, were intended to demonstrate the Coalition's "strenuous opposition" to the Pentagon's intention to prepare an Environmental Impact Statement on the elimination of ICBM silos. The environmental assessment would be prepared as part of the New START implementation process; however, the Coalition called such a move "premature" and noted that "[t]reaty terms do not require the destruction of a single one of the 450 silos housing our Minuteman III force," and that considering such an action "would represent a serious breach of faith."[25]

At the same time, Senator John Hoeven (R-ND) and Senator Jon Tester (D-MT)—two members of the ICBM Coalition who also held influential positions on the Senate Appropriations Committee—inserted amendments into the FY2014 defense appropriations bill that explicitly blocked the Obama administration from conducting the environmental assessment that would be legally necessary in order to reduce the number of ICBM silos. Specifically noting the importance of the silos to their local communities, the ICBM Coalition stated that the amendment was specifically designed "to bar the Defense Department from initiating any process

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[23] The Senate ICBM Coalition members who voted in favor of New START ratification were: Max Baucus (D-MT), Jon Tester (D-MT), Kent Conrad (D-ND), Byron Dorgan (D-ND), Bob Bennett (R-UT). Coalition members who voted against ratification were: Orrin Hatch (R-UT), John Barrasso (R-WY), Mike Enzi (R-WY). Louisiana's Senate delegation was split: Mary Landrieu (D-LA) voted in favor, while David Vitter (R-LA) voted against.

[24] "Enzi, Barrasso: Hagel's ICBM positions are cause for alarm," News Release, *Office of Senator Mike Enzi* (30 January 2013), accessed 16 February 2021 via The Internet Archive, <https://web.archive.org/web/20201228235420/https://www.enzi.senate.gov/public/index.cfm/2013/1/enzi-barrasso-hagel-s-icbm-positions-are-cause-for-alarm>.

[25] "Senators' ICBM group tells Hagel no environmental study," *Minot Daily News* (28 September 2013), accessed 8 December 2020, <https://www.minotdailynews.com/news/local-news/2013/09/senators-icbm-group-tells-hagel-no-environmental-study/>, text of the letter available via Scribd: <https://www.scribd.com/document/171234825/Senate-letter-to-Defense-Secretary-Hagel>; "N.D. senators support delaying ICBM silo study," *Minot Daily News* (31 December 2013), accessed 8 December 2020, <https://www.minotdailynews.com/news/local-news/2013/12/n-d-senators-support-delaying-icbm-silo-study/>;

that could result in the loss of these vital assets."[26] In a subsequent statement, Coalition members specifically boasted about how they had overruled the Pentagon on the ICBM issue: "the Defense Department tried to find a way around the Hoeven-Tester language, but pressure from the coalition forced the department to back off."[27]

Occasionally, the members of the Senate ICBM Coalition have relied upon their counterparts in the House of Representatives to introduce and advance legislation, especially during periods when the Republicans controlled the House but not the Senate. In 2013, for example, representatives from Wyoming, Montana, North Dakota, and Utah inserted a "Sense of Congress" amendment into the FY2014 National Defense Authorization Act, declaring that any silos that would soon be emptied due to New START force restructuring should be kept "warm," so that the silos could be made fully operational on short notice.[28] The amendment also noted that "the distribution of any such warm-status silos should not disproportionately affect the force structure of any one operational intercontinental ballistic missile wing"—once again demonstrating that the Coalition's main preoccupation was with economic interests, not necessarily strategic ones.[29] A nonpartisan budget watchdog, Taxpayers for Common Sense, suggested that this was "a cynical move by members of the states where ICBMs are currently deployed to maintain force structure at bases in their Congressional Districts."[30]

Additionally, during the fight over New START force posture in 2013, representatives from ICBM states helped kill an NDAA amendment that sought to reduce the number of ICBMs from 450 to 300. As Illinois Democrat Rep. Mike Quigley's amendment was defeated by voice vote, he took to the House floor to lambast his colleagues: "I've been here for four years, and I now recognize what the Department of Defense is. It is our jobs program. I respect my colleagues defending jobs in their district. But this isn't about national security, it's about job maintenance.

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[26] "ICBM Coalition Senators Press DOD to Retain Silos," *Office of Senator John Hoeven* (28 February 2014), accessed 10 December 2020, <https://www.hoeven.senate.gov/news/news-releases/icbm-coalition-senators-press-dod-to-retain-silos>.

[27] "Tester, Enzi lead Senate ICBM Coalition in hailing decision to keep nation's missile silos operational," News Release, *Office of Senator Mike Enzi* (8 April 2014), accessed 10 February 2021 via The Internet Archive, <https://web.archive.org/web/20201228202011/https://www.enzi.senate.gov/public/index.cfm/2014/4/tester-enzi-lead-senate-icbm-coalition-in-hailing-decision-to-keep-nation-s-missile-silos-operational>.

[28] "Sense of Congress" provisions have no force in law; however, they can demonstrate the government's commitment to a particular agenda or course of action.

[29] Public Law 113-66: National Defense Authorization Act for Fiscal Year 2014," H.R. 3304 (26 December 2013), 127 Stat. 864, <https://www.congress.gov/113/plaws/publ66/PLAW-113publ66.pdf>.

[30] "The ICBM Budget Bunker," *Taxpayers for Common Sense* (29 April 2014), accessed 18 December 2020, <https://www.taxpayer.net/national-security/tcs-on-intercontinental-ballistic-missile-icbm-retention/>.

That's not what this is supposed to be about. If we're going to spend money creating jobs, I want to build bridges, schools, and transit systems."[31]

In subsequent years, Congress—with the help of the ICBM Coalition—has been massively successful in preventing the Department of Defense from fully determining its own nuclear force posture. In 2015, the Coalition helped inject another provision into the FY2016 NDAA that specifically prohibited the Pentagon from further reducing the alert level of the ICBM force, with the exception of changes "that are carried out in compliance with the New START treaty."[32] The following year, they helped pass an expanded NDAA prohibition on reducing alert level and the *quantity* of deployed ICBMs below 400—a provision that has since been included in every subsequent NDAA to date.[33] In 2017, they even went so far as to help pass a provision in the FY2018 NDAA that prevented the Air Force from awarding an engineering and manufacturing development contract for the GBSD that would reduce the number of fixed launch control centers below current levels, unless the Commander of STRATCOM overruled it.[34] This provision, however, was not included in subsequent NDAAs and appears to have been overridden, as the Air Force's recent Environmental Impact Statement announcement indicates a significant reduction in each missile wing's launch control centers—from the current 15 to an eventual eight per wing.[35]

These actions all proved to be highly consequential in determining US nuclear force posture levels under New START. By the time that the treaty's central limits came into effect on 5 February 2018, the reduction of the ICBM leg by 50 missiles (11%) was substantially smaller than either the air (reduction of 45 bombers, or 48%) or sea (reduction of 133 missile launchers, or 40%) legs of the triad. Given that the Pentagon's earlier attempts to reduce the ICBM force were thwarted by the Coalition, it is fair to suggest that this disparity in reductions can be directly attributed to the actions of the ICBM Coalition.[36]

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[31] "House Session, Part 2: Begin Consideration of H.R. 2397," C-SPAN Video, 8:04:15 (23 July 2013), accessed 17 February 2021, <https://www.c-span.org/video/?314135-3/house-session-part-2>.

[32] Public Law 114-92: National Defense Authorization Act for Fiscal Year 2016," S. 1356 (25 November 2015), 129 Stat. 1123, <https://www.congress.gov/114/plaws/publ92/PLAW-114publ92.pdf>.

[33] Public Law 114-328: National Defense Authorization Act for Fiscal Year 2017," S. 2493 (23 December 2016), 130 Stat. 2618-2619, <https://www.congress.gov/114/plaws/publ92/PLAW-114publ92.pdf>.

[34] Public Law 115-91: National Defense Authorization Act for Fiscal Year 2018," H.R. 2810 (12 December 2017), 131 Stat. 1766, <https://www.congress.gov/115/plaws/publ91/PLAW-115publ91.pdf>; Original bill language included in Subcommittee on Strategic Forces markup: <https://docs.house.gov/meetings/AS/AS29/20170622/106134/BILLS-115HR2810ih.pdf>.

[35] Matt Korda, "Environmental Assessment Reveals New Details About the Air Force's ICBM Replacement Plan," *FAS Strategic Security Blog* (3 November 2020), accessed 6 January 2021, <https://fas.org/blogs/security/2020/11/environmental-assessment-reveals-new-details-about-the-air-forces-icbm-replacement-plan/>.

[36] Thanks to Piers Mitchem for this.

In recent years, the ICBM Coalition has put particular pressure on military and civilian officials in order to lock in—and even accelerate—the Ground-Based Strategic Deterrent program. In 2016, Coalition members sent a letter to then-Secretary of Defense Ash Carter asking him to recommit to pursuing the GBSD program "as expeditiously as possible," in light of concerns "that the Administration now may consider steps to slow down modernization programs or withdraw them from future year defense plans."[37] Later that year—facing the prospect of a nuclear modernization review from the incoming Trump administration—the ICBM Coalition published a white paper on "The Enduring Value of America's ICBMs," arguing that "[t]he administration and Congress should reject any proposal to delay GBSD or extend the life of Minuteman III beyond the currently-planned 2030 timeframe."[38] Riddled with flawed assumptions, the white paper also claimed that ICBMs are necessary to deter China and North Korea, despite the fact that ICBMs face serious limitations with regards to deterrence missions against either country due to overflight concerns over Russian territory.[39]

During negotiations over the FY2020 NDAA, the ICBM Coalition's allies in the House of Representatives helped quash an amendment that called for an independent study on a life-extension program for the Minuteman III.[40] Three months later, the ICBM Coalition sent a letter to Secretary of Defense Mark Esper with concerns over "recent calls to modify the GBSD acquisition strategy," and urging him to "ensure the GBSD program is not disrupted or delayed."[41] The following year, ICBM Coalition ally Rep. Liz Cheney (R-WY) led the fight against California Rep. Ro Khanna's (D-CA) amendment to transfer $1 billion from the GBSD program towards a national response to the ongoing Covid-19 pandemic.[42]

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[37] Letter to Secretary of Defense Ashton B. Carter, *Office of Senator John Hoeven* (8 July 2016), accessed 8 January 2021, <https://www.hoeven.senate.gov/imo/media/doc/070816Carter.pdf>.

[38] Senate ICBM Coalition, "The Enduring Value of America's ICBMs," *Office of Senator John Hoeven* (December 2016), accessed 28 October 2020, <https://www.hoeven.senate.gov/imo/media/doc/ICBM%20Coalition%20White%20Paper%20December%202016%20-%20final.pdf>.

[39] Ibid, pp. 10-11; for further elaboration on the relevance of the ICBMs to North Korean or Chinese deterrence missions, see Bruce Blair, Jessica Sleight, and Emma Clare Foley, "An Alternative U.S. Nuclear Posture Review: The End of Nuclear Warfighting, Moving to a Deterrence-Only Posture," *Global Zero* (September 2018), p. 62, <https://www.globalzero.org/wp-content/uploads/2018/09/ANPR-Final.pdf>.

[40] Amendment No. 32 to H.R. 2500 submitted by Rep. Earl Blumenauer (D-OR): "Requires an independent study on options to extend the life of the Minuteman III intercontinental ballistic missiles and delaying the ground-based strategic deterrent program (GBSD). Prevents 10% of funds for the Secretary of Defense from being distributed until the study is submitted," Roll Call 454 (11 July 2019): Ayes 164; Noes 264; Not Voting 10, full results available at the Office of the Clerk of the House of Representatives: <https://clerk.house.gov/evs/2019/roll454.xml>.

[41] Letter to Secretary of Defense Mark Esper, *Office of Senator John Hoeven* (25 September 2019), accessed 21 November 2020, <https://www.hoeven.senate.gov/imo/media/doc/GBSD%20Letter%20to%20SecDef%20Esper%20FINAL%209.25.19.pdf>.

[42] Rep. Liz Cheney, "Cheney: Cuts To GBSD Would Embolden China," *YouTube* (2 July 2020), accessed 3 July 2020, <https://youtu.be/QcXsD1nmGVw>.

The ICBM Coalition is generously funded by weapons contractors and other corporations that stand to materially benefit from the GBSD program. A 2021 report by the Center for International Policy revealed that between 2012 and 2020, major ICBM contractors contributed approximately $1.2 million to the members of the Senate ICBM Coalition, and over $15 million to members of the Senate and House Armed Services Strategic Forces Subcommittees and the Senate and House Defense Appropriations Subcommittees—committees which play a direct role in authorizing and appropriating funds for the ICBM force.[43]

Not only have weapons contractors dramatically influenced the ICBM process through campaign contributions, but they have regularly conducted substantial lobbying campaigns in order to sway critical votes in their favor.

Northrop Grumman—which was selected from an unprecedented single-source bidding process in September 2020 to develop and build the new GBSD—employed 49 lobbyists in 2020, most of whom came from previous positions in government.[44] In collaboration with the teams from other ICBM contractors like Lockheed Martin, Northrop Grumman's lobbying team helped kill the aforementioned 2019 NDAA amendment calling for an independent study on a Minuteman III life-extension program. Rep. Mike Turner (R-OH), one of the most vocal opponents of the amendment during that debate, received $376,910 in contributions from ICBM contractors between 2012 and 2020.[45]

GBSD is not a useful avenue for job creation

As the debate over the Ground-Based Strategic Deterrent reaches new levels of intensity, its proponents have leaned further into the economic justifications for the system's development. In March 2021, Senator Jon Tester (D-MT), the new chair of the Senate Defense Appropriations Subcommittee, said in an interview that given Montana's position as an ICBM host state, he supports the GBSD "from a parochial standpoint."[46] Additionally, Northrop Grumman claimed in August 2020 that the development stage of the GBSD program will involve over 10,000 people across 32 states; however, as the Center for International Policy's William Hartung recently suggested, "claims of the numbers of jobs and production locations for projects like the GBSD

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[43] William Hartung, "Inside the ICBM Lobby: Special Interest or the National Interest?" *Center for International* Policy (9 March 2021), p. 14, <https://3ba8a190-62da-4c98-86d2-893079d87083.usrfiles.com/ugd/3ba8a1_89fe183f8a164e22a2fa29d4d6381d7b.pdf>.

[44] Ibid, p. 16.

[45] Ibid, p. 14.

[46] Anthony Capaccio, "Hard Look at $246 Billion for New ICBMs Pledged by a Top Senator," *Bloomberg* (2 March 2021), accessed 3 March 2021, <https://www.bloomberg.com/news/articles/2021-03-02/hard-look-at-246-billion-for-new-icbms-pledged-by-a-top-senator>.

are often exaggerated," further noting that "Northrop Grumman has failed to provide documentation for its estimates."[47]

In reality, the ICBM force does not create nearly as many jobs as its advocates often claim. Analysis by Dr. Heidi Peltier of the Costs of War Project at Brown University shows that defense investment is among the least productive of federal investment opportunities: while $1 million in defense spending supports 6.9 jobs, the same amount directed towards clean energy and infrastructure supports 9.8 jobs, health care supports 14.3 jobs, and education supports 15.2 jobs.[48] Therefore, as the Costs of War Project report summarizes, "for the same amount of spending, clean energy and infrastructure create 40 percent more jobs than the military, healthcare creates 100% more, and education 120% more."[49] This is largely due to significant discrepancies between the salaries of those working in the defense sector and those working in comparable industries. For example, in 2020 the average salary for a mechanical engineer at Lockheed Martin was $125,000; however, the median salary a mechanical engineer across all industries was only $87,370.[50] According to Dr. Peltier,

> *This pay discrepancy distorts the national labor market by making it more difficult for other firms, or for the military itself, to compete. This is problematic because it signifies a loss or misallocation of human capital, with workers seeking contractor employment and thereby contributing to war profiteering instead of providing their services to the military or other socially important sectors of the economy. A talented engineer, for example, might choose to work for Lockheed Martin rather than a renewable energy company because of the higher salary.*[51]

Further analysis from the Costs of War Project suggests that "For every billion that we shift from defense to green manufacturing, we create a net increase of over 2,000 jobs," and that shifting $125 billion per year from the Pentagon budget would create a net increase of 250,000 jobs.[52] This kind of economic conversion is already taking place in defense sector hubs like Huntsville,

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[47] "GBSD Nationwide Team Map," *Northrop Grumman* (August 2020), accessed 19 September 2020, <https://www.northropgrumman.com/wp-content/uploads/Approved-NG20-1485-200812-GBSD-Nationwide-Team-Map.pdf>; Hartung, "Inside the ICBM Lobby," *Center for International Policy* (9 March 2021), p. 17.

[48] Heidi Garrett-Peltier, "War Spending and Lost Opportunities," *Costs of War Project* (14 March 2019), accessed 20 September 2020, <https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/March%202019%20Job%20Opportunity%20Cost%20of%20War.pdf>.

[49] Ibid.

[50] Heidi Peltier, "The Growth of the 'Camo Economy' and the Commercialization of the Post-9/11 Wars," *Costs of War Project*, (30 June 2020), p. 24, accessed 24 February 2021, <https://watson.brown.edu/costsofwar/files/cow/imce/papers/2020/Peltier%202020%20-%20Growth%20of%20Camo%20Economy%20-%20June%2030%202020%20-%20FINAL.pdf>.

[51] Ibid, p. 3.

[52] Heidi Peltier, "Cut Military Spending, Fund Green Manufacturing," *Costs of War Project* (13 November 2019), accessed 24 February 2021, <https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/Peltier%20Nov2019%20Short%20GND%20CoW.pdf>.

Alabama, known as the "Pentagon of the South." In October 2020, a *Southerly* feature story documented how a portion of Huntsville's engineers and STEM specialists were leaving their jobs at weapons companies to take new ones in the clean energy industry. One success story—a former Tomahawk cruise missile engineer turned renewables CEO—reportedly spends very little time on recruitment, saying that his staff "came to us" from previous positions at Raytheon and the Army Corps of Engineers.[53] The feature quoted Miriam Pemberton, a research fellow at the Institute for Policy Studies, who suggests that "if towns and businesses see the government choosing to shift spending from the military to the green economy, 'they would move. They follow the money.'"[54] According to another Huntsville resident who transitioned to the renewables sector, "'This is something our politicians miss. It's not about getting rid of jobs' […] 'It's about transforming the workforce.'"[55]

Redirecting defense dollars towards these priorities would also help increase local communities' resilience to the potential economic impacts of ICBM elimination. Analysis of previous military base closures indicates that most military communities have actually increased their employment levels—in many cases, by several hundred percent—after their nearby bases closed and those federal investments were reallocated towards other priorities.[56] With respect to the GBSD specifically, the Center for International Policy's William Hartung suggests that "if even part of the savings from cancelling the GBSD and savings on maintenance and support of existing ICBMs were to be directed towards alternative economic activities in the states that host ICBM bases, it could provide a significant cushion as the affected communities transition to replace the jobs tied to those facilities with new economic activities."[57]

The militarization of American society

Congressional pushes to sustain and modernize the ICBM force have unfailingly invoked national security in order to justify their actions. Very rarely in the countless letters, debates, vocalizations, and white papers has the ICBM Coalition overtly tied their support to ICBMs to jobs in their districts, or to their campaign contributions by the ICBM contractors.

However, it is clear that these two factors play a significant—if not overwhelming—role in driving the Coalition's actions. Time after time, Congress managed to thwart the Pentagon's

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[53] Taylor Barnes, "From Arms to Renewables: How Workers in this Southern Military Industrial Hub are Converting the Economy," *Southerly* (27 October 2020), accessed 28 October 2020, <https://southerlymag.org/2020/10/27/from-arms-to-renewables-how-workers-in-this-southern-military-industrial-hub-are-converting-the-economy/>.

[54] Ibid.

[55] Ibid.

[56] Data retrieved from the Office of Economic Adjustment, Department of Defense.

[57] Hartung, "Inside the ICBM Lobby," *Center for International Policy* (9 March 2021), p. 22.

intentions to determine its own nuclear force posture. Over the past 15 years, the ICBM Coalition has played a leading role in adjusting ICBM standards and moving project goalposts, in order to ensure the acceleration of the GBSD program and to simultaneously quash any prospect of another Minuteman III life-extension. "To be sure," as Gretchen Heefner suggests, "they could still justify it in the name of national security. But under that veneer it was really just about butter."[58]

However, while missile field politicians have ultimately been very successful in bringing the ICBM pork home—both during and after the Cold War—their efforts have also served to enmesh the fates of their constituents with the spigot of federal military investment. As long as the tap continues to flow, the complaints will be few and far between. But if the tap ever shuts off, the consequences will be dire.

As Heefner writes in *The Missile Next Door*,

> *The Cold War turned towns and communities across the country into defense dependencies, often in ways unseen. The result is a defense-based economy reliant on conflict, or the threat of conflict, for sustenance. Americans do not necessarily invent their enemies, but they are quick to embrace and amplify them once identified. This is in part because there is a vested interest in doing so, precisely the sort of militarization of everyday life that Americans have so long claimed to abhor.*[59]

The cruel irony here is that by creating more targets for the ICBMs to aim at, these politicians are implicitly refusing to remove the existing targets on the backs of their constituents. While often claiming that these weapons are crucial for national security, rarely do they acknowledge that their actions have firmly entrenched their own districts as nuclear ground zero. As House Armed Services Committee Chairman Adam Smith remarked of his ICBM Coalition colleagues in October 2019, "Apparently, they want to be targeted in a first nuclear strike."[60]

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[58] Heefner, *The Missile Next Door,* p. 198.

