THE ISSUE
This brief is the second in the CSIS Project on Nuclear Issues (PONI) Deep Dive Debrief Series that explores emerging or contentious nuclear challenges. These briefs are based on a series of “deep dive” workshops convened by PONI that bring together next generation technical, operational, and policy experts from across the nuclear community to debate and discuss these nuclear challenges. This brief reflects discussion and insights from a deep dive workshop convened by CSIS PONI and the Royal United Services Institute’s (RUSI) UK PONI on September 15, 2020. The brief examines the debate surrounding the development of U.S. nuclear warhead capabilities and whether the United States is or is not creating “new” nuclear weapons. It discusses the expansion of U.S. nuclear warhead capabilities and its potential implications for U.S. relations with the United Kingdom and the North Atlantic Treaty Organization (NATO), warhead production infrastructure, and arms control and nonproliferation efforts.

KEY CONCLUSIONS
Most workshop participants recognized the need for the U.S. and UK nuclear-warhead modernization programs and agreed that these projects pose substantial fiscal and geopolitical challenges—including how to sustain political support, fund modernization efforts across lengthy acquisition time horizons, compete with adversaries’ nuclear modernization programs, and adequately address nonproliferation challenges. In addition, participants agreed that the tight coupling of the U.S. and UK nuclear programs, particularly in terms of modernizing the SSBN missile and warhead systems, calls for greater consistency among policy statements regarding these programs and greater appreciation of the required timeframes for modernization in both countries. To respond to these obstacles, it is crucial that the nuclear community develop effective and informed expertise on warhead modernization among government bodies and the NGO community and cultivate a common understanding of the benefits and risks associated with various warhead modernization approaches.

OVERVIEW
The Science-based Stockpile Stewardship Program, which began in 1993 after the United States instituted a moratorium on explosive nuclear weapons tests, requires that the National Nuclear Security Administration (NNSA) maintain confidence in the safety, security, and effectiveness of the U.S. nuclear arsenal without relying on nuclear testing. Under the Stockpile Stewardship Program, the United States does this through surveillance, maintenance, and modernization activities. Instead of developing and producing new types of warheads, the United States has almost exclusively focused on extending the life of existing warheads by replacing aging materials and components. These alterations and life-extension programs (LEPs) are part of ongoing efforts in the Department of Defense (DoD)
and NNSA to modernize nearly every aspect of the U.S. nuclear arsenal. Additionally, NNSA plans to produce at least two new warheads for the stockpile, the W93 and the Future Strategic Missile Warhead.

The Obama administration’s 2010 Nuclear Posture Review stated that the Stockpile Stewardship Program would allow the United States to “ensure a safe, secure, and effective deterrent without the development of new nuclear warheads or further nuclear testing.” Additionally, the life-extension programs “will use only nuclear components based on previously tested designs and will not support new military missions or provide for new military capabilities.” This position was consistent with the Obama administration’s general approach to warhead modernization, which included reducing the role of nuclear weapons, limiting operational functions or applications of nuclear weapons beyond the level required for deterrence, and reducing the stockpile’s overall number and designated types of warheads wherever possible.

This promise of no new testing, new designs for warheads, or new military capabilities was also highlighted in the U.S. statement to the Nuclear Non-Proliferation Treaty (NPT) Review Conference in 2015, when John Kerry said, “We have pledged not to pursue new nuclear warheads or support new military missions or military capabilities for the weapons that we do have, and we haven’t tested a nuclear weapon in 23 years.”\(^1\) The last nuclear weapon to be given a previously unused numbered designation was the W88, a warhead that entered the force in the late 1980s and is generally considered the “last to be added to the U.S. nuclear stockpile.”\(^3\)

In fiscal year (FY) 2021, the Trump administration introduced the W93 warhead designation, which had not previously existed in the U.S. arsenal. If developed and deployed, this warhead would sit atop the Trident D5 missile and its replacement submarine-launched ballistic missile (SLBM); the administration requested initial research and development (R&D) funding in FY 2021.\(^4\) The FY 2021 NNSA budget request also mentioned a second novel warhead, temporarily called the Future Strategic Missile Warhead, for which NNSA plans to request R&D funding in FY 2027.

