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Air Force B-21 Raider Long-Range Strike Bomber

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Summary

The Department of Defense is developing a new long-range bomber aircraft, the B-21 Raider (previously known as LRS-B), and proposes to acquire at least 100 of them. B-21s would initially replace the fleets of B-1 and B-2 bombers, and could possibly replace B-52s in the future.

B-21 development was highly classified until the summer of 2015, when the Air Force revealed initial details of the aircraft and the program. Although technical specifications and other data remain out of public view, many details of the budget, acquisition strategy, procurement quantities, and other aspects of the B-21 program are now in the public arena.

The Administration's FY2019 budget request included $2.31 billion for further development of the B-21. As passed, the FY2019 defense appropriations bill funded the program at $2.28 billion.

As a large defense program that involves issues of strategic and nuclear policy, as well as substantial expenditures, the B-21 is likely to be subject to significant congressional interest.

Contents

Introduction 1
History 1
Next-Generation Bomber 1
Long-Range Strike (Bomber) 2
Basic Design 3
Technical Maturity 4
Acquisition Strategy 5
Budget Profile 6
Industrial Base 7
Issues for Congress 8
How Many B-21s to Procure 8
Should Older Bombers Be Extended? 9
When Will B-21 Actually Be Available? 10
Cost Issues 10
What Other Budget Items Support B-21? 10
Cost of Nuclear Capability 11
Acquisition Process Issues 11
What Type of Contract Should Be Used for B-21? 11
Accuracy of Cost Estimating 12
Oversight Issues 12
Oversight of Rapid Acquisition Programs 12
Oversight of Highly Classified Programs 12
Appropriate Level of Classification 13
Should B-21 Be Financed Through a Separate Strategic Forces Fund? 13

Figures

Figure 1. B-21 1
Figure 2. Proposed B-21 Outyear Funding 6
Figure 3. U.S. Fixed-Wing Manned Military Aircraft Programs 8

Tables

Table 1. NGB/LRS-B Funding, FY2006-FY2018 3

Contacts

Author Information 14

Introduction

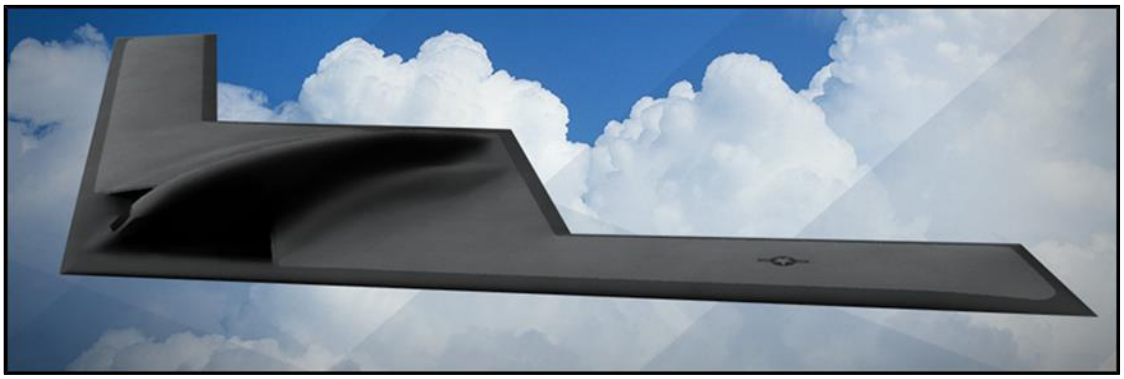
On October 27, 2015, the Department of Defense (DOD) announced its intention to award a contract to build the new Long Range Strike-Bomber (LRS-B) to the Northrop Grumman Corporation. Subsequently, the Secretary of the Air Force announced that the bomber would be designated the B-21 "Raider," in honor of the Doolittle Raiders of World War II.[1]

The B-21 is intended to operate in both conventional and nuclear roles, with the capability of penetrating and surviving in advanced air defense environments.[2] It will be capable of operation by an onboard crew or piloted remotely. It is projected to enter service in the 2020s, building to an initial fleet of 100 aircraft.

The B-21 is one of the Air Force's top three procurement priorities.[3]

Figure 1. B-21

Artist's rendering



Source: U.S. Air Force.

History

Next-Generation Bomber

The B-21 has its roots in the Air Force's Next-Generation Bomber (NGB) program.[4] Begun in 2004 as a congressional initiative to explore new technologies, NGB grew in response to the 2006 Quadrennial Defense Review's (QDR's) call for development of a next-generation bomber that

[1] Mike Martin, *The B-21 has a name: Raider*, U.S. Air Force, Press release, Washington, DC, September 19, 2016, http://www.af.mil/News/Article-Display/Article/948366/the-b-21-has-a-name-raider/. The "B-21" type designation, which does not follow in the standard sequence, ostensibly recognized the B-21's role as a "21st century" bomber.

[2] Department of Defense, Department of Defense Press Briefing on the Announcement of the Long Range Strike Bomber Contract Award, Washington, DC, October 27, 2015, http://go.usa.gov/cswxQ.

[3] The other top priorities, as enunciated by Air Force officials on many occasions, are the F-35A Lightning II fighter and the KC-46A tanker, both of which are in initial production.