[59] Ibid, p. 206.

[60] Rep. Adam Smith, "Rep. Adam Smith on US Nuclear Policy," transcript of remarks and Q&A, *Ploughshares Fund's The Future of US Nuclear Policy*, National Press Club, Washington, DC (24 October 2019), accessed 3 July 2020, <https://www.ploughshares.org/issues-analysis/article/rep-adam-smith-us-nuclear-policy>.

V. GROUND-BASED STRATEGIC DETERRENT: PROGRAM DETAILS

Although the final design of the GBSD has not yet been decided and many details remain classified, some specifics have become public in recent months:

Name: The Air Force will soon give its new missile a descriptive name, along the lines of previous ICBMs (i.e. Titan, Peacekeeper, Minuteman, etc.). In February 2021, General Timothy Ray, commander of Air Force Global Strike Command, suggested that the GBSD's official name would be announced "any week now."[1]

Warhead and reentry vehicle: The GBSD will ultimately be deployed with brand-new W87-1 warheads. The National Nuclear Security Administration (NNSA) plans to newly manufacture the entire warhead, including both the primary and the secondary, at an estimated cost of $13.4 billion (in Then-Year dollars) between FY2019-FY2037 *not including* the cost of associated pit production—the most expensive warhead modernization program since the end of the Cold War.[2] However, if the NNSA fails to meet its production schedule of 80 plutonium pits per year by 2030—which both internal and external analysts agree is extremely unlikely—the W87-1 will not be completed in time for the GBSD's deployment.[3] The Air Force is already anticipating this delay, and is therefore planning on the GBSD reaching Initial Operational Capability with legacy W87-0 warheads and Mk21 reentry vehicles.[4] The GBSD's W87-1

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[1] Kingston Reif (@KingstonAReif), Twitter, "Gen. Hyten: 'Oh by the way, for T-Ray, we gotta find a name for GBSD. GSBD just doesn't hack it. I don't care whether its Minuteman IV, or Peacekeeper II, or Black Forest I...GBSD is very hard to explain to the American people.' Gen. Ray: 'It's coming sir. Any week now.'" (25 February 2021), accessed 25 February 2021, <https://twitter.com/KingstonAReif/status/1364984778970304518>.

[2] National Nuclear Security Administration, "Fiscal Year 2021 Stockpile Stewardship and Management Plan – Biennial Plan Summary: Report to Congress," *Department of* Energy (December 2020), pp. 5.32-5.33, <https://www.energy.gov/sites/prod/files/2020/12/f82/FY2021_SSMP.pdf>; National Nuclear Security Administration, "W78 Replacement Program (W87-1): Cost Estimates and Use of Insensitive High Explosives: Report to Congress," *Department of Energy* (December 2018), p. 5.

[3] Allison B. Bawden et al., "NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program," *Government Accountability Office* (September 2020), GAO-20-703, p. 5; David E. Hunter et al., "Independent Assessment of the Two-Site Pit Production Decision: Executive Summary," *Institute for Defense Analyses* (May 2019), NS D-10711, p. 4, <https://www.ida.org/-/media/feature/publications/i/in/independent-assessment-of-the-two-site-pit-production-decision-executive-summary/d-10711.ashx>.

[4] Department of the Air Force, "Report on Development of Ground-Based Strategic Deterrent Weapon," Report to Congressional Committees (May 2020), p. 4.

warhead will ultimately be carried by a new Mk21A reentry vehicle, which is a modernized version of the Mk21 with an upgraded fuze to increase the system's destructive potential.[5]

Modularity: The GBSD employs a "modular design," meaning that the Air Force will be able to replace the missile's subsystems as they age or as technology advances. The GBSD's open architecture also allows the Air Force to control the system's intellectual property, meaning that upgrades could be completed on a competitive basis, without relying solely on the prime contractor.[6]

Maintenance and security: The GBSD's modular architecture will allow missile maintenance to be conducted without opening the launcher closure door—meaning that fewer security forces will need to be present during maintenance operations. According to GBSD administrations this will result in a "two-thirds" reduction in weapons exposures, and general maintenance operations will take significantly less time.[7]

Design: Unlike the Minuteman III's boosters, which use heavy steel casings, the GBSD's boosters will use a lighter, composite material to increase the missile's range.[8] Northrop Grumman's early mock-up of its missile design included wider second and third stages, as well as a wider payload, which could allow for multiple warheads in the future, or potentially defensive countermeasures.[9] Illustrations of the GBSD in a 2020 Air Force Nuclear Weapons Center briefing appear to show the missile carrying two warheads; however, the Air Force currently plans to deploy the GBSD with just one warhead per missile.[10]

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[5] Amy F. Woolf, "U.S. Strategic Nuclear Forces: Background, Developments, and Issues," *Congressional Research Service* (10 December 2020), RL33640, pp. 15-16, accessed 2 February 2021, <https://fas.org/sgp/crs/nuke/RL33640.pdf>; Hans M. Kristensen, Matthew McKinzie, and Theodore A. Postol, "How US nuclear force modernization is undermining strategic stability: The burst-height compensating super-fuze," *Bulletin of the Atomic Scientists* (1 March 2017), accessed 5 September 2020, <https://thebulletin.org/2017/03/how-us-nuclear-force-modernization-is-undermining-strategic-stability-the-burst-height-compensating-super-fuze/>.

[6] Benji Johnson, "Defense Primer: Ground Based Strategic Deterrent (GBSD) Capabilities," *Congressional Research Service* (10 November 2020), IF11681, accessed 12 November 2020, <https://fas.org/sgp/crs/natsec/IF11681.pdf>.

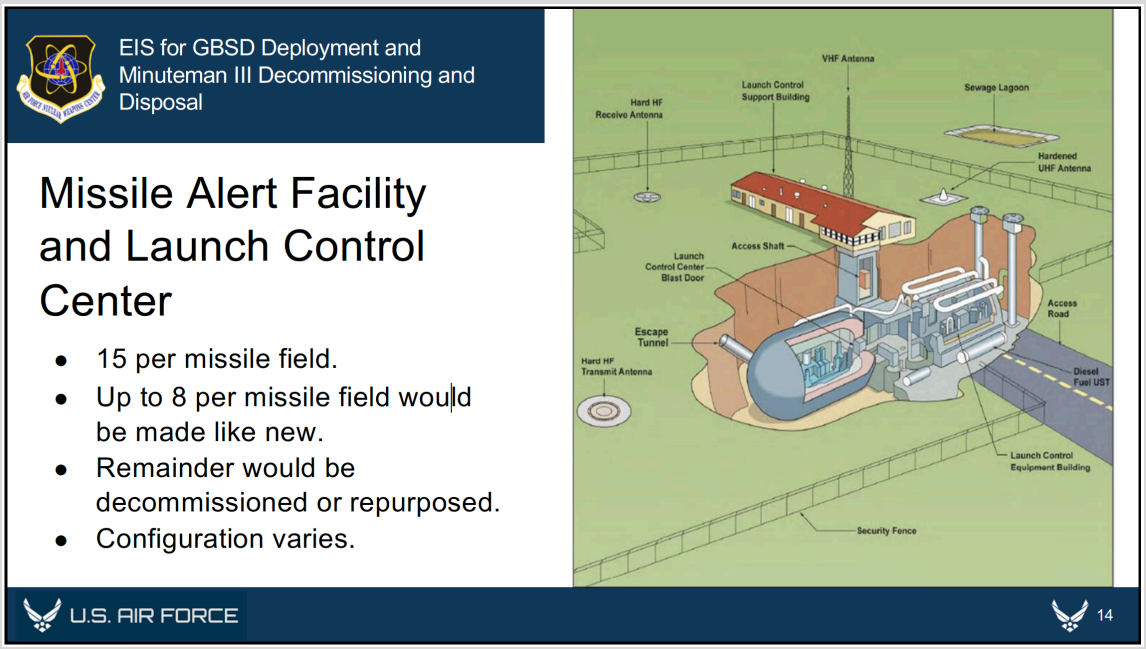
[7] Lt. Col. Daniel Voorhies, "GBSD: An Update," *20th Nuclear Triad Symposium*, Bossier City, LA (10 December 2020), accessed 10 December 2020, <https://youtu.be/vSyVoL5SFiw>, transcript available via the Cyber Innovation Center: <https://cyberinnovationcenter.org/wp-content/uploads/2021/02/voorhies-transcript.pdf>

[8] Johnson, "Defense Primer: Ground Based Strategic Deterrent (GBSD) Capabilities," *Congressional Research Service* (10 November 2020).

[9] Hans Kristensen (@nukestrat), Twitter, "What do industry illustrations show about new GBSD ICBM capabilities? 1. Lockheed Martin: wider 2d stage (longer range), similar payload; 2. Boeing: same as MM3; 3. Northrup Grumman: wider 2+3 stages (even longer range), wider payload (larger RVs: MIRV W87-1, future warhead)." (17 September 2019), accessed 5 June 2020, <https://twitter.com/nukestrat/status/1173971761634926592>.

[10] Air Force Nuclear Weapons Center, "Integration Support Contract (ISC) 2.0: Industry Day #3," Briefing (16 March 2020), pp. 14-15; Johnson, "Defense Primer: Ground Based Strategic Deterrent (GBSD) Capabilities," *Congressional Research Service* (10 November 2020).

Launch infrastructure: Although the GBSD uses the same launch facilities as the current Minuteman III force, these facilities will be modernized and standardized in order to create a common, recognizable layout for both operators and maintainers.[11] The missile alert facilities and launch control centers will be completely renovated to improve quality of life for the operators; however, it appears that GBSD will use only eight launch control centers per missile wing, instead of the current configuration of 15 per wing.[12] This could indicate that fewer missileers will be needed to operate the replacement ICBM force. Despite the smaller number of launch control centers, new overlapping areas of responsibility will allow each missile to be observed by a greater number of LCCs, in addition to a new integrated command center based at each wing. According to GBSD administrators, at each command center "you're going to have defenders, we'll have maintainers, operators, cyber warriors, all integrated together in one facility overseeing the day-to-day mission that's going on at the wing."[13]



Slide from "Environmental Impact Statement for the Ground Based Strategic Deterrent Deployment and Minuteman III Decommissioning and Disposal: Public Scoping Materials," Air Force Global Strike Command (September 2020), p. 14.

[11] Ibid.

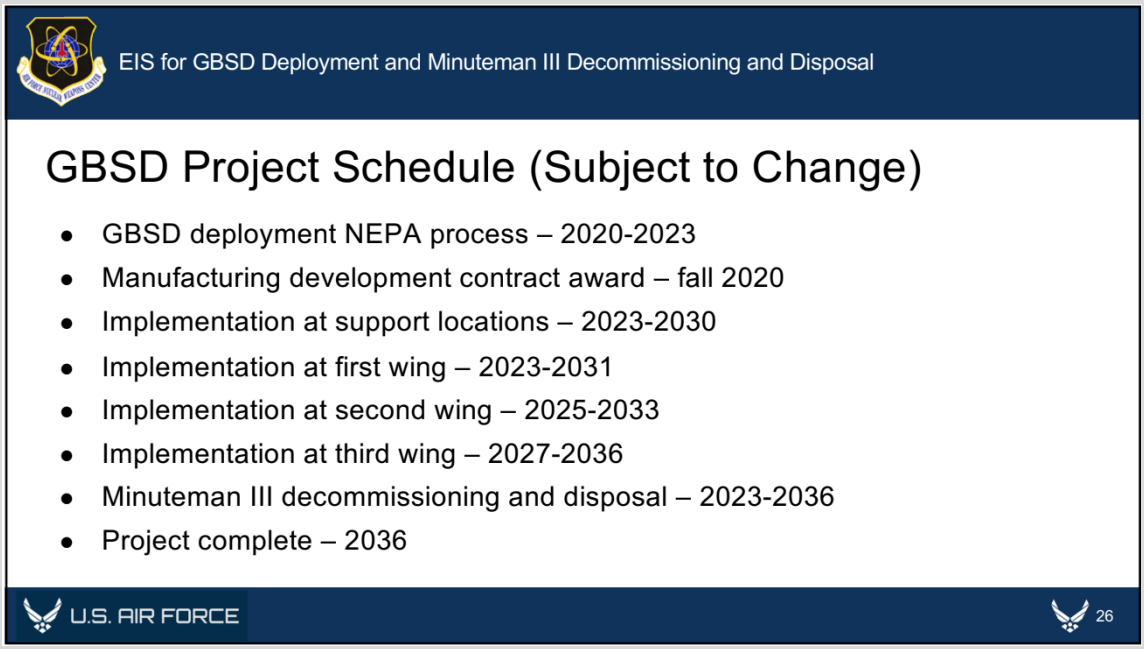
[12] "Environmental Impact Statement for the Ground Based Strategic Deterrent Deployment and Minuteman III Decommissioning and Disposal: Public Scoping Materials," *Air Force Global Strike Command* (September 2020), p. 14, accessed 1 November 2020, <https://drive.google.com/file/d/1BQXd36ek8EispPEPOCvAz8O8Jt9aP02w/view>.

[13] Voorhies, "GBSD: An Update," *20th Nuclear Triad Symposium* (10 December 2020).

Deployment timeline:
The Air Force plans to reach Initial Operating Capability in FY2029. In order to do this, the Air Force must:
- deploy 20 GBSD missiles loaded with legacy W87-0/Mk21 warheads and reentry vehicles.
- upgrade 20 Minuteman III launch facilities to GBSD standards;
- operationally certify three GBSD launch control centers and one integrated command center.[14]

The Air Force is required to reach Full Operating Capability no later than FY2036. In order to do this, the Air Force must:
- upgrade 450 Minuteman III launch facilities to GBSD standards;
- deploy 400 GBSD missiles
- complete the Minuteman III-to-GBSD transition for no less than 24 launch control centers (eight per wing), three integrated command centers (one per wing), and all associated command and control infrastructure.[15]

The infrastructure upgrades at all three missile wings are expected to take place between 2023 and 2036, and are expected to begin in 2023 at F. E. Warren, followed by Malmstrom in 2025, and by Minot in 2027.[16]



Slide from "Environmental Impact Statement for the Ground Based Strategic Deterrent Deployment and Minuteman III Decommissioning and Disposal: Public Scoping Materials," Air Force Global Strike Command (September 2020), p. 26.

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[14] Department of the Air Force, "Report on Development of Ground-Based Strategic Deterrent Weapon," Report to Congressional Committees (May 2020), p. 4.

[15] Ibid, p. 4.

[16] "Environmental Impact Statement for the Ground Based Strategic Deterrent Deployment and Minuteman III Decommissioning and Disposal: Public Scoping Materials," *Air Force Global Strike Command* (September 2020), p. 26.

VI. THE FLAWED ASSUMPTIONS BEHIND THE GBSD PROGRAM

When seeking to plug a capability gap, the Pentagon is required to consider a range of procurement options before proceeding with its acquisition. This process takes place over several years and culminates in an "Analysis of Alternatives"—a comparative evaluation of the operational effectiveness, suitability, risk, and life-cycle costs of the various options under consideration. This assessment can have tremendous implications for an acquisition program, as it documents the rationale for recommending a particular course of action.

The Air Force's Analysis of Alternatives (AoA) for a follow-on ICBM was conducted between 2013 and 2014, and recommended "[r]eplacement of the MMIII weapon system, ensuring a safe, secure, and effective land-based deterrent through 2075" with a "missile similar in size to the MMIII, addressing capability needs, strategic stability, and available technologies."[17] In that same document, the Air Force ruled out the possibility of a Minuteman III life-extension: "While a life extension of the MMIII system was considered and its costs were very similar compared with the costs of the final GBSD candidate solution," the Air Force later suggested in a 2016 report to Congress, "maintaining and extending the life of a system that does not meet capability goals eliminated it as a final candidate solution."[18]

The AoA offered several discrete reasons for its consequential recommendation, noting that a replacement GBSD capability would:

A. address the capability gaps identified by the Capabilities-Based Assessment and Initial Capabilities Document, in order to meet current and future threats;[19]
B. maintain the large solid rocket motor industrial base;
C. share subcomponent commonality with the Navy's ballistic missiles; and
D. be cheaper than the cost of life-extending the Minuteman IIIs.[20]

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[17] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," Department of Defense (July 2016), p. 4.

[18] Ibid, p. 7.

[19] In the defense acquisition process, a Capabilities-Based Assessment provides recommendations to pursue either a materiel or non-materiel solution to an identified capability gap. If a material solution is deemed necessary, an Initial Capabilities Document explains why this solution will resolve the previously identified capability gap.

[20] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent," *Department of Defense* (July 2016), pp. 4-6.

It has since become clear that these factors were based on flawed assumptions, and many have since been been deprioritized. Each of these are examined in depth below.

What capability gaps would the GBSD need to fill?

The Air Force's 2016 congressional report on the GBSD program—one of the few public documents describing the findings of the classified Analysis of Alternatives—noted that "Although MMIII continues to perform as originally designed, capability gaps, along with sustainment and attrition issues, drive the need for replacement or modernization."[21]

Despite these Minuteman III "capability gaps" that apparently need filling, it is notable how similar the proposed GBSD and Minuteman III systems appear to be. The Air Force's 2016 report describes the "basic characteristics" of the GBSD as follows:

- *Guidance: Inertial; non-externally aided*
- *Propulsion: Solid rocket motor boosters and a post-boost propulsion system*
- *Range: Equal to, or exceeding, current MMIII range*
- *Standard Load: One reentry vehicle (RV) per missile; maintain ability for multiple RVs per missile in accordance with Nuclear Posture Review*
- *Basing: Continental United States (current Missile Wing locations)*[22]

With the exception of a potential range improvement and a latent MIRV capability, this list of system characteristics might as well describe the Minuteman III. If any fundamental "capability gaps" were indeed identified during the Air Force's analysis, it is difficult to see how a brand-new, yet highly-similar GBSD system would plug them.

Additionally, as has been addressed in previous chapters, the Air Force's basis for touting these perceived "capability gaps" is somewhat murky. The former commander of US Strategic Command has suggested that the US nuclear force must be modernized because "ICBMs have additional importance today that wasn't envisioned during the Cold War."[23] However, STRATCOM has not articulated what is meant by "additional importance."

With respect to US-centric nuclear deterrence, what has changed since the end of the Cold War? China is slowly but steadily expanding its nuclear arsenal and suite of delivery systems, and North Korea's nuclear weapons program continues to mature. However, the range and deployment locations of the US ICBM force would force the missiles to fly over Russian territory in the event that they were aimed at Chinese or North Korean targets, thus significantly

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[21] Ibid, p. 5.

[22] Ibid, p. 4.

[23] Gen. (ret.) C. Robert Kehler, "The U.S. Needs a New ICBM Now," *National Institute for Public Policy*, Information Series No. 444 (16 August 2019), <https://www.nipp.org/wp-content/uploads/2019/08/IS-444.pdf>.

increasing the risk of using ICBMs to target either country.[24] Moreover, as Chapter II suggests, other elements of the US nuclear force—especially SSBNs—could be used to accomplish the ICBM force's mission under a revised nuclear force posture, potentially even faster and in a more flexible manner.

GBSD advocates have suggested that adversarial advances in "missile defense and anti-access/area denial" tactics could soon negate the threat of the Minuteman III force, thus requiring a brand-new missile.[25] However, this seems highly improbable, as this assumption suggests that within just a few years Russia or China will be able to leapfrog the United States in defensive capabilities—thus transforming their currently inferior missile defense systems into groundbreaking systems capable of intercepting hundreds of US ICBMs armed with penetration aids. The United States' current homeland defense system—Ground-Based Midcourse Defense—has a successful test record of approximately 50% against single targets in highly-controlled and scripted environments; the suggestion that Russia or China could soon surpass this record to defeat the Minuteman III force entirely is highly unlikely.[26]

It is additionally important to note that even if adversarial missile defenses improved significantly, the ability to evade missile defenses lies with the payload—not the missile itself. By the time that an adversary's interceptor was able to engage a US ICBM in its midcourse phase of flight, the ICBM would have already shed its boosters, deployed its penetration aids, and would be guided solely by its reentry vehicle.[27] Reentry vehicles and missile boosters can be independently upgraded as necessary, meaning that any concerns about adversarial missile defenses could be mitigated by deploying a more advanced payload on a life-extended Minuteman III ICBM.

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[24] For further discussion on the concerns with ICBM overflight, see: Dennis Evans and Jonathan Schwalbe, "Intercontinental Ballistic Missiles and their Role in Future Nuclear Forces," *Johns Hopkins Applied Physics Laboratory*, NSAD-R-16-001 (2017), p. 17, <https://www.jhuapl.edu/Content/documents/ICBMsNuclearForces.pdf>; Gen. (ret.) James Cartwright et al, "Global Zero U.S. Nuclear Policy Commission Report: Modernizing U.S. Nuclear Strategy, Force Structure and Posture," *Global Zero* (May 2012), p. 7, <https://www.globalzero.org/wp-content/uploads/2018/09/gz_us_nuclear_policy_commission_report.pdf>; Bruce Blair, Jessica Sleight, and Emma Clare Foley, "An Alternative U.S. Nuclear Posture Review: The End of Nuclear Warfighting, Moving to a Deterrence-Only Posture," *Global Zero* (September 2018), p. 62, <https://www.globalzero.org/wp-content/uploads/2018/09/ANPR-Final.pdf>.

