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Long-Range Bombers: Background and Issues for Congress

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Summary

The Air Force's long-range bombers were designed during the Cold War to deliver nuclear strikes against the Soviet Union. Although they can be vulnerable to enemy defenses if detected, they combine the ability to fly extended distances, much farther than most other combat aircraft, with the ability to carry weapons payloads many times larger than that of fighters. Over the past decade, the Air Force has taken advantage of these characteristics by migrating its bomber fleet from a nuclear to a conventional role. Today, the Air Force maintains three bombers: the B-1B, the B-2, and the B-52, and each has been outfitted with a variety of precision and "dumb" weapons for conventional strikes. In recent conflicts in Afghanistan (2001) and Iraq (2003), bombers have played prominent roles.

Questions remain, however, about where bombers fit into Air Force spending priorities. Some argue that because bombers can be vulnerable against advanced air defenses, scarce resources are best spent on other programs that can address the full spectrum of potential future conflicts, such as the F/A-22 Raptor. Others counter that the range and payload of the bombers — many times that of fighters like the F/A-22 — make them extremely valuable and believe that modernizing them, building additional aircraft, and developing a next-generation bomber should be top budget priorities.

Decisions in Congress and the Department of Defense regarding bombers may have important long-term implications. Each of the three bombers is in need of expensive upgrades, and decisions about the funding of these upgrades may affect the continued utility of these aircraft. Second, a debate has arisen over whether to expand or contract the bomber fleet. Third, military observers and policymakers disagree about when to begin a next-generation bomber program; some push to begin a new program immediately, while others advocate waiting a decade or more before initiating development of a new bomber.

This report discusses the background, status, and current issues surrounding the Air Force's long-range bomber fleet. Before addressing each of the three bombers individually, this report analyzes issues affecting the entire fleet.

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Long-Range Bombers: Background and Issues for Congress

Background

During the Cold War, the primary mission of long-range bombers was to deter a nuclear attack on the United States by threatening the Soviet Union with retaliation. Manned bombers, the airborne leg of the U.S. strategic triad, were designated as a second-strike force that would hit back after a Soviet attack. In the Cold War-era, policy makers envisioned a fleet of over four hundred bombers enabling the United States to overwhelm perceived, on-going improvements in Soviet air defenses.

During the late 1980s and early 1990s, the end of the Cold War and the breakup of the Soviet Union led policymakers to reconsider the value of bombers. At the same time, a U.S. economic recession led to military spending cuts. Because bombers are among the most expensive systems in the Air Force inventory, they were ripe targets for funding cuts. During this period, the planned procurement of B-2s was reduced, many B-52s were retired, and an ongoing debate began about retiring a number of B-1s.

In 1992, the bomber force was combined with other power-projecting assets of the Air Force when Strategic Air Command and Tactical Air Command merged to form Air Combat Command (ACC). According to the Air Force, this restructuring reflected an integrated way of thinking about air power. The role of long-range bombers within the ACC is to combine mass (large payloads), reach (long range), and immediacy (quick response) with the ability to conduct precision strikes with non-nuclear weapons.

Today the United States Air Force maintains three long-range bombers: the venerable B-52 *Stratofortress*, the supersonic B-1B *Lancer*, and the stealthy B-2 *Spirit*. Table 1 lists the characteristics of each. Since the end of the Cold War, their primary mission has shifted from nuclear deterrence to conventional bombing, and all three have been reconfigured to carry a variety of modern conventional bombs and air-to-surface missiles. Since the debut of precision weapons in the late 1990s, the bombers have seen their role increase, with bombers increasingly used for precision strikes and close air support to U.S. and allied ground forces. Despite the shift to conventional missions, some bombers retain nuclear capabilities: the B-2 is certified to deliver nuclear weapons, and twelve B-52s "are held ready for nuclear missions."[1]

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[1] Secretary of Defense. *Annual Report to the President and the Congress*. 2000. Washington, DC.

In 1999, the three bombers were used together for the first time in air strikes against Yugoslavia under NATO's *Operation Allied Force*. The B-2 bomber made its operational debut, flying to Yugoslavia from Whiteman Air Force Base in Missouri. All three bombers also played prominent roles in *Operation Enduring Freedom* in Afghanistan in 2001 and in *Operation Iraqi Freedom* in 2003.

Table 1. Comparison of U.S. Long-Range Bombers

Feature	B-1	B-2	B-52
Un-refueled Range (miles)	7,455	6,000 +	8,800
Weight, empty (lbs.)	192,000	160,000	185,000
Max. takeoff weight (lbs.)	477,000	336,500	488,000
Payload (lbs.)	55,000	40,000	50,000
Crew	4	2	5
Speed	1.2 mach	High subsonic	.84 mach
Altitude	> 30,000 ft. ceiling 200 ft. minimum;	50,000 ft. ceiling	50,000 ft. ceiling
Un-refueled range (miles)	7,455	6,000 + miles	8,800
Stealth	Some	Excellent	None

Sources: Jane's All the World's Aircraft (various years), USAF Fact Sheets. Air Force Magazine, Air Force Almanac. (Various years). U.S. Air Force Long-Range Strike Aircraft White Paper. November 2001.

Congressional Considerations

Introduction

Despite a prominent and widely praised role in the recent operations in Afghanistan (2001) and Iraq (2003), there is little consensus among military leaders and policymakers regarding the future of long-range bombers. While some advocate increasing today's bomber fleet and beginning development of a new bomber immediately, others are pushing to cut the fleet and postpone a new bomber program. Supporters point to bombers' ability to carry massive weapons payloads, to loiter over battlefields for long periods of time, and to strike targets around the globe from bases in the continental United States. Detractors contend that large, lumbering bombers are vulnerable to enemy air defenses, including surface-to-air missiles as well as enemy fighters. In the high-threat environments for which the Air Force plans, the role of most bombers would be reduced, and fighter/strike aircraft, which are more "survivable" but have much shorter range and a fraction of the payload, would have to take up the slack. Bomber advocates counter that the conflicts the United States has faced in recent years, and those it is most likely to face in the foreseeable future, would not involve high-threat environments, and that even if they

did, bombers would likely play an important role once enemy air defenses have been destroyed. Moreover, they say, bombers should be upgraded so they can penetrate advanced air defenses.

At issue, then, is what priority to give bombers in the overall defense budget. Advocates argue that the United States does not have enough bombers, that they are not being modernized quickly enough, and that the Air Force needs to begin investing in a next generation bomber immediately. There are currently no open production lines for bombers, although some have advocated for re-opening production of B-2 stealth bombers. Bomber detractors believe that defense dollars are better spent elsewhere, on programs that address the "full spectrum" of missions the Air Force might confront, not just the low-threat environments faced in Afghanistan and Iraq. These detractors say that even though the bombers performed well in Afghanistan and Iraq, those conflicts were anomalies; the former was among the poorest states, while the latter had had its air defenses destroyed by the first Gulf War and more than 10 years of sanctions and air strikes. Contingencies in other parts of the globe, they argue, could involve more extensive air defenses, requiring more survivable aircraft, such as the F/A-22, to "knock down the door" and clear the way for follow-on aircraft. Others disagree and contend that the wars the United States is likely to fight in the foreseeable future, like those it has fought over the past 30 years, have been against poorly defended opponents in the developing world.

Long-range bomber issues that may confront Congress include the following: What types of conflicts does the United States need to prepare for and how relevant are bombers to those scenarios? How many bombers does the Air Force need to meet the requirements of these conflicts? To what extent, if at all, do the bombers need to be upgraded to meet these requirements? Is a next-generation bomber needed, and if so, when? This report will address these big-picture issues, which relate to the entire bomber fleet, before turning to each of the three bombers individually.

The Role of Bombers in Current and Future Conflicts

A key consideration in decisions about modernizing the bombers, expanding or contracting the fleet, and developing a next-generation bomber is the type of conflict the United States might face in the foreseeable future. The three bombers have different roles in different types of conflicts. The large but vulnerable B-52 serves as a bomber in "low-threat" environments, dropping a variety of precision and "dumb" bombs, while in higher-threat environments it serves as a "stand-off" missile launcher, firing air-to-ground cruise missiles from beyond the range of enemy defenses. The B-1, in addition to serving as a bomber in low threat environments, is capable of penetrating some air defenses because of its speed, anti-missile defensive systems, and reduced radar signature (stealth). The B-2, which has superior stealth, can undertake penetration missions against more sophisticated defenses.

In recent conflicts, the United States has faced opponents with rudimentary or battered air defenses, and all three bombers have been able to attack targets with impunity. Against an opponent with sophisticated defenses, however, the B-52 and possibly the B-1 could be reduced to a stand-off role. In the case of the B-1, the plane's existing defensive systems will soon become obsolete and the program to

design a replacement was cancelled by the Department of Defense (DOD) in late 2002 (See B-1 DSUP, below). As a result, the B-1, like the B-52, could be relegated to a stand-off role against even modest air defenses. Although the B-1 and B-52 are being outfitted with more sophisticated stand-off weapons, the B-2, of which the Air Force maintains only 16 combat-ready aircraft, would be the only long-range strike aircraft capable of penetrating air defenses. Other than the 16 B-2s, the Air Force would need to rely on fighter/attack aircraft such as the F/A-22 and the Joint Strike Fighter (JSF) despite their shorter range and smaller weapons payload, to attack ground targets in high-threat areas.

Table 2. Projected Range and Air-to-Ground Strike Capabilities of Bombers and Select Fighters

Feature	B-1	B-2	B-52	F-35 (JSF)	F/A-22
Un-refueled Combat Radius (nautical miles)	2,200	3,000	3,826	633	540
Payload (lbs.)	55,000	40,000	50,000	14,600	4,500
Max. takeoff weight (lbs.)	477,000	336,500	488,000	50,000	60,000
2,000 lb. JDAMs	24	16	18	2	2 [a]
500 lb. JDAMs	n/a	80	30	2	n/a
Small Diameter Bombs [b]	144	320+	144	8	8

Sources: Air Combat Command Public Affairs Office, Jane's All the World's Aircraft (various years), USAF Fact Sheets, Air Force Almanac (various years).

Note: Stated numbers for the JSF and F/A-22 assume an air-to-ground strike configuration and that fuel and weapons are carried internally. Although both are capable of carrying external fuel tanks and weapons, doing so can compromise stealth. Data for the JSF is projected; flight testing has not been completed.

a. The F/A-22 cannot carry the 2,000 lb. JDAM. It can carry two 1,000 lb. JDAMs internally for strike missions.
b. Numbers for the SDB are estimates; SDB development has not been completed.

The Air Force points out that against the most sophisticated air defenses, the F/A-22 will be the most "survivable" and effective aircraft because of its stealth, speed, and agility, even though its range is shorted and its payload smaller in comparison to the B-2. The Air Force and other observers contend that the F/A-22 will be the only aircraft that can reliably penetrate advanced defenses and "break down the door" for follow-on aircraft; resources are therefore best spent on such aircraft rather than on upgrading or building more bombers. B-1s and B-52s will continue to play a role as stand-off platforms and as follow-on strike platforms, and B-2s will continue to serve as penetrators, but to ensure access in high-threat environments, these observers say, the bulk of Air Force investment should go to fighters.

Bomber advocates, on the other hand, argue that building more B-2s and upgrading the B-1's defensive systems are cheaper, more effective ways to address the high-threat environment than developing advanced fighters. Modernizing

existing bombers and expanding the fleet will not only address the high-threat environment, they say, but also will improve capabilities in lower-threat environments. They point to several advantages of bombers:

- Long-range bombers are designed to operate from far-away bases and can strike targets around the globe from the United States if necessary. Allies sometimes restrict the Air Force's use of bases close to conflicts. In the recent war in Iraq, Saudi Arabia and Turkey prohibited the use of their air bases for combat missions, and other countries denied rights to fly through their air space. Even with aerial refueling, short-range aircraft require bases close to the conflict zone to operate effectively, and their value in future conflicts could be severely diminished if nearby countries deny access.
- Even if neighboring countries provide access to bases near a future conflict, opponents could use surface-to-surface missiles to disable those bases, again limiting the capabilities of short-range aircraft.
- New targeting technologies have dramatically increased the capabilities of bombers. Because of GPS- and laser-guided munitions and new targeting pods, high-flying bombers now conduct precision strikes previously conducted only by low-flying, short-range aircraft. In Afghanistan and Iraq, bombers performed close air support missions, previously the exclusive domain of low-flyers like the A-10 *Warthog*.
- Bombers' long range and massive payload enable them to loiter for hours above conflict zones so they can respond rapidly to newly designated, time-sensitive targets.

