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America's B-21 Raiders: Deterring and Assuring in the New Cold War

REBECCAH L. HEINRICHS, MACKENZIE EAGLEN, DR. JENNIFER BRADLEY, DR. CHRISTOPHER BOWIE, DR. REBECCA GRANT, KARI A. BINGEN

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Cover: A B-21 Raider. (Northrop Grumman)

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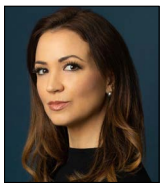
ABOUT THE AUTHORS

Rebeccah L. Heinrichs



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Ms. Heinrichs currently serves as a commissioner on the bipartisan Strategic Posture Commission, which was created in the Fiscal Year 2022 National Defense Authorization Act. She also serves on the US Strategic Command Advisory Group and the National Independent Panel on Military Service and Readiness.

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Ms. Eaglen also serves on the 12-member US Army War College Board of Visitors, which offers advice about academic program objectives and effectiveness, and the US Army Science Board, an advisory body that provides guidance on scientific and other matters to the Army's senior leadership. In 2023, she became a member of the Commission on the Future of the Navy, established by Congress to study the strategy, budget, and policy concerning the future strength of the US Navy fleet.

While working at AEI, Ms. Eaglen served as a staff member on the National Defense Strategy Commission, a congressionally mandated bipartisan review group whose final report in November 2018, *Providing for the Common Defense*, included assessments and recommendations for the administration. Earlier, Ms. Eaglen served as a staff member on the 2014 congressionally mandated National Defense Panel and in 2010 on the congressionally mandated bipartisan Quadrennial Defense Review Independent Panel.

Before joining AEI, Ms. Eaglen worked on defense issues in the House of Representatives, in the US Senate, and at the Pentagon in the Office of the Secretary of Defense and on the Joint Staff.

A prolific writer on defense-related issues, Ms. Eaglen has been published in the popular press, including in *Foreign Affairs*, the *New York Times*, *Politico*, the *Wall Street Journal*, the *Washington Post*, and *War on the Rocks*. She has also testified before Congress.

Ms. Eaglen has an MA from the Edmund A. Walsh School of Foreign Service at Georgetown University and a BA from Mercer University.

Dr. Jennifer Bradley

Dr. Jennifer Bradley is a senior deterrence analyst in the Plans and Policy Directorate of United States Strategic Command. As the program manager for deterrence analysis and research, she leads a team dedicated to applying deterrence theory to strategic problems in order to inform strategy and plans development. On this team, she serves as the lead analyst for the Indo-Pacific region. Prior to becoming an Air Force civilian, Dr. Bradley served as a deterrence analyst for the National Institute for Public Policy contracted to US Strategic Command developing tailored deterrence processes and analysis.

Dr. Bradley is a senior fellow at the National Institute for Deterrence Studies where she writes on deterrence challenges facing the United States and its allies. In 2023, Dr. Bradley completed her doctorate in defense and strategic studies at Missouri State University, where she previously earned her master of science in the same discipline in 2007. She received her bachelor of science in political science, philosophy, and economics from Eastern Oregon University in 2002.

Dr. Christopher Bowie

Dr. Christopher Bowie joined the RAND Corporation in 1981 as a member of the technical staff, where he worked on nuclear bomber operations, aerial refueling concepts, fighter employment operations, and a variety of air power doctrine and strategy issues.

Dr. Bowie left RAND to serve as a member of the secretary of the Air Force's personal staff from 1989–91 and was awarded the Exceptional Civilian Service medal. Following this assignment, Dr. Bowie returned to RAND to serve as associate director of the National Security Studies Program. In 1994, Dr. Bowie joined Northrop Grumman, where he held a variety of management positions at the B-2 division, air combat systems, integrated systems, and corporate.

In 2002, the Air Force selected him for the senior executive service to serve as the deputy director for strategic planning on the air staff. In that capacity, Dr. Bowie helped develop future USAF force structure plans, force structure planning tools, Air Force advocacy and outreach products, divestiture contingency planning, space policy, and a variety of other key long-range planning issues.

Dr. Bowie rejoined Northrop Grumman in 2005 to conduct cost-effectiveness and policy analyses of a wide array of issues, including aerial refueling, long-range strike, unmanned systems, radar technology, aircraft sustainment, and ballistic missiles. In 2010, he was

appointed director of the corporate analysis center, where he and his team provided analytic support to senior management on a variety of key issues.

Dr. Bowie retired from Northrop Grumman in 2021 and continues to write on key air power and national security issues.

Dr. Rebecca Grant

Dr. Rebecca Grant is president of IRIS Independent Research, a small, woman-owned business specializing in defense and aerospace research and consulting.

Her recent projects include analyses of autonomy on the future battlefield, tier 1 suppliers in the defense industrial base for assistant secretary of the Air Force for acquisition, long-range strike, and intelligence, surveillance, and reconnaissance (ISR) recapitalization for industry clients. Dr. Grant is also the author of major reports for the USAF and US Navy on air operations in Afghanistan and Iraq.

Dr. Grant is a frequent guest speaker on airpower and technology at venues ranging from active-duty Air Force units to Wall Street investors. She has lectured at the USAF's Air University and for the air forces of the United Kingdom, Italy, the Netherlands, Australia, and Turkey. She has appeared on TV as an expert on national security for Fox News, Fox Business, CNN, MSNBC, OANN, and the Smithsonian Channel and as a guest on Veterans Radio, the *Laura Ingraham Show*, and Sirius XM Patriot.

Dr. Grant has written over 100 articles for *Air Force* magazine on air operations, technology trends, airpower history and great airmen. She served a three-year term as the founding director of the Mitchell Institute from 2008 to 2011.

Dr. Grant received her BA from Wellesley College and a PhD in international relations from the London School of Economics, University of London. Her first job was with RAND in Santa Monica, California. She also spent three years on the Air Staff at the Pentagon working directly for secretary of the Air Force and Air Force chief of staff.

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Kari A. Bingen

Kari A. Bingen is the director of the Aerospace Security Project and a senior fellow in the International Security Program at the Center for Strategic and International Studies (CSIS). She joined CSIS from HawkEye 360, an innovative space technology company creating a new class of radio frequency (RF) data and analytics, where she was the chief strategy officer. Prior to the private sector, Kari served as the deputy undersecretary of defense for intelligence and security, overseeing the defense intelligence and security enterprises, comprising more than 120,000 personnel and an annual budget of over $54 billion. Before that, Kari served as the policy director on the House Armed Services

Committee and staff lead for its Strategic Forces Subcommittee, advising members of Congress on defense policy, program, and budget matters. Prior to entering government, Kari specialized in national security space issues, working with US defense and intelligence community clients, first as a space systems analyst at SRA International's Adroit C4ISR Center, and then as a senior space policy analyst at the Aerospace Corporation.

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The views expressed in these essays are those of the respective authors and do not represent their employers.

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EXECUTIVE SUMMARY | THE B-21 RAIDER: AMERICA'S NOT SO SECRET WEAPON IN THE NEW COLD WAR

BY REBECCAH L. HEINRICHS

For the first time in history, the United States faces two major nuclear adversaries—the Russian Federation and the People's Republic of China. These authoritarian countries, along with rogue states Iran and North Korea, seek to undermine the United States and replace the US-led order with one dominated by the PRC and its authoritarian partners. The threat environment is far more complex, tense, violent, and dangerous than a "competition" between states. It is a rivalry between adversaries. The PRC and its partners are engaging in a new cold war, which the United States is trying to prevent from going hot.

Russia preceded its unprovoked full-scale invasion of Ukraine with a nuclear exercise,[1] and has continued to engage in nuclear saber-rattling to deter the United States and its allies from giving Ukraine what it needs to prevail. Moscow, which has an extensive record of cheating on arms control agreements, is no longer abiding by the New START Treaty.[2] And while Russia has been focused on its war against Ukraine, it is also nearing the completion of its nuclear recapitalization program.