[4] For more on the predecessor program, see CRS Report RL34406, *Air Force Next-Generation Bomber: Background and Issues for Congress*, by Jeremiah Gertler.

would enter service by 2018. The NGB program sought to develop a new land-based, penetrating long-range strike capability to complement a modernized bomber force.[5]

Prior to 2006, the Air Force had indicated that its fleet of B-1, B-2, and B-52 bombers would suffice until 2037, when advanced technologies, such as hypersonic cruise vehicles, would potentially reach maturity and be incorporated into a follow-on bomber aircraft. The 2006 QDR's call for a new bomber to enter service in 2018 thus accelerated Air Force plans for fielding a new bomber by almost 20 years.

Two competitors participated in the NGB program: Northrop Grumman and a team composed of Boeing and Lockheed Martin.[6] Both competitors had experience with modern bomber design and development: Northrop was the prime contractor for the B-2, and Boeing was a major subcontractor on that program. Rockwell International (later acquired by Boeing) was the prime contractor for the B-1. Boeing was the prime contractor for the B-52.

From FY2004 to FY2009, DOD requested more than $1.4 billion in the unclassified Air Force research and development budget for the NGB. After these initial development efforts, Secretary of Defense Robert Gates announced that he would recommend deferring the start of an NGB program: "We will not pursue a development program for a follow-on Air Force bomber until we have a better understanding of the need, the requirement, and the technology."[7] Several issues regarding the NGB had not been resolved, most notably whether it should be capable of unmanned operations and whether the NGB should have the capability to deliver nuclear weapons. Either of these capabilities would have added cost and complexity to the system.

Long-Range Strike (Bomber)

Following cancellation of the NGB program in 2009, Air Force and DOD officials conducted a "front-end analysis," considering different concepts to accomplish the long-range strike mission. Options included large aircraft carrying long-range standoff weaponry, conventionally armed ballistic missiles, air- and sea-launched cruise missiles, and other configurations.[8] After considering the options, Secretary Gates approved the Air Force request to continue developing an optionally manned penetrating bomber in 2011. LRS-B reportedly differs in concept from the NGB:

> [NGB] was far more ambitious and expensive, in part because of the assumption that the aircraft would operate nearly independently, which drove requirements up. NGB would have needed to be capable of its own intelligence and other functions that LRS-B will get through support from a network of already fielded Air Force platforms.[9]

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[5] Department of Defense, *Quadrennial Defense Review Report*, February 6, 2006, p. 46.

[6] See, for example, Douglas Barrie and Amy Butler, "Double Duty," *Aviation Week & Space Technology*, April 28, 2008: 24; Amy Butler, "USAF Chief De-emphasizes 2018 For Bomber," *Aerospace Daily & Defense Report*, March 4, 2009: 1-2. Boeing and Lockheed announced their joint development effort for the NGB in January 2008. (Boeing and Lockheed Martin, "Boeing and Lockheed Martin Team for Next Generation Bomber Program," press release, January 25, 2008, http://boeing.mediaroom.com/2008-01-25-Boeing-and-Lockheed-Martin-Team-for-Next-Generation-Bomber-Program.)

[7] Department of Defense, Defense Budget Recommendation Statement (Arlington, VA), As Prepared for Delivery by Secretary of Defense Robert M. Gates, Arlington, VA, Monday, April 06, 2009, available at http://go.usa.gov/czcnw.

[8] The concept of large aircraft carrying long-range weaponry has resurfaced as DOD's proposed "Arsenal Plane." See, inter alia, James Drew, "USAF flaunts 'arsenal plane' concept at Air Warfare Symposium," *FlightGlobal.com*, February 26, 2016, https://www.flightglobal.com/news/articles/usaf-flaunts-arsenal-plane-concept-at-air-warfare-422472/.

[9] Amy Butler, "USAF Offers Long-Awaited Peek At Secret Bomber Plans," *Aerospace Daily*, September 3, 2015, pp.

Congress subsequently authorized a follow-on to the NGB program that became the Long Range Strike (Bomber), or LRS-B, in the FY2011 defense authorization bill.[10] It is perhaps notable that cancellation of the NGB program caused only a two-year break in unclassified funding, as **Table 1** indicates. LRS-B was funded in the same budget line as the predecessor NGB.[11]

Table 1. NGB/LRS-B Funding, FY2006-FY2018

(in millions of dollars)

FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
24.1	37.5	7.0	0	0	199.0	294.9	291.7	359.4	883.4	736.2	1290.3	2003.6

Source: Justification books for Air Force research and development, PE 0604015F, for FY2019 and prior years.

The form of the program's name varies depending on the source, but it was typically shown as "Long Range Strike (Bomber)" or "Long Range Strike-Bomber." This syntax implied that the Air Force was potentially developing other long-range strike systems and/or complementary systems (like sensors and/or communications capabilities) to enable the bomber in its long-range strike role. At the initial public rollout of the LRS-B program, Air Force officials confirmed that LRS-B was part of a family of systems, and that other unspecified programs would support the bomber in operation.[12]

Two LRS-B designs were submitted, and on October 27, 2015, Air Force Secretary Deborah Lee James announced DOD's intention to award the contract to Northrop Grumman. The other competitor, a team of Boeing and Lockheed Martin, protested the award. On February 16, 2016, the Government Accountability Office (GAO) denied the protest.[13]

Basic Design

Although the specific design remains classified, and the Air Force has released an artist's rendering of the bomber, the B-21 was designed around three specific capabilities:

1. A large and flexible payload bay capable of carrying a full range of current and future armament.
2. Range (although classified).
3. Projected average procurement unit cost of $550 million per plane in FY2010 dollars, which was announced publicly to encourage competing manufacturers to constrain their designs.