Bomber advocates point out that these new capabilities have substantially increased demand for bombers in recent conflicts. In Operation Iraqi Freedom, for example, B-1s were in such demand that CENTCOM air component commander Lt. Gen. Michael Moseley personally managed their scheduling.[2] Since 12 of the 36 combat ready B-1s were deployed to Guam in case of an emergency in Korea and another 12 were undergoing maintenance or modernization, only 12 were available for the war. The demand for bombers is also apparent in statistics for recent conflicts: in Afghanistan, bombers accounted for 20% of combat missions and dropped 76% of the bomb tonnage in the first three weeks of the air campaign.[3] In Iraq, the B-1 flew fewer than 2% of the total number of combat sorties, yet dropped roughly half of the JDAMs.[4]

Bomber advocates also contend that few potential opponents are likely to obtain advanced air defenses because they are expensive and difficult to operate. In recent

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[2] David A. Fulghum and Robert Wall, "Baghdad Confidential," *Aviation Week*, April 28, 2003.

[3] Bruce Rolfson. "Bombers Shine in Air War But Remain Budget Targets." *Air Force Times*. November 26, 2001.

[4] David A. Fulghum and Robert Wall, "Baghdad Confidential," April 28, 2003.

wars and in the most likely scenarios for future conflict, air defenses are modest at best. Bomber advocates therefore say that a bomber fleet with upgraded defensive systems will remain valuable in the vast majority of future conflicts.

Inventory

How many bombers does the Air Force need? How many will it need in the future? The Air Force currently maintains 183 long-range bombers, of which 96 are combat ready. It plans to reduce the number of B-1s to 60, although some members of Congress oppose this consolidation (see B-1 consolidation, below). Likewise, DOD has sought to cut 18 B-52s from the fleet, but has met with resistance from Congress (see B-52 consolidation, below).

Table 3. Inventory, Status, and Age of Air Force Bombers

	B-1	B-2	B-52	Total
Active Inventory	78	21	84	183
Reserve Inventory	0	0	9	9
Combat Ready	36	16	44	96
Average Age	15.2	8.1	40.8	—

Source: *Air Force Almanac*, 2003 (September, 2002).

When evaluating the inventory requirements for tomorrow's long-range bomber force, a number of factors must be weighed, including the anticipated politico-military environment, the numbers and capabilities of other military platforms that can deliver long-range weapons (e.g., Navy ships), and improvements in targeting and weapons technologies. What impact will the conversion of ballistic-missile submarines (SSBN) into cruise-missile carriers (SSGN; each converted Trident submarine would carry 154 Tomahawk cruise missiles) have on the required number of B-52s? Can bomber variants of the F/A-22 or Joint Strike Fighter be developed that could contribute to the long-range bombing mission? Can unmanned aerial vehicles (UAVs) be armed so they can take on a bombing role? If so, would this reduce the needed number of B-1s or B-2s?[5]

Bomber advocates, including some members of Congress, contend that more bombers are needed given the expanded roles of these aircraft in recent conflicts and the possibility that the United States will be denied access to overseas bases in the future. In particular, some in Congress have argued for re-opening production of the B-2 to augment the bomber fleet and improve long-range penetration capabilities (see B-2, below).

[5] See CRS Report RL31673 for more information on a potential bomber variant of the F/A-22.

The Air Force and DOD, however, remain opposed to expanding the bomber fleet and continue to press for cuts in the numbers of B-1s and B-52s. The Air Force contends that the current number of combat-ready bombers is adequate for current and projected needs and that other needs are more pressing than expanding the bomber force. Air Force Chief of Staff John Jumper, when asked if today's bomber fleet is sufficient for future challenges, replied: "There's nothing I've seen that informs me we don't have enough bombers."[6]

The Air Force contends that the current bomber force is sufficient because bombers today are vastly more capable than in the past. Where previously several bombers and scores of bombs were required to eliminate a single target, today a single bomber can reliably destroy a dozen or more targets using precision weapons. Thus the Air Force and others turn around the argument that increased capabilities have increased demand for bombers to reason that increased capabilities mean fewer bombers are needed. Moreover, the Air Force is developing smaller and more precise weapons that will enable bombers and other aircraft to attack more targets with great accuracy. A 500 lb. version of the JDAM and the 250 lb. Small Diameter Bomb (SDB) will greatly increase the capabilities of existing bombers in coming years, and even smaller weapons are planned. Improved accuracy, it is hoped, will give these smaller munitions the same destructive power as today's larger, less accurate weapons.

Today the B-2 carries sixteen 2,000 lb. JDAMs, but soon it will carry an estimated eighty 500 lb. JDAMs, which are scheduled to debut in 2004. General Jumper believes these new weapons will reduce the number of bombers needed: "Ten B-2 bombers with 90 weapons each will take care of the target decks that we have prepared for conflicts in most parts of the world."[7] Each B-2 is anticipated to carry over 300 SDBs, which are expected in 2007.[8] Thus, 21 B-2s could theoretically attack over 6,000 separate targets in a single operation. Today, such an attack would require nearly 400 B-2s, assuming 16 weapons each.

Bomber supporters counter that the math doesn't always translate to the battlefield. If the United States were to face two simultaneous conflicts, for example, the 16 combat-coded B-2s would be stretched thin regardless of how many bombs each carries. Moreover, enhanced capability has increased, not decreased, demand for bombers in recent conflicts. Lastly, bomber advocates note that neither the 500 lb. JDAM nor the SDB has been successfully fielded yet, and it may be imprudent to make decisions about the future size of the bomber inventory based on weapons that have not yet been deployed.

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[6] John Roos. "Holding the Heading: Air Force Chief Shares His View of Transformational Activities." *Armed Forces Journal International.* May 2002.

[7] *Ibid*

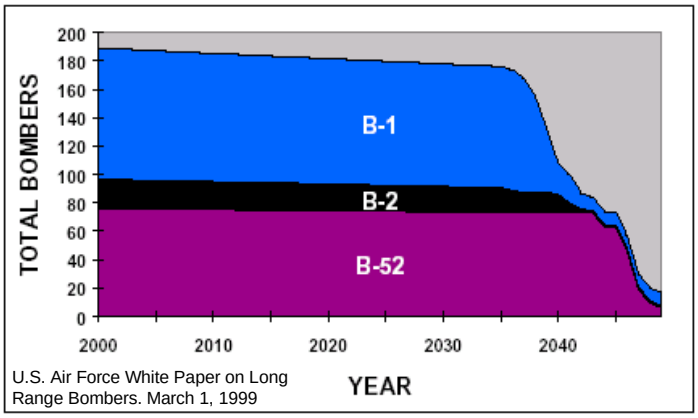
[8] John Tirpak. "Bomber Questions." *Air Force Magazine*. September 2001.

Next Generation Bomber

A key consideration regarding a next-generation long-range bomber is when to begin a development program. Other questions that may confront Congress include the desired characteristic of a future bomber and how it will fit into a future fleet structure.

Urgency. How urgent is the need for a next generation bomber program? Current Air Force plans call for a new long-range bomber to come on line in 2037, about the time when it predicts that corrosion, fatigue, or other problems will render substantial numbers of existing bombers inoperable. The Air Force's 1999 bomber roadmap states that 190 bombers are needed to fulfill its long-range strike mission requirements and estimates that the numbers of existing bombers will drop below that level in 2037.[9]

Figure 1. Economic Service Life and Attrition



The bomber roadmap laid out the following schedule for research and development of a next generation bomber that would enter service in 2037:

Event	Date
Mission Area Assessment	2013
Mission Needs Statement	2014
Concept Exploration	2016
New Acquisition Program	2019
Production	2034
Initial Operational Capability	2037

[9] U.S. Air Force White Paper on Long Range Bombers. March 1, 1999.

The House Armed Services and Appropriations Committees, contending that a new bomber will be needed before 2037, recently added $100 million to the Bush Administration's FY2004 budget request to accelerate research and development of a next generation bomber.[10] The Armed Services Committee expressed concern that the Air Force's schedule will not ensure a sufficient bomber force for future requirements and states that it expects the Air Force to update its Future Years Defense Program to include funding to develop and procure a new bomber "well prior" to its previous plan.[11]

The arguments put forward by advocates of a new bomber include the following:

- The need for more and better long-range, high-payload strike aircraft that can penetrate advanced air defenses.
- The old age and vulnerability of the B-52. The youngest B-52 is now over 40 years old. While its remarkable durability and flexibility has sustained the B-52's relevance, at some point fatigue will catch up to it. Additionally, because the B-52 lacks sophisticated defenses and is easily detected by radar, its capabilities are limited unless enemy defenses have been suppressed.
- The possibility that the United States will be denied access to overseas bases for future conflicts.
- The heavy reliance on bombers in recent conflicts.

Bomber advocates' contend that the Air Force tends to be biased toward fighter aircraft and has chronically underfunded bomber programs. One noted aviation historian argues:

> They (USAF leaders) recoil at the idea of sending Air Force fighter pilots into air-to-air combat during the first decade of the 21st century in F-15C, which were first built in the 1970s, but upgraded and produced into the 1990s. Yet, they apparently have no qualms about condemning bomber pilots to fly the ancient B-52Hs, which were last produced in 1962, into combat during the first three decades of the 21st century.[12]

These observers argue that the Air Force gives priority to fighters because the generals who run the service tend to be tactical fighter pilots. Their bias, some say, is indicated by the increasingly lopsided ratio of dollars invested in tactical fighters versus bombers, which increased from slightly less than 5:1 in 1999 to more than 30:1 in 2003.[13] This funding imbalance is reflected in a growing imbalance between

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[10] House Committee on Armed Services, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 221. House Committee on Appropriations, "Department of Defense Appropriations Bill, 2004," H.Rept. 108-187 (H.R. 2658), p. 269.

[11] House Armed Services Committee, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 221.

[12] Williamson Murray. "U.S. Needs New Bomber, Not more Fighters." *Aviation Week & Space Technology*. March 27, 2002. p.66.

[13] *Ibid*.

tactical fighters and bombers in the Air Force inventory: in 1950, the ratio of fighters to bombers was two to one, but by the late 1990s, the ratio had grown to 16 to one, meaning that less than 5% of the service's 4,000 aircraft were bombers.[14]

The Air Force has opposed accelerating development of a follow-on bomber because it believes other priorities are more urgent. Major General Dan Leaf, Director of Air Force Operational Requirements, has said that "we can't realistically afford to modernize everything at once." Fielding the future strike platform "is not as pressing a problem...as continued modernization of the fighters."[15] Leaf also argues that the Air Force plan favors fighter modernization not only because fighter capabilities need to be upgraded, but also because there have not been major technological leaps that apply to bombers. "The next generation bomber study...led the service to postpone development of a future strike platform because 'there wasn't significant technological advance anticipated in the near term to merit going forward right now,'" Leaf explained.[16] Air Force Chief of Staff General John Jumper also states that existing bombers, including the venerable B-52, meet foreseeable needs: "...there's nothing that would prompt me to begin retiring the B-52s that continue to work very well and carry large loads."[17]

Desired Capabilities. What characteristics should a next-generation bomber have? Among the factors to be considered are range, payload, speed, unit cost, stealth, and whether the aircraft will be manned or unmanned. Reportedly, Air Combat Command (ACC) is examining four options:

- The B-3: An upgraded version of the B-2 that has greater payload and range along with better stealth and communications.
- Hypersonic Cruise Vehicle (HCV): An aircraft that would operate in the upper atmosphere at "hypersonic" speeds (Mach 12). It would be virtually invulnerable to enemy defenses because of its speed and altitude and could reach east Asia from the continental United States in less than two hours.[18]
- A high-altitude, low-cost unmanned combat aerial vehicle (UCAV) with a range of 17,000 nautical miles and a payload of 4,000 lbs.
- A lower-flying, stealthy UCAV.[19]

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[14] Laura Colarusso. "Analysts: USAF Bomber Force Dangerously Close to Serious Disconnect." *Inside the Air Force.* October 19, 2001.