Photo Caption: A B-21 Raider was unveiled at a public ceremony on December 2, 2022, in Palmdale, California. (US Air Force)

The PRC is expanding and improving its nuclear capabilities. According to Pentagon officials, the PRC now possesses more land-based intercontinental ballistic missile (ICBM) launchers than the US. Additionally, the PRC is investing heavily in theater systems with lower yield and precision accuracy; hypersonic glide vehicles, which are difficult to maintain and track, and whose intended destination is difficult to assess; and the highly provocative fractional orbital bombardment system (FOBS).[3] On top of this, the PRC has formidable anti-access/area denial (A2/AD) capabilities, which would make it difficult for the United States to project power in the event of a war in the Pacific.[4]

Making matters even more concerning, the PRC and Russia are increasingly collaborating to undermine the United States and US interests, including in the nuclear sphere. The Pentagon has publicly confirmed that Moscow is assisting Beijing's capacity to produce nuclear warheads.[5]

North Korea remains a rogue nuclear nation. It continues its record-breaking missile launches, flouting international demands that it ceases its illicit nuclear missile program. Meanwhile, Iran is a nuclear threshold nation and the world's leading sponsor of terrorism. The regime in Tehran conceals the extent of its nuclear program, using this ambiguity to extort the international community for economic gain. The North Korean and Iranian regimes have materially aided Russia's war in Ukraine and indicated support for the PRC's malign behavior.

US allies are understandably made uncomfortable by the risk that the authoritarian, expansionist powers in their geographic regions will use nuclear coercion to deter the United States from coming to their defense. But an even greater threat is that an expansionist power could cross the nuclear threshold in an otherwise regional war that begins as a limited and conventional conflict. Some allies are asking for more initiatives to bolster the credibility of American nuclear assurances.[6] But the US also needs to do more to deter conventional war. This is an imperative step to prevent adversaries from going down the paths of escalation that lead to a larger scale war—including crossing the nuclear threshold or launching a conventional attack of strategic consequence, such as attacking US territories or the US mainland.

To deter China, Russia, and rogue nations—and reassure allies—it is imperative that the United States complete its planned nuclear modernization program; however, because this program was designed and initiated in 2009, it is no longer sufficient to deter both Russia and the PRC. At the time, the PRC was considered a "lesser included case." As policymakers seek to adapt and build on the US strategic deterrent, the sixth-generation B-21 bomber—the first strategic bomber to join the fleet in decades—comes at a pivotal moment.

When Secretary of Defense Lloyd Austin introduced the B-21 at its unveiling in December 2022, he led by telling of the bomber's namesake.[7] Four months after the Imperial Japanese struck Pearl Harbor, 16 US Army bombers took off from an aircraft carrier in the Pacific. The "Doolittle Raiders," led by Lieutenant Colonel Jimmy Doolittle, impressed the world by demonstrating American airpower's long reach. The successful strike boosted the morale of the United States and signaled American formidability and resolve.

The stealthy B-21 Raider is suited to do the same things now in this high-stake new cold war. It will signal American formidability and resolve to defend the US-led order that the first Raiders built and which the United States has to defend. The B-21 Raiders will play an integral role against nuclear peer adversaries, both of whom possess advanced air defenses. The B-21 will eventually replace both the nuclear-capable B-2 Spirit and conventional-only B-1B Lancer. Only the B-52H, which has been in the US inventory since the 1960s, will complement the B-21 until at least 2040. Though the B-52H is not stealthy, it remains suited to launch long-range standoff weapons. But the B-21's original planned fleet size of 100, like the rest of the program of record, which was decided a decade ago, is insufficient to maximize the credibility of deterring both nuclear peers simultaneously.

The aim of this compilation and the associated panel discussion is to assess the attributes and benefits of the Raider and its applicability to this new complex threat environment. While each expert addresses different aspects of the Raider and each essay stands on its own, six themes emerged across the studies.

The following points are the editor's views and may be shared by the essayists but are not meant to be understood as a consensus summary.

1. The B-21's flexibility makes it essential for holding at risk the growing number of Russian and Chinese conventional and strategic weapons, regime facilities, and other objects hidden deep in adversary territory, which is a necessary capability to meet US nuclear deterrent requirements. The B-21 has a unique role in nuclear deterrence, as it can carry a large payload of either nuclear or conventional munitions. The bomber's long range, aided by aerial refueling, gives it a significant advantage and makes it vital to meeting the challenge of deterring two major nuclear powers. The bomber force can be dispersed or placed on airborne alert to improve its survivability during a crisis. This differs from the deterrent role of submarine-launched ballistic missiles (SLBMs) and ICBMs, as the US can deploy bombers in theater to demonstrate resolve while also communicating restraint by withholding the employment of their nuclear weapons. Without the B-21, America's adversaries would have a far simpler risk calculation. For example, the Chinese Communist Party (CCP) has obscured some of the objects it values far from its shores and behind significant defenses. The B-21's long-range penetrating strikes ensure these defensive measures offer the adversary no sanctuary, thereby bolstering the credibility of US deterrence.
2. The B-21 has tremendous warfighting potential against highly sophisticated defenses, which will be vital if deterrence fails and peer adversaries choose war with the United States. The Raider embodies decades of advances in stealth technologies, which are expected to have far outpaced advances in defensive systems.[8] This is essential to winning a war with China. Many of the PRC's high-priority targets are deep inside Chinese territory and protected by advanced air defenses. The B-21's stealth would deny even peer adversaries like China or Russia the critical information they need to neutralize the bomber. Bomber pilots can also adapt and change targets during a mission, giving the B-21 an advantage against time-sensitive and mobile targets. The B-21 can deliver large payloads accurately and in a timely manner to gain the initiative and halt an aggressive campaign against US troops or allies. The B-21 provides flexibility, both mission flexibility (it can be equipped with a variety of payloads) and operational flexibility (it can be operated from a range of bases and locations). This flexibility is hugely advantageous for US planners. It will also have the ability to interdependently target, assess damage, and possibly react as required.
3. A sufficiently large fleet of B-21s would bolster assurance of allies and deterrence against nuclear peer adversaries, even while some bombers are engaged in missions against other adversaries. If the US fleet of conventionally and nuclear-armed B-52Hs and B-21s is sufficient in quantity, the US will have indispensable tools to deter one adversary from crossing the nuclear threshold and assure allies during competition and conflict, while at the same time carrying out conventional penetration and standoff strike operations against another peer like China or Russia. The United States should employ a mixed bomber fleet that can carry out a conventional campaign with a nuclear backstop in one theater while simultaneously maintaining nuclear deterrence and assurance in another theater.
4. The B-21's unique attributes enable it to enhance US nuclear assurances across the globe. The B-21 is a visible signal of American commitment to allies. Notably, allies in regions without persistent US forward-deployed strategic forces are likely to appreciate that the B-21 has an extended range and can loiter for a long period of time. Allies can also participate in the bomber mission, as discussed

in greater depth by one of the expert essayists. It could operate from many different places, including from an ally providing refueling (for example, Japan or South Korea) or basing (possibly Australia.)

5. The costs to operate and sustain (O&S) the B-21 are comparable to other manned planes. Policymakers can make decisions now to optimize the Raider's advantages and lower the cost per plane. According to independent analysis, more than any other factors, O&S costs for all manned aircraft directly correlate with the size of the fleet.[9] There are two significant implications of this. One, the B-21's stealth does not mean that it will carry a similar operating cost to the famously pricey B-2 Spirit. The Air Force operates only 21 B-2s but intends to procure more than 100 of the cheaper B-21s.[10] Two, increasing the size of the B-21 fleet beyond the floor of 100 would drive down the O&S costs per plane.[11]

6. For the B-21 force to be able to deter two major powers or to engage in a major power war while simultaneously deterring opportunistic aggression in another theater, the US will require more than 100 of the bombers. Washington should immediately begin planning to produce more and assess additional basing space. The US Air Force has confirmed that 100 B-21s is the minimum order, not the maximum.[12] The original number, 100, was selected before the US realized that it would need to deter China and Russia simultaneously, and the PRC's number of strategic systems has rapidly grown since then. Several of the other expert essayists in this report noted this conclusion as well. The Center for Strategic and Budgetary Assessments recommends that the US plan to construct a force capable of defeating two major powers simultaneously and suggests that the US procure 288 B-21s for this purpose.[13] A prominent former national security official projected the number to range from 300–400.[14] Washington should conduct an updated study to assess the growing target set and provide a new assessment of the necessary fleet size. As a starting point, the US should plan to acquire at least double the original number of planes. Congress should be aware of the need for more B-21s so that it can adjust funding and plan for additional production.

Washington faces a great challenge to the US-led international system of alliances—a system that has benefited Americans, as well as US partners and allies, since the Second World War. The stakes are high, and the US urgently needs to make changes to its strategic posture to protect this system. Taking full advantage of the B-21 Raider—and planning now to significantly expand the size of the fleet—is one such change.

