The Heritage Foundation

BACKGROUNDER

No. 3834 | JUNE 3, 2024

DOUGLAS AND SARAH ALLISON CENTER FOR NATIONAL SECURITY

Columbia Submarine Fleet Production Should Be Radically Expanded

Robert Peters and Brent D. Sadler

KEY TAKEAWAYS

The current ballistic missile submarine fleet was designed for a relatively benign security environment.

That security environment never materialized. Instead, the world has become far more dangerous, and China is on track to become a nuclear peer by 2035.

Action, both near-term and long-term, is needed to ensure that our ballistic missile submarine force remains a credible deterrent for the next half-century.

For decades, the United States Navy has operated submarines capable of launching nuclear-armed ballistic missiles. First fielded in the 1960s, nuclear ballistic missile submarines (SSBNs) patrol the waters of the North Atlantic and Pacific Oceans undetected, with only the ships' captains knowing exactly where they lie.

The secrecy of these submarines and their ability to deliver more than 200 nuclear warheads in a relatively brief period of time together represent their value proposition. Amazingly silent—to the point of being undetectable—these submarines represent the assured second-strike leg of the American nuclear triad, each component of which has a specific role and function in America's deterrence posture.

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- Land-based intercontinental ballistic missiles (ICBMs) represent an ability to strike any target in the world promptly;

- Nuclear-capable bombers represent a recallable and highly visible means of signaling intentions to friends and foes alike; and

- SSBNs represent the triad's assured, survivable second-strike capability.

Put another way, fielding a credible fleet of SSBNs means that even if an adversary successfully carried out a nuclear first strike on the United States, thereby causing widespread death and catastrophic physical destruction, the United States would still be able to launch an overwhelming nuclear retaliation from the depths of the world's oceans. Thus, the submarines' role is to convince America's adversaries that any attempt to disarm the United States with a nuclear strike on its homeland would be an act of suicide.

The United States currently fields 14 *Ohio*-class ballistic missile submarines, at least five of which are on continuous patrol at any one time, along with an additional four *Ohio*-class submarines that have been reconfigured to fire long-range conventional cruise missiles and conduct special forces operations. Taken together, the 18 *Ohio*-class submarines have served the United States—and global security—for over four decades as the ultimate backstop of a credible deterrence arsenal.

The Next Generation of Ballistic Missile Submarines

It is projected that beginning in 2030, the United States Navy will begin to replace the *Ohio*-class SSBNs with the *Columbia*-class ballistic missile submarines. These new submarines will perform a function similar to that of the *Ohio*-class subs, albeit in smaller numbers. As planned, the United States will replace the 14 *Ohio*-class SSBNs with 12 Columbia-class SSBNs, which will carry fewer missiles than the current *Ohio*-class boats.

When originally deployed, the *Ohio*-class operated 24 ballistic missile tubes. After the 2010 New START nuclear arms control treaty entered into force, the U.S. Navy shuttered four tubes to comply with the treaty. *Columbia* will have a still smaller capacity, fielding only 16 missile tubes per boat. With the current Trident II (D5) missile, this fleet of 12 *Columbia* SSBNs could deploy at most 1,920 warheads as opposed to the nearly 5,000 possible warheads loaded onto the original *Ohio*-class ballistic missile fleet.[1] The new *Columbia* is designed to be the quietest submarine ever put to sea and

therefore safely undetectable by current technologies. At an average cost of $8.4 billion to $9.2 billion per boat for the 12 to be built, they are certainly not cheap, but they will be patrolling into the 2080s.[2]

All of this raises two important questions:

- With fewer boats, each of which carries significantly fewer warheads than its predecessor, is the current *Columbia* order sufficient to deter a world in which Russia is modernizing its nuclear arsenal and regularly threatens its neighbors with nuclear annihilation?

- Why, given the rapidly expanding nuclear arsenals of China and North Korea and the increasing possibility of an Iranian nuclear breakout capability, is the United States reducing its at-sea deterrent?

