

# WAR ON THE ROCKS

National

## A Cheaper Nuclear Sponge

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“With today’s technology, land-based [ballistic] missiles are an embarrassment,” the late, great strategist Thomas Schelling [wrote](#) in 1987. The weapons, he added, “seem to give the entire deterrent a bad name.”

Schelling was right: Intercontinental ballistic missiles (ICBMs) are by far the least valuable leg of the so-called [nuclear triad](#), which also consists of submarine-launched ballistic missiles, and air-delivered cruise missiles and gravity bombs.

So long as U.S. adversaries possess nuclear weapons, we believe the United States should maintain a safe, secure, and effective nuclear arsenal to deter nuclear attacks against itself and its allies. But the Trump administration’s [approach](#) to sustaining and upgrading the arsenal is unnecessary, unsustainable, and unsafe. Nowhere is this more evident than with respect to its plan to build a new ICBM.

Instead of proceeding with current plans to build an entirely new ICBM system at a cost that is likely to exceed \$100 billion, the Pentagon could save scores of billions — without sacrificing U.S. security — by continuing to rely on a smaller number of existing Minuteman III missiles.

### A New ICBM

The U.S. Air Force [currently deploys](#) about 400 single-warhead Minuteman III ICBMs at three locations: F.E. Warren Air Force Base, Wyoming; Malmstrom Air Force Base, Montana; and Minot Air Force Base, North Dakota. The Air Force also maintains 50 extra missile silos in a “warm” reserve status, meaning the silos no longer contain ICBMs.

The Minuteman III was designed in the 1960s and entered service in the 1960s and 1970s. But the missile today is the product of decades of continuous enhancement. The Pentagon [last conducted](#) a major upgrade of the missile in the early 2000s, spending over \$7 billion to keep it reliable through 2030. This effort has resulted in expanded targeting options and improved accuracy and survivability.

The Air Force is aiming to replace the Minuteman III missile and its supporting launch control facilities and command-and-control infrastructure. The [plan](#), which began under the Obama administration, is to purchase 666 new missiles, 400 of which would be operationally deployed through 2070. The remaining missiles would be used for test flights and as spares. The service is [seeking](#) to make significant capability upgrades as part of the recapitalization program, known as the ground-based strategic deterrent.

The program is off to a rocky start. The Air Force initially [estimated](#) the cost of the new ICBM program at \$62 billion, but the Pentagon in August 2016 [set](#) the estimated acquisition cost at \$85 billion — at the [lower end](#) of an independent Pentagon cost estimate that put the price tag as high as \$150 billion. The Defense Department [completed](#) another independent cost estimate of the program in June, but has yet to disclose whether the projected cost has changed. A price tag of over \$100 billion would make it one of the Pentagon’s costliest planned acquisition programs.

Citing concerns about the need for and ability to execute the ground-based strategic deterrent program as planned, the fiscal year 2020 National Defense Authorization Act (NDAA) and defense appropriations bill passed by the Democratic-led House this summer [eliminated](#) the Pentagon's funding request to proceed to the main development phase of the program.

Both bills also halved the funding request to replace the W78 ICBM warhead — one of two ICBM warheads — and reduced the Energy Department's request to expand the production of plutonium pits in support of the warhead replacement program. In contrast, the Republican-led Senate [provided](#) additional funding above the Air Force's request for the new ICBM program and supporting efforts, setting up a clash between the two chambers on the issue as they work to reconcile their versions of the defense authorization and appropriations bills in the coming weeks.

Meanwhile, Boeing [announced](#) in July that it would not bid on the contract for the ground-based strategic deterrent program. Boeing's exit leaves Northrop Grumman as the only company competing for the contract. Boeing subsequently [proposed](#) to team up with Northrop, but Northrop has so far refused to do so. If the Pentagon moves ahead with a single bidder, it would have less leverage to control costs. There is no precedent for the absence of competition for a contract the size of the ground-based strategic deterrent program.

### **The Least Valuable Leg**

The primary [mission](#) of the land-based leg of the nuclear triad is to deter a nuclear attack by presenting an adversary, namely Russia, with a large number of targets — 450 missile silos — that would have to be destroyed if Russia is to have any hope of limiting damage to its own country. Another rationale is that the land-based missiles act as a tripwire, forcing an adversary to attack the U.S. homeland directly, all but assuring an American response with nuclear weapons. In other words, ICBMs purportedly keep the United States safe by their ability to serve as a “warhead sponge,” absorbing a massive Russian nuclear attack. An additional [rationale](#) for the ICBM force is that it serves as a backstop to an unforeseen, and unlikely, future vulnerability in the submarine leg.