The last nuclear weapon to be given a previously unused numbered designation was the W88, a warhead that entered the force in the late 1980s and is generally considered the “last to be added to the U.S. nuclear stockpile.”

The Trump administration’s Nuclear Posture Review directly challenged the notion of “no new capabilities,” stating that the “need for flexibility to tailor U.S. capabilities and strategies to meet future requirements and unanticipated developments runs contrary to a rigid, continuing policy of ‘no new nuclear capabilities.’” The 2018 Nuclear Posture Review additionally called for the creation of two capabilities that the United States did not then have, a low-yield variant of the Trident D5 SLBM and a sea-launched cruise missile (SLCM).\(^5\) The low-yield Trident II D5 was first deployed in 2020, and the sea-launched cruise missile has not yet received NNSA R&D funding. The Trump administration also did not choose to endorse the Obama administration’s policy of not designing new nuclear warheads.

**WHY IS THIS AN ISSUE?**

- As noted, while the Obama administration stated that the United States would not develop new nuclear weapons, the Trump administration did not make similar commitments regarding nonproliferation policy. The Trump administration has sought additional modernization and diversification within the nuclear weapons stockpile. However, it is unclear which of these changes will result in new capabilities and which—those with few of no enhanced features—are better described as replacements for existing warhead types.
- The U.S. nuclear arsenal is physically aging, as is U.S. nuclear weapons expertise. Some experts argue that life-extension programs, modernization, and the design of novel warheads will provide essential training for the next generation of nuclear weapons scientists. Given the rate of the arsenal’s decline, new warhead designs (and the designers needed to develop them) will likely be required even if the United States does not seek to enhance its nuclear capabilities.
• The development of “new” warheads has raised concerns about the prospect of renewed nuclear testing by the United States. Quietly, administration officials have suggested that testing is neither planned nor needed for the warhead designs under consideration, but clear, public statements have been lacking. Concerns that the United States might require testing for new warhead types were amplified by the 2020 Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments (Compliance Report), which emphasized U.S. concerns about possible Russian and Chinese nuclear testing. It is reasonable to assume that the incoming Biden administration will not support new nuclear testing and that any support for proceeding with warhead modernization efforts will be based upon that condition.

• Increased competition between the United States, China, and Russia and the collapse of most forms of bilateral arms control have heightened concerns about how “new” weapons could contribute to arms-race dynamics.

• For the purposes of policies that encourage nonproliferation and disarmament in the context of the Nuclear Non-Proliferation Treaty, “new” nuclear weapons lack definitional clarity. Is it a new nuclear mission or capability? What role should these types of assurances play in U.S. nonproliferation policy? Can the United States continue to support the principles of no new weapons, capabilities, or testing, and what are their pros and cons?

**EXPANDING NUCLEAR WEAPONS CAPABILITIES**

Critics and proponents of expanding nuclear warhead types under the Obama and Trump administrations have argued over three broad categories of capabilities: enhancing precision, developing variable- and low-yield technologies, and creating warheads that expand upon existing designs. In some cases, proponents of newer designs do not seek new capabilities but believe that stockpile needs should be met with newer designs that are less expensive, more reliable, or have longer warhead lifespans—rather than relying exclusively on older designs, largely for policy or political purposes.

Although several nuclear-weapons modernization programs have adjusted the yield and/or precision of some U.S. warheads, publicly available information on the issue is limited. For example, the B61-12 life-extension program was paired with the development of a new guided tail kit that could enhance its targeting precision. This was reportedly done to maintain the B61-12 warhead’s operational capability, not to improve it, because it had a reduced yield compared to its predecessors.