[15] Laura Colarusso. "Future Strike Platform Takes Back Seat to Fighter Modernization. *Inside the Air Force.* March 1, 2002. Undersecretary of Defense Aldridge makes similar arguments in "Interim Bomber?" *Aerospace Daily*. August 12, 2002.

[16] *Ibid.*

[17] John Roos. "Holding the Heading: Air Force Chief Shares His View of Transformational Activities." *Armed Forces Journal International.* May 2002.

[18] "Hypersoar," [http://www.globalsecurity.com]. Accessed on 7/22/2003.

[19] Laura Colarusso. "Future Strike Platform Takes Back Seat to Fighter Modernization." *Inside the Air Force.* March 1, 2002.

There are two general approaches to developing a next generation bomber: "leap ahead" and "incremental." The former favors the development of expensive, revolutionary technologies, while the latter prefers to build upon existing technologies. The Air Force appears to favor a leap ahead approach. Former Chief of Staff General Mike Ryan states the Air Force "wants to make a big leap in capability with its next strategic system...we need to go to the next level of strike capability, beyond the B-2."[20]

Supporters of the leap ahead approach argue that competitors may arise to challenge U.S. air power in the future. The proliferation of advanced Russian surface-to-air missiles, for example, is just a hint of the kind of weapons that may emerge tomorrow. Potential adversaries are also developing anti-access systems and techniques like GPS jamming, "anti-stealth" radars, and terminal defenses that will require serious technological advances to defeat, they argue.

Incrementalists, on the other hand, point out that the United States has dominated the air in every conflict since Vietnam, and especially since the Persian Gulf War in 1991. They argue that while we should improve on today's capabilities, we can strive toward cost effective solutions. Developing leap ahead capabilities will be difficult and expensive — Air Force officials say that research into hypersonics has advanced little beyond the X-30 National Aerospace Plane, which was cancelled in 1995.[21] Yet it is unclear that we need such exotic capabilities in tomorrow's long-range bombers. Retired Air Force General Richard Hawley argues, for example, that

> It is not even clear that supersonic flight is a desirable, much less required attribute for a future long-range strike platform. From the standpoint of military utility, loiter capability appears more valuable than speed, given the strategic premium now being placed on dealing with mobile and other time-critical targets.[22]

Incrementalists believe tomorrow's bomber could leverage existing platforms and technologies. Adapting technologies developed for the F/A-22, for example, or outfitting the Global Hawk UAV with more powerful engines and state-of-the-art weapons such as the Small Diameter Bomb, might be cost-effective ways to expand strike capabilities. Some even argue that commercial aircraft such as the 767 could serve as the foundation of a new bomber. Savings would be achieved by using parts and structures built in large numbers for airlines.[23] Because the United States can achieve air supremacy quickly and because bombs have become so accurate, some incrementalists argue that bombers have essentially become "trucks" for hauling large quantities of ordnance over great distances. They argue that only a few bombers with expensive capabilities such as stealth and supersonic speed are needed.

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[20] John Tirpak. "Bomber Questions." *Air Force Magazine.* September 2001.

[21] Nick Cook. "USAF Hones Future Bomber Requirement." *Jane's Defence Weekly*. January 2, 2002.

[22] General Richard Hawley and John Backshies. "Closing the Global Strike Gap." *Armed Forces Journal International.* September 2001.

[23] Robert Wall. "USAF Bomber Plans Spark Renewed Debate." *Aviation Week & Space Technology.* April 2000. p.30.

There is an important role, they say, for cheap, commercially-derived aircraft that simply carry lots of weapons and fuel.

Fleet Diversity Versus Uniformity. DOD currently operates three different bombers. This diversity offers advantages in terms of planning flexibility in different types of conflicts. At the same time, diversity challenges enemy air defenses because a system that may be effective against one plane might be ineffective against another. Further, diversity avoids "single point failure." If one bomber were to experience a serious problem such as airframe fatigue, a software bug, or vulnerability to a new air defense technology, other types of bombers may not be affected.

While fleet diversity has advantages, it also has drawbacks, primarily in terms of cost. Describing the current bomber force, General Richard Hawley remarked:

> The fact is that we've got three small fleets of airplanes...every time you own a fleet of airplanes, you incur a lot of overhead cost....You have to fund that overhead for each system so we're carrying three software maintenance facilities. We're funding three small armies of engineers to support each of these three bombers and what we ought to do is neck down to one bomber.[24]

As a point of reference, the Joint Strike Fighter (JSF) program was designed in part to reduce the costs of fleet diversity. The JSF attempts to reduce operations, maintenance and training costs by increasing the commonality between the Air Force, Navy, and Marine Corps variants of the aircraft, while maintaining enough diversity so that one basic platform will satisfy the unique requirements of three different users.[25] Policy makers will have to weigh the costs and benefits of fleet diversity when contemplating a next generation bomber.

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[24] Laura Colarusso. "Analysts: USAF Bomber Force Dangerously Close to Serious Disconnect." *Inside the Air Force.* October 19, 2001.

[25] For more information on the JSF, see CRS Report RL30563.

B-52 Stratofortress

Overview

The 40-year-old B-52 has remained relevant to a changing battlefield. Although nuclear strikes were its primary mission during the Cold War, the B-52 has carried out important non-nuclear missions in conflicts going back to the Vietnam War. Air Force Secretary James Roche stated recently that the B-52 has transformed three times in its history, from a high-level bomber to a low-level intruder to a stand-off cruise missile carrier to a close air-support aircraft.[26] The B-52 is the only platform that can operate with more than 20 types of bombs and cruise missiles in the U. S. inventory. In high-threat areas where enemy defenses are robust, B-52s employ air-launched cruise missiles (20 per aircraft) to attack ground targets from a distance. In low-threat environments such as Afghanistan or Iraq, B-52s can use JDAM precision bombs or various gravity bombs.

Figure 2. B-52 Stratofortress

Source: USAF.

Eighty five B-52s are on active duty and nine are in the reserve. Of these, 44 are combat ready. In accordance with plans stated in the 1992 Bomber Road Map, all G models have been retired, and their role has been assumed by H models, which have more powerful engines, longer range, and lower operating cost. According to current Air Force plans, B-52s will remain in service through 2037 when a next generation bomber should come on line.

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[26] Lance M. Bacon, "Think Bombers Are Bad Now? Just See What They Get Next," *Air Force Times*, June 16, 2003.

Program Status

B-52 Consolidation. For several years, the Air Force has tried to retire 18 B-52s. Much like the B-1 consolidation plan, the rationale is to save money that could be spent to improve the readiness and effectiveness of the remaining aircraft. Air Force officials argue that these 18 "attrition reserve" aircraft are unneeded. According to a March 1999 USAF White Paper on Long Range Bombers (p.2, 21), the Air Force needs only 76 B-52s to support its full range of mission taskings.[27] In July 2001, Air Force Secretary James Roche reiterated the Air Force's desire to retire 18 B-52s.[28] Congress has consistently resisted this retirement, citing the lack of an active bomber production line and the importance of the long range bomber force. In June 2001, the House Appropriations Committee refused to sanction a move that would have prevented upgrade of 18 B-52s.[29] In several recent years, Congress has increased funding for B-52 operations and maintenance and has directed the Air Force to keep all 93 in the inventory.

Electronic Warfare. With the EA-6B *Prowler* approaching the end of its service life, the Air Force has explored adding radar jamming equipment to B-52s as part of the Air Force's diversified approach to jamming. B-52s, which are vulnerable in high-threat environments to enemy air defenses, would serve primarily in a standoff jamming role while other aircraft would conduct close-in jamming. The Air Force stresses that B-52s equipped with jamming equipment would retain their full capabilities as bombers and would not become dedicated electronic warfare aircraft.[30] Some have suggested that converting the 18 attrition reserve B-52s into electronic jamming platforms could have the additional benefit of satisfying Congress' desire to keep these aircraft active as a hedge against potential future needs.[31] The Air Force has not made final decisions about future radar jamming plans and, at present, lacks funding for a B-52 electronic warfare program.

Modernization

Electronics. The 1999 Air Force White Paper on Long Range Bombers (p.7) stated that improving situational awareness is the "highest priority modification needed for the B-52." The Situational Awareness Defensive Improvement program will attempt to improve B-52 situational awareness by significantly upgrading the AN/ALR-46 radar warning receiver. Valued at $48 million in 2000, the program will run through 2003. Work was also started in 2000 on the Avionics Mid Life

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[27] Adam Herbert. "With Law On Its Side, Air Force Ignores Congressional B-52 Language." *Inside The Air Force*. August 11, 2000, p. 1.

[28] "Air Force Secretary Says He Intends To Cut B-52 Fleet." *InsideDefense.com*. July 16, 2001.

[29] Aerospace Daily. "House panel rejects $30 million cut for B-52 modifications."June 13, 2001.

[30] Robert Wall, "Jammer Bomber: B-52's electronic attack role faces funding, technical roadblocks," *Aviation Week*, June 2, 2003.

[31] Robert Wall and David A. Fulghum. "Air Force Embraces Jammer, But Plots Independent Course." *Aviation Week and Space Technology*. May, 27, 2002, vol. 156.

Improvement (AMI). AMI is a five year contract, valued at $108 million, and will replace three key offensive avionics component subsystems: the avionics computers, the inertial navigation, and the data transfer system. The AMI underwent successful testing in May 2003 and the entire fleet is scheduled to receive the upgrade by 2007.[32]

Engines. Since 1996, the Air Force has explored replacing the B-52's engines to improve performance and lower costs. After a lull, interest has been renewed by a March 2003 report form the Defense Science Board (DSB) unanimously recommending that the Air Force re-engine the B-52 "without delay."[33] According to the DSB, replacing the aircraft's 1950s-era engines with four modern engines would increase range by 46% while reducing aerial refueling needs and maintenance costs. The benefits of reengining, particularly less demand on refueling tankers, would far outweigh the costs, according to the DSB. They state that new engines would cost $3 to $3.5 billion, but savings would total between $6 and $9 billion between 2011, when the new engines are completed, and 2037, when the B-52 is retired. In July 2003, the Air Force asked Boeing to investigate the feasibility of replacing the B-52's eight engines with eight modern engines, rather than four as had been suggested earlier. An eight-engine upgrade could boost the B-52's performance and expand is mission possibilities as well as increase efficiency, according to the Air Force.[34]

The Air Force states that although it is interested in re-engining, it does not currently have adequate funds.[35] It is exploring alternative funding, such as the federal Energy Savings Performance Contracts (ESPC) program, which uses private sector financing to improve energy efficiency and then pays back investors with the savings. In early 2003, however, Congress moved to block use of the ESPC for the B-52 by capping the program at $100 million. Some in Congress apparently objected to the use of non-appropriated funds, such as the ESPC or a lease arrangement.[36]

Targeting Pod. Operation Iraqi Freedom marks the first time that a bomber has been able to laser designate targets for itself. B-52s equipped with the Northrop Grumman Litening II targeting pod were able to locate and designate targets, something previously only done by fighters or ground forces.[37] Integration of the pod on the B-52 was originally scheduled for June 2003, but was rushed so that it could be employed in Iraq, where it was used successfully to destroy targets with laser-guided bombs. In addition to enabling B-52 crews to locate and designate targets, the

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[32] Wes Auldridge, "B-52 Undergoes Worldwide Testing," Air Force Flight Test Center Public Affairs, May 20, 2003.

[33] Michael Sirak and Christopher Stagg, "Fresh Interest Brews to Re-Engine B-52s," *Jane's Defense Weekly*, April 30, 2003.

[34] Stephen Trimble, "Air Force Widens Review of B-52 Re-Engineing Options," *Aerospace Daily*, July 7, 2003.

[35] Sirak and Stagg, op. cit.

[36] Trimble, op. cit.