[25] Jennifer-Leigh Oprihory, "Ray: US Needs to Balance Nuclear Upgrades, Arms Control," *Air Force Magazine* (12 December 2020), accessed 19 December 2020, <https://www.airforcemag.com/ray-us-needs-to-balance-nuclear-upgrades-arms-control/>.

[26] Missile Defense Agency, "Ballistic Missile Defense Intercept Flight Test Record," *Department of Defense* (December 2018), accessed 20 December 2020, <https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/ballistic-missile-defense-intercept-flight-test-record-UPDATED.pdf>; Cristina Chaplain, et al., "Missile Defense: Delivery Delays Provide Opportunity for Increased Testing to Better Understand Capability," *Government Accountability Office* (June 2019), GAO-19-387, <https://www.gao.gov/assets/gao-19-387.pdf>.

[27] "How It Works: Midcourse Discrimination," *Center for Strategic & International Studies* (22 November 2016), <https://youtu.be/I9XuQ7_p1DU>.

Overall, as Chapter II explores in further detail, since the Cold War ended the case *against* ICBMs has become much stronger than the case *for* them. Therefore, it is quite unclear which deterrence or capability "gaps" the Air Force is describing when it claims that a brand-new ICBM is needed to plug them.

Does GBSD actually maintain the large solid rocket motor industrial base?

For years, internal and external analysts have sounded alarm bells about corporate consolidation in the defense industry. In its FY2017 Annual Industrial Capabilities Report to Congress, the Pentagon noted that "the trend toward fewer and larger prime contractors has the potential to affect innovation; narrow industrial capabilities and technology; limit the supply base; pose entry barriers to small, medium, and large businesses; and ultimately reduce competition that may otherwise not be in the Department's or the public's interests."[28] Additionally, the report's authors concluded, "The Department is mindful of past loss of competition at the prime level, resulting from significant industry consolidations over the past 20-plus years."[29]

With specific regard to the GBSD, both Congress and the Pentagon have been particularly concerned about the effect of these mergers on the domestic large solid rocket motor (LSRM) industry: in 1990, there were five LSRM manufacturers in the United States; now there are only two.[30]

Having fewer providers of big-ticket systems like LSRMs means that the Pentagon has less ability to control costs through competition, generally resulting in increased costs. Additionally, the presence of system monopolies can create chokepoints in the defense acquisition process, since the entire supply chain can be affected by the conduct of a single corporation. This could easily result in delays to the weapon system coming online.[31]

In its justification for the GBSD program, the Air Force has continuously emphasized that a brand-new missile program would protect the ailing LSRM industry better than a simple

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[28] Office of the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, "Fiscal Year 2017 Annual Industrial Capabilities: Report to Congress," *Office of the Under Secretary of Defense for Acquisition and Sustainment* (March 2018), 18-C-0754, pp. 24-25, <https://www.businessdefense.gov/Portals/51/Documents/Resources/2017%20AIC%20RTC%2005-17-2018%20-%20Public%20Release.pdf?ver=2018-05-17-224631-340>.

[29] Ibid, pp. 24-25.

[30] Office of the Deputy Assistant Secretary of Defense for Industrial Policy, "Fiscal Year 2019 Annual Industrial Capabilities: Report to Congress," *Office of the Under Secretary of Defense for Acquisition and Sustainment* (23 June 2020), 18-C-0754, pp. 24-25, 1-6A0A3FA <https://www.businessdefense.gov/Portals/51/Documents/Resources/USA000954-20%20RPT%20Subj%20FY19%20ICR%2007092020.pdf?ver=2020-07-10-124452-180>.

[31] Loren Thompson, "Competition In Rocket Motors At Risk As Northrop Absorbs Orbital," *Forbes* (14 April 2018), accessed 19 November 2020, <https://www.forbes.com/sites/lorenthompson/2018/08/14/competition-in-rocket-motors-at-risk-as-northrop-absorbs-orbital/?sh=a4060fdbe498>.

refurbishment.[32] However, after Northrop Grumman purchased one of the two remaining LSRM manufacturers and subsequently won the GBSD's unprecedented sole-source engineering contract in 2020, the state of the industrial base today is significantly less healthy than it was just a couple of years ago. As is catalogued in the following paragraphs, despite the concerns of Congress and civil society watchdogs, the Pentagon's nonchalant reaction indicates that the department may not be as concerned with preserving the industrial baseline as was previously advertised in its justifications for pursuing GBSD.[33]

In September 2017, immediately after the Air Force awarded Northrop Grumman and Boeing contracts to begin the Technological Maturation and Risk Reduction phase of the GBSD acquisition process, Northrop Grumman announced its intention to acquire Orbital ATK—one of two remaining LSRM providers left in the United States.[34]

If Northrop Grumman's acquisition was successful, and if the company ultimately won the contract for the Engineering, Manufacturing and Development (EMD) phase of the GBSD program, it could theoretically exclude the only other LSRM provider—Aerojet Rocketdyne—from its production team, thus probably putting its new competitor out of business.[35] Aerojet Rocketdyne was already on precarious footing, and in April 2017, the company had announced that it would shutter its operations at its complex in Sacramento as a cost-saving measure.[36] The new prospect of a LSRM monopoly dominated by Northrop Grumman was therefore a significant concern for Aerojet Rocketdyne, who urged the Pentagon to step in.[37]

Legal mechanisms are available for the Pentagon to object to such an acquisition and make relevant recommendations to the Federation Trade Commission and the Department of Justice "to ensure that mergers and acquisitions do not reduce competition or cause market distortions

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[32] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent," *Department of Defense* (July 2016), p. 4.

[33] Kingston Reif, "Air Force Awards New ICBM Contract," *Arms Control Today* (October 2020), accessed 23 February 2021, <https://www.armscontrol.org/act/2020-10/news/air-force-awards-new-icbm-contract>.

[34] Dana Mattioli and Doug Cameron, "Northrop Grumman to Buy Orbital ATK for $7.8 Billion in Cash," *The Wall Street Journal* (18 September 2017), accessed 17 October 2020, <https://www.wsj.com/articles/northrop-grumman-nears-deal-to-buy-orbital-atk-1505686431>.

[35] Thompson, "Competition In Rocket Motors At Risk As Northrop Absorbs Orbital," *Forbes* (14 April 2018); Sandra Erwin, "In the wake of Northrop-Orbital merger, Aerojet's solid rocket engine business teetering on the brink," *Space News* (27 June 2018), accessed 19 November 2020, <https://spacenews.com/in-the-wake-of-northrop-orbital-merger-aerojets-solid-rocket-engine-business-teetering-on-the-brink/>.

[36] Office of the Deputy Assistant Secretary of Defense for Industrial Policy, "Fiscal Year 2019 Annual Industrial Capabilities: Report to Congress," *Office of the Under Secretary of Defense for Acquisition and Sustainment* (23 June 2020), p. 67.

[37] Thompson, "Competition In Rocket Motors At Risk As Northrop Absorbs Orbital," *Forbes* (14 April 2018).

that are not in the Department's ultimate best interest."[38] However, despite Aerojet Rocketdyne's concerns over a LSRM monopoly, the Pentagon did not make a public objection of this kind, and it remains unclear whether such an objection was made in private.[39]

This did not prevent the Federal Trade Commission from investigating the merger: in June 2018, when Northrop Grumman made its move to formally acquire Orbital ATK for $7.8 billion, the Federal Trade Commission immediately began to explore whether the sale might "substantially lessen competition and […] create a monopoly in the relevant market for missile systems." Specifically, the FTC noted,

> *The Acquisition would provide Northrop with the ability and incentive to foreclose missile system prime contractor competitors by denying them access to Northrop's SRMs or by making pricing, personnel, schedule, investment, design, and other decisions that disadvantage those competitors. If Northrop were to withhold effective access to its SRMs, or increase the price of those SRMs, to its prime contractor competitors, competition would be lessened because the foreclosed prime contractors would be forced to raise the prices of their missile systems, decide not to compete, or invest less aggressively to win missile programs, which, in turn, would decrease competitive pressure on Northrop.*[40]

According to the FTC, not only could the fairness of the Boeing-Northrop Grumman competition suffer as a result of the sale, but so too would the United States government:

> *If Northrop were to foreclose its missile system prime contractor competitors in any of these ways, the United States Government would be harmed because cost of missile systems may increase, innovation may be lessened, and/or quality would be reduced because the United States Government would be less likely to obtain the best possible combination of missile system prime contractor and SRM supplier.*[41]

The FTC did not block the acquisition; however, it ruled that Northrop Grumman was required to "not Discriminate in any Missile Competition where Northrop is currently competing to be the Prime Contractor."[42] Specifically, Northrop Grumman would have to make its solid rocket motor products and services fully available to Boeing, and would not be permitted to share

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[38] Office of the Deputy Assistant Secretary of Defense for Industrial Policy, "Fiscal Year 2018 Annual Industrial Capabilities: Report to Congress," *Office of the Under Secretary of Defense for Acquisition and Sustainment* (23 June 2020), 18-C-0754, p. 3, 6-BC890CE <https://www.businessdefense.gov/Portals/51/Documents/Resources/2018%20AIC%20RTC%2005-23-2019%20-%20Public%20Release.pdf?ver=2019-06-07-111121-457>.

[39] It is possible that such an objections was made in private; however, there has been no public suggestion that this was the case.

[40] Federal Trade Commission, "Complaint: In the Matter of Northrop Grumman Corporation and Orbital ATK, Inc.," Docket No. C-4652 (5 June 2018), p. 3, <https://www.ftc.gov/system/files/documents/cases/1810005_c-4652_northrop_grumman_orbital_complaint_6-5-18.pdf>.

[41] Ibid, p. 3.

[42] Federal Trade Commission, "Decision and Order: In the Matter of Northrop Grumman Corporation and Orbital ATK, Inc.," Docket No. C-4652 (4 December 2018), p. 7, <https://www.ftc.gov/system/files/documents/cases/181_0005_c-4652_northrop_grumman_orbital_atk_modified_decision_and_order_12-4-18.pdf>.

Boeing's proprietary data with other parts of the Northrop Grumman corporation in order to gain leverage over its competitor in other projects.[43]

However, according to Boeing's CEO, Leanne Caret, Northrop Grumman only signed this firewall agreement on 3 July 2019—over a year after the FTC's ruling and only five months away from the RFP submission deadline for the EMD contract—apparently not leaving enough time for Boeing to negotiate a competitive price for solid rocket motors.[44]

Only a few days later, Boeing officially announced that it would withdraw from the GBSD competition, stating that "the current acquisition approach does not provide a level playing field for fair competition."[45] In a series of letters addressed to Air Force acquisition executive Will Roper, Caret wrote, "We lack confidence in the fairness of any procurement that does not correct this basic imbalance between competitors," explicitly citing Northrop Grumman's acquisition of Orbital ATK as evidence that there were "inherently unfair cost, resource and integration advantages" at play.[46]

Reflecting on the GBSD procurement process, House Armed Services Committee chairman Adam Smith—who has a sizable Boeing presence in his home state of Washington—suggested in October 2019 that the Air Force is "way too close to the contractors they are working with," and implied that the service was biased towards Northrop Grumman.[47] He additionally revealed that the Air Force had accidentally shared Boeing's proprietary information with Northrop Grumman, contrary to the spirit of the FTC ruling.[48] However, Boeing CEO Leanne Caret subsequently stated that the leak was not "the sole reason for why we did not bid. It was more to do with the structure of the source selection…"[49]

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[43] Ibid, pp. 7-8.

[44] Valerie Insinna, "Boeing drops from next-generation ICBM competition," *Defense News* (25 July 2019), accessed 26 July 2019, <https://www.defensenews.com/space/2019/07/25/boeing-drops-from-next-generation-icbm-competition/>.

[45] Ibid.

[46] Valerie Insinna, "With Boeing no-bid, Northrop is the likely maker of US Air Force's next-generation ICBMs," *Defense News* (13 December 2019), accessed 13 December 2019, <https://www.defensenews.com/air/2019/12/13/with-boeing-no-bid-northrop-is-the-likely-maker-of-the-air-forces-next-generation-icbms/>.

[47] Joe Gould, "House Armed Services chairman takes aim at Air Force's handling of ICBM replacement program," *Defense News* (24 October 2019), accessed 24 October 2019, <https://www.defensenews.com/congress/2019/10/24/hasc-chair-takes-aim-at-air-forces-handling-of-icbm-replacement-program/>.

[48] Ibid.

[49] Valerie Insinna, "US Air Force leak of Boeing's proprietary info not driving bid decision on ICBM replacement," *Defense News* (17 November 2019), accessed 18 November 2019, <https://www.defensenews.com/digital-show-dailies/dubai-air-show/2019/11/17/air-force-leak-of-proprietary-info-not-driving-boeings-no-bid-decision-on-gbsd/>.

While it is certainly possible that bias was at play, further scrutiny reveals that Boeing may not have used all of the tools in its arsenal to launch a fully competitive bid. Firstly, it appears that Boeing never reached out to Aerojet Rocketdyne—the other contractor capable of providing solid rocket motors for the GBSD—for pricing on its SRMs. This is despite the fact that Aerojet Rocketdyne was reportedly "eager" to participate in the GBSD program, and was ultimately included in Northrop Grumman's bid.[50] Additionally, Chairman Smith revealed that the House Armed Services Committee had offered to address Boeing's anti-competitiveness concerns in the 2020 National Defense Authorization Act, but Boeing—somewhat bizarrely—declined.[51]

It is difficult to reconcile these actions—or lack of actions—with Boeing's rhetoric. As a result, one analyst has speculated that given Boeing's highly disappointing fiscal quarter—characterized by two fatal 737 Max crashes and the subsequent grounding of the aircraft—it is possible that Boeing simply did not want to risk losing an expensive and unlikely bid, which would drive shareholder confidence down even further.[52] Therefore, one might suppose that Boeing may have simply pursued the least risky option: attempting to insert themselves into the bid through government intervention, as is detailed in the following paragraphs, and when that ultimately failed, simply declining to bid altogether.

Despite its stated intention to not bid for the EMD contract, for the next several months Boeing attempted to court Northrop Grumman into partnering with Boeing to form a "best-of-industry GBSD team."[53] When Northrop Grumman rejected the offer on September 3rd, Boeing lobbied both Congress and the Air Force, requesting the Pentagon to force Northrop Grumman into submitting a joint bid with Boeing.[54] Citing the potential creation of over 1,000 jobs in Huntsville, Alabama, Boeing successfully convinced Alabama Senator Doug Jones to publicly

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[50] M. Thomas Davis, "Boeing's withdrawal from the Ground Based Strategic Deterrent program must not cause delays," *Defense News* (22 September 2019), accessed 23 September 2019, <https://www.defensenews.com/opinion/commentary/2019/09/22/boeings-withdrawal-from-the-ground-based-strategic-deterrent-program-must-not-cause-delays/>.

[51] Gould, "House Armed Services chairman takes aim at Air Force's handling of ICBM replacement program," *Defense News* (24 October 2019).

[52] Davis, "Boeing's withdrawal from the Ground Based Strategic Deterrent program must not cause delays," *Defense News* (22 September 2019.

[53] Aaron Mehta, "Northrop denies Boeing's request to join ICBM replacement team," *Defense News* (13 September 2019), accessed 13 September 2019, <https://www.defensenews.com/smr/nuclear-arsenal/2019/09/13/northrop-says-no-to-boeing-joining-icbm-replacement-program/>.

[54] Aaron Mehta, "Boeing wants government to force Northrop to partner on ICBM replacement," *Defense News* (17 September 2019), accessed 18 September 2019, <https://www.defensenews.com/digital-show-dailies/air-force-association/2019/09/17/boeing-calls-for-government-intervention-on-icbm-replacement-fight/>; John A. Tirpak, "Boeing Rebuffed in Bid to Partner with Northrop Grumman on New ICBM," *Air Force Magazine* (13 September 2019), accessed 24 September 2019, <https://www.airforcemag.com/Boeing-Rebuffed-in-Bid-to-Partner-with-Northrop-Grumman-on-New-ICBM/>.

voice his support for a joint bid.[55] The former commander and deputy commander of Air Force Global Strike Command, both of whom had been hired as Boeing consultants, also penned a November 2019 op-ed in Breaking Defense to argue in favor of a joint team.[56] However, Boeing's overall lobbying effort was unsuccessful—possibly due to counter-lobbying by Northrop Grumman and Lockheed Martin, which was folded into Northrop's contract team after its departure from the competition in 2017.[57] The Air Force declined to force Northrop Grumman into a joint bid, and effectively cancelled the remainder of Boeing's TMRR contract by refusing to allocate any further funding to the contract in October 2019.[58]

On December 13th, the RFP deadline passed with the Air Force receiving only a single bid for the GBSD's engineering and manufacturing development contract, and on 8 September 2020, the Air Force officially awarded the $13.3 billion EMD contract to Northrop Grumman.[59]

Putting aside the fact that this sole-source contract will likely drive up the total costs of the GBSD program—a consideration which will be explored in more depth later in this chapter—it is clear that the Air Force made no attempt to mitigate the risks of a LSRM monopoly by requiring Northrop Grumman to solicit its solid rocket motors from both Aerojet Rocketdyne and Orbital ATK (since renamed to Northrop Grumman Innovation Systems). The Air Force *had* done this for the previous stage of the GBSD acquisition process—the Technology Maturation and Risk Reduction phase—by putting in "non-exclusion language that the prime contractors cannot set up any binding contracts or relationships with key subcontractors that keep them from being able

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[55] Mary Sell, "For Pentagon mega contract, Boeing proposes partnership with Northrop Grumman, jobs in Huntsville," *Alabama Daily News* (12 September 2019), accessed 24 September 2019, <https://www.aldailynews.com/for-pentagon-mega-contract-boeing-proposes-partnership-with-northrup-grumman-jobs-in-huntsville/>.

[56] Robin Rand and Michael Fortney, "Boeing Revives Push For GBSD Team With Northrop," *Breaking Defense* (1 November 2019), accessed 29 October 2020, <https://breakingdefense.com/2019/11/boeing-revives-push-for-gbsd-team-with-northrop/>.

[57] Aaron Mehta, "Northrop teams with Lockheed on ICBM replacement. Here's who else is involved.," *Defense News* (16 September 2019), accessed 16 September 2019, <https://www.defensenews.com/digital-show-dailies/afa-air-space/2019/09/16/northrop-teams-with-lockheed-on-icbm-replacement-heres-who-else-is-involved/>; Mehta, "Boeing wants government to force Northrop to partner on ICBM replacement," *Defense News* (17 September 2019).

[58] Valerie Insinna, "Boeing could be out of the Air Force's competition for next-gen ICBMs for good," *Defense News* (21 October 2019), accessed 22 October 2019, <https://www.defensenews.com/smr/nuclear-arsenal/2019/10/22/boeing-could-be-out-of-the-air-forces-competition-for-next-gen-icbms-for-good/>.

[59] Valerie Insinna, "With Boeing no-bid, Northrop is the likely maker of US Air Force's next-generation ICBMs," *Defense News* (13 December 2019), accessed 14 December 2019, <https://www.defensenews.com/air/2019/12/13/with-boeing-no-bid-northrop-is-the-likely-maker-of-the-air-forces-next-generation-icbms/>; Robert Burns, "Air Force awards $13.3 billion contract for nuclear missiles," *Washington Post* (8 September 2020), accessed 8 September 2020, <https://www.washingtonpost.com/world/national-security/air-force-awards-133-billion-contract-for-nuclear-missiles/2020/09/08/e0167fb2-f22a-11ea-8025-5d3489768ac8_story.html>.

to team on other efforts."[60] However, this emphasis on mitigating anti-competitive behavior was not prioritized for the significantly larger EMD contract; in June 2019, an Air Force spokesperson reaffirmed the Air Force's hands-off approach, stating that "The prime contractors will determine which LSRM vendor(s) to include as part of the engineering and manufacturing development phase proposals."[61]

Despite the fact that one of the Air Force's key justifications for the GBSD program was to preserve the LSRM industry, it ultimately refused to wield its own power to do exactly that. As a result, the Air Force is now effectively relying on the benevolence of Northrop Grumman to include its own competitor in its GBSD contracting team.

Ultimately, Northrop Grumman *did* elect to include Aerojet Rocketdyne as a producer for both solid rocket motors and post-boost systems for the GBSD; however, it remains unclear how much of the overall LSRM order will be filled by Aerojet, and how much will be filled by the newly-acquired (and newly-renamed) Northrop Grumman Innovation Systems.[62] Even if Northrop Grumman counterintuitively chooses to offer equal opportunity to both companies with this particular contract, the fact remains that Northrop Grumman effectively now holds a near-monopoly over the LSRM industry, which means that the future viability of Aerojet Rocketdyne could rely largely on Northrop's goodwill going forward.

This may soon change, however, as Lockheed Martin announced its intention to purchase Aerojet Rocketdyne for $4.4 billion in December 2020.[63] Raytheon Technologies—one of Lockheed Martin's largest competitors—has since announced its intention to formally oppose the deal on the grounds that if the merger goes through, "you don't have an independent supplier on the solid-rocket-motor side."[64]

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[60] Aaron Mehta, "Labor Costs, Data Questions Driving ICBM Replacement Cost Estimate," *Defense News* (4 November 2016), accessed 10 September 2020, <https://www.defensenews.com/space/2016/11/04/labor-costs-data-questions-driving-icbm-replacement-cost-estimate/>.