MORE BOOM FOR THE BUCK: HOW THE AIR FORCE'S NEW BOMBER BECAME A RARE PENTAGON ACQUISITION SUCCESS STORY

BY MACKENZIE EAGLEN

When the United States Department of Defense inked the contract for the B-21 Raider in 2015, many were skeptical of the Pentagon's ability to efficiently work with private industry to deliver the high-end capability on time and on budget. The ambitious goals of the new next-generation stealth bomber program seemed unrealistic after myriad headlines criticizing expensive Defense Department weapons.[15]

Yet despite the initial unease, the development of the B-21 has drawn bipartisan praise as a success story. It has been lauded by Secretary of Defense Lloyd Austin as "a testament to America's enduring advantages in ingenuity and innovation."[16] Representative Adam Smith (D-WA), ranking member of the House Armed Services Committee, stated at the American Enterprise Institute that the B-21 program had learned lessons from the F-35 and was "on time, on budget . . . [and] making it work in a very intelligent way."[17] Senator Mike Rounds (R-UT) has even emphasized that the B-21 "could one day emerge as a model acquisition program."[18]

The rapid success of the B-21 program has been no accident. Two key factors have kept the program on track. First, the Raider has benefited from stability in its requirements, design, and

Photo: Artist rendering of a B-21 Raider in a hangar at Ellsworth Air Force Base, South Dakota, one of the future bases to host the new bomber. (US Air Force)

funding. Steady funding, locked specifications, and the classification and special status of the program under the Air Force Rapid Capabilities Office (RCO) have all allowed the new bomber to proceed rapidly without costly requirements creep. Second, the B-21 has undergone active contract management, with the program progressing under a variety of fixed-cost and cost-plus contract specifications, which have allowed private contractors to remain flexible and share risk with government partners.

History

The development of the B-21 can be traced back to the Air Force's Next-Generation Bomber (NGB) program, which began in 2004 as a congressional initiative to explore the implementation of new technologies in the US bomber fleet. Following the 2006 Quadrennial Defense Review, which called for the development of a next-generation bomber which would enter active service by 2018, the program gained momentum.[19] Prior to this, the Air Force had planned to rely largely on its existing fleet of B-1, B-2, and B-52 bombers, with lifespans scheduled to last into the 2030s. Between 2004 and 2009, the Air Force requested $1.4 billion in unclassified research and development funding for the NGB project.[20] However, after years of development, several issues arose with the growing scope of the requested capabilities—including the abilities to operate unmanned and deliver nuclear payloads—and created added costs and complexities that led then Secretary of Defense Robert Gates to cancel the program.[21]

Pentagon leaders reevaluated the requirements for a long-range strike program, eventually settling on an optionally manned medium-range penetrating bomber. This project was endorsed by Gates, who emphasized that the resulting fleet must be affordable and available for production at scale.[22] After a two-year hiatus, the Air Force continued its development of a new bomber under the Long Range Strike Bomber (LRSB) program, using the same budgetary line item as its predecessor, the NGB.[23]

In 2015, the development contract for the program was awarded to Northrup Grumman,[24] and one year later the LRSB program was officially designated as the B-21 Raider.[25] Its development then made rapid strides. Just two years later, in 2018, the program completed its critical design review, a major acquisition milestone that indicated the bomber was ready to begin full-scale fabrication and testing. (By comparison, the F-22 Raptor fighter jet took twice the time to reach the same stage of its development.)[26] Swift progress continued, and production officially began later in 2019.[27] While no operational B-21s have yet been delivered, the first flight of the aircraft occurred in early November 2023—just seven years after contract award.[28]

On Time and On Budget

Despite the turbulence of its preceding programs, the B-21 is on time and on budget. Stability in its requirements, design, and funding have been crucial to its success.

It is rare for major acquisition projects to run as smoothly as the B-21. Headlines often feature programs with ever-growing price tags leading to the so-called acquisition death spiral.[29] But cost growth can sometimes be a product of the purchasing process itself.

Military contracts are subject to rigorous bureaucratic reviews at every step of development. Traditional defense acquisition programs are subject to statutory milestones, which measure different stages of their development.[30] Milestones are created, evaluated, and tested to measure the progress and effectiveness of a program. Throughout a new project's timeline, program officers conduct numerous reviews to determine if it is meeting requirements. While these milestones are key in measuring progress, an overly hands-on approach can lead to the creation of new and unnecessary checks, which often require fresh testing and evaluation. This slows the progress and increases the cost of a weapons system.[31]

The B-21 developed under the purview of the Air Force RCO. This nontraditional classification allowed it to proceed in a streamlined oversight process directly under senior Air Force

leadership.[32] This lean chain of command has kept the B-21's requirements stable, since any change to the program must be approved directly by the Air Force chief of staff.[33] Historically, repeated changes to a program's requirements during development, known as requirements creep, are often cited as reasons for cost overruns or for a program's delay.[34] These increases can trigger a breach of the Nunn-McCurdy Act, legislation that requires the Department of Defense to report to Congress whenever an acquisition program has cost growth greater than 15 to 30 percent of estimated costs.[35] This slows down the program's development and may be a reason to later reduce its total buy. This process occurred in the development of the F-22.[36]

As an RCO project, the Raider is subject to different milestones unavailable to the public. The B-21 has been held to a tight unit price estimated to be around $700 million—substantially lower than the inflation-adjusted cost of America's last stealth bomber, the B-2 Spirit—and has been repeatedly described by congressional leaders as a well-run program.[37]

The steady and adequate funding of the B-21 has also allowed its development to progress unimpeded. Every year since the announcement of the program in fiscal year (FY) 2016, Congress has matched the Pentagon's publicly reported funding request for the bomber.[38] This has not always been the case with major defense acquisition programs. When a major program experiences cuts or changes to planned funding levels and production timelines, it can often catalyze a spiral of cost overruns and delays. This can make weapons unaffordable and therefore cause the Department of Defense to purchase them in inadequate quantities.[39] This happened with the F-22 Raptor program, where congressional skepticism led to cuts in funding for engineering and manufacturing development (EMD), ultimately contributing to higher unit costs and lower procurement quantities.[40] Randall Walden, director of the RCO, has repeatedly warned Congress on this matter, stating, "If you want to damage a program or make it unsuccessful, create requirement and funding instability."[41] By fully funding the development of the B-21, Congress seems to have heeded his warning.

Additionally, the B-21's secret design specifications have helped the program avoid the requirements creep that has troubled other programs, like the DDG-1000 *Zumwalt*-class destroyer and the Expeditionary Fighting Vehicle.[42] Many cost increases in the development of the B-2 stealth bomber were caused by changes to its requirements, like a redesign to allow the aircraft to conduct low-altitude penetration and the repeated integration of new software.[43] A RAND report analyzing major acquisition projects found that shifting requirements are responsible for nearly 20 percent of all cost growth in the development process for new equipment.[44] To counter potential requirement creep and to avoid the problems that befell the B-21's preceding programs, the B-21's initial unit cost was designated as a key performance indicator in the program's acquisition. This has remained unchanged, allowing for inflation, since the program's inception.[45]

This seeming secrecy around the B-21's specifications has drawn detractors. In the early years of the B-21, members of the Senate Armed Services Committee attempted to declassify elements of the program, citing the need for more public oversight of its research and development.[46] In FY2017, just one year into its development, then Senate Armed Service Committee Chairman Senator John McCain (R-AZ) repeatedly pressed the secretary of the Air Force, Heather Wilson, on why the non-warfighting aspects of the B-21 program were kept "under a veil of secrecy."[47]

While more transparency in the spending of taxpayer dollars is a reasonable request, this criticism stemmed from a misconception that the program's secrecy exempted it from congressional oversight. Despite being classified, the bomber is subject to congressional reporting, as most defense technology programs are. The B-21 is designated a special access program, with stricter access requirements at varying levels of clearance.[48]

While access to it is more restrictive than to other programs, the B-21's next-generation stealth capability and strategic implications for the defense of the United States justify this heightened security. Though public disclosure is often conducive to oversight, it can also have the unintended consequence of hampering certain programs. Onerous disclosure requirements can also encourage political tampering, which has historically spawned cost overruns,[49] schedule delays, and the oversharing of critical technical details with potential adversaries.[50]