In an effort to achieve the $550 million cost target, unit cost was designated as a key performance parameter in the acquisition strategy, meaning that inability to reach that price could disqualify a bid. (That price is based on acquisition of 100 aircraft; variations in quantity may affect actual

1-2.

[10] P.L. 111-383, Ike Skelton National Defense Authorization Act for Fiscal Year 2011.

[11] Development of the NGB, like development of the B-21, was carried in Air Force RDT&E program element 0604015F.

[12] Air Force briefing to and discussion with CRS and think tank representatives, September 1, 2015. This meeting was conducted under Chatham House rules, which preclude identifying the specific briefers or attendees.

[13] GAO's protest decision, noted at http://www.gao.gov/docket/B-412441.1, was classified. Instead of a formal report, GAO issued a statement describing the decision, available at http://ec.militarytimes.com/static/pdfs/ALL-STAFF-852618-v1-B-412441-PUBLIC-STATEMENT-ON-OUTCOME-OF-BOEING-PRO.pdf.

unit cost.) At the award announcement, the independent cost estimate for Northrop's winning bid was revealed to be $511 million per plane, equivalent to $564 million in FY2016 dollars.[14]

The released rendering (**Figure 1**) shows a flying-wing design not dissimilar to the B-2, although simpler in shape. It resembles early proposed designs that later evolved into the B-2.

Initial B-21s will be manned, with unmanned operation possible several years after initial operational capability (IOC). Nuclear qualification will also take two years or so after IOC.

Few technical details have been revealed. No mention has been made of a desired speed, although the combination of long range, large payload, and cost constraints strongly suggest B-21 will be subsonic. Details such as the B-21's size, required stealth, structure, number and type of engines, projected weapons, and onboard sensors remain classified, which makes evaluating the proposed cost difficult.

What Is Stealth?

"Stealthy" or "low-observable" aircraft are those designed to be difficult for an enemy to detect. This characteristic most often takes the form of reducing an aircraft's radar signature through careful shaping of the airframe, special coatings, gap sealing, and other measures. Stealth also includes reducing the aircraft's signature in other ways, as adversaries could try to detect engine heat, electromagnetic emissions from the aircraft's radars or communications gear, and other signatures.

Minimizing these signatures is not without penalty. Shaping an aircraft for stealth leads to different choices than shaping for speed. Shrouding engines and/or using smaller powerplants reduces performance; reducing electromagnetic signatures may introduce compromises in design and tactics. Stealthy coatings, access port designs, and seals may require higher maintenance time and cost than more conventional aircraft.

As the United States has gained experience with stealth and advanced its technologies from the F-117 through the B-2, F-22, and F-35, some of the operational and maintenance costs have been reduced.[15] The B-21 will benefit from that knowledge, although some of the performance compromises inherent in designing for stealth cannot be avoided.[16]

Technical Maturity

A previous CRS Insight noted that the B-21's proposed funding and deployment schedule implied that considerable development had been accomplished prior to contract award.[17] The Air Force later confirmed this, with senior program officials stating that both competing designs were at an unusually high level of detail and development for a system in which the prime contractor had not been selected. The low-observable characteristics of both designs were investigated in detail against current and anticipated threats, and final designs were complete down to the level of, for example, individual access panels.[18] This high level of technical readiness may help explain why the Air Force anticipates IOC approximately 10 years from contract award, whereas other technically complex aircraft like F-22 and F-35 have taken more than 20 years.[19]

[14] Air Force briefing to and discussion with CRS and think tank representatives, September 1, 2015.

[15] By 2008, for example, the man-hours required to maintain the B-2 fleet's low-observable characteristics had been reduced 30% from initial levels. Guy Norris, "Born-Again Bomber," *Aviation Week and Space Technology*, August 3, 2009, p. 47.

[16] CRS discussions with Northrop Grumman officials, March 10, 2016.

[17] CRS Insight IN10351, Long Range Strike Bomber Begins to Emerge.

[18] Air Force briefing to and discussion with CRS and think tank representatives, September 1, 2015.

[19] B-21's timeline more closely approximates F-22 and F-35 if it is dated from the initiation of the NGB program, not from the October 2015 contract award.

Major subsystem risk reduction was also accomplished, and both competitors' designs incorporated substantial quantities of existing subsystems (sometimes with B-21-specific refinements). This effort presumably reduces technological risk and shortens the time required for the engineering and manufacturing development (EMD) phase that precedes production. Indeed, although DOD's usual Technology Readiness Levels are not being used to measure maturity on the program, program officials stated that no further technology development is required to move B-21 to production.[20] They see the most challenging part of B-21 as the integration of technologies in the EMD phase.

Air Force officials have emphasized that B-21 is part of a family of systems, implying that it is the node of a larger, distributed network of sensors and communications, not all of which may have been publicly disclosed. Connectivity with this family of systems has been included in the B-21 design from the start, although it is not possible to gauge the maturity or stability of these systems—and thus how much the B-21 may have to be adapted in the future should those external systems change.

B-21 will employ open systems architecture, similar to that already being demonstrated on F-22, U-2, B-2, and other platforms. Open architecture allows new sensors or other subsystems from various vendors to be easily integrated into the aircraft. As a result, the initial B-21 aircraft can be augmented more easily as advanced technologies are developed; it also means that what might otherwise be expensive development of advanced sensors and/or other subsystems may be deferred and/or competed independent of the aircraft itself. This comports with earlier comments about the possibility of B-21 being part of a family of systems, and suggests that some relevant capabilities may be under development in other budget lines.