Advocates of enhanced accuracy—such as Stephen M. Younger, the former director of the Sandia National Laboratories and former associate director of Los Alamos National Laboratory’s nuclear weapons research and development division—have argued that “a sizable factor governing the explosive force required to defeat a target of given hardness is the precision with which weapons can be delivered.” A more precise weapon can lower the number of warheads and/or the explosive yield required per target and may reduce collateral damage from a limited nuclear strike. Opponents of enhanced precision argue that coupling enhanced accuracy and precision with reduced collateral damage could make nuclear options more palatable or encourage the development of first-strike counterforce options. Complicating the ability to assess new or enhanced warhead capabilities are the tradeoffs between yield and precision that together determine the warhead’s overall capability. For example, is a warhead that

---

**NNSA Nuclear Warhead Modernization**

possess a wide variety of low-yield weapons, thereby closing a critical gap in the escalation ladder. The 2018 Nuclear Posture Review suggested that Russia might resort to limited nuclear use in a regional conflict, forcing the United States to choose between nuclear retaliation with a disproportionately high-yield weapon—thereby risking a large-scale nuclear war—or back down from the conflict. Critics dismiss this dilemma, stating that claims of a Russian limited-nuclear-use doctrine are overblown, that the United States has sufficient variability within the existing stockpile to give the president an appropriate range of options, and that expanding the number and varieties of low-yield weapons could make nuclear use more likely by lowering the perceived consequences of use. As former secretary of defense William Perry wrote, “The greatest concern about the proposed low-yield Trident warhead is that the president might feel less restrained from using it in a crisis.” We can fully expect the U.S. arsenal to continue to maintain variable-yield options—the questions are rather about how many and on which platforms.

The second area of debate surrounding U.S. nuclear-arsenal modernization programs concerns the introduction of low-yield capabilities and the continued reliance on variable-yield nuclear weapons capabilities. It is important to note that the U.S. arsenal has had many variable- and low-yield capabilities in some form since the 1950s. For example, the now-retired B43, developed in 1956, included multiple yield options. However, the modern U.S. nuclear weapons arsenal has trended toward increased yield flexibility. The Long-Range Standoff Weapon (LRSW) reportedly has a yield range of 5–150 kilotons (kt), similar to reported yields for the W80-1. The B61-12 reportedly has four discrete explosive yields: 0.3 kt, 1.5 kt, 10 kt, and 50 kt. Additionally, while the W76 warhead (with a reported yield of around 100kt) was undergoing a life-extension program, the DoD approved a low-yield variant of the warhead known as the W76-2, creating an SLBM capability not previously found in the U.S. arsenal. NNSA completed the first production of this warhead in 2019, and the DoD confirmed in 2020 that the warhead has now been fielded.

Advocates of greater flexibility in U.S. yield options have argued that these technologies allow the United States to offset advantages posed by adversaries who already increase precision and decreases yield more capable? What about the reverse?

It is important to note that the U.S. arsenal has had many variable- and low-yield capabilities in some form since the 1950s. For example, the now retired B43, developed in 1956, included multiple yield options. For example, the now-retired B43, developed in 1956, included multiple yield options. However, the modern U.S. nuclear weapons arsenal has trended toward increased yield flexibility. The Long-Range Standoff Weapon (LRSO) reportedly has a yield range of 5–150 kilotons (kt), similar to reported yields for the W80-1. The B61-12 reportedly has four discrete explosive yields: 0.3 kt, 1.5 kt, 10 kt, and 50 kt. Additionally, while the W76 warhead (with a reported yield of around 100kt) was undergoing a life-extension program, the DoD approved a low-yield variant of the warhead known as the W76-2, creating an SLBM capability not previously found in the U.S. arsenal. NNSA completed the first production of this warhead in 2019, and the DoD confirmed in 2020 that the warhead has now been fielded.

The third trend in U.S. nuclear-warhead modernization is the expansion of pit production. Most U.S. life-extension programs provide maintenance on existing warheads. To ensure they continue to function until the end of the century, a handful of U.S. nuclear warheads may require newly produced plutonium pits, which have...
an estimated lifespan of 80–90 years. This applies to the W87-1 and, if developed, possibly to the W93, the Future Strategic Missile Warhead, and SLCM warhead. The W93, which would sit atop the Trident D5 missile and its follow-on replacement, is the designation for a warhead based on an existing design but that has not previously been deployed in the U.S. arsenal. The W87-1, as with the W87, will sit atop the proposed Ground-Based Strategic Deterrent missile system. While the W87-1 kept the W87 modifier, this warhead will require new plutonium pits to function for the duration of its estimated lifetime.