Congress has successfully overseen classified programs for decades. Classified oversight for the B-21 likely follows a framework similar to what had been in place for programs like the F-117 Nighthawk and B-2, both of which had their military and nonmilitary specifications concealed from the public for some time.[51] Additionally, senior Air Force leadership keeps congressional stakeholders informed through quarterly briefings on the progress of RCO programs.[52]

Despite this adherence to secrecy, the Air Force has still worked to publicize B-21 program progress, releasing updates as the aircraft passed critical design review,[53] started production,[54] and reached other milestones.[55] Although the complete funding picture of the B-21 program is not publicly available, the Pentagon has published some key figures regarding its development and procurement funding. Enacted spending levels for development stood at $3.14 billion in 2023 and are set to decrease to $2.9 billion in FY2024, indicating a shift from development to procurement.[56] The proposed totals for FY2024 make up eight percent of the Air Force's total requested $55.4 billion research, development, test, and evaluation (RDT&E) budget.[57]

Secrecy over the B-21's design specifications has also created a military advantage that will limit adversarial information gathering. Key details of important assets are often hidden for reasons of operational security, as some details like weight and cost correlate with potential capability in new aircraft. This is important as the standard openness and insecurity of the Pentagon's acquisition system has contributed to the erosion of the US military's technological edge.[58] The past two decades have seen numerous instances of theft of state secrets by China and other adversaries, as with the C-17 Airlifter and F-35 Lightning programs.[59] This has given our rivals a second-move advantage that allows them to quickly capitalize on America's technological advances.

Contracts with Northrup Grumman have been another key component of the B-21's rapid development. The Air Force and Northrup Grumman have developed a system of "active contract management," where transparency through an "industry-first" data sharing agreement allows full information sharing and heightened cooperation between the two stakeholders.[60] The B-21's development has progressed primarily under a "cost-plus-incentive fee-development" arrangement,[61] in which the contractor is paid as it performs work, with other components of the program, including procurement, under a "fixed-price" contract where payment is given up front.[62] This mix-and-match contracting approach has allowed the government and the contractor to share responsibility for managing learning and risk in the development of the B-21.

The cost-plus contract model has been an enabling factor in the B-21's success by allowing room for error while incentivizing efficient work with partnered vendors. The Air Force has had its fair share of costly failures, such as the A-12 Avenger, which was a project to implement unproven stealth technology under a fixed-cost contract. That program's contractors overpromised, costs were overrun, and the project was ultimately shuttered.[63] A more recent example is the KC46 tanker, developed under a fixed-price contract with Boeing. Although it possessed less initial risk, the tanker's early development problems led to rapid cost growth,[64] resulting in nearly $5.4 billion in losses for Boeing.[65] While larger defense contractors have greater financial resources and market incentives to weather cost increases, failures like this could bankrupt smaller contractors. By providing the B-21 contractor with financial wiggle room, the Air Force

has enabled rapid progress unimpeded by restrictive financial constraints.

Cost-plus contracts are sometimes viewed with suspicion by overly fastidious appropriators, since contractors are compensated for development costs, with profit, even when costs may increase unexpectedly. However, the use of a cost-plus contract does not mean that Northrup Grumman and its partners are taking advantage of the Pentagon's pocketbook by exorbitantly charging for the B-21. Cost-plus contracts are often issued for programs with high potential risk in their development, as contractors often want their government partners to share this risk in experimental programs.[66]

Additionally, significant research has found little difference between fixed-price and cost-plus contracts and their effect on overall program growth. To date, research has found no significant correlation between the use of contract types (i.e., cost-plus or fixed-price types) and lower costs in procurement programs. One Pentagon study of 433 acquisition contracts between 1970 and 2011 noted that the use of either a cost-plus or fixed-price contract has not resulted in a "statistically significant difference in cost growth."[67]

Analysis shows that cost growth is often a result of other factors independent of contract type. These other factors, such as changing program requirements and incorrect cost estimates, are more likely to cause cost growth than the type of contract used for a program.[68] A RAND study on the sources of cost growth in major programs further found that development processes are more prone to cost growth than procurement programs, owing primarily to erroneous initial cost estimates and shifting requirements.[69]

In accordance with these findings, the Air Force has supplemented the cost-plus model with effective methods for controlling the overall cost growth of the Raider. For example, as stipulated by the Weapon System Acquisition Reform Act of 2009,[70] the Air Force used an independent cost estimate to establish a baseline budget for the B-21,[71] a key measure given that faulty cost estimates have been found responsible for nearly 15 percent of total cost growth in major defense acquisition programs.[72] The Air Force based its independent cost estimate for the B-21 on historical data, including previous initiatives.[73] This was done to increase the accuracy of the estimate and the likelihood that the contractor remained on budget.

Conclusion

While many of the B-21's program costs are not public, the information the Air Force has released confirms that the program has stayed on budget. If all goes as planned, the B-21 will be a cheaper aircraft compared to its most comparable alternative, the B-2. Adjusted for inflation, the average procurement unit cost (APUC) of a single B-2 was $1.38 billion,[74] while the APUC of a B-21 is an estimated $706 million,[75] roughly half the price.

But up-front purchase cost is only half the battle. The B-2 has proven an expensive aircraft to operate and maintain. For every flight hour, a B-2 costs the Air Force anywhere between $110,000 and $150,000,[76] plus an additional 60 hours of maintenance on the aircraft.[77] Furthermore, B-2s must be stored in specialized $5 million air-conditioned hangers that protect their stealth coating.[78]

While the exact operating costs of the B-21 remain unknown, the program was designed to learn from past projects' shortcomings. At the unveiling of the aircraft last year, Defense Secretary Austin proclaimed that the B-21 would be "carefully designed to be the most maintainable bomber ever built."[79] This appears to be true, as decades of innovation in stealth technology have made its coating easier and cheaper to maintain.[80] Northrup Grumman has continuously improved on its radar absorbent material coating, and its latest development will allow the aircraft to be maintained and housed on the flight line rather than in cooled hangers.[81]

The Air Force has also opted for an "open architecture" approach for flexible hardware and software, which allows new technologies, capabilities, and weapons to be more easily incorporated into the aircraft.[82] This is in conjunction with Northrup Grumman's "digital engineering" approach, which lets engineers run tests on computer simulations as opposed to real-world models.[83] Both of these new models directly address key obstacles uncovered in making changes to the B-2, where frequent and complex hardware and software modifications created steep additional costs.[84]

In conclusion, the B-21's rapid development through an expedited procurement program is an important success. It's not often that major acquisitions meet their requirements on time and on budget. With the B-21's exceeding early expectations and appearing on track for rapid and affordable procurement, policymakers should aim to apply the lessons of its success to high-risk, cutting-edge technological projects in the future.

The B-21 is a next-generation capability necessary for ensuring that the US military maintains long-range strike capability as its existing bomber fleet ages and retires.[85] To adequately replace the aging US fleet, the B-21 is the right investment: affordable to procure, easier to produce, and more efficient to maintain far into the future. It will constitute a key component of a resilient and capable bomber force for decades to come.

THE B-21 RAIDER: A KEY PILLAR FOR THE FUTURE OF EXTENDED DETERRENCE AND ASSURANCE

BY DR. JENNIFER BRADLEY

The United States is committed to a once-in-a-generation modernization of its nuclear triad. Secretary of Defense Lloyd J. Austin III recently commented on the importance of this modernization program, stating, "Our nuclear capabilities remain the ultimate backstop for our strategic deterrence. And that's why we're fully committed to modernizing all three legs of our nuclear triad."[86] While each leg of the triad is integral for strategic deterrence, the B-21 Raider strategic bomber replacement has unique attributes for extended deterrence and assurance that the land and sea legs of the triad do not possess. As the emergence of China and Russia as nuclear peer adversaries and the growth of North Korea's capabilities have left allies under the US nuclear umbrella increasingly anxious about their security, deterrence and assurance are more important than ever.

