Cost Overview

The United States maintains an arsenal of about 1,650 strategic nuclear warheads deployed on Intercontinental Ballistic Missiles (ICBMs), Submarine-Launched Ballistic Missiles (SLBMs), and Strategic Bombers and some 180 tactical nuclear weapons at bomber bases in five European countries.

The Congressional Budget Office (CBO) published a major report in October 2017 that estimates the nuclear weapons spending plans President Donald Trump inherited from his predecessor will cost taxpayers $1.2 trillion in inflation-adjusted dollars between fiscal years 2017 and 2046. This amounts to about 6 percent of all spending on national defense anticipated for that period, as of President Barack Obama’s final budget request to Congress in February 2016. When the effects of inflation are included, the 30-year cost would approach $1.7 trillion, according to a projection by the Arms Control Association.

The CBO estimate captures spending on the triad of nuclear delivery systems and command and control systems at the Defense Department and on nuclear warheads and their supporting infrastructure at the Energy Department’s semi-autonomous National Nuclear Security Administration (NNSA). Nearly every element of the U.S. nuclear arsenal is slated to be upgraded over the next 20 years. Most of these efforts are in the early stages, and a few others have yet to begin.

Other nuclear-armed states, notably Russia and China, are upgrading their arsenals and have tested, produced, and deployed more brand new systems than the United States over the past decade. But the U.S. military has upgraded and refurbished nearly all of its existing strategic and tactical delivery systems and the warheads they carry to last well beyond their originally planned service life and is now in the early stages of replacing many of these aging systems with new systems. Though decades old, these modernized forces are more capable than the originals and the new systems will include additional capability upgrades. The current and planned U.S. financial investment in nuclear forces is unrivaled by any other nuclear power.

Gen. Paul Selva, the Vice Chairman of the Joint Chiefs of Staff, noted in testimony to the House Armed Services Committee in March 2017 that while Russia and China continue to modernize their nuclear forces, "we [the United States] do have a qualitative advantage."
The Trump administration, as outlined in its Nuclear Posture Review (NPR) released on Feb. 2, 2018, intends to continue the modernization plan laid out by the Obama administration, and also develop several new nuclear weapons capabilities that will add to the price tag for nuclear forces, including the near-term development of a low-yield submarine-launched ballistic missile (SLBM) and the longer-term development of new nuclear submarine-launched cruise missile (SLCM).

The NPR acknowledges that the upgrade costs are “substantial” but claims that nuclear weapons will consume no more than 6.4 percent of the defense budget. This projection does not include the cost of the new capabilities proposed in the review nor the major costs that must be borne by NNSA to upgrade nuclear warheads and their supporting infrastructure.

The CBO estimates that annual spending on nuclear weapons will peak at about $50 billion during the late 2020s and early 2030s. During this period, nuclear weapons would consume about 8 percent of total national defense spending and 15 percent of the Defense Department’s acquisition costs. The CBO estimate includes the full cost to sustain and upgrade long-range strategic bombers.

White House and Pentagon officials and defense budget watchers have expressed concern that the current triad modernization plans may not be executable in the absence of significant and sustained increases to overall military spending in the coming 15-20 years, in large part due to the fact that nuclear costs are scheduled to rise and overlap with a large "bow wave" in projected spending on conventional weapon system modernization programs, as well as rising personnel and readiness costs.

Former head of U.S. Strategic Command Gen. Robert Kehler said in November 2017 that he is "skeptical that we are capable of remaining committed to a long-term project like this [nuclear modernization] without basically messing with it and screwing it up."

The 2011 Budget Control Act puts in place caps on military spending through 2021. According to the CBO, in the long-term an aging population, rising health care costs, and the rising interest on the national debt will constrain the amount of funding available for discretionary spending, including...
defense spending, if tax revenues do not increase significantly. However, the Bipartisan Budget Act of 2018 increased the FY 2018 cap for national defense spending by $80 billion to $269 billion and increased the FY 2019 cap by $85 billion to $647 billion. Regardless, pressure on the defense budget and the implicit trade-offs within that budget are likely to persist into the 2020s and 2030s.