Proponents of these newer weapons designs have argued that these programs provide vital capacity building for U.S. nuclear weapons expertise. For example, Linton Brooks, John Harvey, and Franklin Miller argue that the W93 and its Mk7 aeroshell “involves refreshing the scientific and engineering prowess of the DoD and DoE [Department of Energy] in order to be able to design, when needed, modern nuclear warheads and the reentry vehicles which carry them.” Some workshop participants noted that newly designed pits may be more resilient and reduce demands for nuclear testing due to failures caused by aging. On the other hand, as some of those who oppose the creation of new weapons argue, constructing nuclear weapons based on existing designs that have not been explosively tested at full scale introduces uncertainties into the U.S. nuclear arsenal—and that the certification process for these untested warheads would increase demands for full-scale nuclear-weapons testing. Some argue that certain warheads, such as the W87-1, may differ from existing designs, driving U.S. demand for expanded plutonium-pit production sites. If true, this design approach is a substantial departure from other forms of modernization, which tend to modify capabilities or extend the life of existing warheads.

INFRASTRUCTURE CHANGES AND WARHEAD PRODUCTION

In order to support nuclear-warhead modernization projects, the United States currently plans to produce 80 pits per year by 2030 at two sites: Los Alamos National Laboratory in New Mexico and the Savannah River Site in South Carolina. The United States has not operated a full-scale plutonium pit production facility since 1989, when the Rocky Flats Plant was closed in an FBI environmental crimes raid. New plutonium-pit production facilities are necessary for building nuclear warheads that differ from existing designs. Additionally, as nuclear weapons age, they will eventually require new pits, although it is unclear how long plutonium pits in the U.S. arsenal will last. Currently, only the United States lacks an indigenous pit production capability to support long-term maintenance of its nuclear stockpile.

NNSA’s planned schedule for the expansion of Los Alamos and construction at the Savannah River Site has been called overly ambitious by academics, advocates, and federally funded research and development agencies. In 2019, the Institute for Defense Analyses (IDA) released a report evaluating NNSA’s two-site solution for plutonium pit production and questioning the expected timeline for the Savannah River location. It noted that “IDA examined past NNSA programs and could find no historical precedent to support starting initial operations . . . by 2030, much less full rate production.” IDA assessed that the plans for the Savannah River Site were likely to experience substantial cost growth and schedule slippage—and could even be completely canceled. It also questioned whether Los Alamos could meet its goals by 2030. More broadly, the proposal has come under fire from a variety of nuclear disarmament sources as potentially costly, environmentally harmful, or unnecessary. However, former NNSA administrator Lisa Gordon-Hagerty has insisted that NNSA will meet the 2030 timeline for both facilities.

Regardless of how fast plutonium pits age, at some point nuclear weapons production capabilities will be required to maintain the U.S. arsenal. This nuclear weapons infrastructure could be used to maintain the existing arsenal or to build new nuclear weapons. It remains unclear how, if at all, potential delays in pit production or manufacturing the U.S. W93 warhead would affect the United Kingdom’s parallel warhead-development program.

THE W93 AND U.S.–UK NUCLEAR COOPERATION

The longstanding history of cooperation between the United States and the United Kingdom on nuclear weapons issues is a significant driving force behind designing and building the W93 warhead. Although the United Kingdom would not use or copy the W93, the UK government is developing a parallel program to replace the Holbrook warhead to “respond to future threats and the security environment,” and there is considerable support within both governments’ militaries to continue cooperation on these issues. While the two countries would cooperate
closely on the warhead, their plans for incorporating it into their stockpiles appear to differ—and perhaps contributes to confusion. On the UK side, this new warhead would directly replace the existing Trident Holbrook, which has many corresponding characteristics with the W76, even as the new Dreadnought-class SSBN comes online. For the United States, the new warhead would (at least initially) complement the W76 and W88 warheads that are currently carried on the U.S. “sea leg” of the nuclear triad without increasing the size of the overall stockpile. Over time, the W93 would facilitate the retirement of one or both older warheads, but those decisions have yet to be made.