[61] Sara Sirota, "DOD will not require use of both LSRM providers for GBSD," *Inside Defense* (4 June 2019), accessed 14 September 2020, <https://insidedefense.com/daily-news/dod-will-not-require-use-both-lsrm-providers-gbsd>.

[62] "Aerojet Rocketdyne Selected to Power Nation's Next Generation Strategic Deterrent," Press Release, *Aerojet Rocketdyne* (8 September 2020), accessed 12 October 2020, <https://www.rocket.com/article/aerojet-rocketdyne-selected-power-nations-next-generation-strategic-deterrent>.

[63] Sandra Erwin, "Lockheed Martin to acquire Aerojet Rocketdyne for $4.4 billion," *Space News* (20 December 2020), accessed 22 February 2021, <https://spacenews.com/lockheed-martin-to-acquire-aerojet-rocketdyne-for-4-4-billion/>.

[64] Joe Gould, "Raytheon to challenge Lockheed's takeover of Aerojet, CEO says," *Defense News* (18 February 2021), accessed 22 February 2021, <https://www.defensenews.com/congress/2021/02/17/raytheon-to-challenge-lockheed-aerojet-merger-ceo-says/>.

However, despite the FTC taking a close look at the acquisition, Lockheed Martin is confident that the deal will be approved, *specifically* because of how it mirrors Northrop Grumman's acquisition of Orbital ATK during the GBSD competition: "There's already an example of how DoD handled a prime contractor in the space domain taking in a propulsion supplier," stated Lockheed Martin CEO Jim Taiclet, "Our overall expectation is that this may be the same lens through which this transaction is viewed."[65]

As a result, not only did Northrop Grumman's acquisition of Orbital ATK undermine the health of the LRSM industrial base, but it provided a template for Lockheed Martin to erode it even further two years later. Therefore, despite the Air Force's argument that pursuing GBSD would help the LRSM industry, it has done the opposite: after Lockheed Martin's acquisition goes through, there effectively will be no more independent LRSM industry.

Is subcomponent commonality feasible—or wise?

Since the early days of GBSD, the Air Force has pursued "smart commonality" between the GBSD and the Navy's Trident D5 SLBMs, with the ultimate goal of reducing costs and risks for both systems.[66] In July 2015, Admiral Cecil Haney—then-commander of US Strategic Command—and the Air Force and Navy's top acquisition executives tasked the two services to conduct a Strategic Systems Commonality Assessment.[67]

Some external analysts have suggested that the most cost-efficient way of pursuing commonality would be to deploy canisterized and life-extended Trident D5 SLBMs in ICBM silos, rather than pursuing a brand-new missile.[68] This would be technologically feasible; the Peacekeeper ICBM was deployed in Minuteman silos in the 1990s, and the Trident canisters have even smaller

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[65] Sandra Erwin, "Lockheed Martin confident Aerojet deal will be approved, but it's not a slam dunk," *Space News* (21 December 2020), accessed 22 February 2021, <https://spacenews.com/lockheed-martin-confident-aerojet-deal-will-be-approved-but-its-not-a-slam-dunk/>.

[66] Gen. Robin Rand, responses to questions submitted for the record, "Subcommittee on Strategic Forces Hearing on Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces," *US House of Representatives*, 114th Congress, 2nd Session (2 March 2016), pp. 4-5, 103; United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent," *Department of Defense* (July 2016), p. 4.

[67] Vice Admiral Terry Benedict, prepared statement, "Subcommittee on Strategic Forces Hearing on Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces," *US House of Representatives*, 114th Congress, 2nd Session (2 March 2016), pp. 80-81; Daniel Wasserbly, "US ICBM replacement to soon emerge, officials seek SLBM commonality," *IHS Jane's Defence Weekly* (23 October 2015), accessed 18 November 2020 via The Internet Archive, <https://web.archive.org/web/20160730053607/www.janes.com/article/55465/us-icbm-replacement-to-soon-emerge-officials-seek-slbm-commonality>.

[68] Jeffrey Lewis, "Nuclear Modernization Under Austerity: Hard but Necessary Choices," *Nuclear Threat Initiative* (25 May 2017), accessed 18 November 2020, <https://www.nti.org/analysis/articles/nuclear-modernization-under-austerity-hard-necessary-choices/>; Steve Fetter and Kingston Reif, "A Cheaper Nuclear Sponge," *War On The Rocks* (18 October 2019), accessed 19 October 2019, <https://warontherocks.com/2019/10/a-cheaper-nuclear-sponge/>.

diameters than Peacekeeper canisters.[69] Furthermore, as Steve Fetter and Kingston Reif suggest, "deploying Trident D5 on land would allow for the consideration of a common replacement for both missiles beginning roughly a decade from now when the Navy is planning to start development of a new submarine-launched ballistic missile, thereby obviating the need for the ground-based strategic deterrent program."[70] Although it would require the Pentagon to purchase additional life-extended Trident D5 SLBMs to fill the Minuteman silos, the overall costs of pursuing this approach would likely be significantly less than buying a brand-new missile.

However, the possibility of utilizing a standard common weapon system based on the life-extended Trident D5 SLBM for both the Navy and Air Force was quickly ruled out as "unfeasible," because in order to meet Air Force specifications, "modifications would be needed for payload, performance, survivability, storage and transport, infrastructure, command and control, and production."[71] According to a 2015 Pentagon report to Congress, "[t]his would raise significant technical issues and would substantially increase overall program costs—far outweighing any potential savings from enhanced commonality."[72]

The assessment concluded that the only worthwhile commonality pursuit would be at the subcomponent level, which could create "opportunities to eliminate redundant efforts, leverage economies of scale, and sustain shared critical skills and capabilities needed by securing the industrial base."[73] Nine inter-service working groups suggested that over 40 technologies—including rocket nozzles, radiation-hardened electronics, and guidance system components—

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[69] "Trident II (D5) Missile," Fact Sheet, *US Navy* (15 May 2019), accessed 16 February 2021, <https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2169285/trident-ii-d5-missile/>; "LGM-118A Peacekeeper," *Federation of American Scientists* (15 August 2000), accessed 16 February 2021, <https://fas.org/nuke/guide/usa/icbm/lgm-118.htm>.

[70] Fetter and Reif, "A Cheaper Nuclear Sponge," *War On The Rocks* (18 October 2019).

[71] Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Report to Congress on Strategic Missile Commonality," *Department of Defense* (December 2015), p. 3, accessed via Freedom of Information Act request 21-F-0228 on 3 February 2021; Vice Admiral Terry Benedict, "Subcommittee on Strategic Forces Hearing on Nuclear Forces and Atomic Energy Defense Activities Fiscal Year 2018 Priorities," *US House of Representatives*, 115th Congress, 1st Session (25 May 2017), <https://dod.defense.gov/Portals/1/features/2017/0917_nuclear-deterrence/docs/Transcript-HASC-Subcommittee-Hearing-on-Nuclear-Forces-25-May-2017.pdf>.

[72] Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Report to Congress on Strategic Missile Commonality," *Department of Defense* (December 2015), pp. 3-4.

[73] Vice Admiral Terry Benedict, prepared statement, "Subcommittee on Strategic Forces Hearing on Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces," *US House of Representatives*, 114th Congress, 2nd Session (2 March 2016), pp. 80-81.

could potentially be shared between the GBSD and Trident D5 SLBM, and this information was passed onto the GBSD bidding companies as they drafted their TMRR proposals.[74]

It appears, however, that the Pentagon's early emphasis on commonality has since been deprioritized, as Air Force leadership declined to enforce the approach in its acquisition strategy—preferring instead to allow competition to drive the process. As then-Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall explained in October 2016, "Where [the bidding companies] have a case for [commonality], they'll propose it, but where there is a case to do something new that might be less expensive or even more capable, then they can propose that."[75] This sentiment was echoed by General Robin Rand, then-Commander of Air Force Global Strike Command General, in May 2017, when he testified to the House Armed Services Subcommittee on Strategic Forces that "we're very supportive of commonality but we believe in open competition and that's where the acquisition strategy is driving us right now."[76] This commitment to competition over commonality prompted Vice Admiral Terry Benedict, then-Director of the Navy's Strategic Systems Program, to note during a 2016 Air Force Association event that "I do have concerns for where the overall commonality effort is going."[77] Only months earlier, Vice Admiral Benedict had testified to the House Armed Services Subcommittee on Strategic Forces, "I am concerned that without proactive leadership involvement, we will miss the opportunity to take advantage of the team's effort as we transition to execution."[78]

It is additionally unclear whether there is much material benefit that could be derived from an emphasis on subcomponent commonality in the first place, if the possibility of a common missile program had already been dismissed. The cost savings would likely be minimal; one external analyst projects that this approach would save less than one percent of the anticipated GBSD

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[74] Sydney R. Freedberg, Jr., "Nuke Missile Collaboration Now Up To Air Force: Navy VADM Benedict," *Breaking Defense* (24 June 2016), accessed 12 November 2020, <https://breakingdefense.com/2016/06/nuke-missile-collaboration-now-up-to-air-force-navy-vadm-benedict/>; Vice Admiral Terry Benedict, "Subcommittee on Strategic Forces Hearing on Nuclear Forces and Atomic Energy Defense Activities Fiscal Year 2018 Priorities," *US House of Representatives* (25 May 2017).

[75] Mehta, "Labor Costs, Data Questions Driving ICBM Replacement Cost Estimate," *Defense News* (4 November 2016); This position has since been renamed to Under Secretary of Defense for Acquisition and Sustainment.

[76] Gen. Robin Rand, "Subcommittee on Strategic Forces Hearing on Nuclear Forces and Atomic Energy Defense Activities Fiscal Year 2018 Priorities," *US House of Representatives*, 115th Congress, 1st Session (25 May 2017), <https://dod.defense.gov/Portals/1/features/2017/0917_nuclear-deterrence/docs/Transcript-HASC-Subcommittee-Hearing-on-Nuclear-Forces-25-May-2017.pdf>.

[77] Vice Admiral Terry Benedict, "The Navy's Contribution to Nuclear Deterrence," prepared remarks, *Air Force Association, Reserve Officers Association, and National Defense Industrial Association,* Capitol Hill Club, Washington, DC (24 June 2016), <https://www.defensedaily.com/wp-content/uploads/post_attachment/145970.pdf>.

[78] Vice Admiral Terry Benedict, prepared statement, "Subcommittee on Strategic Forces Hearing on Fiscal Year 2017 Budget Request for Department of Defense Nuclear Forces," *US House of Representatives*, 114th Congress, 2nd Session (2 March 2016), pp. 7-8.

cost. At the same time, he notes, "commonality-driven programs have often led to cost overruns, schedule slips, and cancellations—the exact outcomes the Department of Defense is seeking to avoid when time and money are running short."[79]

Although the FY2021 President's Budget Request notes that an objective of the Engineering and Manufacturing Development phase of GBSD is to "pursue 'smart commonality' with Navy, Space, and Missile Defense Agency," it is not a program requirement.[80] To that end, it remains unclear to what degree Northrop Grumman will ultimately incorporate "smart commonality" into its GBSD design—if at all. It appears, therefore, that the emphasis on commonality in the Air Force's early justification for GBSD is no longer as strong as it once was.

Is GBSD cheaper than life-extending the Minuteman III?

During the Analysis of Alternatives process, the Air Force's Cost Analysis Working Groups concluded that building an entirely new ICBM system from scratch would cost roughly the same amount as simply life-extending the current Minuteman force. In fact, somewhat counterintuitively, the GBSD was slightly *lower*: $160.3 billion projected for a Minuteman life-extension versus $159.2 billion for the GBSD.[81]

Base Year 2014 ($B)	MMIII LE	GBSD Solution
TOTAL	**$160.3**	**$159.2**
Development	$29.6	$31.0
Procurement	$63.3	$61.1
Operations/Maintenance	$32.6	$32.5
MILPERS	$30.4	$30.3
Disposal	$3.6	$3.5
MILCON	$0.8	$0.8

Source: United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," Department of Defense (July 2016), p. 7.

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[79] M. Thomas Davis, "Why a Common Nuclear Missile Design is Poor Acquisition Strategy," *Defense News* (23 August 2016), accessed 15 November 2020, <https://www.defensenews.com/smr/space-missile-defense/2016/08/24/why-a-common-nuclear-missile-design-is-poor-acquisition-strategy/>.

[80] Department of Defense, "RDT&E Budget Item Justification: PE 0605230F / Ground Based Strategic Deterrent," *Department of the Air Force* (February 2020), Vol. 2–273, accessed 18 November 2020, <https://www.saffm.hq.af.mil/Portals/84/documents/FY21/RDTE_/FY21%20Air%20Force%20Research%20Development%20Test%20and%20Evaluation%20Vol%20II.pdf?ver=2020-02-12-145218-377>.

[81] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent," *Department of Defense* (July 2016), p. 7.

However, that same year, a 2014 RAND report commissioned by the Air Force concluded that "[a]ny new ICBM alternative will very likely cost almost two times—and perhaps even three times—more than incremental modernization of the current Minuteman III system."[82] On the surface, this calculation appears to be more accurate, especially when considering that throughout the 2000s, the Air Force admitted that it cost only $7 billion to turn the Minuteman III ICBMs into "basically new missiles except for the shell."[83]

With that in mind, how did the Air Force's Cost Analysis Working Group yield such misleading results? A 2016 report to Congress reveals that the Air Force baked a number of flawed assumptions into its cost assessment process, the most influential of which was the presumed "60-year life cycle of the candidate solution."[84] This is because the Air Force was working with a predetermined requirement to maintain current ICBM force levels until 2075.[85] However, as the Carnegie Endowment for International Peace's George Perkovich and Pranay Vaddi explained in a January 2021 report, "Basing analysis on a straight-line requirement projected all the way to 2075 practically predetermines the outcome."[86] The authors further suggest that "[t]here is no inalterable security imperative behind the number 400 and the year 2075," and reference a 2013 inter-agency review—which included the participation of the State Department, the Defense Department, the National Security Council, the intelligence community, the Joint Chiefs of Staff, US Strategic Command, and then-Vice President Joe Biden's office—which concluded that US deterrence requirements could be met by reducing US nuclear forces by up to one-third.[87]

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[82] Lauren Caston, Robert S. Leonard, Christopher A. Mouton, Chad J.R. Ohlandt, Craig Moore, Raymond E. Conley, and Glenn Buchan, "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Corporation* (2014), MG-1210-AF, pp. 116-117, <https://www.rand.org/pubs/monographs/MG1210.html>.

[83] Carla Pampe, "Life Extension Programs Modernize ICBMs," *Air Force Global Strike Command* (25 October 2012), accessed 12 February 2021, <https://www.af.mil/News/Article-Display/Article/110241/life-extension-programs-modernize-icbms/>.

[84] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," Department of Defense (July 2016), p. 6.

[85] It is worth noting that the Air Force's Analysis of Alternatives also assumed that force levels would remain constant at 450 deployed ICBMs. Since then, the ICBM force has been reduced to 400 deployed ICBMs; United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," Department of Defense (July 2016), p. 6; Todd Harrison, "Options for Ground-Based Leg of the Nuclear Triad," *Center for Strategic & International Studies* (September 2017), p. 19. <https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170921_Harrison_OptionsGroundBasedLegNuclearTriad.pdf?_q2TQEeJsoYEGK0hBv.6Nm6kHAiWq2nx>.

[86] George Perkovich and Pranay Vaddi, "Proportionate Deterrence: A Model Nuclear Posture Review," *Carnegie Endowment for International Peace* (21 February 2021), p. 100, <https://carnegieendowment.org/files/Perkovich_Vaddi_NPR_full1.pdf>.

[87] Office of the Press Secretary, "Fact Sheet: Nuclear Weapons Employment Strategy of the United States," The White House (19 June 2013), <https://obamawhitehouse.archives.gov/the-press-office/2013/06/19/fact-sheet-nuclear-weapons-employment-strategy-united-states>.

ICBM force posture is not—and has never been—sacred. When the Bush administration deactivated the "Odd Squad" at Malmstrom Air Force Base in the mid-2000s, for example—bringing the ICBM force down from 500 to 450—the main driver was economics, not security: the 564th Missile Squadron used completely different and more expensive communications and launch control systems from the rest of the Minuteman III force.[88] In a similar vein, when the Obama administration made an effort to reduce the deployed ICBM force below 450—and then ultimately down to 400—it was Congress, not the Pentagon, that stood in their way.[89]

The current force level of 400 deployed ICBMs is not a magic number, and it could be reduced further between now and 2075 for a variety of reasons, including those related to security, economics, or—as Perkovich and Vaddi suggest—a good faith effort to reduce deployed US nuclear forces. "This assumption that the ICBM force would not be eliminated or reduced before 2075 is difficult to reconcile with U.S. disarmament obligations under Article VI of the Nuclear Non-Proliferation Treaty," they write, further noting that "[i]t makes little sense to invest in a new generation of over 400 ICBMs without exhausting the possibility that arms reduction agreements could be reached over the next decade or two that would obviate the perceived need for ICBMs through 2075."[90]

As Perkovich and Vaddi suggest, "[a] more appropriate study would consider how long and at what cost Minuteman III could be extended under several scenarios."[91] As will be explored in more depth in the following chapter, it is technologically feasible to extend the life of the Minuteman III ICBM force at current force levels until at least 2040, and possibly beyond. The Center for Strategic and International Studies' Todd Harrison has suggested that Minuteman III could even be safely life-extended until 2050, if the annual testing rate was lowered to three tests per year instead of the current 4.5.[92] However, because the Air Force's AoA requirement was to

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[88] David N. Spires, *On Alert: An Operational History of the United States Intercontinental Ballistic Missile Program, 1945-2011*, 2nd ed. (Barksdale Air Force Base, Louisiana: Air Force Global Strike Command, 2019), pp. 185: "Unlike the nine Minuteman III WS 133A-M squadrons, which deployed Boeing-manufactured communications systems, the 564th possessed the General Electric WS-133B system. The Boeing command and control systems relied on a redundant matrix of hardened, underground cables interconnecting the launch sites and launch control centers. The General Electric configuration, on the other hand, used a single-strand network of hardened, buried cables with a medium-frequency radio to provide command and control and system monitoring. The two communications systems also required their own unique training programs for maintenance personnel and launch crews as well as a separate logistics supply chain."

[89] See Chapter IV for further consideration of Congress' role in preventing alterations to ICBM force posture.

[90] Perkovich and Vaddi, "Proportionate Deterrence," *Carnegie Endowment for International Peace* (21 February 2021), pp. 100-103.

[91] Ibid, p. 100.

[92] Harrison, "Options for Ground-Based Leg of the Nuclear Triad," *Center for Strategic & International Studies* (September 2017), p. 9.

maintain current ICBM force levels until 2075, the Cost Analysis Working Group ultimately concluded that a life-extension option would have to include the cost of life-extension *plus* the cost of building a follow-on missile, in order to push the system over the 2075 finish line.[93] This is the primary reason why the Air Force's cost assessment estimated that the two options would cost roughly the same amount—the service was not simply comparing the costs of a life-extension and a brand-new system; instead, they were effectively comparing the costs of building a brand-new system *earlier* versus building one *later*. In this way, the outcome favoring GBSD was largely predetermined by arbitrary force requirements and timelines that have little 21st century strategic rationale.

To further illustrate this point, consider how the cost comparison between a Minuteman III life-extension and the brand-new GBSD would have changed if the Pentagon had selected a timeline of 2050—or even 2100—instead of 2075.

If the Pentagon sought to compare the relative costs between these two options with the intent of retaining an ICBM capability until 2050, the results would look quite different. The price tag to acquire GBSD—estimated by CAPE to be approximately $95.8 billion (in Then-Year dollars)—would remain the same; however, pursuing a Minuteman III life-extension until 2050 would cost *significantly* less. Recall that in 2012, after the completion of a comprehensive round of Minuteman III life-extension programs, the Air Force admitted that it cost only $7 billion to turn the Minuteman III ICBMs into "basically new missiles except for the shell."[94] There is little public evidence to suggest that a similar round of life-extension programs would cost that much more, and they would likely come nowhere close to the GBSD's $95.8 billion acquisition fee.[95]

Comparing the same options with the requirement to maintain the ICBM force until 2100 also favors a Minuteman III life-extension. The Air Force's 2075 cost assessment for the GBSD already includes the cost of a life-extension program; therefore, to meet the 2100 requirement it is likely that the Air Force would have to pursue a follow-on system to replace the GBSD before 2100, at similarly exorbitant costs. In contrast, life-extending Minuteman III until 2050 and *then* deploying GBSD would allow the Air Force to deploy ICBMs at current force levels through 2100 *without* acquiring a follow-on system for the GBSD.

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[93] Ibid, p. 19.

[94] Pampe, "Life Extension Programs Modernize ICBMs," *Air Force Global Strike Command* (25 October 2012).

