

# CRS Report for Congress

## The Next Generation Bomber: Background, Oversight Issues, and Options for Congress

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Anthony Murch  
National Defense Fellow  
Foreign Affairs, Defense, and Trade Division



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## Summary

The Air Force is in the initial stages of formalizing a new bomber aircraft acquisition program. This program, in accordance with Department of Defense (DOD) and congressional mandates, is to produce a new long-range strike aircraft to be operational by 2018. Air Force plans for acquiring a new bomber aircraft have been accelerated by about 20 years from earlier projections because of a combination of the Air Force's desire to retire a portion of its B-52 fleet and DOD's perception of a developing "bomber capability gap." Defense analysts have estimated that it will cost between \$8 billion and \$10 billion to develop a new bomber using current or "soon-to-mature" technologies.

The Air Force expects the 2018 bomber to serve as an "interim fix" to bridge a bomber capability gap, allow it to retire a portion of the current bomber fleet, and position itself for development of a follow-on bomber with more advanced technologies such as hypersonic (faster than Mach 5) drive engines. While the Air Force has yet to release a formal bomber Request for Proposal, defense and industry experts expect the 2018 bomber program to call for the acquisition of around 100 stealthy bomber aircraft capable of high-subsonic flight and delivery of both nuclear and conventional munitions. It remains to be seen if a portion of the "next generation" 2018 bomber fleet will be designed to be unmanned. Both congressional and DOD mandates, however, point in the direction of at least a portion of the planned new fleet being unmanned.

The Air Force has not finalized the requirements for the 2018 bomber and has called for a "fly-off" between potential aircraft in the 2010 timeframe. Boeing and Lockheed Martin have already teamed up and are working to develop a bomber design for consideration. Northrop Grumman, the only other potential competitor, may also join in the competition given its experience with the B-2 and ongoing work on the Navy's new unmanned strike aircraft.

The 2018 next generation bomber raises several potential oversight issues for Congress: balancing capability, affordability, and procurement quantity of a new bomber; balancing the mix between long- and short-range strike aircraft; monitoring DOD's ability to execute an additional large aircraft acquisition program in a highly fiscally constrained environment; assessing the acceptability of an unmanned B-2 "like" bomber aircraft; ensuring the appropriate overall long-range strike force structure (specifically, addressing the retirement of a portion of the B-52 fleet); and assessing the industrial-base implications of delaying the development of a new bomber aircraft.

For the FY2009 budget deliberations, Congress will be called upon to assess the Air Force's decision to delay program funding to FY2010 and whether this will affect the Air Force's ability to deliver a new bomber by 2018. This report will be updated as events warrant.

## Contents

|  |    |
|--|----|
| Background .....   | 2  |
| What Is Long-Range Strike? .....                                     | 2  |
| Defining “Long Range” .....  | 2  |
| Current Bomber Fleet .....   | 3  |
| B-52H Stratofortress .....   | 4  |
| B-1B Lancer .....  | 5  |
| B-2 Spirit .....   | 6  |
| DOD’s Next Generation Bomber: Evolution of a Direction .....         | 6  |
| Trends from 1992 to 2007 .....                                       | 8  |
| Past Congressional Actions .....                                     | 9  |
| FY2009 Budget Request .....  | 10 |
| Issues for the Air Force .....                                       | 11 |
| The Need for a New Bomber by 2018 .....                              | 11 |
| The Feasibility of a “2018” Bomber .....                             | 12 |
| 2018 Bomber Capabilities .....                                       | 14 |
| Speed Versus Persistence .....                                       | 15 |
| Dual Role: Conventional/Nuclear Capability .....                     | 16 |
| 2018 Bomber: Interim Fix or Final Solution? .....                    | 17 |
| Man-in-the-Loop Issues .....   | 19 |
| Industrial-Base Implications .....                                   | 20 |
| Issues for Congress .....  | 20 |
| Appendix A. Aircraft Classification Definitions and Discussion ..... | 23 |
| Definitions .....  | 23 |
| Discussion .....   | 24 |
| Appendix B. DOD Bomber Direction, 1992 to 2007 .....                 | 25 |
| 1992 U.S. Air Force Bomber Roadmap .....                             | 25 |
| 1993 Bottom-Up Review .....  | 25 |
| 1994 Nuclear Posture Review .....                                    | 26 |
| 1995 DOD Heavy Bomber Force Study .....                              | 26 |
| 1997 Quadrennial Defense Review .....                                | 27 |
| 1999 USAF White Paper on Long-Range Bombers .....                    | 28 |
| 2001 QDR, 2001 Long-Range Strike White Paper and 2002 NPR .....      | 28 |
| 2006 QDR and the 2007 USAF Long-Range Strike White Paper .....       | 29 |

## List of Figures

|   |    |
|---|----|
| Figure 1. Table from Chairman of the Joint Chiefs of Staff Instruction<br>(CJCSI) 4410.01D, Standardized Terminology for Aircraft<br>Inventory Management, March 23, 2007 ..... | 23 |
|---|----|

## List of Tables

|   |    |
|---|----|
| Table 1. Current U.S. Air Force Bomber Fleet .....  | 4  |
| Table 2. DOD-Recommended Bomber Force Structure Changes, 1992-2007 ...                        | 7  |
| Table 3. Air Force Aircraft Acquisition Programs: Planned Buy vs.<br>Actual Procurement ..... | 18 |

# The Next Generation Bomber: Background, Oversight Issues, and Options for Congress

## Introduction

The 2006 Quadrennial Defense Review (QDR) began laying the groundwork for the development of a new long-range strike platform to either replace or augment the current fleet of ~180 long-range heavy bomber assets (B-1s, B-2s, and B-52s). Prior to the 2006 QDR, the Air Force had indicated that its current bomber fleet would suffice until 2037, when advanced technologies, such as hypersonic cruise vehicles, would potentially reach maturity and be incorporated into follow-on bomber aircraft. The Office of the Secretary of Defense (OSD), responding to the Air Force's desire to retire 38 B-52Hs and concerned about the Air Force's ability to successfully execute long-range bombing missions in the future, accelerated Air Force plans for fielding a new aircraft by almost 20 years, to 2018.

The 2007 National Defense Authorization Act (P.L. 109-364; 120 Stat 2111 [Sec 131]), acknowledging OSD and Air Force desires to retire a portion of the B-52 fleet, mandated the fielding of a new long-range strike platform by 2018 before additional reductions to the current B-52 fleet would be allowed. Current Air Force plans call for fielding a new bomber by 2018, but many outside the Air Force have noted that current funding and program development appear to be behind schedule for meeting the 2018 mandate.

There is currently no consensus, within DOD or among military analysts, on the capabilities needed in a next generation bomber, or even whether an "interim" bomber is needed. This lack of consensus and direction has caused some to speculate that the Air Force is not supporting an interim bomber development program because it might threaten the acquisition of a more advanced system in the late 2030s. In addition, the Air Force has a host of other acquisition programs that will compete for limited dollars during the same timeframe.

During its oversight hearings and review of budget requests, Congress will assess the need for a potential interim long-range strike capability and review what force structure funding adjustments would be needed to bring the acquisition program to fruition in the 2018 timeframe.

## Background

### What Is Long-Range Strike?

DOD is currently analyzing two similar but different concepts to address future requirements for striking targets at great distances: Prompt Global Strike (PGS) and Long-Range Strike (LRS). Prompt Global Strike, on the one hand, is U.S. Strategic Command's effort to strike any target globally in a matter of minutes or hours.<sup>1</sup> There are a number of options currently being analyzed, ranging from long-range missiles to space-based assets, to meet the response timing goals of Prompt Global Strike. Long-Range Strike, on the other, is the USAF Air Combat Command's current efforts to field an "air breathing" bomber/strike aircraft. In 2006, there was a push within OSD's Program Analysis and Evaluation Office to combine the two efforts, but OSD eventually determined that LRS and PGS analyses would remain separate with separate sets of requirements. General Moseley, the Air Force Chief of Staff, noted that long-range strike is about "persistent, survivable, penetrating capability" with significant weapons loads (bomber-like aircraft), while prompt global strike could be achieved with very fast "standoff" weapons (missiles).<sup>2</sup> This report focuses only on the potential evolution of a new bomber aircraft to meet DOD's goals for Long-Range Strike by 2018.

### Defining "Long Range"

There is no consensus definition for the term "long range." Further, some studies confuse the terms "range" and "combat radius," treating them as synonymous. The following definitions will be used for "range" and "combat radius"<sup>3</sup>:

- **Range:** The distance an unrefueled aircraft can fly (or is permitted to fly) with specified load (a "one-way" flight).
- **Radius:** The approximate distance an unrefueled aircraft can fly from base and return without intermediate landing (out and back to the point of origin).

It should be noted that most studies referenced in this report use the term *range* to define what would be more appropriately called *combat radius* (out-and-back distances).

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<sup>1</sup> For more on the Prompt Global Strike mission and status, see CRS Report RL33067, *Conventional Warheads for Long-Range Ballistic Missiles: Background and Issues for Congress*, by Amy F. Woolf.

<sup>2</sup> Grossman, Elaine M. "Air Chief Resists Combining Future Bomber, Prompt Strike Studies," *Inside the Air Force*, March 24, 2006.

<sup>3</sup> Jane's All The World's Aircraft, 2007-2008, p. 38.

While a number of studies use various distances to differentiate medium from long-range, this report uses the Congressional Budget Office's (CBO) unrefueled distance milestones as a delineation of distance categories:<sup>4</sup>

**Medium-Range:** Range — 3,000-5,000 Nautical miles (nm)  
Radius — 1,500-2,500 Nautical miles (nm)

**Long-Range:** Range — 5,000 Nautical miles (nm) or more  
Radius — 2,500 Nautical miles (nm) or more

There is, however, a drawback to adhering too closely to this yardstick. While most would agree that B-1s and B-2s are “long-range” platforms, CBO noted in this study that the B-1B bomber has an “unrefueled, full combat payload” combat radius of 1,800 nm, while the B-2's combat radius is 2,000 nm. Using these numbers would result in both of these aircraft being labeled as “medium range” or “regional” bombers.<sup>5</sup> However, the USAF bomber concept of operations assumes aerial refueling, which moves the bombers back up to long-range. Indeed, with aerial refueling, the B-2 flew against targets in Serbia, taking off and recovering at Whiteman AFB in Missouri.