For FY 2019 President Trump requested $11 billion to fund NNSA's nuclear weapons activities. This represents a massive 19 percent increase over the FY 2017 appropriation and reflects the direction in the NPR to significantly expand the agency’s work to prepare the United States to develop, test, and deploy new nuclear weapons and to increase the size of the nuclear stockpile. According to former deputy NNSA administrator Madelyn Creedon, “The biggest challenge laid out in the 2018 report is the new assignment for the NNSA.”

A U.S. Government Accountability Office report issued last year, warned that the “NNSA’s plans to modernize its nuclear weapons do not align with its budget, raising affordability concerns.” And former agency administrator Frank Klotz said in a Jan. 23 interview just two days after leaving office that the agency is “working pretty much at full capacity.”

### Nuclear Modernization Snapshot

The overall nuclear modernization effort includes:

- **Modernized Strategic Delivery Systems**: Existing U.S. nuclear delivery systems are undergoing continual modernization, including complete rebuilds of the Minuteman III ICBM and Trident II SLBM. The service lives of the Navy’s 14 Trident Ohio-class ballistic missile submarines are being extended. Additionally, a new submarine, the Columbia class, which will replace the Ohio-class ballistic missile submarines, is undergoing development and is expected to cost about $128 billion to develop, according to the Defense Department. The B-2 strategic bomber, a relatively new system, is being upgraded, as is the B-52H bomber. The Air Force is also planning a new strategic bomber, the B-21, and a new nuclear-capable cruise missile, known as the Long-Range Standoff Weapon (LRSO) to replace the existing Air-Launched Cruise Missile (ALCM).

- **Refurbished Nuclear Warheads**: The U.S. stockpile of nuclear warheads and bombs is continually refurbished through NNSA’s Life Extension Program (LEP). Existing warheads are certified annually to be safe and reliable. The NNSA is currently pursuing a controversial and expensive plan to consolidate the existing number of nuclear warhead types from 10 down to 5, although this program has been delayed. Known as the “3+2” strategy, the five LEPs associated with this approach are estimated to cost over $60 billion.

- **Modernized Production Complex**: The nuclear weapons production complex is being modernized as well, with new facilities planned and funded. For example, the FY 2019 NNSA budget request includes $703 million for the Uranium Processing Facility (UPF) at Oak Ridge, Tennessee. The total construction cost for UPF is estimated at $6.5 – 7.5 billion, according to an independent study conducted by the Corps of Engineers, although some estimates put the price tag at $11 billion. NNSA has pledged to complete construction by 2025 for $6.5 billion.

- **Command and Control Systems**: The Defense Department maintains command, control, communications, and early-warning systems that allow operators to communicate with nuclear forces, issue commands that control their use, and detect or rule out incoming attacks. The department plans to spend $40.5 billion on these activities between FY 2017 and FY 2026. This estimate is probably understated as the Pentagon is still developing its plan for modernizing these systems. In addition, the 2018 NPR calls for placing greater attention and focus on sustaining and upgrading command and control capabilities.

- **Nuclear Force Improvement Program**: In the wake of revelations of professional and ethical lapses and poor morale in the U.S. nuclear force, Defense Secretary Chuck Hagel announced in November 2014 steps the department is taking to address the numerous setbacks. These include changing the conduct of inspections to reduce the burden on airmen
Nuclear Modernization Overview

The following is a status update of existing programs to enhance the nuclear stockpile and modernize the delivery systems that make up each element of the U.S. nuclear triad:

1. Intercontinental Ballistic Missiles (ICBMs)

The United States Air Force currently deploys about 400 Minuteman III ICBMs (as of February 5, 2018) located at F.E. Warren Air Force Base, Wyoming; Malmstrom Air Force Base, Montana; and Minot Air Force Base, North Dakota. U.S. nuclear-armed ICBMs are on high alert, meaning the missiles can be fired within minutes of a presidential decision to do so. Under the New START treaty, the United States maintains 50 extra missile silos in a "warm" reserve status.

Today's Minuteman weapon system is the product of almost 40 years of continuous enhancement. The Pentagon has spent over $7 billion over the past 15 years on life extension efforts to keep the ICBMs safe, secure and reliable through 2030. This modernization program has resulted in an essentially "new" missile, expanded targeting options, and improved accuracy and survivability.

