U.S. Nuclear Modernization Programs

- Fact Sheets & Briefs

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Executive Summary

The United States maintains an arsenal of about 1,750 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 Departments of Defense and Energy requested approximately $23 billion in Fiscal Year (FY) 2015 to maintain and upgrade these systems and their supporting infrastructure, according to the nonpartisan Congressional Budget Office (CBO). CBO estimates that nuclear forces will cost $348 billion between FY 2015 and FY 2024. Three independent estimates put the expected total cost over the next 30 years at as much as $1 trillion.

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 systems with new systems. These modernized forces are more capable than the originals. The current and planned U.S. investment in nuclear forces is unrivaled by any other nuclear power.

Though the president and his military advisors have determined that U.S. security can be maintained while reducing the size of its deployed strategic nuclear arsenal by up to one-third below the 2010 New Strategic Arms Reduction Treaty (New START) levels, the proposed spending is based on maintaining roughly the New START levels in perpetuity.
The Obama administration has requested large increases for nuclear weapons programs at the Defense and Energy Departments to sustain and modernize the arsenal. Indeed, current and proposed spending levels for many key efforts currently exceed what the administration originally advertised early in its first term.

Defense Secretary Ash Carter told the Senate and House armed services committees in March 2016 that he “expects the total cost of nuclear modernization to be in the range of $350-$450 billion.” The estimate includes the cost to modernize and replace all three legs of the triad, including the full cost of the strategic bomber force. The estimate covers a period of 20 years and is in constant fiscal year 2016 dollars. The extent of the Energy Department costs included in the estimate is unclear.

Carter said that although the nuclear modernization plan “still presents an enormous affordability challenge for [the Defense Department], we believe it must be funded.”

A Defense Department chart obtained by Arms Control Today shows that total department nuclear spending is projected to average more than $40 billion in constant fiscal year 2016 dollars between 2025 and 2035, when modernization costs are expected to peak. The chart was prepared in January by the Pentagon’s Office of Cost Assessment and Program Evaluation, which provides the Defense Department with detailed analysis of the costs of major acquisition programs.

The chart includes only a small fraction of the NNSA’s projected weapons-related spending during this period. Including these costs would push average spending during this period to more than $50 billion per year.

Pentagon officials have said that when combined with the cost to sustain the current arsenal as new systems are built, planned modernization costs will increase spending on nuclear weapons from the current level of approximately 3 percent of the overall defense budget to about 7 percent.

A January report assessing 120 major defense acquisition programs by Todd Harrison, the director of defense budget analysis at the Center for Strategic and International Studies, showed that spending on nuclear weapons programs accounts for about 12%-19% of total modernization costs over the next 15 years, depending on how dual-use systems, such as the planned B-21 bomber, are counted.
The projected costs of nuclear modernization prompted Senate Armed Services Committee chairman John McCain (R-Ariz.) to utter the following on May 19, 2016, at the Brookings Institution: “it's very, very, very expensive....Do we really need the entire triad, given the situation?”

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.

For Fiscal Year (FY) 2017 President Obama has requested $9.2 billion to fund nuclear weapons activities in the Department of Energy’s National Nuclear Security Administration (NNSA), which oversees the U.S. nuclear stockpile and production complex, a 4.3 percent increase over the FY 2016 appropriation. The agency projects more than $300 billion in spending on nuclear weapons programs over the next 25 years.

Notably, NNSA says it may need $2.9 billion more in funding between 2022 and 2026 to implement its weapons activities than the agency is projecting to request. During this period, the NNSA is planning to be in the midst of simultaneously executing four to five major warhead life extension programs and several major construction projects.

The administration’s FY 2017 request for nuclear weapons programs at the Energy Department is roughly $2.9 billion more (or 45%) than the Bush administration’s final budget request. The GOP-led Congress has provided less funding for this program than requested by the President.

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 SSBN(X), which will replace the Ohio-class ballistic missile submarines, is undergoing development and is expected to cost about $140 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 JASON panel of independent scientists has found “no evidence” that extending the lives of existing U.S. nuclear warheads would lead to reduced confidence that the weapons will work. The panel concluded in its September 2009 report that “Lifetimes of today’s nuclear warheads could be extended for decades, with no anticipated loss in confidence.” The United States does not need to resume nuclear test explosions, nor does it need to build new “replacement” warhead designs to maintain the reliability and effectiveness of the U.S. nuclear stockpile. The NNSA is currently pursuing a controversial and expensive plan to consolidate the existing number of nuclear warhead types from 10 down to 5. Known as the "3+2" strategy, the five LEPs associated with this approach are estimated to cost over $60 billion in then-year dollars.

- **Modernized Production Complex:** The nuclear weapons production complex is being modernized as well, with new facilities planned and funded. For example, the FY 2017 NNSA budget includes $575 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.