[37] Lorenzo Cortes, "B-52 Crew Credits Arsenal, Loiter Capability During Operation Iraqi Freedom," *Defense Daily*, May 9, 2003.

pod enables them to personally verify ground-designated targets to prevent errors such as the accidental designation of friendly troops or civilians. Finally, the pod enables the crew or others to assess battle damage by recording video of bomb hits.[38]

SWING. The Air Force plans to continue upgrading the B-52's capabilities under the Smart Weapons Integration Next Generation (SWING) program. Under current plans SWING will arm the aircraft with an extended range version of the Wind Corrected Munitions Dispenser (WCMD-ER) and the yet-to-be completed 250 lb. precision Small Diameter Bomb, Miniature Air-Launched Decoy (MALD), and extended range Joint Air-to-Surface Stand-off Missile (JASSM-ER).[39] Currently the B-52 can carry twelve 2,000 lb. JDAMS, while new bay wiring will increase that number to 20 and permit the aircraft to carry 30 of the 500 lb. JDAM. According to the Air Force, the B-52 will be able to carry 144 independently targeted SDBs once SWING is completed. The B-52 would carry 12 JASSMs, each capable of hitting a moving target with a 1,000 lb. warhead from a range of 200 miles.[40]

Readiness

Mission Capable Rate. The B-52 fleet continues to maintain a relatively high degree of readiness. The B-52 has the highest MCR of all bombers in the force, and is second to the F-117 for both fighters and bombers.[41] Over the past decade (FY1992 to FY2002), the B-52's MCR has hovered around 80%, standing at 81% in FY2002, according to GAO.[42]

Aging Issues. The Air Force plans to maintain and upgrade the B-52 through 2037. Generally speaking, the B-52's aging issues include wear and tear of the wings and fuselage, and metal corrosion. Regarding wear and tear, Air Force Chief of Staff General John Jumper has expressed his confidence in the B-52's robustness:

> "First, the B-52 is over-engineered by a (very substantial factor). These planes were built before the age of computer-aided design; the plane's designers built it by multiplying by two or three what they felt was needed (structurally). So the airplane is built well."[43]

In 1999, wing upper surface was believed to be the weak link in terms of B-52 wear and tear. The estimated life span of this component is 28,300 flight hours, as

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[38] Tony Wickman, "B-52 Dons New Upgrade," Air Force Flight Test Center Public Affairs, April 9, 2003.

[39] "B-52H SWING Plan Includes MALD, SDB, JASSM-ER, and WCMD-ER," *Defense Daily*, May 21, 2003.

[40] Lance M. Bacon, "Think Bombers Are Bad Now? Just See What They Get Next," *Air Force Times*, June 16, 2003.

[41] Bruce Rolfsen. "The B-52's Big 5-0." *Air Force Times*. April 15, 2002, p. 14.

[42] "Military Readiness: DOD Needs a Clear and Defined Process for Setting Aircraft Availability Goals in the New Security Environment," GAO, April 2003.

[43] John Roos. "Holding the Heading Air Force chief Shares His View of Transformational Activities." *Armed Forces Journal International.* May 2002.

opposed to 42,000 hours for the fuselage, 44,800 hours for the horizontal stabilizer, and 73,500 hours for the wing lower surface. As of May 2003, the average B-52 has completed 15,858 flight miles, while the oldest has completed 20,709.[44]

Corrosion has become a concern for the KC-135 aerial refueling aircraft, and some fear that corrosion will force that aircraft into early retirement. Because the KC-135 and B-52 are approximately the same age, it has been suggested that corrosion may become a problem for the *Stratofortress*. Thus far, however, fatigue, caused by wear and tear, appears to be a greater concern than corrosion for the B-52.

Recent Operations

Before Desert Storm, the B-52 was used in Vietnam both for close air support and area bombing. Its success, manifest during Linebacker II (the Hanoi bombing in 1972) was mitigated in part by heavy losses: 15 aircraft were lost to enemy fire in the two weeks of that operation

Desert Storm (Iraq, 1991). On the second day of combat, 80 B-52s flying from the continental U.S. and four overseas locations fired Conventional Air-Launched Cruise Missiles (CALCMs) with 2,000 lb. warheads. On January 17, 1991, seven B-52s flew from Louisiana on a 35 hour-mission, at the time the longest sortie ever. B-52s flew 414 missions against targets in Iraq. No aircraft were lost to enemy fire, but one crashed in the Indian Ocean returning to Diego Garcia. Three crew members lost their lives. The aircraft dropped 27,500 tons of ordnance in 1,624 sorties — 31% of all U.S. bombs and 41% of all Air Force bombs employed during the conflict."[45]

Operation Desert Fox (Iraq, 1998). Two B-52s operated from Diego Garcia, and launched approximately 90 Block 1 3,000 lb. CALCMs equipped with an improved guidance system.[46] The Block 1 CALCMs were considered twice as accurate as those used in Desert Storm.

Operation Allied Force (Kosovo). B-52s operating from Fairford, England launched CALCMs and 11,000 bombs in 270 missions during the 1999 Operation Allied Force attacks on Yugoslavia. B-52s also employed the AGM-142 *Have Nap*, a jointly developed U.S.-Israeli missile.

Operation Enduring Freedom (Afghanistan). Many observers have lauded the B-52's performance in the war against terrorism in Afghanistan. Operating from Diego Garcia, B-52s were able to loiter for extended periods, and dropped weapons on targets designated by ground forces, including mobile targets. Using precision bombs, B-52s were able to provide close air support from altitudes

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[44] Lance M. Bacon, "Think Bombers Are Bad Now? Just See What They Get Next," *Air Force Times*, June 16, 2003.

[45] Airpower in Operation Desert Storm, USAF Fact Sheet 91-03 Special Edition. May 1991.

[46] Robert Wall. "New Weapons Debut In Attacks on Iraq." *Aviation Week and Space Technology*. December 28, 1998, vol. 149, No. 25, p. 14.

above 30,000 feet while also hitting traditional targets. This mission flexibility was made possible by training conducted a year before the campaign began.[47]

Support to Northern Alliance fighters from B-52s was crucial to the fall of Mazar-e-Sharif, a key battle in the war. Prior to the B-52's employment, ground forces were stalemated.[48] From mid-January to the end of March 2002, B-52s flew 255 sorties, including 80 in Operation Anaconda, a key attack on Taliban and Al-Qaeda positions. Illustrating its payload diversity, the B-52s employed JDAMs, Mk82 bombs, Wind-corrected Munition cluster bombs, and 115 M-129 leaflet-dispensing bombs.[49]

Operation Iraqi Freedom (2003). B-52s also played an important role in the recent war in Iraq, where 28 of the aircraft conducted 280 combat sorties.[50] B-52 crews credited the plane's ability to carry a wide variety of weapons and its ability to loiter over battlefields as the key to its success. They also lauded the Litening II targeting pod, which enabled them to designate targets themselves for the first time.[51] The B-52 was also praised for being the among the few platforms able to continue operating during a sandstorm: when the storm grounded helicopters and forced fighter strike packages to turn around, B-52s armed with 500 lb. bombs flew over the storm and devastated Iraqi mechanized forces that were trying to maneuver under cover of the storm.[52]

Costs

The acquisition costs for the 744 bombers are indicated in Table 4, a total of $4,916 million, with the unit cost varying between $30 million and $74 million.[53]

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[47] Frank Wolfe. "Bombers Able To Use Flexible Targeting For Afghan Campaign." *Defense Daily*. October 26, 2001

[48] "Power of B-52s Proves Telling As In Gulf War, Heavy Bombers Pave Way For Military Successes in Afghanistan." *Dayton Daily News.* November 28, 2001.

[49] Bruce Rolfsen. "The B-52's Big 5-0." *Air Force Times.* April 15, 2002. p.14.

[50] Lt. Gen. T. Michael Moseley, "Operation Iraqi Freedom — By The Numbers," U.S. Air Force, April 30, 2003.

[51] Lorenzo Cortes, "B-52 Crew Credits Arsenal, Loiter Capability During Operation Iraqi Freedom," *Defense Daily*, May 9, 2003.

[52] Lance M. Bacon, "Think Bombers Are Bad Now? Just See What They Get Next," *Air Force Times*, June 16, 2003.

[53] Heather Kirkwood. "Mechanics' Creativity Keeps 50-year-old B-52s In The Air." *South China Morning Post*. 29 April 2002.

Table 4. B-52 Appropriations, by Year

($ Millions Then-Year)

Year	RDT&E	Procurement	Quantity	Milcon	Total
FY1981	16.3	460.1	The last B-52 (H model) was produced in 1961 and procured with FY1962 funds		476.4
FY1982	96	438.4			534.4
FY1983	90	532.2			622.2
FY1984	78.8	461			539.8
FY1985	22	466			488
FY1986	16	451.2			467.2
FY1987	10	397.2			407.2
FY1988	13	238.7			251.7
FY1989		216			216
FY1990		181.7			181.7
FY1991		58.6			58.6
FY1992	3.9	31.1			35
FY1993	22	76.7			98.7
FY1994	6.3	37.4			43.7
FY1995		32.8			32.8
FY1996	21	4.9			25.9
FY1997	11.6	20.2			30.8
FY1998	1.8	39.3			41
FY1999	6.4	38.3			42.1
FY2000	40.1	24.8			64.9
FY2001	50.7	42.5			93
FY2002	66.8	14.3			85
FY2003	55.7	24.7			80.4
Total	628.4	4,288.0			4,916.4

FY2004 Developments.

Administration Request. The Administration requested $61.1 million in procurement funds and $28.6 million in RDT&E for avionics upgrades.

Authorization. The House Armed Services Committee (HR1588) authorized $80.1 million, $19 million more than the Administration's procurement request. The increase funds Litening II targeting pod integration. The House Committee matched the Administration's R&D request of $28.6 million. The Senate Armed Services Committee (S1050) matched the Administration's requests for both procurement and R&D.

Appropriation. The House Appropriations Committee (HR2658) reduced procurement for the Offensive Avionics System by $9.2 million, bringing total B-52 procurement down to $51.9 million. The Committee did not add any funds for the Litening II pod as the Armed Services Committee did. The House Appropriations Committee left the RDT&E request unchanged at $28.6 million. The Senate Appropriations Committee (S1382) added $17 million to the Administration's procurement request, for a total of $78 million. They matched the Administration's request for RDT&E.

B-1B Lancer

Overview

Like all the long-range bombers currently serving in the Air Force, the B-1B was designed to carry nuclear weapons deep into Soviet territory during the Cold War. The plane's supersonic speed, reduced radar signature, and large payload gave it important advantages over the B-52, even though its range was shorter. Since the end of the Cold War, the Air Force has adapted the B-1B to carry conventional weapons, although its value in conventional warfare has only been tested in the recent conflicts in Afghanistan (2001) and Iraq (2003). The B-1B has the largest payload capacity of the three bombers and can carry a broad array of precision and non-precision weapons. Ongoing upgrades will increase the variety of weapons it can carry and will enable it to deliver three different munitions to separate targets in a single sortie, a first among U.S. warplanes.

Figure 3. B-1B Lancer

Source: USAF Photo by MSgt. Rose Reynolds

The B-1 entered service in 1986 and the total order of 100 aircraft was completed in 1988. However, the plane has been controversial throughout its history. In 1977, President Carter cancelled the program in development, believing that existing air- and sea-launched missiles provided adequate nuclear strike capability. President Reagan revived the B-1 program in 1981, and following modifications to the original design, the plane was designated the B-1B. After it sat out or played marginal roles in the conflicts of the 1990s, Secretary of Defense Donald Rumsfeld

suggested in 2001 that the B-1 be retired. In response, the Air Force decided to reduce the B-1 fleet by roughly one third, or 33 aircraft. Although the retirement process is underway, supporters of the B-1 in Congress and elsewhere are fighting to reinstate all or some of the decommissioned planes. They argue that the B-1's performance in Afghanistan and Iraq demonstrate its value on the modern battlefield. Debate over the future of the plane continues. Under current plans, the Air Force will maintain and upgrade the B-1B for service through 2040, by which time a new long-range bomber should enter the fleet.[54]

Program Status

Consolidation. In early 2001, advisors to Secretary of Defense Donald Rumsfeld suggested that the Air Force retire the entire B-1B fleet.[55] A study commissioned by Rumsfeld highlighted the B-1 as one of four programs least compatible with the Pentagon's future plans. The study recommended that DOD place higher priority on B-2 and B-52 modernization and consider purchasing more B-2s to replace the B-1 in the fleet.[56] At the time, the Air Force was $2 billion short in modernization funds for the B-1B. To address this shortfall without eliminating the plane, the Air Force opted to retire a third of the fleet, reducing the number of B-1s to 60 from 93 and consolidating basing to two active duty locations from three active duty and two Air National Guard locations.