Acquisition Strategy

Although it is one of the Air Force's largest programs, B-21 is being acquired through nontraditional means. Instead of the regular acquisition process, the B-21 program is managed and acquired through the Air Force Rapid Capabilities Office, with reduced overhead including a much smaller program office than typical for such a significant program.[21] Nevertheless, B-21 will be designated as a Major Defense Acquisition Program and is therefore subject to Nunn-McCurdy requirements.[22]

Plans call for initial acquisition of B-21s to take place in five low-rate production lots totaling 21 aircraft. Two or three test aircraft will precede the production lots. The development program began on Friday, October 23, 2015, when Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall selected Northrop Grumman as the prime contractor.

[20] Air Force briefing to and discussion with CRS and other think tanks, September 1, 2015. Technology Readiness Levels are DOD's accepted method of measuring the maturity of a specific technology. They use a 9-point scale; technologies ranked 6 or above have been demonstrated in a relevant environment (as opposed to a laboratory setting.) The B-21's subsystems' readiness for production appears to indicate a TRL equivalent of 6 or 7.

[21] Created in 2003, the Air Force Rapid Capabilities Office "expedites development and fielding" of systems and "conducts projects on accelerated timelines." U.S. Air Force, *Fact Sheet: Rapid Capabilities Office*, Washington, DC, August 28, 2009, http://go.usa.gov/czcnB. "The RCO reports to a board of directors chaired by Pentagon procurement chief Frank Kendall; Air Force Secretary Deborah Lee James, Chief of Staff Gen. Mark Welsh and service acquisition head William LaPlante are also on the board." Amy Butler, "USAF Offers Long-Awaited Peek At Secret Bomber Plans," *Aerospace Daily*, September 3, 2015, p. 2.

[22] Correspondence from DOD Legislative Affairs to CRS, April 1, 2016. Nunn-McCurdy requirements specify how DOD reports program cost growth to Congress; for more details, see CRS Report R41293, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, by Moshe Schwartz and Charles V. O'Connor.

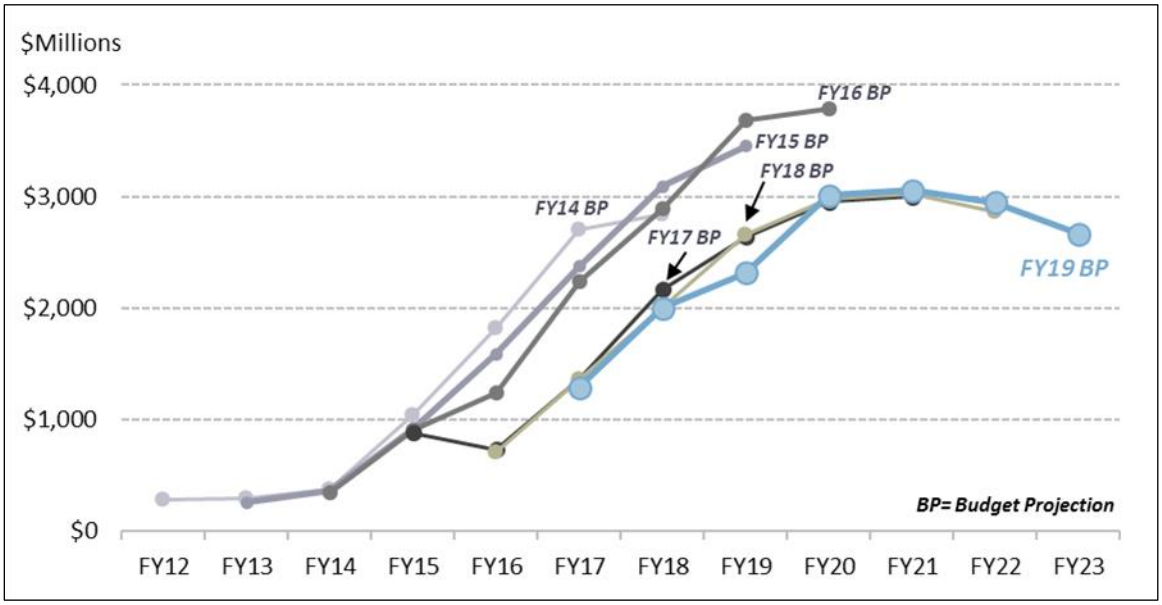
According to program officials, selection of a contractor constituted "Milestone B" in this acquisition, although it is not clear whether all of the required steps for a formal Milestone B review were carried out under the B-21's rapid acquisition construct.[23] Subsequently, the Air Force announced the B-21 had passed its preliminary design review, a step normally required before Milestone B.[24]

DOD proposes to acquire the B-21 through a cost-plus-incentive-fee development contract followed by firm-fixed-price procurement.[25] This has occasioned some critical comment; see "Issues for Congress" below for further discussion.

Budget Profile

As depicted in **Table 1**, projected annual funding for the B-21, after increasing markedly over the past several years, has begun to decline. Over the same time, the accompanying projections for each year's Future Years Defense Program (FYDP) had usually shown a substantial increase in funding in the following five years.

Figure 2. Proposed B-21 Outyear Funding



Source: Air Force R&D justification books, PE 0604015F, for years indicated.