The disadvantages of silo-based ICBMs, however, are significant. The missiles cannot survive a large-scale Russian nuclear attack unless they are launched during the less than 30 minutes between the detection of the Russian missile attack and the arrival of those warheads at their targets. Under current U.S. policy, ICBMs are postured to allow [“launch under attack.”](#) meaning the president would have to make a quick decision, in less than 10 minutes, about whether to launch U.S. ICBMs before they are destroyed. This could lead the president to order the use of nuclear weapons based on inaccurate or incomplete information. False warnings of nuclear attack [have occurred](#) in the past; fortunately, all were identified as false before a presidential decision was required. A false warning during a crisis — particularly during a military conflict with Russia — would be particularly dangerous.

Being ready to launch ICBMs on attack is not only dangerous, it's pointless. Even if a Russian attack eliminated all U.S. ICBMs, the remaining force of ballistic missile submarines at sea and those long-range bombers that had been alerted and dispersed before the attack would be more than sufficient to deliver a devastating retaliatory blow. And if, as is [commonly assumed](#), most U.S. ICBMs are targeted against Russian nuclear forces, those Russian forces would be launched on warning of the U.S. retaliatory attack — if they had not [already](#) been launched as part of the initial attack.

ICBMs do not provide unique capabilities. The sea leg of the triad is more survivable and the air leg is more flexible. Unlike bombers, ICBMs cannot be recalled after launch or used to signal resolve (e.g., by dispersing or deploying them to forward bases). Moreover, the assumption that land-based missiles are the fastest means of delivering nuclear weapons is false. A 1993 [report](#) by the Government Accountability Office found “no operationally meaningful difference in time to target” between the ICBMs and submarine-launched ballistic missiles. Furthermore, to use ICBMs against targets in China or North Korea, the missiles would have to fly over Russia. This [targeting inflexibility problem](#) greatly diminishes the utility of ICBMs outside a nuclear conflict with Russia, because overflying Russia to attack other states risks nuclear retaliation from Russia.

Eliminating ICBMs would, it is true, reduce the number of aimpoints an adversary would have to strike to destroy the smaller number of delivery systems based at submarine and bomber bases on U.S. soil. ICBM proponents [argue](#) that without the ICBMs, Russia or China might be tempted to launch a limited attack against the small number of remaining targets.

But that argument ignores the eight or so undetectable ballistic missile submarines (SSBNs) that are always [at sea](#), which together carry more than 700 warheads, a number that in a crisis could be increased even further. So long as submarines and their supporting command-and-control infrastructure remain invulnerable, why would Russia risk attacking the U.S. homeland with nuclear weapons when at least 700 U.S. warheads would remain at sea to respond? Indeed, deterrence would be strengthened if the 400 warheads currently deployed on vulnerable ICBMs were replaced by additional warheads deployed on submarines. This could be done by deploying an average of six warheads on each Trident D5 submarine-launched ballistic missile instead of the four to five currently planned. Prior to the Obama administration, Trident D5s [carried](#) an average of about six warheads, and many of the warheads removed since then are maintained in reserve for possible redeployment.

According to the Trump administration's 2018 *Nuclear Posture Review*, "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." But if an unforeseen breakthrough in anti-submarine warfare were to emerge, silo-based ICBMs would not provide a reliable hedge given their vulnerability. This has led some to [suggest](#) the development of a mobile basing mode to enhance the survivability of ICBMs. In fact, the *Nuclear Posture Review* suggests the Pentagon might consider a mobile basing mode. But such an approach would be [far more](#) expensive than even the already pricey ground-based strategic deterrent program, which will retain silo basing, and would likely be a political nonstarter.

### **A Lower-Cost Alternative**

Given the many weaknesses of ICBMs, a [good case](#) can be made to eliminate them entirely. But even if one agrees with the sponge, tripwire, and hedge rationales for ICBMs, spending over \$100 billion to buy a new ICBM force is unnecessary. These functions can be performed at lower numbers and by deferring the development of a new ICBM, which would free up funds to help pay for other priorities.

The [budget challenges](#) facing the Defense Department are real as it attempts to execute the 2018 *National Defense Strategy* and reorient the military toward great-power competition with Russia and China. On nuclear modernization, the estimated cost of the Trump administration's plans is staggering and growing. The Congressional Budget Office earlier this year [projected](#) the cost to maintain and replace the arsenal over the next decade at nearly \$500 billion, after including the effects of inflation. This is an increase of nearly \$100 billion, or about 23 percent, above the already enormous projected cost as of the end of the Obama administration. Over the next 30 years, the [price tag](#) is likely to top \$1.5 trillion and could approach \$2 trillion.

These big nuclear bills are [coming due](#) as the Defense Department is [seeking](#) to replace large portions of its conventional forces and must contend with internal fiscal pressures, such as [rising](#) maintenance and operations costs. In addition, external fiscal pressures, such as the [growing](#) national debt, are likely to limit the growth of — and perhaps reduce — military spending. "We're going to have enormous pressure on reducing the debt which means that defense spending—I'd like to tell you it's going to keep going up—[but] I'm not terribly optimistic," Alan Shaffer, deputy undersecretary of defense for acquisition and sustainment, [said](#) in February 2019.