Adding to the difficulty of defining and comparing range/radius values is that these values are highly dependent on the conditions in which they are measured (altitude of flight, aircraft configuration, etc.). Aircraft loaded to maximum weight or having external weapons “hung” on the wings or fuselage will have a shorter range/radius than a “lighter” aircraft flying in a “clean” configuration (no external weapons). These caveats need to be taken into consideration when comparing aircraft capabilities.

While aerial refueling gives current and future weapon systems range only limited by crew endurance, unrefueled range is still an important variable. The real value in unrefueled range is the bomber's ability to reach deep into an adversary's interior, safely strike high-value targets without the need for support aircraft (such as tankers and fighters), and return to a base outside the “reach” of the enemy. If travel distance to the target is not a factor, longer unrefueled range/radius translates to longer loiter time<sup>6</sup> over a target area without the need for aerial refueling support.

## Current Bomber Fleet

Currently, the USAF has 181 bomber aircraft in its inventory of B-52Hs, B-1s, and B-2s. The following table provides more detailed information:

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<sup>4</sup> U.S. Congressional Budget Office, *Alternatives for Long-Range Ground Attack Systems*, by Robie Samanta Roy and David Arthur, March 2006: Summary p. X.

<sup>5</sup> The B-58 and FB-111 are examples of medium range/regional bomber aircraft.

<sup>6</sup> Maximum loiter time is based on flying at an airspeed and aircraft configuration that will allow the maximum time over a target area before having to return to base (otherwise known as maximum endurance).

**Table 1. Current U.S. Air Force Bomber Fleet**

|                         | <b>B-52H</b>         | <b>B-1B</b>          | <b>B-2</b>      |
|-------------------------|----------------------|----------------------|-----------------|
| # Aircraft              | 94 (85 active/9 res) | 67                   | 20              |
| Combat Ready            | 62 (54 active/8 res) | 51                   | 16              |
| First Flight            | 1954                 | 1984                 | 1988            |
| Last Delivery           | 1962                 | 1988                 | 1997            |
| Range (nm) <sup>a</sup> | 8,800                | 7,455                | 6,000+          |
| Payload                 | 70,000               | 75,000               | 40,000          |
| Crew                    | 5                    | 4                    | 2               |
| Max Speed               | Mach .86             | Mach 1.2 (sea level) | “High Subsonic” |
| Fuel Capacity           | 312,000 lb.          | 265,000 lb.          | 167,000 lb.     |

**Sources:** Center for Strategic and International Studies Read-Ahead “Long-Range Strike: Options and Alternatives,” December 12, 2007, *Air Force Almanac*, May 2007, U.S. Air Force Fact Sheets.

a. Range noted is unrefueled “one-way” distances in Nautical miles.

**B-52H Stratofortress.** The Boeing B-52 has been the workhorse of the USAF manned bomber fleet for more than 50 years. On average, the current aircraft are over 44 years old.<sup>7</sup> Initially designed for a Cold War nuclear role, 744 B-52s have been built and have delivered only conventional weapons in combat. The Air Force still has 102 B-52Hs; all were built between 1960 and 1962. There are 62 B-52Hs available for combat operations today. Of the three current manned bombers, the B-52’s extensive upgrades have allowed it to carry the widest array of conventional and nuclear munitions. In addition to its varied payload capability, the B-52 has the longest unrefueled loiter time of all the current bombers.

The B-52 has seen service in almost every military campaign since joining the active force in 1955. The B-52, however, suffers from a number of age-related issues that may cause some to question its future viability as an effective and survivable weapon system. Structurally, the service life of the B-52 was examined and extended in 2007 from ~32,000 flight hours to a maximum of ~39,000 flight hours.<sup>8</sup> This service life extension should carry the B-52 at least into the 2030s.<sup>9</sup> However, given the age of the airframe and disappearance of parts manufacturers for the B-52, spare parts availability will need to be addressed and closely managed.<sup>10</sup> In terms of survivability and effectiveness, past bomber operational concepts have relegated the

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<sup>7</sup> “Age of the Active Duty Fleet,” *Air Force Magazine*, May 2007, p. 63.

<sup>8</sup> “Long-Range Strike White Paper,” HQ USAF/A5RC, 2007, p. 6.

<sup>9</sup> *Ibid.*, p. 6.

<sup>10</sup> Axelso, Peter D., Major, “The B-52: Can It Fly Until 2050?” School of Advanced Airpower Studies, June 2000, p. 14.



B-52 to the role of “standoff”<sup>11</sup> weapons carrier and delivery vehicle of massive firepower in low threat areas. Today, the Air Force’s operational assessment is that the B-52 will not be survivable under the 2015-2020 threat picture, and therefore its effectiveness and utility could be limited except in benign threat environments.<sup>12</sup> Ongoing modernization of its electronic suites will be essential to keeping the B-52 viable as a standoff weapons delivery vehicle.

**B-1B Lancer.** The Boeing<sup>13</sup> B-1B evolved from numerous bomber studies conducted in the 1960s for a supersonic replacement for the B-52 and B-58 bombers. B-1A development ultimately began in June 1970, with design requirements for high speed, low altitude penetrating capability, high altitude supersonic “dash” (higher speed for a short distance), and intercontinental range. The Air Force hoped to procure a sufficient number to replace the B-52 fleet.<sup>14</sup> Initially, OSD was skeptical about the B-1 program, given the backdrop of an evolving surface-to-air missile (SAM) threat and enhancements to the United States’ intercontinental strategic missile systems as alternatives to manned bombers. In addition, events such as the shoot-down of a U-2 over Russia and the high development and operational costs of supersonic aircraft at the time led to the cancellation of the Mach 3 XB-70 bomber and early retirement of the Mach 2 B-58 mid-range bomber. The Carter Administration terminated the B-1 program in 1977 in favor of fielding air-launched cruise missiles on the B-52, but the Reagan Administration resurrected it in 1981 as part of its defense build-up program. The new program, the B-1B, reached operational status in October 1986. One hundred B-1Bs were built and delivered to the Air Force between 1985 and 1988. Today, 67 B-1Bs are still operational.

The B-1B was designed to serve as an effective low altitude supersonic bomber. The B-1B’s better navigation systems allowing lower altitude flight; its increased speed (Mach 1+), and a greatly reduced front-aspect radar cross-section compared with the B-52, made it less vulnerable to attack by missiles and fighter aircraft. With the fall of the Soviet Union, the Air Force reassessed the strategic bomber force and decided to focus the B-1B on the conventional weapons delivery role. The Air Force initiated the Conventional Mission Upgrade Program (CMUP) to improve B-1 lethality and survivability in support of the conventional mission.<sup>15</sup> CMUP provided the B-1B with systems that would allow the delivery of the latest cluster bombs, Joint Direct Attack Munitions, and other precision-guided conventional weapons. Today, the B-1B is actively involved in operations in Afghanistan and Iraq but no longer is tasked with nuclear weapons delivery.

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<sup>11</sup> Standoff weapons are weapon systems capable of being launched or dropped from beyond the threat environment and using their own propulsion systems to carry themselves to the target.

<sup>12</sup> “Long-Range Strike White Paper,” HQ USAF/A5RC, 2007, p. 13.

<sup>13</sup> Boeing purchased Rockwell International’s defense and space companies, the original builder of the B-1B, in December 1996.

<sup>14</sup> Telephonic conversation with B-1B System Program Office, Wright-Patterson Air Force Base, OH, January 10, 2008.

<sup>15</sup> Ibid.

**B-2 Spirit.** The Northrop Grumman B-2 stealth bomber, born from the High Altitude Penetrating Bomber and Advanced Technology Bomber programs in the mid-1970s, reached initial operational capability in April 1997. The first aircraft was delivered to Whiteman Air Force Base, Missouri, in December 17, 1993. President Reagan decided to fund both the B-1 and B-2 programs, initially conceived as a replacement for the B-52. In 1992, the first Bush Administration reduced the planned buy from 132 to 75, then 20 aircraft, owing to the high unit cost and fall of the Soviet Union. Congress added an additional B-2 to the fleet by providing funding to convert one of the test vehicles into a combat aircraft.

The B-2 retains both a conventional and nuclear bomber mission today. It is the only bomber aircraft to employ all-aspect “low-observable” or “stealth” characteristics to enhance its survivability, but its unrefueled range and payload are more limited than the B-1 or B-52.<sup>16</sup> In addition, the aircraft is expensive to operate because of its radar-absorbing skin and is handicapped by its older computer architecture. Making the B-2 more survivable goes beyond the materials and structure of the aircraft. The B-2 must also keep itself away from potential threats to prevent enemy radars from detecting and targeting the aircraft’s much reduced radar cross-section.<sup>17</sup> The B-2’s data processing systems, based on the Intel 286 processor, are limited in their ability to be upgraded to interoperate with other DOD systems. This limitation makes real-time mission changes more difficult in comparison to more modern aircraft like the F-22 or F-35. The B-2’s current processing capabilities also limit the aircraft’s ability to incorporate the latest enhancements (sensors) that would enhance its survivability.

Some have suggested in the past that the Air Force should “reopen” the B-2 line to increase B-2 inventory. However, the USAF and OSD have stated that it would be better to invest in a new system to take advantage of technological advancements.<sup>18</sup>

## **DOD’s Next Generation Bomber: Evolution of a Direction**

For the first time since 1917, with the delivery of the last B-2 in 1997, the United States did not have a long-range bomber either in production or on the drawing board.<sup>19</sup> One defense analyst notes, “That’s a remarkable situation for a nation whose security relies on its ability to project military power worldwide in

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<sup>16</sup> However, with air refueling, range is only limited by crew endurance.

<sup>17</sup> Low observability, while not making an aircraft truly invisible, reduces the range at which enemy radars can detect and track stealth aircraft. At some reduced distance, enemy radars should be able to detect and possibly target stealth aircraft. Therefore, aircraft data processing systems are needed to recognize threats and aid the pilots in keeping adequate distance away from enemy radar systems.

<sup>18</sup> Skeen, Jim, “Defense Exec Advises Against B-2 Restart,” *Los Angeles Daily News*, January 31, 2002.