[95] Despite his stated preference for the GBSD, one GBSD advocate acknowledges that "replacements for some critical Minuteman III components" would cost roughly between $6 billion and $8 billion. For more, see Dave Deptula, "Five Persistent Misconceptions About Modernizing The U.S. ICBM Force," *Forbes* (22 December 2020), accessed 23 December 2020, <https://www.forbes.com/sites/davedeptula/2020/12/22/five-persistent-misconceptions-about-modernizing-the-us-icbm-force/?sh=294c4e1f3ba7>.

These hypothetical scenarios suggest that if the Pentagon changed its requirement from 2075 to either 2050 or 2100, then immediately pursuing a Minuteman III life-extension program would be significantly more cost-effective than pursuing GBSD. Given that 2075 is a relatively arbitrary timeframe and is not codified in the Nuclear Posture Review or other key strategic documents, it is reasonable to suggest that this particular benchmark was selected in order to ensure a favorable outcome for GBSD.

Another assumption that contributed to the Air Force's cost discrepancies was that a competitive and healthy industrial base would be available to keep the overall price tag down. As Gen. Timothy Ray, Commander of Air Force Global Strike Command, told reporters in 2019, "our estimates are in the billions of savings over the lifespan of the weapon."[96]

This was the logic that Boeing ultimately employed during its unsuccessful attempt to convince the Air Force to force a "best-of-industry" GBSD partnership in 2019. According to Yellowhammer News, "Boeing reportedly explained to the Air Force the significant time and cost savings a team approach between the two companies could result in on the project, cutting the implementation schedule by approximately two years and reducing initial development costs by about 10%."[97]

Boeing's claims are self-serving, and therefore must obviously be taken with a grain of salt; however, it is generally true that the presence of competing bids ultimately lowers the overall program cost. This is why the Air Force is required to submit a "Justification and Approval" document if it intends to limit the scope of a procurement competition. In March 2018, the Air Force Nuclear Weapons Center submitted such a document in order to justify its intention to limit the EMD bidding process to just two contractors—Boeing and Northrop Grumman—stating that it was fine to do so because "typically, expected cost savings from a competition come from a competition premium—the cost savings which come from competing a contract rather than soliciting a single supplier. In this case, the [Air Force] expects to obtain a competition premium despite the exclusion of sources, because the selection will be a competition between the two TMRR offerors *[sic]*."[98]

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[96] Valerie Insinna, "Air Force's next-gen ICBM program takes another step forward," *Defense News* (17 July 2019), accessed 18 October 2020, <https://www.defensenews.com/2019/07/17/air-forces-next-gen-icbm-program-takes-another-step-foward/>.

[97] Sean Ross, "Boeing 'increasingly concerned' about ICBM replacement program; Alabama jobs at stake," *Yellowhammer News* (16 September 2019), accessed 19 October 2020, <https://yellowhammernews.com/boeing-increasingly-concerned-about-icbm-replacement-program-alabama-jobs-at-stake/>.

[98] "Justification and Approval (J&A) for Other Than Full and Open Competition," GBSD program document approved by William B. Roper, Jr., Assistant Secretary of the Air Force for Acquisition, Technology & Logistics (26 February 2019), p. 5.

In other words, the Air Force could limit the number of EMD bidders and the program costs would still stay down—because Boeing and Northrop Grumman would still be competing against each other for the contract. However, that competition premium was ultimately lost when Boeing declined to bid. There is no precedent for sole-sourcing a contract of this size—one of the largest Pentagon contracts in a generation—as doing so generally results in increased costs and lasting harm to the country's underlying industrial base.

It is therefore unsurprising to see that GBSD program costs have already risen substantially under the sole-source contract. In August 2020, only two weeks before the Air Force officially awarded Northrop Grumman the EMD contract—and approximately a year after Boeing announced its withdrawal from the competition—CAPE's projected GBSD acquisition cost jumped from its previous estimate of $85 billion to $95.8 billion, with total life-cycle costs reaching as high as $263.9 billion.[99] In October 2020, the Pentagon reported that CAPE's latest life-cycle estimate was $1.9 billion greater than its 2016 estimate, but did not explain why the estimate had grown.[100] The GBSD's ever-increasing price tag indicates that the program is not nearly as cost-effective as initially projected.

Overall, the Air Force's consequential recommendation to pursue a brand-new missile was based upon a series of flawed assumptions about how GBSD would address perceived capability gaps, maintain the health of the large solid rocket motor industrial base, share commonality with the Navy's missiles, and—most importantly—be cheaper than the cost of a Minuteman life-extension. In hindsight, and upon further scrutiny, these assumptions appear to have either been flawed, exaggerated, or deprioritized—meaning that the Air Force's case for GBSD needs to be reevaluated in light of cost escalation and surrounding budget pressures. This is especially true given that a Minuteman III life-extension program remains a cheaper and less risky option—this will be discussed in depth in the following chapter.

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[99] Under Secretary of Defense for Acquisition and Sustainment, "(U) Ground Based Strategic Deterrent Milestone B Summary: Report to Congress," *Department of Defense* (September 2020), p. 5, accessed via Freedom of Information Act request 21-F-0065 on 24 November 2020.

[100] Anthony Capaccio, "New U.S. ICBMs Could Cost Up To $264 Billion Over Decades," Bloomberg, 3 October 2020, accessed 3 October 2020, <https://www.bloomberg.com/news/articles/2020-10-03/new-u-s-icbms-could-cost-up-to-264-billion-over-decades>.

VII. EXPLORING POSSIBILITIES FOR A MINUTEMAN III LIFE-EXTENSION

After the first round of life-extension programs in the mid-2000s, Air Force analysts described their 50-year old Minuteman III ICBMs as "basically new missiles except for the shell."[1] Despite this characterization, it has since become relatively common to hear a contradictory refrain that the missiles cannot be life-extended any further, because they are simply too old.[2]

The latter is often presented by GBSD advocates as justification for a complete replacement of the ICBM force; indeed, in a 2016 report to Congress, the Air Force noted that given the imminent "age-out" of the Minuteman III's booster stacks and guidance modules, "the GBSD solution ensures the land-based leg of the Triad remains viable in the post-MMIII 2030 timeframe."[3]

However, it is an exaggeration to suggest that the ICBM force could become "unviable" after 2030 if GBSD were not pursued, in several key respects:

First, the 2030 benchmark appears to have been selected by Congress, not by the Air Force. A consequential amendment inserted into the FY2007 National Defense Authorization Act directed the Secretary of the Air Force to "modernize Minuteman III intercontinental ballistic missiles in the United States inventory as required to maintain a sufficient supply of launch test assets and spares to sustain the deployed force of such missiles through 2030."[4] This amendment ultimately had a significant impact on the timeline of the Ground-Based Strategic Deterrent because, as Air Force historian David N. Spires describes, "Although Air Force leaders had asserted that incremental upgrades, as prescribed in the analysis of land-based strategic deterrent alternatives,

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[1] Carla Pampe, "Life Extension Programs Modernize ICBMs," *Air Force Global Strike Command* (25 October 2012), accessed 12 February 2021, <https://www.af.mil/News/Article-Display/Article/110241/life-extension-programs-modernize-icbms/>.

[2] Valeria Insinna, "US Strategic Command chief defends ICBM replacement program," *Defense News* (6 January 2021), accessed 7 January 2021, <https://www.defensenews.com/air/2021/01/06/us-strategic-command-head-defends-icbm-replacement-program/>.

[3] United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent: Report to Congress," *Department of Defense* (July 2016), pp. 5-6.

[4] Public Law 109-364: John Warner National Defense Authorization Act for Fiscal Year 2007," H.R. 5122 (17 October 2006), 120 Stat. 2114, <https://www.congress.gov/109/plaws/publ364/PLAW-109publ364.pdf>.

could extend the Minuteman's life span to 2040, the congressionally mandated target year of 2030 became the new standard."[5]

Second, the Minuteman III's critical subsystems continue to show high reliability with age. Under the Pentagon's Rocket Systems Launch Program (RSLP), surplus ICBM motors are converted into space launch vehicles, sounding rockets, and suborbital missile defense target vehicles. Since the program's inception in 1972, most of the converted rockets have utilized surplus motors from the Minuteman II, which shares its first and second stages with the Minuteman III. Despite the Minuteman II's thirty-year service life and subsequent retirement, in 2011 RSLP administrators declared with "high confidence that the Minuteman II motors continue to provide a reliable boost capability." They additionally suggested that the "motors are currently well beyond design life but continue to show high reliability," noting that it was more prudent to focus on "useful life estimates" as a measure of their utility and reliability, rather than their shorter, predetermined service lifespans.[6]

To date, first-stage Minuteman II motors between 27 and 54 years of age have performed successfully in all 27 RSLP test launches, as well as 23 static tests. Second-stage Minuteman II motors older than 17 years have achieved success in 60 out of 61 test launches, as well as 26 static tests.[7] In 2017, the Air Force reported an inventory of 537 remaining Minuteman II motors, and the Government Accountability Office subsequently assessed that it would take between nine and ten years to completely deplete Minuteman II stockpile through scheduled decommissioning and conversion through the RSLP program.[8] Under this proposed schedule, the total "useful life" of Minuteman II solid rocket motors could amount to approximately 60 years.

Additionally, there is little evidence to suggest that the Minuteman III's guidance modules will fail after 2030. When the Air Force sought to upgrade the Minuteman III's guidance systems after the Cold War, the Government Accountability Office noted that the Air Force's own assessments "are not identifying any Minuteman III missile guidance set system-level performance concerns.

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[5] David N. Spires, *On Alert: An Operational History of the United States Intercontinental Ballistic Missile Program, 1945-2011*, 2nd ed. (Barksdale Air Force Base, Louisiana: Air Force Global Strike Command, 2019), pp. 184-185. This 2030 target year has since been extended to 2036, when the transition from Minuteman III to GBSD is expected to be completed; however, this reference demonstrates how the initial timeline for the transition was arbitrarily influenced by Congress—despite the reassurances by Air Force leaders that a longer-term incremental upgrade was possible.

[6] Jim Riley and Randy Wagner, "Keeping Models Current: Aging Surveillance of Solid Rocket Motors," Briefing, *TASC Inc.* (13 September 2011), CEWS-11-LMP-316, accessed 19 October 2020, <https://www.nasa.gov/sites/default/files/585639main_KeepingModelsCurrent.pdf>.

[7] Steve Fetter and Kingston Reif, "A Cheaper Nuclear Sponge," War on the Rocks (18 October 2019), accessed 19 October 2019, <https://warontherocks.com/2019/10/a-cheaper-nuclear-sponge/>; Steve Fetter, personal communication, 11 December 2020.

[8] Cristina T. Chaplain, "Surplus Missile Motors: Sale Price Drives Potential Effects on DOD and Commercial Launch Providers," *Government Accountability Office* (August 2017), GAO-17-609, pp. 36-49, <https://www.gao.gov/assets/690/686613.pdf>.

To the contrary, for the last several years the Minuteman III missile guidance set flight reliability has improved."[9] The study further assessed that "missile guidance set failure rates have remained at an acceptable level, with no adverse failure rate trends," and quoted a previous Air Force study which suggested that "[t]here is no conclusive evidence of degradation within the Minuteman III missile guidance set that cannot be corrected on a case-by-case basis."[10] Despite the evidence suggesting that the Minuteman III's guidance systems continued to perform reliably with age, they were modernized under the Guidance Replacement Program.[11] Today, these newer guidance systems continue to succeed in their regular flight tests, and a March 2020 Air Force Nuclear Weapons Center brief even acknowledged that the useful life of the Minuteman III force could be extended with "better NS-50 [guidance module] failure data," because "current age-out on guidance is an engineering 'best guess' with no current data."[12] This suggests that the Air Force's prediction about the post-2030 "unviability" of these subsystems is based on little actual evidence.

If a life-extension option were pursued in lieu of GBSD, it is likely that these subsystems would eventually need to be replaced. However, this appears to be technologically feasible. In March 2019, Lt. Gen. Richard Clark—the Air Force's deputy chief of staff for strategic deterrence and nuclear integration—testified to the House Armed Services Committee that it would be possible to extend the lives of the propulsion and guidance systems one more time, despite his stated preference for proceeding with the Ground-Based Strategic Deterrent.[13]

Furthermore, a 2014 RAND report commissioned by Air Force Global Strike Command found "no evidence that would necessarily preclude the possibility of long-term sustainment." In fact, the report noted, "we found many who believed the default approach for the future is incremental modernization, that is, updating the sustainability and capability of the

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[9] Steven F. Kuhta et al., "ICBM Modernization: Minuteman III Guidance Replacement Program Has Not Been Adequately Justified," *Government Accountability Office* (June 1993), GAO/NSIAD-93-181, p. 3, <https://www.gao.gov/assets/160/153500.pdf>.

[10] Ibid, pp. 3, 16-17.

[11] Paul G. Kaminski, "Sustaining the U.S. Nuclear Deterrent in the 21st Century," prepared remarks of the Under Secretary of Defense for Acquisition and Strategy, *US Strategic Command Strategic Systems Industrial Symposium*, Offutt Air Force Base, Nebraska (30 August 1995), accessed 25 November 2020, <https://fas.org/nuke/guide/usa/doctrine/dod/di1099.htm>.

[12] Air Force Nuclear Weapons Center, "Integration Support Contract (ISC) 2.0: Industry Day #3," Briefing (16 March 2020), p. 12.

[13] U.S. House Armed Services Subcommittee on Strategic Forces, "Hearing on Fiscal 2020 Budget Request for Defense Nuclear Activities," *United States House of Representatives* (28 March 2019), <https://armedservices.house.gov/hearings?ID=FA8DBDAB-5585-4437-AF88-61FBB1B7D428>, transcript available via US Strategic Command: <https://www.stratcom.mil/Media/Speeches/Article/1800469/house-armed-services-subcommittee-on-strategic-forces-holds-hearing-on-fiscal-2/>.

Minuteman III system as needed and in perpetuity."[14] This echoed the findings of an earlier review conducted by the ICBM System Program Office and TRW Inc. as part of the 2000 Future Ballistic Missile Requirements Study. The study concluded that "[w]hile it is difficult to foresee all possible problems with the [Minuteman III] system, the review concluded that another life extension appears feasible."[15]

In reality, the most significant obstacle to a Minuteman III life-extension is not depreciation, but attrition—specifically, the concern that the available stockpile of Minuteman III test assets will be eventually depleted, thus potentially impacting force posture. This problem was identified early on in the GBSD acquisition process by both internal and external analysts, who noted that increasing the ICBM test rate from three to 4.5 test firings per year—as was done in 2017—would inevitably exhaust the surplus boosters and lead to a depletion of the currently-deployed ICBM force around 2040.[16]

However, there are several ways to overcome this obstacle.

One option involves the Air Force lowering the test rate from 4.5 tests per year back down to three, in an effort to stretch out the available stockpile of boosters. Testing is critical to the technical surveillance process to ensure that the missiles are working as designed; however, if the Air Force was prepared to accept a slight additional risk of booster failure as explained later in this chapter—given the fact that doing so would have no discernible effect on deterrence—then the number of tests per year could realistically be decreased. To that end, in a 2017 report, Todd Harrison from the Center for Strategic and International Studies estimated that if the United States chose to re-core its ICBMs and move the firing rate back to three tests per year, then it would be possible to maintain the Minuteman III force at New START levels (400 deployed ICBMs) until 2050, before the tests begin to cut into the deployed force in the 2050s and the new cores age out in the 2060s.[17]

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[14] Lauren Caston, Robert S. Leonard, Christopher A. Mouton, Chad J.R. Ohlandt, Craig Moore, Raymond E. Conley, and Glenn Buchan, "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Corporation* (2014), MG-1210-AF, p. 84, <https://www.rand.org/pubs/monographs/MG1210.html>.

[15] Maj. Jeff Schaff, Matt Bille, Lamberth Blalock, and Stan Bailey, "Future Ballistic Missile Requirements: A First Look," *Air Force Space Command, Directorate of Requirements*, DTIC ADA386554, p. 5.

[16] Todd Harrison, "Options for Ground-Based Leg of the Nuclear Triad," *Center for Strategic & International Studies* (September 2017), p. 9. <https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170921_Harrison_OptionsGroundBasedLegNuclearTriad.pdf?_q2TQEeJsoYEGK0hBv.6Nm6kHAiWq2nx>; Caston et al., "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Corporation* (2014), p. 85; United States Air Force, "Cost Comparison of Extending the Life of the Minuteman III Intercontinental Ballistic Missile to Replacing it with a Ground-Based Strategic Deterrent," *Department of Defense* (July 2016), p. 5.

[17] Harrison, "Options for Ground-Based Leg of the Nuclear Triad," *Center for Strategic & International Studies* (September 2017), p. 19.

The Pentagon's Proposed Number of GBSD and Minuteman III Flight Tests from VAFB by Fiscal Year									
Test Program	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**
GBSD	0	0	0	4	4	5	6	5	4
Minuteman III	4	5	3	4	4	4	3	3	3
Total Flight Tests	4	5	3	8	8	9	9	8	7
Percent Increase	0%	0%	0%	100%	100%	125%	200%	166%	133%

Source: "Draft Ground Based Strategic Deterrent Test Program Environmental Assessment / Overseas Environmental Assessment," Air Force Nuclear Weapons Center (February 2021), p. 4-65.

Another option involves the Air Force reducing the number of deployed ICBMs. As explored in previous chapters, doing so would not meaningfully affect deterrence, and would suddenly make a significant quantity of additional missiles available for testing purposes. For example, if the Pentagon reduced its deployed ICBM force from 400 to 300 missiles, it could maintain the current testing rate of 4.5 tests per year, and the missile inventory would not drop below 300 until approximately FY2060, assuming every available missile was put towards testing purposes.[18] A portion of those missiles could also be converted into commercial or governmental space launch vehicles, thus eliminating the requirement to eventually "re-core" them to ICBM standards.[19]

It is certainly possible to reduce ICBM force levels without meaningfully affecting strategic stability. In fact, after a 2013 inter-agency review concluded that US deterrence requirements could be met by reducing US nuclear forces by up to one-third, the Pentagon began to explore the possibility of significantly reducing the ICBM force—before ultimately being pressured into backing down by the Senate ICBM Coalition.[20]

A renewed commitment to reducing ICBM force levels, however, could yield several positive effects. First, it could open up fertile new ground for arms control with Russia. Like the United

[18] Ibid, p. 9.

[19] Thanks to Peter Zimmerman for this suggestion; George Perkovich and Pranay Vaddi, "Proportionate Deterrence: A Model Nuclear Posture Review," *Carnegie Endowment for International Peace* (21 February 2021), p. 101, <https://carnegieendowment.org/files/Perkovich_Vaddi_NPR_full1.pdf>.

[20] Office of the Press Secretary, "Fact Sheet: Nuclear Weapons Employment Strategy of the United States," The White House (19 June 2013), <https://obamawhitehouse.archives.gov/the-press-office/2013/06/19/fact-sheet-nuclear-weapons-employment-strategy-united-states>; See Chapter IV for further consideration of Congress' role in preventing alterations to ICBM force posture.

States, Russia cannot afford to modernize all of the systems that it wants.[21] A mutual commitment to substantially reducing each country's ICBM force would allow both countries to reinvest in more important security priorities, and could therefore be an appealing arms control possibility. The United States would have the upper hand in any ICBM-focused arms control negotiations, because Russia has fewer ICBMs than the United States (~310 versus the United States' 400), and significantly fewer overall strategic launchers (510 versus the United States' 675).[22]

Second, reducing the number of deployed ICBMs would also alleviate a significant amount of pressure associated with the GBSD's planned warhead production schedules. The National Nuclear Security Administration (NNSA) is currently planning to produce 80 plutonium pits per year by 2030 in order to meet the ambitious schedule of the W87-1 GBSD warhead. However, as this report explores in more depth in subsequent sections, two separate government-sponsored studies have recently concluded that this schedule is all but impossible, due to a lack of current capacity and the likelihood of both budgetary and scheduling overruns.[23] To that end, significantly reducing the scope of the ICBM deployment would help mitigate these scheduling concerns.

Another option to resolve the attrition problem could involve the Air Force exploring the possibility of utilizing nondestructive methods to test the reliability of their solid rocket motors. George Perkovich and Pranay Vaddi suggest in their recent "Model Nuclear Posture Review" that this could be achieved through technological advances in ultrasound and computed tomography.[24] The Air Force could also consider adapting the Navy's current nondestructive testing techniques—which involve sending a probe into the bore to measure the elasticity of the propellant—to evaluate the reliability of the Minuteman III force.[25] As Steve Fetter and Kingston Reif noted in 2019, these types of nondestructive testing methodologies "would permit the lifetime of each motor to be estimated on an individual basis. Rather than retire all motors at an age when a small percentage are believed to be no longer reliable, only those particular motors

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[21] Hans M. Kristensen and Matt Korda, "Russian nuclear forces, 2020," *Bulletin of the Atomic Scientists* 76:2 (March 2020), pp. 102-117, DOI: 10.1080/00963402.2020.1728985.

[22] Hans M. Kristensen and Matt Korda, "United States nuclear weapons, 2021," *Bulletin of the Atomic Scientists* 77:1 (January 2021), pp. 42-63, DOI: 10.1080/00963402.2020.1859865.

[23] Allison B. Bawden et al., "NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program," *Government Accountability Office* (September 2020), GAO-20-703, p. 5.; David E. Hunter et al., "Independent Assessment of the Two-Site Pit Production Decision: Executive Summary," *Institute for Defense Analyses* (May 2019), NS D-10711, p. 4, <https://www.ida.org/-/media/feature/publications/i/in/independent-assessment-of-the-two-site-pit-production-decision-executive-summary/d-10711.ashx>.