For more than seven decades, the United States' alliances with the North Atlantic Treaty Organization, Australia, Japan, and the Republic of Korea have been key pillars of US security strategy. Based on mutual values, common interests, and a shared threat perspective, these symbiotic relationships contribute to global stability and prosperity. The security guarantees that the United States provides these allies are underscored by extended

Photo: A B-21 Raider at a public ceremony on December 2, 2022, in Palmdale, California. (US Air Force)

nuclear deterrence, and made credible by US nuclear capabilities. From its roots defending allies from the threat of the Soviet Union during the Cold War, the policy of extended deterrence remains a key component of US nuclear policy today. The 2022 Nuclear Posture Review affirmed these commitments, stating that the US would "[ensure] our strategic deterrent remains safe, secure, and effective, and our extended deterrence commitments remain strong and credible."[87]

The policy of extended deterrence embodies a grand bargain among the United States and the nations of NATO, Australia, Japan, and South Korea. These allied nations have foresworn nuclear weapons, entering the Nuclear Non-Proliferation Treaty (NPT) as non-nuclear states while entrusting the United States to deter nuclear attacks on their territory and people.

Accordingly, preventing nuclear proliferation has been and remains a key policy priority of the United States. In fact, the United States Department of State has stated, "Nuclear umbrella security agreements, whether unilateral or multilateral, have been, and are expected to continue to be, effective deterrents to proliferation."[88] However, as adversaries rely more on nuclear weapons—not just to defend themselves, but to achieve objectives through coercion—many longtime US allies share a growing concern with the credibility of Washington's extended deterrence.

China, Russia, and North Korea have made nuclear weapons a prominent part of their respective security strategies. China is modernizing and expanding its nuclear force and is developing novel capabilities, including hypersonic glide vehicles and the fractional orbital bombardment (FOB) system.[89] The pace of China's expansion is staggering. In 2020, the US Department of Defense estimated in its annual report to Congress that China would double its force to approximately 400 nuclear weapons by 2030.[90] This year's edition of that same report estimates that China currently possesses 500 nuclear warheads and is on pace to expand its force to 1,500 warheads by 2035.[91]

Russia's invasion of Ukraine demonstrated Moscow's willingness to threaten both NATO and non-NATO states with nuclear weapons, a threat made credible by its robust modernization program.[92] Furthermore, the poor performance of Russia's conventional forces in Ukraine may require it to rely more on nuclear weapons for its security. North Korea also continues to advance its missile technology and expand its nuclear force in service of a nuclear doctrine that calls for "preemptive and offensive nuclear strike."[93] Such a low nuclear threshold in a nation known for its provocative behavior could increase the potential for miscalculation.

Since the most plausible scenario for the use of nuclear weapons is a regional conflict that escalates to limited nuclear use, allies under the US nuclear umbrella find themselves on the front lines against the threat posed by China, Russia, and North Korea.[94] US allies' anxiety, therefore, grows in proportion to their concern about the credibility of their guarantor's extended deterrence. This anxiety contributes to a growing "assurance gap" among US-allied nations.

Where deterrence aims to instill caution in an adversary, assurance strives to reassure an ally. How an ally perceives its security situation, therefore, matters greatly in measuring the effectiveness of assurance. While deterrence has often been described as "the threat that leaves something to chance," bolstering assurance requires maintaining high levels of certainty and credibility, as allies are justifiably unwilling to leave their security to "chance."[95] Closing the assurance gap with its allies is imperative for the health of the United States' alliance relationships and the longevity of its nuclear non-proliferation regime.

The B-21 Raider has unique attributes that directly address this assurance gap. The B-21 will have global reach, can carry both nuclear and conventional munitions, and possesses stealth capabilities that allow it to penetrate an adversary's air defenses. As a deterrent it is both credible and lethal. Unlike the other two legs of the nuclear triad, the capabilities of the B-21—its

persistence in theater, its visibility, and its viability in combined operations with allies—make it uniquely suited to conducting missions that bolster US assurance.

- Persistence in Theater: The B-21 will have global range. It will also be able to loiter in theater without needing to be stationed in theater. Furthermore, it will be capable of encompassing a high number of targets with both conventional and nuclear munitions. This will give the United States increased flexibility, while also assuring its allies that it can move significant forces into theater if a given security environment deteriorates. This is especially important in a two-peer nuclear environment: if the United States finds itself in a crisis or conflict with one adversary, it needs to be able to move its forces to a different theater to deter opportunism from its second peer adversary. This is a demand that the B-21 is more than capable of meeting if produced in sufficient numbers.
- Visibility: The strategic bomber is traditionally the most visible leg of the nuclear triad. While its visibility is often described as a way to signal to adversaries during times of crisis or conflict, it is also essential for signaling US commitment to allies during day-to-day operations. Unlike the United States' NATO allies, its Indo-Pacific allies no longer have regionally forward-deployed nuclear forces. The B-21, therefore, will provide a visible demonstration of the United States' commitment to its extended deterrence guarantees to Australia, Japan, and South Korea.
- Combined Operations: While combined operations are impractical with an intercontinental ballistic missile (ICBM) or ballistic missile submarine (SSBN) force, there is a realistic opportunity for allies to participate in bomber operations. Refueling is a critical component of long-range persistent bomber operations, and the ability of US allies to participate in and contribute to these missions in this regard is mutually beneficial, as it eases the demand on US tanker capability while also encouraging allies to be active participants in their own security.[96] Moreover, this joint participation would not require the stationing of nuclear weapons inside allied territory, a politically unpalatable contingency for some US allies like Japan.[97] Allies could also serve as forward basing options for bomber operations, or as recovery and reconstitution leaders for completed bomber missions. These contributions could allow a higher number of mission sorties and increase the tempo of operations.

All this makes rightsizing the B-21 force critically important, not only for enhancing the strategic deterrence capabilities of the United States, but also for assuring US allies of Washington's commitment to extended deterrence. The existence of two nuclear peer adversaries and an unpredictable North Korea makes this a difficult challenge and increases the demands on the US strategic deterrent. The United States, therefore, has to be capable of deterring attacks in one theater while simultaneously responding to attacks in a different theater. This may dramatically increase the demands placed on the B-21, as the platform has the flexibility to accomplish both missions. Yet it also risks turning the B-21 into a low-density, high-demand asset—but only if the United States fails to invest in sufficient numbers to fulfill its commitments to deterrence, extended deterrence, and assurance.

It is therefore important to understand the demands that will be placed on the B-21 for extended deterrence and assurance. South Korea has increasingly communicated its concern over the reliability of US extended deterrence in the Korean peninsula. Recent polling of the South Korean public indicates that an astonishing 71 percent of South Koreans support either a return of US nuclear weapons to South Korea or the development of South Korea's indigenous nuclear deterrent.[98] While the recent Washington Declaration between Washington and Seoul included a renewed pledge from South Korea to refrain from developing its own deterrent, the United States should continue to convince both South Korea's leaders and its people that US extended deterrent security guarantees are robust. The B-21, produced in sufficient numbers, would make those security

guarantees more credible and politically sustainable for both the United States and South Korea. For South Korea, the B-21 can be persistent in theater and visible while simultaneously providing assurance to its populace. In this way, both the United States and South Korea can avoid the political and security complications of stationing nuclear weapons on the peninsula, as was done prior to 1991.

For the United States, bridging the assurance gap with its allies will continue to be challenging. Yet as global threats intensify, it is critical that the US maintain its alliance relationships. The continued benefits of alliances far outweigh their costs. Alliances contribute to global stability and prosperity by binding powerful nations with a shared vision and purpose, while also building militaries that are interoperable, increasing the overall military capabilities of allied nations. The B-21 is a necessary addition to the United States' extended deterrence and assurance capabilities. Its flexibility will prove invaluable as the global security environment becomes more dangerous and complicated.

The more successful the United States is in deterring its adversaries, the more secure both it and its allies will be. During World War II, Winston Churchill observed, "There is only one thing worse than fighting with allies, and that is fighting without them."[99] By prioritizing the B-21, the United States can improve the odds that it will not be faced with Churchill's worst-case scenario.

THE TWO-PEER THREAT AND THE CASE FOR MORE THAN 100 B-21S

BY DR. REBECCA GRANT

On the night of October 24, 2023, the crew of a United States Air Force B-52H bomber was flying a lengthy mission over the South China Sea when a Chinese J-11 aircraft closed in on it. Flying with uncontrolled, excessive speed, the J-11 crossed "below, in front of and within 10 feet of the B-52, putting both aircraft in danger of collision," according to US Indo-Pacific Command, which added, "We are concerned this pilot was unaware of how close he came to causing a collision."

This dangerous encounter was a vivid reminder that the security environment is changing fast. Aggressive Chinese military activity and nuclear weapons modernization were not part of the calculus when the B-21 Raider program began. Yet the B-21 fleet needs to be ready to grapple with threats from both Russia and China.

