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Assessing U.S. Options for the Future of the ICBM Force

Report to the Office of the Under Secretary of Defense for Policy

Toby Dalton, Megan DuBois, Natalie Montoya,
Ankit Panda, and George Perkovich

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Summary

Our task was to consider the relative risks and benefits of options for the future U.S. intercontinental ballistic missile (ICBM) force. Our task was not to assess *whether* the United States should deploy ICBMs at all or change its nuclear strategy and doctrine.

In our work, we engaged former officials from Democratic and Republican administrations, nuclear policy specialists from universities and defense and arms control think tanks, and senior military officers, as well as other representatives of combatant commands and the Office of the Secretary of Defense.

The current policy, established following a 2014 Analysis of Alternatives (AOA), is to replace the Minuteman III system with a new Ground Based Strategic Deterrent (GBSD) system, now named the LGM-35A Sentinel. Some observers, including members of Congress, have urged reassessing whether deterrence and other requirements could be met more cost-effectively by extending the life of the current Minuteman III missiles and their supporting infrastructure.

Department of Defense (DOD) officials note that upgrades that otherwise would have been necessary to sustain the Minuteman III system to 2043 were not undertaken once the decision was made in 2015 to proceed with GBSD. Therefore, they insist, there is no realistic option today to pursue a life extension program for Minuteman III missiles beyond 2030, when they are due to be replaced by GBSD. Although we received considerable data from DOD officials on these topics, the iterative process through which we received information,

the unclassified nature of our study, and the limited time available for investigating DOD conclusions left us unable to assess the DOD's position regarding the technical and cost feasibility of an extended Minuteman III alternative to GBSD. To strengthen public confidence in its decisionmaking on the future ICBM, we believe the DOD should commission an independent, classified technical study (with an unclassified version) to address outstanding questions relating to the options and timelines in the 2014 Analysis of Alternatives, cost estimates, procurement decisions, and adversary threats to future silo-based ICBMs.

One of the most salient issues that surfaced in our study is the projected medium-term increase in the vulnerability of silo-based ICBMs to attack by precision conventional weapons. A non-nuclear attack on U.S. nuclear-armed ICBMs would confront the president with the choice of initiating in response what could be a large-scale nuclear attack on adversary homelands (either by launching U.S. ICBMs before they were destroyed or by using other nuclear forces). This threat is likely to materialize well before the notional GBSD service life expiration in 2075. We believe this issue deserves more debate, as it may raise questions about the declining strategic value of a long-term commitment to silo-based nuclear-armed ICBMs inherent in the decision to proceed with GBSD.

Our discussions and research also explored issues that senior leaders, including the president, should consider regarding any silo-based ICBM system that the United States would deploy, today and in the future. These include allocating forces to simultaneously deter Russia (possibly in the absence of nuclear arms control, if occurring after the New Strategic Arms Reduction Treaty, or New START, expires in 2026) and a more nuclear-capable China from escalating regional conflicts; confronting possible risks posed by ICBMs overflying Russia to target China; building allies' confidence in U.S. extended nuclear deterrence; mitigating risks of launch under attack scenarios; and facilitating the negotiation of verifiable nuclear arms control agreements with Russia and China.

Consideration of these challenges and issues will be especially important in fashioning the Employment Guidance that will follow from the Nuclear Posture Review.

Preface

Our task was to consider the relative risks and benefits of options for the future U.S. ICBM force. It was not our task to assess *whether* the United States should deploy ICBMs at all or change its nuclear strategy and doctrine.

Recognizing that after the completion of an Analysis of Alternatives in 2014 the government decided to retire Minuteman III ICBMs and to deploy GBSD ICBMs as the ground leg of the triad, we asked three questions:

1. Are there viable ICBM alternatives to continuing the GBSD program, including options for extending the service lives of Minuteman III ICBMs?
2. Have any new factors arisen since 2014 that should lead to reconsideration of a fifty-year commitment to the GBSD program?
3. What questions or concerns regarding silo-based ICBMs in general should be presented to the president rather than be resolved at lower levels without his awareness? (Presidential consideration of these issues can and should inform the Employment Guidance that the administration will prepare.)