Ground-Based Strategic Deterrent

The Air Force is planning to replace the Minuteman III missile, its supporting launch control facilities, and command and control infrastructure. The Air Force intends to purchase over 600 missiles, 400 of which would be operationally deployed through 2070. The remaining missiles would be used for test flights and as spares. The replacement program is known as the Ground-Based Strategic Deterrent (GBSD). The service is seeking to make significant capability upgrades as part of the recapitalization program. The Pentagon in August 2016 set the estimated acquisition cost of the program at $85 billion and the total life-cycle cost at $238 billion (in then-year dollars). The $85 billion estimate is at the lower-end of an independent Pentagon cost-estimate that put the acquisition price tag as high as $140 billion.

For FY 2019, the Trump administration requested $345 million for the program, a 60 percent increase over 2018. On Aug. 21, 2017, the Air Force awarded contracts to both Boeing Company and Northrop Grumman to continue development and begin design of the new ICBM system.

W78 and W87 Warheads

The Air Force has also upgraded the Minuteman’s nuclear warheads by partially replacing older W78 warheads with newer and more powerful W87 warheads, formerly deployed on the now-retired MX Peacekeeper ICBMs. The W87 entered the U.S. stockpile in 1986, making it one of the newest warheads in the arsenal with the most modern safety and security features, including insensitive high explosive and a fire-resistant pit design, which can help to minimize the possibility of plutonium dispersal in the event of an accident. Under a 2004 LEP, the W87 warhead was refurbished to extend its service life past 2025.

NNSA has proposed a joint LEP to field a common, refurbished warhead to replace the W78 and W88 (see SLBMs, below). Congress approved NNSA's 2014 proposal to delay production of this warhead by five years from 2025 to 2030. However, the 2018 NPR proposes to accelerate the program by one year and the FY 2019 budget request would provide $53 million for the project.

2. Submarine-Launched Ballistic Missiles (SLBMs) and Submarines

The United States Navy deploys, as of February 2018, 203 Trident II D5 SLBMs on 12 Ohio-class ballistic missile submarines (SSBNs) based out of Bangor, Washington (7 boats) and Kings Bay, Georgia (5 boats). The Ohio-class submarines have a service life of 42 years — two twenty-year
cycles with a two-year mid-life nuclear refueling. The total fleet includes 14 boats but due to the
refueling process, only 12 SSBNs are operational at any given time. Four to five submarines are
believed to be "on station" in the Atlantic and Pacific oceans ready to fire their missiles at targets at
any given time.

The Ohio-class SSBNs were first deployed in 1981, and will reach the end of their services at a rate of
approximately one boat per year between 2027 and 2040. The Navy plans to replace each retiring
boat, starting in 2031, with a new class of ballistic missile submarine, now referred to as the
Columbia class. The Navy originally planned to begin using the replacement boats in 2029, but in
2012 the Pentagon announced a two-year delay to the replacement program. This pushed back
completion of the first new submarine to 2031.

Taking into account the delay, the Navy now plans to purchase the first Columbia class submarine in
2021, the second in 2024, and one per year between 2026 and 2035. The first vessel is scheduled to
become operational in 2031. As a result, the Navy will field 10 ballistic missile submarines between
2030 and 2040.

In its FY 2019 request, the Navy asked for $3.7 billion for the Columbia class program — a 97
percent increase over 2018, making it the second-most expensive program in the 2019 Pentagon
budget request, next to the F-35 Joint Strike Fighter. The Navy ultimately wants 12 boats, and in
2017 estimated the cost to develop and buy the submarines to be $128 billion in then-year dollars at
the total life-cycle cost to be $267 billion. However, a report on the Columbia class program
published by the Government Accountability Office (GAO) in December 2017 warned that the
program is not adequately funded to address program risks and that the acquisition cost is likely to
exceed $128 billion.

Under New START, each Ohio-class submarine serves as a launch platform for up to 20 SLBMs loaded
with up to eight warheads each, or 240 total SLBMs. The Columbia class will carry up to 16 SLBMs,
for a maximum of 192 deployed SLBMs when the fleet is fully converted to the new boats in 2040.