According to unclassified documents distributed to congressional members, the development of a replacement warhead is important for the U.K. government for several reasons. First, although the United Kingdom is in the process of replacing its Vanguard-class SSBNs with new Dreadnought-class SSBNs, these new submarines will continue to use the Trident II D5 SLBM system, making compatibility between a replacement warhead and the Trident II system necessary for the foreseeable future. (In 2019, the U.S. Strategic Systems Program indicated it would pursue a second life-extension program to maintain the Trident II missile through the expected lifetime of the U.S. Columbia-class SSBN, meaning the missile may be in service until the 2080s.) Second, as the United States considers developing the W93 warhead to complement the W76 and W88, the UK government argues that “cooperation with the U.S. is essential to the long-term viability and affordability of the U.K’s nuclear deterrent,” as “certain non-nuclear components of the existing UK nuclear warhead are procured from the U.S. and this will remain the case for the UK replacement warhead.” One such component is the Mk7 aeroshell, the atmosphere-reentry body that will house the warhead on the Trident II missile, as well as another unspecified non-nuclear component. Finally, the UK government argues that cooperation on the warhead benefits the transatlantic relationship in several ways, including boosting collaboration on nuclear technologies and materials vital to both the United States and United Kingdom, supporting a history of British financial investment in U.S. Navy programs, and maintaining the United Kingdom’s deterrence role in NATO, all while upholding its obligations under the NPT.

Similar arguments are echoed in official U.S. documents, reflecting an intergovernmental consensus that the W93 is beneficial for security arrangements between the United States and the United Kingdom. According to an unclassified memo prepared by the Department of Defense and National Nuclear Security Administration for distribution to Congress, “The W93/Mk7 program is . . . vital for continuing [the United States’] longstanding commitment of support to the United Kingdom.” The document and accompanying talking points primarily focus on the necessity of developing the W93 to bolster the U.S. nuclear deterrent as a technical hedge for the SLBM stockpile but briefly mentions the role the United Kingdom’s nuclear program plays as “important to U.S. national security and critical to NATO.”

The UK government appears to be continuing outreach
efforts in support of W93 development, as UK defense secretary Ben Wallace reportedly sent a letter to Congress in April 2020 urging lawmakers to support initial funding for the W93 as part of their ongoing defense budget discussions for FY 2021. According to reports, Wallace emphasized the importance of the $53-million initial weapon-design work, saying, “Congressional funding in [2021] for the W93 program will ensure that we continue to deepen the unique nuclear relationship between our two countries, enabling the United Kingdom to provide safe and assured continuous-at-sea deterrence for decades to come.”

“NEW” WEAPONS AND NONPROLIFERATION OBLIGATIONS

Just as the development and deployment of arguably “new” nuclear weapons capabilities have implications for U.S. relations with nuclear-armed allies like the United Kingdom and competitors like Russia, there are similarly significant implications for non-nuclear weapons states considering pursuing nuclear-weapons programs. Under Article VI of the NPT, signatories pledge to pursue “effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.” While some view this pursuit of disarmament as a long-term aspirational sentiment rather than a near-term realistic goal, efforts by the United States to field “new” nuclear weapons could significantly affect nonproliferation efforts on several fronts.

Some workshop participants noted that the United States could be viewed as hypocritical when it comes to nonproliferation if it is perceived as strengthening its nuclear forces (either quantitatively or qualitatively) while at the same time demanding that non-nuclear states forego such capabilities. While this risk of perceived hypocrisy has existed for decades, the end of the Cold War and reductions in global nuclear arsenals have made such arguments more plausible, with some U.S. policymakers having to declare that the United States is not interested in pursuing new weapons in order to work toward long-term disarmament goals. Should the United States depart from such commitments, or even the language describing such intentions, non-nuclear states may feel less pressure to abide by nonproliferation obligations in the future.

Additionally, even though the United States remains strongly committed to nonproliferation, efforts to develop “new” weapons come at a time of reduced U.S. influence abroad, raising concerns about how much blowback states would face if they pursued nuclear weapons programs of their own. As the United States has either withdrawn from or questioned the future of international arms-control agreements (such as the Intermediate-Range Nuclear Forces Treaty and New START), alliance arrangements (such as NATO), and engagement abroad more generally, perceptions of reduced U.S. leadership on nuclear issues could increase pressure on states to seek alternative security arrangements.

