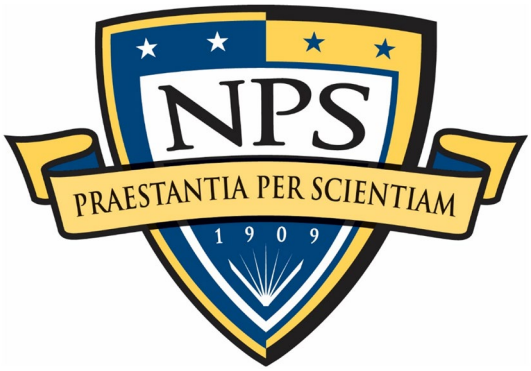

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DISSERTATION

**THE BOMBER WILL ALWAYS GET THROUGH:
THE ORIGIN OF THE B-21 STEALTH BOMBER**

by

Adam B. Young

June 2022

Dissertation Supervisor: Daniel J. Moran

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13. ABSTRACT (maximum 200 words)

The aim of this dissertation is to explain why and how the United States decided to build the B-21 stealth bomber. The B-21 Raider is the most recent endeavor to find a worthy successor (though not, strictly speaking, a replacement) for the B-52 Stratofortress. The B-21's immediate predecessor, the B-2 Spirit, was conceived over forty years ago with the same purpose in mind. Understanding why and how the B-2 came to life, and how and why it fell far short of its intended production goal, offers insights into its successor, the B-21. By conducting a comparative analysis of the B-2 and the B-21 via the four dominant forces found in the defense acquisition literature—bureaucratic politics, technology, politics, and strategic need—it was found that neither program could begin until all of the forces were in alignment. And in the case of the B-2, it was discovered that when those forces fell out of alignment, the program was subsequently terminated. While it cannot be known how successful the B-21 program will be, thus far, the program has exhibited signs of institutional learning from the B-2 program's early demise, which portends it will not suffer the same fate. Given the historical contribution of this study and its associated findings, this research will be of particular interest to defense acquisition professionals, military elites, Congress, scholars, and students of history, among others.

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THE BOMBER WILL ALWAYS GET THROUGH:
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ABSTRACT

The aim of this dissertation is to explain why and how the United States decided to build the B-21 stealth bomber. The B-21 Raider is the most recent endeavor to find a worthy successor (though not, strictly speaking, a replacement) for the B-52 Stratofortress. The B-21's immediate predecessor, the B-2 Spirit, was conceived over forty years ago with the same purpose in mind. Understanding why and how the B-2 came to life, and how and why it fell far short of its intended production goal, offers insights into its successor, the B-21. By conducting a comparative analysis of the B-2 and the B-21 via the four dominant forces found in the defense acquisition literature—bureaucratic politics, technology, politics, and strategic need—it was found that neither program could begin until all of the forces were in alignment. And in the case of the B-2, it was discovered that when those forces fell out of alignment, the program was subsequently terminated. While it cannot be known how successful the B-21 program will be, thus far, the program has exhibited signs of institutional learning from the B-2 program's early demise, which portends it will not suffer the same fate. Given the historical contribution of this study and its associated findings, this research will be of particular interest to defense acquisition professionals, military elites, Congress, scholars, and students of history, among others.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAA	Anti-Aircraft Artillery
AAF	Army Air Forces
ACC	Air Combat Command
ACTS	Air Corps Tactical School
AFMC	Air Force Material Command
ALCM	Air Launched Cruise Missile
AoA	Analysis of Alternatives
AMSA	Advanced Manned Strategic Aircraft
APUC	Average Procurement Unit Cost
ARPA	Advanced Research Projects Agency
ASD SOLIC/IC	Assistant Secretary of Defense for Special Operations, Low Intensity Conflict, and Interdependent Capabilities
ASPA	Advanced Strategic Penetrating Aircraft
AT&L	Acquisition, Technology and Logistics
ATB	Advanced Technology Bomber
AWPD	Air War Planning Document
BSAX	Battlefield Aircraft Surveillance eXperimental
CAPE	Cost Analysis and Program Evaluation (formerly PA&E)
CSAF	Chief of Staff of the Air Force
DARPA	Defense Advanced Research Projects Agency
DDR&E	Director of Defense Research and Engineering
DOD	Department of Defense
DSB	Defense Science Board
ECM	Electronic Countermeasures
EMD	Engineering and Manufacturing Development
FEBA	Forward Edge of the Battle Area
FSD	Full Scale Development
FYDP	Future Years Defense Plan
GAO	Government Accountability Office or General Accounting Office
GPS	Global Positioning System

ICBM	Intercontinental Ballistic Missile
IGE	Independent Government Estimate
IOC	Initial Operating Capability
ISR	Intelligence, Surveillance, and Reconnaissance
ITASS	Integrated Target Acquisition and Strike System
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council
KPP	Key Performance Parameter
LRAPP	Long-Range Air Power Panel
LRRDPP	Long Range Research and Development Planning Program
LRS-B	Long-Range Strike-Bomber
LRSA	Long-Range Strike Aircraft
MDA	Milestone Decision Authority
MOP	Massive Ordnance Penetrator
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NGB	Next Generation Bomber
OSD	Office of the Secretary of Defense
PA&E	Program Analysis and Evaluation
PACOM	Pacific Command
PGS	Prompt Global Strike
PMD	Program Management Directive
QDR	Quadrennial Defense Review
R&D	Research and Development
RCO	Rapid Capabilities Office
RCS	Radar Cross Section
RFP	Request for Proposal
SAC	Strategic Air Command
SAM	Surface to Air Missile
SAP	Special Access Program
SAPCO	Special Access Programs Central Office

SAR	Special Access Required
SECAF	Secretary of the Air Force
SPO	System Program Office
STRATCOM	Strategic Command
SWG	Senior Working Group
TAC	Tactical Air Command
TERCOM	Terrain Contour Mapping
TFX	Tactical Fighter Experimental
USD-P	Under Secretary of Defense for Policy
USSBS	United States Strategic Bombing Survey
XST	eXperimental Survivable Testbed

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The African proverb, “It takes a village to raise a child,” echoed in my mind throughout the entire dissertation process. And like a child being guided to adulthood by those in the village around them, I, too, found myself guided and supported to becoming a scholar by the “village” around me.

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I. THE FORCES THAT DRIVE MAJOR DEFENSE ACQUISITIONS

A. INTRODUCTION

This study explains why and how the United States decided to build the B-21 stealth bomber. The B-21 Raider is the most recent attempt to find a worthy successor (though not, strictly speaking, a replacement) for the B-52 Stratofortress, which entered into service in 1955 and remains a mainstay of American airpower to this day. The B-21's immediate predecessor, the B-2 Spirit, was conceived over forty years ago with the same purpose in mind. It first flew in 1989, and remains the world's only operational stealth bomber. Yet its role in the U.S. arsenal has been limited as only a fraction of the planned force made it through production, which has made the bomber the most expensive aircraft in history (~$2B apiece).

The story of the B-2—the way it was envisaged and developed, and the successes and disappointments that have colored its history—provides an important framework for understanding how the B-21 has come to exist. The analysis presented here will accordingly incorporate a comparative case study of these two acquisition programs, whose combined histories have much to teach about what happens when cutting-edge technologies meets the realities of politics, changes in the strategic landscape, and bureaucratic politics.

B. SIGNIFICANCE OF DISSERTATION

Despite the precipitous rise of scholarly literature focused on analyzing defense acquisitions in the late 1960s, scant scholarly attention has been given to the subject in recent years. The most recent, detailed scholarly study into understanding the origins of operationally fielded weapon systems was David Sorenson's *The Politics of Strategic Aircraft Modernization*, was published in 1995.[1] To be sure, scholarly research in the

[1] David S. Sorenson, *The Politics of Strategic Aircraft Modernization* (Westport, Conn: Praeger, 1995). See also: James Perry Stevenson, *The $5 Billion Misunderstanding: The Collapse of the Navy's A-12 Stealth Bomber Program* (Annapolis, MD: Naval Institute Press, 2000). Stevenson also provides a worthy study in this arena, though his study dealt with a system that never became an operational.

security and strategic studies fields have loosely examined defense acquisition programs—including their origins and outcomes—but none have done so with the level of academic rigor that were the hallmark of the early studies.

The ongoing lack of scholarly attention given to modern defense acquisitions has occurred at a time when weapons systems have jumped exponentially in price per unit. Defense acquisition decisions command significant consequence and studies that examine them in detail are sorely needed. Filling the contemporary lacuna in this field—by examining the decision to procure the B-21—is the primary ambition for this study. The examination will also shed light on the level of influence that predecessor programs have on subsequent defense acquisitions—an interaction in which little is presently known.

With an approximately 30-year gap between the genesis of the B-2 and the B-21, this historical comparison will reveal the level of influence that predecessor programs have on its successor. The gap in time between the two programs provides fertile ground to identify if there have been changes in the forces that drive modern weapons system programs. And by examining the B-2 program, a program that was cut far short of its original goal, insights will be gained into what caused its early termination. Such insights can then be used to detect if there are signs of institutional learning present in the B-21 program.

The primary beneficiaries of this study will be leaders across the U.S. Air Force, Defense Department, and national security policy-making apparatus, including members of Congress. Students and scholars in the security and strategic studies fields will also find great utility in this study as it illuminates complex practices in defense acquisitions through a contemporary approach useful to the present day. This study will not only contribute to the historical literature, but it has the potential to serve as a guide to navigate future defense acquisition programs.

C. SUMMARY OF RELEVANT LITERATURE

The conclusion of World War II brought with it a torrent of scholarly interest in military technologies. This is not surprising, given that the deadliest weapon in history—the atomic bomb—was unleashed on mankind and credited with spurring Japan to

surrender. Nevertheless, the atomic bomb was one of many seemingly "game-changing" technological advances (e.g., jet aircraft, advances in cryptography, German V-1 and V2 rockets, etc.) that emerged during the Second World War, which motivated many scholars to understand more on the role of technology in modern warfare. Scholars sought to understand whether superior technology led to victory, how technology differed in use, and what the key drivers were behind successful weapons development programs. Studies also ranged the gamut from the comprehensive in nature—efforts that sought to uncover broad conclusions from analyzing humankind's relationship with military instruments over vast spans of time[2] to the specific—studies where military instruments were singled out as the primary object for investigation.[3] Regardless of the scope of the study, most of the military technological literature advanced two primary conclusions. First, technologically superior weapons alone can achieve victory.[4] And second, social forces—how the weapon was envisaged, developed, and deployed in a social construct—mattered equally as much as the

[2] J. F. C. Fuller, *Armament and History: The Influence of Armament on History from the Dawn of Classical Warfare to the End of the Second World War*, 1st Da Capo Press ed. (New York: Da Capo press, 1998); Ralph Eugene Lapp, *Arms Beyond Doubt: The Tyranny of Weapons Technology*, 1st ed. (New York: Cowles Book Co., 1970.); Bernard Brodie, and Fawn McKay Brodie. *From Crossbow to H-Bomb*, Rev. and enl. ed. (Bloomington: Indiana University Press, 1973); Robert L. O'Connell, *Of Arms and Men: A History of War, Weapons, and Aggression* (New York, NY: Oxford University Press, 1989); Martin L. Van Creveld, *Technology and War: from 2000 B.C. to the Present,* A rev. and expanded ed., 1st Free Press ed.; 1st Free Press paperback ed. (New York: Free Press, 1991); Stephen D. Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, N.J: Princeton University Press, 2004); *inter alia.*

[3] Richard Glenn Head, "Decision-Making on the A-7 Attack Aircraft Program" (PhD diss., Syracuse University, 1971); Harvey M. Sapolsky, *The Polaris System Development; Bureaucratic and Programmatic Success in Government* (Cambridge, Mass: Harvard University Press, 1972), 253.; Edmund Beard, *Developing the ICBM: a Study in Bureaucratic Politics* (New York: Columbia University Press, 1976); Robert J. Art, *The TFX Decision; McNamara and the Military* (Boston: Little, Brown, 1968); Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform* (Princeton, N.J: Princeton University Press, 1977); Lauren H. Holland, and Robert A. Hoover. *The MX Decision: A New Direction in U.S. Weapons Procurement Policy?* (Boulder, Colo: Westview Press, 1985); Nick Kotz, *Wild Blue Yonder: Money, Politics, and the B-1 Bomber*, 1st ed. (New York: Pantheon Books, 1988); W. Blair Haworth, *The Bradley and How It Got That Way: Technology, Institutions, and the Problem of Mechanized Infantry in the United States Army*, Contributions in Military Studies, no. 180. (Westport, Conn: Greenwood Press, 1999); *inter alia*.

[4] This point is debated in the literature and is beyond the scope of this paper to fully address. For more see the sources listed under footnote 1 in addition to: George Raudzens, "War-Winning Weapons: The Measurement of Technological Determinism in Military History." *The Journal of Military History* 54, no. 4 (October 1, 1990): 403–34.; Colin S. Gray, *Weapons for Strategic Effect: How Important Is Technology?* (Maxwell Air Force Base, Ala: Center for Strategy and Technology, Air War College, Air University, 2001); Michael Howard, and John F. Guilmartin, *Two Historians in Technology and War,* (Carlisle Barracks, PA: Strategic Studies Institute, U.S. Army War College, 1994); *inter alia.*

weapon itself.[5] Hence, the literature is replete with studies that sought to not only understand the role of technology in weapons acquisition decisions, but also the sociological and organizational aspects of weaponization.

The vast majority of literature in weapons system studies examine four common causal drivers: bureaucratic politics; technology; politics; and strategic need.[6] As would be expected, not all scholars agree on which driver(s) are most important, but the explanations offer a useful lens to examine weapons acquisition decisions. Each is explored below.

1. Bureaucratic Politics Explanations

Bureaucratic politics explanations figure prominently throughout the defense acquisitions literature.[7] The basic argument in this line of explanation, which leans heavily on the work of Graham Allison and Morton Halperin's *Bureaucratic Politics Model,*[8] contends that weapons system acquisition decisions are driven by the military service's preferences.[9] It is said that each service's preferences are shaped by its parochial interests

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[5] This point is debated in the literature but is beyond the scope of this review. For a useful commentary see Colin S. Gray, *Modern Strategy* (New York: Oxford University Press, 1999).

[6] These drivers were used in Michael E. Brown's *Flying Blind*.

[7] Although the terms "bureaucratic," "bureaucratic politics," "culture," and "organizational culture" have slightly different definitions, they are often used interchangeably throughout the literature. Thus, it makes no substantive difference for Carl Builder to claim that the organizational culture of the Navy created a service doctrine heavily dependent on the employment of capital ships instead of citing bureaucratic politics. All of these terms are closely related and found manifest in service doctrine (or service strategies) and interservice rivalries that—most importantly for the purposes of this study—result in procurement decisions. See Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis*. A Rand Corporation Research Study. (Baltimore: Johns Hopkins University Press, 1989).

[8] Graham Allison, and Morton Halperin. "Bureaucratic Politics: A Paradigm and Some Policy Implications." *World Politics* 24, no. S1 (1972): 40–79. https://doi.org/10.2307/2010559. Examples of studies that structure their analysis using Allison and Halpern's model include Richard Glenn Head, "Decision-Making on the A-7 Attack Aircraft Program" (PhD diss., Syracuse University, 1971); Harvey M. Sapolsky, *The Polaris System Development; Bureaucratic and Programmatic Success in Government* (Cambridge, Mass: Harvard University Press, 1972), 253; Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics (*New York: Columbia University Press, 1976); Robert J. Art, *The TFX Decision; McNamara and the Military* (Boston: Little, Brown, 1968); Lauren H. Holland, and Robert A. Hoover. *The MX Decision: A New Direction in U.S. Weapons Procurement Policy?* (Boulder, Colo: Westview Press, 1985); *inter alia*.

[9] Graham T. Allison, and Frederic A. Morris. "Armaments and Arms Control: Exploring the Determinants of Military Weapons." *Daedalus* (Cambridge, Mass.) 104, no. 3 (July 1, 1975): 125.

and organizational culture. To that end, the services strive for autonomy, preservation of the organization's essence, maintenance of its core missions, and budgetary dominance.[10] Bureaucratic politics scholars find that "the services and their subunits are the primary actors in weapons development" and that "political officials might disturb this process; only rarely do they control it."[11] Due to the weight attributed to the service's preferences in weapons acquisition decisions, scholars have leaned heavily on evaluating service-level doctrine (or service strategy) and interservice rivalry dynamics to analyze bureaucratic politics.

Examination of service-level doctrine is a common approach found in investigating the role of bureaucratic politics in weapons system acquisition decisions. Service-level doctrine is shaped by myriad factors—most notably national strategy, political, and societal forces—though scholars widely accept that service doctrine reveals preferences in tangible ways and is the most important when analyzing weapons acquisition decisions.[12] Set by the services' elites (i.e., the Generals, Admirals, and senior civilians), service doctrine provides a window into what the service values most, and what weapons they are most likely to want.[13] It is argued by some that service doctrine can prove deterministic in weapons acquisition decisions. For example, the Air Force has long held to the doctrine of

[10] Graham T. Allison, *Essence of Decision; Explaining the Cuban Missile Crisis*: (Boston, Little, Brown, 1971) 166.; Allison and Morris. "Armaments and Arms Control: Exploring the Determinants of Military Weapons." 125.

[11] Allison and Morris, "Armaments and Arms Control: Exploring the Determinants of Military Weapons," 123.

[12] For more on military doctrine see Barry R. Posen. *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (New York: Cornell Univ. Press, 1986); Jack L. Snyder, *The Ideology of the Offensive: Military Decision Making and the Disasters of 1914* (New York: Cornell University Press, 1984); Builder, *The Masks of War*. Elizabeth Kier, *Imagining War: French and British Military Doctrine Between the Wars* (Princeton, N.J: Princeton University Press, 1997); Richard Overy. "Doctrine Not Dogma: Lessons From The Past." Royal Air Force Air Power Review, Vol. 3 No. 1, 32–47.; Harald Hoiback. *Understanding Military Doctrine: A Multidisciplinary Approach* (London: Routledge, 2013), https://doi.org/10.4324/9780203559345.

[13] Please note this section is focused on service doctrine and not national military doctrine. While they are related, they are different. The analysis of service doctrine is also useful in that it assumes intraservice competition has been accounted for.

strategic bombardment.[14] Consequently, bomber aircraft have been a major part of the Air Force's funding requests and subsequent procurements. Service doctrine has also been found as causal in cases where the Air Force resisted shifting major portions of their funding to missiles at the expense of manned aircraft. Edmund Beard found that doctrinal determinism proved so dogged in his study of Intercontinental Ballistic Missiles (ICBMs) that despite a clear and present need to diversify nuclear delivery systems, it took years, and ultimately, external forces—most importantly, interservice rivalry dynamics—to force the Air Force to increase funding for its missile forces.[15]

Interservice rivalry is advanced as another lens through which to examine the impact of bureaucratic politics in military acquisition decisions. The argument advanced here is that due to a finite defense budget, each service will compete for the largest share of the pie.[16] Not only does the largest share of the budget help the service acquire the weapons it wants, but budget share percentages are used as a gauge to measure comparative political influence.[17] An example of the worst effects of this rivalry is seen in James P. Stevenson's study of the U.S. Navy's failed effort to procure the A-12 stealth bomber. Rather than originating from a logically assessed strategic need, Stevenson found that the U.S. Navy's prime motivation to develop the A-12 was to gain a larger share of the defense budget.[18] Beard's analysis of the ICBM also found that interservice rivalry—in this case the fear that the Air Force would lose budget share to the other services—was the causal spur needed to get the Air Force to adopt them as a weapon that would complement its bomber force in the mission of nuclear weapons delivery.[19]

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[14] Studies into Air Force weapon systems, notably bomber aircraft, have consistently found doctrinal drivers present. See: Nick Kotz, *Wild Blue Yonder: Money, Politics, and the B-1 Bomber* 1st ed. (New York: Pantheon Books, 1988), 7.; Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program* (Ithaca, N.Y: Cornell University Press, 1992), 310–311.; John Alic. *Trillions for Military Technology: How the Pentagon Innovates and Why It Costs So Much* 1st ed. (New York: Palgrave Macmillan U.S., 2007), 62, https://doi.org/10.1057/9780230606876.

[15] Beard, *Developing the ICBM*, 222.

[16] Alic, *Trillions for Military Technology*, Chapter 6.

[17] Anand Toprani. "Budgets and Strategy: The Enduring Legacy of the Revolt of the Admirals." *Political Science Quarterly* 134, no. 1 (2019): 117–46. https://doi.org/10.1002/polq.12870.

[18] Stevenson, *The $5 Billion Misunderstanding*, 9.

[19] Beard, 222.

2. Technological Explanations

With the march of time comes the progression of new and improved weapons technologies. After all, we are living in an age dominated not by sling shots and spears but by nanotechnology and drones. Accordingly, the defense literature is replete with studies that examine the interaction between weapons and technology. This is especially true when a technology is deemed as a "game-changer" or one that is perceived as critical to victory or defeat. Most notable in these studies is an analysis of what came first. Did the technology appear first, later to give rise to a new weapon such as technological determinism would suggest? Or did the demand—technological opportunism or technological adventurism—for a new weapons system drive the development of a new weapons technology and subsequent acquisition?

While few scholars claim that technological determinism is the most important factor to drive weapons acquisition decisions, some do make the case. Ralph Lapp for example, concluded in his wide-reaching treatise on military technology that humanity is akin to automatons when it comes to new technologies. He claimed that "Whenever a new weapon possibility beckoned, society meekly moved in this direction, without questioning the consequences."[20] In a similar but slightly nuanced view, Matthew Evangelista argued that it is the "scientists and weapons designers" who take "technocratic initiative" to ignite weapons procurement processes.[21] Here he claims that once a technology is created in the laboratory, its creators will cajole their military contacts into seeing the military value that their new technologies can bring.[22] Evangelista cites tactical nuclear weapons and the Star Wars program of the 1980s as evidence of his claim.[23] Paul Kaminski makes a related argument in his analysis of the B-2. As one of the major leaders in low observable technologies in the 1980s, Kaminski argued that the technological invention of stealth

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[20] Lapp, *Arms Beyond Doubt,* 3.

[21] Matthew Evangelista, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies* (Cornell Studies in Security Affairs. Ithaca: Cornell University Press, 1988), 52.

[22] Evangelista, *Innovation and the Arms Race*, 52. To be sure Evangelista does not argue that all weapons programs begin this way, but it is a major thrust of his thesis.

[23] Evangelista*,* 86, 258.

played "almost an equal" role to the perceived strategic need that ultimately led to the procurement of the B-2 bomber.[24]

The technological opportunism camp is made up of those who find evidence where a reasonable survey of the technological landscape made conception of a new weapon system possible. The argument follows that when these two factors align with a strategic need, the birth of a new weapons system is probable. Michael Armacost, for example, found this to be true in his analysis of the development of Intermediate Range Ballistic Missiles.[25] Armacost's analysis showed that after a reasonable survey of technological possibility, the conceptualization of a new weapon to meet an emerging strategic need was viewed as a feasible endeavor.[26] The end result were the Thor and Jupiter missiles.[27] Harvey Sapolsky similarly found these conditions to be present in his analysis of the Polaris missile system where he noted its success was in large part due to "…a convergence between technological opportunity and a widely accepted policy need."[28] Others, such as Ted Greenwood in his study of the development of the Multiple Independently-targetable Reentry Vehicle observed a similar finding.[29]

The last camp, that of technological adventurism, argues that the need for a new weapon drives the pursuit of a technology that is outside of a reasonable assessment of the technological landscape.[30] Michael E. Brown found this to be the case in a number of Air Force strategic bomber programs from the 1940s to the 1980s.[31] In what Brown called

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[24] Paul G. Kaminski, "Low Observables: The Air Force and Stealth," in *Technology and the Air Force: A Retrospective Assessment*, ed. Jacob Neufeld, George M. Watson, Jr., and David Chenoweth (Washington, DC: Air Force History and Museums Program, 1997), 65.

[25] Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy* (New York: Columbia University Press, 1969), 51.

[26] Armacost, *The Politics of Weapons Innovation*, 51.

[27] Armacost, 51.

[28] Harvey M. Sapolsky, T*he Polaris System Development; Bureaucratic and Programmatic Success in Government* (Cambridge, Mass: Harvard University Press, 1972), 253.

[29] Ted Greenwood, *Making the MIRV: A Study of Defense Decision Making* (Cambridge, Mass: Ballinger Pub. Co, 1975), 3, 15.

[30] Brown, *Flying Blind*, 3.

[31] Brown, 3.

"technological adventurism," he found that in the majority of cases, the technological demands went well beyond what was thought technologically feasible.[32] He found that in the cases where that happened, myriad problems subsequently occurred, including program cancelation, unmet expectations, cost overruns, and program delays.[33] Whether technology precedes the conceptualization of a new weapons system or whether a desire for a game changing weapons system—either opportunistic or adventurous—understanding the role of technology is a critical element in the defense acquisitions literature.

3. Political Explanations

Arguments that politicians and the defense industry lobby that supports them are the primary drivers behind defense acquisition decisions is a common theme explored throughout the literature.[34] The basic argument—oftentimes called "pork barrel politics"—is that politicians derive benefit from having defense contracts in their voting districts.[35] And since defense contractors are solely dependent on defense dollars for their survival—a monopsony—they are incentivized sell their wares regardless of whether there is a strategic need.[36] It is argued that over time the defense industry has entrenched its political influence by establishing beachheads in as many states as possible. The more voters' jobs that depend on defense contracts, the more sway it is said that defense contractors will curry in gaining political favor. There are three primary arguments where these so-called pork barrel politics and defense lobby influences are found as causal in defense acquisitions: decline or loss of a strategic threat, cases when voting districts are

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[32] Brown, 3.

[33] Brown, 3.

[34] Art, *The TFX Decision*.; Kotz, *Wild Blue Yonder*; Kurth, "Why We Buy the Weapons We Do." 33–56.; Sorenson, *The Politics of Strategic Aircraft Modernization*.

[35] Ann Markusen and Joel Yudken, *Dismantling the Cold War Economy* (New York: Basic Books, 1992), xv.; and J. Paul Dunne, "The Defense Industrial Base," in Keith Hartley and Todd Sandler, eds., *Handbook of Defense Economics* (Amsterdam: North-Holland, 1995), 409–411, 422.

[36] Markusen and Yudken, *Dismantling the Cold War Economy*, xv.; and Dunne, "The Defense Industrial Base," 409–411, 422.

overly dependent on defense contracts for their economic well-being, and when a defense firm is in financial decline.[37] Each one is explored below.

When a strategic threat decreases or disappears (e.g., the dissolution of the Soviet Union), it is argued that economic and political interests become the primary drivers in defense acquisition decisions.[38] The argument, advanced by scholars Harvey Sapolsky and Eugene Gholz, contends that despite predictable cuts to defense industrial capacity at the conclusion of the Cold War, no such cuts were made.[39] In fact, they found that in the decade following the dissolution of the Soviet Union, "not one Cold War weapon platform line has closed."[40] Sapolsky and Gholz claim the reason for this was due to newly "cemented" military-industrial ties set in place by the defense contractors and congressional representatives.[41] Sapolsky and Gholz do not go into detail on the level of influence pork barrel politics and the defense lobby command when a major threat is present, but their argument implies they would not find causality given that condition.