Trident II D5 Submarine-Launched Ballistic Missiles

First deployed in 1990, the force of Trident II D5 missiles has been successfully tested over 160
times since design completion in 1989 and is continuously evaluated. (By contrast, Russia's newest
SLBM, the Bulava, has failed in roughly half its flight tests.) The Trident II D5 LEP is underway to
modernize key components, notably the electronics, and extend the life of the missile until 2042. In
2008, 12 life-extended variants of the D5 were purchased; 24 D5s were produced each year through
2012 for a total of 108 missiles at a total cost of $15 billion. The first modified D5s were deployed in
2013. The Navy's FY 2019 budget request includes a proposed $1.23 billion to fund the Trident II
LEP.

The Pentagon has yet to establish replacement program of record for the Trident II (D5),
development of which is likely to begin in the 2020s.

W76 and W88 Warheads

The D5 SLBMs are armed with approximately 768 W76 and 384 W88 warheads. In 2009, NNSA
began delivery of the W76-1, a refurbished version of the W76 that extends its service life for an
additional 30 years. NNSA plans to complete the $4 billion production of up to 2,000 W76-1
warheads by 2019. NNSA requested $114 million for the W76 life extension program for FY 2019,
down from $222 million the year before.

The W88 entered the stockpile in 1989, making it the newest warhead in the arsenal. The W88 was
the last U.S. warhead produced before the Rocky Flats Plant - which made plutonium "pits" - was
shut down in 1989. NNSA re-established pit production capacity at Los Alamos National Laboratory
with the first "certifiable" pit in 2003, and new production resumed in 2007. A new plutonium
research and pit production facility, the Chemistry and Metallurgy Research Replacement Nuclear
Facility (CMRR-NF), was planned for Los Alamos, but was put on hold for budget reasons in 2012.
With the rebuilt Trident D5 missile in service to 2042, the W76-1’s life extended to 2040-50, the relatively new W88 in service, and a new class of SSBNs lasting into the 2070s, the U.S. Navy’s Trident Fleet will be kept robust and modern deep into the 21st century.

3. Strategic Bombers

The United States Air Force currently maintains 13 deployed B-2 Spirit bombers at Whiteman Air Force Base in Missouri, and 36 deployed B-52H bombers at Minot Air Force Base, North Dakota, and Barksdale Air Force Base, Louisiana, that can be equipped for nuclear missions as of September 2017.

B-52H Bomber

The B-52H fleet, first deployed in 1961, has an on-going modification program, beginning in 1989, incorporating updates to the global positioning system, updating the weapons capabilities to accommodate a full array of advanced weapons developed after the procurement of the B-52H, and modifying the heavy stores adapter beams to allow the B-52H to carry up to 2,000 pound munitions and a total of 70,000 pounds of mixed ordnance armaments. In FY 2011 the Air Force added to its modernization efforts for the B-52H, receiving funding for the Combat Network Communications Technology (CONECT) program, which updates the B-52 computer infrastructure. The upgrade is projected to cost a total of $1.1 billion.

The B-52H is expected to remain in service until 2040.

B-2 Bomber

The Air Force continually modernizes the B-2 fleet, which first became operational in 1997 and is expected to last through 2058.

Ongoing B-2 modifications include an incremental three-part program to update the Extremely High Frequency Satellite Communications and Computer Upgrade program (EHF SATCOM). Increment 1 will upgrade the B-2’s flight management computers. Increment 2 provides more secure and survivable strategic communications by integrating the Family of Beyond-Line-of-Sight Terminals with the low observable antenna. Increment 3 connects the B-2 with the Global Information Grid. The Air Force also began procuring components for a Radar Modernization Program (RMP) in FY 2009.
The RMP includes replacing the original radar antenna and upgrading radar avionics.

The Air Force announced in February 2018 that "once sufficient B-21 aircraft are operational, the B-1s and B-2s will be incrementally retired."

**B-21 Bomber**

The Air Force is planning to purchase at least 100 new, dual-capable long-range penetrating bombers that will replace the B-1 and B-52 bombers. Known as the B-21, the Pentagon estimates the average procurement unit cost per aircraft will be between $546 million and $606 million (in Fy 2016 dollars). Fielding is slated to begin in the mid-2020s. The Trump administration requested $2.3 billion for the program in FY2019. The Air Force plans to spend $38.5 billion between FY 2017 and FY 2026 on research and development for the new bomber (in then-year dollars). The Air Force has refused to release the value of the contract awarded to Northrop Grumman Corp. in October 2015 to begin developing the B-21 program and the estimated total cost of the program, citing classification concerns.