Supporters of the Trump administration's *Nuclear Posture Review* argue that even at its peak, spending on nuclear weapons will consume no more than 6 to 7 percent of total Pentagon spending. But even 6 percent of a budget as large as the Pentagon's is an enormous amount of money. By comparison, the March 2013 congressionally mandated sequester reduced national defense spending (minus exempt military personnel accounts) by 7 percent. Military leaders and lawmakers repeatedly [described](#) the sequester as devastating.

The Congressional Budget Office [projected](#) in 2017 that \$17.5 billion (in 2017 dollars) could be saved between fiscal years 2017 and 2046 by delaying development of a new ICBM by 20 years and instead further extending the life of the Minuteman III by buying new engines and new guidance systems for the missiles and replacing the missile's command-and-control infrastructure as planned. Crucially, this approach would save \$37 billion through fiscal year 2036 when the vast majority of nuclear recapitalization spending is scheduled to take place. Such savings on their own won't solve the massive budget challenge facing the Pentagon, but they are far from trivial. The Air Force has to contend with the high cost of several other priorities over the next two decades on which money slated for the ground-based strategic deterrent could be spent, including the F-35, B-21, and new tanker programs.

The Pentagon argues that a new ICBM is necessary because the fleet of 400 deployed Minuteman III missiles is aging into obsolescence and losing its capability to penetrate adversary missile defenses. According to the *Nuclear Posture Review*, the life of the Minuteman III “cannot be extended further” and the missile “will have increasing difficulty penetrating future adversary defenses.”

As the Congressional Budget Office notes, extending the life of the Minuteman III could [entail](#) some technical risk. But a 2014 Air Force analysis of alternatives to sustain the ICBM leg of the triad [did not determine](#) that extending the life of the Minuteman III is infeasible. Likewise, Lt. Gen. Richard Clark, the Air Force’s deputy chief of staff for strategic deterrence and nuclear integration, [told](#) the House Armed Services Committee in March 2019 that while the missile’s propulsion and guidance systems are aging, there is still one more opportunity to extend their life before a new missile is needed.

The Air Force’s 2014 analysis found that the price to build and operate a new missile system would be [roughly the same](#) as the cost to maintain the Minuteman III. Pentagon officials have [repeatedly touted](#) this conclusion in making the case against extending the life of the missile. But the service arrived at this conclusion by comparing the total life-cycle cost of each option through 2075. This meant that the Minuteman III life-extension option included the costs of both refurbishing the existing missiles *and* the costs of building a new fleet of replacement missiles. The analysis of alternatives also assumed a need to deploy 450 missiles.

In contrast, the Congressional Budget Office evaluated the cost of the two options over a shorter period of time. Furthermore, a 2014 [report](#) by the RAND Corporation on the future of the ICBM force found that “any 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.” The report said continuing to maintain the Minuteman III through life-extension programs and “gradual upgrades is a relatively inexpensive way to retain current ICBM capabilities.”

The RAND study identified two challenges to this approach. First, the number of Minuteman III missile bodies is declining due to test launches. Based on the current testing pace of four to five tests per year, maintaining a force of 400 missiles, as is the plan under New START, would exhaust the test inventory by 2035. Second, the report said incremental modernization would be viable only if the capability the Minuteman III provides “is not substantially changed.”

Reducing the number of ICBMs to 300 and forgoing capability upgrades would mitigate these challenges while allowing the ICBM force to continue to serve its sponge, tripwire, and hedge functions. Life-extended Minuteman III missiles can be destroyed in their silos by incoming Russian warheads less expensively than new missiles produced under the ground-based strategic deterrent program. A force of 300 ICBMs would [match](#) the number of deployed Russian ICBMs and reduce by only 100 the total of 1,550 deployed strategic warheads the United States is planning to deploy under New START. If the nation believes it essential to field those 100 warheads, an additional eight submarine-launched ballistic missile warheads could be deployed among the 20 missiles carried by each of the 12 deployed ballistic missile submarines.

Reducing the size of the ICBM force could free up additional savings by allowing for the reconsideration of current ICBM warhead requirements. Current plans call for replacing both the W78 and W87 ICBM warheads and developing the capability to produce at least 80 plutonium pits per year by 2030. A smaller ICBM force should prompt scrutiny of whether it is necessary to maintain two different warhead types. The urgency of the requirement to produce so many pits, which a recent independent [report](#) determined would be “extremely challenging,” is driven in large part by the ambitious [scope](#) of the plans to replace the W78 ICBM warhead.