The second argument advanced finds that pork barrel politics can be a causal force in districts and states where the defense industry is largely responsible for its economic well-being. Scholar Rebecca Thorpe, for example, found this to be true in her study of defense contracts over the period of 1999–2005.[42] Her analysis found a positive correlation for political weapons acquisition support from districts where there was a "disproportionate reliance on local weapons suppliers as a source of employment and revenue"—even in "excess of strategic requirements."[43] Nick Kotz uncovered a similar finding in his case study of the B-1 bomber. Specifically, he found that the political incentives for bringing military bases to states and in the creation or sustainment of defense industry jobs for

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[37] For an excellent overview of these issues see Harvey M. Sapolsky, Eugene Gholz, & Caitlin Talmadge, U.S. *Defense Politics: The Origins of Security Policy* 3rd ed. (Routledge, 2017).

[38] Gholz and Sapolsky, "Restructuring the U.S. Defense Industry*,* 21–22.

[39] Gholz & Sapolsky, 21–22.

[40] Gholz & Sapolsky, 5.

[41] Gholz & Sapolsky, 6.

[42] Rebecca U. Thorpe, *The American Warfare State: The Domestic Politics of Military Spending* (Chicago: The University of Chicago Press, 2014), 115.

[43] Thorpe, *The American Warfare State*, 115.

constituents played "at least as much" a role as did the strategic need in the decision to procure the B-1.[44] In other words, and as Robert J. Art concluded in his study of the Tactical Fighter Experimental (TFX) program, "political lobbying for contracts is one of the prices we pay for geographic representation."[45] Nevertheless, the conditions for when they are causal remains debated.

The last of the pork barrel politics and defense lobby arguments is the contention that when firms are in or projecting to be in financial decline due to a lack of defense contracts, Congress will find a path to keeping the firm solvent. James Kurth advanced two sub-arguments in this camp.[46] First, he found that in analyzing defense contracts over a 15-year period (1960-1975) that there was a consistent stream of follow-on programs initiated when the production of a previous-era weapons system stopped.[47] Labeling this the "follow-on imperative," he found the military's elites and Congress viewed the closing of production lines to be strategically harmful, which subsequently resulted in the award of follow-on contracts.[48] Second, Kurth found that when defense firms were facing financial decline, they were typically saved with new defense contracts.[49] This he called the "Bail-out imperative." [50] As an example of empirical support for Kurth's claims, Tim Weiner argued that the Northrop corporation's poor financial condition and lack of future defense contracts in the late 1970s led to their invitation to build the B-2 stealth bomber.[51]

4. Strategic Explanations

Perhaps the most commonly cited reason for weapons acquisition decisions is credited to strategic need explanations. The argument here is straightforward: weapons

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[44] Kotz, *Wild Blue Yonder*, 234.

[45] Art, *The TFX Decision*, 2.

[46] Kurth, "Why We Buy the Weapons We Do," 33–56.

[47] Kurth, 38–42.

[48] Kurth, 38–42.

[49] Kurth, 43–46.

[50] Kurth, 43–46.

[51] Tim Weiner, *Blank Check: The Pentagon's Black Budget* (New York, NY: Warner Books, 1991), 82–83.

systems are procured in response to a strategic threat or need. At this explanation's core is an understanding that weapons ensure security: the better the weapon, the more security.[52] The literature is saturated with claims that strategic need explanations are the primary driver behind defense acquisitions.[53]

Michael Brown's study, for example, found that the majority of U.S. strategic bomber programs were attributed to strategic explanations.[54] Taking the B-52 for example, Brown found that the Air Force set its performance requirements to outrun high-speed German fighters to carry out its strategic bombing mission.[55] David Sorenson concluded similarly in his study of the B-36, B-52 and B-2 bombers. He claimed that "strategic objectives, operationalized through doctrine, played a more important role in the choice of bombers than did any other factor."[56]

Arms races have also been a dominant theme cited under the strategic need umbrella in the defense literature. Here, it is contended that when a state's elites believe a competitor's military capabilities (offensive or defensive) have improved in quality or increased in quantity, the state responds by developing forces of its own that either replicate or counter the new capability.[57] This is most commonly called the action-reaction

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[52] This is a fundamental argument found in the realist theory of international relations, which assumes the world is in a state of anarchy and the primary goal of a sovereign country is to achieve security. For more see: Edward Hallet Carr, *The Twenty Years' Crisis, 1919–1939* (London: MacMillan and Co., 1939); Thucydides., Robert B. Strassler, Richard Crawley, and Victor Davis Hanson. *The Landmark Thucydides: A Comprehensive Guide to the Peloponnesian War*, A newly rev. ed. of the Richard Crawley transl (New York: Simon & Schuster, 1998).; Robert, Jervis, "Cooperation under the Security Dilemma." World Politics, Vol. 30, No. 2 (January 1978).; John J. Mearsheimer, The Tragedy of Great Power Politics (New York: W.W. Norton & Company, 2014), *inter alia*.

[53] Art, *The TFX Decision*.; Robert F. Coulam, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform* (Princeton, N.J: Princeton University Press, 1977); Brown, *Flying Blind*.; Sorenson, *The Politics of Strategic Aircraft Modernization*; Haworth, *The Bradley and How It Got That Way.*

[54] Brown, 312.

[55] Brown, 125.

[56] Sorenson, 214.

[57] Ronald E. Powaski, *March to Armageddon: The United States and the Nuclear Arms Race, 1939 to the Present* (Oxford University Press, Incorporated, 1989).; Herbert York, *Race to Oblivion* (New York: Simon and Schuster, 1970).; Herz, John H. "Idealist Internationalism and the Security Dilemma." *World Politics* 2, no. 2 (1950): 157–80, doi:10.2307/2009187.; Colin S. Gray, *The Soviet-American Arms Race* (Westmead, Farnborough: Saxon House; and Lexington, Mass: Lexington Books, 1976).

model.[58] A common example of this is found in the nuclear arms race during the Cold War between the U.S. and the Soviet Union.[59]

Robert J. Art also found support for strategic explanations in the genesis of the Tactical Fighter Experimental (TFX) program, but he noted that the strategic need is interpreted through bureaucratically motivated interests.[60] While he blended multiple explanations, his contribution is valuable to understanding that strategic explanations are rarely forthright. In support of this claim, Sapolsky made a similar conclusion: "Conflicting views on defense strategies abound, their number and intensity no doubt influenced by differing perceptions of technological opportunities, but also by differing value orientations, organizational loyalties, and, perhaps most importantly, perceptions of enemy threats."[61] The findings by Art and Sapolsky are important in understanding that the strategic need is far from an objective reality.

D. METHODOLOGY

This dissertation executes a hybrid methodology that combines historical explanatory, evaluative, and process-tracing approaches through the examination of two cases: the B-2 Spirit and the B-21 Raider.[62] The cases are studied via the four dominant defense acquisition forces: bureaucratic politics; technology; politics; and strategic need.[63] The forces explained in this chapter are used as a lens with which to examine the cases. They are not used to force a complex history into neat and tidy bins.

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[58] More on the action-reaction model can be found here: Thee Marek, "The Arms Race, Armaments Dynamics, Military Research and Development, and Disarmament." *Bulletin of Peace Proposals* 9, no. 2 (January 1, 1978): 103–20.; George Rathjens; "The Dynamics of the Arms Race." *Scientific American* 220, no. 4 (1969): 15–25. https://doi.org/10.1038/scientificamerican0469-15.; Barry Buzan, Eric Herring, *The Arms Dynamic in World Politics*. Boulder: Lynne Rienner, 1998. Ch. 6.

[59] Powaski, *March to Armageddon*.

[60] Art, 15–20.

[61] Sapolsky, *The Polaris System Development*, 237.

[62] Stephen Van Evera, *Guide to Methods for Students of Political Science* (Ithaca: Cornell University Press, 1997), 91–92.

[63] The approach this dissertation as selected to employ has been greatly influenced by the studies of Brown, *Flying Blind.;* and Sorenson, *The Politics of Strategic Aircraft Modernization*. In many ways this dissertation is a follow-on study to these two works.

On the role of bureaucratic politics, examination is given to understanding the role it played in the initiation of the B-2 and B-21 programs. The dissertation explores the role who the principal bureaucratic stakeholders were and how powerful their preferences were. Accordingly, it seeks to identify the bureaucratic powers involved and what their role was in starting the B-2 and B-21 programs. The study also seeks to understand whether bureaucratic alignment was achieved and whether alignment was needed.

As the only stealth bombers in existence, the study seeks to understand the role that technology played in the genesis of the B-2 and B-21 programs. Was the pursuit of technological advance unbridled? Or was it metered by other forces, such as economic realities and the impact of other defense programs? Specific attention is given to understanding whether agreement—especially between Congress and the Air Force—was reached on the level of technological pursuit that would be sought. If there was not agreement, efforts are given to understanding the impact that that had.

Finally, understanding the role of the strategic need in both cases is especially important to this study. The examination explores how differing perceptions of the strategic need—most notably, the end of the Cold War and the rise of China—impacted the B-2 and B-21 programs. Great pains are taken to comprehend the impact of the variance or congruence on the perception of the strategic need from the key civilian leadership in the Department of Defense (DOD), the military's top brass, and the Congress.

Finally, decisions to modernize and procure new military capabilities are typically influenced to some degree by the programs that precede them. To that end, empirical analysis of predecessor programs can help illuminate the main forces that were present at the creation of its follow-on program. For example, despite the incredible performance of submarines in the First World War, the Americans, British, and Germans mostly neglected their development in the interwar period.[64]

[64] Holger Herwig. "Innovation Ignored: The submarine problem – Germany, Britain, and the United States, 1919–1939." Murray, Williamson., and Alan R. Millet, *Military Innovation in the Interwar Period* (Cambridge; Cambridge University Press, 1996).

In addition to the use of primary and secondary sources, the study relies heavily on interview research conducted by the author. Interviews were conducted primarily with political and military elites involved in either the B-2 or B-21 programs.

E. OUTLINE OF DISSERTATION

Chapter II provides a fresh look at understanding the historical underpinnings of strategic bombardment doctrine in the Air Force and why the Air Force failed to field a replacement bomber to the B-52 through the late 1970s. Chapter III focuses on the technological advancements that had to be achieved in order to keep the bomber force viable through the Air Force's first stealth programs. Chapter IV conducts a fresh analysis on the origins of the B-2 stealth bomber. With newly available sources and extensive interview research conducted as a part of this study, the B-2 chapter offers new insights on how the B-2 program began and why Northrop was awarded its development contract in 1981. Chapter V then traces the B-2's origin from its development process to the 1992 decision to terminate the program at 21 aircraft. Chapter VI chronicles the fallout from the B-2 curtailment decision and the many efforts to get a new bomber program started, the last of which was the failed Next Generation Bomber (NGB). Chapter VII picks up the story from the 2009 decision by Secretary of Defense Robert Gates to terminate the NGB program and explores how the Defense Secretary's support was finally given to start a new bomber program—what is known today as the B-21. Chapter VIII provides a summary on the origins of the B-2 and B-21 programs and why and how the B-2 program fell far short of its original production goal. The study ends with a list of significant findings that were uncovered in the research.

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II. UNDERSTANDING THE FOUNDATION

This chapter chronicles the foundational underpinnings of the Air Force and the many trials it faced as it sought to develop its arsenal. The chapter pays particular attention to the bedrock importance of strategic bombardment, not only for its role in granting the Air Force its independence, but also in how the Air Force viewed it as its central mission. Born from the ashes of nuclear devastation, the chapter examines the Air Force's relationship with science and technology. Finally, the chapter examines the many attempts to develop a follow-on bomber to the B-52 and how missile technologies repeatedly prevented that effort from materializing.

A. THE DOGMA OF STRATEGIC BOMBING TAKES ROOT

While early traces of the concept of strategic bombing emerged during World War I, it was not until the interwar period that the doctrine became rooted. In World War I, air power was mostly viewed as a means of supporting ground forces. It served as an extension of ground artillery and added reconnaissance capability. In the later stages of the war allied aircraft carried out longer-range bombing missions against German industrial and manufacturing targets, but the war ended before this "strategic" bombing could demonstrate its full potential.[65] It was not until after the war that air-minded men had the opportunity to envision the future of air power, free from the immediate demands of an all-consuming war.

Captivated by the idea that air power could overcome the carnage of the trenches in future conflicts, political and military leaders established the Air Service as a combat arm of the Army, via the National Security Act of 1920.[66] This placed the air service on the same footing as the infantry or calvary. Airmen established the first air power-focused professional schools shortly thereafter. In what ultimately evolved into the Air Corps

[65] Robert Frank Futrell, *Ideas, Concepts, Doctrine Vol. I* (Maxwell AFB, AL: Air University Press, 1989), 26–27.

[66] Robert T. Finney, *History of the Air Corps Tactical School 1920–1940* (Washington, D.C: Air Force History and Museums Program, 1998), v.

Tactical School (ACTS) at what is now called Maxwell Air Force Base in Alabama, the nation's first airmen were free to envision air power in the safety of their own hermitage.

Among the multiple influences that shaped the early thinking on air power, the visions of Brigadier General William "Billy" Mitchell were perhaps the most influential.[67] Mitchell was a master of the written and spoken word. He used these skills to great effect and was highly successful in cementing the ideas of his disciples while changing the minds of unbelievers. Mitchell's works and effort were many, though, his core ideas—especially those that proved foundational to the doctrine of strategic bombing—are best summarized in his testimony before the House Committee on Military Affairs in 1926:

> There has never been anything that has come which has changed war the way the advent of airpower has. The method of prosecuting a war in the old days always was to get at the vital centers of the country in order to paralyze the resistance. That meant the centers of production, the centers of population, the agricultural districts, the animal industry, communications - anything that tended to keep up war. Now, in order to keep the enemy out of that, armies were spread in front of those places and protected them by their flesh and blood. You had mass killings there, sometimes for years before these vital centers were reached. It led to the theory that the hostile army in the field was the main objective, which it was. Once having been conquered, the vital centers would be gotten at.... Now we can get today to these vital centers by airpower.... So that, in the future, we will strike, in case of armed conflict, when all other means of settling disputes have failed, to go straight to the vital centers, the industrial centers, through the use of an air force and hit them. That is the modern theory of making war.[68]

It was these ideas that historian Robert T. Finney, in his *History of the Air Corps Tactical School: 1920–1940*, found so pervasive throughout ACTS:

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[67] A note about Giulio Douhet and his influence on American airpower: While there is some evidence of American air officers interacting with Douhet at the tail end of WWI and in the early 1920s, his translated works did not enter the ACTS until 1933. Even after his works were made available, though, his influence on early airmen (Mitchell in particular) is debatable. To be sure, Douhet's influence has grown over time, especially in the years after WWII. His theories of the need to gain air superiority (command of the air), the need for an independent Air Force, and specific aspects of his bombing concepts have been particularly useful for American Airmen to ponder as they matured as a service.

[68] *Department of Defense and Unification of Air Services: Testimony before the Committee on Military Affairs,* 69th Cong. 1 (1926) (statement of William Mitchell) In Futrell, *Ideas, Concepts, Doctrine Vol. I,* 49. For Mitchell's contribution to air power, the Army Air Forces named the B-25 for Mitchell and remains the only aircraft named after an individual.

> When instructors at the school began to graft the concept of the primacy of the bomber onto the concept of air warfare and strategic air operations, they were consciously or unconsciously providing the covering for the skeleton built by Mitchell.[69]

And though Mitchell was famously court-martialed due to the flagrant manner in which he advanced his air-centric beliefs—clearly out of sync with the entrenched military establishment—the episode only served to immortalize Mitchell, which made his future influence even more potent.

Out of the fertile ground for conceptual exploration provided by ACTS and spurred on by the prophecies of Mitchell, grew the doctrinal foundations of strategic bombing and the burgeoning idea that air power could achieve victory independent of the other services.[70] In the summer of 1941 it was these ideas, albeit in a somewhat moderated form, that guided the development of the first air war plan to defeat Germany in the summer of 1941—Air War Planning Document-1 (AWPD-1).[71] AWPD-1 cemented core doctrinal principles that guided the Air Force for years to come. It articulated the preferred sequence of air operations: first, gain air superiority; and second follow up with a massive bomber offensive.[72] The bomber offensive would break the will of the enemy through the systematic targeting of their key industries and economic centers.[73] Keeping in line with the ideas from ACTS, the authors of AWPD-1 believed that if the "air offensive was successful, a land invasion may not be necessary."[74]

This prediction, of course, turned out to be wrong. Major land invasions and huge armies were needed in the European theater to win the war. Nevertheless, the claims of the air enthusiasts were not entirely vitiated.

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[69] Robert T. Finney, *History of the Air Corps Tactical School 1920–1940* (Washington, D.C: Air Force History and Museums Program, 1998), 57.

[70] Phillip S. Meilinger, *Bomber: The Formation and Early Years of Strategic Air Command* (Maxwell Air Force Base, Ala: Air University Press, Air Force Research Institute, 2012), 29.

[71] Meilinger, *Bomber,* 38.

[72] Meilinger, *Bomber,* 39–40.

[73] Meilinger, *Bomber,* 39–40.

[74] Quoted from Air War Planning Document-1 in Meilinger, *Bomber*, 41..

To understand the effect of air power during World War II, President Franklin D. Roosevelt in 1944 commissioned the *United States Strategic Bombing Survey* (*USSBS*). While not reducing the importance of ground power, the *Survey* largely vindicated the prophesies of Mitchell and interwar thinking on air power:

> Allied air power was decisive in the war in Western Europe. Hindsight inevitably suggests that it might have been employed differently or better in some respects. Nevertheless, it was decisive. In the air, its victory was complete. At sea, its contribution, combined with naval power, brought an end to the enemy's greatest naval threat—the U-boat; on land, it helped turn the tide overwhelmingly in favor of Allied ground forces. Its power and superiority made possible the success of the invasion. It brought the economy which sustained the enemy's armed forces to virtual collapse, although the full effects of this collapse had not reached the enemy's front lines when they were overrun by Allied forces. It brought home to the German people the full impact of modern war with all its horror and suffering.[75]

In the Pacific theater, the conclusions were equally affirming of airpower.

> The experience of the Pacific war supports the findings of the Survey in Europe that heavy, sustained and accurate attack against carefully selected targets is required to produce decisive results when attacking an enemy's sustaining resources. It further supports the findings in Germany that no nation can long survive the free exploitation of air weapons over its homeland. For the future it is important fully to grasp the fact that enemy planes enjoying control of the sky over one's head can be as disastrous to one's country as its occupation by physical invasion.[76]

The *Survey* also laid the foundations for strategic deterrence based on air forces equipped with nuclear weapons: "The threat of immediate retaliation with a striking force of our own should deter any aggressor from attacking."[77] This recommendation would become central to future deterrence doctrine. It would also become central in making the case for the Air Corps to become a separate service.

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[75] The United States Strategic Bombing Surveys (European War) (Pacific War). (Maxwell AFB, AL: Air University Press, 1987), 37.

[76] The United States Strategic Bombing Surveys, 45–120.

[77] The United States Strategic Bombing Surveys, 114.

While the conclusions made in the *USSBS* have been the subject of debate since its printing, it unequivocally allowed airmen to hold on to their belief in strategic bombing.[78] The *Survey* was especially important in the argument for an independent air service. And when its conclusions were combined with the fact that the Pacific War was quickly brought to an end after nuclear weapons were delivered from the air, everyone's understanding of what air forces might be capable of in the future expanded. It is thus no surprise, that just two years later, in 1947, the Air Force was established as a separate service with strategic bombardment as its defining mission. The question thereafter was how to achieve that mission given a rapidly changing technological and scientific landscape.

B. TECHNOLOGY AND THE AIR FORCE

Recognizing science and technology as inseparable parts of a modern air force, General Henry "Hap" Arnold sought to institutionalize the relationship between the nation's best and brightest scientists and the Air Force, via the formation of the AAF Scientific Advisory Group in late 1944.[79] In selecting Dr. Theodore Von Karman as the Scientific Advisory Group's chairman, Arnold chose both a trusted advisor and friend whom he had leaned on heavily for advice on scientific matters during the war.[80] Von Karman quickly established a team and set out to accomplish Arnold's first request, which was to forecast what air power could accomplish in the postwar world.[81] In Arnold's memoir, *Global Mission*, he recalls how he wanted the task to be carried out:

> I wanted them to think ahead twenty years. They were to forget the past; regard the equipment now available only as the basis for their boldest predictions. I wanted them to think about supersonic speed airplanes, airplanes that would move and operate without cruise; improvements in bombs, so that we could use smaller bombs to get greater effect; defenses against modern and future aircraft; communication systems between

78 For more on the debate of the credibility of the United States Strategic Bombing Surveys see: Robert Anthony Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, N.Y: Cornell University Press, 1996).

79 Futrell, *Ideas, Concepts, Doctrine* Vol. I, 205.

80 Herman S. Wolk, *Planning and Organizing the Postwar Air Force 1943–1947* (Washington, D.C.: Air Force History and Museums Program, 1984), 39.

81 Michael H. Gorn, *Prophecy Fulfilled: "Toward New Horizons" and Its Legacy* (Washington, D.C.: Air Force History and Museums Program, 1994), 92.

> airplanes and the ground, and between the airplanes themselves in the air; television, weather, medical research; atomic energy, and any other phase of aviation which might affect the development and employment of the air power to come.[82]

Arnold's address to the Scientific Advisory Group in January of 1945 is also revealing of the magnitude of importance he placed on the elite group's task:

> I don't think we dare muddle through the next twenty years the way we have…the last twenty years. I have worked with Von Karman the last twenty years, and I was sometimes scared by the knowledge he had that we weren't using…I don't want ever again to have the United States caught the way were this time.[83]

On 22 August 1945, Von Karman presented his first report, entitled *Where We Stand*. It catalogued the many "significant advances" in aerial warfare that were made throughout the Second World War while providing "some indications as to 'where we shall go.'"[84] Von Karman followed the report on 15 December 1945 with *Toward New Horizons*—the forecast Arnold initially sought.

Toward New Horizons produced three main outcomes. First, it recommended the scientific and technological pursuit be institutionalized in the future air arm. To that end, it envisioned an air service made up of airmen and scientists woven together as they jointly worked to develop the future of air power.[85] With so much technological advance in the area of air power that occurred during World War II, nuclear weapons were seen as only the tip of the iceberg.[86]

Second, *Toward New Horizons* affirmed the Air Force's *raison d'etre* of strategic bombing. It forecasted that a "powerful air force [should] be capable of reaching remote

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[82] General H. H. Arnold, *Global Mission.* (New York, Harper & Brothers, 1949), 533.

[83] General H. H. Arnold quote in Thomas A. Sturm, *The USAF Scientific Advisory Board: Its First Twenty Years* 1944–1964. (Washington, D.C., U.S. Government Printing Office, 1967), 2.

[84] Theodore Von Kármán, Toward New Horizons: Science, Key to Air Supremacy (Washington, DC: Army Air Forces Scientific Advisory Group, 1945) In Dik Daso, *Architects of American Air Supremacy General Hap Arnold and Dr Theodore von Karman* (Maxwell AFB, AL: Air University Press, 1997), 212.

[85] Daso, *Architects of American Air Supremacy General Hap Arnold and Dr Theodore von Karman*, 295.

[86] Daso, *Architects of American Air Supremacy*, 293.

targets swiftly and hitting them with great destructive power [in addition to] securing air superiority over any region of the globe." [87] The report went on to state that "only an air force which fully exploits all the knowledge and skill which science has available now and will have available in the future, will have a chance of accomplishing these tasks."[88]

Finally, *Toward New Horizons* resulted in the establishment of the Scientific Advisory Group.[89] Later renamed the Scientific Advisory Board, which consisted of an elite group of civilian scientists that would report directly to the air arm's commanding general, the organization was made permanent in 1946.[90] To this day it remains largely unchanged from Von Karman's original conception.[91]

C. THE DAWN OF THE BOMBERS VERSUS MISSILES DEBATES

At the conclusion of World War II, the Air Force possessed the nation's sole nuclear delivery platform—the manned bomber. Though this unique monopoly soon propelled the fledgling service ahead of its peers in funding, overall defense spending trended downward in the years following World War II, forcing the Air Force to make tough decisions on the kind of force it could procure.[92] The most institutionally challenging of these decisions

[87] Daso, 301.

[88] Daso, 301.

[89] Daso, 388.

[90] Daso, 141, 160.

[91] The initially stated goals from Kármán were: "a.) inform the commanding General of new developments in science and the results of fundamental scientific research which offer possibilities for the solution of AAF problems; b.) prepare special studies for the Commanding General on the relations between scientific thought, technical research, and air power; c.) assemble and evaluate facts for the Commanding General on long-range plans for scientific research and development; d.) advise the Commanding General on general problems of organization of scientific effort on Air Force problems, both in and outside of the Air Forces; e.) make such additional studies of scientific problems as may be requested by the Commanding General." Taken from Theodore Von Kármán, AAF Scientific Advisory Group, "Organization of the AAF Scientific Advisory Group," memorandum to the Commanding General, AAF, Jan 9, 1946. https://www.scientificadvisoryboard.af.mil/Portals/73/Documents/History/VonKarman_SAB_creation_Letter.pdf?ver=iLEI64saLciNDBh0ZrhDpA%3D%3D&timestamp=1613508559380.

[92] Kevin N. Lewis, *The U.S. Air Force Budget and Posture Over Time* (Santa Monica, CA: RAND, 1990). https://www.rand.org/pubs/reports/R3807.html.

centered on whether to invest in the Air Force of the present—manned bombers, or the Air Force of the future—unmanned missiles.[93]

Military missiles were an old idea, given vigorous new life in World War II by the introduction of the German "V" weapons: the V-1, a pilotless drone similar to a cruise missile, and the more powerful V-2, a true ballistic missile.[94] While the weapons were not decisive in World War II, U.S. military commanders quick to understand their potential. General Eisenhower, for example, perceived that there was a "noticeable" impact on morale wrought by the devastation of the V-weapons, and went so far as to predict that "It seemed likely that, if the German had succeeded in perfecting and using these new weapons six months earlier than he did, our invasion of Europe would have proved exceedingly difficult, perhaps impossible."[95] Such speculation reflected a belief in the importance of missiles that was quickly spreading throughout the ranks.

After the war, senior leaders continued to beat the drum for the research and development of missile technologies. For example, General Hap Arnold, Commander of the Army Air Forces, in his final report of the war, envisioned future battlefields where missiles would feature prominently: "It is entirely possible that the progressive development of the air arm, especially with the concurrent development of atomic explosive, guided missiles, and other modern devices will reduce the requirement for or employment of mass armies and navies."[96] The future Arnold envisioned was not only one where missiles were commonplace, but one where missiles were under the control of an independent Air Force. Much to Arnold's and other senior Air Force leader's dismay, however, the other branches of the Army, notably the Army Ground and Services Forces also perceived the impact that missiles would have on future conflicts. To that end, the

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[93] Elliot V. Converse. *Rearming for the Cold War: 1945–1960* (Washington, D.C., Historical Office, Office of the Secretary of Defense, 2012), 205.

[94] For an excellent discussion on the motivators behind the drive to develop missile technologies see Trevor Gardner. "How We Fell Behind in Guided Missiles" *The Air Power Historian* 5, no. 1 (1958): 3–14. http://www.jstor.org/stable/44513003.

[95] Dwight D. Eisenhower, *Crusade in Europe* (Baltimore: Johns Hopkins University Press, 1997), 259–260.

[96] Henry H. Arnold, "Third Report of the Commanding General of the Army Air Forces to the Secretary of War" (Nov 12, 1945), 59.