[24] Perkovich and Vaddi, "Proportionate Deterrence," *Carnegie Endowment for International Peace* (21 February 2021), p. 101.

[25] Ibid, pp. 101, 129; Steve Fetter, personal communication, 27 February 2021.

with measurements indicating unacceptable aging could be retired."[26] If the Air Force were to adopt a reliable, nondestructive technique of assessing its missiles, the aforementioned attrition problem would be eliminated altogether.

It is telling that the Navy is not currently contemplating the purchase of a brand-new missile to replace its current arsenal of Trident SLBMs, and instead plans to conduct a second life-extension to keep them in service until 2084.[27] In January 2021, Vice Admiral Johnny Wolfe Jr.—the Navy's Director for Strategic Systems Programs—remarked that "solid rocket motors, the age of those we can extend quite a while, we understand that very well."[28] To demonstrate this fact, in 2015 the Navy conducted a successful Trident SLBM flight test using "the oldest 1st stage solid rocket motor flown to date" (over 26 years old), with 2nd and 3rd stage motors that were 22 years old.[29] Rather than replace these missiles as they exceed the planned design life of 25 years, the Navy stated in 2015 that "we are carefully monitoring the effects of age on our strategic weapons system and continue to perform life extension and maintenance efforts to ensure reliability."[30]

Not only would life-extending the Minuteman III force be technologically feasible through the methods described above, but it would be significantly cheaper than building a brand-new ICBM force. During the first round of life-extension programs in the mid-2000s, the Air Force spent only $7 billion to turn the Minuteman III into "basically new missiles except for the shell."[31] Clearly, life-extension operations are possible—not to mention significantly cheaper than building a new ICBM force from scratch—and the Air Force has a good track record of completing them.

Pursuing a Minuteman III life-extension would also allow the Pentagon to defer a decision on GBSD for up to two decades. This is a highly desirable option, given that the Pentagon is currently facing a "bow wave" of expenditures over the coming decade, with the bills for several big-ticket procurement projects—including the GBSD, the Long-Range Standoff Weapon, the F-35 fighter, the B-21 bomber, the Columbia-class ballistic missile submarine, and the KC-46A tanker—all coming due at roughly the same time. With growing recognition that the Pentagon

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[26] Fetter and Reif, "A Cheaper Nuclear Sponge," *War On The Rocks* (18 October 2019).

[27] Megan Eckstein, "Navy Beginning Tech Study to Extend Trident Nuclear Missile Into the 2080s," *USNI News* (17 November 2019), accessed 20 June 2020, <https://news.usni.org/2019/11/14/navy-beginning-tech-study-to-extend-trident-nuclear-missile-into-the-2080s>.

[28] Vice Admiral Johnny Wolfe, Jr., remarks at the *Mitchell Institute for Aerospace Studies' Nuclear Deterrence Forum* (14 January 2021), accessed 14 January 2021, <https://youtu.be/UWosVAJ_1_o?t=1631>.

[29] Under Secretary of Defense, Acquisition, Technology, and Logistics, "Compendium of Annual Program Manager Assessments for 2015," *Department of Defense* (23 September 2015), p. 90, <https://www.acq.osd.mil/fo/docs/Compendium-PM-Assessments-2015.pdf>.

[30] Ibid, p. 90.

[31] Pampe, "Life Extension Programs Modernize ICBMs," *Air Force Global Strike Command* (25 October 2012).

simply cannot afford all of these programs simultaneously, these major acquisition programs have been characterized as "fiscal time bombs."[32]

As a result, it is important to note the security tradeoffs associated with spending nearly $100 billion to acquire the Ground-Based Strategic Deterrent right now, at the expense of more essential programs. This means that solutions to 21st century security challenges—strengthening pandemic response and relief capabilities, for example, or hardening US command and control systems against cyber threats—could be deprioritized or left unfunded. The Pentagon currently plans to spend $77 billion to modernize its nuclear command, control, and communications systems over the next decade; however, these upgrades could be coupled to a life-extended Minuteman III force rather than a brand-new force, thus freeing up additional funds to either further improve these critical systems or fund more pressing programs.[33]

Life-extending the Minuteman III is therefore a feasible option, in order to ensure that the most critical security priorities are adequately funded over the coming decades. If the United States ultimately chooses to pursue GBSD two decades from now, then the Congressional Budget Office estimates that approximately $42 billion (in 2017 dollars) of the costs of replacing the Minuteman IIIs would be pushed beyond 2046—which would allow for the total costs of nuclear modernization to be spread out over several decades and would reduce the likelihood that the aforementioned "fiscal time bombs" would explode over the coming years.[34]

There is also a possibility, however, that twenty years from now—when a decision about a follow-on ICBM would have to be taken—the national security environment will have changed dramatically, and ICBMs may no longer be deemed strategically important by American political or military leaders. In that case, GBSD could simply be cancelled; the Congressional Budget Office estimates that doing so would save an additional $120 billion (in 2017 dollars).[35]

The role of presidential guidance

A closer examination of the Air Force's Analysis of Alternatives suggests that the service's recommendation to pursue GBSD was based upon a series of flawed assumptions about how the

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[32] Kingston Reif and Mackenzie Eaglen, "The Ticking Nuclear Budget Time Bomb," *War on the Rocks* (25 October 2018), accessed 18 November 2020, <https://warontherocks.com/2018/10/the-ticking-nuclear-budget-time-bomb/>; Sydney J. Freedberg Jr., "Bow Wave Time Bomb: B-21, Ohio Replacement Costs Likely to Grow," *Breaking Defense* (4 August 2016), accessed 18 November 2020, <https://breakingdefense.com/2016/08/bow-wave-time-bomb-b-21-ohio-replacement-costs-likely-to-grow/>.

[33] Congressional Budget Office, "Projected Costs of U.S. Nuclear Forces, 2019 to 2028" (January 2019), p. 2, <https://www.cbo.gov/system/files/2019-01/54914-NuclearForces.pdf>.

[34] Congressional Budget Office, "Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046" (October 2017), p. 30, <https://www.cbo.gov/system/files/115th-congress-2017-2018/reports/53211-nuclearforces.pdf>.

[35] Ibid, p. 41.

new missile would address perceived capability gaps, maintain the health of the large solid rocket motor industrial base, share commonality with the Navy's missiles, and—most importantly—be cheaper than the cost of a Minuteman life-extension.

In hindsight, and upon further scrutiny, all of these assumptions appear to have either been flawed, exaggerated, or since deprioritized.[36] A 2014 RAND report commissioned by the Air Force understood this at the time, and suggested that given the significant cost disparities between a Minuteman life-extension and GBSD, "The only viable argument for developing and fielding an alternative would therefore have to be requirements-driven."[37]

These "requirements" are primarily driven by the military's interpretation of presidential nuclear employment guidance. When the President sets the country's nuclear employment policy, they issue a directive that then gets translated into strategy as it flows down the chain of command. As a former deputy director of the Joint Strategic Target Planning Staff, Admiral Gerald E. Miller, once wrote, "It is in the implementation that the true strategy evolves, regardless of what is generated in the political and policy-meeting rooms of any Administration."[38]

In order to ensure that they can fulfill presidential nuclear employment guidance, the military must ensure that their systems can operate above a certain threshold of reliability. This is why the RAND report alludes to a potential "requirements-driven" reason for pursuing GBSD over Minuteman III: if the Air Force believes that the Minuteman III might dip below a preset reliability threshold, then the service has incentive to push for GBSD in order to meet the current nuclear employment guidance. However, the President can revise nuclear employment guidance to accept a slightly higher threshold for risk, which would allow the Air Force to meet presidential guidance with a life-extended Minuteman III.

By the Air Force's own projections, a 30-year old missile core has an estimated probability of failure of 1.3 percent.[39] Although this failure rate increases exponentially for each additional year, it is still relatively low (under ten percent) until the cores reach 36 years old. Although a hypothetical ten percent failure rate sounds bad on paper, an adversary would realistically still

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[36] See Chapter VI for further discussion on the Air Force's flawed justifications for pursuing the Ground-Based Strategic Deterrent over a Minuteman III life-extension.

[37] Caston et al., "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Corporation* (2014), pp. 116-117.

[38] Gerald E. Miller, "Beres and Others Have No Access to the 'True Strategy,'" *Center Magazine (*November/ December 1982), quoted in Hans M. Kristensen and Robert S. Norris, "Reviewing Nuclear Guidance: Putting Obama's Words Into Action," *Arms Control Today* (November 2011), accessed 24 February 2021, <https://www.armscontrol.org/act/2011_11/Reviewing_Nuclear_Guidance_Putting_Obama_Words_Into_Action>.

[39] Air Force Nuclear Weapons Center Intercontinental Ballistic Missile (ICBM) Systems Directorate, "Minuteman III Propulsion Replacement Program," p. 11; Harrison, "Options for Ground-Based Leg of the Nuclear Triad," *Center for Strategic & International Studies* (September 2017), p. 18.

have to target every silo in a nuclear first strike, because there would be no way of knowing which missiles were functional and which were duds. Additionally, it is extremely unlikely that the United States would ever elect to launch only a small number of ICBMs in a crisis. As a result, a ten percent failure rate inflicted on 400 launched ICBMs would still enable approximately 360 fully-functional missiles to reach their targets. This projected failure rate would drop significantly if the Air Force chose to life-extend the Minuteman III force; however, the above calculations suggest that *even if* a decision to conduct a life-extension project was delayed for a few years, strategic stability would not be meaningfully affected.

If one accepts the role that ICBMs are supposed to play in nuclear deterrence—although those arguments merit scrutiny and are challenged in other chapters of this report—in order to be an "effective" deterrent, ICBMs simply need to exist and be a credible *enough* retaliatory threat that an adversary would not risk a first strike. This means that a life-extended Minuteman III force—which, by the Air Force's own admission, is technologically feasible—would theoretically produce the same deterrence result as a brand-new GBSD force, since an adversary would still be forced to target them in a nuclear crisis.[40] It is additionally important to note—albeit somewhat ominously—if we are ever in a position to find out that a percentage of the missile force did not launch as expected, then this knowledge would not affect deterrence whatsoever, because deterrence would have already failed.

Therefore, when it comes to the ICBM force, it is fair to say that failure rate should not be a significant factor in how either the United States or its adversaries think about ICBMs. These considerations are important, because it implies that presidential nuclear employment guidance could be specifically revised to accept greater technical risk with regards to the ICBM force. This is openly acknowledged in a March 2020 Air Force Nuclear Weapons Center briefing, which states that the useful life of the Minuteman III force could be extended by "assuming additional risk on booster propellant life."[41] Doing this would establish a Minuteman III life-extension as a more cost-effective option to meet these requirements than pursuing a brand-new GBSD force.

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[40] During a March 2019 House Armed Services Subcommittee on Strategic Forces hearing, Lt. Gen. Richard Clark stated: "We have several of the components that are becoming obsolete. The propulsion system, the guidance system, even the ability to provide the solid rocket motor fuel, we only have one more opportunity to do that for these weapons. After that, we have to--will have to buy a new weapon." For more information, see U.S. House Armed Services Subcommittee on Strategic Forces, "Hearing on Fiscal 2020 Budget Request for Defense Nuclear Activities," *United States House of Representatives* (28 March 2019), <https://armedservices.house.gov/hearings?ID=FA8DBDAB-5585-4437-AF88-61FBB1B7D428>, transcript available via US Strategic Command: <https://www.stratcom.mil/Media/Speeches/Article/1800469/house-armed-services-subcommittee-on-strategic-forces-holds-hearing-on-fiscal-2/>.

[41] Air Force Nuclear Weapons Center, "Integration Support Contract (ISC) 2.0: Industry Day #3," Briefing (16 March 2020), p. 12.

Pursuing GBSD is riskier than life-extending Minuteman III

Although it may be politically challenging for decision-makers to consider accepting additional risk in order to life-extend Minuteman III, it is important to recognize that proceeding with GBSD comes with significant risks of its own. Large procurement programs like the GBSD are prone to delays as a matter of course, and this particular program could face inevitable and significant delays, for several reasons.

First, it is worth noting that the vast GBSD modernization program is being administered by Air Force Global Strike Command, which RAND described in a 2019 report as "a relatively young command with a relatively small staff that has limited experience in fielding new systems."[42] Having only reached full operational capability in September 2010, AFGSC has no prior experience fielding a major weapons system—let alone multiple, ambitious, and simultaneous programs like the GBSD, B-21, and the LRSO. As the RAND report notes, "The scale of these acquisition programs is ambitious even for an experienced sponsoring major command. But to further complicate matters, AFGSC is not resourced at the level of more mature commands."[43]

Furthermore, the Air Force has a very limited institutional memory when it comes to acquiring and fielding major nuclear weapons systems; the last time that the service did so was in the 1980s, when it procured the B-2 bomber and the Peacekeeper ICBM. As the RAND report explains, "In the 30-some years that have elapsed since then, much of this workforce, both in the government and in industry, is now long retired. Some of the art of engineering these systems—how to do nuclear certification, how to test for survivability for nuclear weapon effects, and the challenges of training the operators and fielding these systems—is lost."[44] Additionally, "Unfortunately, when these programs were last done, those involved left an incomplete written record of their experiences. Our surveys of the extant records from past major nuclear systems reveal a record that is spotty at assisting the current workforce."[45]

Air Force Global Strike Command has a daunting task ahead of it. As the RAND report describes,

> *It is not just coordinating and ensuring that all the major fielding activities will be done on time; the transition from legacy to new platforms is in itself a large problem. In particular, the transition from Minuteman III to GBSD presents considerable logistical complications. The legacy systems need to be sustained until the day they are decommissioned, and the new systems need to be ready the day they are*

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[42] Don Snyder, Sherrill Lingel, George Nacouzi, Brian Dolan, Jake McKeon, John Speed Meyers, Kurt Klein, Thomas Hamilton, "Managing Nuclear Modernization Challenges for the U.S. Air Force," *Rand Corporation* (2019), RR3178, p. vii, <https://www.rand.org/pubs/research_reports/RR3178.html>.

[43] Ibid, pp. 3-4.

[44] Ibid, p. 3.

[45] Ibid, p. 3.

> *needed. And this transition is not limited to the missiles and warheads, but also encompasses an extensive infrastructure of launch control centers, launch facilities, and weapon system command and control. AFGSC, as the lead major command, will need to confront these matters with a relatively small, inexperienced staff.*[46]

The Pentagon is already concerned about the prospect of delays to the GBSD program. In September 2020, Undersecretary of Defense for Acquisition and Sustainment Ellen Lord testified to Congress that existing bureaucratic red tape could create an "operational risk" with the GBSD program—particularly with regards to upgrading nearly 500 ICBM launch facilities and launch control centers spread across three operational wings, five states and 31,500 square miles.[47] According to the Pentagon, in order for the GBSD to hit the scheduled full operational capability date of 2036, they must convert *one facility per week for nine years*—with no delays.[48] For this reason, an Air Force report to Congress in May 2020 noted "that the GBSD Program carries a 'high-risk' schedule due to challenges imposed by the conventional MILCON process for the required construction and conversion of GBSD-related infrastructure."[49]

The prospect of an under-resourced and inexperienced command like AFGSC meeting internal program schedules like these seems highly improbable, especially given the aforementioned budget constraints and the possibility of a less GBSD-friendly administration.

Additionally, it is important to recognize that the new W87-1 warheads slated for the GBSD are already on an impossible timeline. The NNSA plans to newly manufacture the entire warhead, including both the primary and the secondary, at an estimated cost of $13.4 billion (in Then-Year dollars) between FY2019-FY2037 *not including* the cost of associated pit production—the most expensive warhead modernization program since the end of the Cold War.[50]

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[46] Ibid, pp. 23-24.

[47] Ellen M. Lord, "Senate Armed Services Committee Hearing on Matters Relating to the Budget of the National Nuclear Security Administration," *US Senate*, 116th Congress, 2nd Session (17 September 2020), <https://www.armed-services.senate.gov/hearings/20-09-17-matters-relating-to-the-budget-of-the-national-nuclear-security-administration>.

[48] Aaron Mehta, "DoD seeks legislative help for ICBM replacement construction costs," *Defense News* (25 September 2020), accessed 28 September 2020, <https://www.defensenews.com/smr/nuclear-arsenal/2020/09/25/dod-seeking-legislative-help-for-icbm-replacement-construction-costs/>.

[49] Department of the Air Force, "Report on Development of Ground-Based Strategic Deterrent Weapon," Report to Congressional Committees (May 2020), p. 6.

[50] National Nuclear Security Administration, "Fiscal Year 2021 Stockpile Stewardship and Management Plan – Biennial Plan Summary: Report to Congress," *Department of* Energy (December 2020), pp. 5.32-5.33, <https://www.energy.gov/sites/prod/files/2020/12/f82/FY2021_SSMP.pdf>; National Nuclear Security Administration, "W78 Replacement Program (W87-1): Cost Estimates and Use of Insensitive High Explosives: Report to Congress," *Department of Energy* (December 2018), p. 5.

In order to produce the W87-1 in time to meet the GBSD's planned deployment schedule, the NNSA has set itself an extremely ambitious production schedule, one which external analysts have described as "unnecessary," "unexecutable," and "irresponsible."[51] The expected setbacks are primarily due to the NNSA's incapacity to produce enough plutonium pits—a central component of the W87-1's nuclear explosive package. Immediately after the Cold War, the Department of Energy closed its last major plutonium pit production facility at Rocky Flats, Colorado, following an FBI raid over environmental contamination—meaning that the NNSA currently maintains only a limited pit production capability and has not manufactured a new pit for use in a nuclear explosive package since 2012.[52]

As a highly-critical September 2020 report from the Government Accountability Office notes, the United States has not had the capability to produce more than 10 plutonium pits per year for over 2 decades; however, in order to meet the GBSD's tight schedule, the NNSA is expected to produce up to 30 pits in 2026, and ultimately produce up to 80 pits during 2030.[53] To that end, the NNSA intends to spend approximately $3 billion to modernize its Plutonium Facility (PF-4) at Los Alamos National Laboratory and approximately $4.6 billion to repurpose the partially constructed Mixed Oxide Field Fabrication Facility at South Carolina's Savannah River Site to create the new Savannah River Plutonium Processing Facility.[54]

Both internal and external analysts, however, agree that this pit production schedule is nearly impossible to complete. In its September 2020 report, the Government Accountability Office flagged that the NNSA has not followed best practices with regards to producing cost assessments or an integrated master schedule, and that "NNSA's past performance, agency documents, and an independent study suggest that achieving and sustaining production of sufficient pits per year may be challenging."[55]

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[51] Colin Demarest, "Defense leaders discuss the need for plutonium pits," *Aiken Standard* (28 December 2019), accessed 17 September 2020, <https://www.postandcourier.com/aikenstandard/news/why-80-defense-leaders-discuss-the-need-for-plutonium-pits/article_e70a1be2-82e0-5202-86ae-a0f485238e0c.html>; Marylia Kelley and Joseph Rodgers, "Expanding nuclear weapon production is reckless," *The Hill* (8 October 2019), accessed 17 September 2020, <https://thehill.com/opinion/national-security/464904-expanding-nuclear-weapon-production-is-reckless>.

[52] Bawden et al., "NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program," *Government Accountability Office* (September 2020), p. 5.

[53] National Nuclear Security Administration, "Plutonium Pit Production," Fact Sheet, *Department of Energy* (April 2019), accessed 19 September 2020, <https://www.energy.gov/sites/prod/files/2019/05/f62/2019-05-13-FACTSHEET-plutonium-pits.pdf>; Bawden et al. "NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program," *Government Accountability Office* (September 2020), pp. 14-15.

[54] Bawden et al. "NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program," *Government Accountability Office* (September 2020), pp. 15-16.

[55] Ibid, pp. 29-31.

Additionally, a March 2019 study by the Institute for Defense Analyses emphasized that the NNSA's plan to repurpose the Savannah River Site as intended had "no historical precedent," and any similar past programs "all experienced substantial cost growth and schedule slippage" and were eventually cancelled.[56] The report further noted that "we could find no successful historical major project that both cost more than $700 million and [was completed] in less than 16 years."[57] Ultimately, the authors concluded that "[n]o available option can be expected to provide 80 [pits per year] by 2030."[58] These concerns appear to be warranted: the NNSA's FY2020 performance evaluation noted that despite improving its processes, Los Alamos National Laboratory "did not meet all scheduled Pit development builds" for the latest evaluation year.[59]

If the NNSA fails to meet its production schedule of 80 pits per year by 2030—which both internal and external analysts agree is extremely unlikely—the W87-1 will not be completed on-time. The Air Force is already anticipating this result, and is therefore planning on the GBSD reaching Initial Operational Capability with legacy warheads.[60]

Overall, the GBSD program timeline is quite precarious, and there is a chance that a significant delay to the program could unintentionally trigger an eventual depletion of the ICBM force below New START levels. Given that such delays may be inevitable, legislators most interested in protecting the size of the overall force should seriously consider whether life-extending the Minuteman III force might offer a better method of protecting their bottom line than pushing for the highly precarious GBSD program. The safer, former option would ensure a viable ICBM force at New START levels for the next two decades, while the riskier, latter option could result in a smaller force altogether.