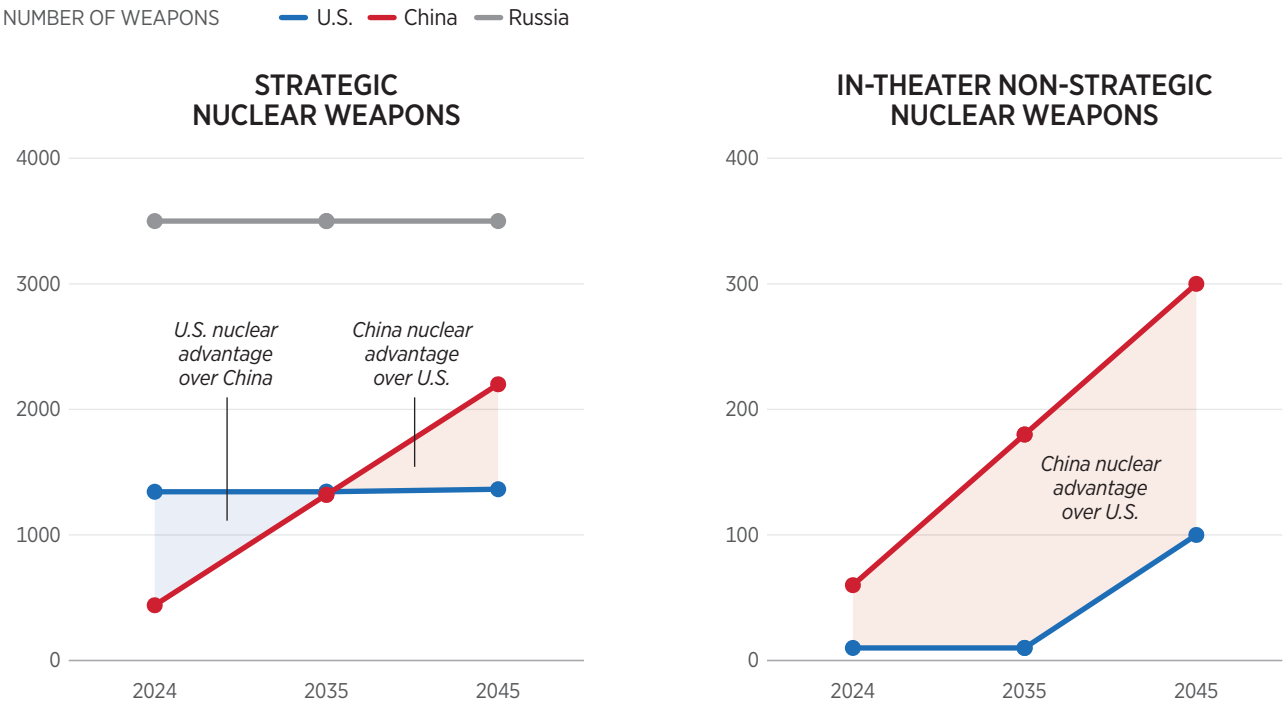
The answers lie in the genesis of the *Columbia* subs themselves. President Barack Obama won a Nobel Peace Prize in part for his "commitment to seek the peace and security of a world without nuclear weapons."[3] Seeking to make good on his commitment, the United States Senate ratified the New START nuclear arms control treaty with Russia in 2010. President Obama's 2010 *Nuclear Posture Review* posited that future arms control treaties would follow New START, to include multilateral treaties that would reduce further the arsenals not only of Russia and the United States, but of China as well, and that those three states would work together to counteract the greatest threat to humanity—nuclear weapons in the hands of terrorists.[4]

The world, of course, turned out very differently. Instead of cutting its nuclear forces, China is expanding them a rate of one hundred new nuclear weapons every year and "is on track to numerically match the U.S. nuclear arsenal by 2032."[5] North Korea is steadily fielding increasingly modern nuclear weapons that are capable of striking targets across North America from land-based and sea-based platforms and has abandoned any pretense of interest in arms control. Moreover, deterrence must be sufficient to deter an Iran that is on the verge of becoming a nuclear power and a Russia that is threatening the West daily with nuclear strikes and, according to the Commander of U.S. Strategic Command, is expanding its nuclear arsenal.[6]

Because the current *Columbia* program's size and composition were designed with a relatively benign world in mind, it is fair to ask whether that program is sufficient to deter our adversaries in today's far more dangerous environment. We believe that, given the increasing number and diversity of adversary nuclear weapons, which create additional targets that the United States must consider holding at risk both to deter strategic attack

CHART 1

China Will Soon Have Nuclear Weapons Advantage Over the U.S.