Army Ground and Service Forces also sought to gain control of the new weapons, reasoning that missiles were nothing more than "an evolutionary extension of artillery."[97] Competition for control over missile technologies quickly ensued.[98]

To understand how critical winning the missile fight was for the Army Air Forces (AAF), Major General Curtis LeMay's letter to then Commander of the AAF, General Carl Spaatz, on 20 September 1946 is illuminating:

> One very serious reason for not giving ground is the stated opinion of Army Ground Forces that Army Ground Forces should operate its own guided missiles, close air support aircraft, strategic bombardment aircraft, classing all these as extensions of artillery. It is fairly certain that if development of missiles is turned over to Ordnance, operation will be done by Army Ground Forces, and it will only be a short and logical step from this to operation of support and strategic aircraft by Army Ground Forces.[99]

LeMay continued:

> The Long-range future of the AAF lies in the field of guided missiles. Atomic propulsion may not be usable in manned aircraft in the near future, nor can accurate placement of atomic warheads be done without sacrifice of the crews. In acceleration, temperature, endurance, multiplicity of functions, courage, and many other pilot requirements, we are reaching human limits. Machines have greater endurance, will stand more severe ambient conditions, will perform more functions accurately, will dive into targets without hesitation. The AAF must go to guided missiles for the initial heavy casualty phases of future wars.[100]

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[97] Max Rosenberg, *The USAF and the National Guided Missile Program 1944–1950* (Washington, D.C., United States Air Force Historical Division Liaison Office, 1964), 14. https://media.defense.gov/2011/Mar/21/2001330247/-1/-1/0/AFD-110321-029.pdf.

[98] The Navy was also viewed as a threat to the AAF's control over missiles, however, as they were in a separate service, the immediate threat was viewed as the AGF and ASF. For more on the rivalry between the Navy and the AAF/U.S. Air Force pertaining to missile technologies see Max Rosenberg, "The USAF and National Guided Missile Program" (Washington, D.C., United States Air Force Historical Division Liaison Office, 1964); Sapolsky, The *Polaris System Development; Bureaucratic and Programmatic Success in Government*; Beard, *Developing the ICBM: A Study in Bureaucratic Politics*.

[99] Memorandum from General Curtis Lemay to, DCAS, R&D, to General Spaatz, dated 20 September 1946. File "AAF, in memo Sept 1946, in Beard*, Developing the ICBM*, 37–38.

[100] Beard, 39.

While Spaatz's response is unknown, the historical record reveals that he played a vital role in wresting AAF control over missile technologies from the Army Ground and Service Forces.[101]

In all, three years of vitriolic intra-service debate over the control of missile development would ensue before an authoritative decision on roles and responsibilities was issued. After a successful lobbying effort and much to the AAF's pleasure, on 3 October 1946, the Secretary of War, Robert P. Patterson, sided with the AAF and endorsed a memorandum assigning development responsibility of missile technologies to the AAF.[102] Its path to independence became more secure as a result.

Just before the enactment of the National Security Act of 1947, which established the Air Force as an independent service, the Army and Air Force worked to further clarify the division of responsibility for missile technologies. In what was called the "Army-Air Force Agreements as to the Initial Implementation of the National Security Act of 1947," language on strategic and tactical missiles was introduced to clarify how missiles were to be managed.[103] The Air Force was given responsibility over strategic missiles, defined as:

> those designed for employment against targets, the destruction or neutralization of which does not have a direct effect on current Army tactical operations, and which are normally the targets of bombers, other than those operating on close-support missions incident to Army tactical operations and which require coordination with the operations of such bombers.[104]

Tactical missiles were assigned to the Army, defined as:

> those capable of employment in support of land operation and capable employment against targets, the destruction or neutralization of which will

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101 For an excellent overview of the many actions taken by Carl Spaatz to gain control over missile programs see Rosenberg, *The USAF and the National Guided Missile Program 1944–1950*.

102 Msg, WAR 82213, 3 Oct 46; memo, Brig Gen H.I. Hodes, Asst DC/S, USA to CG's, AAF and AGC, and Chiefs, all Tech Svcs, 7 Oct 1946, subj: Guided Missiles in Rosenberg, *The USAF and the National Guided Missile Program 1944–1950*, 37.

103 "Army – Air Force Agreements as to the Initial Implementation of the National Security Act of 1947," (Compiled by the Offices of the Deputy Chief of Staff and the Deputy Commander of the Army Air Forces. Sept 15, 1947) In Richard I. Wolf, *The United States Air Force Basic Documents on Roles and Missions*, (Washington, D.C., Office of Air Force History, 1987), 110.

104 Wolf, *The United States Air Force Basic Documents on Roles and Missions*, 110.

> have a direct effect on current Army operations. Such missiles include those which supplement the fires of and require coordination with artillery and/or tactical aircraft operating on close support mission incident to Army tactical operations.[105]

This agreement inevitably strengthened the Air Force's commitment to strategic bombing, and to manned bombers specifically. When the Air Force achieved its independence, its mission of strategic bombardment—by either manned bombers or missiles—was secure. How it would build the force to carry out that mission was less certain.

Notwithstanding great interest in furthering missile technologies, the Air Force prioritized increasingly scarce budget dollars in favor of manned bombers. Arnold's thinking following the Second World War still commanded influence:

> Improvements in aerodynamics, propulsion, and electronic control will enable unmanned devices to transport means of destruction to targets at distances up to many thousands of miles. However, until such time as guided missiles are so developed that there is no further need for manned aircraft, research in the field of "conventional" aircraft of improved design must be vigorously pursued.[106]

The Vice Chief of Staff for the AAF, General Ira Eaker, held a similar view of how far off into the future it would be until missile technologies were capable enough to challenge manned bombers. His 1947 testimony before congress was illuminating in this regard:

> We cannot abandon the development of the very long-range heavy bomber as a primary weapon of our long-range striking force but we should, as a wise precaution, spend the necessary experimental funds to insure that we are the first in the field with a long-range guided missile which may be the primary weapon at some future date, but probably not within 15 years.[107]

As a service that prioritized game-changing technologies, the senior brass had to balance those pursuits with a need to field a fighting force tomorrow. The cultural penchant for strategic bombers could also not easily be ignored. These initial debates portended a tension that would not soon go away.

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[105] Wolf, 110.

[106] Henry H. Arnold, "Third Report of the Commanding General of the Army Air Forces to the Secretary of War" (Nov 12, 1945), 67.

[107] Futrell, *Ideas, Concepts, Doctrine* Vol. I, 221.

Early investments in advanced technologies and missiles specifically were thus cautious, but not inconsequential. For example, the Fiscal 1949 budget (only slightly more than that of 1948) awarded approximately $190 million to Air Force R&D where $25 million was earmarked for aircraft; $15 million for guided missiles; and powerplants and electronics made up the lion's share with $50 million.[108] Based on assessments that long range, surface to surface missiles were more than ten years away, the Air Force prioritized its efforts on air to air and air to surface missiles, which would help manned bomber hit their targets.[109] It was not until the early 1950s that investments in long-range missiles accelerated.

In 1950, Air Force R&D budgets more than doubled due to the Korean War and the Soviet detonation of its first atomic weapon.[110] Monies dedicated to missile development increased, along with the interest in the topic shown by senior officials. In 1950, President Truman appointed K.T. Keller to oversee guided missile development on his behalf. Shortly thereafter, projects that had been cancelled, such as the Air Force's MX-774 long-range surface to surface missile program, were restarted.[111]

The MX-774 was first commissioned in 1946 as a study project for the Consolidated-Vultee Aircraft Corporation (Convair) to develop the nation's first Intercontinental Ballistic Missile (ICBM). Budget cuts led to its cancellation in 1948.[112] With an influx of new resources and motivation to pursue advanced missile technologies, the Air Force was able to put Convair back on contract for the MX-774 in January of 1951.[113] Convair had recognized the impact that an ICBM could have, and had continued

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[108] Department of Defense, *Second Report of the Secretary of Defense for the Fiscal Year 1949* (Washington, D.C., Government Printing Office, 1950), 287.; Gardner, "How We Fell Behind in Guided Missiles." 9.

[109] Memo, Brig Gen T.S. Power, Dep AC/AS-3 to CG, AAI', 15 Jun 47, subj: Operational Requirements (Priorities) for Guided Missiles, 1947 -1957 (with Lt Gen H. S. Vandenberg, DC/AS, AAF initialed approval on 18 Jun 47) in Rosenberg, *The USAF and the National Guided Missile Program 1944–1950*, 84–85.

[110] Futrell, *Ideas, Concepts, Doctrine* Vol. I, 487.

[111] Futrell, 487–488. Keller's impact is discussed in Beard, *Developing the ICBM*. 124–125.

[112] Futrell, 221.

[113] Futrell, 221.

work using their own money, which meant the project was not completely dormant.[114] MX-774 was later named the Atlas and became the United States' first ICBM.

Interest in such weapons received an enormous boost from the first thermonuclear test in November 1952. Shortly after the test, the Air Force commissioned an ad hoc Scientific Advisory Board study led by Dr. John Von Neumann to assess the feasibility of mating small, high-yield thermonuclear weapons on ICBMs.[115] According to General Bernard Schriever, the conclusions made from the study "indicated you could actually develop a dry thermonuclear weapon that would have a megaton yield and would not weigh more than 1,500 pounds."[116] The breakthrough was instrumental in moving the ICBM program forward. By the end of 1955 ICBM development was declared via a presidential directive to be the nation's highest priority in the area of military research and development.

The successful launch of Sputnik in 1957 confirmed suspicions that, despite such declarations, the United States was nevertheless falling behind the Soviets. There could be no doubt that the Soviets would soon have the capability to launch nuclear armed ICBMs—a capability the United States did not possess. Multiple hearings and inquiries sought to understand why the United States was coming up short. Most explanations suggested that mismanagement and a preoccupation with economizing defense budgets at the cost of national security were to blame.[117] Others blamed the Air Force itself, where, it was argued, that a cultural bias for manned bombers had resulted in an underinvestment in missile technologies.[118]

Whatever reservations the Air Force may have had about ICBMs in the 1950s, world events (i.e., falling behind the Soviets in the space race) ensured that, by 1960, the

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[114] Futrell, 221.

[115] Daso, 172.

[116] General Bernard Schriever quoted in Richard H. Kohn, *Reflections on Research and Development in the United States Air Force* (Washington, D.C.: Center for Air Force History, 1993), 46–47.

[117] Kohn, *Reflections on Research and Development in the United States Air Force*, 46–47.

[118] See Beard, *Developing the ICBM: A Study in Bureaucratic Politics.*

ICBM was here to stay. What this meant for the force structure of the Air Force remained an open question.

With the arrival of the John F. Kennedy administration in 1961, Robert S. McNamara was installed as the nation's eighth Secretary of Defense. With a background as an AAF officer during World War II, and later as a highly successful businessman running the Ford Motor company, McNamara entered the Pentagon with an ambitious goal to improve the integration of policy, strategy, force structure and budgets.[119] To accomplish this mission, McNamara sought to gain efficiencies through "analysis" (operations research) and displayed no patience for parochial interests.[120] The Air Force would not be spared.

As the Air Force's first B-52s were undergoing their final production phases and had yet to enter into its operational inventory, the Air Force began to realize that improving Soviet air defenses would present a significant challenge to the new bomber.[121] This prompted the service to initiate studies into a follow-on bomber program in 1953, the result of which was the B-70 Valkyrie.[122] The B-70 was intended to be a high-altitude, supersonic (Mach 3) bomber, capable of surviving against advancing air defenses.[123] The initial development contract for the B-70 was awarded to North American Aviation in

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[119] Robert S. McNamara, interview by Alfred Goldberg and Maurice Matloff, April 3, 19186, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_McNamaraRobert4-3-1986.pdf?ver=2014-05-28-121606-850 http://digitalcollections.baylor.edu/cdm/ref/collection/buioh/id/5361.

[120] Robert S. McNamara, interview by Maurice Matloff and Roger Trask, May 22, 1986, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_McNamaraRobert5-22-1986.pdf?ver=2014-09-19-080955-267.

[121] Brown, *Flying Blind*, 197–198.

[122] Brown, 197–198. It should be noted that other efforts such as the B-58 Hustler were ongoing at this time, however, the B-58 was not meant to be a replacement for the B-52 as its payload was only about 20,000 lbs. The B-52 has a payload of 70,000 lbs.

[123] Bernard C. Nalty, *The Quest for an Advanced Manned Strategic Bomber: USAF Plans and Policies 1961–1966* (Washington, D.C., United States Air Force Historical Division Liaison Office, 1966), 2.

1958, only months after the launch of Sputnik.[124] Even as the United States was scrambling to get an ICBM of their own off the ground, the contract for a new manned bomber was a clear signal that the Air Force was not ready to transition to an all-missile force.[125]

Arguments made for the continued relevancy of the manned penetrating bomber resembled those made just a decade prior. For example, when pressed on the issue of whether manned bombers were still necessary in an age of missiles, Lieutenant General Charles S. Irvine, Deputy Chief of Staff for Material, stated:

> We think we need both. We think we cannot afford to pin the hopes of the nation on just 1 machine and 1 solution…it costs you more to take out a target with an intercontinental ballistic missile than it does to take out a number of targets with bombers, plus the fact that you have control of the bomber forces. You can start bombers toward the target and call them back…. I do not know how to show your teeth with a missile particularly when you have it in the silos, and you do not want the enemy to know where they are.[126]

Similarly, in his testimony before Congress, Lieutenant General John Gerhart, Air Force Deputy Chief of Staff for Plans and Programs, argued the dangers of pinning the nation's defense on an unproven technology:

> For some time to come, missiles, ballistic and otherwise, will not have the payloads nor the accuracy to cope with some of the more difficult targets…Until these missiles are completely operationally proved and possess the demonstrated capability to attack certain types of targets carrying enough warhead yield to destroy such targets, then we must depend on the manned force to carry the major portion of attack.[127]

Finally, Air Force Chief of Staff, General White, made the Air Force's position clear: "Even if missiles prove out in every respect that we hope they will, there is a great

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[124] Marcelle Size Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems: Post-World War II Bombers 1945–1973*, Vol II, (Washington, D.C.: Office of Air Force History, 1988), 565–566.

[125] These core arguments have remained largely unchanged since this period.

[126] *Department of the Air Force Appropriations for 1959: Hearing before the Committee on Appropriations*, House of Representatives, 85th Congress, 2 (1958), 353.

[127] H.R., Department of the Air Force Appropriations for 1959, 39.

requirement for the mixed force, one which complicates the enemy defenses and gives us a flexibility that cannot be attained in any other way."[128]

McNamara and his data-driven Whiz Kids nevertheless believed the missile was clearly the superior weapon when compared to manned bombers based on key metrics that measured the acquisition and life cycle costs of delivering a warhead to a target. His remarks before the Senate Armed Services Committee in April of 1961 are revealing as to the level in which McNamara believed missile technologies had surpassed manned bombers: "Only a year or so ago the principal general war threat to our security was a surprise attack by large numbers of nuclear-armed manned bombers…A year or two from now our principal concern will be a surprise attack by large numbers of nuclear-armed ICBMs."[129]

McNamara, with President John F. Kennedy's full support, cancelled the B-70 program in 1961.[130] In his view, the B-52 was a "more effective, efficient system than the B-70."[131] Given improvements in Soviet air defenses, McNamara noted that "the speed and altitude of the B-70, in itself, would no longer be a very significant advantage."[132] No doubt, the shoot down of Gary Powers' high-altitude U-2 over the Soviet Union by its new SA-2 Surface-to-Air Missile (SAM) factored into his decision. To be sure, McNamara believed that manned bombers would continue to be useful, and he did not advocate their complete removal from the force; at a minimum the presence of multiple air bases would complicate the targeting program faced by the Soviets. But to spend large sums of money on a new bomber with questionable survival odds when missiles and B-52s could do the job just as well was untenable to the Defense Secretary.

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[128] H.R., *Department of the Air Force Appropriations for 1959*, 30.

[129] *Department of Defense for Appropriations for 1962*, Hearing Before the Subcommittee on Appropriations, House of Representatives, 87th Cong. 1 (1961), 4.

[130] John F. Kennedy, Special Message to the Congress on the Defense Budget in Gerhard Peters and John T. Woolley, "The American Presidency Project," https://www.presidency.ucsb.edu/node/236195.

[131] H.R., *Department of Defense Appropriations for 1962*, 51.

[132] H.R., *Department of Defense Appropriations for 1962*, 17.

Harold Brown's postmortem of the event proves telling as to what the Air Force would do next. According to Brown, the one question the Air Force could not convincingly answer for McNamara with regard to the B-70 was: "What is it you are going to do with this that you can't do better or as well or cheaper in other ways?"[133] If the Air Force was to get a replacement for the B-52, they would have to conceive of a platform that could realistically execute missions that missiles and B-52s manifestly could not perform.

D. THE CONTINUED QUEST TO GET THE BOMBER THROUGH

The cancellation of the B-70 left the Air Force without a replacement for the aging B-52 and called into the question the utility of manned bombers in the missile age. The Air Force would not give up in its quest for a new manned bomber. General Curtis LeMay initiated the Advanced Manned Strategic Aircraft program 1963, which departed from the B-70 in that it was envisioned as a "low-altitude manned penetrator."[134] A terrain following bomber would "frustrate radar-directed antiaircraft missiles" and thus allow for survivable penetration in an age of improving air defenses.[135] Whether or not McNamara would buy it was the question.

Soon after the idea of the Advanced Manned Strategic Aircraft was born, LeMay wielded his political clout to gain preliminary support.[136] After socializing his plan for the new bomber with President Lyndon B. Johnson at the President's Texas ranch in December of 1963, LeMay brought his proposal to the Joint Chiefs of Staff, in January of 1964.[137] LeMay's arguments for the new bomber echoed those made in the past with little variation:

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[133] Harold Brown, interviewer unknown, May 9, 1964, in Washington, D.C., transcript, John F. Kennedy Presidential Library, Boston, MA. https://www.jfklibrary.org/asset-viewer/archives/JFKOH/Brown%2C%20Harold/JFKOH-HAB-03/JFKOH-HAB-03.

[134] Summary report (S) Analysis of Mission and Performance Characteristics for an AMSA, April 1965, in Plans RL (65) 4: System Mgt Directive (S), 2 February 66, in Acft Br, Strat Div, Dir/Op Rqmts and Deve Plans & Hist (S-RD), Dir/Op Rqmts, Jul-Dec 63, pp. 25–28 in Nalty. *The Quest for an Advanced Manned Strategic Bomber: USAF Plans and Policies 1961–1966*, 20.

[135] Nalty. *The Quest for an Advanced Manned Strategic Bomber: USAF Plans and Policies 1961–1966*, 20.

[136] Nalty. *The Quest for an Advanced Manned Strategic Bomber*, 24.

[137] Nalty, 23–24.

> There is no way of showing force with the missile. With a manned system you can maneuver and change bases. You can fly them out so they can be seen on the radar screen, or actually conduct some limited attacks if you want to. There are many options you have with a manned system that you do not have with a missile system…The follow-on system will have a capability with its higher resolution sensors to assess the target condition and will deliver a weapon only if it is determined that the ballistic missile attack was unsuccessful… the follow-on strategic aircraft will provide the flexibility to perform many such tasks for which ballistic missiles are not well suited. Examples might include the assured destruction of hard targets using shoot-look-shoot techniques; the attack of residual targets for which surviving ICBMs are lacking necessary targeting data, and the discriminate attack of targets collocated with population centers. Follow-on missions for the purpose of damage assessment and restrike as required in cases where postattack intelligence information regarding the effectiveness of prior strikes is lacking. The follow-on strategic aircraft, since it is reusable, would provide a unique capability for national defense in such circumstances without any increase in otherwise required force levels.[138]

The Joint Chiefs supported the new bomber, save the Chairman, General Maxwell Taylor, who, despite LeMay's arguments was uncertain what its addition to the force would bring.[139] In other words, to many observers free of the Air Force's bomber culture spell, it seemed unlikely that the additional flexibility supplied by the Advanced Manned Strategic Aircraft would make much of a difference in a full-scale nuclear exchange.

McNamara likewise remained unconvinced. He viewed the Advanced Manned Strategic Aircraft as an aircraft without a requirement.[140] Missiles appeared to be more militarily useful, and more economical.[141] In McNamara's view, the B-52 long-range bomber and a modified F-111 medium range bomber could satisfy any manned bombing mission the Air Force would be tasked with. Ultimately, McNamara earmarked $5 million in the Fiscal Year 1965 budget to study the "technical feasibility and military value of

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[138] *Department of Defense Appropriations for 1965*: *Testimony before the House of Representatives Subcommittee on Appropriations*, 88th Cong. 2, (1964), 459, 460, 537.

[139] Nalty, 24.

[140] *Department of Defense Appropriations for 1966: Testimony before the Subcommittee on Appropriations*, House of Representatives, 89th Cong. 2., March 2, 1965, 131.

[141] H.R., *Department of Defense Appropriations for 1966*, 135.

possible new advanced strategic aircraft," knowing full well it was an inadequate sum to move the program forward to production.[142]

McNamara's successor, Clark Clifford, mostly held to McNamara's position of only supporting conceptual studies and component research. It was not until the transition to the Richard Nixon administration that the Advanced Manned Strategic Aircraft was finally able to move forward in the next stage of development.

President Nixon's Secretary of Defense, Melvin Laird, ushered in a new approach to weapons development and procurement. Laird transitioned the Department away from McNamara's highly centralized control model to one "based on (1) participatory decision-making, (2) defined decentralization, and (3) delegation of authority under specific guidance."[143] He also installed David Packard as his Under Secretary and gave him a "free hand to run the day-to-day affairs of the Department, particularly the research and development and procurement," which allowed Laird to set policy and be the primary interface with the President, the National Security Council, and Congress.[144] Both of these were welcome changes to the Joint Chiefs who, according to Walter Poole's official history of the Joint Chiefs of Staff from 1969–1972, "hoped to recover the influence they lost during Secretary of Defense Robert McNamara's tenure."[145]

Upon McNamara's departure, the. Air Force rebranded the Advanced Manned Strategic Aircraft as the B-1.[146] Citing the age of the B-52, the increased conventional role for strategic bombers as evidenced in Vietnam, and the requirement for a "'mixed force'

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142 H.R., *Department of Defense Appropriations for 1966*, 40.

143 *Department of Defense Appropriations for 1971: Testimony before the Subcommittee on Appropriations*, House of Representatives, 91st Cong. 2 (1970) 76.

144 David Packard, interview by Alfred Goldberg and Maurice Matloff, November 9, 1987, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PackardDavid%2011-9-1987.pdf?ver=2015-06-30-144714-967.; Melvin Laird, interview by Alfred Goldberg and Maurice Matloff, September 2, 1986, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_LairdMelvin%209-2-1986.pdf?ver=2015-06-30-110159-040.

145 Walter S. Poole, *The Joint Chiefs of Staff and National Policy: 1969–1972* (Washington, D.C., Office of the Chairman of the Joint Chiefs of Staff, 2013), 2.

146 Kotz, *Wild Blue Yonder*, 92.

which included bombers as well as missiles…[to] complicate Soviet defenses," Air Force Chief of Staff, General John Ryan, won Packard's support.[147] The Air Force issued Request For Proposals in 1969 for the B-1 and awarded the primary contract to North American Rockwell in 1970.[148]

Despite having Packard's support and a contract awarded, the B-1 program quickly encountered difficulties. First, Congress was not fully sold on the B-1 and drastically cut development funding for the program it in Fiscal Years 1970 and 1971.[149] Delays in the program's planned milestones consequently followed.[150] Second, by 1974, actual costs of the B-1 far exceeded the original cost estimates, and the trend was set to continue.[151] Third, the B-1's requirement to be survivable against modern air defenses by having a low radar cross section (RCS) and technologies to suppress infrared signatures from its engines were proving far too technologically ambitious.[152] Finally, there were also growing concerns that a low-altitude aircraft would be susceptible to attack from newly developed interceptor aircraft with look-down/shoot-down capabilities.[153] Such capabilities would allow aircraft to find and intercept aircraft flying at low altitudes. For these reasons, Congress decided to postpone full production funding to the B-1 program in 1976. The final decision would be deferred to the Jimmy Carter administration in 1977, but by then a new competitor for the B-1's missions had appeared.[154]

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147 Kotz, 92–93.

148 Brown, *Flying Blind,* 251.; General Accounting Office, *Staff Study: B-1 Weapon System*, 13. Analysis of the decision to select Rockwell ahead of General Dynamics yields two primary hypotheses that are useful to this study. First, according to scholar, Michael E. Brown in his book, *Flying Blind*, Rockwell was selected due to the Air Force's assessment that it best met the stated performance and cost in his book on the origins and outcome of the B-1 program in *Kotz, Wild Blue Yonder.* Kotz argued that the deciding factor in the contract decision was Rockwell's impending financial insolvency.

149 Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, 581; Committee on Armed Services Report on Authorizing Appropriations for Fiscal Year 1971, Senate, 91st Cong. 2 (1970), 29.

150 Knaack, *Encyclopedia of U.S. Air Force Aircraft and Missile Systems*, 29.

151 General Accounting Office, *Staff Study,*19.

152 General Accounting Office, *Staff Study,* 22, 36.

153 *Department of Defense Appropriations for 1977: Hearings before Subcommittee on Appropriations*, Senate, 94th Cong. 2 (1976), 70, 875.

154 Richard P. Cronin, *Options Available to the President in Deciding the Future of the B-1 Bomber Program*., CRS Report 77–11F (Washington, D.C.: Congressional Research Service, 1976), 1.

E. RISE OF THE CRUISE MISSILE AND THE DEMISE OF THE B-1

United States cruise missile development began in earnest at the twilight of World War II. Cruise missiles received considerably more R&D funding than ballistic missiles in the late 1940s and early 1950s, by virtue of their perceived technological simplicity.[155] Nevertheless, this impression faded in the 1960s as improved ballistic missile performance made ICBMs the missile of choice for strategic purposes.

The reasons for the demise of cruise missiles were many but the most important factors were inadequate technologies. Historian Kenneth Werrell captures this well in his analysis of the issue:

> The technology of the 1950s produced a cruise missile that looked like an aircraft, but which performed less well. Cruise missiles could fly as high and as fast as bombers, and far enough, but they lagged in a number of other areas. First, compared with the bomber, they were inflexible. A bomber can be recalled, rerouted in flight, used as a show of force, or used in a nonnuclear conflict. It can hit numerous targets, targets of opportunity, and report back its observations. The bomber is reusable. Second, cruise missiles were vulnerable. They could not defend themselves with either maneuver or active defenses, as they essentially fly straight and level at a constant speed. Third, cruise missile accuracy was much less than that of a bomber. Fourth, taking man out of the loop with this level of technology left serious reliability problems. In contrast, bombs and bombers were proven, reliable weapons. As General LeMay put it, missiles could not replace bombers because missiles could not think.[156]

When compared to ICBMs, cruise missiles simply could not compete in the categories of speed, reliability, payload and accuracy. Though long-range cruise missiles were cheaper per unit than ICBMs, their operational inferiority could not be overcome.

Even so, cruise missile development never came to a full stop. Research and development on shorter-range missiles continued because the Air Force thought they could improve bomber survivability by serving as decoys and standoff weapons.[157] Cruise

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155 Kenneth P. Werrell, *The Evolution of the Cruise Missile*. (Maxwell AFB, Ala: Air University Press, 1985), 104.

156 Werrell, *The Evolution of the Cruise Missile*, 103.

157 Werrell, 225.

missiles also could increase a bomber's footprint by allowing it to strike more targets without varying its general course. Nevertheless, it was not until the early 1970s improvements in computing technologies, decreased size and weight of critical on-board missile components, Terrain Contour Mapping capabilities (TERCOM), and more efficient propulsion systems breathed new life into cruise missiles.[158] The benefits of these technologies enabled fast, long-range, terrain hugging missiles with small radar signatures, and warheads capable of producing high yields with small payloads.[159] By 1974 all of these new technologies were integrated in the development of the Air Launched Cruise Missile (ALCM).