<sup>19</sup> Grant, Rebecca, *Return of the Bomber: The Future of Long-Range Strike*, Air Force Association Special Report, February 2007, p. 7.

defense of its interests and allies.”<sup>20</sup> While there has not been a replacement next generation bomber on the “drawing board” for quite a while, there have been numerous studies conducted on the subject of the future of long-range strike. On average, one study of long-range strike requirements has appeared each fiscal quarter since the Cold War ended over 20 years ago.<sup>21</sup> The general trend appears to have been to defer any firm decision in favor of letting potential long-range strike technologies mature.<sup>22</sup>

The 1992 Air Force Bomber Roadmap set the stage for the transformation of the bomber force from its nuclear-centric role to a key piece of a combatant commander’s conventional arsenal. This transition began with the merging of Strategic Air Command (the “bomber” force) with Tactical Air Command (the “fighter” force) to form Air Combat Command in 1992. For the first time, bombers and fighters were under one major command. **Appendix B** steps through the various “roadmaps,” studies, and defense reviews. **Table 2** below summarizes the changes called for by the Department of Defense since the initial 1992 Bomber Roadmap. From 1992 to present day, DOD and the Air Force have published five bomber “roadmaps” or “white papers,” undergone three Quadrennial Defense Reviews in addition to the 1993 Bottom-Up Review, two Nuclear Posture Reviews, and a host of independent bomber studies. While the overall trend of these reviews has been to reduce bomber aircraft numbers, Congress has resisted DOD’s desires to trim its long-range strike arm.

**Table 2. DOD-Recommended Bomber Force Structure Changes, 1992-2007**

|                        | Recommended Force Structure |      |      |                       | Comments                            |
|------------------------|-----------------------------|------|------|-----------------------|-------------------------------------|
|                        | B-52H                       | B-1B | B-2A | Total                 |                                     |
| 1992 AF Bomber Roadmap | 95                          | 96   | 20   | <b>211</b>            | B-1 priority of focus               |
| 1993 DOD BUR           | (94)                        | (70) | (20) | <b>184</b>            | 100 bombers per regional conflict   |
| 1994 DOD NPR           | 66                          | N/A  | 20   | <b>86<sup>a</sup></b> | B-52H: -28 aircraft                 |
| 1995 DOD Bomber Study  | (66)                        | 95   | 20   | <b>181</b>            | Recommends no more B-2s             |
| 1997 DOD QDR           | 71                          | 95   | 21   | <b>187</b>            | B-52H: +5 aircraft                  |
| 1999 AF White Paper    | 76                          | 93   | 21   | <b>190</b>            | B-52H: +5 aircraft, B-1: -2 (crash) |
| 2001 AF White Paper    | 76                          | 60   | 21   | <b>157</b>            | B-1: -33 aircraft                   |
| 2001 DOD QDR           |                             |      |      |                       | <b>112 combat-coded bombers</b>     |

<sup>20</sup> Ibid., p. 7.

<sup>21</sup> Thompson, Loren “Searching for the Next B-52,” *Armed Forces Journal*, September 2006

<sup>22</sup> Barry Watts, Center for Strategic and Budgetary Assessments, February, 26, 2008.

|                     | Recommended Force Structure |      |      |                 | Comments                       |
|---------------------|-----------------------------|------|------|-----------------|--------------------------------|
|                     | B-52H                       | B-1B | B-2A | Total           |                                |
| 2002 DOD NPR        | 76                          | N/A  | 21   | 97 <sup>a</sup> | 97 bombers for nuclear mission |
| 2006 DOD QDR        | 56                          |      |      |                 | New bomber by 2018             |
| 2007 AF White Paper | 76                          | 67   | 21   | 164             |                                |

**Notes:** BUR-Bottom-Up Review, QDR-Quadrennial Defense Review, NPR-Nuclear Posture Review, AF White Papers are Long-Range Strike White Papers. Numbers in parenthesis () were calculated from sources other than the source document.

- a. The total aircraft numbers for the two Nuclear Posture Reviews do not include B-1B aircraft numbers because B-1Bs are no longer supported strategic nuclear weapons delivery.

**Trends from 1992 to 2007.** Over the past 15 years, the overall trend in the Air Force-manned bomber fleet has been to move toward a leaner, more conventionally effective force. The 1992 Air Force White Paper charted the initial course for enhancements in conventional weapons delivery capabilities to ensure all bomber aircraft had the ability to deliver the latest in precision-guided munitions. While executing this strategy, budgetary pressures have resulted in trimming the fleet from over 360 bombers, around the end of the Cold War, to a potential fleet size of only 122 aircraft today. For comparison, in 1963, the United States had 709 B-52s and more than 1,000 other regional bombers (B-47s and B-58s).<sup>23</sup> Many DOD and Air Force officials have touted the modernized bomber fleet as “more effective, more survivable, and more supportable.”<sup>24</sup> For example, one analyst noted that planned B-2 modifications would allow the bomber to “achieve on one mission the same effects that it took six missions to achieve during Operation Allied Force.”<sup>25</sup>

While the size of the bomber fleet has diminished over the past 15 years, its utilization in combat has climbed. Since its inception in 1992, Air Combat Command has charted the conversion path of today’s bombers from “dumb bomb” droppers to a fleet that can deliver precision conventional weapons. During Operation Allied Force over the Federal Republic of Yugoslavia in 1999, all three U.S. bombers saw action. The B-2 made its combat debut; the B-1 delivered close to 20% of the total tonnage of bombs, while flying not quite 2% of the total strike sorties.<sup>26</sup> The B-2s destroyed 90% of the targets they engaged. In Operation Enduring Freedom in Afghanistan, bombers accounted for only 20% of the combat missions but dropped 76% of the bomb tonnage in the first three weeks of the air

<sup>23</sup> U.S. Congressional Budget Office, *Alternatives for Long-Range Ground Attack Systems*, by Robie Samanta Roy and David Arthur, March 2006, p. 2.

<sup>24</sup> 2001 USAF White Paper on Long-Range Strike, November 2001.

<sup>25</sup> Tirpak, John A. “Bomber Questions,” *Air Force Magazine*, September 2001.

<sup>26</sup> Grant, Rebecca, *Return of the Bomber: The Future of Long-Range Strike*, Air Force Association Special Report, February 2007, p. 13.

campaign.<sup>27</sup> In Operation Iraqi Freedom (OIF), B-1s were in such demand that Central Command (CENTCOM) air component commander (then) Lt. Gen. Moseley personally managed their scheduling.<sup>28</sup>

A number of defense analysts have noted that the past decade of funding bomber advanced conventional weapons delivery enhancements, along with improvements in support and sustainment, have paid off in recent air campaigns. However, others have noted as the bomber becomes more a “weapon system of choice,” bomber fleet availability will become more of an issue.

## Past Congressional Actions

Congress has closely monitored the B-52H fleet after DOD’s decision to remove the remaining B-52Gs from of service in the early 1990s. The 1995 National Defense Authorization Act (NDAA) (P.L. 103-337; 108 Stat 2687-2688 [Sec. 133 and 134]), in response to the 1993 Bottom-Up Review and 1994 Nuclear Posture Review bomber force recommendations, introduced language preventing DOD from retiring any B-52H, B-1B, or F-111 aircraft, while calling for a heavy bomber force study. Over the next 12 years, Congress restricted DOD from retiring a portion of its B-52H bomber fleet. In the 1996 NDAA (P.L. 104-106; 110 Stat 490 [Sec. 1404]), Congress specifically directed DOD to terminate its plans to retire 28 B-52Hs and provided funding to retain all 94 B-52H bombers. However congressional language did allow for the Air Force to sustain the 28 B-52Hs in “attrition reserve” status.<sup>29</sup> The allowance to place 28 B-52Hs in attrition reserve matches with the 2002 DOD Nuclear Posture Review’s stated requirement of 66 “operational” B-52Hs. Congress’s intent was to ensure that all 94 B-52Hs received standard maintenance and scheduled upgrades, while allowing the Air Force to focus training and operations on 66 “operational” B-52Hs.

In 1996, further Air Force analysis of the recommendations in the 1994 Nuclear Posture Review’s bomber force requirements indicated that the Air Force would need more than 66 B-52Hs in order to maintain 56 bombers in “mission-ready” status.<sup>30</sup> Congress approved the Air Force’s requirement in the 1998 NDAA (P.L. 105-85; 111 Stat 1948 [Sec. 1302]) calling for 71 B-52H bombers to support strategic nuclear delivery requirements. The 2000 NDAA (P.L. 106-65; 113 Stat 806 [Sec. 1501]) increased the B-52H “operational” force structure level to 76, matching the force structure called for in the 2001 Air Force Long-Range Strike White Paper, while leaving the remaining 18 to be kept in “attrition reserve” status.

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<sup>27</sup> Rolfson, Bruce, “Bombers Shine in Air War but Remain Budget Targets,” *Air Force Times*, November 26, 2001.

<sup>28</sup> Fulghum, David A. And Wall, Robert, “Baghdad Confidential,” *Aviation Week*, April 28, 2003. Note: Only 12 B-1s were available at the time for OIF because a portion of the B-1 fleet was undergoing modification and others were on alert for other contingency support.

<sup>29</sup> H.R. 104-450, Sec. 1404, January 22, 1996.

<sup>30</sup> CRS Report 96-645, *Nuclear Weapons in U.S. Defense Policy: Issues for Congress*, by Amy F. Woolf.