When the Air Force publicly justified its consolidation plan, it cited not only budgetary constraints,[57] but also the need to improve B-1 maintenance and supply.[58] The B-1 has historically suffered from severe parts shortages that forced technicians to "cannibalize" parts from one plane to keep others flying: by 2001 the plane had the highest cannibalization rates in the Air Force by a wide margin. Parts shortages also contributed to some of the lowest mission capable rates in the Air Force in the late 1990s and 2000s.[59] Further, the B-1 is among the most expensive planes to fly, costing $14,343 per flying hour, or more than double the cost for either the B-2 or the B-52.[60]

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[54] U.S. Air Force Long-Range Strike Aircraft White Paper. November 2001, p. 27.

[55] Jefferson Morris, "GAO Criticizes Air Force on Handling of B-1B Consolidation," *Aerospace Daily*, September 9, 2002.

[56] Lance M. Bacon, "Back in the Big Game," *Air Force Times*, June 16, 2003. See also Jim Garamone. "Conventional Forces Group Makes Report to Rumsfeld." *American Forces Press Service*. June 26, 2001.

[57] Robert Wall. "B-1B Backers, Air Force Clash Over Bomber Ax." *Aviation Week and Space Technology*. July 16, 2001, and General John Jumper's confirmation hearing excerpts. *Air Force Magazine*. October 2001, p. 39.

[58] Darren Heusel. Oklahoma City Air Logistics Center Public Affairs, "Maintainers overcome challenges to keep B-1Bs flying." *Air Force News Archive*. March 29, 2002 and Drew Brown. "Pentagon Officials Stand By B-1 Move." *Macon Telegraph*. June 30, 2001.

[59] See "Readiness" below.

[60] "Military Readiness: DOD Needs a Clear and Defined Process for Setting Aircraft Availability Goals in the New Security Environment," GAO, April 2003.

Another argument behind consolidation is that with more and more effective precision weapons, a single bomber is vastly more capable than in the past. In *Operation Desert Storm* in Iraq (1991), for example, numerous bombs and possibly multiple sorties were needed to destroy individual targets; in *Operation Iraqi Freedom* (2003), however, a single bomber could reliably destroy as many as two dozen separate targets.

Effects of Consolidation. The Air Force reports that consolidation has brought substantial savings and improved performance to the remaining B-1 fleet for two reasons. First, consolidation has expedited modernization of the remaining fleet because, according to an Air Force spokesman, "the USAF is aggressively reinvesting dollars saved from the B-1 consolidation to significantly increase the capabilities of the remaining aircraft."[61] In the first year since consolidation, savings amounted to $130 million according to the Air Force.[62] Initial estimates pegged total consolidation savings over five years at $1.4 billion, but subsequent estimates lowered that figure to roughly $800 million.[63] Second, consolidation has boosted B-1 performance both by reducing the demand for spare parts and by enabling the Air Force to take needed parts from retired planes. By early 2003, the cannibalization rate had dropped dramatically, while the mission capable rates during Operation Iraqi Freedom have been the highest yet reported for the aircraft — 79%.

Criticism of the Consolidation Plan. A September 2002 GAO study criticized the plan for failing to analyze how the reduction would affect national security needs or detailing how the Air Force would replace the capabilities of the lost B-1's using other aircraft. The study also found that the Air Force was inconsistent in its methodology for implementing consolidation and incomplete in estimating savings.[64] The GAO report further criticized the decision to move planes from the Air National Guard to active duty, finding that Guard units had lower flying hour costs, higher mission capable rates, and more experienced crews.[65] A 1998 GAO report argued that moving B-1s from active duty to the National Guard could save millions of dollars while maintaining bombing capabilities.[66]

Others have criticized the B-1 consolidation for failing to live up to its promise. The primary justification for reducing the number of aircraft was to free up funds to modernize the remaining aircraft. Yet, the Air Force subsequently cancelled the B-1's defensive systems upgrade program (See DSUP below), a decision that could

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[61] Hampton Stephens, "Air Force Neglects B-1 Defensive System Upgrades in FY-04 POM," December 13, 2002.

[62] Lance M. Bacon, "Back in the Big Game," *Air Force Times*, June 16, 2003.

[63] Robert Wall. "B-1B Fights Demotion In Combat Role." *Aviation Week and Space Technology*. June 24, 2002. David Castellon. "B-1B Blunder? GAO Finds Air Force's B-1B Cuts Might Not Be So Cost-Effective After All." *Air Force Times*. July 15, 2002.

[64] Jefferson Morris, "GAO Criticizes Air Force on Handling of B-1B Consolidation," *Aerospace Daily*, September 9, 2002.

[65] Jefferson Morris, op. cit.

[66] "Air Force Bombers: Moving More B-1s to the Reserves Could Save Millions Without Reducing Mission Capabilities." GAO/NSIAD-98-64. February 1998. Washington, DC.

have important implications for the future utility of the B-1. Without an upgrade to its defenses, the B-1 may lose its ability to penetrate even meager enemy anti-aircraft systems. The B-1 would then essentially become a standoff platform like the B-52, and the only remaining long-range, high-payload aircraft capable of penetrating air defenses would be the 16 combat-ready B-2s. Critics of consolidation question whether the Air Force needs additional standoff aircraft and whether 16 long-range bombers capable of penetration missions is enough. These critics also ask why the B-1's capabilities should be downgraded substantially when the purpose of the consolidation was to free up funds for upgrades.

Reinstatement of Retired B-1s. Some members of Congress have fought the consolidation plan since it was first proposed. The decision concerned some in Congress because DOD did not consult with them beforehand. Shortly after the plan was announced in 2001, Senator Larry Craig introduced an amendment to the FY2001 Defense Supplemental Appropriations Bill to prevent DOD from using money authorized or appropriated in that year to implement the consolidation plan. This amendment was withdrawn.[67] On August 1, 2001 the House Armed Services Committee amended the FY2002 Defense Authorization bill to prevent B-1 consolidation at the request of Representative Saxby Chambliss.[68] In conference, however, Congress modified its position and required the Air Force to conduct a study of the bomber force structure before proceeding with consolidation (Sec. 1032. H.Rept. 107-333, S. 1438).

In 2003, the House Armed Services and Appropriations Committees added $20.3 million, plus additional funds for construction, personnel, and base operations, to the Administration's FY2004 request to begin the reconstitution of 23 B-1s that had been slated for retirement. The Armed Services Committee stated that the aircraft's "contributions were crucial to the success of both operations [Enduring Freedom in Afghanistan and Iraqi Freedom]."[69] Some members of Congress expressed concern that the reduced B-1 fleet could leave too few bombers to meet demand.[70] Air Combat Command presently keeps 36 B-1Bs at combat-ready status, with the remaining planes undergoing maintenance or upgrades, being used in training, or being retired. During the recent war in Iraq, roughly 12 of these were deployed to support the war and another 12 were deployed to Guam in case of an emergency on the Korean Peninsula, leaving 12 combat-ready planes as backup for the Iraq war or for contingencies elsewhere.[71]

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[67] Ibid.

[68] Kerry Gildea. "HASC Move Stalls Air Force Plan To Move Bombers." *Defense Daily*. August 2, 2001.

[69] House Armed Services Committee, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 95.

[70] Lori Lessner. "B1 Battle Takes Off: Kansans In Congress Battle Those Who Say The Plane Is Not Worth Its Cost." *Wichita Eagle*. July 2, 2001.

[71] David A. Fulghum and Robert Wall, "Baghdad Confidential," *Aviation Week*, April 28, 2003.

Within the Air Force, there is some concern that reinstating the 23 bombers will lead to a return to the spare-parts shortages of past years. According to an Air Force spokesman, the FY2004 funding authorized by the House Armed Services Committee would not go far in reinstating and modernizing the planes, let alone ensuring adequate future parts supplies.[72] The Air Force has estimated that it will need an additional $1 billion in operations and maintenance funding through FY2009 to operate the 23 planes, and the House Armed Services Committee, in its FY2004 authorization bill, "strongly urges" DOD to budget an additional $1.1 billion for the B-1B reconstitution in future year requests.[73] Despite its concerns about funding, some within the Air Force do believe more B-1s are needed, pointing out that two thirds of the combat-ready fleet was deployed during Iraqi Freedom' leaving an inadequate buffer against other potential conflicts.[74] Separately, B-1 supporters within the Air Force, together with advocates at Boeing, are pushing for the reinstatement of 12 retired aircraft.[75]

New Basing for the B-1B. Under the consolidation plan, B-1Bs formerly associated with the Georgia and Kansas Air National Guard have been removed from Robins and McConnell Air Force Bases (AFBs), respectively (9 aircraft each). The seven aircraft stationed at Mountain AFB in Idaho were also removed. The 60 remaining aircraft are now based only at Dyess AFB near Abilene, Texas (which lost 8 aircraft and now houses 32) and Ellsworth AFB in South Dakota (which retains 26 B-1Bs). The remaining two aircraft are used for testing at Edwards AFB near Los Angeles.

Alternative Air National Guard (ANG) Missions. Under the consolidation plan, the 184th Bomb Wing, located at McConnell AFB, was re-tasked in September 2002 with 10 KC-135, becoming the 184th Air Refueling Wing. The 116th Bomb Wing, located at Robins AFB, has become the 116th Air Control Wing operating E-8 JSTARS surveillance aircraft.

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[72] Tara Copp, "Congress Could Reinstate 23 B-1 Bombers," *Scripps Howard News Source*, May 15, 2003.

[73] House Armed Services Committee, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 95.

[74] Stephen Trimble, "USAF Estimates $1B Cost for Changing B-1B Retirement," *Aerospace Daily*, June 2, 2003.

[75] Stephen Trimble, "B-1B's War Achievements Spur New Upgrade Proposals," *Aerospace Daily*, May 7, 2003.

Modernization

The Conventional Munition Upgrade Program (CMUP). The CMUP, which began in FY1992, is a 15 year program comprised of several blocks. Its original purpose was to convert the B-1B from a nuclear to a conventional bomber, while current and planned upgrades aim to improve the mission capable rate, increase weapon flexibility, and incorporate new communications and defensive systems.

Block E (Wind Corrected Munition Dispenser (WCMD) Integration and Computer Upgrade). Block E is a computer systems upgrade intended to increase the roster of precision weapons the B-1B can carry and enable it to attack three different targets with three different types of munitions in a single sortie. The upgrade will add the Joint Stand-off Weapon (JSOW), the Joint Air-to Surface Stand-off Weapon (JASSM), and the Wind-Corrected Munition Dispenser (WCMD) to the B-1B's arsenal, while also improving the plane's avionics. In 2000, the upgrade faced a five month delay, half of it due to a strike by contractor engineers. A May 7, 2002 test demonstrated the B-1's ability to deliver three different kinds of weapons in one pass.[76] The Air Force has three Block E B-1Bs as of June 2003 and expects to complete the upgrade by late 2004.[77]

Block F (Defensive System update Program, DSUP). The goal of the Block F upgrades is to improve the B-1B's ability to operate in well-defended enemy territory by providing it with countermeasures to defend against guided missiles. The upgrade will equip B-1Bs with a defensive system developed by the Navy, the Integrated Defensive Electronic Countermeasure (IDECM). The IDECM uses the ALR-56M radar warning receiver and radio frequency countermeasures and the ALE-55 towed fiber-optic decoy, a replacement of the Block D ALE 50 towed decoy system. Block F will not be completed until 2009, assuming the original schedule is kept.[78]

Block F has suffered from technical problems with the ALE-55 fiber optic towed decoy from BAE Systems. Initial flight tests revealed problems with the decoy's in-flight deployment. Boeing, lead integrator for the DSUP, states that subsequent tests have demonstrated that the problems have been resolved. Still, Boeing has been exploring alternative decoys at the behest of the Air Force, in particular the FO-50 from Raytheon.[79] Because of delays and cost overruns related

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[76] Lt. Col. Mark Spillman. "B-1B achieves triple munitions drop, target kill." *Air Force News Archive*. May 9, 2002.