Here again was a weapon that raised questions about the continued relevancy of manned bombers. Indeed, the advent of cruise missiles raised the possibility that bombers could "standoff" beyond an opponent's air defense and still hit targets deep within enemy territory. Defense appropriation hearings in 1975 bore a striking resemblance to the missile-bomber debates of the 1960s.[160]

The Air Force remained resolute in its view the ALCM would augment the manned bomber—especially the B-1— not replace it.[161] The debate reached an apex in 1976 when then Secretary of the Air Force, Thomas Reed, and the Chief of Staff of the Air Force, General David Jones, submitted a special memorandum to the Senate Armed Services Committee, in which they claimed that the ALCM would only be "an adjunct to the strategic bomber force" and that a "pure standoff force" had dubious viability.[162] Citing arguments that echoed the past, they pointed to the manned bomber's flexibility and the "added stress" it put on enemy defenses.[163] A special point was also made to say that as

158 Werrell, 103.

159 Werrell, 103.

160 *Fiscal Year 1975 Authorization for Military Procurement, Research and Development, and Active Duty, Selected Reserve and Civilian Personnel Strengths: Hearing before the Committee on Appropriations*, Senate, 93rd Cong. 2 (1974), 2724.

161 S., *Fiscal Year 1975 Authorization for Military Procurement, Research and Development*, 2724.

162 *Department of Defense Appropriations for Fiscal Year 1977: Hearing before the Committee on Appropriations*, Senate, 94th Cong. 2 (1976), 3001–2.

163 S., *Department of Defense Appropriations for Fiscal Year 1977,* 3002.

ALCMs entered the field, there would be no need to consider mounting them on the penetrating B-1 as a signal of their remarkable faith in the new bomber's capabilities.[164] President Gerald Ford's Secretary of Defense, Donald Rumsfeld, backed the Air Force. He trumpeted the B-1's flexibility, recallability, ability to conduct shows of force and its ability to hedge against developments that could diminish the other two legs of the triad.[165] Despite these arguments, Congress was not convinced, and as the debates occurred during an election year, Congress decided to postpone the entire production decision. As a stopgap, they chose to fund the program on a monthly basis until the new Carter administration could weigh in on the matter.

President Jimmy Carter, his Secretary of Defense Harold Brown, and his closest advisers took on the task as a high priority.[166] Brown immediately commissioned a study to compare the B-1 to B-52s armed with ALCMs.[167] Although the study was inconclusive, Brown initially supported the Air Force's desires and recommended that B-1 production move forward, albeit at a slower rate than the Air Force wanted.[168] The inconclusiveness of the study, however, signaled that Carter's decision would not be an easy one. Adding to Carter's decision matrix was a new technology—stealth—which was proving that an aircraft could be developed in such a way that it could be concealed from enemy defensive systems.[169] If stealth could be applied to a new bomber, it might make sense to scrap the entire B-1 program and start anew.

President Carter cancelled the B-1 program on June 30, 1977. He pointed to its high costs, improving Soviet air defenses, the improved capabilities of cruise missiles, and last,

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164 S., *Department of Defense Appropriations for Fiscal Year 1977*, 3002.

165 S., *Department of Defense Appropriations for Fiscal Year 1977*, 541.

166 Kotz, Chapter 13.

167 Kotz, Chapter 13.

168 Kotz, Chapter 13.

169 William Perry, interview by Edward Keefer and Philip Shiman, June 21, 2012, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam%206-21-2012.pdf?ver=2017-10-31-071231-627.

but certainly not least, the dawn of stealth.[170] Thirty years after its creation, the Air Force remained frustrated in its efforts to replace the B-52. Being dealt this blow by a former Naval submariner made the loss sting just a little more.

F. CONCLUSION

Owing its independence as a separate service to the mission of strategic bombardment—a mission conducted by manned bombers—it is no surprise that the airmen of yesterday and the airmen of today consider the mission a central part of its identity. Nevertheless, the Air Force is also a service that is deeply rooted in the pursuit of scientific and technological advancement, which has resulted in a tension. The tension has manifest most outwardly in the types of forces the service has sought to pursue (i.e., missiles vs bombers) and the response it received.

While the B-52s were developed during a period where missiles were not capable enough to execute the Stratofortress' core mission of delivering nuclear weapons, each Air Force-led follow-on bomber effort that was pursued did not enjoy the same freedom. From the advent of ICBMs to cruise missiles, the Air Force quickly found out that its preferences were not strong enough to result in a new bomber program being funded. From the failed attempts of the B-70 to the B-1, the Air Force struggled to convince its civilian leadership of the primacy of the strategic bomber in the missile age. Missiles were not only seen as more effective and cheaper than heavy bombers, but as air defenses advanced, bombers were increasingly viewed as relics of a time gone by. If the Air Force was going to succeed in their quest to get a new bomber, they would not only need to convince the civilian leadership of the need, but a major technological breakthrough would have to occur.

[170] Jimmy Carter, interview by Maurice Matloff and Alfred Goldberg, March 12, 1986, in Atlanta, GA, transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_CarterJimmy03-12-86.pdf?ver=2017-10-12-155232-177.

III. THE ROAD TO STEALTH AND THE DAWN OF THE STEALTH BOMBER

This chapter surveys the key developments—strategic and technological—that would later become the underpinnings of the stealth bomber. It explores the shift in strategic thinking, which began in the late 1960s when it began to be widely understood that the United States' advantage in nuclear weaponry had been matched by the Soviet Union. This was made worse by the reality that the Soviet Union enjoyed a significant numerical advantage in conventional forces and that advances made in air defenses caused many to question whether airpower, especially penetrating air power, was still a viable military tool. With those realizations in mind, this chapters surveys the strategic initiatives that resulted and gave rise to stealth technologies, specifically the Have Blue and Tacit Blue programs that followed. It is only through these critical developments that the stealth bomber could be envisioned.

A. NUCLEAR PARITY AND THE VULNERABILITY OF AMERICAN AIRPOWER

The late 1960s kicked off a major shift in defense thinking. Rather than preparing for a nuclear exchange with the Soviet Union, the United States recognized that a state of nuclear parity between had been reached the two superpowers.[171] The use of nuclear weapons by either side would produce catastrophic levels of destruction. Further, as both sides were in possession of second-strike capabilities, there was no way to prevent a retaliation attack. As a result of the conditions of a nuclear balance, the likelihood that either side would resort to the use of nuclear weapons became prominently low. The chance for a conventionally constrained conflict to break out, however, did not share the same characteristics and low chance of occurrence. For that reason, the goal to assure victory or

[171] Richard A. Hunt, *Melvin Laird and the Foundation of the Post Vietnam Military 1969–1973*, Secretaries of Defense Historical Series, volume 7 (Washington, DC: Historical Office, Office of the Secretary of Defense, 2015), 314.; Gordon. S. Barrass, "The Renaissance in American strategy and the Ending of the Great Cold War," *Military Review*, vol. 90, no. 1, 2010, 103.

succeed in deterrence in a conventional contest became a chief higher priority for both sides.[172]

In recognition of the possibility that a clash between the East and West would likely be limited to a conventional contest, both sides sought to gain the upper hand in this arena. In the East, Soviet and Warsaw Pact member states embarked on a major conventional force buildup in the late 1960s, which continued throughout the 1970s.[173] Complementing their force build up, the Warsaw Pact employed a strategy of "echelonment."[174] The echelonment strategy consisted of two phases: First, there would be a concentrated attack to penetrate NATO's defensive perimeter, most likely through the Fulda Gap in Western Germany. Once a hole was made, second and third echelon forces made up mostly of reservists who would be mobilized in the event of war would stream through the gap to gain physical control over NATO's rear bases to "disrupt the Alliance's ability to send reinforcements into the battle."[175]

In the West, finding a way to counter the Warsaw Pact's strategy with numerically inferior in-theater forces was a daunting challenge if nuclear weapons were not to be used. In 1969, the Joint Chiefs of Staff went so far as to conclude that if United States and NATO force levels remained at current levels, they would be "incapable of conducting a successful forward defense against a determined conventional attack."[176] There were simply not enough available forces to repel such an attack, especially if the second and third echelon forces made it to the forward edge of the battle area. What is more, the quality of Soviet

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[172] President Richard Nixon's National Security Decision Memorandum-95, published in November 1970, reveals the extent to which the shift to conventional warfare occurred. See NSDM 95 for more.

[173] Boyd D. Sutton, John R. Landry, Malcolm B. Armstrong, Howell M. Estes III & Wesley K. Clark "Deep attack concepts and the Defense of Central Europe," *Survival*, 26:2, (1984). 50–70, DOI: 10.1080/ 00396338408442156, 51.

[174] Jim Tegnelia and Rich Wagner: "Technology-Strategy Seminar: NATO's AirLand Battle Strategy and Extended Deterrence," Sept 13, 2013, YouTube video, https://www.youtube.com/ watch?v=rSukv1CcORk&t=3657s.

[175] Sutton et al., " Deep attack concepts and the Defense of Central Europe," 50–70. Tegnelia and Wagner, "Technology-Strategy Seminar: NATO's AirLand Battle Strategy and Extended Deterrence."

[176] Walter S. Poole, *The Joint Chiefs of Staff and National Policy, 1969–1972* (Washington, DC: Office of Joint History, Office of the JCS, 2013), 114–115.

forces had also improved, which decreased the United States' comparative advantage in weaponry.[177]

While already up against the seemingly impossible challenge of defending Europe against a Warsaw Pact offensive, the problem was made worse after analyses of the Vietnam and Yom Kippur Wars were taken into consideration. Both conflicts revealed that the United States no longer commanded a markedly superior qualitative advantage in weaponry, especially in view of the numerical challenge it would face. This was particularly the case in aerial warfare where Soviet-supplied ground-based air defenses called into question whether airpower would remain a sustainable warfighting domain.

During the Vietnam War, Soviet-supplied Anti-Aircraft Artillery (AAA) and Surface to Air Missile (SAM) systems—shot down 2,250 fixed-wing aircraft and approximately 3,500 helicopters.[178] Despite efforts made throughout the conflict to counter the ground-based air defenses through tactics and the fielding of new capabilities (i.e., radar-homing missiles, electronic counter measures (ECM), etc.), the threat could not be fully neutralized. For example, as the war drew to an end in late 1972, 15 B-52 strategic bombers were shot down by enemy SAMs during the Linebacker II bombing campaign.[179] While official Air Force analysis claimed that the losses could have been mitigated through improved tactics, the message that American aircraft, including strategic bombers, were highly vulnerable could not be ignored.[180]

Shortly after the Vietnam conflict concluded, the United States had another chance to assess how American weaponry would fare against Soviet weaponry in the Yom Kippur

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[177] Gordon. S. Barrass, "The Renaissance in American Strategy and the Ending of the Great Cold War," *Military Review*, vol. 90, no. 1, 2010. 103.

[178] Benjamin S. Lambeth, *The Transformation of American Air Power*, Cornell Studies in Security Affairs (Ithaca, N.Y: Cornell University Press, 2000), 13. Detailed analysis of the losses revealed that AAA claimed the lion's share at 89% followed by 8% attributed to SAMs, and a mere 3% to enemy fighters. See: Kenneth P. Werrell, *Archie to SAM: A Short Operational History of Ground-Based Air Defense*, 2nd ed (Maxwell Air Force Base, AL: Air University Press, 2005), 118.

[179] Ronald Bruce Frankum, *Like Rolling Thunder: The Air War in Vietnam, 1964–1975*, Vietnam--America in the War Years, v. 3 (Lanham, Md: Rowman & Littlefield, 2005), 164.

[180] Calvin R. Johnson *Linebacker Operations, September - December 1972,* Project CHECO Southeast Asia Report, Prepared by HQ PACAF, Hickam AFB, HI, 31 Dec. 1978. Declassified from Secret, 60–66.

War in October 1973. This time the war would be fought between Israelis using United States-supplied aircraft and training and a combined force of Egyptian and Syrian forces supplied with the latest Soviet ground-based air defense systems and training. Of the new Soviet systems, the SA-6 and ZSU-23-4 were especially challenging to the Israelis ability to employ airpower.[181] Not only did their mobility help these ground-based systems elude attack by the Israelis, but the new systems were also equipped with improved radars and counter-counter measure systems.[182] By the war's end, approximately 150 Israeli aircraft had been lost to Soviet-made air defense systems.

The staggering number of American-made aircraft losses to Soviet-supplied enemy air defenses prompted the Pentagon to deploy a team of analysts to Israel to assess what went wrong.[183] The data brought back was then extrapolated and applied to a conventional war game between the U.S. and the Soviet Union. The war game revealed that United States Air Forces in Europe would be destroyed in under three weeks if faced with similar capabilities.[184]

The conflicts in Vietnam and the Yom Kippur Wars revealed that American weaponry suffered from significant vulnerabilities. The viability of conventional and strategic airpower was brought into question. Not only could American and NATO forces no longer rely on American strategic bombers to penetrate Soviet borders in a worst-case scenario, but as conventional conflict came to the fore, the use of airpower in a conventional role no longer appeared viable. To prevail in a conventional contest against the Soviet Union and to ensure the survivability of the penetrating bomber, the United States would need a significant breakthrough in terms of both strategy and capability.

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181 Werrell, *Archie to SAM,* 149–155.

182 Werrell*,* 149–155.

183 Joseph S Doyle, *The Yom Kippur War and the Shaping of the United States Air Force* (Maxwell AFB, AL, 2019), 18.

184 Edward C. Keefer, *Harold Brown: Offsetting the Soviet Military Challenge 1977–1981*, Secretaries of Defense Historical Series, Volume 9 (Washington, DC: Historical Office, Office of the Secretary of Defense, 2017), 575.

B. A WING AND A THEORY: THE BIRTH OF STEALTH

The goal of developing a low-observable aircraft can trace its origins to World War II, though it was not until the 1970s when advances in computing and manufacturing made the development of such an aircraft possible. Stimulated by these new technologies and motivated by the staggering numbers of air losses during the Vietnam and Yom Kippur Wars, the idea of building an aircraft that was undetectable to enemy air defenses began to be viewed by some as more than just science fiction. Surprisingly, this initial group of believers came from outside the Air Force.

Established in 1958 in response to the launch of Sputnik, the Advanced Research Project Agency (ARPA), was created "for the direction or performance of such advanced projects in the field of research and development as the Secretary of Defense shall, from time to time, designate by individual project or by category."[185] While ARPA's mission was somewhat vague, the motivation for its creation came from the space race. However, once National Aeronautics and Space Administration (NASA) stood up that same year alongside an increased effort by the military services to develop space capabilities, ARPA's central focus became less clear.[186] It remained an organization in search of a defined mission until the early 1970s.[187] It was not until 1974, upon Malcolm Currie's appointment as Director of Defense Research and Engineering (DDR&E), the office responsible for the newly named Defense Advanced Research Project Agency (DARPA), that its mission ambiguity would finally come to an end.[188]

Around the same time as Currie became the DDR&E, a Defense Science Board (DSB) study released sobering conclusions about the devasting losses that would befall United States and NATO forces should Soviet and Warsaw Pact forces punch across the

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[185] Department of Defense Directive, Department of Defense Advanced Research Projects Agency. February 7, 1958. https://www.darpa.mil/ddm_gallery/ARPA-Founding-Directive.JPG

[186] Richard J. Barber Associates, Inc., *The Advanced Research Projects Agency, 1958–1974*, December 1975, III-9.

[187] Barber, *The Advanced Research Projects Agency*, X-3.

[188] Malcom Currie, interview by Peter J. Westwick, May 9, 2013, in Agoura, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/9220/rec/1.

Fulda Gap into West Germany.[189] While much in line with the previous analyses discussed above, the DSB study confirmed the major challenges that faced the West in their goal to win or deter a conventional conflict against the Soviet Union and paid particular attention to "the proliferation of advanced networked air defenses."[190] In consideration of these new air defense capabilities, the study concluded that without "game-changing capabilities," United States and NATO forces would be unable to repel an invasion without resorting to nuclear weapons.[191] Keeping conflict below the nuclear threshold was critical to NATO, as the West Germans feared their country becoming a "nuclear wasteland" and "would never authorize nuclear use on German territory, which was their right by the North Atlantic Treaty."[192]

Currie believed that DARPA was the right organization to lead the charge towards developing game-changing conventional capabilities.[193] The problem was that DARPA, according to Currie, was quickly on its way to becoming "just another well-functioning bureaucracy suffering from encroaching middle age."[194] To "get DOD's R&D back on track," Currie got straight to the point and informed DARPA's director, Dr. Stephen Lukasik, that the "innovation coming out of DARPA was inadequate."[195] It was Currie's view that DARPA's niche in R&D should be in taking risks and tackling "big projects that could make a difference."[196] In response, Lukasik put out a wide call for ideas—even

189 Ian A. Maddock, *DARPA's Stealth Revolution: Now You See Them… in DARPA 50 Years of Bridging the Gap* (DARPA, 2012), 152. https://www.darpa.mil/attachments/(2O24)%20Global%20Nav%20-%20About%20Us%20-%20History%20-%20Resources%20-%2050th%20-%20Stealth%20(Approved).pdf.

190 Maddock, *DARPA's Stealth Revolution*, 152.

191 Maddock, 152.

192 James Tegnelia, email message to author 23, August 2021.

193 Richard H. Van Atta, Seymour J. Deitchman, and Sidney G. Reed, *DARPA Technical Accomplishments,* Volume III (Alexandria, VA: Institute for Defense Analyses, 1991), II–14.

194 Van Atta et al., *DARPA Technical Accomplishment*, II–14.

195 Van Atta et al., II–14.

196 Van Atta et al., II–14.

radical ones—that could assist the United States and addressing its strategic challenges.[197] Of the many ideas that came forward, the idea of reducing an aircraft's signature to a point where it could fly undetected by radar quickly gained traction.[198]

By the early 1970s, two men—Charles Myers and Robert Moore—believed that state of the art might have advanced enough to make the design of a low-observable aircraft a real possibility. The primary goal for the aircraft would be to exploit the laws of physics through passive measures: coating and shaping.[199] The aircraft's mission and air-worthiness, while important, were not the primary objective. To say this approach was radical would be an understatement.

As it happened, Myers worked in the office of DDR&E as Currie's air warfare program director. As part of his regular interface with DARPA, Myers discussed the possibility of developing a low-observable aircraft with Robert Moore, the head of DARPA's Tactical Technology Office.[200] Moore was quickly sold on the idea and thought this could be just the type of project that Currie and Lukasik were looking for DARPA to lead. Moore quickly dubbed the low-observable aircraft project with the name that remains today, "stealth," and ran it up his chain of command.[201] The quest for a "game-changing" stealth aircraft was on.

To lead the stealth program—commissioned as the eXperimental Survivable Testbed program (XST)—Moore selected Ken Perko, who had just transitioned to DARPA from Air Force Systems Command and had the unique background of working with

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197 Robert H. Van Atta et al., *Transformation and Transition: DARPA's Role in Fostering an Emerging Revolution in Military Affairs*, Volume I – Overall Assessment, Institute for Defense Analyses Paper P-3698 (Institute for Defense Analyses: Alexandria, VA, April 2003), 12.

198 Robert H. Van Atta et al., *Transformation and Transition: DARPA's Role in Fostering an Emerging Revolution in Military Affairs,* Volume II – Detailed Assessments, Institute for Defense Analyses Paper P-3698 (Institute for Defense Analyses: Alexandria, VA, November 2003), I-1 to I-2.

199 Van Atta et al., *Transformation and Transition,* Volume II, 11.

200 Van Atta et al., *Transformation and Transition*, Volume I, I-1 to I-2.

201 Van Atta et al., *Transformation and Transition, Volume II,* I-1 to I-2. Myers originally called the project "Harvey" after a movie depicting an invisible rabbit in the 1950s.

remotely piloted vehicles designed to decrease their signature to radar.[202] Perko's bureaucratic acumen and unique background were a potent mix to get the XST project up and running. His first order of business was to cast a wide net to defense aerospace corporations for concept studies. The stated goal for XST, as was originally envisioned by Myers and Moore, was to design an aircraft using "passive measures (coating and shaping) rather than depending on support aircraft carrying jammers."[203] Accordingly, Perko asked each company to respond to two questions:

> First, what were the signature thresholds that an air vehicle would have to achieve to be essentially undetectable [primarily to radar sensors] at an operationally useful range? Second, what were the capabilities of each company to design and build an aircraft with the necessary low signatures?[204]

After evaluating the responses, Perko selected Northrop and McDonnell Douglas as the contenders that showed the most promise.[205] Each company was subsequently awarded $100,000 to develop their ideas further.[206]

Lockheed, the company that would go on to develop the F-117, was not included in the original XST call for white papers. The reason for their exclusion was twofold. First, they were not considered a tactical aircraft designer. Second, their previous work on incorporating low-observable design features in programs like the SR-71 and A-12 was so classified that DARPA had no knowledge of their involvement.[207] Nevertheless, as the XST program had yet to be put under deep security, the head of Lockheed's Skunk Works,

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202 Van Atta et al., *I-2.* Institute for Defense Analyses Paper P-3698, *Overall Assessment*, (Institute for Defense Analyses: Alexandria, VA, April 2003), 12.; Westwick, *Stealth,* 26.

203 Van Atta et al., *Transformation and Transition,* Volume I, *Institute* for Defense Analyses Paper, P-3698, 11.

204 David C. Aronstein and Albert C. Piccirillo, *Have Blue and the F-117A: Evolution of the Stealth Fighter* (Reston, VA: American Institute of Aeronautics & Astronautics, 1997), 14.

205 Aronstein and Piccirillo, *Have Blue and the F-117A*, 14.

206 William D. O'Neil, W*hat to Buy? The Role of Director of Defense Research and Engineering (DDR&E)*: lessons from the 1970s, Institute for Defense Analyses P-4675 (Alexandria, VA, January 2011), 63.

207 Aronstein and Piccirillo*,* 14–15.; Ben R. Rich and Leo Janos, *Skunk Works: A Personal Memoir of My Years at Lockheed* (London: Warner, 1995), 23–24.

Ben Rich, got wind of the program.[208] After getting permission from the Central Intelligence Agency to share their previous work on low-observables with DARPA, Rich got Lockheed added to the contest.[209] Thus, by the spring of 1975, three companies were in the hunt to build the XST and the aircraft's feasibility seemed more likely.[210] Recognizing that the XST program would likely materialize into a full-scale flight demonstration, in late 1974 DARPA's new director, Dr. George Heilmeier, concluded that if XST had any chance to become operational, the Air Force would have to be a committed partner.[211]

By 1975, the Air Force had mounted a full court press to get its long-sought replacement for the B-52: the B-1 bomber. Despite concerns over air defense systems, the Air Force held to its belief that a high-speed, low-altitude bomber equipped with advanced ECM would keep the strategic bomber viable.[212] Simultaneously, the Air Force was set on procuring a modern fleet of fighter aircraft. Viewing the Vietnam War as further evidence that gaining air superiority[213] was critical to the employment of airpower, they were set on finalizing the procurement of the F-15 and developing a new Lightweight Fighter, what would later become the F-16.[214] Anything that might challenge those efforts

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208 Rich and Janos, *Skunk Works*, 23–24.

209 Aronstein and Piccirillo, 14–15.; Rich and Janos, 23–24.

210 Critical to Lockheed's entrance into the competition was Ben Rich's approval to share early efforts to decrease detectability in the U-2 and SR-71 programs that were so highly classified by the CIA that DARPA did not know of them. See Rich and Janos, 22–25.

211 Van Atta et al., *Transformation and Transition, Volume I,* 13.; George Heilmeier, interview by Unknown, January 16, 2007 in Unknown, transcript, https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/DARPA/15-F 0751_DARPA_Director_George_Heilmeier.pdf.

212 General Accounting Office, *Staff Study,* 1.

213 In addition to other missions (i.e., Close Air Support, Aerial Interdiction, etc.), official Air Force analysis following the Vietnam War concluded that air superiority greatly increased the chances of bombers making it to their targets. See: Melvin F. Porter., *Linebacker: Overview of the First 120 Days*, Project CHECO Southeast Asia Report, Prepared by HQ PACAF, Hickam AFB, HI, 27 Sept. 1973. Declassified from Top Secret. 63.

214 Van Atta et al., *Transformation and Transition: Volume 1,* 13.; Malcom Currie, interview by Peter J. Westwick, May 9, 2013 in Agoura, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/9220/rec/1; David C. Jones, Chief of Staff of the United States Air Force, *Department of Defense Appropriations for Fiscal Year 1976: Hearings Before the Senate: Subcommittee on Appropriations,* 94th Cong. 1st Session (February 26, 1975), 118.

would receive stiff resistance, especially if it seemed like it came from a science fiction novel.

The Air Force's senior brass at the Pentagon and in the Air Force's major commands were initially loath to join DARPA in their stealth aircraft development program for several reasons. There was a general concern that if such a technology was proven, the B-1 and existing fighter aircraft programs that did not incorporate it would be viewed as obsolete.[215] The numbers of aircraft in the Air Force's inventory would also likely decrease, which did not sit well for those who wanted the Air Force to grow.[216] The Air Force was also convinced that Soviet air defense radars had become highly capable and could not be mitigated by passive measures alone. This caused the Air Force to put its faith in the B-1's low altitude capabilities and improved ECM support.[217] Air Force officers also reacted badly to the idea of investing in a "non-traditional concept" that sacrificed aerodynamic performance.[218] The idea that DARPA was leading the development of a combat aircraft was anathema, if not humorous, to the blue suiters.[219]

Despite Air Force resistance, especially from senior leaders who believed that "nobody but the Air Force builds Air Force aircraft," there was a great deal of cooperation on the XST program between lower-level personnel from the Air Force and DARPA.[220] According to Dr. James Tegnelia, who worked for Ken Perko, "the technical competence on the DOD side was from the Air Force," and most of the DARPA people had Air Force

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215 Keefer, *Harold Brown:* 578–579.

216 On September 15, 2021, the author spoke with Dr. James Tegnelia where he stated "The Air Force leadership (primarily General Wilber Creech) believed that the strategy of a larger Air Force was the most effective strategy for the Air Force with or without stealth. A smaller Air Force dependent on stealth was a riskier strategy for air superiority particularly before stealth was thoroughly investigated. U.S. military, in general, will not agree to applying technical improvements to offset force size because as a rule, countermeasures to technical advances are developed by a potential enemy and the U.S. is thus left with a smaller less effective force."

217 Rich and Janos, 18.

218 Van Atta et al., *Transformation and Transition Volume II,* S-3.; George Heilmeier, interview by Unknown, January 16, 2007 in Unknown, transcript, https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/DARPA/15-F-0751_DARPA_Director_George_Heilmeier.pdf

219 Heilmeier, interview, January 16, 2007.

220 James Tegnelia, email message to author November 15, 2021.

backgrounds.[221] Nevertheless, for the program to succeed, the Air Force's top brass, especially its Chief of Staff, had to be onboard.

Heilmeier decided to bring the issue directly to the Chief of Staff of the Air Force, General David C. Jones, whose senior staff had largely kept him shielded from the progress being made in the XST program.[222] Heilmeier's presentation and gamble of going directly to the top worked. Jones directed that the Air Force commence a formal partnership with DARPA on the XST program.[223] Jones also agreed, albeit with a promise from Currie that the Air Force's Lightweight Fighter and B-1 programs would not lose any funding, that the Air Force would also use its R&D monies to support the XST program.[224]

Shortly after the Heilmeier-Jones meeting, DARPA and the Air Force came to an agreement on the radar cross section (RCS) value a stealth aircraft would have to achieve to remain undetected to enemy radar and solicited Northrop, Lockheed and McDonnell Douglas to generate proposals.[225] Harnessing the power of state-of-the-art computer technology to calculate the RCS of stealth aircraft design concepts, both Lockheed and Northrop put forward promising designs and were selected to move to the next phase of the XST competition.[226] McDonnell Douglas, however, took a different approach and was eliminated as they leaned too heavily on previous designs and relied on ECM—the opposite of what the XST program was about.[227] The next phase of the competition was to produce full-scale models and submit them to a battery of radar tests at the newly constructed Air Force Radar Target Scatter facility in New Mexico.[228]

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[221] James Tegnelia, email message to author August 23, 2021.