As **Figure 2** shows, however, the outyear funding projection changed in the FY2017 Administration budget proposal, which cut $3.5 billion over the FYDP from the previous projection while maintaining approximately the same rate of growth. Senior Air Force officials indicate that this revision is due to the actual bids for the B-21 being considerably lower than either the Air Force's budget estimate or the independent estimate developed by DOD's Office of

[23] Air Force briefing to and discussion with CRS and think tank representatives, September 1, 2015. "Milestone B," defined in DOD regulation, marks the point at which a program exits technology maturation/risk reduction and proceeds to engineering and manufacturing development. A specific set of reports and certifications are required for a standard Milestone B.

[24] Valerie Insinna, "B-21 Raider covertly completes preliminary design review," *Defense News*, March 8, 2017.

[25] Lara Seligman, "Air Force Defends B-21 Bomber on Capitol Hill, but McCain Still 'Concerned,'" *DefenseNews.com*, March 2, 2016.

Cost Analysis and Program Evaluation. This budget revision results in the program growing at approximately the same rate, but starting from a lower baseline.

The current unclassified budget projection does not include procurement funds for the B-21, nor explain whether the initial LRIP lots will be purchased with procurement or R&D funding.

Industrial Base

Northrop Grumman intends to build the B-21 at its facilities at Air Force Plant 42 in Palmdale, CA, which were previously used to produce the B-2. The company currently builds F-35 subassemblies and Global Hawk and Triton UAVs on the site, and this work would continue alongside the B-21. Although the delivery schedule has not been announced, work has been underway for some time to prepare the production line.[26]

On March 7, 2016, the Air Force released a list of B-21 major subcontractors, without commenting on what part of the aircraft they would provide. Subcontractors include

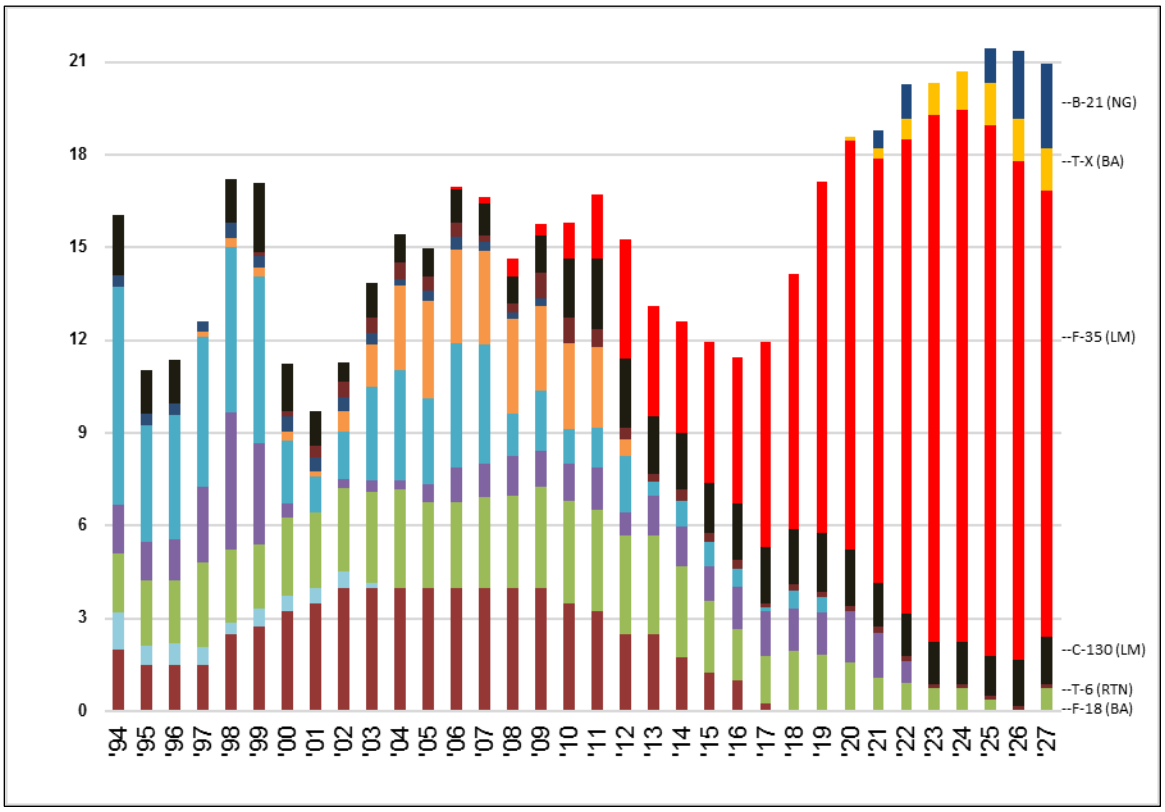
- Pratt & Whitney, East Hartford, CT;
- BAE Systems, Nashua, NH;
- GKN Aerospace, St. Louis, MO;
- Janicki Industries, Sedro-Woolley, WA;
- Orbital ATK, Clearfield, UT, and Dayton, OH;
- Rockwell Collins, Cedar Rapids, IA; and
- Spirit AeroSystems, Wichita, KS.

Following the B-21 contract award to Northrop Grumman, Lockheed Martin will remain the principal supplier of purpose-built combat aircraft to the DOD, as shown in **Figure 3**.

[26] CRS site visit to Palmdale, CA, March 10, 2016, and Guy Norris and Jen DiMascio, "Northrop Speeds Up B-2 Work, Primes For LRS-B," *Aviation Week,* December 14, 2015, http://aviationweek.com/defense/northrop-speeds-b-2-work-primes-lrs-b.