To address the study questions in the limited duration of this project, we convened former officials from Democratic and Republican administrations and nuclear policy specialists from universities and defense and arms control think tanks to join with senior military officers and other representatives of Commands and the Office of the Secretary of Defense (OSD) for three discussions of ICBM alternatives. These meetings included a briefing on the GBSD

program by a senior Air Force official and a sustained question-and-answer session with him and senior military and OSD officials. The discussions were open-ended, substantive, and respectful in ways that several participants noted have become rare on these issues.

We informed and backed up these discussions with a review of many government, think tank, and scholarly reports on ICBM alternatives. We also posed questions by email to Department of Defense officials, who provided substantive and detailed answers in several iterations.

Ultimately, the lack of classified information, technical and construction expertise, and time precluded us from conducting a detailed assessment of the feasibility or cost of alternative ICBM options. Whenever we sought to clarify what was or was not assessed in the 2014 Analysis of Alternatives, or to suggest that earlier studies indicated that Minuteman III and supporting infrastructure could be updated at costs similar to those of GBSD, the DOD provided information and/or argumentation that the ensuing eight years have rendered life extension of the missile and its supporting infrastructure nearly impossible and certainly not cost competitive. The information and argumentation we received were plausible, but given the limitations of the study we could not be confident in the fullness and conclusiveness of what we were presented. Much has changed since the 2014 AOA; perhaps there were options then that ought to have been given greater consideration but instead were ruled out. A new AOA conducted today would start with a different baseline, and it is not clear whether any Minuteman III life extension program is technically feasible or cost effective at this point. Even if it would not alter the decision to proceed with GBSD, we believe for future stewardship of the nuclear weapons enterprise there is a public interest in better understanding the decisionmaking process regarding the ICBM program from 2014 onward; a technical expert body would be necessary to conduct such a classified study and produce an unclassified report on it.

In any case, comparison of weapons system alternatives involves trade-offs between estimated benefits and risks for deterrence, conflict and escalation management if deterrence fails, assurance for allies, and stability provided by arms control arrangements. Presidential guidance establishes the framework for making these trade-offs. There are also differences in cost that have implications for public spending and associated contractor profits, which affect decisionmaking calculations. A group as varied in its approaches to nuclear policy as the one we assembled would be unable to agree on how to measure and prioritize benefits and risks, especially with the information available.

The DOD Sees No Feasible ICBM Alternatives Now to GBSD

There are reasons to prefer a less vulnerable basing mode than silos drilled into flat ground, but none of the workshop participants suggested that it was politically or economically feasible to make the ICBM force mobile beginning in 2029 when existing ICBMs are due to begin replacement. There was even less interest in exploring whether the technical and financial feasibility of deep underground (mountainous) deployment has improved to the point of deserving serious study and consideration. Thus, the practical choice facing successive administrations has been GBSD or Minuteman III life-extended in some form.

Instead of pursuing a new ICBM, one could imagine the use of a common missile that meets both Air Force and Navy safety requirements, but no such missile exists. According to Department of Defense officials, the deployment of Trident D5 missiles in silos was considered in “precursor” activities to the 2014 Analysis of Alternatives. They further informed us that this approach was rejected because “the use of D5 motors would create a need for costly infrastructure modifications and missile design changes to meet more stringent hazard classification requirements” (among other reasons). Several workshop participants also noted that even if the Trident D5 missile could affordably be made to operate safely from silos, doing so would stake a large majority of the United States’ deployed strategic warheads on one missile system. If a systemic technical problem arose with the Trident D5 missile, it could seriously undermine nuclear deterrence.¹

The 2014 Analysis of Alternatives considered options for maintaining a force of up to 450 ICBMs through 2075. (The United States currently deploys 400 ICBMs, but there was, and still is, a military requirement to generate up to 450 missiles.) The projected lifespan of the Minuteman III ICBM system and the challenges and costs of further extending its life was a primary consideration driving the analysis.

The Department of Defense informed us that it assessed, during the Analysis of Alternatives, that “there were only enough missile casings ([for the Minuteman] III) to support the ICBM force through” the “2043 time frame.” After 2043, the number of ICBMs would fall below “required levels” unless “a booster similar to GBSD assessed options” was introduced.

In our communications, the Department of Defense did not enumerate all the assumptions, including about the rate of missile testing, underlying these estimates. Nor did it describe the precise alternatives and timeframes pertaining to Minuteman III extension considered in the Analysis of Alternatives (which remains a classified document).