[222] Heilmeier, interview, January 16, 2007.; O'Neil, "What to Buy?" 64–65.

[223] Heilmeier, interview, January 16, 2007.

[224] Aronstein and Piccirillo, 28; Van Atta et al., *DARPA's Role in Fostering an Emerging Revolution in Military Affairs*, Volume II, Detailed Assessments, I–4.; Keefer, Harold Brown, 579.

[225] Westwick, *Stealth*, 29.

[226] Aronstein and Piccirillo, 195–196.; Rich and Janos, 19–21.

[227] Aronstein and Piccirillo, 26 & 29.

[228] Westwick, 29; Aronstein and Piccirillo, 195–96.

In what has come to be known as a "pole off" due to model aircraft being mounted atop a pole and blasted with radar to determine RCS values across a broad spectrum of frequencies, Lockheed and Northrop dueled against one another in March 1976. Both companies knew the stakes. The prize for winning the XST competition would likely be followed by a high dollar procurement contract and continued work in a revolutionary new military technology. While the actual results remain classified, most accounts of the competition conclude both Northrop and Lockheed were able to achieve remarkably low RCSs.[229] Lockheed's Skunk Works was ultimately awarded the prototype contract in April 1976 because it was thought their production proficiency was on a level ahead of Northrop.[230]

Following Lockheed's victory in the XST shoot out, DARPA transitioned management of the program to the Air Force but remained a partner which provided technical expertise and funding.[231] The new full-scale R&D program was given the codename, "Have Blue." Have Blue went from contract award to flyable prototype in less than twenty months with its first flight taking place on December 1, 1977.[232] Designed with stealth rather than aerodynamic performance as the primary design objective, the aircraft utilized a first-of-its-kind, highly faceted design, which resembled a diamond with sharp angles to minimize radar returns. While the design muted radar returns, the aircraft was highly unstable and caused many to call Have Blue "the hopeless diamond."[233] To overcome the issue of an unstable aircraft, Lockheed was required to install advanced digital fly-by-wire technology that made it possible to control the aircraft.[234] Without this technology, there is a very real possibility that Have Blue would have failed.

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229 Ken Perko in John M. Griffin, *Pioneers of Stealth: from Have Blue to B-2*, Lulu Publishing, 2017, 265.; Aronstein and Piccirillo, *Have Blue and the F-117A*, 32.

230 Aronstein and Piccirillo, 33.

231 James Tegnelia, email message to author August 23, 2021.

232 Westwick, 94.

233 Rich and Janos, 26.

234 Aronstein and Piccirillo, 39.; James Tegnelia, email message to author August 23, 2021.

The revolutionary shaping of Have Blue resulted in an aircraft that according to Ben Rich had the radar observability the size of a "ball bearing."[235] It promised to be the "game-changer," DARPA had set out to find years earlier. To be sure, the program suffered its share of setbacks throughout the test program as both prototypes ultimately crashed. Nevertheless, Have Blue flew 88 test sorties in total between the two prototype aircraft and convinced the Air Force and DOD that the world's first operational stealth aircraft was within reach.[236] The final question that remained was how large the combat production model could be without comprising its stealth characteristics.

To answer the question of size, in October of 1977, about a year prior to Lockheed's production contract being signed and just months after President Jimmy Carter made the decision to cancel the B-1 program, the Air Force provided Lockheed with $11.1 million to conduct a concept definition study that compared and contrasted two options for the operational version of Have Blue.[237] The first option, "Advanced Tactical Aircraft-A," was about 5 times larger than Have Blue, with a payload of 5,000 pounds and a combat radius of 400 nautical miles.[238] The second option, "Advanced Tactical Aircraft-B," was about 7 times larger, with a payload of 7,500 pounds and a combat radius of 1,000 nautical miles.[239]

As would be expected in light of the B-1's cancellation, many in the Air Force, especially those in Strategic Air Command, desired the "B-variant" due to its heavier payload and longer range.[240] The problem with an aircraft of that size, however, was that as the volume of the aircraft increased, so did its weight whereby keeping the aircraft airworthy with Have Blue's low-observable faceted design was deemed "not technically

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235 Rich and Janos, 36, 63.

236 Keefer, 580–581.

237 Aronstein and Piccirillo, 56.

238 Paul G. Kaminski, "Low Observables: The Air Force and Stealth," in *Technology and the Air Force: A Retrospective Assessment*, eds. Jacob Neufeld, George M. Watson, Jr., and David Chenoweth, (Washington, DC: Air Force History and Museums Program, 1997), 302.; Aronstein and Piccirillo, *Have Blue and the F-117A*, 56.

239 Kaminksi, "Low Observables," 303.; Aronstein and Piccirillo, 56.

240 Kaminksi, 303.; Joseph Ralston in *Pioneers of Stealth*, 268–269.

feasible."[241] Chief of Staff of the Air Force, General Lew Allen, concurred with that assessment and recommended that the "A-variant" move forward.[242] While Allen served a few years as a bomber pilot, he spent most of his career in science and technology positions leveraging his PhD in nuclear physics and was the first Chief to come from such a background. In contrast, Chairman of the Joint Chiefs of Staff, Air Force General David C. Jones, never received a college education but was known to possess a "brilliant intellect and a lot of courage."[243] He was also a highly decorated bomber pilot in the Korean War, served as an Aide-De-Camp to General Curtis Lemay, and rose to the highest position in the United States military. Despite the differences in background, the two men agreed with the assessment that the "A-variant" would not only be less risky, but that lessons learned from the program could later be applied to a future aircraft—a stealth bomber.[244] DDR&E William Perry and Secretary of Defense Harold Brown concurred.[245] The production contract was signed in November 1978 under the new codename of "Senior Trend," and later, when it became operational, it was dubbed the F-117 Nighthawk.[246]

C. THE STEALTH BOMBER BECOMES POSSIBLE

With the stealth fighter—Senior Trend—in development, the next technological puzzle was how to efficiently apply stealth to an aircraft the size of a bomber while maintaining its airworthiness. After the Senior Trend contract was signed, efforts by Lockheed set out to do just that by continuing their "B-variant" studies. Still, what was unknown to Lockheed, or anyone at the time, was that a little-known DARPA and Northrop initiative—Tacit Blue—which can trace its origins to 1973 would play a critical role in the forthcoming stealth bomber competition.

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241 Aronstein and Piccirillo, 58.

242 Kaminksi, 303.

243 Kelly Burke., interview by Hugh Ahmann, April 22–23, 1991, in Shalimar, FL, transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell AFB, AL. 282.

244 Kaminksi, 303.; Aronstein and Piccirillo, *58.*

245 Joseph Ralston in Griffin, *Pioneers of Stealth,* 269.

246 Keefer, 582.; Aronstein and Piccirillo, 60.

246 Joseph Ralston in Griffin, *Pioneers of Stealth*, 269.

In the summer of 1973, DARPA's Director, Stephen Lukasik, and the Director of the Defense Nuclear Agency, Jack Rosengren, commissioned the Long Range Research and Development Planning Program (LRRDPP).[247] Motivated to find solutions to deter or win in a conventional conflict against a numerically superior Soviet Union, the purpose of the study was to "to identify and characterize those technologies that would have to be developed to provide the National Command Authority with a variety of options suitable for response to limited Soviet aggression as alternatives to massive nuclear retaliation."[248] More specifically, the LRRDPP was an effort to deter or keep conflict below the nuclear threshold through the use of conventional technologies and strategies. While not explicitly studied as a scenario, the Fulda Gap was the prime motivator behind the LRRDPP.[249]

After two years of inquiry, the study's findings were released in February 1975. While many recommendations were put forward, the most consequential was the call for the U.S. to develop "near zero miss, non-nuclear weapons…as alternatives to massive nuclear destruction."[250] To qualify their recommendation, the authors stated:

> A United States force which could make highly effective attacks with low collateral damage [read precision weapons] would provide the National Command Authority available options for response to Soviet limited aggression which would not otherwise be available; the effect of this capability would be to deter limited aggression in the first place, since the credibility of a United States response with this type of attack would be much higher than that of a United States response in which millions of civilians would be killed.[251]

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247 To lead the LRRDPP, Lukasik and Rosengren enlisted heavy hitters across the U.S. defense apparatus, notably Albert Wohlstetter. The directors of DARPA and the Defense Nuclear Agency hoped Wohlstetter's notoriety would overcome any resistance to the study as it was commissioned outside the walls of the Pentagon. See: Sharon Weinberger, The *Imagineers of War: the Untold History of DARPA, the Pentagon Agency That Changed the World* (New York: Alfred A. Knopf, 2017).

248 D. A. Paolucci, *Summary Report of the Long Range Research and Development Planning Program*, Draft, February 7, 1975, declassified from Top Secret, 2. Available from *www.albertwohlstetter.com/writings/LRRDPP.* Of note, there is no evidence to suggest that Currie motivated the commissioning of the LRRDPP.

249 Weinberger, *The Imagineers of War*, 216.

250 Paolucci, *Summary Report of the Long Range Research and Development Planning Program*, 2.

251 Paolucci, 7–8.

In their view, the possession of "low collateral damage, near zero miss" weapons would change the decision calculus on both sides of the equation.[252] The United States would be more willing to use the weapons if pressed, and the Soviets would be less willing to press the United States due to a perception that there was a higher likelihood they would respond with discriminate force. For such weapons to be effective, though, the authors realized that targets must first be located—a recommendation that would feature prominently in one of the many DARPA follow-up initiatives.

In response to the recommendations that came from the LRRDPP, DARPA commenced a follow-on project entitled the Integrated Target Acquisition and Strike System in 1975.[253] The goal for the endeavor was to identify the technologies that would be required for "attacking armor deep in enemy territory using airborne reconnaissance to guide long-range missiles carrying terminally guided submunitions."[254] As was the case with the LRRDPP, the effort was highly motivated by the Fulda Gap scenario. It was thought that if Soviet forces could be located and interdicted before they reached the Forward Edge of the Battle Area (FEBA), then their numerical advantage could be negated.[255] To achieve this, the Integrated Target Acquisition and Strike System recommended that disparate technologies including ISR (i.e., sensing), strike (i.e., missiles and submunitions) and battle management (i.e., command and control) capabilities would

252 As precision laser guided weapons were used to great effect at the conclusion of Vietnam and in the Yom Kippur War, it is likely the authors were influenced by those conflicts. For more on the first uses of precision, laser guided munitions see: David R. Mets, "Stretching the Rubber Band: Smart Weapons for Air-to-Ground Attack," in *Technology and the Air Force: A Retrospective Assessment*, eds. Jacob Neufeld, George M. Watson, Jr., and David Chenoweth, (Washington, DC: Air Force History and Museums Program, 1997), 130.; Joseph S Doyle, *The Yom Kippur War and the Shaping of the United States Air Force,* (Maxwell AFB, AL 2019), 40.

253 Robert C. Wolcott and Michael J. Lippitz, *Innovation in Government: The United States Department of Defense—Two Cases* (London, 2021), 8.; Van Atta et al., *Transformation and Transition*: Volume I, 17.

254 Wolcott and Lippitz, *Innovation in Government*, 8.; Van Atta et al., *Transformation and Transition*, Volume I, S-4.; Van Atta et al., Transformation and Transition, Volume 2, S-6.

255 Wolcott and Lippitz, *Innovation in Government*, 8.

need to be employed as a coherent system.[256] But with the various capabilities and missions existing in different services, "no one in the DOD was approaching the challenge as a system."[257] To be sure, the development of the technologies to make the system work would be a challenge in itself, but so too was the daunting task to get the services to work together.[258] Not to mention, the recommendations from the Integrated Target Acquisition and Strike System project were sponsored by DARPA—a reason in itself to provoke service resistance. If DARPA was to get traction, they would need help.

In an effort to further the thinking on how the United States could prevail in a conventional contest with the Soviet Union, the Secretary of Defense Donald Rumsfeld commissioned a 1976 DSB study entitled, "Conventional Counterforce Against a Pact Attack." [259] While the DSB study was not directly motivated by the LRRDPP or the Integrated Target Acquisition and Strike System concept, it proved to be a boon for both and contained many parallel lines of inquiry. Accordingly, its main task was to investigate the "means for achieving improvements in non-nuclear land warfare capabilities of the NATO force to counter a Warsaw Pact attack in Central Europe." To that end, the DSB study concluded in the summer of 1977 that the Secretary of Defense should establish an office to oversee the "development of such a system" of strike, ISR and battle management capabilities as were called for in the original Integrated Target Acquisition and Strike System study.[260] A year after the DSB findings were released, the new Secretary of

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256 David W. Cheney and Richard Van Atta, "DARPA's Process for Creating New Programs" in William B. Bonvillian, Richard Van Atta, and Patrick Windham (eds.), *The DARPA Model for Transformative Technologies Perspectives on the U.S.: Defense Advanced Research Projects Agency* (Cambridge, UK: Open Book Publishers, 2019), 246. https://doi.org/10.11647/OBP.0184.

257 Wolcott and Lippitz, *Innovation in Government*, 9.

258 Wolcott and Lippitz, 9.

259 While it was not directly stated, the 1976 DSB study was a direct outgrowth of the LRRDPP. See: Defense Science Board, *1976 Summer Study Final Report* on *Conventional Counterforce Against a PACT Attack* ODDR&E, May 26,1977 (Declassified from Secret), 1.

260 Defense Science Board, *Conventional Counterforce Against a PACT Attack,* 21.; Robert R. Tomes, "Military Innovation and the Origins of the American Revolution in Military Affairs," (PhD diss., University of Maryland 2004), 260.

Defense, Harold Brown, and his DDR&E, William Perry, did exactly that in August 1978 when they established the "Assault Breaker" program with DARPA at the helm.[261]

By the time DARPA was formally designated to lead the DOD's Assault Breaker program, they had already accomplished much of the foundational technological development work that would be vital to make the system work. Since Assault Breaker was conceptually in-line with the Integrated Target Acquisition and Strike System, the basic premise behind each was to leverage advanced airborne ISR sensors to locate targets behind enemy lines, which would then be transmitted to strike assets for subsequent destruction.[262] To find targets, especially deep targets, behind enemy lines, DARPA knew that they would need a survivable airborne ISR platform.[263] It would orbit on the fringes of friendly territory and employ a Low Probability of Intercept Radar with a Moving Target Indicator and Synthetic Aperture Radar for imaging to find targets.[264] The platform would then push off its collected target information to a battle management center who would then direct strike assets to destroy the located targets. If that were not challenging enough, the aircraft would also have to be low observable so as not to get shot down by enemy air defenses.[265] At the time of conception, the technology did not exist for either the airframe or the radar. The effort to develop the unique radar for this mission and the low-observable airframe that would carry it was called the Battlefield Aircraft Surveillance eXperimental (BSAX) program. And luckily, DARPA had already started on its development in advance of the formal designation of the Assault Breaker program.

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261 Keefer, 588.

262 Keefer, 586–588.

263 David W. Cheney and Richard Van Atta, "DARPA's Process for Creating New Programs" in William B. Bonvillian, Richard Van Atta, and Patrick Windham (eds.), *The DARPA Model for Transformative Technologies Perspectives on the U.S.: Defense Advanced Research Projects Agency*. Cambridge, UK: Open Book Publishers, 2019, 246. https://doi.org/10.11647/OBP.0184; Van Atta and Lippitz Vol 1, 17–18; Wolcott and Lippitz, *Innovation in Government,* 8.; Defense Science Board, *Conventional Counterforce Against a PACT Attack,* 21.

264 Westwick*,* 125.; John Cashen, interview by Peter J. Westwick, December 15, 2010 in Space Park, California, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45053/rec/1.; Aronstein and Piccirillo, *Have Blue and the F-117A*, 33.

265 Westwick*,* 125.; John Cashen, interview, December 15, 2010.; Aronstein and Piccirillo, 33.

Starting in December 1976, over a year and a half before Assault Breaker was started, DARPA initiated the BSAX program after it comprehended the technological requirement for the capabilities that would be needed to enable the Integrated Target Acquisition and Strike System. DARPA selected Hughes aircraft to design the Low Probability of Intercept Radar with Moving Target Indicator and radar imaging capability. The decision for Hughes was a natural one as DARPA was already engaged with them in an unclassified project named Pave Mover, a radar that shared many of the characteristics envisioned for the BSAX version.[266]

The decision to award the contract for the low observable aircraft, which would house the advanced radar was made for a different reason. Just months before the BSAX program started, Northrop had lost the XST competition by a small margin and had no forthcoming stealth projects in sight. If that remained the case, Lockheed would be in a monopolistic position.[267] And, perhaps more importantly, DARPA surmised that having two firms involved in the development of stealth aircraft would create the conditions of a competitive environment, which could expand the envelope of known possibilities. Hence, in December 1976, DARPA awarded Northrop the contract to develop the low observable BSAX aircraft—the highly-secretive effort which would become known as the Tacit Blue.

Unlike the XST program, the BSAX mission called for a design that would conceal the aircraft from side detection instead of only from the nose and tail.[268] This meant that Northrop's design challenge was to find a way to conceal the largest part of the airplane—the side that would be exposed to enemy radars as it flew up and down enemy borders with its surveillance radar searching for enemy positions. Challenged by this mission requirement, Northrop engineers persevered and discovered that by using curvilinear shaping rather than facets they could not only conceal the largest cross section of the aircraft to radar but could also add volume without compromising the stealth

[266] John Cashen, interview by Peter J. Westwick, December 15, 2010.

[267] Westwick, 124.; Aronstein and Piccirillo, 33.

[268] John Cashen, interview by Peter J. Westwick, December 15, 2010.

characteristics.[269] And in contrast to facets as was the case with Lockheed's XST winning design, the curved edges allowed for a more aerodynamically stable and efficient design—a feature that would prove consequential in the future stealth bomber competition—a prospect that neither Lockheed or Northrop would have envisioned at the time.[270]

Based on initial successful testing of Northrop's BSAX aircraft design, in April 1978 the Air Force and DARPA awarded Northrop with a sole-source contract[271] to build two flyable prototypes for testing under the codename of "Tacit Blue."[272] While the mission for Tacit Blue remained focused on locating targets deep in enemy territory via a survivable aircraft and an advanced radar surveillance system, the breakthrough of using curved edges to achieve low observability was just the outcome the DARPA leaders had hoped for when they brought Northrop on the BSAX contract in late 1976 .[273] The discovery that curved edges, instead of facets, could enable "all aspect stealth" while retaining aerodynamic efficiency would later become the key reason why Northrop was invited to the stealth bomber design competition.[274]

D. CONCLUSION

In reflecting on the period covered in this chapter, William Perry stated "In the last decade or so, the advantage has shifted from the airplane, from the offense, to the defense—from the airplane to the systems that are defending against it…what low-observable

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269 The story of how Northrop was able to achieve stealth through curved designs is well told in Peter J. Westwick, Chapter 9.

270 James Kinnu, interview by Volker Jannsen, December 8, 2010, in Fountain Valley, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45046/rec/11.; Westwick, *Stealth,* 133.

271 The story of how Northrop gained a sole-source contract is well-told in Westwick, Chapter 9.

272 Irving Waaland, interview by Volker Janssen, November 10, 2010, in Fullerton, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45052/rec/1.; Westwick, 133.

273 Of Note, the first Tacit Blue prototype would not fly until 1982.

274 Kent Kresa, interview by Peter J. Westwick, December 7, 2018, in Bel Air, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45047/rec/2

technology, the stealth technology, does, is to shift it back."[275] Thus, while the 1970s began under inauspicious conditions, which cast grave doubt on the future utility of strategic bombers, the advent of stealth technologies, notably the Have Blue and Tacit Blue programs, would prove to give the strategic bomber a new lease on life. And with the decision by the Carter administration to cancel the B-1 in the summer of 1977, the arrival of stealth could not have come at a more propitious time for the Air Force.

[275] William Perry, interview by Arthur Goldberg, January 9, 1981, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., (Declassified from Secret). https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam1-9-81.pdf?ver=2020-03-02-085133-340.

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IV. THE BIRTH OF THE B-2 STEALTH BOMBER

This chapter explores the harmony that was achieved between the bureaucratic, technological, political, and strategic forces, which led to the contract between the Air Force and Northrop to develop the world's first stealth bomber in 1981. First, it examines the origin and implementation of the "offset strategy" to counter Soviet numerical superiority, which was conceived by Secretary of Defense Harold Brown and implemented by his Director of Defense Research and Engineering (DDR&E) William "Bill" Perry under the Jimmy Carter administration. It explores the criticality of stealth to the realization of the offset strategy and how the Have Blue and Tacit Blue programs contributed to the idea that it was possible to develop a long-range, high payload stealth bomber. This idea would later manifest as the Advanced Strategic Penetrating Aircraft (ASPA), a concept which would survive the transition from the Carter to the President Ronald Reagan administration. The chapter pays particular attention to how Reagan's campaign promise to revive the B-1 impacted the ASPA program, especially in the decision of when to start its development and in the expansion of its requirements, both of which contributed to the selection of Northrop as the winner of the stealth bomber contract. Finally, the chapter explores how Air Force brass maneuvered through diverse political climates and managed entrenched bureaucratic interests to finally get not one bomber, but two bombers, under development by the end of 1981.

A. THE OFFSET STRATEGY AND THE STEALTH BOMBER CONCEPT

By the late 1970s, the strategic aims that had germinated at the start of the decade—to overcome the Soviet Union's numerical superiority via technological dominance—were in full bloom. The result was the so-called "offset strategy," whose creation is credited to President Jimmy Carter's Secretary of Defense, Harold Brown. The offset strategy would have a profound impact on the genesis of the stealth bomber.

Brown earned a PhD in physics at age 21.[276] Soon thereafter, he joined the Lawrence Radiation Laboratory in Livermore, California where he led a team of physicists that reduced the size of nuclear warheads so that they would be better suited for submarine deployment.[277] In 1960, he was named director of Lawrence Livermore Laboratory following in the footsteps of Edward Teller.[278] After less than a year, Secretary of Defense McNamara asked him to serve as his Director of Defense Research and Engineering (DDR&E), a post he held until 1965 when he was asked to serve as Secretary of the Air Force. He served in that position through the end of the Lyndon B. Johnson administration in 1969, which was followed by his appointment as the President of Caltech—a position which he held until he became Carter's Secretary of Defense in 1977. Brown's pedigree and technical acumen made him a superb choice to serve as Secretary of Defense during the height of the Cold War.

The thinking behind Brown's offset strategy can be traced to the Long-Range Research and Development Planning Program (LRRDPP), the Integrated Target Acquisition and Strike System (ITASS), and the conclusions from the 1976 Defense Science Board (DSB) entitled "Conventional Counterforce Against a Pact Attack" efforts that preceded it. Brown was familiar with each effort and the core problem they sought to address: How could the U.S. overcome the Soviet's three to one conventional advantage while remaining below the threshold of nuclear weapons use?

To flesh out the offset strategy, Brown leaned heavily on his Director of Defense Research and Engineering (DDR&E), Bill Perry, a PhD in mathematics. According to Perry, Brown's offset strategy would not endeavor to match the Soviets "man for man or tank for tank," but "to leverage technology to offset their quantitative advantage."[279] Hence, at the core of the offset strategy was "an abiding faith in new technology as an

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276 Keefer, 4.

277 Keefer, 4.

278 Keefer, 5.

279 William Perry, interview by Erin Mahan, Edward Keefer, Philip Shiman and Ryan Carpenter, June 21, 2012, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam%206-21-2012.pdf?ver=2017-10-31-071231-627.

affordable and winning battlefield force multiplier"—one that did not rely on nuclear weapons except for the role they played in deterrence.[280] What was needed to realize the offset strategy was a "'system of systems'—stealth, smart weapons, and smart intelligence."[281] Only then could the United States "compete effectively with a force even three times [its] size."[282] Stealth was the newest (and riskiest) of the technologies central to the offset strategy.

Stealth was made central to the offset strategy soon after Perry and Brown took their posts in the Carter administration. The men were brought up to speed on the ongoing stealth programs, notably Have Blue and the Battlefield Surveillance eXperimental (BSAX) program, which later became known as Tacit Blue. Based on the substantial progress achieved in stealth technologies to date, they were quick converts in understanding the power that stealth aircraft could provide in contesting a numerically superior adversary. According to Perry, stealth aircraft could provide "a sudden and overwhelming advantage in tactical close air support, even if engaging a numerically superior opposing force."[283] They could also serve as a force multiplier to target enemy air defense systems and "enhance survivability for our conventional aircraft."[284]

In addition to tactical battlefield advantages, stealth technologies also promised strategic benefits. Not only could they impose significant financial costs on the Soviet Union as it would relegate the vast majority of their $100 billion air defense apparatus to obsolescence, but if stealth could be successfully applied to a bomber, the United States would have a unilateral advantage in being able to penetrate deep inside enemy territory, which would make no target safe from attack and the penetrating leg of the triad sustainable

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[280] William James Perry, *My Journey at the Nuclear Brink* (Stanford, CA: Stanford Security Studies, 2015), 29.

[281] William Perry, interview by Arthur Goldberg and Rebecca Welch, October 18, 2004, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C.. https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam10-18-04.pdf?ver=2017-11-17-134335-103.

[282] Perry, interview, October 18, 2004.

[283] Perry, *My Journey at the Nuclear Brink*, 29.

[284] Memo, Perry for Brown, 13 Jun 1978 (quotes), folder 020 DDR&E, 1978, box 1, SecDef Files, Acc 330–81-0212. In Keefer, 581.

well into the future.[285] And, when stealth aircraft were combined with a standoff force of bombers armed with cruise missiles (to include stealth cruise missiles) the Soviets would be unable to focus their countermeasures against only one threat.[286] This would not only create an operational challenge for the Soviets but would contribute to their already exorbitant military spending as they would fund expensive research efforts to defeat the new technology.

Mesmerized by the potential military impact of stealth technologies, Perry wasted no time in early 1977 and sketched out an aggressive plan to develop and field operational stealth aircraft. Ushering stealth aircraft into the force as quickly as possible became Perry's primary ambition. According to Lockheed Skunk Works' Ben Rich, who led the Have Blue program, in the spring of 1977 Perry articulated his plan to Lieutenant General Alton (Al) Slay, the Air Force's head of R&D: "Al, this stealth breakthrough is forcing me into a snap decision. We can't sit around and play the usual development games here. Let's start small with a few fighters and learn lessons applicable to building a small bomber."[287] Stealth fighters first, stealth bombers second—that was the plan.

Since no timeline was established for when the stealth bomber program would begin, the Air Force and Slay forged ahead with plans to award a production contract to Rockwell for the B-1 bomber. While they knew the B-1's future was uncertain for reasons discussed in the previous chapter and with the view that the stealth bomber would not be ready in time to keep the penetrating leg of the triad viable in the near term, the B-1 remained the Air Force's priority for bomber modernization. After Carter terminated the B-1 program later in the year for concerns over survivability of the B-1 when pitted against modern Soviet air defenses and arguments of cost-effectiveness when compared to cruise

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285 William Perry, interview by Arthur Goldberg, January 9, 1981, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., Declassified from Secret.. https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam1-9-81.pdf?ver=2020-03-02-085133-340.