Congressional restrictions on B-52H force structure remained the same until the 2007 NDAA. Prompted by the 2006 QDR's desire to retire 38 B-52Hs, the 2007 NDAA (P.L. 109-364; 120 Stat. 2111 [Sec. 131]) authorized retiring no more than 18 B-52s while directing the Air Force to maintain no less than 44 "combat-coded" B-52s. In addition, the 2007 NDAA specified this retirement limitation period would not end until a long-range strike replacement aircraft reached initial operational capability, or January 1, 2018, whichever comes first. Finally, besides directing the Air Force to provide a report on bomber force structure, the 2007 NDAA directed the Air Force to place all retired B-52s in Type-1000 storage at the Aerospace Maintenance and Regeneration Center (AMARC).<sup>31</sup>

The 2008 NDAA (P.L. 110-181 [Sec. 137]) modified slightly the guidance in the 2007 NDAA to ensure DOD maintained at least 63 "Primary Aircraft Authorized" B-52Hs.<sup>32</sup> The 2008 NDAA also specified that 11 aircraft would serve as backup inventory and 2 as attrition reserve for a B-52H force structure of 76 aircraft. The conference report noted:

The conferees believe that a B-52 total aircraft inventory of less than 76 aircraft is not sufficient to meet combatant commander requirements for conventional, long-range strike requirements if the need should arise to conduct near simultaneous operations in two major regional conflicts. The conferees strongly discourage the Secretary of the Air Force from taking action to reduce the B-52 aircraft inventory below 76 total aircraft prior to the next generation bomber reaching initial operational capability status and strongly oppose a strategy that reduces current conventional long-range strike capability.<sup>33</sup>

## FY2009 Budget Request

The President's Budget for FY2009 contained no funding for the Next Generation Bomber. Even with the compressed timeline, this is in line with DOD's stated intentions. Sue Payton, Air Force head of Acquisition, stated that "we will not have a budget to really move forward with the money that we need to do integration of the currently existing technologies that are out there until FY10."<sup>34</sup> While some industry experts continue to question the Air Force's commitment to meeting the 2018 mandate, IRIS Independent Research president, Dr. Rebecca Grant, notes that the new bomber will not need a lot of freshly developed technology, but can utilize technologies developed for other aircraft such as the F-22 and F-35.<sup>35</sup> The Air Force is hoping to take advantage of industry expertise through a "fly-off" between companies vying for the next bomber aircraft contract. As discussed below, Boeing

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<sup>31</sup> Type-1000 (long-term storage) is where the integrity of all aircraft systems are maintained and each aircraft is re-preserved after inspection every four years.

<sup>32</sup> Refer to **Appendix A** for additional information.

<sup>33</sup> H.R. 110-477, December 6, 2007.

<sup>34</sup> Putrich, Gayle, S. "U.S. Air Force: No 2009 Money for Next-Gen Bomber," *Defense News*, December 10, 2007.

<sup>35</sup> *Ibid.*

and Lockheed Martin have already teamed up and are investing their own funds in an effort to win a potential competition.

The President's FY2009 Budget also contains funding for only 56 operational B-52 bombers. While this action is in line with the Air Force's desire to reduce the B-52 fleet by an additional 20 bombers, it goes against the 2008 NDAA guidance to keep a B-52 force structure of 76 aircraft.

## Issues for the Air Force

### The Need for a New Bomber by 2018

The Air Force has acknowledged its need for a new long-range strike system given expected advances in air defense systems. The issue will be whether the Air Force can afford a new bomber or will have to sustain and improve the bombers it currently has. The overall average age of the current bomber fleet is 30.9 years and will reach over 40 years, at best case, before a new bomber will take to the air. There is considerable debate whether a new bomber is needed or can be delivered to the Air Force by the 2018 mandate. The current fleet of long-range bombers is structurally sound and should be available to fly well into the 2030s and 2040s, barring any unforeseen major structural issue.<sup>36</sup> As recently at 2007, the Air Force extended the B-52's and B-1's service lives, while the B-2's service life was last analyzed in 2004. More of an issue, however, is the current bomber fleet's viability in a medium- or high-threat environment. During a recent long-range strike assessment seminar hosted by the Center for Strategic and International Studies (CSIS), one participant noted that "the bomber fleet will be largely relegated to stand-off engagements because the threat of double digit [advanced surface-to-air missiles], fighters and next generation [integrated air defense systems] will be too difficult to penetrate."<sup>37</sup> The latest Air Force bomber White Paper simply states that "...the B-1 and B-52 are not survivable under the 2015-2020 expected threat picture."<sup>38</sup> The Air Force believes that anticipated advances in defensive systems will leave only 21 (now 20) B-2s with the capability to penetrate and survive in a high-threat environment.

However, some analysts have noted that advocacy from the "relevant combatant commands, particularly Strategic Command and Pacific Command, seems weak and ambivalent."<sup>39</sup> Another analyst noted that "the Air Force has not yet made either the policy case or the technical case for a new bomber, nor has it provided a realistic assessment of likely costs and tradeoffs."<sup>40</sup> Without combatant command advocacy, successfully defending the requirement for a new bomber in a fiscally constrained

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<sup>36</sup> 2007 USAF Long Range Strike White Paper, p. 6.

<sup>37</sup> Murdock, Clark A, "US Air Force Bomber Modernization Plans: An Independent Assessment," *Center for Strategic and International Studies*, January 25, 2008, p. 12.

<sup>38</sup> 2007 USAF Long Range Strike White Paper, p. 13.

<sup>39</sup> Murdock, p. 7.

<sup>40</sup> *Ibid.*, p. 7.

environment could prove extremely challenging. James Durham, director of joint advanced concepts in the Pentagon's Acquisition, Technology, and Logistics (OSD/AT&L), commented in late 2006 that "we all know we need [a new bomber] but we don't know how much or when."<sup>41</sup>

Part of the combatant command's ambivalence and Air Force concern could stem from the issue of what role the next (or interim) bomber is expected to fill. Is the focus of the interim bomber going to be lower-end missions, such as close air support for ground forces engaged in irregular warfare, or high-end missions penetrating deep into a peer adversary's heavily defended territory? One analyst, following the long-range strike seminars at CSIS, questioned whether a bomber focused more on the low-end threats would even qualify as a "next generation bomber" because it would reduce the need for revolutionary capabilities required for survival in a higher-threat environment.<sup>42</sup>

In addition, the Air Force will most likely need to reexamine its overall mix of long- and short-range attack assets in the current fiscally constrained environment. At present, there is over a 14:1 ratio of fighter to bomber aircraft in both the active and reserve Air Force inventory.<sup>43</sup> In terms of investment, a Center for Strategic and Budgetary Assessments (CSBA) study in 2005 noted that the ratio of short- to long-range investments is approximately 18:1 when taking unmanned strike systems into consideration.<sup>44</sup> The appropriate mix of long- and short-range assets will be highly dependent on what OSD, Congress, and the next administration see as the United State's next major threat. Potential issues such as U.S. basing-rights in allied/friendly nations and enemy "anti-access/area-denial" capabilities will play a large role.

## The Feasibility of a "2018" Bomber

The feasibility of a "2018" bomber will be highly dependent on the capabilities that will be required in the new aircraft. Again, this goes back to the anticipated role the new bomber is expected to play. As one defense analyst puts it, "you can have a new bomber [by 2018], but the issue is really how capable a bomber you'll have."<sup>45</sup> A number of senior defense analysts and industry representatives expressed reservations about the feasibility of meeting the 2018 target date "if radical solutions

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<sup>41</sup> Bennett, John T. "USAF 'Having A Hard Time' Starting Bomber Program, OSD Official Says," *Inside The Air Force*, September 1, 2006.

<sup>42</sup> Conversation with Clark Murdock, Center For Strategic and International Studies, March 1, 2008.

<sup>43</sup> This ratio drops to just under 10:1 when analyzing the active force only.

<sup>44</sup> Watts, Barry D. "Long-Range Strike: Imperatives, Urgency and Options," *Center for Strategic and Budgetary Assessments*, April 2005, Pg. 20.

<sup>45</sup> Conversation with Clark Murdock, Center For Strategic and International Studies, March 1, 2008.



are to be pursued [e.g., to penetrate highly defended areas].”<sup>46</sup> However, a commercial derivative, or a derivative of an aircraft already in production (such as the F-22), capable of handling the lower-end threats appears to be achievable by 2018.<sup>47</sup>

To accelerate development of a new aircraft, the Air Force is currently looking into the possibility of commissioning a “fly-off” to determine the best system to meet the Air Force’s specifications. However, for the Air Force to have a new bomber reach Initial Operational Capability by 2018, some have noted that cutoff for development of technologies for the bomber will be 2009, useful prototype demonstrations need to be conducted by 2011, and procurement has to begin around 2013.<sup>48</sup> One defense analyst stated that the 2018 target date is unrealistic and that it will put heavy pressure on companies to begin gearing up for the competition.<sup>49</sup> Michael Wynne, the Secretary of the Air Force, noted that it was going to be a struggle to carry out the QDR mandate.<sup>50</sup>

Myriad ongoing or near-term acquisition projects will compete with the next generation bomber for funding. KC-X, CSAR-X, C-5 RERP, F-22, Joint Strike Fighter (F-35), and Joint Cargo Aircraft will all compete for a share of the potentially shrinking DOD budget over the next decade. Successful procurement of the new bomber is going to rely on strong advocacy from the Air Force — something one analyst stated “lacks conviction and credibility.”<sup>51</sup>

However, industry is moving ahead to field a new bomber by 2018. Boeing and Lockheed Martin, two of the three industry leaders who are expected to compete for the bomber contract, recently teamed up to begin work on a new bomber aircraft. Their main competitor is expected to be Northrop Grumman, builder of the B-2. The Boeing/Lockheed Martin partnership comes a year after Lockheed Martin’s executive vice president and general manager of Advanced Development Programs and Strategic Planning, Frank Cappuccio, expressed frustration over DOD’s lack of clarity in defining what it wants in its next generation bomber.<sup>52</sup> Now that the two leading defense contractors have teamed up to compete for the next big aircraft program, it is unknown how this will affect a decision by Northrop Grumman, the third-largest defense contractor, to compete in the program. If Northrop Grumman

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<sup>46</sup> Murdock, Clark A., “US Air Force Bomber Modernization Plans: An Independent Assessment,” *Center for Strategic and International Studies*, January 25, 2008, p. 14.

<sup>47</sup> *Ibid.*, p. 14.

<sup>48</sup> Murdock, p. 14.

<sup>49</sup> Montgomery, Dave, “Long-Range Plan; Pentagon Wants New High-Tech Bomber,” *Fort Worth Star-Telegram*, February 4, 2006.

<sup>50</sup> Bennett, John T., “USAF Officials Offer Glimpse of Requirements for Long-Range Strike,” *Inside The Air Force*, February 10, 2006.

<sup>51</sup> Murdock, p. 2.

<sup>52</sup> Sirak, Michael, “Skunk Works Head Calls on Industry to Take Lead in Defining Future Long-Range Strike,” *Defense Daily*, February 2, 2007.

bows out, there would probably be no competitor for Boeing and Lockheed Martin and the Air Force desire for a “fly-off” might become moot.