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on the United States or its allies and to hedge against future uncertainty and further degradations in the security environment, *the United States must field a larger SSBN force for the next half-century in order to ensure that it is capable of fielding a credible deterrent*.

The fundamental question facing the U.S. Navy is how the current ballistic missile submarine program of record, conceptualized in 2010, can be amended to ensure that we have a fleet of ballistic missile submarines that is sufficient to maintain that credible deterrent. The *Columbia*-class submarines will have a service life of more than 40 years and must therefore be able to meet the strategic challenges to America's security until well beyond 2070.

The U.S. Navy has a duty to ensure the viability and credibility of the nation's assured second-strike capability in a way that is both flexible and responsive to the evolving threat environment. For this reason, it is time to revisit the *Columbia* program writ large.

Retaining a Credible At-Sea Deterrent

Fortunately, four practical options are available to strengthen the credibility of our at-sea nuclear deterrence. They include retaining aging *Ohio*-class submarines past service life, uploading more nuclear warheads on each missile in today's *Ohio*-class SSBNs, modifying *Columbia*-class SSBNs to carry more missiles, and building more *Columbia*-class SSBNs faster. An option to replace or reverse the permanent deactivation of four missile tubes, in accordance with the New START Treaty, was not considered due to likely prohibitive cost and extended time to execute in limited dry dock space.[7]

Option 1: Retaining *Ohio*-Class Submarines Past Their Service Life. The first option focuses on service life extension of today's *Ohio*-class SSBNs. As the first *Columbia* reaches its delivery date with too few missile tubes, it will be necessary to retain some of the *Ohio*-class boats longer to defer the loss of at-sea nuclear firepower. This would not include consideration of repurposing the oldest *Ohio*-class SSBNs as cruise missile carriers (SSGNs), as reconfiguring those boats would be both costly and time-consuming for little added at-sea life.

Determining how much life older SSBNs have available to be extended is a function of the remaining nuclear fuel as well as hull metal fatiguing. Nuclear reactors have long lifespans measured in decades, but at a certain point, the radioactive fuel that runs the reactors must be replaced, and the reactors themselves must eventually be completely refurbished or replaced. Current *Ohio*-class submarine reactors are at the end of their life and must be either completely overhauled (and at significant cost), refueled, or replaced entirely—given the age of these boats, not a viable option.

Metal fatiguing refers to the weakening of the submarine's metal hull due to the stresses caused by decades of operating at depths where the ocean's pressure continually squeezes the submarine. Over time, hull strength is weakened to the point where there is little the Navy can do to mitigate the impact of metal fatiguing, and the submarines can no longer safely submerge without running the risk of a critical hull breach. Given the ages of the *Ohio*-class boats, long-term life extensions cannot be relied upon indefinitely. The combination of the two may make service life extension infeasible for most boats. For those that can undergo life extension, such an extension is feasible only for a few years.

These service life extensions can mitigate the loss of at-sea submarine nuclear firepower over the course of the next 10 years, but without additional actions, the drop in at-sea deterrent capacity will continue as enemies grow their own arsenals. Maximizing nuclear firepower at sea requires any *Ohio*-class SSBNs that still has life available should undergo life extension. If the Navy can defer retiring aging *Ohio* SSBNs through 2030, that would ensure 296 missile tubes rather than 216.

Reporting in late 2023 indicated that the Navy was moving forward with a plan to extend the service life of as many as five *Ohio*-class submarines by up to three years.[8] Not said is which boats are potential candidates for service life extensions, but assuming this includes the oldest *Ohio* SSBNs, the plan would defer the beginning of their retirement until 2030. This limited service life extension would increase the number of missile tubes at sea until as late as 2034, depending on specific requirements and hull assessments from the Navy.