As the October 2023 report from the Congressional Commission on the Strategic Posture of the United States explains, "Being unprepared for two nuclear peers . . . is not an option."[100]

The B-21 Raider is designed to penetrate airspace and strike targets across the globe. But the program's initial buy of 100 aircraft was set almost 10 years ago, and the fleet has not been increased to account for the rapidly growing combined threats of Russia and China.

The B-21 fleet should be resized to take on the two-peer threat from Russia and China. Because this threat affects the opera-

Photo: A B-21 Raider during an unveiling ceremony on December 2, 2022, in Palmdale, California. (US Air Force)

tional requirements for the B-21, the size of its fleet needs to be reevaluated to address its conventional target set, nuclear tasking, and the very real chance of combat attrition.

The Two-Peer Threat

As a sixth-generation stealth aircraft, the B-21 will become the sole manned aircraft in the Air Force inventory designed to attack and re-attack deep target sets of the mid-twenty-first century. Unlike the B-52s of Vietnam and Operation Desert Storm, the bombing of enemy ground forces and their positions, artillery, vehicles, and other equipment is not likely to figure as prominently in the coming decades. Peer adversaries present a large range of targets such as airfields, fixed and mobile missile launchers, air defenses, ships, and other strategic targets. In addition, scenarios involving rogues like North Korea and Iran present additional challenges.

Meanwhile, only the B-21 (and perhaps unmanned wingmen) can carry out direct attacks on targets deep inside enemy borders. Mobile targets can travel a considerable distance while standoff weapons fly to them—this distance is enough to make the difference between a kill and a miss. For that reason, direct attack options remain essential.

The next section examines several potential B-21 target categories. However, achieving mission-focused air superiority is essential for success in all cases. As the US Air Force has warned for over a decade, air superiority against a peer will look nothing like the fast campaigns over Iraq or the roving combat air patrols of Afghanistan and Syria. The B-21 will be necessary wherever US forces must carve out a corridor for air superiority. Air commanders will use standoff weapons, electronic attack, the full suite of networked information, and of course penetrating aircraft to carve out corridors for weapons engagement.

Airfields

Attack of selected airfields and suppress enemy fighter sorties will be an important part of workable air superiority. Operation Desert Storm—a conflict that lasted from January 17 to March 2, 1991—remains the most relevant example of the sortie demands of a large-scale theater war. In that conflict, Coalition air forces carried out 100 strikes per day on Iraq's airfields in the first two weeks of combat, and ended with a total of 2,990 strike sorties over the Iraqi air force's 19 main operating bases.[101] China, by comparison, has at least 75 military airfields, and may have over 150 if considering dual-use bases where the People's Liberation Army Air Force (PLAAF) maintains a presence. A significant portion of available B-21 sorties could be dedicated to pressure airfields like these in an effort to diminish an opponent's sortie generation rates.

Mobile Missiles

Referencing Operation Desert Storm again, Coalition air forces flew 1,460 sorties against Iraq's short-range Scud missile launchers. Postwar analysis found that about half of these strikes were on fixed sites or stationary hiding places such as the areas beneath highway bridges. A campaign against even small numbers of Chinese or other mobile missiles will be far more difficult. B-21s can work with fighters and unmanned platforms to address this problem. The range, endurance, and stealth of the B-21 will ensure that they remain essential for striking elusive mobile missiles.

Space Launch Facilities

China has direct ascent weapons and ground-based lasers that can disrupt or destroy US satellites. Although the Space Force is building a new, small satellite mesh network, there may still be a need to threaten or take out specific space weapons before China can use them. For example, B-21s can hold high-value targets on Hainan Island and other locations at risk. However, this would again require rapidly available strike coverage for credibility.

Command and Control of Integrated Air and Missile Defenses

In the South China Sea, China extends its integrated air and missile defense 300 nm from the coast via its outposts on ter-

rain features. Over 800 modern fighters and numerous missile systems create a stiff threat. The key to countering this challenge will be coordinated attacks that destroy command and control. "Chinese SAM systems protecting its critical vulnerabilities will have to be overwhelmed with munitions to make sure the SAM system expends all its munitions on incoming targets, opening a window of vulnerability," noted B-52 and B-2 pilot Dr. Mel Deaille.[102] B-21s have the ordnance and restrike capacity for this mission.

Ships

While rarely a top priority, air attack against enemy ships grows in importance when major combat operations get underway. The classified magazine for the Army Air Forces of World War II was named *Impact*, and it featured stunning sequence photos of B-17s, B-25s, and other bombers performing precision attacks on enemy ships. Army planes in the Pacific flew 7,250 (1.5 percent) of their sorties to maritime interdiction and sank 265,360 tons of enemy shipping. Navy and Marine Corps aircraft flew 25,657 (9.9 percent) of their sorties against merchant shipping and sank 102,702 tons.[103] The Office of Naval Intelligence estimates that China's navy will have 425 ships by 2030 with at least 5,500 merchant ships.[104] B-21s may well employ direct-attack weapons and standoff missiles like the Long-Range Anti-Ship Missile (LRASM) against these maritime threats.

Hardened and Buried Targets

The B-21 can quickly take over a mission of direct attack on hardened, deeply buried targets. These targets could range from artillery and missile-hide sites to underground facilities for weapons of mass destruction. The B-21 can carry weapons like the GBU-57 Massive Ordnance Penetrator and the GBU72 Advanced 5K Penetrator for such targets.

Rogue Target Sets

With its global reach, the B-21 can also be on call for select high-value targets worldwide. Its predecessor aircraft have experience of this nature. On January 18, 2017, B-2s flying from Missouri struck two Daesh terrorist sites near Sirte, Libya. F-22s using the Small Diameter Bomb conducted a precision strike on Taliban opium production buildings in Helmand province, Afghanistan, in 2017. Recently, F-15Es hit an Islamic Revolutionary Guard Corps weapons depot in the mountains west of Damascus, Syria, on November 8, 2023. The B-21 will be a top choice for these types of strikes in the future.

B-21 Raider Force Size: The Case for More than 100

This quick sketch of campaign targets for a two-peer future shows that a B-21 fleet size of 100 is too small. Even with 46 B-52s re-engined and on active service, the US Air Force will not have enough penetrating aircraft for credible conventional strikes and nuclear deterrence as it retires its fleet of B-2s and B-1s.

Also, it is time to bring back the attrition reserve factor in bomber fleet sizing. In the past, the USAF added 10 to 15 percent to its total fleet purchases solely to account for attrition. The intercept of the B-52 by the Chinese J-11 pointed out that bombers are at risk during operations in a way not seen since the Vietnam War. Encounters with aggressive Chinese pilots are likely to be a fact of life for B-21 Raider crews. So the Department of Defense's plan for the B-21 force structure needs to take into account potential attrition from hostile encounters, combat missions, and operational accidents.

In a 2021 interview, then-Director and Program Executive Officer Randy Walden said it was absolutely possible to build more than 100 B-21s. However, the Air Force would need lead time to add tooling and workers for a higher production rate.[105]

Buying more bombers could require another facility for their basing. The B-21 is set to be based at Ellsworth Air Force Base in South Dakota, Dyess Air Force Base in Texas, and Whiteman Air Force Base in Missouri. The Air Force is spending approximately $1 billion to build hangars and weapons storage facilities

for the B-21s at these bases. If it needs another B-21 base, military construction planning and funding should start early.

Some may argue that buying more than 100 B-21s will be too expensive, but they are worth the investment. Numerous studies have shown that bombers are cheaper than cruise missiles for sustained conflict. After about 20 days of intensive operations, the total procurement and operating costs of cruise missiles surpass those of bombers. Bomber costs stay level after 30 days of conflict, while cruise missile costs continue to soar.[106]

Ready to Fight

The B-21 program has drawn lessons from the B-2, F-117, F-22, and F-35 programs regarding the importance of an efficient production line. The F-117 program of the early 1980s had a compressed acquisition cycle configured for steady, low-rate production from the start. It achieved initial operating capability in 59 months.

While the B-21 has experienced some schedule slip prior to first flight, the next steps should come quickly. The B-2 completed its first flight in 1989, and the first aircraft (which was actually a later production air vehicle) was delivered to Whiteman AFB on December 17, 1993. Initial operating capability came in 1996 with the integration of the GPS-Aided Targeting System/GPS-Aided Munition (GATS/GAM) precision weapons.