Analysts also don’t know how far the Air Force is actually along in its efforts to field a new bomber aircraft. Then Commander of Air Combat Command, General Ronald Keys, stated in 2006 that he felt the new bomber program would start out as “black” — meaning a number of the capabilities of a potential new aircraft would be kept classified.<sup>53</sup> Besides potentially limiting a program’s scrutiny and oversight, “black” programs have been known to streamline the acquisition process and allow fielding of a new weapons system without the typical hurdles of their unclassified counterparts. Many point to the F-117 Stealth Fighter as a successful acquisition program because the program remained classified. However, some have noted that when the B-2 went from “black” to “white” — unclassified — “the sticker shock undermined support, even among defense supporters that would normally be allies.”<sup>54</sup> While it is possible that the Air Force is farther along in development of the next generation bomber than is publically known, a number of defense analysts are concerned that keeping the program classified will, in the end, undermine its political support.<sup>55</sup>

## 2018 Bomber Capabilities

There has been a tremendous amount of discussion and debate about what capabilities should be included in the next bomber. Industry and the Air Force are currently weighing tradeoffs between speed and persistence, range and weapons load, and manned versus unmanned flight. Although it has yet to precisely define the requirements for the 2018 bomber, the Air Force has identified nine desired capabilities of a new long-range strike system<sup>56</sup>:

- Responsive: Strike remote targets quickly (hours to minutes)
- Sufficient Range: Reach target from U.S. or forward location
- Mixed Load of Modern Munitions: Nuclear-capable
- Highly Survivable in Hostile Airspace: Low observable
- Persistent: Ability to attack targets over prolonged timeframe
- Comprehensive Situational Awareness: Advanced sensors
- Robust Connectivity: Tied into global military networks
- Operate Autonomously
- Flexible and Adaptable: Modularity and Open Architecture

Analysts have noted that it is highly unlikely that all of these attributes can be achieved in a single aircraft by the 2018 timeframe. However, Rebecca Grant of IRIS

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<sup>53</sup> Munoz, Carlo, “Long-Range Strike Effort Will Start as ‘Black’ Program, Keys Says,” *Inside the Air Force*, September 29, 2006.

<sup>54</sup> Murdock, p. 17.

<sup>55</sup> *Ibid.*, p. 18.

<sup>56</sup> Thompson, Loren “Searching for the Next B-52,” *Armed Forces Journal*, September 2006.

notes the following list of capabilities and program milestones are solidifying with respect to the 2018 bomber<sup>57</sup>:

- Total Buy: ~100 aircraft
- Combat Radius: 2000 Nautical miles minimum (unrefueled)
- Payload: 28,000 lb.
- Speed: “High Subsonic”
- 2 Engines
- Very Low Observable — Improved Stealth technology
- Manned cockpit
- Nuclear-capable
- Technology reaching maturity by 2009
- Demonstration flight by 2011

**Speed Versus Persistence.** Most analysts agree that one of the major “tradeoffs” the Air Force might have to make to meet the 2018 mandate is the speed of the aircraft. While DOD is pursuing the development of hypersonic engines capable of accelerating an aircraft beyond Mach 5, they are unlikely to be ready for a 2018 bomber. Further, there is an “observability” penalty that a stealth design incurs at speeds above Mach 2+. The Air Force would need to develop new types of radar-absorbing materials to operate at higher airspeeds. In addition, DOD will need to overcome manufacturing issues in creating an affordable “ramjet” engine for hypersonic speeds. DOD, however, is poised to unveil a new program called “Blackswift.” The Blackswift Program will be the follow-on to the Defense Advanced Research Projects Agency’s (DARPA) FALCON — Force Application and Launch from the Continental United States. FALCON’s goal was to develop a vehicle capable of delivering 12,000 lb. of payload across a distance of 9,000 Nautical miles in less than two hours.<sup>58</sup> Consequently, Blackswift, and other programs like it, addresses more the issue of “prompt” rather than “persistence.”

On the other hand, the Air Force will likely be able to develop an aircraft with a speed below Mach 2 by 2018. Initially, both Lockheed Martin and Northrop Grumman expressed interest in offering designs with at least a supersonic “dash” capability — short duration flight above Mach 1. As with all design features, there will be a tradeoff in range, payload, or aircraft size in order to support higher than Mach 1 speeds. Currently, it appears that the need for range and persistence, relying on stealth for increased survivability, is driving a high-subsonic speed requirement (not to mention the added cost of higher than Mach 1 travel). George Muellner, president of Boeing’s Advanced Systems, noted, “The materials used for signature

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<sup>57</sup> Grant, Rebecca, “Long-Range Strike: Options and Alternatives (Read-Ahead for CSIS working Group), *IRIS*, December 12, 2007. Note: PowerPoint presentation provided to the Long-Range Strike seminars conducted by Clark Murdock of CSIS. Some additional expected capabilities were discussed and added by the seminar participants (namely, the expectation of the next generation aircraft to be 2-engine).

<sup>58</sup> Sprenger, Sebastian, “DOD to Unveil ‘Blackswift’ Hypersonic Aircraft Program Next Month,” *InsideDefense.com*, January 25, 2008.

reduction get stressed above Mach 2, and you have to get much faster if you are going to rely only on speed to survive.”<sup>59</sup>

One final note on the concept of persistence. Persistence can be achieved a number of ways. In addition, persistence could mean different things in different operational environments. Normally, one equates long loiter time to persistence, and this concept is well-suited for today’s operations supporting troops on the ground. However, one might argue that the Air Force need is for a weapons system that is able to attack targets deep in enemy territory over a continuous period. Persistence in this case might focus more on persistent intelligence and an ability to strike promptly. One’s view of persistence could alter the quantities needed of the next generation bomber. It would be difficult to replicate the operational construct of NORTHERN and SOUTHERN WATCH over Iraq during the 1990s, in which numerous fighter aircraft flew watch over the region, with only a handful of bombers. It is not that anyone is expecting the next generation bomber to be procured in numbers capable of supporting round-the-clock coverage over a large landmass; however, one must take into consideration the impacts on “persistence” if the buy profile is too small.

**Dual Role: Conventional/Nuclear Capability.** With the B-1 removed from the nuclear mission in the 1990s, the bomber portion of the “nuclear triad” consists of 76 B-52s and 20 B-1s. While the B-52 currently has a service life well into the 2030s, the Air Force has been trying to retire the venerable bomber for a number of years. Both the B-1 and B-2 initially were conceived as replacement platforms for the B-52. If the Air Force were to retire the B-52 without a replacement aircraft designed to assume its nuclear delivery role, the “strategic” portion of the bomber fleet would then reside in 20 B-2 aircraft. Some defense analysts point to this issue as the key reason why the next generation bomber needs to be nuclear-capable. Those supporting the need for a new nuclear bomber also see it serving in a counter-proliferation role. One analyst noted “that an air-breathing [long-range strike system] will be more credible in terms of deterring countries such as Iran than the threat of intercontinental ballistic missiles.”<sup>60</sup>

However, others have argued that making the next bomber dual-capable decreases the likelihood of it actually being fielded. Opponents of a new nuclear bomber note that protecting the aircraft against electro-magnetic pulses (EMP) is a very expensive proposition and could increase the cost of the bomber by up to 25%-30%.<sup>61</sup> The costs to “harden” the next generation bomber against EMP will depend on the degree of hardening the designers deem necessary. While some have noted that some level of EMP-hardening will be necessary, the ability to operate in an environment in which multiple nuclear detonations have occurred could greatly increase costs. Moreover, countries such as China could view a new U.S. penetration nuclear bomber as threatening and respond accordingly.

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<sup>59</sup> Warwick, Graham, “US Industry Leans Toward Solutions That Can Switch From Manned to Unmanned,” *Flight International*, August 1, 2006.

<sup>60</sup> Murdock, p. 13.

<sup>61</sup> *Ibid.*, p. 13.

The Bush Administration, through the 2002 Nuclear Posture Review, has stressed “adaptive planning” and increasing the range of strategic deterrence options available to US officials. Basically, numbers became less important and overall deterrence capability became the primary focus. It remains to be seen whether arguments to enhance strategic deterrence with a new nuclear-capable bomber will overcome the added costs, international implications, and possible negative public perceptions stemming from a potentially unmanned bomber replacement.

## 2018 Bomber: Interim Fix or Final Solution?

The 2018 bomber began as the 2037 bomber. In 2001, following the September 11 attacks, Pentagon acquisition chief E.C. “Pete” Aldridge told the Air Force to accelerate its development of a new long-range strike platform.<sup>62</sup> DOD didn’t begin to focus on the 2018 date until the 2006 QDR, formally accelerating development of the next bomber by almost 20 years. As previously noted, the current bomber fleet should remain structurally sound until the 2030s or 2040s. However, the viability of the B-1 and B-52 as effective weapons systems, coupled with the Air Force’s desire to retire 38 B-52s, prompted DOD’s 2018 mandate. Many have questioned the Air Force’s efforts towards fielding a new bomber while facing the challenge of recapitalizing numerous other aircraft.<sup>63</sup> Further, the timeline is going to be very tight to meet the 2018 target date. General Moseley noted back in 2006, however, that 2018 is a “mark on the wall.”<sup>64</sup>

If one takes the current plan for an interim bomber in the 2018 timeframe, and a follow-on bomber with advances such as hypersonic flight in 2037, building a bomber with 2008-2009 technology might not be problematic for the Air Force. The major difficulty will probably be the fiscal tradeoffs that will have to take place to fit this acquisition program into a crowded field. The past is replete with examples of budgetary constraints resulting in drawn out or severely curtailed programs. If history repeats with the 2018 bomber, the Air Force might field its interim fix in the mid to late 2020s with far fewer bombers than planned. **Table 3** shows the disparity between the initial planned Air Force aircraft acquisition procurement numbers and the end result of those programs.

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<sup>62</sup> “Long Distance Affair; The Pentagon’s Fixation on Long-Range Strikes is Shortsighted,” *Armed Forces Journal*, August 2006.

<sup>63</sup> This concern was again highlighted during the recent seminars on Long-Range Strike hosted by CSIS. See Clark Murdock’s CSIS Assessment for more.