The claim that the Minuteman III may not be able to overcome expected advances in adversary missile defenses over the next two decades is unconvincing. There is a sizable inventory of countermeasures the missile is already [believed](#) to contain to overcome such defenses. Given the shortcomings of U.S. missile defenses against ICBMs despite a mammoth investment, what have Moscow and Beijing discovered about intercepting large numbers of ICBMs armed with countermeasures that the Pentagon has not?

Some analysts have [argued](#) that another less-expensive alternative to building a new ICBM would be for the Defense Department to place life-extended Trident D5 submarine-launched ballistic missiles on land in existing ICBM silos. The Trident D5 has been [successfully tested](#) 176 times and is the most [reliable](#) ballistic missile the United States has ever

deployed. The life-extended version of the missile is expected to remain in service through the early 2040s and its range [exceeds](#) that of the Minuteman III. Although Trident D5 is larger than Minuteman III, it is smaller than the retired Peacekeeper ICBM, which was deployed in Minuteman silos and which, like Trident D5, was cold-launched from a canister.

Deploying submarine-launched ballistic missiles on land would require the purchase of additional missiles (the Navy has [purchased](#) 533 Trident D5 missiles to date), but this would still be less expensive than developing and buying a new ICBM, particularly since the life-extended Trident D5 production line [remains](#) open. In addition, 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.

The Air Force and Navy completed in early 2016 a [joint assessment](#) of pursuing “full commonality” between the sea and land legs of the triad. The study determined that using the Trident D5 to replace the Minuteman III would not work due to “unique operating environments, nuclear surety features and mission requirements.” The most significant [issue](#) with Trident D5 is its use of a high-energy propellant and the arrangement of warheads around the third stage, which creates the possibility of plutonium-dispersal accidents, even with warheads incorporating insensitive high explosive. This could be addressed by designing a new third stage using lower-energy propellant.

### **An Even Lower-Cost Alternative**

An even less expensive approach would be to keep the Minuteman III past its expiration date in the early 2030s, which would delay, if not obviate, the need to refurbish the rocket motors.

The Air Force estimates the operational lifetime of ICBM motors using highly conservative methods. During the first decade or so after production, a relatively small number of motors are destructively tested and various physical, chemical, and mechanical properties are measured. Statistical models are fit to these data and used to predict the motor age when these properties will exceed specifications or thresholds that have been determined for motor reliability. Because the data are limited, there are large uncertainties and a lower boundary for the motor age is selected as the service life.

The useful life of the motors can be longer — in some cases, much longer. We know this because motors retired from active service in the ICBM force are [transferred](#) to the Rocket Systems Launch Program for use in test and space launch vehicles, where they have proved highly reliable many years beyond their service life. For example, the Air Force estimated the service life of the Minuteman II Stage 3 motor to be only [13.5 years](#), but the motor performed successfully in 60 of 64 RSLP launches (and all 34 static tests) conducted 25 to 40 years after production — two to three times the estimated service life.

This suggests that an independent evaluation of the methods used by the Air Force to determine service life is warranted. First-principles physics- and chemistry-based models may give more accurate estimates than statistical models based on limited data. Better still, the Air Force could develop methods to nondestructively measure motor properties. This 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 with measurements indicating unacceptable aging could be retired.

A draft version of the House NDAA would have required an [independent study](#) on the benefits, risks, and estimated cost savings of extending the life of the Minuteman III through 2050 and delaying the ground-based strategic deterrent program. The study would have required analyses “of incorporating sensors and nondestructive testing methods and technologies,” the “methods used to estimate the operational service life of Minuteman II and Minuteman III motors,” and “alternative methods of estimating the operational service life of Minuteman III motors.”

But the provision was stripped out during the House Armed Services Committee’s markup of the bill in June. While opponents argued that the Air Force has already conducted several studies of extending the Minuteman III, to our knowledge the kind of assessments called for in the original bill have not been undertaken.

An [amendment](#) to restore the study on the House floor failed by a [vote](#) of 164–264. Several congressional aides told us that Northrop Grumman aggressively lobbied against the amendment. If the contractor is convinced that a new missile is the only option, why would it oppose a study that, if the contractor is correct, would presumably validate the need for a new missile?

### **There's Still Time for a Smarter Approach**

The United States is planning to spend hundreds of billions of dollars over the next two decades to rebuild its nuclear arsenal. At the end of the process, the arsenal will look like the one the country has today, and will last another 50 years. But the spending plans face significant budgetary, programmatic, and political challenges. There's a better way. It is not too late to pursue a different path. Now is the time to re-evaluate nuclear weapons spending plans before the largest investments are made.

The Minuteman III can be sustained beyond the missile's expected retirement in the 2030 timeframe. Pursuing this approach would defer a decision on whether to build a costly new missile, freeing up billions to spend on other, higher priority Pentagon modernization programs. And doing so would still allow the ICBM force to provide the purported deterrent benefits that it provides today.

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