In a series of communications with the DOD, we sought to understand whether there might exist options today to extend the life of the Minuteman III system for some limited period.

The information we received from the DOD was surprisingly detailed in some instances, yet piecemeal and vague in others. Given the lack of clarity on some issues and timelines involved with replacement or refurbishment of certain Minuteman III system components, as well as the time and information constraints governing this study, we were not able to assess the potential for a Minuteman III extension. A technically informed, classified study of sufficient duration would be needed.

In our workshops and in subsequent communications, the DOD view was clearly expressed: there is no alternative to GBSD today involving life extension of Minuteman III. According to DOD officials:

The 2043 date [for the service life of Minuteman III missile casings] identified in the AOA is no longer correct. The Minuteman III weapon system as a whole is not affordably sustainable beyond 2030 because of attrition, limited availability of spare components, and a constrained industrial base to support 50+ year-old technology. The decision to forgo extending the service life of the Minuteman III system was made in 2014. Efforts to life-extend would have needed to begin in 2015 to meet various end of life component needs. Based on DOD's decision to pursue GBSD, only critical Minuteman III sustainment programs were executed to keep Minuteman III viable until the GBSD system reaches full operational capability.

Notably, among the challenges to a Minuteman III life extension program today, the DOD cited engineering assessments showing that due to the material removed from missing casings during the wash-out process, as many as 50 percent of the casings would become unserviceable. Thus, according to the DOD, there is no ICBM alternative to GBSD at this point and “a decision to switch to a life extension of the Minuteman III system now would not meet projected military requirements.”

In addition to issues of service life, the Department of Defense stated to us that GBSD would provide greater capability than Minuteman III in terms of “accuracy, probability-to-penetrate, range/payload, targeting flexibility, nuclear safety, and physical and cyber security.” The Department of Defense further argued that these capabilities were needed to meet U.S. Strategic Command's requirements and that GBSD would be more “cost effective” than the Minuteman III life extension alternative.

Desired or required military capabilities are an obviously key variable in assessing GBSD and any alternative. As adversary counter-capabilities improve with time, U.S. capabilities may need to improve just to retain their prior net effectiveness.

In the workshops, various participants expressed concern about future developments in Chinese and Russian missile defenses. They argued that GBSD's enhanced capabilities are needed to ensure the United States' continued ability to penetrate these defenses. Other participants expressed doubt that Chinese or Russian missile defenses could plausibly be

developed to the point where they significantly undermined the effectiveness of Minuteman III (which was designed to carry three warheads, but is only loaded with one, and so can presumably accommodate various countermeasures). We could not assess this issue on the basis of unclassified information and believe it would be helpful for the Department of Defense to explain its concerns about foreign ballistic missile defense developments in more depth.²

Another argument offered to support GBSD is that it would allow the United States to increase its ICBM force beyond 450 deployed missiles, silo-based or potentially mobile, if a decision is made to exceed the current cap. Such an expansion could be motivated by the large buildup in China's nuclear forces—the Department of Defense assesses that China “likely intends to have at least 1,000 warheads by 2030”—or by an expansion of Russian forces following the expiration of New START.³ (The marginal cost of deploying more silo-based ICBMs would increase significantly beyond 450, however, because of the need to build new silos.)

To the extent that China's growing ICBM force intensifies the United States' interest in a more capable ICBM—namely GBSD—some workshop participants expressed concern that ICBMs launched from existing U.S. bases toward targets in China must fly over Russia, which could create the risk of inadvertent escalation. China's ICBMs also would fly over Russia en route to their targets in the United States. But Russia, for political and technical reasons, would be much less likely to react dangerously to a Chinese overflight than an American one. We discuss this issue in more depth later in this paper. Here we note that the overflight issue raises the requirements question, which asks how many targets in China, if any, could be destroyed with sufficient reliability only by GBSD and not D5 (or future replacement) sea-launched ballistic missiles launched from U.S. submarines.

Ultimately, whether or not it is possible to further life-extend Minuteman III to some intermediate date, if a presidential determination deems capabilities beyond those of Minuteman III are necessary, and that GBSD will provide those capabilities, then it is clear to us that there is no ICBM alternative other than GBSD.