Figure 3. U.S. Fixed-Wing Manned Military Aircraft Programs

(Deliveries in 2018 $B)



Source: The Teal Group.

Issues for Congress

How Many B-21s to Procure

When it initially released information about the program, the Air Force announced that it hoped to buy "80 to 100" B-21s. That number was subsequently resolved to a request for 100 in the FY2017 budget submission and subsequent testimony.

> We require a fleet size that will ensure sustained dominance well into this century and intend to procure a **minimum** of 100 B-21s. Procuring **at least** 100 B-21s will also reduce lifecycle ownership costs. Further, we are continuing to study the right size of the total future bomber force.[27]

Through a spokesman, the Air Force confirmed the number, saying the change happened "in Spring 2016" at the request of Air Force Global Strike Command. At that time, USAF established 100 "as the floor—not the ceiling" for the B-21 fleet size, he said. AFGSC

[27] U.S. Air Force, *Statement Of General Stephen W. Wilson, Vice Chief of Staff of the Air Force to the Committee on Armed Services, United States House Of Representatives regarding Military Assessment of Nuclear Deterrence Requirements*, March 8, 2017, http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF. Emphasis in original.

> "requires a minimum of 100 B-21 Raider aircraft, with a mix of legacy bombers, to meet future COCOM [combatant commander] requirements," the spokesman said.[28]

The B-21 is intended to initially replace the 20 B-2 and 63 B-1 strategic bombers currently in the fleet. B-2s date from the 1990s; B-1s date from the 1980s.

When the B-2 was procured in the 1990s, initial plans called for 132 aircraft. Ultimately, 21 B-2s were procured.[29] The B-2 was not primarily intended to replace existing bombers, but to add stealth capability to the fleet. Arguably, that role as an enhancement rather than a replacement made it easier to reduce the number bought, since adding any quantity of B-2s would leave the bomber force more capable than before.

By contrast, the Air Force plans to retire its B-2s and B-1s by 2040. Following those retirements, with the full planned buy of 100 B-21s, the bomber fleet would grow in number from 159 to 176. In testimony, the Air Force Deputy Chief of Staff for Strategic Plans, Programs and Requirements stated that the United States needed a fleet of 165 bombers.[30] Others argue that the resulting bomber force will be too small, and that DOD should acquire more than 100 B-21s. For example, a paper by retired Air Force Lieutenant General Michael Moeller recommended a force of 150 to 160 combat-coded bombers, which would require 200 B-21s.[31]

Subsequently, Secretary of the Air Force Heather Wilson announced a goal of increasing the bomber fleet by seven squadrons.[32] Although the goal was not accompanied by specific procurement plans, observers note that would likely necessitate 75 additional bombers, with only the B-21 then in production.[33]

Should Older Bombers Be Extended?

In deciding whether and how quickly to acquire B-21s, Congress may wish to consider the trade-off between the cost and effectiveness of new aircraft and extending the service lives of existing B-52s, B-1s, and B-2s. This may be a challenging comparison, particularly as the B-52s are already scheduled to remain in service for 80 years, an unprecedented service life for a combat aircraft. Quite apart from the B-52's suitability to operate in evolving air defense environments, the challenges of maintaining and operating an 80-year-old aircraft in regular service are unknown. That said, many of the B-52's systems have already been upgraded and replaced over the years, so the time since manufacture may not represent the actual maturity of the aircraft.[34]

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[28] John A. Tirpak, "It's Official: Minimum of 100 B-21s," *Air Force*, March 16, 2017, http://www.airforcemag.com/DRArchive/Pages/2017/March%202017/March%2015%202017/It%E2%80%99s-Official-Minimum-of-100-B-21s.aspx.

[29] One B-2 was subsequently lost in an accident, and one is used for testing.

[30] Colin Clark, "B-21 Bomber Boost? KC-46 Still Late," *Breaking Defense*, May 25, 2017, http://breakingdefense.com/2017/05/b-21-bomber-boost-general-touts-165-kc-46-still-late/.

[31] Lt Gen Michael R. "Mike" Moeller, USAF (Ret.), *US BOMBER FORCE: Sized to Sustain an Asymmetric Advantage for America*, Mitchell Institute, 2015. Combat-coded aircraft are those containing full equipment and capabilities, maintained to be fully ready, and not designated for training or other purposes. Of the force of 20 B-2s, 16 are combat-coded.

[32] Secretary of the Air Force Public Affairs, *Air Force We Need: 386 operational squadrons*, Washington, DC, September 17, 2018, https://go.usa.gov/xPXAg.

[33] See, inter alia, Colin Clark, "What Will New Bomber Squadrons Mean For Air Force? 75 More B-21s?," *Breaking Defense*, September 18, 2018, pp., https://breakingdefense.com/2018/09/what-will-new-bomber-squadrons-mean-for-air-force-75-more-b-21s/.

[34] For more information on B-52 and B-1 modernization, see U.S. Air Force Bomber Sustainment and Modernization:

When Will B-21 Actually Be Available?

Budget documents and testimony have long indicated that the B-21 was expected to reach IOC in the mid-2020s. More recently, Air Force statements have raised the possibility of a later IOC.