**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 $37.5 billion on these activities between FY 2016 and FY 2025.

### The Coming Nuclear Enterprise Recapitalization

![Graph showing the coming nuclear enterprise recapitalization](image)

Source: Cost Assessment and Program Evaluation (CAPE)

**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 and sailors, eliminating micromanagement of nuclear personnel seen as overtaxed by excessive bureaucratic and administrative requirements, and elevating the head of Air Force Global Strike Command, which oversees the Air Force’s nuclear forces, from a three- to a four-star rank. Hagel also said the Defense Department will request a 10 percent annual increase in funding for nuclear weapons over the next five years. The FY 2016 budget request included $1.1 billion in proposed new funding pursuant to this effort. The proposal would support 1,120 additional military and civilian personnel working on Air Force nuclear issues and accelerate investments in Navy shipyard infrastructure. To help fund improvements across the nuclear enterprise, the Pentagon requested an increase of approximately $200 million in FY 2017 from FY 2016 and approximately $10 billion more in the FY 2017 Future Years Defense Program (FYDP) relative to the President’s Budget in 2016 to ensure the continued health of this enterprise.
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 441 Minuteman III ICBMs (as of September 1, 2015) 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 will reduce to 400 the number of deployed missiles and maintain 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. Enhancements to the Minuteman III missiles include:

- Rapid Execution and Combat Targeting (REACT) Service Life Extension Program: The first REACT system was installed in the Minuteman III in the 1990s. REACT reduces the time required to re-target the missiles. In 2006 the Air Force began modernizing REACT to extend its service life. The Air Force completed the effort in 2006.
- Safety Enhanced Reentry System Vehicle (SERV): SERV modifies the reentry vehicles for the W-87 warheads that were removed from the Peacekeeper missiles and redeployed on the Minuteman III.
- Propulsion Replacement Program (PRP): The PRP replaces the propellant in the Minuteman III.
- Guidance Replacement Program (GRP): The GRP extends and improves the reliability of the Minuteman III guidance sets.
- Propulsion System Rocket Engine Program (PSRE): PSRE is designed to replace the post-boost propulsion system components on the Minuteman III missiles.
- Solid Rocket Motor Warm Line Program: In FY 2009 Congress approved an Air Force program to continue producing the solid rocket motors for the Minuteman III in order to preserve the manufacturing capabilities.

This modernization program has resulted in an essentially “new” missile, expanded targeting options, and improved accuracy and survivability.

The Air Force is currently assessing how to replace the Minuteman III missile and its supporting launch control, and command and control infrastructure. In June 2015 Arms Control Today reported that the Air Force has proposed procurement of 642 follow-on missiles, 400 of which would be operationally deployed through 2070. The replacement program is known as the Ground-Based Strategic Deterrent (GBSD). The Air Force says it is not pursuing a GBSD design that could be transitioned to a mobile platform in the future, despite earlier reports to the contrary. In February 2015 the Air Force estimated the acquisition cost of the replacement program at approximately $62.3 billion over 30 years (in then-year dollars). However, 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 price tag as high as over $100 billion.

For FY 2017, the Obama administration requested $113.9 million for the program.

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.
There is no evidence to suggest that the W87—or any current U.S. nuclear warhead, for that matter—cannot be refurbished indefinitely. NNSA has proposed a joint LEP to field a common, refurbished warhead to replace the W78 and W88 (see SLBMs, below). However, Congress approved NNSA's 2014 proposal to delay production of this warhead by five years from 2025 to 2030.

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

The United States Navy currently has the ability to deploy 288 **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; 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. (By contrast, most of Russia’s 12 ballistic missile submarines **usually** perform deterrence patrols at dockside rather than venturing out to sea.)
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, referred to as the SSBN(X) or the Ohio-class replacement. The Navy originally planned to begin using the replacement boats in 2029, but in 2012 the Pentagon announced a two year delay to the SSBN(X) program. This would push back completion of the first SSBN(X) to 2031. In its FY 2017 request, the Navy asked for $1.86 billion for the Ohio replacement program. The Navy ultimately wants 12 boats, and in 2014 estimated the cost to develop and buy the submarines to be $140 billion in then-year dollars. The total lifecycle cost of the SSBNX program is estimated at approximately $282 billion (also in then-year dollars).

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

Each Ohio-class submarine serves as a launch platform for up to 24 SLBMs loaded with up to eight warheads each. Under the New START treaty, by 2018 the Navy plans to deploy 20 SLBMs on each Ohio class submarine rather than the full 24. This will result in a total of 240 deployed SLBMs. The SSBN(X) will carry up to 16 SLBMs, for a maximum of 192 deployed SLBMs when the fleet is fully converted to the SSBN(X) in 2040.

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 2017 budget request included a proposed $1.2 billion to fund the Trident II LEP.

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. According to NNSA, the W76 LEP is refurbishing the nuclear explosive package, the arming, firing, and fusing system, the gas transfer system, and associated cables, elastomers, valves, pads, cushions, foam supports, telemetries, and other miscellaneous parts. NNSA plans to complete the $4 billion production of up to 2,000 W76-1 warheads by 2019. NNSA requested $222.8 million for the W76 life extension program for FY 2017.