Finally, in the midst of a defense budget crisis, it is crucial to acknowledge the risks associated with prioritizing the funds for GBSD over other critical security priorities.

By its own admission, the Pentagon cannot afford all of the weapons it wants to buy. In July 2020, the then-Air Force Chief of Staff, Gen. Dave Goldfein, remarked at a Brookings Institution appearance that "this will be the first time that the nation has tried to simultaneously modernize

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[56] Hunter et al., "Independent Assessment of the Two-Site Pit Production Decision: Executive Summary," *Institute for Defense Analyses* (May 2019), p. 4.

[57] Ibid, p. 4.

[58] Ibid, p. 5.

[59] National Nuclear Security Administration, "FY2020 Performance Evaluation Summary," *Department of Energy* (January 2021), p. 3, accessed 20 February 2021, <https://www.energy.gov/sites/prod/files/2021/01/f82/FY20%20Triad%20PES%20Final.pdf>.

[60] Department of the Air Force, "Report on Development of Ground-Based Strategic Deterrent Weapon," Report to Congressional Committees (May 2020), p. 4.

the nuclear enterprise while it's trying to modernize an aging conventional enterprise. The current budget does not allow you to do both."[61] These tensions are already coming into stark focus: in early 2020, for example, a decision to dramatically increase the budget of the National Nuclear Security Administration directly led to the cutting of a Virginia-class submarine from the Navy's budget plan.[62]

This is what the "affordability" arguments of GBSD advocates fail to take into account. The true cost of the Ground-Based Strategic Deterrent is not *only* the significant funds spent to acquire it, but also the fact that prioritizing this program means *deprioritizing* other programs.

In 2017, the Congressional Budget Office estimated that the entire US nuclear modernization program would cost approximately $1.2 trillion, and these costs are highly likely to increase with inflation and customary programmatic overruns.[63] Given these aforementioned "fiscal time bombs," it would seem irresponsible to spend nearly $100 billion to acquire the GBSD today when such a decision could be deferred for several decades—thus allowing the United States to reallocate that money towards more pressing security priorities.

Recent polling suggests that this form of reallocation would be widely popular on a bipartisan basis. A July 2020 Data For Progress poll found that 56% of likely voters (69% Democrats; 50% Republicans) were in favor of cutting the Pentagon's budget by 10 percent in order to pay for priorities like education, healthcare, housing, and fighting Covid-19. Only 27 percent were opposed.[64]

Similarly, an October poll conducted by the Federation of American Scientists and ReThink Media found that Americans overwhelmingly do not derive their sense of safety from investments in nuclear or conventional weapons: only 3% of Democrats and 6% of Republicans ranked "a modernized nuclear weapons arsenal" in their top three safety priorities, compared to the 43% of respondents that selected "a sense that Covid-19 is under control," the 35% that selected "a

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[61] Marcus Weisgerber, "We Don't Have Enough Cash to Build New Nuclear Weapons, Says Air Force Chief," *Defense One* (1 July 2020), accessed 1 July 2020, <https://www.defenseone.com/policy/2020/07/we-dont-have-enough-cash-build-new-nuclear-weapons-says-air-force-chief/166598/>.

[62] Roxana Tiron and Travis J. Tritten, "Pentagon Budget Plan to Pit Ships Against Nuclear Arms, Aircraft," *Bloomberg Government* (25 February 2020), accessed 2 July 2020, <https://about.bgov.com/news/pentagon-budget-plan-to-pit-ships-against-nuclear-arms-aircraft/>.

[63] Congressional Budget Office, "Approaches for Managing the Costs of U.S. Nuclear Forces, 2017 to 2046" (October 2017).

[64] Ashik Siddique, "Americans Want to Reinvest Ten Percent of the Military Budget Against Coronavirus," *Data For Progress* (21 July 2020), accessed 28 July 2020, <https://www.dataforprogress.org/blog/2020/7/21/americans-want-to-reinvest-military-budget>.

sense of togetherness or unity in America," the 24% that selected "a lower crime rate," and the 22% that selected "a stronger and more accessible health care system."[65]

These results suggest that a legislative effort to reallocate funds from GBSD towards more proximate security priorities would be widely supported by Americans on both sides of the political spectrum. California Representative Ro Khanna's attempt to do this in July 2020 failed when his amendment lost its House vote; however, similar bills introduced during this congressional session could reinvigorate this issue as the Biden administration prepares for its review of US nuclear policy.[66]

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[65] Matt Korda and Tricia White, "Public Perspectives on the US Intercontinental Ballistic Missile Force," *Federation of American Scientists* (January 2021), <https://fas.org/wp-content/uploads/2021/02/Public-Perspectives-ICBM.pdf>.

[66] Joe Gould, "Next-gen ICBM program survives defunding attempt in House panel," *Defense News* (1 July 2020), accessed 1 July 2020, <https://www.defensenews.com/congress/2020/07/01/next-gen-icbm-program-survives-defunding-attempt-in-house-panel/>.

VIII. PUBLIC PERCEPTIONS OF THE US INTERCONTINENTAL BALLISTIC MISSILE FORCE

On behalf of the Federation of American Scientists, ReThink Media conducted a national survey of 800 registered voters between 12-28 October 2020, with the purpose of exploring Americans' opinions about US nuclear posture in general, and ICBMs in particular.[1] The survey included a 200 oversample of registered voters in "nuclear sponge" states (Colorado, Montana, North Dakota, Nebraska, and Wyoming), in order to gain deeper insight into how residents of the "nuclear sponge" think about the weapons that their states are hosting.

Given the unique and detailed nature of the survey, the results shed significant light on how Americans perceive ICBMs and their role in US nuclear doctrine, and whether they ultimately support continued investment in this particular weapon system in the form of the Ground-Based Strategic Deterrent (GBSD).

Americans believe that the United States has too many nuclear weapons

When informed that the United States currently has about 4,000 nuclear weapons in its active stockpile, a plurality of respondents (38%) said that that was "too many," compared to 15% stating that this was "not enough" and 26% saying it was "the right amount."[2]

These results changed in a subsequent articulation of the same question, however, which directly compared the US arsenal to those of Russia and China. When informed that Russia and the United States have roughly the same number of nuclear weapons, and that China—the third-largest nuclear power—has only around 300, the percentage of respondents who believed that the United States has "the right amount" of nuclear weapons jumped from 26% to 35%—making the percentage roughly equal to those who believed that the United States has "too many" nuclear weapons (36%).

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[1] The survey was conducted online using a panel provided by Qualtrics, and has a confidence interval (similar to a margin of error) of +/- 3.4%. The data were weighted slightly by gender, age, race, educational attainment, party ID, vote history, and region to be representative of the registered voter population. The complete survey was longer than the questions displayed below; however, some questions are being withheld for relevance or for future reporting.

[2] Russia has slightly more than 4,000 warheads in its stockpile, while the United States has slightly less; however, given that the differences are somewhat negligible, the survey flattened them into roughly the same number in order to better gauge how respondents felt about being approximately on par with Russia. Relatedly, in a May 2019 survey conducted by the University of Maryland's Center for International & Security Studies (CISSM), a plurality of nearly half of the respondents (47%) said that the US nuclear arsenal was "bigger than expected." To read the entire CISSM survey, see: Steven Kull, Nancy Gallagher, Evan Fehsenfeld, Evan Charles Lewitus, and Emmaly Read, "Americans on Nuclear Weapons," *Center for International & Security Studies* (May 2019), <https://cissm.umd.edu/sites/default/files/2019-07/Nuclear_Weapons_Report_0519.pdf>.

It is worth noting that this pattern is shared by Republicans and Democrats. Both without and with the comparison to other countries, a plurality of Democrats (45%, then 44%) believed that the United States has too many nuclear weapons; however, the percentage of Democrats who believed that the United States has "the right amount" of nuclear weapons jumps from 22% to 31% after receiving the comparison of other countries' arsenals. Similarly, although a narrow plurality of Republicans believed without the comparison that the United States has "the right amount" of nuclear weapons (35%, compared to 33% of Republicans who believed that they United States has "too many" nuclear weapons), the percentage of Republicans who believed that the United States has "the right amount" jumped from 35% to 40% after receiving the comparison. A similar jump can be seen across a variety of other demographics, including age, gender, income, and race.

Given that this jump was prompted by the respondent's new ability to compare the US arsenal with its strategic competitors, it is reasonable to suggest that it was likely triggered by a fear of military inferiority—a prospect which is uniquely unfamiliar and uncomfortable to most Americans. This could indicate that many Americans implicitly reject the conventional view of deterrence, and instead consider nuclear weapons in a similar manner to conventional weapons: that simply having more of them brings you greater rewards on the battlefield.

However, when it comes to nuclear weapons—having more of them does not necessarily change the strategic balance in a meaningful way. As political scientist Robert Jervis argues, "it does not matter which side has more nuclear weapons. […] Deterrence comes from having enough weapons to destroy the other's cities; this capability is an absolute, not a relative, one."[3] And despite the fact that a portion of the respondents appear to question this fundamental principle of deterrence, a plurality of Americans still think that the United States has too many nuclear weapons in its arsenal.

Nuclear weapons investments do not create a sense of safety

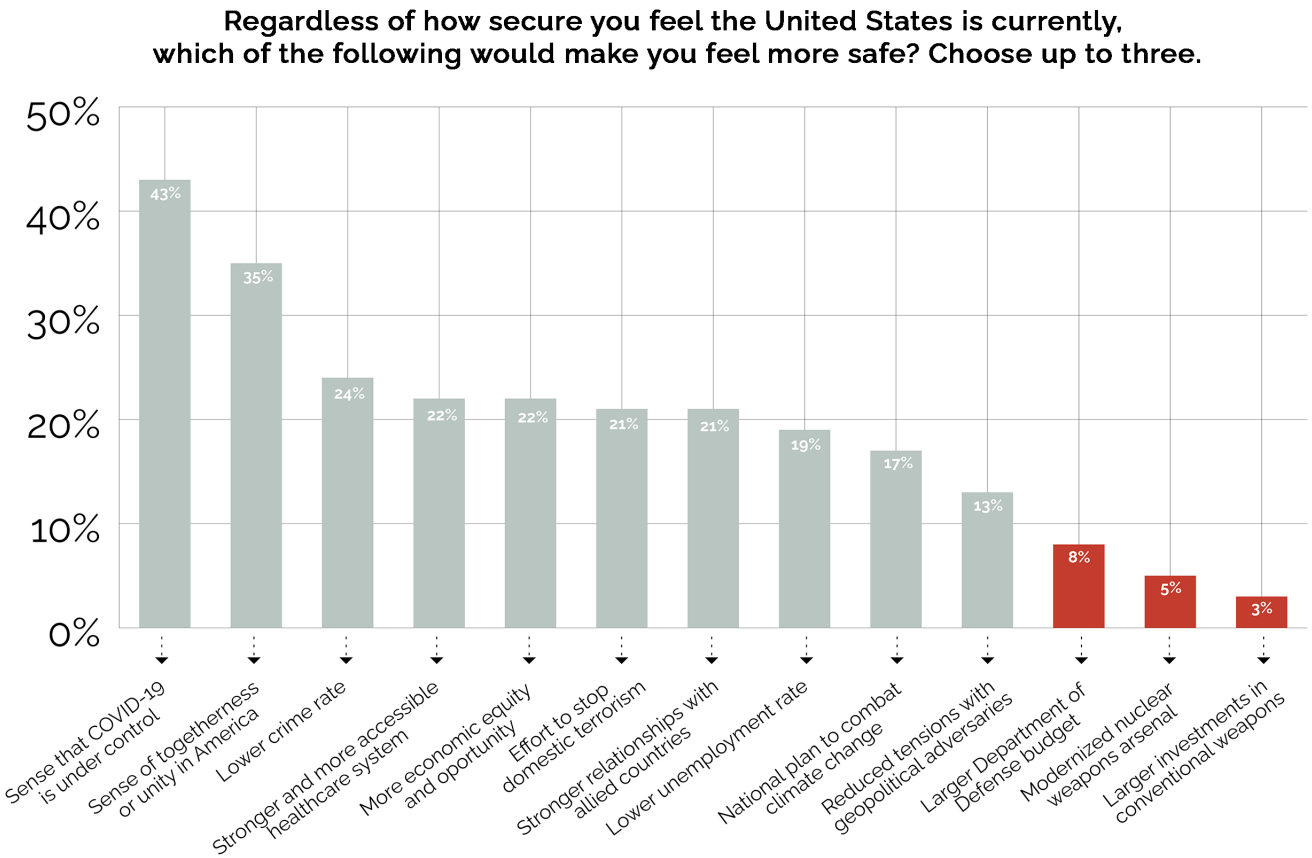
In order to tease apart the distinction between national security and personal safety, the FAS/ReThink Media survey first asked respondents to characterize the *national security* level of the United States, and then to select up to three options that would contribute the most to their sense of *personal safety*.

Overall, 71% of respondents stated that the United States is "secure," although it is notable that there were significant variations on how different demographics answer this question. For example, respondents that were white (76%), male (80%), Republican (89%), older than 65 (74%), and had an annual income of over $100,000 (81%) tended to believe that the United

[3] Robert Jervis, "Why Nuclear Superiority Doesn't Matter," *Political Science Quarterly* 94:4 (Winter 1979-1980), p. 618, DOI: 10.2307/2149629.

States is more "secure" than respondents that were non-white (60%), female (63%), Democrat (63%), younger than 30 (61%), and had an annual income of less than $25,000 (63%).

These demographic variations likely result from competing theories of security and contrasting considerations about which policies best guarantee safety. To that end, the survey's next question asked respondents to select up to three options from a mix of militarized and non-militarized security policies that "would make **you** feel more safe." By far, the most selected option was "A sense that COVID-19 is under control" (43%), followed by "A greater sense of togetherness or unity in America" (35%). After those two choices, the most popular choices were a near-tie between "A lower crime rate" (24%), "A stronger and more accessible health care system" (22%), "More economic equality and opportunity" (22%), "An effort to stop domestic terrorism" (21%), and "Stronger relationships with allied countries" (21%). At the very bottom of the safety priorities list—ranked lower than additional policies focused on unemployment, climate change, and reducing tensions with adversaries—were the three militarized security priorities: "A larger Department of Defense budget" (8%), "A modernized nuclear weapons arsenal" (5%), and "Larger investments in conventional weapons" (3%).



These results complement the findings of a similar pair of surveys conducted in Michigan and Wisconsin by the Union of Concerned Scientists in September 2020.[4] When asked to rate a series of federal government priorities from 0 to 10 (with 10 being the highest priority), respondents from both states ranked "replacing our country's nuclear weapons arsenal" at the bottom of the list (4.25 in Michigan; 4.13 in Wisconsin). In contrast, Michigan and Wisconsin voters rated "cleaning up polluted drinking water supplies across the country" (8.00 in Michigan; 7.55 in Wisconsin), "increasing the number of job opportunities around the country" (7.74 in Michigan; 7.73 in Wisconsin), "expanding access to quality and affordable health care (7.73 in Michigan; 7.63 in Wisconsin), "improving our country's roads, bridges and other infrastructure" (7.55 in Michigan; 7.11 in Wisconsin), and "addressing the causes and effects of climate change (6.26 in Michigan; 6.00 in Wisconsin) significantly higher.

Based on these results, it is clear that regardless of how they would rate the current *national security* of the United States, Americans overwhelmingly do not derive *personal safety* from investments in traditional *national security* priorities like new weapons or military investments. Instead, they would feel much safer with investments in non-militarized security priorities—such as strengthening pandemic response capabilities, combatting domestic terrorism, and strengthening the health care system—that actually contribute directly to their personal sense of security.

Investments in social priorities are more popular than new nuclear weapons.
A series of subsequent survey questions asked respondents to put their money where their mouths were, by asking respondents to assign dollar values to a variety of security priorities. These questions allowed respondents to step into the shoes of actual policymakers with purchasing power. The responses thus offer a more nuanced consideration of how Americans would prefer that government money be spent.

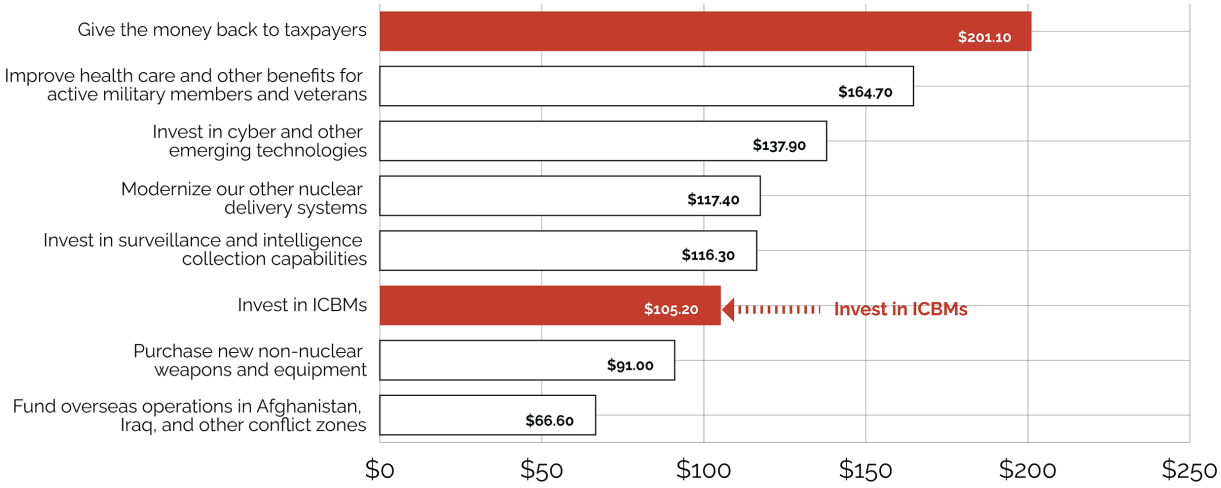
The respondents were each given a budget of $1,000 and split into two groups, designed to test whether Americans would be more amenable to government investment in "guns" (militarized focused spending priorities) or "butter" (non-militarized spending priorities). Each respondent was asked to allocate their $1,000 between a list of priorities, which either included more "guns" policies or more "butter" policies, depending on their randomized group. Both groups, however, received options to "Invest in ICBMs" and "Give the money back to taxpayers."

Interestingly, respondents in the "guns" group strongly prioritized the option to "Give the money back to taxpayers" ($201.1) more than any other option. The second-largest amount of money was allocated to "Improving health care and other benefits for active military members and

[4] "Michigan Voters Have Higher Priorities than Nuclear Weapons," Fact Sheet, *Union of Concerned Scientists* (October 2020), accessed 1 November 2020, <https://www.ucsusa.org/sites/default/files/2020-10/mi-voters-have-higher-priorities-than-nuclear-weapons.pdf>; "Wisconsin Voters Have Higher Priorities than Nuclear Weapons," Fact Sheet, *Union of Concerned Scientists* (October 2020), accessed 1 November 2020, <https://www.ucsusa.org/sites/default/files/2020-10/wi-voters-have-higher-priorities-than-nuclear-weapons.pdf>.

veterans" ($164.7), followed by "Investing in cyber and other emerging technologies" ($137.9). Respondents allocated only $105.2 (the third-lowest amount of money) to "Investing in ICBMs." It is notable that ICBM investment ranked lower than "Modernizing our other nuclear delivery systems (bombers and submarines)" ($117.4), indicating that Americans may see more value in those systems than in land-based missiles. Additionally, it appears that Americans believe that when it comes to military investment, the government should prioritize more modern and emerging technologies—such as cyber and surveillance capabilities—over legacy weapon systems like ICBMs.

Imagine that the Pentagon budget was $1,000. How would you spend that money?

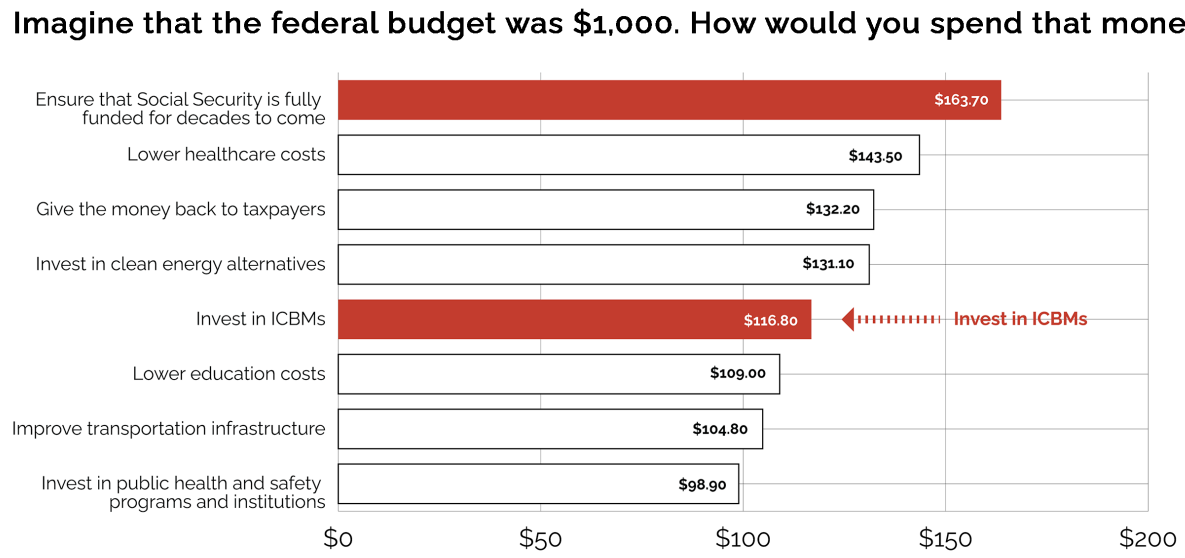


Although respondents in the "butter" group also strongly prioritized "Giving the money back to taxpayers" ($132.2), this policy option came third, behind "Ensuring that Social Security is fully funded for decades to come" ($163.7) and "Lowering health care costs" ($143.5). The option to "Invest in ICBMs" was ranked 5th ($116.8), behind "Investing in clean energy alternatives" ($131.1) and ahead of policies related to education, infrastructure, and public health and safety.