The CBO estimates the B-21 program will cost $97 billion (in FY 2017 constant dollars).

**Air-Launched Cruise Missile and Long-Range Standoff Cruise Missile**

The B-52H carries the air-launched cruise missile (ALCM), first deployed in 1981. Each ALCM carries a W80-1 warhead, first produced in 1982. The Air Force retained roughly 570 nuclear-capable ALCMs as of the spring of 2015. Roughly 200 of these missiles are believed to be deployed at Minot Air Force Base in North Dakota with the W80-1 nuclear warhead.

Some reports indicate that the reliability of the ALCM could be in jeopardy due to aging components which are becoming increasingly difficult to maintain.

The Air Force is developing the long-range standoff cruise missile (LRSO) to replace the existing ALCM. The new missile will be compatible with the B-2 and B-52H bombers, as well as the planned B-21. The first missile is slated to be produced in 2026. The LRSO would carry the refurbished W80-4 warhead.

The current Air Force procurement plan for the LRSO calls for about 1,000 new nuclear-capable missiles, roughly double the size of the existing fleet of ALCMs. According to the service, the planned purchase of 1,000 missiles includes far more missiles than it plans to arm and deploy with nuclear warheads. For FY 2019, NNSA requested $654 million for the W80-4, making it the second-most expensive nuclear warhead, next to the B61-12. In addition, the Air Force requested $615 million for development of the LRSO missile.

The Pentagon projects the cost to acquire the new missile fleet at about $11 billion (in then-year dollars) and the cost to operate and sustain the missile fleet over its expected life at over $6 billion (in constant FY 2016 dollars). The Energy Department projects the cost of the life extension program for the ALCM warhead to be between $8 billion and $11.6 billion (in then-year dollars).

**B61 and B83 Warheads**

The B-2 carries the B61 and B83 strategic gravity bombs. The B61 has several mods, 3, 4, 7, 10, and 11. B61-3 and B61-4 are non-strategic weapons deployed in Europe for NATO aircraft as part of America’s extended nuclear commitment.

The B61-7 and B61-11 are strategic weapons deployed on the B-2 bomber. An LEP recently extended the life of the B61-7 for an additional 20 years by refurbishing the bomb’s secondary stage (canned subassembly) and replacing the associated seals, foam supports, cables and connectors, washers, o-rings, and limited life components. The ongoing B61 LEP would combine mods 3, 4, and 7 into a single bomb, the B61 mod 12. The B61-12 is slated to begin production in 2020 and will refurbish the bomb with new firing, arming, and safety components, updated radar components, permissive action link components and equipment, modified power supplies, thermal batteries, join test
assemblies, weapon trainers, and test and handling gear. The LEP will also modify the B61 for compatibility with the F-35 Joint Strike Fighter. The LEP will extend the life of the B61s for 20-30 years.

An updated assessment of the B61 life extension program (LEP) performed by the NNSA in 2016 put the direct cost of the program at $7.6 billion, an increase of $200 million over the agency’s estimate of $7.4 billion provided in its fiscal year 2017 budget materials. The NNSA’s independent Office of Cost Estimating and Program Evaluation, however, told the GAO that its assessment of the program projects a total cost of approximately $10 billion and a two-year delay to the agency’s estimated March 2020 first production-unit date. NNSA requested $794 million for the B61 LEP in FY 2019.

The upgraded B61 will be equipped with a new tail-kit guidance assembly that will make the bomb more accurate and allow it to have a lower yield than some of the existing variants. The new tail kit is being developed by the Air Force and is estimated to cost $1.3 billion.

The B83 was first produced in 1983, making it one of the newer weapons in the stockpile and the only remaining megaton-class weapon in the stockpile. The B83 has the most modern safety and security features, including insensitive high explosive and a fire-resistant pit.

The Obama administration stated that the B83 would be retired once confidence in the B61 mod 12 is projected to be achieved in the mid 2020s. However, the Trump NPR reverses this decision and calls for retaining the B83 until a suitable replacement is found.

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