[77] Lance M. Bacon, "Think Bombers Are Bad Now? Just See What They Get Next," *Air Force Times*, June 16, 2003.

[78] "B-1 Bomber Upgrade Program Falters Again With New Delays, Expenses," *Inside the Air Force*, May 5, 2000.

[79] Stephen Trimble, "B-1B's War Achievements Spur New Upgrade Proposals," *Aerospace Daily*, May 7, 2002, and Hampton Stephens. "Service Pursues Alternative After Trouble With BAE's Towed Decoy." *Inside the Air Force*. July 5, 2002, vol. 13, n. 27.

to the decoy problems, the House and Senate Appropriations Committees each voted to cut FY2003 funding for the DSUP, but they restored funding in conference.[80]

In late 2003, after a series of restructurings and cost overruns,[81] the Air Force chose not to continue funding the DSUP in its FY2004 budget request, leading many to believe the program has been cancelled. Recognizing that without a defensive upgrade, the B-1 may lose the ability to penetration enemy ani-aircraft systems, the Senate Armed Services Committee added FY2004 funding to accelerate development of an extended range version of the Joint Air to Surface Stand-off Missile (JASSM). The JASSM-ER will enable the B-1 to attack enemy surface targets located in well-defended areas from a distance.[82]

BONE (B-One Next Enhancement) Contract. BONE will improve the targeting capabilities of the B-1 by integrating the Link-16 jam-resistant communication system and beyond line-of-sight satellite communications. Currently, B-1 crews receive target coordinates from ground forces or other aircraft by voice; the B-1 crew must then manually program the coordinates into the chosen weapon.[83] The Link-16 system would automate this process, reducing both the time required for re-targeting and the possibility of human error. The Link-16 program went underfunded in 2002, but funding was restored in FY2003. Funding for FY2004 meets plans, and the House Armed Services Committee "strongly urged" DOD to continue the Link-16 program.[84]

Readiness

Readiness has long been a challenge for the B-1B, but in the past year it appears that readiness has improved substantially. In 1998, its mission capable rate (MCR) fell from the mid-60s to 51% and remained in the low 50s through 2000.[85] A number of studies conducted since the mid-1990s attributed the low MCR to severe spare parts shortages.[86] Some contractors have gone out of business, while others no longer

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[80] Hampton Stephens, "Appropriators Reverse Course, Fund B-1 Defensive System Upgrade," *Inside the Air Force*, October 11, 2002.

[81] Lorenzo Cortes, "Multiple Rebaselinings, Nunn-McCurdy Breaches Doomed B-1 DSUP, Air Force Says," *Defense Daily*, January 30, 2003.

[82] Senate Armed Services Committee, "National Defense Authorization Act for FY2004," S.Rept. 108-46 (S. 1050), p. 210.

[83] David A. Fulghum and Robert Wall, "Baghdad Confidential," April 28, 2003.

[84] House Armed Services Committee, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 219-220.

[85] "Military Readiness: DOD Needs a Clear and Defined Process for Setting Aircraft Availability Goals in the New Security Environment," GAO, April 2003.

[86] Institute for Defense Analyses Bomber Study. Alexandria, VA. May 1995, and "Military Readiness: DOD Needs a Clear and Defined Process for Setting Aircraft Availability Goals in the New Security Environment," GAO, April 2003.

manufacture B-1B parts.[87] Consequently, the B-1B force suffered from cannibalization rates as high as 85% in 2001, compared to an Air Force average of 11%.[88] In the years leading up to consolidation, which reduced the B-1 fleet from 92 to 60, the Air Force operated the B-1 fleet with roughly 20 "attrition reserve" aircraft used for spare parts.[89]

Since the Air Force began to institute the consolidation plan, the B-1's MCR has improved dramatically, reaching a reported 79% during Operation Iraqi Freedom, while the cannibalization rated dropped below 50%. Air Force leaders attribute the improvement to the consolidation because fewer planes now compete for scarce parts and because remaining aircraft can poach freely from those that have been retired.[90]

Mishaps (Accidents). The B-1B has historically had the highest mishap rates of the three bombers and among the highest in the Air Force fleet. Seven out of a total order of 100 B-1s have been lost to accidents. Through FY2002, the lifetime Class A mishap rate for the B-1B is 3.30, while the Class B mishap is 9.65.[91] The corresponding lifetime rates for the B-2A were 0.00 and 5.42 while for the B-52 they were 1.28 and 2.33. B-1 mishaps have been caused by a variety of factors, including engine fires, electronics systems malfunctions, electronic warfare systems, onboard electric generators, and landing gear/hydraulics systems.[92] In December 2001, a B-1 supporting Operation Enduring Freedom in Iraq crashed into the Indian Ocean. The four-member crew ejected and was rescued, but the plane was destroyed. The Air Force has not determined the cause of the crash.[93]

Mishap Costs. Based upon the Air Force definition of class A and class B mishaps, it is estimated that over the past 18 years, B-1B mishaps have cost between $18,300,000 and $41,200,000 (13 class A, 26 class B). The former is a conservative

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[87] Darren Heusel. "Maintainers Overcome Challenges To Keep B-1Bs Flying." *Air Force News Archive*. March 29, 2002.

[88] Lance M. Bacon, "Back in the Big Game," *Air Force Times*, June 16, 2003.

[89] Bruce Rolfsen. "The B-52's 5-0: The Stratofortress Cuts A Wide Swath - And May See Another 40 Years Of Service." *Air Force Times*. April 15, 2002, p. 14.

[90] Lance M. Bacon, "Back in the Big Game," *Air Force Times*, June 16, 2003.

[91] Data from "B-1 Flight Mishap History," available on the Air Force Safety Center website at http://afsafety.af.mil/AFSC/RDBMS/Flight/stats/aircraft_stats.html. The mishap rate is the number of accidents per 100,000 flight hours. A mishap is Class A if 1) the aircraft is destroyed or missing, 2) a fatality or an injury resulting in a permanent disability occurs, or 3) total damage exceeds $1 million. A mishap is Class B if 1) an injury results in partial disability, 2) five or more personnel are hospitalized, or 3) if total damage is between $200,000 and $1 million.

[92] Associated Press. "Engine Flames Out On B-1 Bomber After Takeoff, Sparks Grass Fires" *Fort Worth Star Telegram*. March 9, 2000. Lori Lessner. "B1 Battle Takes Off: Kansans In Congress Battle Those Who Say The Plane Is Not Worth Its Cost." *Wichita Eagle*. July 2, 2001. David Atkinson. "B-1s Provided Needed Long-Range Muscle In Air War." *Defense Daily*. June 25, 1999, vol. 202, n. 61. "B-1B Has The Highest Mishap Rate Of Bomber Fleet, According To Air Force Documents." *Aerospace Daily*. December 13, 2001.

[93] "B-1B Crash Cause Remains Unknown," *Today's Air Force News*, September 24, 2002.

estimate that does not reflect the fact that class A mishaps can cost much more than $1 million.[94]

Recent Operations

Operation Desert Storm (Iraq). B-1Bs did not participate in Operation Desert Storm because these aircraft were still not certified to employ conventional weapons.[95] Consequently, funding for the B-1 conversion to conventional munitions began in FY1992.

Operation Desert Fox (Iraq). The B-1B flew its first combat mission during Operation Desert Fox in 1998. Operating out of bases in Bahrain, three B-1Bs flew four sorties and attacked three targets.[96] They flew with fighter escorts because they were operating without the ALE-50 towed decoy.

Operation Allied Force (Kosovo). The B-1 saw more action in the air war over Serbia in 1999. Six block D B-1Bs flew 25 sorties each — 300 total — during the campaign. The B-1Bs were based in Fairford, England, and needed seven hours for each trip to Kosovo and back. Ground crews rearmed and refueled the B-1s in four hours, enabling numerous sorties.[97] The planes used 500 lb. Mk-82 gravity munitions and cluster bombs. The six B-1Bs had the ability to deliver precision munitions, but because of small inventory of those weapons, they employed only "dumb bombs." B-1s in this conflict experienced problems with retained stores: bombs stuck in the weapons bay.[98]

Operation Enduring Freedom (Afghanistan). The B-1 appears to have been a major contributor to the air campaign in Afghanistan. Some have called the B-1 the "workhorse" of the conflict because it flew just 5% of the sorties, but dropped 40% of the ordnance and 70% of the JDAM guided bombs.[99] Eight B-1Bs were based at Diego Garcia, and flew up to four sorties per day. Operation Enduring

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[94] Air Force Program Acquisition Cost Summary. Selected Acquisition Report (SAR) Summary Table. December 31, 1992. See also CRS Report RL31571, "Military Aviation Safety," by Christopher Bolkcom.

[95] General Richard E. Hawley, USAF-Ret. "Swinging The Air Power Pendulum: The Case For Returning To A Bomber-Centric Attack Force." *Strategic Review*, p. 41. Spring 2001.

[96] "Beginning with the second night of bombings, the team provided the 28th Air Expeditionary Group with satellite imagery for B-1B pre-strike mission planning, and post-strike bomb damage assessment analysis. Prior to take-off, B-1B flight crews familiarized themselves with targeting updates, near real-time intelligence to enhance situational awareness, and threat avoidance information, courtesy of the Space Support Teams." *Air Force Space Command News Service*. January 5, 1999.

[97] David Atkinson. "B-1s Provided Needed Long-Range Muscle In Air War." *Defense Daily*. June 25, 1999, vol. 202, n. 61.

[98] Frank Wolfe. "AF Trying To Fix Retained Weapons Problem On B-1." *Defense Daily*. March 1, 2000, vol. 205, No. 39.

[99] Thomas Hargrove, "Oft-Debated Bomber Gets Shot At Saddam," *Scripps Howard News Source*, April 8, 2003.

Freedom marks the first time the B-1 employed the JDAM (24 2,000 lb. JDAMs per aircraft).

In Enduring Freedom, the B-1B first demonstrated several of the qualities that supporters say validates the plane. In addition to delivering a large proportion of the total ordinance dropped, B-1Bs took advantage of their long range by loitering over battlefields waiting for target information from special forces operatives on the ground. In another first for the B-1, the plane provided close air support to ground forces; precision bombs enabled the high-flying bomber to hit targets close to allied troops, something previously done only by lower-flying attack and fighter aircraft. B-1 advocates have cited Pentagon data suggesting that the B-1Bs was the most cost-efficient platform per target killed, but the Pentagon has not publicly compared the cost per kill statistic of various aircraft.[100]

Operation Iraqi Freedom. The B-1 took on an even larger role in Iraq. Eleven B-1s stationed in Oman conducted 225 sorties (six to seven daily) or roughly one percent of all combat sorties flown, yet they dropped 24% of the overall weapon tonnage and nearly half of the total number of precision guided JDAMs dropped by allied aircraft.[101] Again commanders took advantage of the B-1B's large payload and ability to loiter over battlefields for more than 10 and a half hours and attack targets immediately as they were identified. On April 7, 2003, a B-1 flying near Baghdad diverted from its planned mission to drop four JDAMs on a building where intelligence said Saddam Hussein might be hiding. The plane dropped the bombs 12 minutes after receiving target coordinates, and afterwards completed its original mission, destroying 17 additional targets.[102] According to one report, the B-1 was in such demand that CENTCOM air component commander Lt. Gen. Michael Moseley personally managed its scheduling.[103]

Costs

Because considerable controversy surrounded the B-1, Congress required, and the President delivered , a formal certification that the entire program would not cost more than $20.5 billion (FY1981 dollars). Some attributed the numerous problems later associated with the B-1 program at least partly to the cap. The total program acquisition cost (current DOD estimate) is $30.88 billion (FY1981 dollars) for a unit

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[100] Peter Pae. "Maligned B-1 Bomber Now Proving Its Worth: Military: Plane's Successes In War Have Quieted Critics In Pentagon — For Now." *Los Angeles Times*. December 12, 2001.

[101] Lance M. Bacon, "Back in the Big Game," *Air Force Times*, June 16, 2003; David A. Fulghum and Robert Wall, "Baghdad Confidential," *Aviation Week*, April 28, 2003; Tara Copp, "House Oks Reviving 23 B-1s," *Abilene Reporter-News*, July 11, 2003.