These life extensions do not include the four SSGNs, which are the oldest *Ohio*-class submarines and due to be retired by 2028. Their loss represents a significant decrement to the Navy's long-range conventional strike capacity. Therefore, but only after meeting strategic deterrent requirements, options for future *Columbia* boats as SSGNs should be considered. Ideally, new SSGNs could enter the fleet sooner than current Navy long-range shipbuilding plans postulate, beginning no earlier than 2044.[9]

Option 2: Uploading More Warheads to Existing *Ohio*-Class Submarines. Another near-term option is to put more warheads on the existing submarine-launched ballistic missiles, a function known as "upload." An upload effort assumes that currently deployed missiles are not fully loaded with multiple independently targetable re-entry vehicles (MIRVs).[10]

Maximizing the number of warheads that each missile may carry might not ensure coverage of the rapidly evolving strategic environment with more geographically dispersed targets. Each Trident D5 missile carries its warheads over a limited range along a ballistic path. The more warheads on a missile, the shorter the range of the missile, as it is slowed by carrying additional weight from the warheads. Therefore, to reach more dispersed targets, warheads will need to be delivered from additional SSBNs operating within range of additional targets. This will require more ballistic missiles carrying more warheads to ensure adequate target coverage, which is made necessary by (among other things) the expansion of the Chinese nuclear arsenal into the missile fields of China's western desert.[11]

Assuming available warheads, uploading additional warheads to existing missiles could be executed quickly as today's *Ohio*-class submarines return from patrol. Done aggressively, this could be completed within the course

of a year assuming that special handling facilities and crews are available to execute the uploading.[12] While the load-out of existing ballistic missiles is classified, it is known that ballistic missiles on submarines carry a variety of warhead numbers. Some missiles carry 10 warheads, and others carry significantly fewer warheads. As noted above, the increasing range constriction associated with more warheads on a missile makes it inadvisable to maximize the load-out on all of the missiles. It is nevertheless possible that each ballistic missile submarine on patrol could carry additional warheads—probably no more than 20 per submarine.

In this sense, uploading would be a beneficial but still insufficient step by which to deter the emerging security environment of the 2030s when the United States will face two nuclear peers.

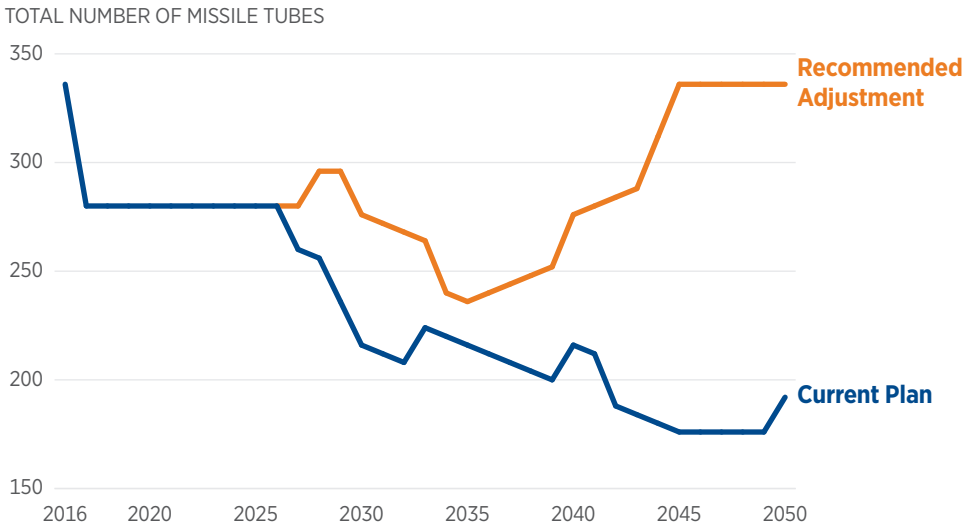
Option 3: Modifying *Columbia*-Class SSBNs to Carry More Missiles. The third option includes modifying the current design of the *Columbia*-class SSBN with hull extensions to carry more missiles. This is not novel and is something submarine designers and shipbuilders have done previously. Notably, the attack submarine *George Washington* as originally designed was converted with hull extensions to carry ballistic missile tubes in the 1950s.