That there remain questions about the feasibility and desirability to sustain the Minuteman III system as a GBSD alternative—including legislation submitted by some members of Congress directing the DOD to carry out an independent study of these issues—is an indication that during and subsequent to the 2014 Analysis of Alternatives, the DOD could have done more to improve public confidence in its ICBM procurement process and decisionmaking. In our view, and in light of questions raised in this paper, the DOD could perform an important public service by commissioning an independent, classified study of the data and argumentation that informed the 2014 Analysis of Alternatives and subsequent deliberations of the Obama, Trump, and Biden administrations on options for the ICBM force. Among pertinent questions to explore are:

- What number of missiles was posited as necessary over time for deployment, testing, and spares? On what evidence were the posited requirements based?
- On what basis was the time horizon established for maintaining the given ICBMs, and how well does this basis withstand scrutiny?
- How comparable (in terms of categories of expenditure) were proffered cost estimates of the alternatives?
- What plausible changes in adversary threats to silo-based ICBMs were considered?

No nuclear weapon system comes without policy and/or technical challenges and trade-offs. Regardless of the answers to these questions, the deterrence provided by GBSD or any other silo-based ICBM comes with questions, challenges, and potential risks. The next section explores whether the potential vulnerability of silo-based ICBMs to non-nuclear threats may diminish the strategic value of GBSD well before it reaches its nominal end of service life in 2075. (Other questions, challenges, and potential risks would come with a decision to either pursue nonfixed basing modes or to eliminate ICBMs or any other leg of the nuclear triad.)

Future Vulnerability to Conventionally Armed Weapons

Developments in long-range non-nuclear weapons—particularly hypersonic boost-glide missiles—could plausibly enable Russia or China to threaten U.S. ICBMs in silos with a non-nuclear attack in the next couple of decades. While conducting such an attack would be exceedingly risky and imaginable only to stave off an existential defeat, it would be less risky than using nuclear weapons against U.S. ICBMs—a threat deemed sufficiently credible to factor into U.S. planning. What implications does this potential change portend for U.S. deterrence strategy and force posture choices, including continued basing of ICBMs in silos?

A *non-nuclear* attack on U.S. nuclear-armed ICBMs would confront the president with the choice of initiating in response a *nuclear* attack on the adversary homelands (either by launching U.S. ICBMs before they were destroyed or by using other nuclear forces). This nuclear first use would in turn be likely to prompt the adversary to launch nuclear strikes against the United States. A major objective of deterrence strategy, and indeed nuclear war planning, is to put the burden of catastrophic escalation on the adversary with the view that a rational adversary will choose not to escalate. If conventional threats to silo-based U.S. nuclear forces materialized, the United States would more likely be the actor deterred from *initiating* nuclear exchanges against homelands. Presumably, the United States would have

similar, if not superior, capacity to target adversary silos with non-nuclear weapons, but such a capability would not obviate the problems caused by the vulnerability of U.S. nuclear-armed ICBM silos. Here, skeptics ask why non-nuclear threats to U.S. ICBMs should pose a major challenge to deterrence when Russian leaders constantly stress their fear of U.S. conventional attack on their silos and assert that such attacks would draw a nuclear response.

There is much to debate under this heading—which is exactly the point. U.S. leaders should consider the possibility that silos could become vulnerable to non-nuclear attack long before 2075 (the planned end date of GBSD). Would it be strategically rational, legal, and credible to initiate nuclear exchanges against the Russian and, through reciprocation, U.S. homelands in response to non-nuclear attacks against silos in remotely populated areas? Would it be feasible and cost effective to adapt GBSD missiles to serve in a mobile basing mode? (We heard contradictory statements from different government officials about this.) Or, if mobility is not feasible for political and/or economic reasons, or if it is insufficient to avoid Russian or Chinese detection and targeting, would vulnerability to conventional strikes argue for eliminating nuclear-armed ICBMs? If so, this would seem to argue for reconsidering the long-term commitment to silo-based ICBMs inherent in the decision to proceed with GBSD.

Further Factors for High-Level Consideration

Deterrence and allied reassurance in the security environment of today and the projected future militate for retaining ICBMs. For political and economic reasons, ICBMs are likely to remain deployed in silos for the near term, at least. As the Biden administration proceeds to develop its Employment Guidance, it would bolster national and international security by fully considering the following factors in making policies regarding the future of the U.S. ICBM force.