286 *Department of Defense Appropriations for Fiscal Year 1980: Hearings Before the House: Subcommittee on Appropriations*. House of Representatives, 96th Cong. 1 (1979), (Statement by William J. Perry, Director of Director for Defense Research and Engineering) 38.

287 Rich and Janos, 64.

missile options, the stealth bomber began to look like the Air Force's best chance at getting its long-sought replacement for the B-52.[288]

Despite the termination of the B-1, the Air Force remained committed to the modernization of its bomber fleet. How they would get a new bomber, though, was unclear. Fighters were the obvious first step for stealth aircraft. While the stealth fighter program, "Have Blue," was showing good progress, when the technology would be ready to transition to large heavy bomber was uncertain. Notwithstanding the technical challenges of building a large stealth aircraft, gaining Carter's support for a new bomber program was also highly improbable after his publicly cited reasons to terminate the B-1 program. According to General Richard Ellis, the Commander of the Strategic Air Command (SAC) at the time, after Carter made his decision, any mention of the word 'bomber' became "forbidden."[289] With a stealth bomber not yet feasible, many in the Air Force believed that a covert campaign to revive the B-1 should be mounted; the Chief of Staff at the time, General David Jones, a career bomber pilot, felt differently.[290]

Having witnessed and been an active participant in General Curtis Lemay's attempt to "overthrow the B-70 decision," Jones believed that another such effort would be damaging to the Air Force in the long run.[291] Thus, while Jones believed unequivocally "that a cruise missile is no substitute for a penetrating bomber," he had to walk a fine line to not oppose his Commander in Chief's decision.[292] To that end, he convened a special meeting of the Air Force's four-star Generals to discuss the controversial issue soon after

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288 Jimmy Carter *Statement on B-1*, 30 June 1977, Office of Staff Secretary; Series: Presidential Files; Folder: 6/30/77 [1]; Container 28. Atlanta, GA. https://www.jimmycarterlibrary.gov/digital_library/sso/148878/28/SSO_148878_028_08.pdf.

289 Richard Ellis interview by Maurice Maryanow, August 17–21, 1987, in Washington, D.C., transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell Air Force Base, AL., 245.

290 Kotz, *Wild Blue Yonder,* 172–173.; David Jones interview by Alfred Goldberg and Maurice Matloff, August 26, 1987, in Arlington, VA, https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_JONESDavid%2008-26-87.pdf?ver=2018-04-10-065945-800.

291 *Department of Defense Appropriations for Fiscal Year 1979: Hearings Before the House: Subcommittee on Appropriations*: House of Representatives, 95th Cong. 2 (1978), (statement of General David C. Jones, Chief of Staff of the United States Air Force), 372.

292 H.R., *Department of Defense Appropriations for 1979*, 376.

Carter cancelled the B-1.[293] At the meeting, Jones "forbid any further mention of building the B-1" but went on to express his support for new options to get the Air Force the manned penetrating bomber it needed.[294]

With stealth technologies not yet far enough along to confidently conclude it could be applied to a bomber, the Air Force's first idea to fill the B-1's void was to modify and "stretch" the FB-111 so that it could perform at longer ranges as a low-altitude, high-speed penetrator.[295] The Air Force's rationale was sound. The B-1 was out, and the B-52 airframe was not designed for the stresses of a low-altitude ingress—still the Air Force's preferred method to penetrate. It was thought that if the FB-111's engines could be made more efficient, its airframe stretched, and its avionics improved, it could serve as an effective interim penetrator until they could convince Carter to support a new bomber program.[296] Still, before they could put the decision to Carter, the Air Force first had to convince a skeptical Brown and Perry that such an interim bomber was necessary and that the stretched FB-111 was the best choice. While Brown and Perry agreed to hear the Air Force out, they made it clear the Air Force would have to make a strong case, which was going to be all the more difficult as advances in stealth technologies continued to be made.[297]

Cementing a way forward in the bomber decision was made even more difficult in the summer of 1978. General Jones transitioned to become the Chairman of the Joint Chiefs of Staff and General Lew Allen took over as the Air Force Chief of Staff. With a PhD in nuclear physics, Allen had never flown in combat, and despite having initial training as a bomber pilot, he spent most of his career in science and technology related posts. Having

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293 Richard M. Scofield and John M. Griffin, "The B-2 Spirit Bomber" in Griffin, *Pioneers of Stealth*, 55.

294 Scofield and Griffin in Griffin *Pioneers of Stealth*, 55.

295 *Department of Defense Appropriations for Fiscal Year 1978: Hearings Before the Subcommittee on Appropriations*. House of Representatives, 95th Cong. 1 (1977), 203.

296 H.R., *Department of Defense Appropriations for Fiscal Year 1978*, 240.

297 H.R., *Department of Defense Appropriations for Fiscal Year 1978*, 203.

worked with Allen previously and due to his penchant to put technical people in his inner circle, it is no surprise that Harold Brown nominated Allen to lead the Air Force.[298]

Like Jones, Allen would not endorse Air Force internal calls to resuscitate the B-1. Allen was not even convinced that a new penetrating bomber was necessary in the short term, especially if the ICBM leg of the triad was going to be modernized through the MX program.[299] It was Allen's initial belief that "as long as we had a reasonable confidence of getting the MX based, I didn't find the cruise missile approach to the air leg as totally unreasonable."[300] Allen viewed the strategic bomber as nuclear delivery vehicle, not as a platform to wage conventional warfare. He initially snubbed viewpoints that contended bombers could be used to achieve strategic effects via conventional weapons, despite the fact that many Air Force officers believed that B-52s demonstrated their conventional effectiveness in operation Linebacker II during the Vietnam War.

Despite his preliminary view that there was little need for a penetrating bomber if the ICBM force was upgraded, Allen could not ignore the vigorous calls for a new bomber inside the Air Force. Despite the increasing influence of fighter pilots in the Air Force, Allen had to contend with an Air Force culture that was still aligned with the core mission of strategic bombardment. The idea that the future bomber force would become cruise missiles trucks did not sit well. Further, no one in the Air Force believed the B-52 would be able to penetrate Soviet air defenses by the late 1980s, a point Allen could not refute. After mere months on the job, Allen relented and agreed to investigate a path forward for a new strategic bomber.

With the B-1 off the table, and the idea to "stretch" the FB-111 not yet in receipt of support from either Perry or Brown, the challenging job of charting a strategy to get a new

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298 Steven Rearden., *Council of War: A History of the Joint Chiefs of Staff 1942–1991*, Joint History Office, Office of the Joint Chiefs of Staff, Washington, DC., 2012, 392–393; David Jones interview by Alfred Goldberg and Maurice Matloff, August 26, 1987, in Arlington, VA. https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_JONESDavid%2008-26-87.pdf?ver=2018-04-10-065945-800.

299 Lew Allen Jr., interview by James Hasdorff, January 8–10, 1986, in Pasadena, CA, transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell AFB, AL.

300 Lew Allen, Interview, January 8–10, 1986, 154.

bomber fell to Lieutenant General Thomas (Tom) Stafford, who became the Air Force's head of R&D in the spring of 1978. It was then that he was briefed into the highly classified stealth programs and quickly became persuaded that the Air Force's best chance to get a new bomber would be for that bomber to be stealth.[301] It is unclear if Stafford knew of Perry and Slay's 1977 discussion; however it is clear that Stafford played a critical role in starting the new bomber program with a stealth design at the fore. With Carter being lambasted in the media for being weak on defense at the time—Carter's B-1 cancellation decision being a prime reason for this commentary—Stafford wagered that if Carter had a bomber program of his own, the chances of him supporting it would be higher.[302]

Around the same time as Stafford solidified his strategy to get the Air Force a new bomber, Lockheed's Ben Rich socialized the idea to develop a stealth bomber based on the Have Blue design with Bill Perry and Eugene Fubini, who was the Chairman of the Defense Science Board.[303] While Perry could not give Rich a guarantee that Lockheed would win the contract, Perry and Fubini were a highly receptive audience, which left Rich convinced Lockheed was a shoo-in for the stealth bomber contract. After all, as far as Rich knew, Lockheed was the only stealth aircraft designer in the game.

With a willing contractor and the operational version of Have Blue in the final stages of contract award, by the summer of 1978, Perry believed it was time to start officially the stealth bomber program. To that end, he sent a memorandum to Brown that contended that the Have Blue stealth fighter would "serve as steppingstone to a strategic aircraft" (i.e., the stealth bomber).[304] Perry told Brown that he believed it was time to start the stealth bomber program and thought he could get a contract awarded by 1980 with a flyable aircraft ready by 1985.[305] While an aggressive timeline, it was not unreasonable,

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[301] Thomas P. Stafford and Michael Cassutt, *We Have Capture: Tom Stafford and the Space Race* (Washington, D.C: Smithsonian Institution Press, 2002). 208.

[302] Kotz, 294.

[303] Rich and Janos, 302.

[304] Memo, Perry for Brown, 13 Jun 1978 (quotes), folder 020 DDR&E, 1978, box 1, SecDef Files, Acc 330–81-0212. In Keefer, 581.

[305] Keefer, 581.

assuming, as Perry and Brown did, that the bomber program would simply be a larger version of Lockheed's Have Blue.[306] With a successful track record as a prime contractor of technologically advanced aircraft, there was no reason for Perry or Brown to think that they could not deliver on such a timeline.[307] The primary hurdle the two men had to overcome was not whether they thought it technically feasible to develop a stealth bomber but to convince Carter that it was.

To gain Carter's support to start the new stealth bomber program, Brown appealed to Carter's technical side and leveraged extrapolated data from the Have Blue program.[308] Given some generous technical assumptions, Brown contended that the enlarged version of Have Blue could safely penetrate Soviet airspace and strike targets.[309] Brown also gently reminded the President of a little known privileged discussion in which Carter assured Brown that his decision to cancel the B-1 was contingent on the development of a stealth bomber to replace it when the technology was ready.[310] With the progress made in Have Blue and a Full Scale Development (FSD) contract forthcoming, Brown assured him that stealth technology was ready for a bomber.[311] Finally, and perhaps, most importantly, Brown made clear to state that the stealth bomber was not the B-1. In fact, the new bomber would be unlike anything that preceded it and would insulate Carter from political attacks of going back on his decision to cancel the B-1. In the end, Carter agreed.

With Carter's approval in hand, Perry and Stafford joined forces to initiate the Advanced Strategic Penetrating Aircraft (ASPA) program. By that time in the fall of 1978, it was known that the smaller version of Have Blue, Advanced Tactical Aircraft-A, would advance to Full Scale Development. The default solution for the stealth bomber thus

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306 William Perry, interview by Erin Mahan, Edward Keefer, Philip Shiman and Ryan Carpenter, June 21, 2012, in Washington, D.C., transcript, Department of Defense Historical Office, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_PerryWilliam%206-21-2012.pdf?ver=2017-10-31-071231-627.

307 William Perry, interview, June 21, 2012.

308 Memo, Brown for Carter, 11 Sep 1978, folder Secretary Brown, Eyes Only, 77–78, box 22, Brown Papers, LC. In Keefer, *Harold Brown,* 582–583.

309 Memo, Brown for Carter in Keefer, 582–583.

310 Keefer, 582–583.

311 Keefer, 582–583.

became Lockheed's larger B-variant of Have Blue. Stafford saw to it that funds were provided to Lockheed to address known deficiencies in the larger design, especially known issues of diminished low-observability, and poor aerodynamic performance.[312] Lockheed was given a sole-source contract for the study.[313]

With funding secured to continue studies of the B-variant of Have Blue, Lockheed's Ben Rich convinced his company's Board of Directors to accept a risky fixed price contract for the operational variant contract of Have Blue codenamed "Senior Trend."[314] Rich argued:

> Right now, we've got a contract and also the inside track on the next step, which is where the big payoff awaits: building them a stealth bomber. That's why this risk is worth taking. They'll want at least one hundred bombers, and we'll be looking at tens of billions in business. So, what's this risk compared to what we can gain later on? Peanuts.[315]

Rich was not wrong in his read of the situation. All of the key players from Perry to Stafford considered Lockheed's faceted design the default solution for the new bomber.[316] At the time, there was no reason to think otherwise.

In the months that followed, Lockheed made little advance to their original submission. Most of Lockheed's talent was prioritized for the Senior Trend program, which left little attention for the ASPA study. Other than naming the program "Have Peg" (later named Senior Peg) for the Commander of SAC's, General Richard Ellis's wife, Peggy, the design they advanced was nothing more than a "blown-up" version of Senior Trend and the same issues were present as they were a year earlier.[317] Simply expanding the faceted design characteristics of Have Blue made the aircraft "so draggy it would need four aerial

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312 William Perry, interview June 21, 2012.; Stafford and Cassutt, *We Have Capture,* 208.

313 Stafford and Cassut, 208.

314 Rich and Janos, 70.

315 Rich and Janos, 70.

316 William Perry, interview June 21, 2012.

317 Rich and Janos, *Skunk Works,* 304–305.; John Cashen, interview by Peter J. Westwick, April 25, 2014, at Caltech, California, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45051/rec/2.

refuelings to reach its final target in the Soviet Union."[318] With a strategic bomber that needed that much help to get to its target, Stafford supposed the more appropriate name for Have Peg would have been "Have Pig."[319]

Stafford's frustration with Lockheed's progress resulted in his decision to bring Northrop into the competition in the summer of 1979.[320] The decision to bring in Northrop specifically was made for two primary reasons. First, by 1979, Northrop had made excellent progress in their Tacit Blue program—a revolutionary design that would enable an all-aspect stealth aircraft. Second and perhaps, more importantly, Northrop was the only other defense firm with experience in building low observable aircraft and there was a desire to prevent Lockheed from gaining a complete monopoly in stealth technologies.

Shortly after he decided to unilaterally bring Northrop in the stealth bomber competition, Stafford arranged a meeting with Northrop's CEO, Tom Jones at a conference in June of 1979.[321] Stafford told Jones what he was after and sketched out the desired capabilities (i.e., radar cross section, range, payload, etc.) on the back of an envelope.[322] He told Jones he couldn't pay him for the study, but Stafford made a compelling argument, and he knew Northrop was in need of the business.[323]

By the time of Stafford's pitch, Northrop was in major financial trouble.[324] They were failing to sell export fighters, which Jones had promised to be a boon for the company, and the company had no forthcoming contracts.[325] The losses in the fighter export program

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[318] Stafford and Cassutt, 208.

[319] Stafford and Cassutt, 208.

[320] Stafford and Cassutt, 208; John Griffin and James E. Kinnu, *B-2 Systems Engineering Case Study*, Air Force Center for Systems Engineering, Wright Patterson Air Force Base (2007), 16.

[321] Stafford and Cassutt, 208.

[322] Kelly Burke., interview by Hugh Ahmann, April 22–23, 1991, in Shalimar, FL, transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell Air Force Base, AL; Stafford and Cassutt, *We Have Capture,* 208.

[323] Stafford and Cassutt, 208. For context, Northrop had no major contracts at this time and was losing money on a major investment in an export aircraft, the F-5.

[324] John Cashen, interview December 15, 2010.

[325] John Cashen, interview December 15, 2010.

had already totaled $100 million and since they lost the F-16 competition a few years earlier, their primary revenue stream was that of a subcontractor to McDonnell Douglass on the F-18.[326] Nevertheless, Jones had to consider more than just profit as he mulled over Stafford's proposal.

Northrop's culture was built around fighter aircraft and the company had not built a large aircraft in over twenty years. In fact, when Jones discussed the stealth bomber prospect with his Vice President, John Patierno, Patierno rebuked the idea: "We are not a bomber house. We're a fighter house. We don't do big airplanes like bombers."[327] Others in the company, such as Don Hicks, argued in favor of the idea and contended that Northrop could not only compete in stealth technologies but with their work done on Tacit Blue, they would be highly competitive.[328] Hicks also supposed that if Northrop was to have a chance to emerge as a worthy competitor to defense industry goliaths like Boeing and Lockheed, a stealth bomber contract that was worth billions of dollars might be its ticket in.[329] Convinced by Hicks, Jones took the design specifications from Stafford and put Northrop's best minds on the design of a Northrop stealth bomber.[330] They had three weeks to deliver.

Northrop's design team took the minimum requirements and decided on their own to double them in both range and payload.[331] It was thought that by doing so, the airplane would produce a capability similar to that of the venerable B-52.[332] A risky strategy to be

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326 John Cashen, interview December 15, 2010.; Donald A. Hicks, interview by Layne Karafantis, February 27, 2019 in Westlake Village, California, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45061/rec/1.

327 Irving Waaland, interview by Volker Janssen, November 10, 2010, in Fullerton, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45052/rec/1.

328 James Tegnelia, email message to author September 5, 2021.

329 James Tegnelia, email message to author November 17, 2021.

330 Irving Waaland, interview November 10, 2010.

331 John Cashen, interview April 25, 2014.; James Kinnu, interview by Volker Janssen, February 22, 2011 in Fountain Valley, California, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45046/rec/2.

332 John Cashen, interview April 25, 2014.

sure, but it was thought that the additional capability would provide a leg up in the competition with Lockheed.[333]

A week after Stafford met with Northrop's Jones, Stafford provided the identical bomber specifications to Lockheed, in full knowledge that the "specifications exceeded the performance outlined in their Have Peg design."[334] At the time Lockheed was not aware that Northrop had been invited to the dance. Despite Stafford's hope that the expanded requirements would result in a better design, Lockheed's follow-up briefing to Stafford in July 1979 was again unimpressive. According to Stafford, it "still had too much drag for a long-range bomber."[335]

After being shown Lockheed's unimaginative proposal, Stafford was excited to see what Northrop had in store for him. Rather than proposing an airplane that met Stafford's minimum requirements, Jones presented Stafford with a bomber that went far beyond them in terms of range and payload. Northrop's concept also leaned heavily on their previous design—Tacit Blue. In contrast to the Have Blue program, the Tacit Blue design benefited from new design technologies, which included computational effectiveness modeling.[336] Tacit Blue was also an all-aspect stealth platform with curved edges—a design which promised great potential in keeping a large aircraft hidden from radar. Northrop's submission, a flying wing design reminiscent of Jack Northrop's YB-49, promised far greater operational capabilities than Lockheed's. It was also a far superior aircraft.[337] Codenamed "Senior Ice," it offered Stafford a low-observable bomber capable of carrying a heavy payload across long distances.[338] It was a strategic bomber worthy of the name.

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333 John Cashen, interview April 25, 2014.

334 Stafford and Cassutt, 208.

335 Stafford and Cassutt, 208.

336 Kaminski, 307.; On July 28, 2021, the author spoke with James Tegnelia.

337 On October 14, 2021, the author spoke to John Griffin.

338 Kinnu, interview, February 22, 2011.; Portions of the official briefing to Lieutenant General Stafford are provided in Griffin and Kinnu, *B-2 Systems Engineering Case Study*, Air Force Center for Systems Engineering, Wright Patterson Air Force Base (2007), 62–72.

Encouraged by Northrop's progress, the following month, Stafford shared the Northrop and Lockheed designs with Secretary of the Air Force Hans Mark, and General Lew Allen. While there was an early momentum to award Lockheed with a sole-source contract, Stafford convinced Mark and Allen that Northrop deserved full consideration.[339] They agreed and sent Stafford to brief Perry.[340]

Much to Perry's surprise, Stafford presented him with two stealth bomber designs. Perry was pleased to see what Northrop offered, though he was not yet ready to dispense with Lockheed.[341] Accordingly, he directed the Air Force to initiate a stealth bomber competition between the two firms reminiscent of the eXperimental Survivable Testbed program just a few years before.[342] Perry's office would retain oversight, while the Air Force would manage the day-to-day engagement with Northrop and Lockheed. To maintain visibility, Perry tasked his military assistant, Air Force Colonel Paul Kaminski, to serve as his primary action officer on all stealth affairs.[343] Kaminski not only ensured that the competition proceeded to Perry's liking but made sure that the Air Force had the "black" funding it needed to move forward.

The allocation of "black" funding to support the stealth programs was necessary due to the "deep security" restrictions Perry placed on them.[344] Perry put all stealth programs under Special Access Required (SAR) controls immediately after being briefed on them in early 1977.[345] The decision to make the stealth programs highly-classified would serve to keep the technology hidden from the Soviet Union and other adversaries, but there were other benefits. The most important of which was the ability to keep the programs free from "cumbersome" acquisition rules and oversight requirements.[346]

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339 Stafford and Cassutt, 209.

340 Stafford and Cassutt, 209.

341 Stafford and Cassutt, 209.

342 Stafford and Cassutt, 209.

343 William Perry interview, June 21, 2012.

344 William Perry interview, June 21, 2012.

345 William Perry interview, June 21, 2012.

346 William Perry interview, June 21, 2012.

Nevertheless, for "black" funding to flow, Perry had to keep certain members of Congress apprised of the stealth programs.

Early on, only a handful of members of Congress were read in. Senators Sam Nunn and John Stennis were notable members of the small group of initial cadre tasked with assuring Congress that the "black" money spent was in the nation's best interest.[347] But as the stealth programs expanded, so too did the number of members of Congress who needed to be briefed. The allocation of $340 million to start Full-Scale Development contract for Senior Trend was one thing, but Perry and Brown knew that the stealth bomber would require dollar figures in the billions.[348] Securing such a high dollar figure would be a tough sell by itself. But, by late 1979, the ASPA program had more to deal with than just issues of budget.

B. THE RESURRECTION OF THE B-1 AND THE ASPA TRAJECTORY SHIFT

Despite early efforts by Generals Jones and Allen to tamp down calls to revive the B-1, many were worried about vesting all the nation's hopes for a new strategic bomber in a program that existed only on paper. In contrast, the B-1 already had four test aircraft built and the tooling required to easily produce more. The bomber could also be modified to take advantage of the latest technology, especially improvements in electronic counter measures. Sure, the FB-111 could penetrate, but it was only half as capable in terms of payload as the B-1 and would therefore require twice as many sorties to deliver the same weapon tonnage.[349] Additionally, as history had shown, starting a new bomber from scratch was not likely to be a quick venture, especially with such a radical changes in technologies such as stealth.[350] While mention of reviving the B-1 had been off-limits

347 William Perry interview, June 21, 2012.

348 Aronstein and Piccirillo, 81. Note: The total cost of the F-117 program was $6.56 billion.

349 H.R., *Department of Defense Appropriations for Fiscal Year 1978*, 313.

350 H.R., *Department of Defense Appropriations for Fiscal Year 1978*, 313.

since Carter killed the program in 1977, by late 1979 support for its restoration came from a most surprising place: the Office of the Secretary of the Air Force.[351]

Carter's Secretary of the Air Force, Hans Mark, who held a PhD in physics, took over his post in the summer of 1979. Following the Soviet Union's invasion of Afghanistan on December 24th of that year, Mark became the B-1's top advocate.[352] While out of step with his President, Mark believed that that the stealth bomber was too far out to be useful in the face of growing Soviet expansionism and that the B-1 should be acquired without delay.[353]

His first order of business was to shore up support from the Air Force's senior brass. To do so, Mark called together a select group of senior Air Force leaders at Maxwell Air Force base in Alabama to discuss his plan. On the invite list was General Ellis, the current Commander of SAC; retired Lieutenant General Glenn Kent, deemed a "recognized expert on strategic bombing"; retired General Russell Dougherty, the previous Commander of SAC; and General Alton Slay, the Commander of Air Force Systems Command.[354] Mark also invited Eugene Fubini, Chairman of the Defense Science Board and one of Brown's closest advisors, to ensure the Secretary of Defense could not accuse him of going behind his back.[355] There was also a chance, albeit a small one, that he could convince Fubini of the need for the B-1.

During the two days of discussion, the primary options for consideration were (1) "go with a new concept (e.g., "cruise missiles on a Boeing 747);" (2) "stretch the FB-111;" (3) "do nothing;" or (4) "revive the B-1."[356] There was no open discussion of the stealth bomber because Mark believed it could not become operational until it was too late.

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351 Hans Mark, *An Anxious Peace: A Cold War Memoir*, First edition, Williams-Ford Texas A&M University Military History Series, number 161 (College Station: Texas A&M University Press, 2019) 341.

352 Mark, *An Anxious Peace*, 340.

353 Mark, 340–341, 347.

354 Mark, 341.

355 Hans Mark., interview by Alfred Goldberg & Ronald Landa, August 4, 1999, in Arlington, VA., transcript. https://history.defense.gov/Portals/70/Documents/oral_history/OH-Trans_MARKHans08-04-99.pdf?ver=2018-04-10-070107-143.

356 Mark, 342.

Additionally, not everyone in attendance was privy to the highly classified stealth programs.

Mark, Slay, Kent and Dougherty were all in favor of reviving the B-1.[357] No one was in favor of doing nothing and only Fubini, who was most certainly knowledgeable of the stealth bomber efforts, voted for a new concept such as the non-penetrating cruise missile carrier.[358] Fubini's vote is telling in that it seemed to signal a belief that an interim solution was needed, though he could not go directly against the President and openly support the B-1. Ellis wanted the "stretch" FB-111 as he was afraid reviving the B-1 would jeopardize the ASPA's development.[359] Due to the classification restrictions at the time, there was little Ellis could do to explain why held this view. Noticeably absent from the meeting was General Lew Allen, who would not discuss the issue with Mark until months later.

Mark also used his position as Secretary to task the Air Force's Scientific Advisory Board to conduct a technical assessment of the Air Force's follow-on bomber and what missions it should perform.[360] The Board met in July 1980 at the Naval Postgraduate School in Monterey, California. Mark leaned on the Air Force's newest R&D chief, Lieutenant General Kelly Burke, as the Scientific Advisory Board's Executive Director, to oversee the study. While Burke had taken over the role of moving the ASPA program forward, he was also a staunch advocate of the B-1's revival.

Dr. Ivan Getting led what was called the "Long Range Combat Aircraft" study. The board's specific task was to provide technical advice on "whether to build more B-1 aircraft of the type we already had, or to modify them in some way that might improve them."[361]

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[357] Mark, 342.

[358] Mark, 342.

[359] Richard Ellis., interview by Maurice Maryanow, August 17–21, 1987, in Washington, D.C., transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell AFB, AL.; Kotz, *Wild Blue Yonder,* 209; Mark, *An Anxious Peace,* 341.

[360] Ivan Getting in *Reflections On Research and Development in the United States Air Force*: An interview with General Bernard A. Schriever and Generals Samuel C. Phillips, Robert T. Marsh, and James H. Doolittle, and Dr. Ivan A Getting by Richard Kohn 1992, 82.

[361] Mark, 342.

While the board's primary task was to focus on the B-1 decision, it was also tasked to examine the role of the strategic penetrating bomber in general.[362] The fact that a majority of the members assigned to the study were not even aware of the existence of the highly secretive stealth programs is telling of what they would ultimately recommend.[363]

Without full knowledge of the state-of-the-art, the board recommended that the Air Force modify the B-1 and bring it back into production.[364] In terms of the unique missions that only a strategic penetrating bomber could perform, the board surveyed the growing threat of mobile weapons (e.g., SA-10 and SS-20 missile systems), which cruise missiles could not credibly hold at risk. Hence, the board contended that the strategic bomber was more than just a nuclear delivery platform. It was also a platform that could locate "imprecisely located targets"—a mission that could clearly not be performed by fire-and-forget cruise missiles.[365] With these three recommendations, Mark got exactly what he hoped for and more. Not only did he now have a "recommendation from a knowledgeable and prestigious group," but with American heroes, such as Lieutenant General Jimmy Doolittle and Dr. Edward Teller, the board's recommendations would hold even more influence.[366]

While the Scientific Advisory Board was meeting in California, Mark finally addressed the strategic bomber issue with the Air Force Chief of Staff, General Lew Allen.[367] Mark knew "it was important to make certain that the chief of staff would support, or at least not oppose, what I was doing."[368] During the meeting, the two men discussed the wide range of options available to keep the strategic bomber viable, including

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362 Getting, *Reflections On Research and Development in the United States Air Force*, 83.