<sup>64</sup> Bennett, John T., “Wynne: FY08 POM Will Include ‘Fly-Before-Buy’ Plan for New Bomber,” *Inside the Air Force*, March 31, 2006.

**Table 3. Air Force Aircraft Acquisition Programs: Planned Buy vs. Actual Procurement**

| Aircraft | Planned | Procured           |
|----------|---------|--------------------|
| B-1      | 244     | 100                |
| B-2      | 132     | 21                 |
| F-22     | 648     | 183                |
| JSF      | 2,852   | 2,443 <sup>a</sup> |
| C-17     | 210     | 190                |
| B-X      | 100?    | ???                |

**Notes:** B-X represents the Next Generation Bomber.

a. The JSF procurement total of 2443 aircraft is the current program position

The two examples of severely curtailed acquisition programs are the B-2 and F-22. The B-2 program began prior to the end of the Cold War and suffered drastic cuts in the 1990s. The F-22 suffered the same fate once the specter of war with the Soviet Union diminished and the program experienced significant cost growth and schedule slippage. It remains to be seen whether the Joint Strike Fighter will suffer the same fate. It currently appears that the initial planned acquisition program for the next generation (2018) bomber will be about 100 aircraft. Program development delays or additional costs resulting from changing requirements could drive a corresponding increase in unit cost for the new bomber. This in turn could result in a decreased buy and a repeat of the acquisition difficulties previous aircraft programs have encountered.

What also remains to be seen is whether the Air Force will establish a firm set of requirements for the bomber and avoid adding technological advances to the program during its development. If there is potential for a future 2037 bomber to be delayed, or abandoned completely, the Air Force may feel pressure to enhance the 2018 bomber as much as possible — creating a final solution instead of the planned interim fix. Some have noted that the Air Force could end up with a bomber that is way over budget, late in delivery, lacking in capabilities, limited in numbers, and, in the end, the cause of delaying or elimination of the 2037 bomber the Air Force truly wants. However one defense expert calls the 2037 bomber “a mythical beast” and questions why the Air Force even talks about it.<sup>65</sup>

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<sup>65</sup> Putrich, Gayle, S. “U.S. Air Force: No 2009 Money for Next-Gen Bomber,” *Defense News*, December 10, 2007.

## Man-in-the-Loop Issues

The 2001 National Defense Authorization Act set a goal for the Armed Forces that one-third of “operational deep strike” aircraft fleet be unmanned by 2010.<sup>66</sup> The DOD 2005 Quadrennial Defense Review directed that the Air Force improve its long-range strike capabilities by 50% and that 35% of those strike forces should be unmanned. Unmanned Aerial System (UAS) proponents and defense analysts, in light of past guidance from Congress and DOD, have noted that the next generation bomber would be an excellent candidate for a potentially unmanned system. The Air Force’s program for a new bomber actually took on new emphasis with DOD’s termination of the Joint Unmanned Combat Air Systems (J-UCAS) program. Some analysts have noted that the joint Air Force/Navy program would have encountered difficulties meeting the disparate needs of the two services. Terminating J-UCAS has allowed the Air Force to refocus its funds on a more appropriate long-range strike system — not necessarily signaling an end to an unmanned bomber system.

Currently, the only unmanned “strike” assets are the Air Force’s MQ-9 Reaper and MQ-1 Predator. The Air Force has just under 100 MQ-1s and 10 MQ-9s in its active inventory, with plans to add approximately 100 additional aircraft. However, the 10 MQ-9s would be the only UAS considered “long-range” given its 1,600 nm combat radius (3,200 nm range).<sup>67</sup> While it remains to be seen whether the Air Force will meet the congressional mandate by 2010, it will have to develop an unmanned version of the next generation bomber in order to meet both DOD’s and Congress’s mandates.

More of an issue is how the debate will flow, both within Congress and publically, over the idea of B-2 “like” unmanned aircraft. While some might not take exception to an unmanned strike aircraft capable of carrying a small number of weapons, the debate could be quite different about an unmanned nuclear-capable bomber aircraft able to carry close to 30,000 pounds of advanced weapons. Issues such as datalink security and weapons surety will have to be addressed. Public perception will most likely play a big role in helping to shape the future debate about an unmanned bomber. “Optionally” manning<sup>68</sup> (can be flown remotely or with a pilot in the seat) the next generation bomber could assuage the fears of those concerned with aircraft command and control. With respect to the technological hurdles of making an unmanned or optionally manned bomber, Boeing, Lockheed Martin, and Northrop Grumman all agree that an unmanned bomber is feasible by 2018.<sup>69</sup>

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<sup>66</sup> P.L. 106-398; 114 Stat. 1654A-38.

<sup>67</sup> U.S. Air Force Fact Sheet, MQ-9 Reaper.

<sup>68</sup> Another term used is “unmappable” — an aircraft that could begin as a manned aircraft and then evolve over time to unmanned operations.

<sup>69</sup> Warwick, Graham, “US Industry Leans Toward Solutions That Can Switch From Manned to Unmanned,” *Flight International*, August 1, 2006.

## Industrial-Base Implications

As previously stated, the anticipated competitors for the next generation bomber are Boeing, Lockheed Martin, and Northrop Grumman. Boeing and Lockheed Martin have already announced their partnership. Northrop Grumman could find it difficult to compete with the combined resources of the two larger defense contractors. However, Northrop Grumman has continued as the prime contractor for the Navy's ongoing effort to develop a new series of weaponized unmanned aerial vehicles, and has the most recent experience building bomber aircraft.

Numerous analysts have expressed concern over the atrophying of the industrial skill set necessary to successfully develop bomber aircraft. It has been over 20 years since the last bomber aircraft, the B-2, was in development. One must add another 20 years to capture the developmental period for the B-1 bomber in its initial form. However, each of the primary competitors has had recent involvement with stealth and other aircraft advances that will play a big part in the next bomber aircraft. One defense expert noted that recent advances in one program, such as the F-22 and F-35, can be applied to another to reduce costs. The RAND Corporation, however, noted that "expertise at designing and developing complex aircraft systems comes only from the direct experience of designing and developing such systems."<sup>70</sup> While RAND notes some interchangeability of experience across military aircraft types, there is great potential for developmental problems stemming from a lack of recent bomber design experience. This potential for development difficulties will only increase as time passes before the next concerted effort to build a follow-on bomber aircraft. The results of the competition among the primary industrial leaders for the 2018 bomber will most likely have a profound effect on the competition for the 2037 bomber.

## Issues for Congress

### How Many Bombers Does the Air Force Need?

Defense analysts and industry are anticipating an Air Force acquisition program of about 100 aircraft. It is unknown how many B-52s and B-1s the Air Force would retain if and when it fields a next generation bomber. The number of bombers procured with this program will be dependent on the viability of the remaining legacy fleet, the cost of the new bomber, and the timeframe in which the Air Force could be expected to field a follow-on to the 2018 bomber. Again, the procurement objective will depend on whether one views this program as an interim fix or a final solution.

Advances in the Prompt Global Strike area of analysis could also have an impact on the required bomber numbers. Missile advances could increase the longevity of

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<sup>70</sup> Lorell, Mark A. "Bomber R&D Since 1945, The Role of Experience," RAND Report MR-670-AF, *RAND*, 1995; Barefield, James L., Major, USAF, "The Heavy Bomber Industrial Base: A Study of Present and Future Capabilities," Air Command and Staff College, March 1997.



the current fleet by allowing those bombers to remain outside the range of potential threats.

Finally, aircraft procurement numbers could depend on the current debate between long-range and short-range attack aircraft. Deep cuts in the Joint Strike Fighter program could generate an increase in requirements for advanced bomber aircraft.

## **When Will the Air Force Need These Bombers?**

While the Air Force has agreed to developing and fielding a new bomber by 2018, this date appears to have been dictated to the Air Force from OSD and Congress. The need for a new bomber is dependent on where and how conflicts between 2015 and 2040 will be fought. If one views conflict in the Far East as either most likely or most dangerous, the need for this bomber increases. If one feels future conflicts will be similar to ones currently being conducted in Iraq and Afghanistan — basically over uncontested airspace — then there is potential for the Air Force to delay its fielding of a new bomber while keeping up with modernization efforts of its current fleet.

## **What Capabilities Should These Bombers Possess?**

The technologies the Air Force truly wants in its future bomber aircraft will not have matured in time for incorporation in a 2018 bomber. A number of industry representatives and defense analysts note that stealth will be needed to allow operations in high-threat environments if hypersonic speeds are unattainable. While a combination of speed and stealth should have an exponential effect on survivability, it appears that they cannot both be available in an “affordable” 2018 bomber. Therefore, it currently appears that speed above Mach 1 and below Mach 2 will be driven more by cost and payload tradeoffs and not by industry limitations.

Another issue that will most likely be debated is the need for the bomber portion of the “nuclear triad.” If the next generation bomber is touted as a replacement for the B-52, then one would assume then that it needs to be nuclear-capable also. If one agrees with the direction of the 2002 Nuclear Posture Review and apparent “de-emphasizing” of the nuclear triad, then one might conclude that the next generation bomber need not be nuclear-capable. Geopolitical issues such as the potential for a “nuclear” Iran will play a role in this decision process.

## **Should the Next Generation Bomber Be Unmanned or “Optionally Manned”?**

Current congressional direction will drive the Air Force to make at least a portion of the new bomber fleet unmanned or “optionally” manned. Optionally manning the bomber — that is, having a seat for a pilot when needed — will most likely increase the cost of the new bomber. Additional factors will be whether there will be a need for one or two pilots. Again, the decision on whether the aircraft will be nuclear-capable, because of nuclear weapons surety policy, will have an impact on that decision. One could expect vigorous public debate over an unmanned “B-2

like” aircraft capable of carrying nuclear weapons. If one concludes that the next generation bomber will need to have a nuclear delivery mission, one might consider developing two similar but different airframes — one unmanned for conventional strike and one manned for both conventional and nuclear missions.

### **How Much Will the Next Generation Bomber Cost?**

Because the Air Force does not have a formal proposal out for the next generation bomber, it is difficult to determine the potential cost of the program. What has been announced is the Air Force’s plan to spend at least \$1.6 billion through 2011 on the future bomber program. However, one analyst notes that it is going to take between \$8 billion and \$10 billion to develop the future aircraft.<sup>71</sup> As for actual aircraft cost, it will be highly dependent on the number of aircraft procured.