[102] Hunter Keeter, "B-1 Drops 2,000 Pound JDAMs In 'Iraqi Leadership' Strike," *Defense Daily*, April 9, 2003.

[103] David A. Fulghum and Robert Wall, "Baghdad Confidential," *Aviation Week*, April 28, 2003.

cost of $225 million (FY1981 dollars). Appropriations for the B-1A program, between FY1965 and FY1981 were $4.2 billion.[104]

Table 5. B-1B Appropriations, by Year

($ Million Then-year)

Year	RDT&E	Procurement	Quantity	Milcon	Total
FY1981	260				260
FY1982	292	1,801	1		2,093
FY1983	754	3,868	7		4,622
FY1984	750	5,572	10	6	6,328
FY1985	465	7,071	34	96	7,632
FY1986	265	4,914	48	211	5,390
FY1987	119			50	169
FY1988	376			1	377
FY1989	222	24		7	253
FY1990		51			51
FY1991		91			91
FY1992	2	160			162
FY1993	86	213			299
FY1994	49	192			241
FY1995	74	180			254
FY1996	202	125			327
FY1997	218	150			368
FY1998	221	125			346
FY1999	195	92			287
FY2000	179	127			306
FY2001	158	49			207
FY2002	152	38			190
FY2003	161	106			267
Total	5,200	25,049	100	371	30,620

[104] The B-1A program was the original design that was cancelled in 1977 by President Carter. When President Reagan revived the B-1 in 1981, the original design was modified and designated the B-1B.

FY2004 Developments.

Administration's Request. The Administration requested a total of $181 million to continue B-1B modernization. It requested $92 million for procurement and $89 million for RDT&E.

Authorization. The House Armed Services Committee (HR1588) added $20.3 million to the Administration's procurement request to begin the regeneration of 23 of the 33 aircraft retired under the consolidation plan. Total procurement funding totaled $111.9 million, while RDT&E authorization matched the Administration's request at $89 million. The Senate Armed Services committee (S1050) authorized $92 million for procurement and $89 million for RDT&E, matching the Administration's request.

Appropriation. The House Appropriations Committee (HR2658) added $20.3 million to the Administration's request to revive 23 B-1s that had been slated for retirement. The Committee also reduced procurement for the Wind Corrected Munitions Dispenser system by half, or $15 million, citing technical problems that must be fixed before procurement of the system continues. Procurement appropriations totaled $96.9 million, a net increase of $5.3 million. The House Committee did not alter the RDT&E request. The Senate Appropriations Committee (S1382) did not add funding to reinstate retired aircraft. Instead, the committee reduced procurement by $15 million from the Administration's request, for a total of $77 million. The Senate Appropriations Committee did not change the Administrations request for RDT&E.

B-2A Spirit

Overview

The B-2 was designed to strike well-protected targets deep in Soviet territory with nuclear weapons. Because of its stealth technology, the B-2 can avoid detection by enemy radar and attack targets without escort or U.S. air superiority. During the 1990s, the Air Force adapted the plane for non-nuclear bombing missions, taking advantage of its long range, large payload, and stealth. Today it can carry 16 independently targeted 2,000 lb. JDAM precision guided bombs, eight massive 4,700 lb. "Bunker Busters," or a variety of other weapons.

The B-2 is slower and has a smaller payload than the other bombers, but its role is different because of its stealth. It is the only bomber capable of operating in well-defended airspace and is intended for early strikes in a conflict. The B-2, along with the F/A-22, is the centerpiece of the Air Force's "Global Strike Task Force" concept, which is designed to attack "anti-access" targets in future conflicts, opening the way for follow-on platforms like the Joint Strike Fighter and the other bombers.[105]

Figure 4. B-2 Spirit

Source: USAF Photo by MSgt. Rose Reynolds

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[105] Representative Norm Dicks *in* Marty Kauchak. "Focus on OEF's Air Campaign: Funding, New Doctrine Needed To Continue Air Campaign's Legacy." *Armed Forces Journal International*. March 2002, p. 20, and John A. Tirpak. "Air Force Leaders Report On The State Of The Force." *Air Force Magazine*. April 2001, p. 28.

Funding in FY1993 enabled the purchase of 20 aircraft. Subsequent funding has upgraded the B-2's capabilities as a conventional bomber. In 1996, the Air Force enlarged the fleet to 21 by adding an existing test aircraft to its force. Sixteen B-2s are combat coded, and the entire fleet is based at Whiteman AFB, Missouri, with the 509th Bomb Wing.

Program Status

New Production. Advocates want the Air Force to order more B-2s to enlarge the fleet. Initially, the Air Force ordered 165 aircraft, but the end of the Cold War and enormous cost increases led the Air Force to reduce the number to just 21. Proponents in Congress and at Northrop Grumman, the lead contractor, contend that a new version of the B-2 would be far less expensive than the original. Northrop Grumman has twice provided the Air Force (1995 and 2001) with unsolicited proposals to reopen the production line. The most recent projected a unit price of $500 million for 40 new aircraft, compared to more than $2 billion each for the original planes. Northrop Grumman officials say they can substantially reduce costs for a modified version of the B-2, dubbed the B-2C, by eliminating the expensive electronic hardening which protects against nuclear blast and by using "off-the-shelf" electronics rather than custom designed systems. Maintenance, parts, training, and support for the B-2C could raise the price to nearly $735 million each for a total bill of $29.4 billion for the 40 aircraft.[106]

Senior Air Force and DOD officials have publicly expressed opposition to restarting the B-2 line.[107] Some suggest that DOD's lack of interest in the B-2 may be caused by concern that it would conflict with funding other procurement programs, such as the F/A-22 Raptor.

Other Air Force officials have called for a larger B-2 force and suggest replacing B-1Bs and B-52s with an additional 60 to 80 Stealth Bombers.[108] They contend that B-1Bs and B-52s are low-threat environment aircraft, unable to address the full spectrum of bombing missions. The B-52's cruise missile launching capabilities, they say, could be taken on by Navy ships and submarines.[109]

Some members of Congress have voiced support for building more B-2s: Representative Ike Skelton and Senator Jeff Sessions have said that the B-2 is the

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[106] Air Force and Pentagon estimate, *Defense Daily*, June 4, 2001.The current 21 B-2s have cost the Air Force a total of $44.4 billion for development and procurement.

[107] Jim Skeen. "Defense Exec Advises Against B-2 Restart." *Los Angeles Daily News*. January 31, 2002.

[108] "Battle Over New, Stealthy B-2s Brews Between Roche And Capitol Hill." *Inside the Air Force*. October 26, 2001." Air Force General Hopes QDR Will 'Pay Attention' To Arguments For More B-2s." *Aerospace Daily*. June 28, 2001.

[109] Adam J. Hebert. "Former ACC Chief Says USAF Should Move To Larger, All-B-2 Bomber Fleet." *Inside Defense*. October 17, 2001.

most advanced bomber aircraft in the force and stressed the need for more.[110] In October 2001, Representative Norman Dicks advocated building 10 or 20 more to enable more strikes early on in future conflicts.[111] More recently, Representatives Duncan Hunter and Howard McKeon stated that the B-2 is the kind of technology the United States need to support and advocated production of the cheaper version.[112] Supporters argue that building more B-2s would send a clear message to potential enemies that the United States was serious about maintaining a long range strike capability.[113] However, history may not be on the B-2's side in regard to restarting production. The Air Force has re-opened only two assembly lines: the U-2 surveillance aircraft and the C-5 heavy air lifter.

Forward Deployment. The B-2's radar-absorbing skin must be serviced under controlled environmental conditions in special hangars. The Air Force does not have any permanent hangars for the B-2 overseas. New deployable shelters, however, enable the Air Force to station B-2s much closer to conflicts, reducing flight times and increasing the number of sorties each plane can fly. Previously, all B-2 combat missions began and ended at Whiteman Air Force Base in Missouri, requiring extremely long sorties to reach far-away conflicts. During the conflict in Afghanistan, for example, B-2s had to fly sorties in excess of 40 hours to reach their targets and return home.

With the new deployable shelters, the Air Force can set up a temporary B-2 base in about one month. However, it appears that the Air Force intends to use the shelters to set up semi-permanent bases at Fairford Royal Air Force Base in England and on the Indian Ocean island of Diego Garcia.[114] Some have speculated that the Air Force may also station B-2s on Guam in the Pacific. B-2s conducting missions against Iraq during Operation Iraqi Freedom were the first to use the shelters for combat missions, flying from Diego Garcia. The hangars cost $2.5 million each and the Air Force currently has five, each capable of housing one B-2 at a time.[115]

Modernization

Radar Upgrade. An upgrade to the Raytheon APQ-181 radar is intended to improve the B-2's bombing accuracy and prevent possible interference when the spectrum used by the plane's current radar becomes available to commercial users.

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[110] Andy Pasztor and Anne Marie Squeo. "Northrop's B-2 Stealth Bomber Re-Emerges As Focus Of Pentagon's Battles Over Budget." *Wall Street Journal*. October 24, 2001.

[111] Jonathan M. Block. "Battle Over New, Stealthy B-2s Brews Between Roche And Capitol Hill." *Inside the Air Force*. October 26, 2001

[112] Jim Skeen, "Politician Pushes B2s," *Los Angeles Daily News*, June 2, 2003.

[113] Nick Johnson. "Additional B-2 Bomber Acquisition Unlikely To Fly, Analysts Say." *Aerospace Daily*. June 15, 2001.

[114] Michael Sirak. "USA Establishing Forward Deployment Capability For B-2", *Jane's Defence Weekly*. September 19, 2001.

[115] Bill Kaczor, "Portable Shelters Bolster B-2's Mobility," *Air Force Times*, February 24, 2003.

Unless resolved, conflict with commercial users could begin in 2007, according to a recent Defense Information Systems Agency's Spectrum Center study.[116]

After considering several options to resolve frequency spectrum conflicts, the Air Force chose to add new components to the existing radar rather than simply modify the existing radar or develop an entirely new system. This hybrid option incorporates Raytheon's Active Electronically Scanned Array (AESA) antenna to the front end of the existing radar.[117] According to Air Force officials, it will provide the "greatest bang for the buck,"[118] increasing performance by 40% in addition to resolving the spectrum conflict, an official at Northrop Grumman said.[119] The Air Force plans to complete installation of the hybrid on all 21 B-2s within eight years. Six aircraft would be upgraded initially to ensure at least part of the fleet will be ready before the 2007 deadline. The upgrade is projected to cost roughly $1 billion.[120]

Link 16 and Beyond the Line of Sight (BLOS) Communications Programs. The Air Force is planning to upgrade the B-2 with the Link 16 jam resistant data link to improve communications and enable B-2 crews to change targets in-flight more effectively. Further, the Air Force intends to add satellite receivers to the B-2 to enable the plane to communicate when out of range of its current systems. The Link 16 upgrade should be completed in FY2006. DOD requested $59 million for the program for FY2004. Congress has supported improving the B-2's retargeting capabilities in general, and implementing Link 16 specifically. In June 2001, Senator James Inhofe pushed for the Link 16 upgrade after DOD did not request funding.[121] The House authorized $104.1 million for continuing upgrades, adding $32 million to the Administration's request through an amendment by Representative Howard McKeon.[122] For FY2004, the House Armed Services Committee added $30 million to the Administration's request to accelerate the satellite receivers.

Alternate High Frequency Material. Alternate High Frequency Material is hoped to enhance the stealth of the B-2, while reducing maintenance. This new material will be applied to each aircraft as it undergoes annual depot maintenance in the next six years. The first aircraft with this new coating should be ready in 2003.

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[116] Frank Wolfe and John Robinson. "Air Force Negotiating With Industry On Possible Contract To Modify B-2 Radar." *Defense Daily*. June 5, 2002, vol. 214, Issue 47.

[117] Sharon Weinberger. "Air Force to Spend $1 Billion on B-2 Upgrade." *Aerospace Daily*. August 12, 2002.

[118] Laura M. Colarusso and Amy Butler, "Air Force Seeks Acquisition Authority for B-2 Upgrade Effort," *Inside the Air Force*, October 4, 2002.

[119] Michael Sirak, "USAF In B-2A Radar Upgrade Dilemma," *Jane's Defense Weekly*, August 14, 2002.