> The B-21 bomber is "progressing really well," Global Strike Command chief Gen. Robin Rand told reporters ... it looks like "in the mid-2020s, we'll have the first one at one of our bases," with initial operating capability "in the late '20s". He reiterated his "strong recommendation" that USAF buy "at least 100" of the bombers and "make sure we get to that [number] by the late '30s." At such a rate, production would be around five per year.[35]

It is not clear whether the move to a potential "late 2020s" IOC is driven by program issues, budget constraints, or other issues. It may also simply be a misstatement, but subsequent Air Force testimony has not refuted this projection.

Cost Issues

What Other Budget Items Support B-21?

In testimony, the Air Force Vice-Chief of Staff said, "The Air Force remains committed to B-21 affordability, with the average procurement cost of $564 million in base year 2016 dollars."[36]

As noted above, many aspects of the B-21's design remain classified, which makes validating the proposed cost difficult. Further, the unclassified budget for the B-21 shown in Air Force Research, Development, Test & Evaluation line 604015F is only a portion of the funding for the program. Whether B-21 itself enjoys additional (presumably classified) funding, Air Force officials have stated that B-21 is part of a family of systems, and that work on enabling technologies continues. It is not clear to what extent the B-21 depends on these other systems in order to accomplish its missions. If they are essential to some or all of the B-21's missions, however, the cost of those enablers might be considered as part of the cost of the B-21. To the extent they enable other systems besides B-21, a portion of the enablers' cost could be attributed to B-21.

DOD has not publicly identified these enabling systems, nor where in the budget their development appears.

Both the House and Senate-passed versions of the FY2017 defense authorization bill included requirements that DOD disclose the total cost of the B-21. However, those provisions did not appear in the final conference report.[37]

Background and Issues for Congress.

[35] John A. Tirpak, "B-21 Update," *Air Force*, March 3, 2017, http://www.airforcemag.com/DRArchive/Pages/2017/March%202017/March%2003%202017/B-21-Update.aspx.

[36] U.S. Air Force, *Statement Of General Stephen W. Wilson, Vice Chief of Staff of the Air Force to the Committee on Armed Services, United States House Of Representatives regarding Military Assessment of Nuclear Deterrence Requirements*, March 8, 2017, http://docs.house.gov/meetings/AS/AS00/20170308/105640/HHRG-115-AS00-Wstate-WilsonUSAFS-20170308.PDF.

[37] John M. Donnelly, "Contractor Won Weak Bomber Oversight, McCain Says," *Roll Call*, December 13, 2016, https://www.rollcall.com/news/policy/contractor-won-weak-bomber-oversight-mccain-says.

Cost of Nuclear Capability

As noted earlier, one of the issues in the earlier Next-Generation Bomber program was whether to incur the additional cost of making the bomber nuclear-capable. That decision has been made in the affirmative for the B-21. Congress may wish to consider the trade-off between the cost of making the B-21 nuclear-capable and other means of delivering nuclear weapons. The contribution of each leg of the nuclear triad to deterrence is a long-standing debate, as are the questions of the cost/effectiveness issue between penetrating platforms and standoff weapons. The latter question is coming to the fore again with DOD's proposals for the Long-Range Standoff Missile (popularly LRSO) and the Arsenal Plane (see footnote 8). Whether standoff missiles or land- or sea-based ICBMs offer the same flexibility as a bomber, and the value of any additional flexibility, may figure into Congress's considerations not only of B-21, but of other nuclear modernization programs.[38]

Acquisition Process Issues

What Type of Contract Should Be Used for B-21?

As noted above, B-21 development is being conducted through a cost-plus-incentive-fee development contract followed by firm-fixed-price procurement. The late Senator John McCain publicly challenged this contract structure, arguing that a fixed-price development contract would be more beneficial to the government:

> "I will not authorize a program that has a cost-plus contract—and I told them that," said McCain, R-Ariz. "If you have a cost-plus contract, tell me one time that there hasn't been additional costs, then I would reconsider. The mindset in the Pentagon that still somehow these are still acceptable is infuriating."[39]

Others noted that fixed-price development worked better when the major technology issues had been solved and there was a broad market for the product that would allow the contractor to recoup its development costs should they be higher than the fixed price.

In evaluating the acquisition strategy, Congress may attempt to assess to what degree the declared subsystem risk reduction has actually reduced the technology risk of the entire B-21 program. Congress may also consider whether it prefers to fix development costs and take a risk on which capabilities can be achieved for that cost, or fix the technology requirement and take a risk that costs will increase.[40] It may also wish to consider any cost inherent in changing the acquisition strategy already being executed.[41]

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[38] For a fuller discussion of these issues, see CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.

[39] Lara Seligman, "Air Force Defends B-21 Bomber on Capitol Hill, but McCain Still 'Concerned,'" *DefenseNews.com*, March 2, 2016.

[40] A useful discussion of these issues can be found in Andrew Hunter, "Long Range Strike: 3 Lessons from Defense Contracting that Tell us the Air Force's New Bomber is Ready to Move Forward," *War on the Rocks*, February 26, 2016, http://warontherocks.com/2016/02/long-range-strike-3-lessons-from-defense-contracting-air-forces-new-bomber-ready-to-move-forward/.

[41] See, for example, James Drew, "Penalty for breaking Northrop's B-21 contract is '$300 million'," *FlightGlobal.com*, March 9, 2016, pp. https://www.flightglobal.com/news/articles/penalty-for-breaking-northrops-b-21-contract-is-3-422960/.