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 Plants - 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. NNSA requested $575 million in FY 2017 for construction of the UPF at Oak Ridge National Laboratory in Tennessee.

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 18 B-2 Spirit bombers at Whiteman Air Force Base in Missouri, and 76 B-52H bombers at Minot Air Force Base, North Dakota, and Barksdale Air Force Base, Louisiana, that can be equipped for nuclear missions. The Pentagon announced in 2014 that in order to meet the New START limits it would retain 42 deployed and 4 non-deployed nuclear capable B-52 bombers. The remainder of the B-52 bombers would be converted to carry only conventional weapons. In 2008 the Air Force created a designated bomber squadron at Minot Air Force Base to focus on the nuclear mission. The squadron began its operations in 2010 and is comprised of 22
B-52s. The B-52H is expected to remain in service until 2040.

The Air Force is planning to purchase 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 $511 million in 2010 dollars when procuring a 100 aircraft. The Obama administration asked for $1.4 billion for the program in FY 2017. The Air Force plans to spend $41.7 billion between FY 2016 and FY 2025 on research and development for the new bomber (in then-year dollars). The service has not released to the total estimated acquisition cost of the bomber, citing classification concerns.

The Air Force continually modernizes the B-2 fleet, which first became operational in 1997 and is expected to last through 2058. In testimony before the House Armed Services Subcommittee on Strategic Forces, on April 5, 2011, Major General William Chambers stated that the B-2 is “capable of long-range delivery of direct attack munitions in an anti-access environment.” To enable the B-2 to continue operating in high threat environments, Chambers testified that, “we have programs to modernize communication, offensive, and defensive systems.”

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 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. 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. NNSA intends to combine mods 3, 4, 7, and 10 into a single bomb, the B61 mod 12. The LEP will refurbish the warheads 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 new Joint Strike Fighter. The LEP will extend the life of the B61s for 20-30 years.

According to the NNSA, the First Production Unit will be completed in FY 2020. Completion of the LEP is scheduled for FY 2025, and will cost an estimated $10 billion dollars. NNSA requested $616.1 million for the LEP in FY 2017.

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. NNSA plans to retire the B83 sometime in the mid- to late-2020s once confidence in the B61 mod 12 is attained.

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 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, down from the original production run of 1,715 missiles, which concluded in 1986. Roughly 200 of these missiles are believed to be deployed at Minot Air Force Base in North Dakota with the W80-1 nuclear warhead. New START does not cap the number of bombs or cruise missiles that can be carried on treaty limited strategic bombers.

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 (or 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 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. The Obama administration’s fiscal year 2016 budget request proposed to increase spending to accelerate by two years the development of the LRSO and the modified W80-4 warhead that it would carry, partially reversing the fiscal year 2015 proposal to delay development of both by three years. For FY 2017, the Obama administration requested $220.3 million for the W80-4 and an additional $95.6 million for 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 $7.4 billion and $9.9 billion (in then-year dollars).

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### U.S. Nuclear Modernization Programs

Published on Arms Control Association (https://www.armscontrol.org)

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<td>Modernization and Replacement Program</td>
<td>$7 billion</td>
<td>through 2030 and possibly longer</td>
<td>Modernizes the propellant, guidance systems, propulsion system, targeting system, reentry vehicles and continues work on the rocket motors</td>
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<td><strong>New ICBM (GBSD)</strong></td>
<td>Replace the Minuteman III missile and associated launch control and command and control facilities</td>
<td>&gt;$85 billion (DoD estimate; FY 2015-2044)</td>
<td>2080s</td>
<td>Air Force plans to purchase 666 new ICBMs</td>
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<td><strong>B-2 Bomber</strong></td>
<td>Modernization Program</td>
<td>$9.5 billion (FY 2000-2014)</td>
<td>2050s</td>
<td>Improves radar and high frequency satellite communications capabilities for nuclear command and control</td>
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<td><strong>B-52H Bomber</strong></td>
<td>On-going modifications</td>
<td></td>
<td>2040s</td>
<td>Incorporates global positioning systems, updates computers and modernizes heavy stores adapter beams, and a full array of advance weapons</td>
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<td><strong>Long Range Strike Bomber (B-21)</strong></td>
<td>Research and development phase</td>
<td>$41.7 billion (FY 2016-2025)</td>
<td>2080s</td>
<td>The exact specifications of the new bomber are classified</td>
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<td><strong>Long Range Standoff Cruise Missile (LRSO)</strong></td>
<td>Replacement for the ALCM</td>
<td>$20 billion (estimated; includes cost of W80-4 warhead refurbishment)</td>
<td>2060s</td>
<td>Air Force plans to procure 1,000-1,100 LRSOs</td>
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<td><strong>Columbia Class SSBN (SSBN(X))</strong></td>
<td>New ballistic missile submarine</td>
<td>$140 billion (2014 Navy acquisition estimate)</td>
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<td>Navy plans to purchase 12 new submarines to replace the existing 14 Ohio-class submarines</td>
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