[120] Ibid.

[121] Lee Ewing and Marc Selinger. "Representative McKeon calls for restarting B-2 line, buying 40 more." *Aerospace Daily*. July 2, 2001.

[122] Ibid.

The Air Force expects that three aircraft will be modified each year (during their scheduled maintenance), with a completion for all by FY09.

Weapons Upgrades. Several modifications are being pursued or considered to increase the B-2's payload capabilities. The Smart Bomb Release Assembly (SBRA) will enable the B-2 to carry 80 500 lb. JDAMs instead of the 16 2,000 lb JDAMs currently employed. The SBRA upgrade began in May 2003 and should be completed in mid-2004. Estimated costs are $31.7 million.[123]

Plans have also been drawn to equip the B-2 with the Small Diameter Bomb (SDB). Although the precision 250-pound SDB is still in development, the Air Force hopes to equip all B-2s with the weapon by FY04. The Air Force estimates that the B-2 could carry between 320 to 360 independently targeted SDBs.[124] In addition, two unused bays on the B-2 (called the LIB-28 bays) are being evaluated to carry either additional weapons or jamming devices. Additional weapons could improve weapons flexibility, while jamming equipment may increase the B-2's survivability or enable new missions.

Readiness

Mission Capable Rate. The mission capable rate for the B-2 fleet is low compared to many other aircraft in the Air Force inventory. The B-2's MCR was 42.2% in 1999 and only 37% in 2000. As noted by DOD's Office of Operational Testing and Evaluation, these rates are far below the service requirement of 60%. The B-2's MCR dropped even lower in 2001, to 31%, which is about half the MCR of the B-1B.[125] More recently, in June of 2002, the B-2's MCR rose to 42%.[126] The Air Force reported a B-2 MCR of 85% during Operation Iraqi Freedom, however, MCRs are typically much higher during wartime.[127]

The B-2's low MCR may be tied to maintaining the aircraft's stealthy features. Due to treatment needed to keep the aircraft stealthy, the maintenance time spent between B-2 flights is longer than that of other aircraft. Air Force officials contend the MCR would be as high as 80% without the low-observability requirements.[128]

Maintenance. The radar-absorbing materials (RAM) used to coat the wings and fuselage have to be applied after each mission. The time needed to "cure" these

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[123] "Northrop Grumman to Produce Smart Rack for B-2," *Defense Week*, May 12, 2003.

[124] Testimony of Secretary of the Air Force James Roche before the House Armed Services Committee. "U.S. Representative Duncan Hunter (R-CA) Holds Hearing on FY2004 Defense Authorization: Day 2 ," FDCH Political Transcripts, February 27, 2003.

[125] Director for Operational Testing and Evaluation. 2002 Report to Congress.

[126] Elaine Grossman. "Northrop Pitches Concept To Ready 16 B-2s For Stunning Attack On Iraq." *Inside the Pentagon*. July 25, 2002.

[127] Lt. Gen. T. Michael Moseley, "Operation Iraqi Freedom — By the Numbers," Assessment and Analysis Division, April 30, 2003, p. 10.

[128] Grossman, op. cit.

materials keeps B-2s in depot and off the flight line. A March 2001 report from DOD's Director of Operational Testing and Evaluation indicated that each hour of flight typically requires 52 to 70 hours of maintenance, of which 20.8 hours are for low-observability coating and treatment.[129] Some hope that this time will be significantly reduced with a spray-on RAM, the Alternative High Frequency Material (AHFM) that Northrop Grumman finished testing in October 2000. Not all aircraft surfaces can be treated with this spray, but it is expected that the B-2's maintenance time will decrease sharply, from 20.8 to 9.2 hour per flying hour. The upgrade will improve the MCR by 8%, according to the B-2 program office deputy director at Tinker AFB.[130]

Spare Parts. Another issue that presents risks of lowering B-2 readiness is an expected engine parts shortage that could begin as early as 2005. The B-2 uses analog engine controllers, which are projected to be scarce in four years at the rate they are currently being replaced. Advances in digital technology will likely make it harder to find suppliers for analog engine hardware. DOD suggests replacing the B-2's analog engine controller with a digital model. In addition to alleviating a spare parts shortage, switching to a digital engine controller may also provide better airspeed control.[131]

Cracks. Cracks appeared in the aft deck of several B-2s in 1990 but were fixed, at a cost of $200 million, after a change in the design of the aircraft. A second series of cracks, located on titanium plates behind the jet engine's exhaust, appeared in 2000 on 16 of the 21 B-2s.[132] The cause of these cracks is being reviewed. Both the Air Force Combat Command and Northrop Grumman are working on a fix, and at this stage it is difficult to predict how much these cracks will cost to repair. In its FY2004 appropriations bill, the House Armed Services Committee added $27 million to DOD's budget request for repairing the cracks.[133] According to Northrop Grumman, the money in the appropriations bill would go toward a permanent solution to the problem.[134]

The cracks range from one inch to as long as nine inches, but according to Air Force officials, they do not represent a threat to stealth capabilities, mission

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[129] James Dao. "Stealth Bomber, Once Scorned, Gains Fresh Backing." *New York Times*. June 26, 2001, and Tony Carpaccio. "Northrop's B-2 Needs Excessive' Maintenance To Keep Flying." *Bloomberg.com*. March 4, 2001.

[130] The B-2 system program office is currently developing a robotics system to apply the new radar absorbing material faster and cheaper than by human labor. The first application on a combat coded aircraft will be made this Fall at Palmdale AFB, California.

[131] Marc Selinger. "Engine Parts Shortages Could Begin to Ground B-2s in 2005, Report Says." *Aerospace Daily*. July 24, 2001.

[132] James Dao. "16 Of 21 B-2's Have Cracks Near Exhaust, Officials Say." *New York Times*. March 20, 2002.

[133] House Armed Services Committee, "National Defense Authorization Act for FY2004," H.Rept. 108-106 (H.R. 1588), p. 95-96.

[134] Hampton Stephens, "Feinstein Pushes for Funds to Fix Cracks in B-2's Stealthy Skin," *Inside the Air Force*, July 11, 2003.

readiness, or flight safety. Still, the Air Force is keeping a close watch on these cracks: aircraft with cracks are examined at the end of every flight day, and those aircraft without cracks every 200 flight hours. The Air Force is concerned that the cracks may expand to the point of affecting the B-2's stealth if not fixed. It appears that fuselage cracking may not be unique to the B-2. Other aircraft have experienced similar cracks, including the F-22, the F-117, and the C-130.[135]

Recent Operations

Operation Allied Force (Kosovo). The B-2 made its operational debut in Kosovo. Beginning March 24, 1999, six B-2s flew combat sorties during the NATO-led air strikes. All B-2 sorties were flown 31-hours round trip, non-stop from Whiteman AFB, Missouri, to Yugoslavia. The 50 B-2 strike sorties accounted for approximately 1% of total sorties flown during the Operation, while releasing 11% of total U.S. Air Force precision weapons, which destroyed 90% of the targets they attacked.[136] The bomber employed GPS guided munitions including 651 2,000 lb. JDAMs and GBU-37. The B-2s reportedly flew without support aircraft for some sorties.

Operation Enduring Freedom (Afghanistan). Six B-2s took part in the conflict, flying from Missouri for missions over Afghanistan beginning October 5, 2001. They were the first bombers deployed in the conflict. B-1Bs and B-52s were employed once enemy air defenses were destroyed and low observability was less important. As in Operation Allied Force, the B-2s were able to deliver 16 JDAMs per mission and demonstrated great accuracy.[137] Crew fatigue was an important consideration for such long missions. After attacking targets in Afghanistan, B-2s stopped at Diego Garcia in the Indian Ocean. With the engines still running, they changed crews, refueled, and flew back to Missouri. The whole trip took six aerial refuelings.

Operation Iraqi Freedom. Four B-2s stationed on Diego Garcia flew 49 sorties during OIF. It was the first time that B-2s have been stationed overseas, using the new deployable shelters. The Air Force has not released detailed information about the activities of the B-2 during the conflict, but did praise the aircraft's ability to carry the 4,700 lb. "bunker buster" guided bomb.

Costs

Unlike the B-1, the B-2 program was not limited by a price cap. Costs for the stealth bomber grew even as planned production shrank. In 1978, planners called for 165 B-2s at a total cost of $36 billion ($218 million each, FY1980 dollars). In early 1986, the Air Force reduced its order to 132 B-2s for a total cost of $58.2 billion

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[135] Ibid.

[136] Vernon Loeb. "From U.S., Bat-Winged B-2 Strikes At Taliban Bomber Aloft for Days In Long-Distance Run." *Washington Post*. October 20, 2001.

[137] Martin Fletcher. "All in a day's work for long distance stealth warriors." *London Times*. October 12, 2001.

($440 million each). By 1991, production was cut to 75 at a total cost of $64.8 billion ($863 million each), and in 1993, the final purchase of 20 B-2s was totaled $44.5 billion ($2.2 billion per plane).

Some argue that this aircraft is not only expensive to purchase, but also to maintain, requiring a workforce of 1,000 mechanics for its 16 combat ready aircraft. Others argue that the B-2 actually costs less than conventional aircraft because, thanks to its stealthy features, it can deliver an enormous payload without escort or air superiority. If one compares the cost of a conventional, multi-plane strike package to a B-2 strike package, the "value of stealth" becomes apparent, advocates argue.[138] However, opponents point out that the B-2 is usually escorted by stand-off jamming aircraft.

The B-2's program Acquisition Cost (current Air Force estimate) was $44.5 billion for 21 B-2s (then-year $), with a unit cost of $2.12 billion (then-year $).[139]

Table 6. B-2 Appropriations, by Year

($ Millions, Then-year)

Year	RDT&E	Procurement	Quantity	Military Construction	Total
FY1988 and prior	13,220	3,810	5	102	17,132
FY1989	2,176	3,037	3	80	5,293
FY1990	1,881	2,087	2	111	4,079
FY1991	1,751	2,349	3	104	4,204
FY1992	1,563	2,800	2		4,363
FY1993	1,261	2,687			3,948
FY1994	790	572			1,362
FY1995 [a]	389	405			794
FY1996	790	624			1,414
FY1997	624	97			721
FY1998	356	345			701
FY1999	131	240			371
FY2000	302	115			417
FY2001	130	25			155
FY2002	219	23			242
FY2003	265	104			369
Total	25,807	19,290	15 [b]	397	45,565

[138] For a graphical depiction of what B-2 advocates call the value of stealth, see CRS Report RL30639, *Electronic Warfare: EA-6B Modernization and Related Issues for Congress*.

[139] Richard Aboulafia. "World Military & Civil Aircraft Briefing." *Teal Group Briefing Book Series*. January 2001.

a. Congress also appropriated $125 million for the "Bomber Industrial Base," to keep open the possibility of acquiring additional B-2s for one year.

b. Six flight-test aircraft funded through R&D appropriations have been retrofitted, using appropriated R&D funds, to join the operational B-2 fleet — yielding a total of 21 operational aircraft.

FY2004 Developments

Administration's Request. The Administration requested $76 million for procurement and $152 million for research and development.

Authorization. The House Armed Services Committee (HR1588) recommended $128 million for procurement and $186 million for research and development. The Committee moved $25 million from R&D to procurement per an Air Force request, and added $27 million to repair cracks in the aft deck. The committee added $4 million to R&D for research into the aft-deck cracks, and $30 million to accelerate research into the B-2 satellite communications link. The Senate Armed Services committee (S1050) also moved the $25 million from R&D to procurement for a total of $101 million. Research and Development was reduced to $127 million. The Senate committee made no other changes to the Administration's request.

Appropriation. The House Appropriations Committee (HR2658) added $27.1 million to the procurement request to repair aft-deck cracks and moved $25 million from RDT&E to procurement. Overall, procurement funding for the B-2 was increased by $51.8 million over the request. In terms of RDT&E, the Committee added $30 million for the B-2's satellite communications link and $4 million for research related to the cracks. RDT&E appropriations totaled $160.9 million, $8.8 million more than requested. The Senate Appropriations Committee (S1383) reduced the procurement request by $5 million, for a total of $71 million. They did not change the Administration's request for RDT&E.