Some workshop participants noted that the United States could be viewed as hypocritical when it comes to nonproliferation if it is perceived as strengthening its nuclear forces (either quantitatively or qualitatively) while at the same time demanding that non-nuclear states forego such capabilities.

Alternatively, modernization, life-extension programs, or other forms of incorporating “new” weapons into the U.S. nuclear arsenal could be viewed by some as strengthening nonproliferation efforts. Maintaining a safe, secure, and effective nuclear deterrent has been a hallmark of U.S. extended deterrence for decades. Bolstering the U.S. arsenal could reduce pressure on allies to pursue nuclear weapons for themselves. U.S. transparency about modernizing or otherwise replacing aging weapons could inspire long-term confidence in partners and allies that the U.S. nuclear deterrent will remain reliable for the foreseeable future despite changes that may otherwise threaten the international security environment.

Workshop participants emphasized that the United States and the United Kingdom are not pursuing nuclear modernization in a vacuum. All nuclear-armed states are developing enhanced nuclear-weapons capabilities, and longstanding U.S. adversaries such as China, Russia, and North Korea are all developing new nuclear weapons. U.S. efforts to modernize the nuclear arsenal must be couched in the logic of deterrence as part of an attempt by the Department of Defense and the Department of Energy to maintain strategic stability.
CONCLUSIONS

Whether current warhead modernization introduces “new” nuclear weapons is a subject of debate. Central to this debate are the varying definitions of what constitutes a “new” nuclear weapon, as these technologies are viewed by some as introducing new capabilities and by others as simply revitalizing or sustaining the existing U.S. arsenal. Some may expect the incoming Biden administration to return to the Obama administration’s three “nos” policy as part of its nuclear policy and posture review process. However, technical, fiscal, and geopolitical considerations—as well as unclear boundaries for what constitutes “new” capabilities—will complicate a wholesale return to the previous warhead-modernization approach.

U.S. nuclear-weapons policy, weapon modernization, and infrastructure revitalization have undergone important shifts in the last decade. Modern technologies such as precision guidance and variable- and low-yield warhead variants have expanded the capabilities of the U.S. stockpile. Novel warhead designs and production facilities may change the shape of the U.S. arsenal, maintain U.S. warhead cooperation with the United Kingdom, and bring forward the next generation of nuclear weapons scientists. All these changes are occurring at a pace unprecedented since the end of the Cold War, and it remains to be seen whether a domestic political consensus will form around these increasingly controversial issues.

Rebecca K.C. Hersman is director of the Project on Nuclear Issues (PONI) and a senior adviser for the International Security Program at the Center for Strategic and International Studies (CSIS) in Washington, D.C. Joseph Rodgers is a program manager with PONI at CSIS. Bryce Farabaugh was a research assistant with PONI at CSIS and is currently a graduate student at the University Chicago’s Committee on International Relations.

Nothing in this briefing should be understood to convey the view or position of any U.S. government organization or its employees. Nor does it imply the endorsement of the contents of the report by any government organization or its employees. This research was made possible through the generous support of the Defense Threat Reduction Agency.

CSIS BRIEFS are produced by the Center for Strategic and International Studies (CSIS), a private, tax-exempt institution focusing on international public policy issues. Its research is nonpartisan and nonproprietary. CSIS does not take specific policy positions. Accordingly, all views, positions, and conclusions expressed in this publication should be understood to be solely those of the author(s). © 2020 by the Center for Strategic and International Studies. All rights reserved.

Cover Photo: U.S. Pacific Fleet/Flickr (CC BY-NC 2.0)
ENDNOTES


16. Ibid.


This briefing note was distributed by the UK Ministry of Defense to members of the U.S. Congress. “Briefing Note: UK Replacement Warhead,” 2020.

Woolf, “U.S. Strategic Nuclear Forces.”


Ibid.

Ibid.


Ibid.


Ibid.


Kerry, “Remarks at the 2015 Nuclear Nonproliferation Treaty Review Conference.”