However, the B-21 Raider's first flight on November 10, 2023, was made by an aircraft that is a production-representative aircraft—not just a kludged-together test article, but a genuine prototype. Several other B-21s are already in various stages of assembly on Northrop Grumman's production lines. The B-21 could perhaps achieve initial operating capability for conventional missions within 24–36 months. Nuclear certification need not be far behind. Rapid progress to combat status is essential to maintain credible deterrence, particularly as China accelerates its nuclear capability and as Vladimir Putin's Russia steps back from arms control treaties.

Many allied pilots have trained in and flown the B-2. With the B-21, it may be time to consider setting up detachments with highly capable partners such as Britain's Royal Air Force, the Royal Australian Air Force, and others.

In 2018, Zbigniew Brzezinski warned that "the most dangerous scenario" the US could face would be "a grand coalition of China and Russia . . . united not by ideology but by complementary grievances."[107] The B-21 fleet needs to have more than 100 bombers to protect the United States from these mounting dangers.

THE ROLE OF THE B-21 IN DETERRENCE

BY DR. CHRISTOPHER BOWIE

The United States Air Force's fleet of long-range bombers is a flexible strategic asset that plays a unique role in US deterrence policy. No other nation fields and maintains such a large force of long-range bombers capable of striking anywhere in the world within hours. A product of US organizational, technical, and operational prowess, these aircraft underpin the United States' position as a superpower by providing significant capabilities to deter conventional aggression and nuclear attacks.

In the early days of the Cold War, the long-range bomber, as the only asset capable of carrying the heavy and bulky nuclear weapons of the period, was the primary system to deter nuclear attack. Over the following decades, a portion of the fleet sat poised on nuclear alert, while other bombers stood ready to begin force generation during a crisis. However, multiple conflicts over the past 70 years have demonstrated these assets' powerful conventional capabilities: Korea, Vietnam, Iraq in 1991, Kosovo in 1999, Afghanistan in 2001, Iraq again in 2003, and multiple strikes against terrorist targets over the past two decades. The advent of precision weapons in the 1990s dramatically increased bombers' combat value by allowing planners to take better advantage of the aircraft's large payload. In the first eight weeks of the 1999 Serbian conflict, B-2s flew 3 percent of the sorties to strike 33 percent of the targets with precision guided weapons; in Operation Enduring Freedom in 2001, bombers comprised just 10 percent of the force but delivered over 66 percent of the munitions (most of which were precision-guided).[108]

Photo: Secretary of Defense Lloyd J. Austin III delivers remarks at the US Air Force B-21 Raider unveiling ceremony in Palmdale, California, on December 2, 2022. (DoD photo by Chad J. McNeeley)

This conventional capability heightens the importance of the B-21, which will join the venerable B-52 to become the backbone of the US bomber fleet as it replaces the B-1B and B-2 in the coming years. When the US fields it in quantity, the new aircraft poses a potent threat that can blunt and disrupt adversary forces engaged in offensive operations, deterring aggressors from launching attacks against US forces and allies.

Conventional Deterrence Capabilities

The B-21, like its forerunner the B-2, provides a revolutionary combination of range, speed, payload, and stealth to conduct conventional power projection operations. These capabilities will be especially valuable as the US faces a historically unprecedented threat environment in which it must simultaneously deter two near-peer adversaries, Russia and China.

Range

The B-21, like other heavy bombers, will likely feature an unrefueled range four to five times greater than that of a fighter. With the support of aerial refueling, its range will be intercontinental. This multiplies the B-21's basing options and enables it to employ multiple penetration axes, complicating adversaries' attempts to defend against it. B-21s based in the United States can strike anywhere on the planet within hours. Moving bombers from the United States to rear theater bases could also serve as a signaling tool to help deter conflict. For example, the US could forward-base B-21s in locations south and west of China, outside the range of Chinese missiles and aircraft. In contrast, US and allied fighter bases located on the periphery of eastern China currently face a significant threat from Chinese offensive systems. Long-range bombers like the B-21 also give the US the ability to threaten the Chinese landmass from the west, where China's defenses are minimal. B-21s based in western Europe could also threaten Russia using southern or northern axes, rather than just from the west.

Speed

The B-21 will give US conventional forces the ability to respond quickly and effectively in a crisis. Should China launch a surprise amphibious invasion of Taiwan, B-21s could deliver effects within hours. Similarly, B-21s could respond quickly to Russian aggression in Europe, utilizing a range of munitions to halt armored formations, knock out lines of communication, damage airbases and ports, sink naval combatants, and strike leadership targets.

Payload

The bomber's payload enables it to deliver large penetrating munitions to strike deep underground facilities. Similarly, it can carry large quantities of precision-guided munitions to hit multiple targets at airfields, ports, and railways. In a cross-straits invasion scenario, B-21s could carry a large payload of anti-ship missiles to shatter Chinese naval and amphibious forces. The aircraft could also strike supporting ports and airfields to further disrupt China's operations.

Stealth

The aircraft's stealth characteristics make detection, tracking, and engagement extremely difficult. The Air Force revealed 30 years ago that the B-2 featured the radar signature of an insect.[109] The B-21—designed using the latest in computer-aided design tools and featuring surface treatments developed over the past four decades—should feature an even smaller signature.

This combination of capabilities enables the B-21 force to hold a wide range of targets at risk. This is especially necessary as China and Russia have dispersed high-value targets across large landmasses—in some cases in deeply buried or hardened locations. To maintain credible deterrence against China and Russia, the US needs to ensure key targets can be held at risk regardless of location, hardening, or defenses. The B-21 provides America's forces this ability.

Nuclear Deterrence Capabilities

The Nuclear Triad

Beyond conventional power projection operations, bombers form the air-breathing leg of the nuclear triad, joining land-

based intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs). Each leg of the triad possesses certain unique and complementary characteristics that, in synergy with the other legs, give the US a retaliatory capability that no adversary could hope to nullify. The elements of the triad work together to confound an adversary's offensive and defensive strategies; the diversity of basing modes and penetration profiles dramatically complicates the problems an adversary faces. Fast-flying ballistic missiles pose one set of problems, and slower-flying bombers another. Should one leg become ineffective due to a technical failure or an adversary's technological breakthrough, the other legs maintain an effective deterrent.

The Bomber's Role

The bomber force provides unparalleled flexibility to the triad. Because the US can generate, disperse, and launch the force under positive control, the air-breathing leg, unlike the other legs, provides the US with a highly flexible means of sending unmistakable messages to an adversary to help defuse and stabilize crises. Through force generation, the bomber leg can significantly increase the number of warheads on alert very rapidly—a capability the other two legs do not possess. Bombers' ability to disperse to multiple locations during a crisis also makes an adversary's targeting problem more difficult, increasing the bomber force's pre-launch survivability.

In addition, the bombers' slow speed relative to ballistic missiles means the aircraft do not pose a credible first-strike threat, which helps stabilize the nuclear balance. And because bombers present an adversary with a significantly different threat profile than that of ballistic missiles, adversaries cannot concentrate purely on ballistic missile defense to degrade US retaliatory capabilities.

The USAF has historically sought to field penetrating bombers alongside cruise missile carriers. Under current plans for the air-breathing leg of the triad, B-52s would stand off outside the range of an adversary's offensive capabilities and launch cruise missiles to saturate air defenses. Meanwhile, stealthy B-21s would penetrate deep into enemy territory along multiple axes. This combination promises devastating retaliation to any potential aggressor.

Penetrating bombers like the B-21 also possess a formidable combination of accuracy and weapon yield compared to the other elements of the triad. The bomber crew's capability to assess whether sites have useful targets present and whether high-priority targets require a follow-up attack increases flexibility and enhances efficiencies. These attributes will become more important in a tripolar nuclear balance.

Future US Bomber Force Structure

The B-21's value in both conventional power projection operations and nuclear deterrence indicates that the nation should field a force larger than the 100 currently planned. No matter how capable an aircraft is, it can be in only one place at a time. Aircraft engaged in conventional operations against China or Russia would not be available to stand on nuclear alert. Commanders might be forced to choose whether to pull aircraft executing conventional strikes out of theater to stand on nuclear alert, or to reduce the effectiveness of the triad to maintain a higher conventional warfighting tempo. A larger force would provide US national security leaders with more options—the capability both to concurrently conduct effective conventional strikes and maintain a formidable nuclear posture.