Given their modular assembly nature, whereby component sections of the boat are built independently and then assembled at the final shipyard, *Columbia*-class SSBNs could be modified with additional missile tubes in so-called quad packs—modular components that carry four ballistic missile tubes per component. It is possible that future *Columbia* SSBNs could carry an additional four or even eight ballistic missile tubes per boat. Assuming no detrimental impact on the operation of these modified boats, the addition of eight tubes should be pursued. Putting eight more tubes on future *Columbia* SSBNs would enable each ballistic missile submarine to carry additional nuclear warheads; within New Start limits, this would add a maximum of 64 warheads to each boat,[13] which would allow each boat to hold more targets at risk and strengthen America's deterrent credibility.

In addition, given that the *Columbia* class will serve as the backbone of America's deterrent until well into the 2070s, it is imperative that these ships have the operational flexibility to respond to future threats. That is, they must be able to hold at risk targets or actors that may not today be threats. In this sense, having a larger missile tube capacity is a way to hedge against strategic risk by ensuring that the United States will not have capacity shortfalls if the U.S. nuclear arsenal of the 2050s has to be significantly higher than that of the 2030s. In addition, given that quad packs cost significantly less than each *Columbia* costs, it is much more cost-effective to build larger *Columbia*-class subs than it is to build more.

CHART 2

Mitigating Lost Deterrence: *Ohio*-Class Life Extension and Additional Missile Tubes



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It should be noted that building larger *Columbia* SSBNs also involves some potential negatives. One possible downside is that making such late design modifications potentially entails operational constraints such as speed. Larger SSBNs might reduce the designed stealthiness of each boat. In addition, a design change now could further delay delivery of *Columbia*-class boats already under construction. The best way to avoid further program delays is to make such a redesign effective beginning with the seventh *Columbia*, which is expected to be delivered in 2036.[14] This further argues for the maximum addition of missile tubes from the seventh *Columbia* through the 12th boat for a total of 240 missile tubes in 2042 versus the currently planned 192 when the last planned *Columbia* is delivered.

Option 4: Building More *Columbia*-Class Ships. The fourth option focuses on building more *Columbia*-class SSBNs faster. This option is not likely to begin delivering added at-sea capacity this decade, as it comes at a

time when the submarine industrial base is struggling to produce even two attack submarines while trying to keep the first *Columbia* SSBN delivered on-time.[15] To this end, Congress's Commission on the Strategic Posture of the United States concluded in 2023 that the Navy would need to build a new shipyard with the capacity to build nuclear submarines to meet the demands of today's strategic environment.[16]

However, building more *Columbia*-class submarines at a faster rate will begin only after the first several hulls are delivered to the Navy early in the next decade. This means that Congress and the Navy must make the budgetary and industrial plans for such expansion in *Columbia*-class production *today*. Investments in industrial capacity will take years to mature and could include cost-effective plans for a next-generation SSGN based on the *Columbia* hull design.

As noted earlier, the current *Columbia* program of record assumes that the United States will build one ballistic missile submarine every year, beginning in 2031. To ensure adequate at-sea nuclear strike capacity, the United States should expand the program of record to include an additional four *Columbia*-class SSBNs for a total of 16. This is necessary to hedge against an uncertain 21st century future and to maintain a credible deterrence posture against not just one nuclear peer—the driving construct that led the U.S. Navy to program for 12 *Columbia* SSBNs in 2010—but two nuclear peers in the 2030s.

Assuming that the build rate of one *Columbia* a year by 2031 can be sustained, the United States could build a total of 16 SSBNs by 2045. In addition, the seventh through 16th of these SSBNs would be built with 24 missile tubes each. This would give the *Columbia* class a total of 336 ballistic missile tubes instead of the 192 currently programmed for the *Columbia* program.

In addition, the *Columbia* program should expand to include *Columbia*-class SSGNs. SSGNs are the aforementioned arsenal ships into which four *Ohio*-class SSBNs were converted years ago. SSGNs carry conventionally armed long-range precision strike cruise missiles. The SSGN concept expands the firepower of the U.S. Navy by giving it a submersible, undetectable platform that can launch extraordinary amounts of ordnance. One such *Ohio*-class arsenal ship, the USS *Florida*, is capable of firing 154 Tomahawk cruise missiles.[17] Programming for *Columbia*-class SSGNs would backfill the existing *Ohio*-class SSGNs, which will be retired this decade, and therefore strengthen our ability to deter bad actors and increase our conventional options for addressing threats.