363 Kotz, 192.

364 Mark, 348–9.

365 Getting 83.

366 Mark, 349.; Frank Greve, "Is the B-1 a Plane Whose Time has Come?" *Philadelphia Inquirer Magazine*, March 19, 1984.

367 Mark, 346.

368 Mark, 346.

both nuclear and conventional scenarios.[369] While the discussion was cordial, Allen made it clear that he was "uncomfortable" with what Mark was doing and voiced his concern that going against the President could negatively impact the Air Force.[370] Nevertheless, Allen remained open to a logical debate, and Mark forged ahead.

Following the Scientific Advisory Board's recommendations to revive the B-1, which were briefed in late July 1980, Bill Perry called a meeting to address the growing strategic bomber debate and the divisions at the top.[371] The major players in attendance came from the Air Force's senior brass, which included Lieutenant General Kelly Burke; officials from the Secretary of Defense' office, including Eugene Fubini; the Chair of the Defense Science Board, Johnny Foster; and the chair of the Long Range Combat Aircraft study, Ivan Getting.[372] According to Mark, the meeting lasted two hours and all viewpoints were given their due.[373] In contrast to the Maxwell meeting and the Scientific Advisory Board study orchestrated by Mark, the stealth bomber was given full consideration, and was highly advocated for by Perry.[374] SAC was also given an opportunity to discuss their desire for the FB-111 to serve as an interim bomber.[375] Finally, Johnny Foster spoke of the need for strategic bombers in conventional missions. This enunciation served to separate B-1B viability from the requirement to penetrate advanced Soviet air defenses, a key point in its favor.[376] No decision was made in the meeting.

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[369] Mark, 346.

[370] Mark, 347.

[371] Mark, 349–350.

[372] Mark, 349–350.

[373] Mark, 350.

[374] Mark, 350.

[375] Mark, 350–352.

[376] Mark, 351.

As the bomber debate continued, Perry and Brown believed it was time to make stealth public.[377] They were having great difficulty in keeping stealth hidden from public view, and as the stealth programs grew in size, so too did the number of leaks about the technology.[378] Additionally, Brown knew that the Fiscal Year 1981 defense appropriations bill included language that directed the Secretary of Defense to provide Congress a "status update" on the "multi-role strategic bomber" the following year.[379] If he was to give the stealth bomber a fair shot, he knew the existence of stealth technologies would have to be made public.[380] For those reasons, Brown recommended to the President that it was time to publicly disclose the existence of stealth technology, and Carter approved.[381]

On August 22, 1980, Harold Brown, Bill Perry, and Lieutenant General Kelly Burke held a press conference to publicly reveal the existence of stealth technologies. Brown noted that "we have demonstrated to our satisfaction that the technology works…to build manned and unmanned aircraft that cannot be successfully intercepted with existing air defense systems."[382] The event portended a world where aircraft, notably bombers could, again, penetrate enemy airspace.

While some praised the public disclosure of stealth, since it was an election year it was viewed by many as nothing more than a political stunt by Carter that jeopardized

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[377] Harold Brown, interview by Edward C. Keefer, October 1, 2012, Washington, D.C., https://history.defense.gov/Portals/70/Documents/oral_history/OH_Trans_BrownHarold%2010-1-2012.pdf?ver=2017-09-27-102358-937; Harold Brown. "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

[378] Harold Brown "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

[379] Harold Brown "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.;* Department of Defense Appropriations Act, 1981., 96th Congress. Pub. L. No. 96–342 (1980). 1080–1081. https://www.govinfo.gov/content/pkg/STATUTE-94/pdf/STATUTE-94-Pg1077.pdf.

[380] Harold Brown, interview October 1, 2012.

[381] Harold Brown, interview October 1, 2012.; *Leaks of Classified National Defense Information—Stealth Aircraft: Hearings Before the House of Representatives: Subcommittee on Investigations*, House of Representatives, 96th Cong. 2 (1980) (letter from Harold Brown).

[382] Harold Brown. "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

national security.[383] Consequently, the release prompted a Congressional inquiry into the stealth disclosure decision, which no doubt was also used as a stage to deride Carter.[384] Both Brown and Perry had to testify in the hearings. The public release of the information also complicated matters for Mark and proponents of the B-1 as intended. The B-1 now had to compete against a new and exotic technology that held the promise of revolutionizing aerial warfare—a prospect the Secretary of Defense and the Air Force's senior brass publicly declared to hold "extraordinary significance."[385] Years later Brown confirmed that if it [the decision to publicly reveal stealth technologies] had not been done, "they [those in Congress in favor of the B-1B] might have been able to kill the B-2."[386]

With stealth in the public sphere and options for more than the B-1 on the table, Brown and Perry worked with the Air Force to issue a request for proposal (RFP) for the stealth bomber to Lockheed and Northrop in September 1980. The RFP called for an Initial Operating Capability of 15 operational ASPA by 1987.[387] By that time, the men were convinced that regardless of the election outcome, there was enough momentum for the stealth bomber to advance regardless of who was in the White House.[388] After all for those in the know, stealth was widely supported and seen as a revolution in military affairs.

To add even more momentum, Perry and Kaminski commissioned a special DSB study to examine the stealth bomber while Lockheed and Northrop prepared their proposals.[389] Perry wanted an independent body of experts to confirm what he had concluded: that stealth technology, and the ASPA specifically, would succeed in its task as

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383 To date, there has been no admission by Carter or Brown that there was any political motivation behind the disclosure. For more see Kotz, *Wild Blue Yonder* and Harold Brown. "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

384 H.R., *Leaks of Classified National Defense Information—Stealth Aircraft: Hearings Before the House of Representatives*: *Subcommittee on Investigations.*

385 Harold Brown. "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

386 Harold Brown, interview October 1, 2012; Harold Brown. "Statement by the Secretary of Defense Harold Brown, 22 August 1980. In *Harold Brown Statements as Secretary of Defense, 1980–1981 V5.*

387 On September 17, 2021, the author spoke to Mr. Kevin Rumble.

388 Kaminski, 303.

389 Kaminski, 303.

a penetrating stealth bomber.[390] While there was certainly a risk that the board might conclude the technology was not yet mature enough, Perry and Kaminski—arguably the most familiar with the programs in government and armed with PhDs in mathematics and aeronautics respectively—were confident the stealth bomber rested on firm technical ground.

Ronald Reagan's election as president in November 1980 meant that Perry and Brown would soon pack up their offices to make way for the new administration. They had accomplished a great deal during their tenure. The offset strategy had gained solid traction, and the advances made in stealth technologies particularly were remarkable. The Senior Trend program was in FSD, and the stealth bomber program was on the precipice of source selection—the competition phase where the government assesses and selects the winner of military contracts. With just over a month left in office, Brown and Perry decided to proceed with source selection, which started on December 1, 1980. They had full concurrence form the Air Force that Northrop and Lockheed were ready and found no reason to delay.[391]

C. TIME TO DECIDE: THE STRATEGIC BOMBER CHOICE

President Ronald Reagan and his Secretary of Defense, Caspar Weinberger, were briefed into the stealth programs days after taking office. By then the Senior Trend program was just months away from its first flight and the ASPA program was in the middle of source selection. Reagan had campaigned in part on a promise to revive the B-1, but knowledge of how far stealth technology had progressed meant his administration could not move forward on that program without considerable political fallout. In political and administrative terms, the question thus became how to honor a campaign promise to revive the B-1 in the face of a technological advancement that seemingly made the platform obsolete.

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390 Kaminski, 303.

391 On August 17, 2021, the author spoke to Dr. Paul Kaminski.

In the months that followed, Weinberger, with a law degree from Harvard and a background in government budget and finance, vigorously pursued an answer to the B-1 question.[392] His concern was to learn whether it was financially foolish or strategically wise to bring the modified B-1, newly named the B-1B, back into production, given that the ASPA program would shortly follow. To answer that he had to know "How soon could the stealth bomber become operational; how long could the B-1B successfully penetrate; and how much would it cost to build the B-1B?"[393] Answers to these questions did not come easy.

As part of the new administration, Hans Mark was replaced by Verne Orr as Secretary of the Air Force. Orr was not in possession of the same technical background as Mark. In contrast to Mark, Orr was much more attuned to the role of politics in national defense, and extremely loyal to the President. To Orr, the idea of going against the President regardless of the strategic rationale as Mark did to Carter was not acceptable. Hence, Orr considered it his job to support Reagan in fulfilling his campaign promise of having "a new bomber [i.e., the B-1B] on the ramp when he ran for reelection in 1984."[394]

The Air Force's Chief of Staff, General Lew Allen, also changed his tune on the B-1 when the Reagan administration came to office, though for a different reason than loyalty to the President. Allen considered it his duty to ensure the nuclear triad remained viable. As long as the MX program improved the survivability of the ICBM leg, he was willing to go along with a less capable force of non-penetrating standoff bombers armed with cruise missiles.[395] Nevertheless, when it became clear to Allen that "the Reagan administration was going to screw up the MX," that approach was no longer tenable.[396] Allen believed that to cover the diminished ICBM leg, the bomber leg had to include a penetration

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[392] Kotz, 203.

[393] Kotz, 203.

[394] Lloyd R Leavitt, Air University (U.S.), and Air Force Research Institute, *Following the Flag: An Air Force Officer Provides an Eyewitness View of Major Events and Politics during the Cold War* (Maxwell AFB, AL: Air University Press, Air Force Research Institute, 2010). 617.

[395] Lew Allen Jr., interview January 8–10, 1986.

[396] Lew Allen Jr., interview January 8–10, 1986.

capability in both the near and long term. To Allen, the B-1 had the benefit of years of development and "would be successful in penetrating Soviet defenses for a long time in the future."[397] The ASPA would then follow when it was ready, and when money to fund it was available.[398]

As Weinberger considered the positions of the Secretary and Chief of Staff of the Air Force, the DSB stealth study that was initiated by Perry and Kaminski released their findings. Chaired by Johnny Foster, who served as DDR&E from 1965 to 1973, the board conducted multiple iterations of modeling and simulation analyses and concluded that the ASPA was both technically feasible and survivable.[399] Surprisingly, their chief concern was not that it was technologically too risky, but that the "requirement" for the new stealth bomber was "too narrow."[400] According to the DSB stealth study, the new bomber should be capable of both high and low-altitude penetration.[401] After all, this was going to be a bomber that would "be in the inventory for twenty or thirty years."[402]

Based on the DSB's recommendation, Weinberger, with support of the Air Force, requested that Northrop and Lockheed modify their proposals to include a low-altitude capability.[403] The change caused a delay in source selection from its originally planned 1 April 1981 date as the two defense firms were given time to revise their designs. Had that change not been authorized, contract specialist and source selection team member, Kevin Rumble, recalled that, "Lockheed would have very likely been the winner"—they were the less risky option, were cheaper, and "could probably pull off a fast IOC."[404] By March, however, the 1 April 1981 contract award date was pushed out for the foreseeable future, and Lockheed's victory was no longer evident.

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397 Lew Allen Jr., interview January 8–10, 1986.

398 Lew Allen Jr., interview January 8–10, 1986.

399 On August 17, 2021, the author spoke to Dr. Paul Kaminski.; Kaminski, 305.

400 Kaminski, 305.

401 Kaminski, 305.

402 Kaminski, 305.

403 Kaminski, 305.

404 On September 17, 2021, the author spoke to Mr. Kevin Rumble.

As Lockheed and Northrop revised their designs, Weinberger came under tremendous pressure from the Air Force's Orr and Allen to advance the B-1B. The Air Force's top leaders believed that the technology for the ASPA was too risky to put all the Air Force's eggs in one basket.[405] By comparison, the B-1B had already gone through development and was a much lower risk program. Orr and Allen believed that the ASPA could not become operational until the 1990s at the earliest, and the B-1B would ensure the United States had a capable penetrating bomber through the late 1980s.

In contrast, the Commander of SAC, General Richard Ellis, was adamant that Weinberger initiate the ASPA program immediately. Ellis argued that the B-1B did not give the United States the long-term penetration capability it needed and that its procurement would be a threat to the ASPA program, since billions would be consumed during its development and production. Instead, Ellis continued to believe that the "stretch" FB-111 (a modified FB-111 with advanced electronic counter measures, upgraded engines, and a more robust airframe to serve in a bomber role) was the best option for an interim bomber. The FB-111 would be drastically cheaper than the B-1B and its capabilities would be commensurate.[406] In Ellis' mind, one of the bombers would be cut and there was no guarantee which one that would be. Any chance of losing the ASPA was a risk he was not willing to take.

Weinberger had a vexing time trying to referee the fissure between the Air Force's senior brass. In the meantime, Northrop and Lockheed had finalized their modified designs to account for both high and low-altitude missions. ASPA source selection subsequently resumed, and Northrop and Lockheed met once again on the New Mexico radar range testing facility for round two of the "pole off."[407] The results were highly encouraging to Weinberger and affirmed the DSB's assessments that a strategic bomber could achieve low observability. The results nudged Weinberger towards an ASPA-only recommendation.[408]

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405 Mark, 445; Lew Allen Jr., interview January 8–10, 1986.

406 Richard Ellis, interview, August 17–21.

407 Rich and Janos, 311.

408 Mark, 452.

Still, Weinberger could not ignore the many voices that believed the stealth bomber could not become operational until the 1990s at the earliest.[409] To decide whether Northrop and Lockheed's claims were true, Weinberger relied on Colonel Paul Kaminski, who after Perry left had moved over to head the Air Force's low-observable office, "RDQ-LO."[410] In that role, Kaminski met weekly with Weinberger to provide updates on the ASPA's progress.[411] He found no compelling evidence that the ASPA could be ready before 1990.[412]

After months of deliberation and emboldened by the first successful flight of Senior Trend on 18 June 1981, just over a week later Weinberger advised the President to leave the B-1B behind in favor of an aggressive pursuit of the stealth bomber.[413] While the stealth bomber might not be ready before the end of the decade, Weinberger reasoned that the current force would do and that an investment of billions of dollars into an obsolete aircraft like the B-1B was unwise. Nevertheless, the decision rested with the President.

Shortly after Weinberger's recommendation reached the President, the Air Force got word soon thereafter that Reagan would honor his campaign promise to bring back the B-1B while he simultaneously embraced the stealth bomber as a major strategic advantage.[414] Reagan would give the Air Force not one, but two new bombers. Reagan's

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409 Kotz, 207–208; Mark OH; Lew Allen Jr., interview January 8–10, 1986.

410 On August 17, 2021, the author spoke to Dr. Paul Kaminski.

411 On August 17, 2021, the author spoke to Dr. Paul Kaminski.

412 On August 17, 2021, the author spoke to Dr. Paul Kaminski.

413 Ronald Reagan, *White House Diaries*, June 30, 1981. https://www.reaganfoundation.org/ronald-reagan/white-house-diaries/diary-entry-06301981/; Frank Carlucci., Interview by Stephen Knott & Philip Zelikow, August 28, 2001 in Charlottesville, VA, transcript, Ronald Reagan Oral History Project, Miller Center of Public Affairs. https://millercenter.org/the-presidency/presidential-oral-histories/frank-carlucci-oral-history.

414 After the decision was made by Reagan, Lieutenant General Kelly Burke was invited to a private lunch with the Secretary of the Navy, John Lehman. During the meeting, Lehman revealed to Burke that the entire assessment between the two bombers was "pure smoke and mirrors" and that Reagan had made the decision in 1979 to revive the B-1 after reading speech given by Burke on the need for a Long-Range Combat Aircraft ("read B-1B"). Lehman went on to inform Kelly that "After that, nothing else counted." For more on this see: Kelly Burke., interview by Hugh Ahmann, April 22–23, 1991, in Shalimar, FL, transcript, United States Air Force Oral History Program, Air Force Historical Research Agency, Maxwell AFB, AL. 282.

decision would prove consequential to the ASPA program and to the decision of whether Lockheed or Northrop would win its contract.

D. CONCLUSION

By the time of Reagan's public address on October 3, 1981, which announced the procurement of 100 B-1Bs and 132 Advanced Technology Bombers (ATB)—the new name for the ASPA—the stealth bomber program had survived through two administrations. Its strategic purpose was unassailable. With the promise to render millions of dollars in Soviet air defenses obsolete while promising a hedge against Soviet numerical advantage in the Cold War, the ASPA program enjoyed significant bipartisan support. Not once after it was conceived as possible was there a serious question by either administration about whether it should be pursued. Instead, the primary debate about the stealth bomber program was always when to initiate its development, how capable the plane could be, which defense contractor would build it, and how to eliminate other soon to be obsolete bombers.

Those questions were finally answered after President Reagan made his decision to procure both the B-1B and the ASPA. Once that decision was made, the source selection team re-evaluated Northrop and Lockheed's revised best and final offers with the newly established IOC date of 1991. Moving out from the original timeline of a 1987 IOC date was only possible due to Reagan's decision to procure both the B-1B and the ASPA. The B-1B would serve as the interim bomber and the ASPA program could, in turn, accept more risk due to the extra time. All of this had a direct impact on how the source selection team made their final recommendation.

In terms of technical evaluation, both entries met the minimum requirements sketched out by General Stafford in 1979.[415] In comparison to Lockheed's submission, Northrop's Senior Ice promised more range and almost twice the payload.[416] Their curved design also promised to be more aerodynamically efficient. Nevertheless, the added

[415] On September 17, 2021, the author spoke to Mr. Kevin Rumble.

[416] Rich and Janos, 312.; On September 17, 2021, the author spoke to Mr. Kevin Rumble.

capabilities came at a cost. Senior Ice was estimated to cost $9.4 billion versus $7.8 billion for Lockheed's Senior Peg for Full Scale Development.[417] Senior Ice was also clearly a riskier design and many questioned Northrop's ability to deliver as a prime contractor.[418] In terms of performance, however, Senior Ice was a more capable airplane.[419] Not to mention, by awarding the contract to Northrop, it "would provide competition to Lockheed in stealth technology."[420]

In contrast to Northrop's submission, Lockheed's Ben Rich relied heavily on their original faceted design—a design that did not compare in range, payload, or aerodynamic efficiency.[421] According to Rich, Lockheed's design leaned heavily on the advice they received from Strategic Air Command, which recommended that they "stay as small as [they] could get while still meeting the basic Air Force requirements for the new bomber" as "small [would] win over big, because budget constraints will force us [the Air Force] to go with the cheaper model in order to buy quantity.'"[422] Holding to that advice, Lockheed's price tag was certainly lower than Northrop's and they met the minimum requirements from the RFP, nevertheless, that advice, and the decision to follow it, contributed directly to Northrop's victory.

Northrop's Senior Ice proposal was awarded the ATB contract on November 4, 1981.[423] Of the four categories evaluated by the source selection team: (1) observability, survivability, range, and payload, (2) operational utility, (3) design approach, and (4) program management, Northrop offered superior range, payload, and operational utility,

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417 On September 17, 2021, the author spoke to Mr. Kevin Rumble. Of note, the cost estimates were part of the final proposals submitted to the Air Force by Northrop and Lockheed, respectively. According to Mr. Rumble, "the government's independent estimates were somewhat higher for both, but the relative difference remained."

418 On September 17, 2021, the author spoke to Mr. Kevin Rumble.

419 On August 17, 2021, the author spoke to Dr. Paul Kaminski.; On September 17, 2021, the author spoke to Mr. Kevin Rumble.; On October 14, 2021, the author spoke to a senior B-2 program official.

420 Dr. James Tegnelia, email message to author, September 5, 2021, and November 16, 2021.

421 On September 17, 2021, the author spoke to Mr. Kevin Rumble.; Westwick, 158.

422 Rich and Janos, 310–311.

423 On September 17, 2021, the author spoke to Mr. Kevin Rumble.

even though they were clearly the riskier option.[424] With the B-1B secured as the interim bomber, that additional risk was acceptable, especially if it meant the Air Force would have a more capable bomber in the long run. Much to Lockheed's dismay, cost was not a chief consideration during the evaluation.[425]

While some critics have tried to make the argument that Northrop won the stealth bomber contract due the chummy relationship between Northrop's Jones and President Reagan, the evidence shows otherwise. Northrop won the competition on the merits in an environment that allowed for more risk acceptance. To be sure, the Air Force's desire to prevent Lockheed from having a monopoly on stealth technologies and the fact that Lockheed could not see past their success in Senior Trend also played important roles. Nevertheless, once Reagan made the decision to pursue a dual bomber program, the conditions were set for the Air Force to pick Northrop's more capable, yet more risky, Senior Ice, which would later become known as the B-2 Spirit.

[424] On September 17, 2021, the author spoke to Mr. Kevin Rumble.

[425] On September 17, 2021, the author spoke to Mr. Kevin Rumble.

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V. THE B-2 SPIRIT: A TECHNOLOGICAL MARVEL IN TURBULENT SKIES

The Advanced Technology Bomber (ATB), later named the B-2 Spirit, is an engineering marvel. The design, development, and production of an aircraft the size of a heavy bomber that can elude modern air defenses is a testament to the men and women who worked tirelessly to bring the aircraft to life. Nevertheless, the story of how the ATB transitioned from contract award in November 1981 to the decision to stop production at 20 B-2s—a number far short of its original goal of 132—is one that illustrates the complexity of modern weapons development.

This chapter chronicles the B-2's development, its production, and the decision to terminate the stealth bomber's production at 20. It follows the program's trajectory from its philosophical underpinnings through how it dealt with development and production challenges, and finally to Congress' decision to cap production at a mere fifteen percent of what was originally planned. The decision to curtail production so dramatically can be explained in large part due to the ending of the Cold War, but there is much more to the story. While in harmony at the start of the program, the major defense acquisition forces—bureaucratic politics, technology, politics, and strategic need—had all fallen out of tune by the program's end.

A. SETTING THE FOUNDATION

After the ATB contract was awarded in November 1981, the Air Force and Northrop set out to do what had never been done before—build a long-range, high-payload stealth bomber. The conditions could not have been more auspicious. Defense budgets were on the rise and the selection of Northrop as the winner brought with it a degree of license to push to the outer limits of the technological frontier. Those involved in the program also felt enormous responsibility as they endeavored to introduce a technology that could shift the military balance in favor of the United States. Reagan's two-bomber decision (i.e., the B-1B and the ATB), afforded an inherent buffer that gave the program breathing room to commence with little interference. As a result, Strategic Air Command's

(SAC) attention and that of Congress, remained focused on the B-1B as the bomber to join the force first.[426] It also allowed the program to set reasonable milestones from the outset.[427]

Colonel Keith Glenn, who also led the ATB source selection team, was put in charge of management of the ATB program on behalf of the Air Force.[428] In his new role as ATB System Program Office (SPO) Director, he would serve as the focal point between the government and the contactor. Glenn and his team were soon thereafter issued Headquarters Air Forces' priorities for program management. Guided with "philosophical" direction from the Secretary of Defense, Caspar Weinberger, and the Secretary of the Air Force, Verne Orr, the Air Force's top brass issued Glenn the document that would guide all program decision making: the ATB Program Management Directive (PMD).[429] The document provided the prioritization that would guide the program in all its aspects: (1) security, (2) performance, (3) schedule, and (4) cost.[430] Despite implicit fiscal guidance included in the prioritization, the PMD did not require Congressional approval.

As was the case during source selection and consistent with the other stealth programs that were ongoing, the ATB program was designated a "black" program.[431] This meant that the technology was considered so important to national security that it had to be protected to the greatest possible extent. Personnel brought into the program were not only hand-picked based on their backgrounds but were also subjected to rigorous screening procedures. Information related to the project could only be communicated in specially

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426 On October 14, 2021, the author spoke to a senior B-2 program official.

427 On October 14, 2021, the author spoke to a senior B-2 program official.

428 Griffin and Kinnu, 20.; James Kinnu, interview by Volker Janssen, February 22, 2011 in Fountain Valley, California, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45046/rec/2.

429 On November 2, 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

430 Griffin and Kinnu, *B-2 Systems Engineering Case Study*, x.i.; Lieutenant General (Ret.) Richard Scofield, email message to author, 11 October 21.

431 Irving Waaland, interview by Volker Janssen, November 10, 2010, in Fullerton, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project. https://hdl.huntington.org/digital/collection/p15150coll7/id/45052/rec/1.

cleared facilities and over secure communication equipment. While inefficient and costly, it was thought that if information on the program was revealed, the Soviet Union could develop methods to defeat the revolutionary stealth technologies.[432]

Notwithstanding the cumbersome security practices, "black" programs enjoyed tremendous advantages. For one, highly classified programs were subjected to much less oversight, which allowed for decisions to be made more quickly.[433] Whereas in a "white" program, decisions required approval at multiple levels, "black" program decisions—even to the tune of billions of dollars—were mostly made by the SPO Director himself. He was of course accountable for his decisions and made regular visits to the Pentagon to brief the Chief of Staff of the Air Force, the Secretary of the Air Force, the Secretary of Defense, and select members of Congress (which included some cleared staffers); but, as long as the program remained "black," the SPO Director had expansive decision authority.

The final guidance received at the outset of the program came from the Secretary of Defense, Caspar Weinberger. According to Lieutenant Colonel Bud Baker, who joined the B-2 program in 1986 and stayed with it until his retirement in 1991, Weinberger issued a memorandum to the Air Force, which "said essentially, 'you can't break the law, but all other restrictions—e.g., DOD regulations, AF policies, etc.,--are negotiable.'"[434] The memorandum was housed in the SPO Director's office safe.[435] For all aware of its existence, it made one thing perfectly clear: get the job done and don't let bureaucratic red tape slow you down.

Knowledge of how the Air Force prioritized decisions drove Northrop's decision making, with one major caveat: Northrop was a publicly traded company with a responsibility the Air Force did not have—the maximization of shareholder value. The ATB contract was the most valuable contract in the company's history. It not only promised

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[432] According to Jim Kinnu and John Griffin, security costs made up 15–20% of the total program costs. See: Griffin and Kinnu, *B-2 Systems Engineering Case Study*, 34.; Perry, interview, June 21, 2012.

[433] Lieutenant General (Ret.) Richard Scofield, "Acquisition Report: Delivering Combat Capability at Home and Abroad" (presentation Air & Space Conference, Washington, DC, September 14, 2004).

[434] Lieutenant Colonel (Ret.) Dr. Bud Baker, email message to author, 12, October 21.

[435] Lieutenant Colonel (Ret.) Dr. Bud Baker, email message to author, 12, October 21.

success in that quest, but the massive size of the contract seemed sure to propel the company into the big leagues of defense contractors. With costs identified as the Air Force's last priority, prospects that future profits would grow seemed all but guaranteed.

The ATB contract could not have come at a better time for the company. Northrop's ventures into selling export fighter aircraft had failed and no other major contracts were on the horizon.[436] When asked about what would have happened to Northrop if the company did not win the ATB contract, Northrop's Kent Kresa remarked that the company would have "been a little nothing."[437] When Northrop was publicly announced as the prime contractor for the development of the ATB, the stock price rose from 33 to 55 dollars per share.[438] The golden age for Northrop appeared to have begun.