ICBMs Overflying Russia to Target China

China's rapid buildup of nuclear forces and other military capabilities is frequently cited as necessitating procurement of GBSD with its greater capabilities than Minuteman III. However, to hit targets in China from current U.S. bases, both Minuteman III and GBSD ICBMs would need to fly north and over Russia. Some participants in our study averred that U.S.-Russian tensions would likely be extremely high during an escalating U.S.-China war; human or technical error could cause the Russian system to wrongly conclude that the missiles' aimpoints were in Russia or that the United States was planning to disrupt Russia's

early-warning system through high-altitude nuclear explosions over Russia.⁴ Either misperception could lead to Russia launching a nuclear attack on the United States.

Some participants argued that these risks are overstated. They argued that U.S. officials could and would alert Russian leaders of impending overflight. These and other participants suggested that Russia's early-warning system would identify from their trajectories that the ICBMs were flying toward targets in China, thus corroborating U.S. messages to Russian officials. Other experts have argued that the United States would not need or choose to use ICBMs against China, so the overflight problem is not real. The role of GBSD and its added capabilities could be confined to deterring Russia, giving the United States more confidence that it could rely on submarine- or air-launched nuclear weapons to contend with China in a sequential two-war scenario.

Neither our discussions nor the extant public literature indicates that the Russia overflight issue has been sufficiently worked through. We submit that in developing the Employment Guidance, the president should request a fuller analysis of the issue and alternatives for addressing it.

Benefits and Risks of Launch Under Attack

The United States retains options to launch silo-based nuclear weapons minutes after detecting an incoming attack. The primary purpose of this policy is to convince Russian (and, in the future, Chinese) leaders that they cannot destroy a significant fraction of the U.S. nuclear arsenal in a first strike and that attempting to do so would most likely lead the United States to use those weapons against opposing nuclear forces and related infrastructure, which could leave the adversary worse off than the United States for having started such an exchange.

A number of prominent defense experts argue that the possibility of the United States' launching a massive nuclear attack based on a mistaken warning of an incoming attack, or on an unprepared president's misjudgment in the extreme pressure of the fifteen-minute window for a decision, is significant enough that an official launch under attack (LUA) protocol should be foresworn. In our workshops, Department of Defense officials argued that the risks of mistaken warning leading to a launch of U.S. ICBMs are greatly exaggerated. The technologies, procedures, and personnel training involved in detecting and assessing launches of adversary attack are designed to prevent one component or person from making an error that could lead to a mistaken or inadvertent launch; the total system is extremely reliable, they argued.

Contextual considerations reduce the risk further, they said. It is extremely unlikely that Russia (or another adversary) would launch an attack against the U.S. ICBM force except in a major conflict in which U.S. military forces have been engaged and the nuclear force generated. In this scenario, a Russian attack on U.S. ICBMs could not negate massive U.S.

nuclear retaliation by the generated submarine- and bomber-based forces, so Russian leaders would not be expected to order such an attack. A U.S. president who did receive warning of an attack would not be pressed to launch the ICBM force because he or she would be confident that already-generated U.S. nuclear forces would survive and be able to inflict unacceptable damage. Conversely, if the United States received warning of an adversary attack on U.S. ICBMs in a non-crisis, non-conflict context, as has occurred previously, military and civilians throughout the system, including in the White House, would be primed to suspect that the warning is somehow mistaken.

There is no way for independent observers to evaluate these assertions one way or the other. That said, given the consequences of a large-scale nuclear launch, the president should consider two potential safeguards to bolster confidence that the risks of LUA are exaggerated.

First, as a matter of policy, if the president (or a designated successor) is presented with one or more options for nuclear employment, he or she should also be presented with a “no immediate nuclear response” option. (Non-use is always a default option for the president; the idea here is to make it an explicit, active option.)

Second, more attention should be given to preparing presidents and their senior advisers for potential nuclear employment decisions, especially LUA. To be fair, these individuals are extraordinarily busy, nuclear employment decisions may seem exceedingly remote to them, and the national security bureaucracy cannot force them to engage. Nonetheless, a nuclear employment decision—especially a large-scale launch—is the most fateful decision a president, who has sole authority, could make.