Sustaining Nuclear At-Sea Deterrence

The SSBN fleet is already inadequately armed for the strategic nuclear environment the nation faces. To catch up and sustain an effective second-strike nuclear capability able to deter a widening range of nuclear-armed foes, the Navy will need to explore design modifications, build more SSBNs, and extend the service life of today's *Ohio*-class SSBNs. Specifically, the Navy (in order of urgency) should:

1. **Fund** the added operational and maintenance costs associated with extending the service life to the maximum extent possible (that is, more than the three-year extension currently being reviewed) for *Ohio*-class SSBNs that are due to be retired before 2036. The first modified *Columbia* SSBNs should begin to arrive in the fleet at about this time.

2. **Accelerate** production of ballistic missile warheads and the missile's service life extension to include potential design modifications. These changes would allow for greater range, maneuverability, and more warheads carried to cover an expanding range of targets per missile.

3. **Conduct** design modifications and begin advance procurement of additional missile modules for installation on hull seven and subsequent *Columbia*-class hulls. This first *Columbia*-class extended hull variant,, according to current plans, would be delivered to the Navy in 2036.

4. **Commit** to producing more *Columbia*-class SSBNs beyond the 12 currently programmed. This is needed both to pace the strategic threats and as a replacement platform for the lost conventional firepower of the four SSGNs that are due to retire this decade. A threat-informed goal should ensure an adequate at-sea second-strike capacity this decade and for the worst-case threat environment in 2070 when the first *Columbia* would retire. Such an assumption would envision a fleet of *Columbia*-class submarines that includes 16 as ballistic missile submarines and six as conventional arsenal ships in SSGN configurations.

Mitigating the loss of strategic deterrent firepower that will accelerate after 2027 as the retirement of aging *Ohio*-class SSBNs begins will require all of the above options. In the near term, service life extensions only defer

this decline, but as *Columbia* SSBNs begin delivery with 16 missile tubes, at-sea capacity can increase up to 2030, after which numbers will again begin to decline. The only way to reverse this decline and ensure that the growth of our at-sea deterrent firepower resumes is by adding eight missile tubes with the seventh and future *Columbia* SSBNs beginning in 2036.

The additional capacity that these options provide is a hedge against the strategic uncertainty that we will face through 2070 when the first *Columbia* SSBN retires. The recommendations in this paper only begin to address this new dangerous world. Executing this larger procurement plan with added service life extensions and added missile tubes will add program costs over the next 20 years. On top of the current $112.7 billion 12-boat program,[18] the added cost of extending the remaining life of the *Ohio*-class SSBNs and building 16 *Columbia*-class SSBNs (seven modified for 24 missile tubes) would be more than $40 billion. Using Congressional Budget Office estimates for a base 12 SSBNs costing $119 billion,[19] the added expenses proposed here would raise the total cost of the SSBN program to approximately $161 billion. This would consider normal cost increases over program life, procuring additional missile tubes on seven *Columbia*-class SSBNs, for a total of 16 boats and service life extensions of no fewer than five *Ohio*-class boats.

Addressing the nation's looming at-sea nuclear deterrent deficit will be expensive, but it is also needed to sustain key elements of our national defense well into the future. The initial phase of this process will require immediate investments in advanced procurement of additional missile quad packs and associated design work. To this end, offsets of about $80 million should be found in the President's proposed Defense Department fiscal year 2025 budget of $162 million for "Diversity, Equity, Inclusion, and Accessibility (DEIA)."[20]

Conclusion

The world is becoming more dangerous, and the nuclear threat is becoming more explicit. Despite the United States' best efforts, the sought-after world without nuclear weapons never materialized. Consequently, we must ensure that we field a credible, survivable second-strike capability to serve as the ultimate backstop of America's deterrence. To do this, we must build more—and more capable—*Columbia* SSBNs.

Robert Peters is Research Fellow for Nuclear Deterrence and Missile Defense in the Douglas and Sarah Allison Center for National Security at The Heritage Foundation. **Brent D. Sadler** is Senior Research Fellow for Naval Warfare and Advanced Technology in the Allison Center.

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