THE B-21 RAIDER: INDUCING UNCERTAINTY

BY KARI A. BINGEN

We marveled at the unveiling of the B-21 Raider in December 2022 and its first flight less than a year later in November 2023.[110] The sixth-generation aircraft is immensely flexible as both a nuclear and conventional platform. It has stealth technology and other high-tech attributes 30 years more advanced than the B-2, which was, until now, America's most modern bomber.

Not much information exists in the public domain about the B-21. Rightly so, lest the People's Republic of China (PRC) and the Russian Federation gain lead time to analyze the aircraft for vulnerabilities and target contractor networks to steal technical data. What the public knows is that the B-21 aircraft will be highly survivable and able to penetrate enemy advanced air defenses, configurable for nuclear and conventional missions as well as manned and unmanned operations, and able to carry a range of munitions.[111] From the outset, the Raider was designed around three specific capabilities: a large and flexible payload bay, a long range (although its exact range is classified), and a manageable cost (with a projected average procurement unit cost of $550 million per plane in 2010 dollars).[112]

Key Questions for America's Adversaries

With the B-21 taking flight, the United States needs to keep its adversaries guessing as to what the bomber can do. As framed by Deputy Secretary of Defense Kathleen Hicks, the Pentagon wants to ensure "PRC leadership wakes up every day, considers the risks of aggression, and concludes, *today is not the day*," through 2049 and beyond.[113] How can the B-21 complicate China's calculus and further strengthen the credibility of the US deterrent? How can the Pentagon induce uncertainty

Photo: A B-21 Raider. (Northrop Grumman)

about the extent of US capabilities and cause Chinese leaders to question their own?

Where Could It Come From?

America's adversaries should be uncertain about where the B-21 will strike from. A key operational benefit of a bomber is its range and mobility. Assuming a range of 2,000 miles or greater, a B-21 could access targets deep inside the Chinese mainland.[114] And it can do so from multiple axes of entry, including from unconventional locations in the Pacific Ocean, the Indian Ocean, or the Arabian Sea, especially when refueled in flight.

The 2018 US National Defense Strategy encouraged such operational unpredictability.[115] While bombers traditionally operate out of the US homeland or bases in the United Kingdom and Diego Garcia, the last few years have seen the first B-52 landing in South Korea in decades, the first B-52 deployment to Indonesia, and the first B-1 landing in Poland. The B-21 was designed from the outset for ease of maintenance. It does not need specialized facilities and personnel, which adds flexibility in operating locations and enables quicker turnaround times.[116]

This range of trajectories complicates China's calculus. It obligates Beijing to invest in greater homeland detection and defense, such as radars and sophisticated air defense systems, not just along its eastern front facing Taiwan, but also from the south, west, and north.

What Munitions Could It Carry?

The US should keep the PRC guessing about which weapons the B-21 will carry. As the existing US fleet has shown, bombers can carry an array of nuclear and conventional weapons, including both standoff munitions fired from a distance and direct attack munitions dispensed in proximity to their targets.

We can expect the B-21 to carry nuclear gravity bombs and the future long-range standoff (LRSO) air-launched cruise missile.[117] On the conventional front, the B-21 could be envisioned to carry precision-guided missiles like the Joint Direct Attack Munition (JDAM), Small Diameter Bomb (SDB), Joint Air-to-Surface Standoff Missile (JASSM), and larger bunker buster munitions like the GBU28. The Raider's open architecture design could more easily allow the US military to adapt it to cross-service weapons, disperse unconventional payloads and electronic warfare weapons, and integrate new strategic and theater weapons.[118]

Drawing from a 2007 Air Force analysis of alternatives study, a next-generation long-range strike aircraft would be designed to hold up to 28,000 pounds of ordnance.[119] While that is a smaller payload capacity than other bombers in the fleet, under this assumption, the B-21 would still have a large magazine to deliver sizeable quantities of munitions on targets behind enemy air defenses.[120]

What Missions Could It Conduct?

Beijing should be questioning what missions the US will conduct with the B-21 and which targets the bomber can hold at risk. With the range, survivability, and munitions previously discussed, the B-21 can threaten military and war-making infrastructure throughout mainland China. The B-21 could linger deep inland, surveil terrain, and await updated targeting information to carry out additional strikes or pass targeting coordinates to other networked platforms.[121]

Importantly, the B-21 gives the president strategic options. Today, the US relies largely on nuclear-tipped, large-yield intercontinental and sea-launched ballistic missiles to hold at risk hard and deeply buried targets, missile launch sites, command and control (C2) nodes, and military infrastructure deep within adversary borders. Current US conventional strike aircraft and cruise missiles do not have the range or the ability to pierce sophisticated air defenses. A B-21 delivering conventional munitions deep inland allows the president to target key military nodes while remaining below the nuclear threshold. It also provides nuclear options complementary to other legs of the nuclear triad.

Bombers have shown their flexibility in conducting a range of missions, including supporting those typically associated with other military services and platforms. The B-21 creates tactical options for a theater commander. It could be used to disable air defenses, thereby creating access corridors for less stealthy tactical aircraft and other assets. The B-52 and B-1, which can both carry advanced radar systems and anti-ship cruise missiles, retain a maritime surveillance and maritime strike mission, with crews still actively trained in finding and targeting enemy surface combatants.[122] The B-21 could follow suit.

It is this range of operational dilemmas that China will have to plan against. Further, we are only at the outset of imagining the different ways the B-21 can be brought to bear and the new operational concepts to be developed around it, as promoted in the most recent national defense strategy.[123] Past examples include the Strategic Capabilities Office's Arsenal Plane, which sought to expand the B-52's capabilities by turning it into "a flying launch pad for all sorts of different conventional payloads" that is networked to other platforms and sensors.[124]

Who Would Support Operations?

Beijing might also take note of which allies are exercising and training with the US bomber force. We need only look to the global deployments of US bomber task forces over the past few years to get a glimpse of how the B-21 could partake in a wide range of exercises and integrate into future joint and allied force operations that aid readiness and bolster deterrence.

In summer 2023, B-1 bomber units participated in the Arctic Challenge, a series of expansive exercises in the Nordic region aimed at integrating NATO allied and partner assets with US strategic bombers.[125] Those bombers also conducted flights over the Baltics and Balkans.[126] In fall 2023, a B-52 task force deployed to Guam, performed drills over the Korean Peninsula, and conducted trilateral integration activities with Japanese and South Korean forces.[127] In the last two years alone, US bomber task forces have also trained with Polish, Turkish, and Indonesian units.[128]

These exercises and training activities showcase the combined capabilities of US and allied forces, demonstrate integration across strategic and tactical forces, and provide opportunities to explore how allies can contribute real capabilities to strategic deterrence missions, such as through airfield access, refueling, or maintenance support. These activities aid in the reassurance of allies and show resolve to adversaries.

Conclusion

Deterrence rests on perception: a perception in the mind of a decisionmaker that the costs of an action outweigh the benefits.[129] Each of these aspects of the B-21 bomber should create uncertainty in the minds of President Xi and PLA officials about the extent of US capabilities and whether China can achieve its objectives considering the risks.

While the B-21 has wide-ranging potential, it is not a panacea. It is a complement to other nuclear and conventional systems and part of a family of long-range strike systems, involving "things that could be carried by or possibly accompany the B-21, [and] things that can support it from off-board," according to Secretary of the Air Force Frank Kendall.[130] The Raider will need targeting information, networked C2 and communications links, and intelligence and counterintelligence support. It will necessitate trained crews.

Further, the bomber would benefit from a reexamination of the targets the US aims to hold at risk and the types of munitions it will need, not limited by what is in today's munitions inventory. Such an update could inform the development of a wider array of strategic options for the president.

However, the size of the B-21 fleet is fundamental to America's ability to sow doubt in the minds of our adversaries. The Air Force plans to acquire at least 100 aircraft, but the service will

be hard-pressed to muster more than a squadron by 2027 or an appreciable deterrent heading into the 2030s with production maxed out at 10 aircraft per year.[131] According to one analyst, "a relative handful of advanced B-21s just isn't likely to complicate the offensive or defense operations of China or any other major US adversary."[132] This is what China is banking on: that America will lose its will to fund the Raider to scale and that the B-21 will succumb to the same fate as the B-2.[133]

For America to make Xi doubt that today is "the day," Washington needs to field and grow the B-21 force with greater urgency.

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