As part of the process of presidential engagement with a Nuclear Posture Review, therefore, the value of exercises should be explained. Given all the expense and care that go into trying to ensure that U.S. nuclear weapons and command-and-control systems function flawlessly and to train the military personnel who conduct nuclear missions, it seems unwise, if not irresponsible, that U.S. presidents and their senior advisers do not participate in realistic exercises. The president should agree to observe exercises that practice nuclear employment decisionmaking in realistic conditions, including in scenarios in which an incoming attack against the U.S. ICBM force is detected. In such nation- and humanity-threatening scenarios, decisionmaking time would be severely compressed and some favored advisers might not be available. Psychologically, this is another reason why the options presented to presidents should include “no immediate nuclear response.”

Revisiting Assumptions Driving Requirements

Nuclear deterrence is an effect that U.S. leaders believe their force posture, doctrine, and projected resolve will have on the decisionmaking of Russian, Chinese, or other leaders. This entails assumptions that have evolved over time and become part of the nuclear inheritance each new U.S. administration receives from its predecessor. For many reasons—bureaucratic, political, economic, and strategic—these inherited weapons, doctrines, and assumptions

often go unquestioned. Nuclear Posture Reviews and, more, Employment Guidance documents provide opportunities to re-examine key assumptions and explore a host of additional questions—including about the ICBM force.

Defense Department officials suggest that the risk of mistaken or inadvertent launch of U.S. ICBMs under attack is extremely slight in part because such an attack is unlikely to occur out of the blue when U.S. submarine- and air-based forces are not generated. If this assumption is correct, then how should it affect the posited requirements for the U.S. nuclear arsenal? Is there anything in the currently planned triad that would not be deemed necessary if the president determined that forces and operations should be predicated on the assumption of at least three days' warning prior to any need to launch a large-scale nuclear attack? Would this determination have any implications for force sizing?

Regarding assurance of allies, what evidence exists that leaders and populations of North Atlantic Treaty Organization member states or other allies and partners such as Australia, Japan, South Korea, and Taiwan would alter their confidence in U.S. leadership and extended deterrence if the United States did or did not shift a fraction of its strategic nuclear forces from silo-basing to submarines, or if it did or did not restudy the feasibility and costs of alternatives to GBSD?

What evidence is there that Russian and Chinese leaders' predilections to initiate and/or escalate war to a scale that could become nuclear depend on specific features of U.S. ICBMs, given the other elements of the triad? Some senior U.S. officials in our discussions insisted that there is no difference between capabilities required to deter adversaries (such as China, North Korea, or Russia) and capabilities required to achieve military objectives if deterrence fails. Others differed. They argued that targeting plans and specific military objectives are not made public; therefore, modest differences in the capabilities of the U.S. ICBM force to hold specific targets at risk could not change the comparative *deterrent* effectiveness of alternatives. Or, as others suggested, some military requirements or attributes of systems can undermine deterrence by giving an adversary an incentive to strike first or by degrading alliance assurance. Writers of Employment Guidance documents, then, should assess whether the capabilities of the planned GBSD system are more likely to deter Russian and Chinese leaders or to make them more prone to escalate a conflict for fear of a successful impending U.S. first strike.

Arms Control and Disarmament Considerations

As noted by military leaders in our discussions, stabilizing nuclear deterrence is extremely difficult to do without the predictability that arms control provides to strategic competitors. For the United States, this has long meant Russia, and now it means China, too. This difficulty is exacerbated when one or more competitors have nuclear weapons systems that are vulnerable to preemptive attack: competitors then seek to exploit this vulnerability, while the defender increases its numbers of weapons or looks for other ways to deny the adversary's quest. To date, two factors have mitigated the vulnerability of silo-based ICBMs.

First, because U.S. ICBMs are currently loaded with one warhead, and it is generally assumed that an adversary would dedicate two warheads to attacking each silo, nuclear attacks on U.S. silos are numerically unattractive. Second, U.S.-Russian strategic arms control treaties have limited the size of the Russian arsenal and have brought transparency and predictability to each side's strategic weapons, reducing concerns about a clandestine buildup by one side that could threaten the survivability of the other's strategic forces—silo-based ICBMs, in particular.