### **Should There Be FY2009 Funding for the Bomber Program?**

As mentioned earlier, Sue Payton, Air Force Chief of Acquisition, has stated, “For the next-generation bomber, we will not have a budget to really move forward with the money that we need to do integration of the currently existing technologies that are out there until FY10.”<sup>72</sup> Ms. Payton has also stated that it is the Air Force’s intent to “put more money up front” and support an industry competition for the best preliminary design.<sup>73</sup> Boeing and Lockheed Martin have already teamed up and are expending their own resources in the hope of winning a future “fly-off.” Northrop Grumman, while not officially announcing its intentions, appears to be formulating its own submission. The question is whether there will be any impact in delaying Air Force funding for this competition till FY2010, or whether initial industry efforts and investments will be sufficient to allow a new bomber to be operational by 2018.

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<sup>71</sup> Nolan, John, “Defense Giants Vie for \$10B Bomber Deal; Lockheed Martin and Boeing Will Pursue the Air Force Contract; Northrop Grumman Interested.” *Dayton Daily News*, January 26, 2008.

<sup>72</sup> Putrich, Gayle, S. “U.S. Air Force: No 2009 Money for Next-Gen Bomber,” *Defense News*, December 10, 2007.

<sup>73</sup> *Ibid.*

## Appendix A. Aircraft Classification Definitions and Discussion

### Definitions

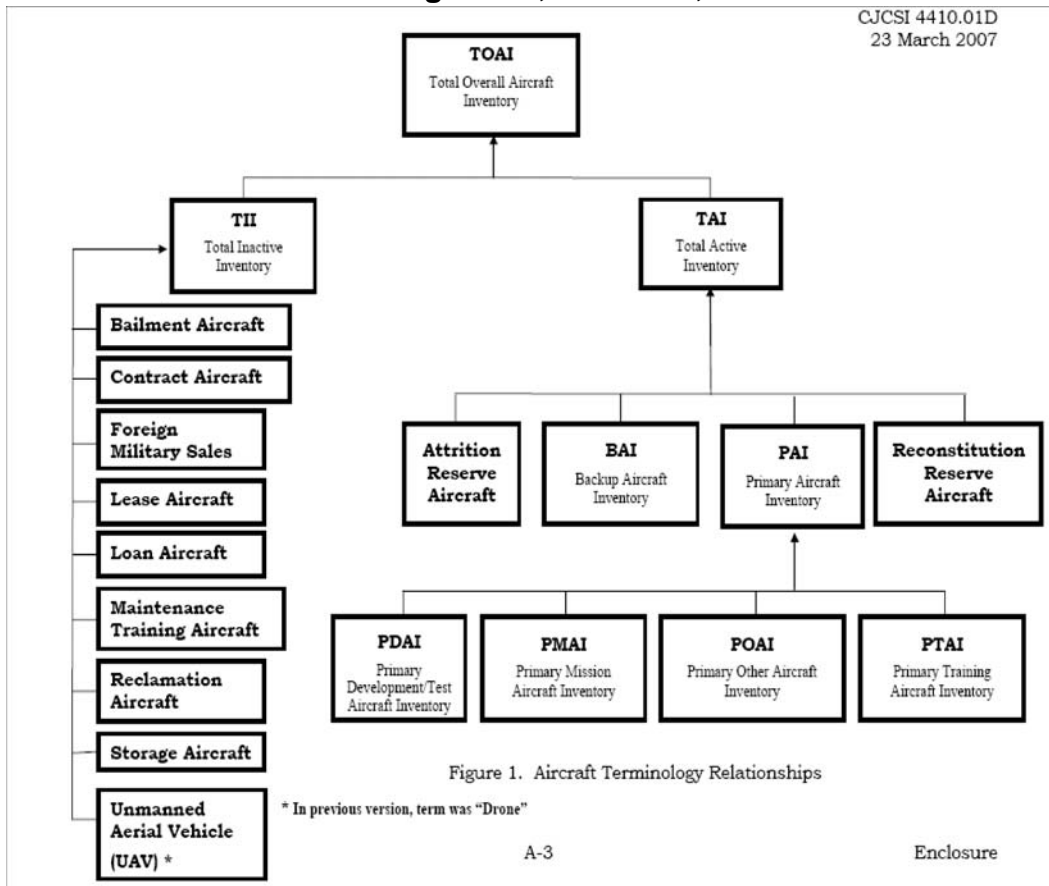
**PAA — Primary Aircraft Authorized:** The number of aircraft authorized to a unit for performance of its operational mission. The primary authorization forms the basis for the allocation of operating resources to include manpower, support equipment, and flying-hour funds.

**BAI — Backup Aircraft Inventory:** Aircraft in addition to the primary aircraft inventory that permit scheduled and unscheduled depot-level maintenance, modifications, inspections, repairs, and other events without reduction of aircraft available for the assigned mission.

**Attrition Reserve:** Aircraft procured for the specific purpose of replacing the anticipated losses of aircraft because of peacetime and/or wartime attrition.

**Combat-Coded:** Aircraft capable of performing “operational wartime” missions. (Note: *Not an official DOD/Joint Staff definition.*)

**Figure 1. Table from Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 4410.01D, Standardized Terminology for Aircraft Inventory Management, March 23, 2007**



## Discussion

It is important to note the challenges one will encounter analyzing the aircraft terms used by the reports. Chairman of the Joint Chiefs of Staff publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, and instruction (CJCSI) 4410.01D, *Standard Terminology for Aircraft Inventory Management*, are the primary sources for aircraft terminology. Over time, terms such as “operational,” “combat-coded,” and “attrition reserve” have been used to help define certain categories of aircraft. Some terms, such as “attrition reserve,” have made their way into the Joint publications. Others, such as “combat-coded,” have yet to make it into these two authoritative Joint documents.

Throughout this report, both congressional language and DOD papers and studies have used terms for bomber aircraft categories that, at times, make it difficult to compare force structure requirements from year to year. The 2008 NDAA took the extra step to define Primary Aircraft Authorized (PAA), Back-up Aircraft Inventory (BAI), and attrition reserve aircraft. These definitions follow closely the definitions in the two Joint documents. However, to highlight the difficulty one might have in tracking bomber numbers, the 2008 NDAA stated a B-52H PAA requirement of 63 aircraft, while the previous year’s NDAA noted a requirement of 44 “combat-coded” B-52Hs. Because PAA also includes trainer and test aircraft that are performing primary unit missions of training and test/evaluation, it could very well be that there was no change in the number of aircraft required for combat operations between the 2007 and 2008 NDAAs. The 2007 Air Force White Paper confirms this by noting that 15 B-52s will be used for training and 4 B-52s for test along with the 44 noted for combat operations.

## Appendix B. DOD Bomber Direction, 1992 to 2007

### 1992 U.S. Air Force Bomber Roadmap

In 1992, the Air Force published a bomber roadmap to help chart the future of the bomber force in a post-Cold War environment. The study notes the focus of this roadmap was to help guide the conversion of the current fleet of long-range strike aircraft from a nuclear to a more conventional mission focus.<sup>74</sup> The newly formed Air Combat Command<sup>75</sup> followed the guidance in the roadmap and began funding the upgrades needed to enhance bomber conventional weapons delivery, develop a bomber “concept of operations” to more effectively incorporate the bomber into conventional operations, and refocus training away from the more detail-oriented nuclear mission towards the more realistic and equally demanding conventional theater air campaign support role. In addition, Air Combat Command needed a bomber plan to address the reduction of B-2 procurement to 20 aircraft as the first Bush Administration adjusted to a post Soviet Union threat environment. The roadmap of 1992 concluded that a bomber force of 95 B-52Hs, 96 B-1Bs, and 20 B-2s (211 heavy bombers in all) would meet current and future requirements.<sup>76</sup> The roadmap also declared the B-1 as the “backbone of the conventional bomber force” and that future bomber investments would focus on B-1 conventional enhancements.<sup>77</sup>

### 1993 Bottom-Up Review

DOD’s 1993 Bottom-Up Review (BUR) took a “building block” approach to force structure. In a new post-Cold War environment, the BUR called for a force structure that will allow the United States to handle two major regional conflicts nearly simultaneously.<sup>78</sup> For bomber aircraft, the BUR called for 100 heavy bomber aircraft to meet the first regional conflict and an overall bomber force of 184 aircraft (B-1s, B-2s and B-52Hs) to execute the remainder of the strategy.<sup>79</sup> The BUR echoed the 1992 Air Force Bomber Roadmap’s recommendations to upgrade the bomber fleet in order to allow the bombers to carry the latest advanced conventional

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<sup>74</sup> Department of the Air Force, *Enhancing the Nation’s Conventional Bomber Force: The Bomber Roadmap*, June 1992, p. 1.

<sup>75</sup> Air Combat Command stood up on June 1, 1992, combining the units of the inactivated commands of Tactical Air Command and Strategic Air Command. In essence, Air Combat Command combined both tactical fighter aircraft and strategic bomber aircraft under one major command.

<sup>76</sup> 1992 US Air Force Bomber Roadmap, p. 6.

<sup>77</sup> *Ibid.*, p. 9.

<sup>78</sup> 1993 Department of Defense “Bottom-Up Review” (Section 2: Defense Strategy for the New Era).