In this context, it may be worth noting that DOD has found "no statistical correlation between the use of contract type (e.g., cost-plus and fixed-price types) and lower cost or schedule growth."[42]

Accuracy of Cost Estimating

As noted above, the winning bid for the B-21 came in substantially below DOD's independent estimates. In the past, contractors have been accused of bidding unrealistically low prices in order to win a given contract, then using their incumbency to appeal for higher appropriations. Use of cost-plus-incentive-fee development, as in the current contract, appears to put some cost risk on the government, while firm-fixed-price procurement appears to put much of the risk for subsequent cost increases on the contractor.

Congress may wish to revisit DOD's cost estimation to understand why the estimated cost was significantly higher than the actual bid. In addition, Congress may wish to use its oversight mechanisms to verify that the contract can be executed at the price bid and/or select a contract type maximizing contractor responsibility to meet the bid price.

Oversight Issues

Oversight of Rapid Acquisition Programs

B-21 is being acquired through nontraditional means, using the Air Force's Rapid Capability Office instead of a standard dedicated program office, as is more typical. Although this approach may improve the speed and ease of the acquisition, Congress has relatively little experience overseeing rapid acquisitions processes. At $3 billion a year, this program is significantly larger than those that have traditionally been the subject of rapid acquisition. Congress may wish to consider whether its ability to oversee such acquisitions is sufficient, and if the advantages gained through rapid acquisition processes outweigh the challenges of oversight when applied to major defense acquisition programs. Alternatively, Congress may consider revising the existing acquisition regulations to more closely approximate the rapid acquisition process.

Oversight of Highly Classified Programs[43]

Like many defense technology programs, most of the B-21 program is designated as a Special Access Program. Special Access Programs implement stricter access requirements than those necessary to obtain information classified at Confidential, Secret, or Top Secret levels.[44] House[45] and Senate[46] rules govern the manner in which Members of Congress and their staffs may gain access to national security classified information.

Primary oversight responsibility for government programs typically lies with the members of committees with jurisdiction established by House and Senate rules. With regard to the B-21 program, these committees include the House and Senate Armed Services Committees, as well as the Defense Subcommittees of the House and Senate Appropriations Committees. Due to the size

[42] Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics, *Performance of the Defense Acquisition System: 2013 Annual Report*, Washington, DC, June 28, 2013, p. 51, http://go.usa.gov/cetBd.

[43] This discussion was prepared by Eric Petersen, CRS Specialist in American National Government, at the author's request.

[44] For further discussion, see CRS Report R43216, Security Clearance Process: Answers to Frequently Asked Questions, by Michelle D. Christensen and Frederick M. Kaiser.

[45] House Rule XXIII, cl. 13.

[46] S.Res. 243, A resolution to establish the Office of Senate Security, 100th Congress, adopted July 1, 1987.

of the B-21 program, its implications for defense budgeting, and other issues like the role of nuclear weapons in U.S. defense strategy, the B-21 may attract interest from Members not typically involved in such issues. Congress may wish to consider whether such Members' interests require a greater level of access to program data, or whether the issues can be adequately addressed under the current rules.

Appropriate Level of Classification

The FY2017 Consolidated Appropriations Act (P.L. 115-31) required the Department of Defense Inspector General to review the secrecy surrounding B-21 development, with a report to Congress due by November 2017. That review is underway.[47]

Should B-21 Be Financed Through a Separate Strategic Forces Fund?

In 2015, Congress authorized that the Ohio Replacement Program, the SSBN(X), which like B-21 has a nuclear mission, be funded not from the Navy budget, but through a National Sea-Based Deterrence Fund in the Defense-Wide budget.[48] On March 16, 2016, Air Force Secretary Deborah Lee James told the House Armed Services Committee that all U.S. strategic forces should be funded outside of service budgets.[49] Two days later, Secretary of Defense Ashton Carter agreed "that a broader nuclear deterrent fund may be appropriate."[50]

Those who support a separate nuclear deterrence fund argue that the nuclear deterrence mission is a joint and national effort, not distinct to a particular military service, and thus should be funded outside the services' budgets. They also note that the military services are facing a "bow wave" of deferred modernization and recapitalization following more than a decade of war, and that moving the expensive nuclear forces to a separate budget will allow the services to focus on enhancing capability for their unique missions without the competing expense of deterrence forces.[51] Others note that regardless of the budget line used, all of these funds will come under the DOD topline, and that reallocating funds to a DOD-wide deterrence fund will reduce the overall amounts available for all of the services.

[47] Anthony Capaccio, "Air Force B-21 Bomber's Secrecy to Be Reviewed by Inspector General," *Bloomberg Politics*, May 15, 2017, https://www.bloomberg.com/politics/articles/2017-05-15/air-force-b-21-bomber-s-secrecy-to-be-reviewed-by-inspector-j2qc0lwh.

[48] For more details on the Sea-Based Deterrence Fund, see CRS Report R41129, *Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress*, by Ronald O'Rourke.

[49] Marina Malenic, "USAF wants to add B-21, ICBM upgrades to 'strategic deterrent' fund," *IHS Jane's 360*, March 16, 2016.

[50] Aaron Mehta, "Carter Open to DoD-wide Nuclear Weapons Fund," *Defense News*, March 18, 2016.

[51] For a discussion of the Air Force bow wave, see CRS Report R44305, *The Air Force Aviation Investment Challenge*. Overall DOD bow wave issues are addressed in Todd Harrison, *Defense Modernization Plans through the 2020s: Addressing the Bow Wave*, Center for Strategic and International Studies, January 27, 2016, https://csis.org/files/publication/160126_Harrison_DefenseModernization_Web.pdf.

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