Various developments could undermine this relative stability. New START will expire in 2026. Developments in non-nuclear intercontinental weapons could threaten ICBM silos. There is also the potential for parallel, bilateral arms races between the United States and Russia and the United States and China to emerge. Until now, the strategic nuclear capabilities that the United States was permitted to deploy pursuant to U.S.-Russian agreements were deemed adequate for any potential operations against China. Because China's nuclear arsenal was so comparatively small, it was treated as a lesser, included challenge. As China's nuclear and broader missile arsenals grow, U.S. leaders may conclude they need to add nuclear capabilities beyond those needed for Russia. U.S. leaders would likely consider exploiting GBSD's capabilities to carry multiple nuclear warheads (known as MIRVing). If de-MIRVing was (correctly) seen as stabilizing, re-MIRVing must be seen as something else. The challenge will then be to redress Russia's and China's worst-case assessments that the capabilities the United States deploys to deter *both* countries could or would be used to defeat *either one* of them. If new approaches to arms control cannot be invented, the world is likely to see worsening security dilemmas, arms racing, and instability.

Conclusions

We make four further conclusions from our research and discussions.

First, in a strategically rational world, U.S. presidential guidance should determine how to rank or balance weapon systems' contributions to the objectives of deterrence effectiveness, damage limitation if deterrence fails, mitigation of escalation risks, and the predictability that arms control enables. To do this, we believe that questions like the ones posed earlier need to be answered in publicly accessible ways—if not in a Nuclear Posture Review, then in a public version of the Employment Guidance.

Second, in a strategically and economically rational world, cost-effectiveness should be the decisive consideration. However, cost may not be decisive in today's Washington. The politics of federal appropriations preclude shifting money saved from expenditure on ICBMs to social programs that many members of Congress and the public might find more beneficial. Thus, there is little political incentive to reduce defense spending by pushing for lower-cost programs.

Third, this study demonstrated that the DOD is able to share considerably more unclassified information pertaining to the future of the ICBM force than is publicly available. Lingering questions about the 2014 AOA and subsequent DOD decisionmaking are an indicator that the DOD can and should be more transparent about a program whose costs over the next fifty years will command a sizable portion of the U.S. defense budget.

Fourth, another critical factor is whether the security environment is likely to change between now and 2075 in ways that will reduce the value of silo-based ICBMs—most significantly, whether silos become vulnerable to non-nuclear attack. If there is serious concern that silos will become vulnerable to non-nuclear attack by the mid-2040s, the case for reconsidering a long-term commitment to silo-based ICBMs through GBSD may warrant a new Analysis of Alternatives, to include alternative basing modes.

Appendix: Workshop Participants

The following individuals participated in at least one of three workshops conducted in December 2021 and January 2022 that informed the writing of this paper. These individuals agreed to have their names listed, but in no way does their participation in the workshops imply endorsement of the contents of this report. Other participants chose not to have their names listed. The views expressed herein are those of the authors; any errors are solely their responsibility.

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Steven Aoki	Richard Johnson	George Perkovich
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Notes

- 1 The Trident D5's real-world test record is superior to that of any other large ballistic missile. (It has 167 successes since 1989, whereas Minuteman III has failed more recently.) Data available at: "Overview: Trident II D5 Fleet Ballistic Missile," Lockheed Martin, accessed February 11, 2022, <https://www.lockheedmartin.com/en-us/products/trident-ii-d5-fleet-ballistic-missile.html>; and Rachel S. Cohen, "Air Force Aborts Test Launch of Unarmed Minuteman III Nuclear Missile," *Air Force Times*, May 5, 2021, accessed February 11, 2022, <https://www.airforcetimes.com/news/your-air-force/2021/05/05/air-force-aborts-test-launch-of-unarmed-minuteman-iii-nuclear-missile>.
- 2 The technical shortcomings of defenses against ICBMs today do not prevent Chinese, Russian, and U.S. defense establishments from positing vast improvements in the future. Some argue this should motivate the development today of new offensive capabilities to penetrate them.
- 3 Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2021: Annual Report to Congress," U.S. Department of Defense, 2021, 92, <https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF>.
- 4 NORAD's apparent recent mistake in extrapolating the trajectory of North Korea's January 11 launch is a cautionary tale. This occurred in peacetime with the United States' early-warning capabilities. A wartime scenario with Russian early-warning systems might raise more concerns. <https://www.cnn.com/2022/01/13/politics/north-korean-missile-faa-grounded-planes/index.html>

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