These results are particularly revealing in light of California Representative Ro Khanna's 2020 effort to insert an amendment into the FY2021 National Defense Authorization Act that would have transferred $1 billion from the GBSD program towards funding pandemic preparedness.[5] This polling demonstrates that despite the amendment losing its vote in committee by a margin

[5] Joe Gould, "Next-gen ICBM program survives defunding attempt in House panel," *Defense News* (1 July 2020), accessed 2 July 2020, <https://www.defensenews.com/congress/2020/07/01/next-gen-icbm-program-survives-defunding-attempt-in-house-panel/>.

of 44 to 12, the spirit of the amendment is, in fact, directly in line with the spending priorities of most Americans.



Not only do these results indicate that Americans are relatively disinterested in investing in ICBMs in particular, but they also tell a larger story about fiscal responsibility: when given the choice, Americans would generally prefer that the government simply *not* spend money at all, unless they are spending it on crucial domestic priorities like health care or social security. In short, Americans *want* the government to spend taxpayer dollars—just not on the military.

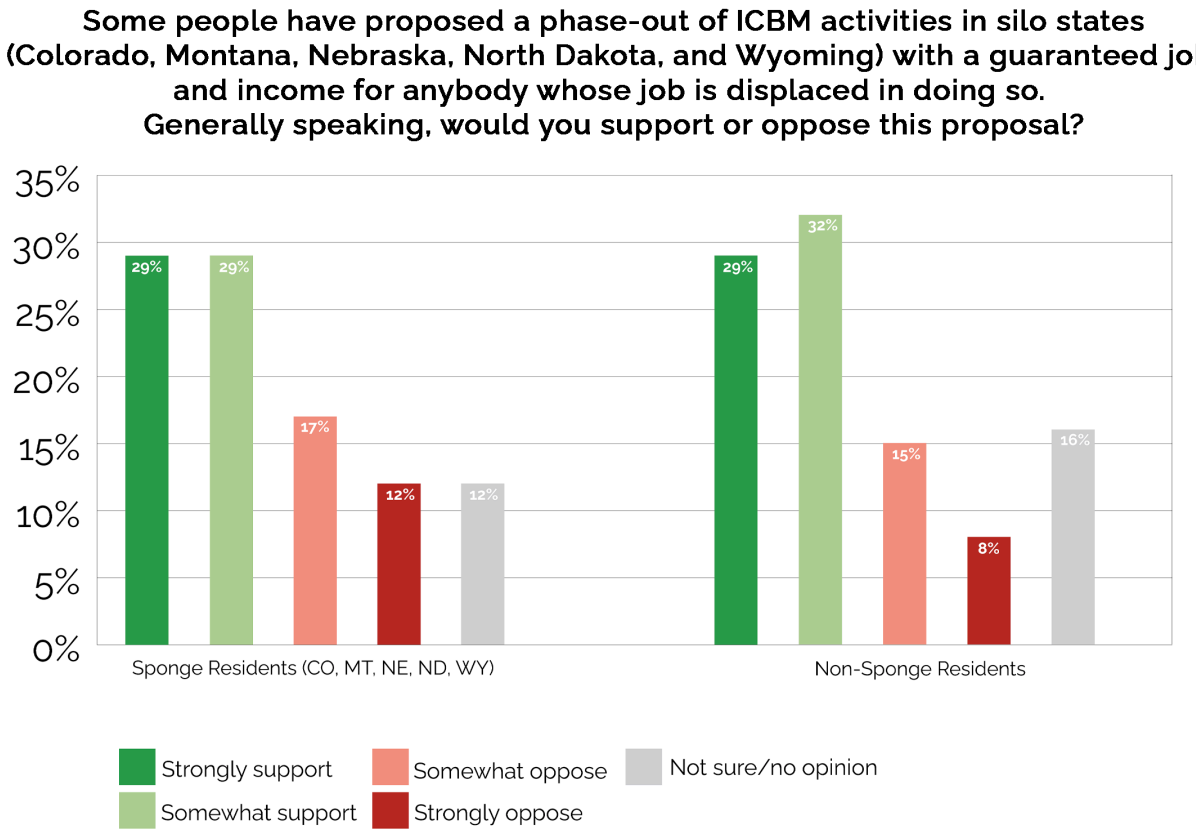
Support for phasing out ICBMs with a guaranteed economic offset

As Chapter IV of this report has already examined in detail, Members of Congress from "nuclear sponge" states generally oppose any cuts to the ICBM force for parochial reasons, out of fear of losing votes from constituents whose jobs could be affected by ICBM reductions. However, Brown University's Costs of War Project has suggested that the ICBM force does not support nearly as many jobs as its advocates often claim, and that "for the same amount of spending, clean energy and infrastructure create 40 percent more jobs than the military, healthcare creates 100% more, and education 120% more."[6]

To that end, respondents—living both inside and outside the "nuclear sponge" states—were asked whether they would support a phase-out of ICBM activities, with the promise of "a

[6] Heidi Garrett-Peltier, "War Spending and Lost Opportunities," *Costs of War Project* (14 March 2019), accessed 20 September 2020, <https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/March%202019%20Job%20Opportunity%20Cost%20of%20War.pdf>.

guaranteed job and income for anyone whose job is displaced in doing so."[7] Somewhat surprisingly, respondents in both sponge and non-sponge states expressed near-equivalent and overwhelming support for this proposal: 58% of sponge residents were supportive, while only 29% were opposed; similarly, 61% of non-sponge residents were supportive, while only 23% were opposed.



These results indicate that Americans—including those living closest to the missiles themselves—believe more in the ICBM force's perceived benefits to economic security, rather than national security. More research is required in order to determine which economic measures would be most effective in protecting these communities during the reductions process, especially if those reductions would result in base closures. However, as discussed in Chapter IV, analysis of previous military base closures indicates that most military communities have actually increased their employment levels—in many cases, by several hundred percent—after their nearby bases

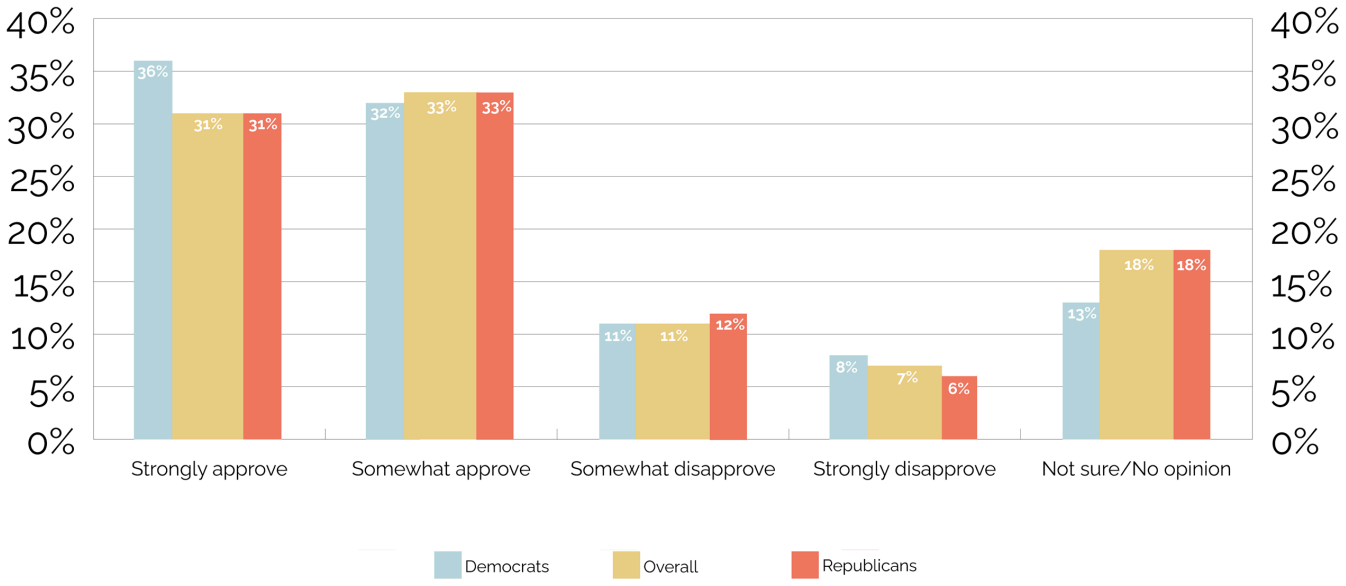
[7] Respondents living in the "nuclear sponge" were asked about phasing out ICBM activities in just their own states, while respondents living outside the "nuclear sponge" were asked about phasing out ICBM activities in all five sponge states.

closed and those federal investments were reallocated towards other priorities.[8] With respect to the GBSD specifically, the Center for International Policy's William Hartung suggests that "if even part of the savings from cancelling the GBSD and savings on maintenance and support of existing ICBMs were to be directed towards alternative economic activities in the states that host ICBM bases, it could provide a significant cushion as the affected communities transition to replace the jobs tied to those facilities with new economic activities."[9] The FAS/ReThink Media survey results suggest that such policies would be supported both inside and outside the "nuclear sponge."

Support for delaying and reviewing GBSD, while life-extending Minuteman III

Respondents were also offered two competing arguments for addressing the GBSD program: either keeping it on schedule ("Some have argued that the ICBM replacement program should proceed at any cost and without delay because of its perceived benefit to national security") or delaying the program ("Others have argued that we should delay the program while it undergoes a full review, and refurbish the existing ICBM arsenal in the meantime").

Would you approve or disapprove of delaying the GBSD program while it undergoes a review, and continuing to refurbish the existing ICBM arsenal in the meantime?



[8] Data retrieved from the Office of Economic Adjustment, Department of Defense.

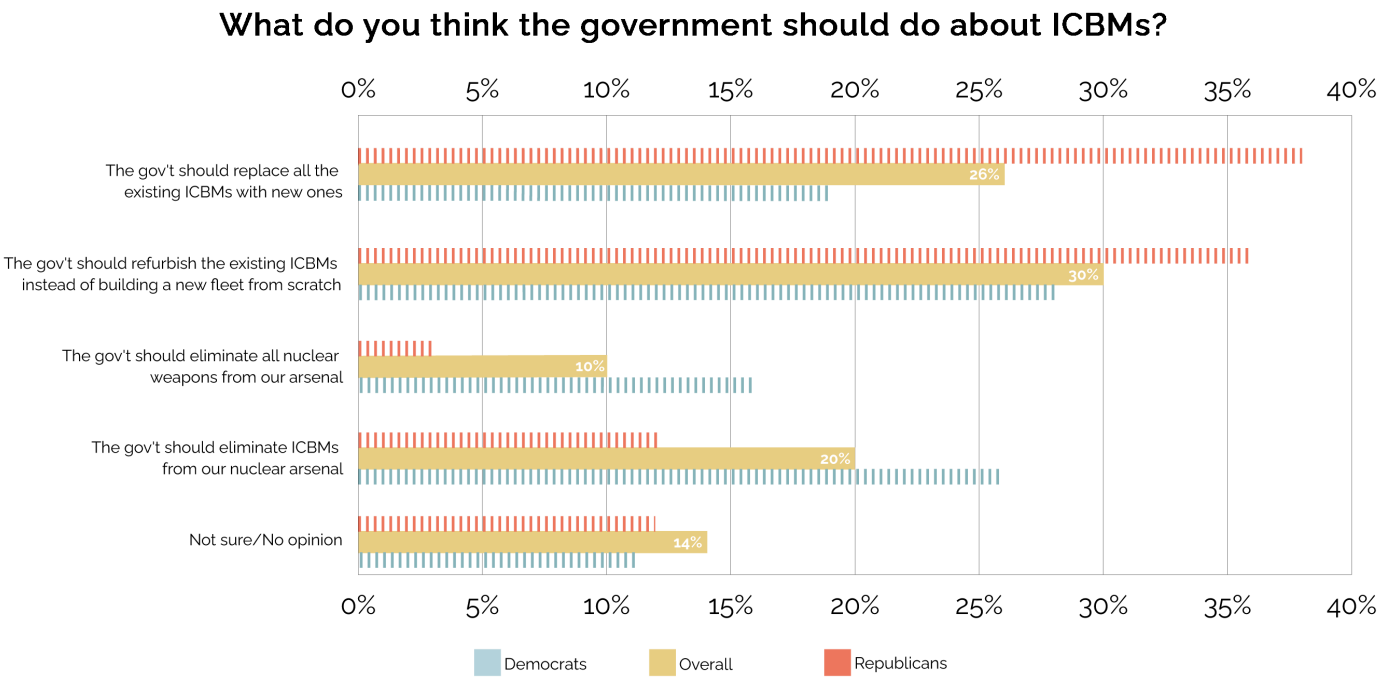
[9] William Hartung, "Inside the ICBM Lobby: Special Interest or the National Interest?" *Center for International* Policy (9 March 2021), p. 22, <https://3ba8a190-62da-4c98-86d2-893079d87083.usrfiles.com/ugd/3ba8a1_89fe183f8a164e22a2fa29d4d6381d7b.pdf>.

When subsequently asked whether they would approve or disapprove of such a delay, 64% of respondents were in favor of delaying the program, while only 18% were opposed. Interestingly, this approval rating was strongly bipartisan: 68% and 64% of Democrats and Republicans, respectively, supported a delay, while 19% and 18% of Democrats and Republicans were respectively opposed.

It is notable that such a strong, bipartisan show of support for delaying the program came immediately after being informed about the GBSD program's sole-source contract and associated potential for increased costs. This could indicate that Americans across the political spectrum are concerned about the perception or influence of corruption, nepotism, or uncompetitiveness on government spending.

Low levels of support for GBSD

Given that a primary impetus for the survey was to gauge Americans' opinions on the ICBM replacement program, our survey asked the exact same question—"What do you think the government should do about ICBMs?"—six times throughout the course of the poll. After an initial "cold" ask at the beginning of the survey, the question was repeated five more times, immediately following different informational prompts or questions. This polling strategy—which allows respondents to change their answers as they learn more about the program—enables in-depth consideration as to which arguments for or against the ICBMs are the most persuasive.



At the end of the survey, after having received a significant amount of information about ICBMs and having already answered over 30 related questions, only 26% of respondents supported the GBSD program of record. Meanwhile, 30% of respondents supported life-extending the current Minuteman IIIs, 20% supported eliminating the ICBM force altogether, and 10% supported eliminating all nuclear weapons from the US arsenal.

These results complement the findings of a May 2019 survey conducted by the University of Maryland's Center for International & Security Studies (CISSM), which found that only 32% of respondents supported replacing the ICBM force with brand-new missiles, while 61% of respondents supported phasing out land-based missiles with adjustments to US warhead numbers.[10] In an effort to find "common ground" between all sides of the political spectrum, CISSM's survey was particularly interested in identifying policy areas where both Democrats and Republicans could agree. This was reflected in their question about ICBMs, in which 68% and 53% of Democrats and Republicans, respectively, supported phasing out the ICBMs, while 24% and 41% of Democrats and Republicans, respectively, supported the GBSD program.

This bipartisan opposition to GBSD was also reflected in the FAS/ReThink Media survey. In the final formulation of the question, only 19% and 38% of Democrats and Republicans, respectively, supported the GBSD program, while 70% and 50% of Democrats and Republicans, respectively, supported alternative policy options. In particular, a plurality of both Democrats (28%) and Republicans (36%) supported life-extending the current Minuteman III force, and 32% and 14% of Democrats and Republicans, respectively, supported options that would involve phasing out ICBMs entirely (either only eliminating the ICBMs or complete nuclear disarmament).

There was some movement between the various policy proposals as the respondents were prompted with new information, followed by the same question: "What do you think the government should do about ICBMs?" Throughout the survey, 57% of respondents changed their answers after the "cold" ask at the top of the survey; however, on the whole, the percentages supporting each policy option did not meaningfully change.

The largest increase in support for life-extending the current Minuteman IIIs (from 30% support to 35% support) was prompted by a preceding explanation of the various life-extension programs throughout the past several decades, potentially indicating that many respondents were confident in the Pentagon's abilities to conduct similar life-extension programs again if necessary.

The largest increase in support for eliminating ICBMs altogether (from 14% support to 20% support) was prompted by a preceding explanation of the "nuclear sponge," noting that "In the

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[10] Kull, Gallagher, Fehsenfeld, Lewitus, and Read, "Americans on Nuclear Weapons," *Center for International & Security Studies* (May 2019).

event of a nuclear attack on the United States, these silos—and thus these states—would be primary targets for our opponent to strike." Respondents were also shown a targeting map of the missile fields, complete with likely radioactive fallout patterns; an overwhelming and bipartisan 81% stated that they found this information "concerning" (47% found it "very concerning"). These results suggest that Americans—even those living outside of the "nuclear sponge"—have a very strong reaction to hearing about the risks of hosting land-based missiles, and that emphasizing these risks can be highly persuasive in convincing Americans to support the elimination of ICBMs.

CONCLUSION

Just as the United States created the ICBM force—in the words of sociologist Donald MacKenzie—"without any agreed understanding […] of why it was doing so," the ICBM force has been sustained and upgraded in the post-Cold War era with a similar absence of agreed logic.

To that end, a comprehensive National Security Council-led review of the ICBMs' role in US nuclear posture is long overdue. Despite substantial reductions in the ICBM force over the past two decades, the Pentagon has not offered a convincing articulation of why ICBMs have ultimately been retained in the US arsenal, or what role these Cold War-era weapons are supposed to play in a post-Cold War security environment.

Additionally, a review should scrutinize the flawed assumptions and arbitrary requirements that helped predetermine the decision to pursue the Ground-Based Strategic Deterrent program. As this report suggests, the Pentagon's key justifications for GBSD were either flawed, exaggerated, or have since been deprioritized. This means that the Air Force's case for GBSD needs to be reevaluated in light of cost escalation and surrounding budget pressures.

However, it is still early enough in the GBSD program to change course. Life-extending the current Minuteman III force remains a cheaper and less risky option. Any underlying concerns regarding subsystem depreciation or test asset attrition could be significantly alleviated by revising presidential nuclear guidance, reducing the rate of flight tests, or pursuing nondestructive testing methodologies to assess the reliability of individual missile components. Ultimately, if those subsystems needed to be replaced in the future, the Air Force has a proven track record of completing such operations at low cost.

It is also possible to make cuts to the ICBM force without harming the national security of the United States or its allies; in fact, any reductions to such a uniquely destabilizing weapon system would reduce the risk of a devastating nuclear attack on US soil.

The security environment of the 21st century is already very different than that of the previous century. The greatest threats to Americans' collective safety are non-militarized, global phenomena like climate change, domestic unrest and inequality, and public health crises. To that end, those entrusted with their constituents' security must ask themselves, are brand-new ICBMs truly the best tool—or even a useful one—to respond to these threats? And if not, could prioritizing them over other potential solutions do more harm than good?

ABBREVIATIONS

AFGSC	Air Force Global Strike Command
AoA	Analysis of Alternatives
ASW	Anti-Submarine Warfare
BRAC	Base Realignment and Closure
CAPE	Cost Assessment and Program Evaluation
CDB	Command Data Buffer
CRS	Congressional Research Service
DOD	Department of Defense
EMD	Engineering and Manufacturing Development
FTC	Federal Trade Commission
GAO	Government Accountability Office
GBSD	Ground-Based Strategic Deterrent
GRP	Guidance Replacement Program
ICBM	Intercontinental Ballistic Missile
ILCS	Improved Launch Control System
LCC	Launch Control Center
LSRM	Large Solid Rocket Motor
MILCON	Military Construction
MIRV	Multiple Independently-Targetable Reentry Vehicle
MMIII	Minuteman III
NC3	Nuclear Command, Control, and Communications
NDAA	National Defense Authorization Act
NNSA	National Nuclear Security Administration
NSC	National Security Council
REACT	Rapid Execution and Combat Targeting System
RFP	Request For Proposals
RSLP	Rocket Systems Launch Program
RV	Reentry Vehicle
SAC	Strategic Air Command
SERV	Safety Enhanced Reentry Vehicle
SIOP	Single Integrated Operational Plan
SLBM	Submarine-Launched Ballistic Missile
SORT	Strategic Offensive Reductions Treaty
SOSUS	Sound Surveillance System
SRM	Solid Rocket Motor
SSBN	Nuclear-Powered Ballistic Missile Submarine
START	Strategic Arms Reduction Treaty
STRATCOM	US Strategic Command
TMRR	Technology Maturation and Risk Reduction

FAS Federation of American Scientists