<sup>79</sup> *Ibid.* (Note: The BUR noted a requirement of 20 B-2s and 94 B-52Hs. While not directly stated, given the BUR’s recommendation for 184 bombers in total, 70 B-1s would fill the remainder of the requirement. That would have required retiring 26 B-1s, which had just reached operational status five years prior.)

munitions.<sup>80</sup> However, many voiced concerns over the bomber cuts being called for in the 1993 BUR. General Loh, Air Combat Command's commander at the time, stated that the nation needed about 180 "operational"<sup>81</sup> bombers to handle two major regional conflicts, excluding aircraft for backup inventory, attrition reserves, and flight test.<sup>82</sup> General (retired) Charles Horner, architect of the Gulf War air campaign, maintained that the Air Force needed at least 40 B-2s, which was twice as many as the planned buy.<sup>83</sup>

## 1994 Nuclear Posture Review

The 1994 Nuclear Posture Review (NPR), serving as the nuclear analog to the 1993 conventional forces Bottom-Up Review, also addressed the manned bomber fleet. The 1994 NPR further cemented DOD's decision to "reorient" the B-1B to a conventional-only role while calling for 66 B-52s and no more than 20 B-2s to support the nuclear mission.<sup>84</sup> This decision called for a 28 aircraft reduction in the B-52 fleet from the previous year's BUR. The NPR also acknowledges the B-52's limited survivability by relegating the B-52 to a "standoff" nuclear delivery weapon employing air launched cruise missiles.<sup>85</sup>

## 1995 DOD Heavy Bomber Force Study

This classified study, initiated at the direction of Congress, was noted to be "the most significant and comprehensive study to date that considered the use of all three heavy bombers in the conventional warfighting role..."<sup>86</sup> Under Secretary of Defense for Acquisition and Technology, Paul Kaminski, presented an unclassified summary of this study to the National Security Subcommittee of the House Committee on Appropriations. The study concluded the following: (1) the currently planned bomber force of 181 aircraft<sup>87</sup> was sufficient to handle two nearly simultaneous major regional contingencies; (2) procurement of additional advanced guided munitions would be more cost effective than procurement of 20 additional B-2s; (3) the planned bomber force with accurate guided munitions provides a prudent hedge against threat

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<sup>80</sup> Gunzinger, Mark, *Beyond The Bottom-Up Review*, National Defense University Institute for National Strategic Studies.

<sup>81</sup> Refer to **Appendix A** for a discussion on aircraft terminology.

<sup>82</sup> Gunzinger, *Beyond The Bottom-Up Review*.

<sup>83</sup> *Ibid.*

<sup>84</sup> Department of Defense news release, "DOD Review Recommends Reduction in Nuclear Force," September 22, 1994.

<sup>85</sup> The Nuclear Information Project, "1994 Nuclear Posture Review," July 8, 2005, at [<http://www.nukestrat.com/us/reviews/npr1994.htm>]; accessed on January 17, 2008.

<sup>86</sup> Under Secretary of Defense for Acquisition and Technology Paul G. Kaminski's testimony before the National Security Subcommittee of the House Committee on Appropriations on Bomber Modernization, May 17, 1995.

<sup>87</sup> The bomber requirement was increased from 181 to 187 in 1995 with the decisions to fund the conversion of 1 B-2 test aircraft to operational status and increasing the B-52 requirement from 66 to 71 aircraft because of desires for a larger attrition reserve force.

uncertainties; and (4) planned B-1 conventional upgrades are more cost effective than procurement of 20 additional B-2s.<sup>88</sup> This study also stressed the value of shorter-range tactical aircraft, noting that “once all the tactical air forces are in place and fully employed — the bomber contribution shrinks to a small portion of the overall aggregate force.”<sup>89</sup> GAO took exception to the Heavy Bomber Force Study, along with the previous BUR, NPR, and 1992 Bomber Roadmap studies, noting that DOD’s requirement for 181 bombers is overstated given DOD’s other ground attack capabilities and the unified commanders in chief plans for using bombers.<sup>90</sup> GAO agreed with DOD’s desire not to procure additional B-2s, but felt a reduction or elimination of the B-1 fleet was warranted with minimal risk.<sup>91</sup>

## 1997 Quadrennial Defense Review

DOD’s 1997 Quadrennial Defense Review (QDR), the first follow-up to the Bottom-Up Review of 1993, produced no major changes to the recommended bomber fleet. The QDR recommended sustaining the bomber fleet at 187 aircraft with 71 B-52Hs, 21 B-2, and keeping all 95 B-1Bs.<sup>92</sup> While the QDR acknowledged that additional B-2s would help the United States in the initial “halt” phase early in an operation, it was not cost-effective to procure additional B-2s in light of other pressing needs.<sup>93</sup> A congressionally mandated independent bomber review, chaired by Brent Scowcroft, was highly critical of the 1997 QDR’s decision not to procure additional B-2s. Unlike the 1996 GAO bomber report calling for bomber aircraft reductions given, in part, the capabilities of tactical aircraft, Scowcroft’s review noted the “Pentagon’s preference for short-range instead of long-range air power raises a puzzling contradiction.”<sup>94</sup> Scowcroft notes that the long-range bomber fleet is ideally suited to the demands of the new security environment and that long-range air power will be more important than ever in the decades ahead.<sup>95</sup> Simply put, the Scowcroft’s Independent Bomber Force Review’s analysis concluded that “current plans for the long-range air power force were woefully deficient,” and, at a minimum, called for Congress to fund at least one additional B-2 squadron (9 aircraft).<sup>96</sup>

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<sup>88</sup> Under Secretary of Defense Kaminski’s Congressional testimony, May 17, 1995.

<sup>89</sup> Ibid.

<sup>90</sup> *Air Force Bombers: Options to Retire or Restructure the Force Would Reduce Planned Spending*, (GAO-96-192) Government Accountability Office, September 1996.

<sup>91</sup> Ibid.

<sup>92</sup> 1997 Quadrennial Defense Review, Section V: Forces and Manpower, May 1997.

<sup>93</sup> Correll, John, T. “The B-2 and Beyond,” *Air Force Magazine*, July 1998.

<sup>94</sup> Brent Scowcroft’s testimony before the Military Procurement Subcommittee of the House National Security Committee, June 23, 1997.

<sup>95</sup> Ibid.

<sup>96</sup> Ibid.

## 1999 USAF White Paper on Long-Range Bombers

The 1999 USAF White Paper on Long-Range Bombers modified aircraft requirements slightly by increasing the B-52 “attrition reserve” by 5 aircraft to compensate for sustainment issues.<sup>97</sup> The new requirement is 76 B-52s, 93 B-1s, and 21 B-2s, with 130 bombers being “combat-coded” for operational taskings.<sup>98</sup> More importantly, this study introduces a replacement aircraft timeline, as requested by Congress the previous year, calling for a new bomber to reach Initial Operational Capability (IOC) by 2037.<sup>99</sup> However, other than acknowledging the eventual need for a new bomber aircraft, this study continues the Air Force’s focus on modifications to its current bomber fleet.

## 2001 QDR, 2001 Long-Range Strike White Paper and 2002 NPR

The USAF updated its White Paper on Long-Range Strike following the 2001 QDR. Guidance continued to call for bomber aircraft reductions. The 2001 White Paper noted a 34-aircraft reduction in “combat-coded” bombers and a total bomber force of 157 aircraft. To get to this force structure, the paper noted that 33 B-1s and 17 B-52s would be retired by the end of 2002.<sup>100</sup> Retirements and other alignments would result in an overall fleet of 76 B-52s, 60 B-1s, and 21 B-2s. The 96 “combat” bomber aircraft called for in the USAF White Paper are 16 aircraft less than the 112 “combat-coded” aircraft noted in the 2001 QDR. The Air Force noted that savings from the retirement of the B-1s would be reinvested in the remaining B-1s. In addition, the Air Force reiterated that “it is far more cost-effective to upgrade current bombers than it is to procure new aircraft.”<sup>101</sup> Finally, the 2001 White Paper noted the service life conclusions about the current fleet may no longer be valid because of operational and force structure changes.<sup>102</sup> Noting that B-52s no longer fly regularly at low-level and that bomber fleet reductions would provide funding for fleet-wide improvements, the 2001 White Paper might lead some to conclude that requiring a bomber by 2037 is premature. The 2002 Nuclear Posture Review, while echoing the requirement for 76 B-52s and 21 B-2s along with the Air Force’s plans for a new bomber in the 2040 time frame, opined that “a need for additional or improved bomber capabilities could, however, move the ‘need date’ closer to the present.”<sup>103</sup>

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<sup>97</sup> 1999 USAF White Paper on Long-Range Bombers, March 1, 1999, p. 2.

<sup>98</sup> Two B-1s were lost in accidents since the 1997 QDR. Seventy B-1s, 44 B-52s, and 16 B-2s make up the “combat-coded” fleet of 130 bombers.

<sup>99</sup> 1999 USAF White Paper on Long-Range Bombers, March 1, 1999, p. 21. The Report of the Committee on National Security, House of Representatives, on H.R. 3616 requested the Air Force to develop a “timeline for consideration of the acquisition of a follow-on bomber.”

<sup>100</sup> 2001 USAF White Paper on Long-Range Strike, November 2001.

<sup>101</sup> Ibid.

<sup>102</sup> Ibid.

<sup>103</sup> 2002 Nuclear Posture Review. Excerpt retrieved from Global Security at [<http://www.globalsecurity.org/wmd/library/policy/dod/npr.htm>].



## 2006 QDR and the 2007 USAF Long-Range Strike White Paper

DOD's 2006 QDR provided clearer direction with respect to the future of long-range strike. The QDR stated:

The Air Force has set a goal of increasing its long-range strike capabilities by 50% and the penetrating component of long-range strike by a factor of five by 2025. Approximately 45% of the future long-range strike force will be unmanned.<sup>104</sup>

The QDR goes on to direct that a new "land-based penetrating long-range strike capability be fielded by 2018," along with continued modernization of current bomber fleet and a reduction in B-52s to 56.<sup>105</sup> The Air Force, in turn, announced a three-phase study to aid in implementation of the QDR's direction. In testimony before the House Armed Services Committee, Gen. Moseley noted phase one would examine continued modifications and enhancements to the current fleet, while phase two would add \$1.6 billion to aid in development of the 2018 bomber.<sup>106</sup> Gen. Moseley went on to state that around \$275 million will be set aside for phase three, which will examine needs "out beyond 2025 and 2030."<sup>107</sup> The Air Force's White Paper goes on to state that the Air Force plans on investing \$4.1 billion in legacy bomber modifications over the 2008-2013 Future Years Defense Plan (FYDP).<sup>108</sup>

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<sup>104</sup> 2006 Quadrennial Defense Review.

<sup>105</sup> Ibid.

<sup>106</sup> Matishak, Martin, "Hunter, Skelton Slam Air Force's Proposed Plan to Retire B-52s Early," *Inside the Air Force*, March 3, 2006.

<sup>107</sup> Ibid.

<sup>108</sup> 2007 USAF White Paper on Long-Range Strike, 2007.