B. MOVING FORWARD AND MOVING BACKWARD

With the foundational guidance established, Northrop and its subcontractors set out to create the massive infrastructure that would be required to develop and produce the large bombers. In early 1982, Northrop purchased and began to retrofit an enormous (2.5 million square feet) Ford motor company plant in Pico Rivera, California. The site would serve as Northrop's ATB nerve center.[439] It housed offices for management and staff; laboratory testing facilities; and was where the ATB's "forward fuselage and leading and trailing edges" were manufactured.[440]

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436 Bill Sing "Northrop Still Pinning Its Hopes on Military Business." *Los Angeles Times*. May 25, 1980. ProQuest.; Weiner, 82.

437 Kent Kresa, interview by Peter J. Westwick, December 7, 2018, in Bel Air, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45047/rec/2.

438 Northrop Annual Report, 1981.

439 Rebecca Grant, *B-2: The Spirit of Innovation, Northrop Grumman Aeronautical Systems*, report NGAS 13–0405 (2013), available at https://www.northropgrumman.com/wp-content/uploads/B-2-Spirit-of-Innovation.pdf, 52. Welko Gasich, interview by Peter J. Westwick, October 28, 2010. at Unknown, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/7970/rec/1. Griffin and Kinnu, *B-2 Systems Engineering Case Study*, 34.

440 Griffin and Kinnu, 34.; Westwick, 173.

Northrop identified their facility in Palmdale as the site for the ATB's final assembly.[441] The massive plant was prepared to support fifteen aircraft at a time moving down the assembly line.[442] The target was to produce 24 airplanes per year.[443] As prime contractor, Northrop would lead the assembly process and oversee the integration of all subcontractor components. All facilities had to meet the highest possible security requirements.

Composite wings were to arrive from Boeing's plant in Seattle, Washington.[444] Intermediate wing sections, which would house many of the subsystems, were to come from Vought's facility in Dallas, Texas.[445] Hughes aircraft company, conveniently located in Southern California and the same company responsible for the Low Probability of Intercept Radar on Northrop's Tacit Blue, would provide the ATB's radar.[446] Finally, General Electric (GE) in Cincinnati, Ohio would supply the engines.[447] Total capital investment costs for Northrop and its subcontractors summed well over $2.5 billion.[448]

In addition to massive investments in facilities, Northrop and its subcontractors labored to rapidly increase their skilled workforces. From 1981 to 1989, Northrop's employee numbers would rise from 31,400 to over 48,200—a 35% increase.[449] Unlike Lockheed's Skunkworks, Northrop was a far less experienced prime contractor and "had no established Northrop way of doing business."[450] As expressed by Northrop CEO Kent

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441 Griffin and Kinnu, 36.

442 Westwick, 174.

443 Westwick, 174.

444 Griffin and Kinnu, 34.; Westwick, 173.

445 Griffin and Kinnu, 31, 34.; Westwick, 173.

446 Westwick, 173.

447 Westwick, 173.

448 Griffin and Kinnu, 34

449 Analysis of Northrop Corporation Annual Reports 1981–1989. ProQuest.

450 Lieutenant Colonel (Ret.) Dr. Bud Baker, email message to author, 12, October 21; Grant, *B-2: The Spirit of Innovation, Northrop Grumman Aeronautical Systems*, 49.

Kresa as he looked back on the period, the result was a "deal with whatever [you] have to deal with as you go" culture.[451]

As the infrastructure to develop and produce the ATB firmed up, the engineering teams began to flesh out the aircraft's design. Northrop's proposal was built upon solid technical ground, but extrapolating a radical low-observable design into a set of production ready engineering drawings was quite a different undertaking.[452] It quickly became clear that advancing a proposal was one thing, building an actual strategic bomber was an altogether different animal.

Jim Kinnu became Northrop's ATB program lead and the Air Force's Keith Glenn's counterpart. Kinnu led Northrop's Senior Ice proposal team and brought with him years of experience from the aerospace industry. As was also the case with Glenn, Kinnu's selection to lead Northrop's ATB team was a natural progression. While Kinnu was cognizant of the realities of Northrop's profit motive, and his bonus structure likely influenced some of his decision making, his primary goal was to bring the stealth bomber to life.[453] Accordingly, Kinnu's first objective was to solidify the aircraft's design to have it ready for the first Preliminary Design Review set for October 1982.

The goal for the first design review was to finalize the design and agree on the detailed requirements for the weapons system.[454] Specifications of the aircraft design, radar, and even "what, if any" defensive avionics should be added to the stealth platform were decided on in this meeting.[455] The final item that was decided was a SAC request that provisions be made to allow space for a 3rd crew member in the cockpit.[456] Despite

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451 Kent Kresa, interview by Peter J. Westwick, December 7, 2018, in Bel Air, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45047/rec/2.

452 On October 8, 2021, the author spoke with Colonel (Ret.) Vinson Grosse.

453 Insight gained from interview with Lieutenant General (Ret.) Richard Scofield.

454 James Kinnu, interview February 22, 2011.

455 As the ATB was designed to be a completely passive platform to evade detection, the decision to add defensive avionics was not at the fore. Griffin and Kinnu, *B-2 Systems Engineering Case Study,* 39.; James Kinnu, interview February 22, 2011.

456 Griffin and Kinnu, 39.; On October 14, 2021, the author spoke to a senior B-2 program official.

studies that showed that "a two-man crew was fully adequate to complete the specified missions," SAC was uncomfortable with the idea of a modern bomber without a navigator.[457] Since the change was requested so early in the program, it only cost an additional $60 million.[458] By the end of the October 1982, the Preliminary Design Review was complete and design specifications set.

Based on the outcome from the first design review, Northrop ran the updated design through state-of-the-art modeling and simulation technologies to evaluate the airplane's aerodynamic performance.[459] By February of 1983, as the test data started to come in, a critical design flaw was noted: the low observable flying wing made the aircraft uncontrollable in high gust weather conditions, especially at low altitudes.[460] Recognizing that at best, the setback would shift the schedule and add costs, or at worst require a complete redesign—one that could dispense with the flying wing design—Kinnu stopped all other efforts and put the entire ATB team to work on the problem.[461]

To overcome issues of controllability, Northrop's engineering team significantly altered the wing design while retaining its low-observable characteristics —a remarkable feat that was accomplished in less than four months.[462] While it ensured Northrop would deliver on its promise, it also meant that all structural and subsystem plans would have to be redone. Whether that would shift the overall schedule was to be decided by the program's senior management.

Shortly after the redesign effort, the Air Force and Northrop teams met for their first "CEOs meeting" in September 1983.[463] In addition to the SPO Director's regular

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457 Griffin and Kinnu, 39.; On October 14, 2021, the author spoke to a senior B-2 program official.

458 On September 17, 2021, the author spoke to Mr. Kevin Rumble.

459 Griffin and Kinnu, 40.

460 Griffin and Kinnu, 40–41.; On October 14, 2021, the author spoke a senior B-2 program official. For a detailed understanding of the engineering challenge, see Grant, *B-2: The Spirit of Innovation;* Westwick*;* Griffin and Kinnu.

461 Kinnu, interview, February 22, 2011.

462 Kinnu, interview, February 22, 2011.

463 Griffin and Kinnu, *B-2 Systems Engineering Case Study,* 49. On 7 October 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

meetings to update selected Air Force brass and the Secretary of Defense, the CEO's meeting served as an additional mechanism for oversight. The group met quarterly and was kept small: only the five major contractor CEOs, their program managers, the Aeronautical Systems Division Commander, and the SPO director, were invited.[464]

The first major decision was whether to keep to the original schedule or push it out to account for the effects of the planform redesign that were still reverberating throughout the program. Kinnu and his fellow program managers from Boeing, Vought, Hughes and GE all recommended that the entire program shift to the right by a year.[465] He also noted that the redesign would cost close to $2 billion, a bill that Northrop agreed to pay since the requirement was part of the original contract.[466] After hearing Kinnu's recommendation, Lieutenant General Tom McMullen, the Commander of the Aeronautical Systems Division, and Tom Jones, Northrop's CEO, "went off in a corner" to debate what should be done.[467]

Notwithstanding the logical argument from Kinnu and the consensus from his peers, Jones and McMullen decided that the schedule would remain.[468] While there was a major concern that shifting the schedule would result in a loss of momentum amongst the workforce, the men also had to carefully weigh external factors that had emerged could emerge as threats to the program.[469]

Even as the ATB program was getting under way, a substantial and multifaceted lobbying effort emerged to take money from it and apply it to the purchase of more B-1Bs.[470] The effort was led by members of Congress whose districts would benefit from

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464 On 7 October 2021 and 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

465 Griffin and Kinnu, 45.; Kinnu interview February 22, 2011.

466 Griffin and Kinnu, 45.; Kinnu interview February 22, 2011.

467 Kinnu interview February 22, 2011.

468 Kinnu interview February 22, 2011.

469 On 7 October 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

470 When the decision to procure the ATB and the B-1B was announced by President Reagan in 1981, the plan was to procure 132 ATBs and 100 B-1Bs.

increased B-1B production, by Rockwell, and by some inside the Air Force, who believed the ATB was nothing more than an idea from a science fiction novel.[471] According to Kinnu, this was the driving factor behind the decision to adhere to the established schedule: "They didn't want the hundred and first B-1 to be built."[472]

In addition to the decision to aid the ATB program by not publicly declaring a schedule delay, Secretary Weinberger also came to the ATB program's aid by shutting down Air Force B-1B proponents. According to a senior B-2 program official, after Weinberger became aware of Air Force efforts to build more than the one hundred authorized B-1Bs he made his position on the matter crystal clear:

> While in a briefing to Secretary of Defense Weinberger, one of the senior General Officers says, "Sir, there has been a lot of debate in the building about taking some B-2 money and using that to buy the 101st and on B-1B." Weinberger replied, 'You know, I appreciate debate in the building, I think there should be more debate in the building, however, on that debate, let me say this, if I catch somebody doing that debate, they are making their final career decision.[473]

It is thus no surprise that the 101st B-1B was never produced. Weinberger's support for the ATB remained consistent throughout the entirety of his tenure as Secretary of Defense, which concluded in November 1987.

Despite the threat that the B-1B presented, on balance it offered the ATB program important benefits.[474] Having the B-1B produced first meant that the ATB program could initially proceed with little interference from its future user: SAC.[475] Had the B-1B not have been procured when it was, SAC would have very likely tried to make changes that would have gone far beyond the request to have provisions made for a third seat in the

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[471] Edgar Ulsamer, "In Focus: The Unsinkable ATB Rumors," *Air Force Magazine*, 1 April 1984, https://www.airforcemag.com/article/0484eagle/.

[472] Kinnu interview February 22, 2011.

[473] On October 14, 2021, the author spoke to a senior B-2 program official.

[474] The first illustration of this benefit was examined in the previous chapter, when Reagan's two-bomber decision allowed additional development time for the ATB and an IOC date in 1991. That decision also led to the selection of the more capable, yet more risky, Northrop Senior Ice submission over Lockheed's Senior Peg.

[475] On October 14, 2021, the author spoke to a senior B-2 program official.

cockpit. Had that been the case, costs would have increased, and the schedule put in even more jeopardy than it already was.

C. GEARING UP FOR PRODUCTION

In December 1985, having weathered the planform redesign crisis and fended off attempts to raid the ATB's coffers, the program initiated its Critical Design Review, per the original schedule.[476] Completion of this milestone would mean that the aircraft was ready to move into production. For that to happen, all design drawings had to be 100% complete.[477]

While structural drawings were ready by December, subsystem drawings and the associated interface configurations were woefully behind.[478] In other programs this may not have been as big of an issue, but in this case the aircraft's signature was so dependent on its external planform and shape that any changes made to the aircraft had to be made without altering the predicated Radar Cross Section.[479] According to then Colonel Scofield, who served as the SPO Director on the F-117 and went on to spend eight years as SPO Director of the ATB, starting in the summer of 1983, "this was a whole new way of building the airplane…it required determining the exterior size and shape first, then figuring out how to incorporate the various sub-systems into the interior volume—basically building the airplane from the outside in." [480] It would take more than six months and significantly more money before the subsystem's drawings were finished and production could be started in earnest.[481]

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[476] Griffin and Kinnu, 26.

[477] James Kinnu interview February 22, 2011.

[478] James Kinnu interview February 22, 2011.

[479] On November 2, 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

[480] On November 2, 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

[481] Griffin and Kinnu, 26.; Kinnu interview February 22, 2011.

With all structures and subsystems drawings finalized by August 1986, the baton was passed to the production and manufacturing teams.[482] Up until then, production plans consisted of mostly "boiler plate" language.[483]

Per the original contract, there was a unique requirement that all Full Scale Development aircraft, including the static and destructive aircraft, were to be built with production tooling.[484] According to Colonel Vinson Grosse, who joined the program in the summer of 1985 as the SPO's Director of Manufacturing, "That meant you had to build the tooling to the external dimensions of the outer mold line before the final design of the aircraft was completed."[485] To attack this problem, Northrop's subcontract managers worked tirelessly to buy "up all of the tooling talent on the West coast and as far East as Kansas City."[486] While the production tooling requirement was a challenge, Colonel Grosse noted that "building the fleet on the same 'hard tooling' guaranteed that if the first one worked, they all worked," and that was in the "national interest."[487]

While Grosse and his Northrop counterpart, Jim Berry, did what they could to improve the production plan, Colonel Scofield and his Northrop counterparts decided that production of the FSD aircraft could begin in January 1986 while the subsystems drawings were being finalized.[488] With full knowledge that the structural components would later have to be "stuffed" with the necessary subsystems and circuitry, it was decided that initiating production was the best chance they had to stay on schedule.[489] While an acceptable level of concurrency—meaning simultaneous development, production, and

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[482] Kinnu interview February 22, 2011.

[483] Vinson Grosse in *Pioneers of Stealth: from Have Blue to B-2*, Lulu Publishing, 2017, 182.; Griffin and Kinnu, 26.

[484] On October 8, 2021, the author spoke with Colonel (Ret.) Vinson Grosse.

[485] On October 8, 2021, the author spoke with Colonel (Ret.) Vinson Grosse.

[486] On October 8, 2021, the author spoke with Colonel (Ret.) Vinson Grosse.

[487] On October 8, 2021, the author spoke with Colonel (Ret.) Vinson Grosse.

[488] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield; General Accounting Office, *Strategic Bombers: B-2 Program Status and Current Issues,* GAO/NSAID 90–120, February 1990. https://www.gao.gov/assets/nsiad-90-120.pdf.

[489] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

testing—had always been part of the ATB contract, this was the first major decision taken in that regard.[490] While the approach offered advantages, especially in terms of producing the ATB as fast as possible, it also cost "a lot more money" as design changes would cause work already accomplished to be undone and brought up to the new specification.[491] Nevertheless, and in accordance with the Program Management Directive, Scofield's goal was to get the aircraft fielded as quickly as possible no matter the cost. According to Colonel Scofield, "Concurrency was a necessary evil."[492]

Colonel Scofield noted there were ways to manage the undesirable impacts.[493] One way to do that was to break the production aircraft into "blocks."[494] Early blocks—aircraft with only basic capabilities—could start production while development and testing efforts progressed.[495] Improvements gained from development and testing would then be added to subsequent block baselines, and the already produced blocks retrofitted. While bringing aircraft back to be upgraded was expensive, it allowed for production to start.

Moving to a block system also allowed for production contracts to be signed well before development and testing were finished—a move that would prevent a break in production.[496] Such a break would be immensely costly as workers would have been paid

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[490] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.; Concurrency is not unique to defense acquisitions. For example, the auto industry has utilized concurrency to great effect for decades.

[491] Kinnu interview February 22, 2011. Added costs were mostly from per diem bills over the period as workers from Boeing and Vought had to physically relocate to California to "stuff" the assemblies in Palmdale.

[492] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

[493] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

[494] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

[495] Block 10 airplanes would follow the FSD aircraft down the line possessing only basic capabilities. Block 20 airplanes would improve on the low-observable signature and advance upon the avionics installed (i.e, additional radar modes, addition of limited terrain following radar capability). Block 20 airplanes would also be capable of precision guided munition employment, improved autopilot features, and increased weather tolerances. Block 30 airplanes, the final block, were to be fully capable of meeting the original contract specifications and all subsequently added requirements. This included an advanced defense management suite, added navigation capabilities, and most importantly, the final low-observable signature. Reference: This paragraph comes from the GAO report NSIAD 94–217.

[496] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield. If the program had to wait until the first six development aircraft were sufficiently tested before production aircraft could be made there would have been a significant gap in the production line.

to sit idle or be laid off after money had already been spent on their training, security background checks, and company in-processing.[497] Parts manufacturers would have also had to close or retool their facilities for different clients to stay solvent.[498] Hence, while the decision to adopt a block production strategy was undoubtedly risky, it was considered a lesser risk than allowing for a break in production, which could result in the entire program being cancelled.[499] With the cancellation of the B-1A in recent memory, a program that did not progress beyond the development aircraft in the Carter administration, Scofield chose the strategy that would give the Air Force its best chance at fielding the ATB.

While the block and concurrency decisions were within the authority Scofield enjoyed as director of a "black" acquisition program, it also meant that the first airplanes would be less capable than originally promised.[500] Although this was clearly understood by the Air Force and Northrop, when the aircraft began to emerge from the shadows, the performance shortfalls gave critics an opportunity to argue that the aircraft was far less than its hype. This problem would come back to haunt the Air Force as they worked to secure future production buys.

D. CONGRESSIONAL INVOLVEMENT GROWS: THE START OF THE TRANSITION TO THE "WHITE"

In early 1986, while the deficiencies from Critical Design Review were being remedied and empty structural components were being produced, the program faced an emerging problem: Congressional and public concerns over "black" programs. With news stories of defense contracting improprieties (e.g., reports of $650 being spent on a hammer and a $9,606 for an Allen wrench) circulating in the popular media, calls for more

497 On 8 October 2021, the author spoke to Colonel (Ret.) Vinson Grosse.; the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

498 On 8 October 2021, the author spoke to Colonel (Ret.) Vinson Grosse.; On October 28, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker. According to Colonel Vinson Grosse, "long-lead time parts and material issues, as well as idle facilities, also had to be considered."

499 On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

500 On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.; Of note then Colonel Scofield had to get approval from select members of Congress for two-year long lead appropriations.

information to be released on the "black" programs began to grow louder.[501] Until that point, the ATB program had mostly enjoyed bipartisan support thanks to the few powerful members of Congress had assured the wider Congressional body that the money spent on the "black" programs was necessary. Yet, as some in Congress grew uncomfortable with that arrangement, the ATB—assumed to be the costliest of the "black" programs—quickly became their prime target.[502]

Despite keeping select members of Congress apprised of the ATB's status and costs (primarily within the armed services and defense appropriations committees), rumors of how much "black" program costs had ballooned provoked new interest. The first example of this occurred in early 1986, when Congressman John Dingell, chair of the Committee on Energy and Commerce pressed Weinberger to release basic figures about "black" programs.[503] He was initially ignored, an insult he would not soon forget.[504] By June of 1986, Dingell and others pressed Les Aspin, the ranking Democrat on the House Armed Services Committee, to compel Weinberger to satisfy Dingell's original request.[505] Weinberger relented and made basic facts of the ATB public—primarily generic cost data.[506]

On June 3, 1986, Weinberger revealed that "the total estimated cost for Research and Development and procurement of 132 ATB aircraft is $36.6 billion in Fiscal Year 1981 dollars."[507] He also noted that each airplane would only cost $277 million per airplane, which the Secretary of Defense made clear to specify only slightly over the unit cost of a

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501 Weiner, *93*–94.

502 Nicholas Kristoff, "Northrop's Crucial Bomber," *New York Times*, April 19, 1986, 33.

503 Weiner. 94.

504 Weiner. 94.

505 Weiner. *93*–95.

506 George C. Wilson. "Stealth Costs Discussed: Weinberger Fails to Satisfy Bomber Critics," *Washington Post*, June 4 1986.

507 Wilson. "Stealth Costs Discussed."

B-1B at $265 million.[508] He also noted that the program was "on schedule," which was technically true, but clearly not representative of the entire story.[509]

A second event of consequence was an attempt by Boeing to usurp Northrop on the forthcoming production contracts. Knowing that production contracts would be awarded in the near future, Boeing lobbied Congress to ensure that the production contract be competitive.[510] To that end, the Fiscal Year 1987 National Defense Authorization Act (NDAA) directed that the Secretary of Defense issue a report on the feasibility of a defense industry competition for the production contract.[511]

While Boeing had missed the stealth revolution in the late 1970s, some Boeing executives did not hide the fact that they loathed being a subcontractor to Northrop—a company they considered far beneath them.[512] Once Northrop found out that Boeing was behind the addition to the NDAA, they were furious.[513] According to a senior B-2 program official, "Finally someone [from Northrop] told Boeing, 'You keep this up, we are going to throw you off the program and go find someone else.'"[514] Northrop was also aided by a RAND Corporation's report that was commissioned to answer the NDAA requirement. The report was led by Michael Rich, the son of Lockheed's Skunk Works chief, Ben Rich, who lost the stealth bomber contract to Northrop years earlier. The report Rich authored unequivocally stated that moving production to a company other than Northrop would "add billions to the price tag."[515] With the program already exorbitantly costly, there was no Congressional appetite to add to the bill, which settled that Northrop would be awarded future production contracts.

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[508] Wilson.

[509] Wilson.

[510] On October 28, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[511] National Defense Authorization Act, Pub. L. No. 99–106, 100 Stat. 3816 (1986).

[512] On October 14, 2021, the author spoke to a senior B-2 official.; On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[513] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[514] On October 14, 2021, the author spoke to a senior B-2 program official.

[515] Rick Atkinson "How Stealth's Consensus Crumbled: As Costs Became Clearer, Political Climate and Priorities Changed" *The Washington Post*, Oct 10, 1989.

E. THE FIRST PRODUCTION BUY

Unlike during source selection, an event where contractors knew that higher prices could cause them to lose out on the contract entirely, by 1987 Northrop's actions reveal that they knew they were now in an advantageous position. Being in such a position all but dissolved any incentive to keep costs low. Northrop's main concern was not how to cut costs, but to predict how much they could charge without drawing unwanted attention. With the program still shrouded in the "black" and the Cold War still front and center in the public consciousness, Northrop made their decision to cash in.

Despite the myriad challenges to start ATB production through the beginning of 1987, negotiations for the first production buy with Northrop could finally begin. By that point, however, the only question the Air Force and Northrop had to resolve was how much the first production buy would cost. According to then Lieutenant Colonel Bud Baker, who served as the SPO's Production Program Manager, in the Spring of 1987, Northrop came in with a fixed price contract for the first production buy of five airplanes at around $2.1 billion.[516] The thought on the Air Force side was that Northrop would come in around that number, the Air Force would counter with a lower number, and they would meet in the middle around $1.5 or 1.6 billion.[517] After receiving the lower counter, Northrop came back with an even higher number at around $2.3 billion.[518] Northrop was indeed in a commanding position.[519] Determined to keep production ramp-up efforts moving, then-Brigadier General Scofield accepted Northrop's offer in November 1987.[520] While higher than expected, Scofield knew the contract would be renegotiated after the third development aircraft was delivered and more was known about the aircraft's actual costs.[521]

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[516] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[517] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[518] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[519] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[520] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield; General Accounting Office*, B-2 Bomber: Contract Structure and Selected Provisions*, GAO/NSAID 90–230FS, August 1990, 4, https://www.gao.gov/assets/nsiad-90-230fs.pdf.

[521] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.; General Accounting Office, *B-2 Bomber: Contract Structure and Selected Provisions*, 4.

F. ADDED REQUIREMENTS AND ADDED COSTS

As the first FSD aircraft inched down the production line in 1987, the SPO continued to receive change requests from SAC.[521] While SAC had been mostly focused on the B-1B in the early 1980s, by the mid-1980s they had shifted their focus to the ATB. This is not surprising given the forthcoming closure of the B-1B production line and as SAC began to envision how the ATB would be employed, the missions it would accomplish, and the capabilities it would need to do so—especially in light of improving technologies.

Adding or subtracting requirements from an ongoing program can add significant time and costs. In a perfect world, requirements would be set at the start of the program and remain stable throughout the aircraft's development, production, and testing. Nevertheless, this is never the case and tough decisions must be made to balance the requested changes to costs and schedule.

An example of a requirement change request in the ATB program was the addition of the Global Positioning System (GPS) to the aircraft.[522] In November 1981, at the time the contract was awarded to Northrop, GPS was far from a mature technology. By the mid-1980s, however, it became clear that GPS was going to be a critical capability that would not only improve navigation but also targeting and weapons employment—functions that were critical to the mission of a long-range bomber.

When a change such as the request to add GPS came to the Air Force's SPO, a Configuration Control Board with the authority of the SPO director but chaired by his deputy would be commissioned to analyze the requirement, interface industry, and make the final decision of whether to add it.[523] As was the case with all decisions related to the program, the Program Management Directive guided each decision. If there was good

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[521] On October 28, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker.

[522] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.; Lieutenant General (Ret.) Richard Scofield email message to author, 21 February 22. The decision to add GPS was not made until later in the program, but it is an excellent example of how changes were made to the B-2 program's baseline requirements.

[523] On 2 November 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

reason to believe the capability would improve the aircraft's performance and the schedule impacts were acceptable, it would be authorized. While costs were, of course, considered, mission success was the priority. As long as the program remained "black," Scofield could authorize the changes. But if Congressional demands for more oversight grew, the SPO's authority to make those decisions would surely decline.

G. REINING IN COSTS, QUESTIONING THE STRATEGIC NEED, AND B-2 PROGRAM CURTAILMENT

While select members of Congress were informed about the general costs of the ATB program since its inception, by 1986, the demand for information beyond those initially cleared to receive it grew considerably. Initial Congressional inquiries focused on gaining insight into the "black" programs in general, though the ATB was a prime target. Following Weinberger's release of the ATB's initial cost data in June of 1986, the Fiscal Year 1987 NDAA demanded considerably more detailed cost information than Weinberger had provided.[524]

Requests for more information on the ATB continued into the following year, stipulating that updates on the aircraft's performance also be provided.[525] The Fiscal Year 1988 NDAA also mandated that the program establish multiple "initiatives" with the intent of "maintaining cost discipline, contractor performance discipline, and management discipline within the ATB program."[526] For a program that was used to making decisions with little oversight, this was a clear signal from Congress that those days were over.

In response to the Fiscal Year 1988 NDAA language, the Air Force briefed Congress on its plan to reduce costs on the ATB program, which was newly designated the "B-2" in September 1988. The Air Force thought that $6.2 billion could be saved through new cost saving measures, but by that time, even with the cost savings, the total costs for

[524] National Defense Authorization Act for Fiscal Year 1987, Pub. L. No. 99–661, 3832–3834 Stat. 100 (1986).

[525] National Defense Authorization Act for Fiscal Year 1988 and 1989, Pub. L. No. 100–180, 1040–1042, Stat. 101 (1987).

[526] National Defense Authorization Act for Fiscal Year 1988 and 1989, Pub. L. No. 100–180, 1040–1042, Stat. 101 (1987).

the program had grown to $42.5 billion in 1981 dollars for the full complement of 132 aircraft.[527] Adjusted for inflation that amount would be $68.1 billion in 1988 dollars.[528] The increase in total cost was the opposite of what Congress wanted.

With the Cold War still hot, the Secretary of the Air Force, Pete Aldridge, attempted to justify the high costs of the program and rhetorically asked members in Congress, "how much is deterrence worth?" [529] He went on to argue the strategic advantages of the stealth bomber and claimed that "whatever it [the B-2] costs, it's worth it."[530] Whether Congress would agree was doubtful, especially with the legislated changes made in the program to date.

In addition to dealing with new oversight requirements, Northrop had become embroiled in scandal in the late 1980s. After years of failed attempts to sell their F-20 fighter to the Air Force, they turned to the international market and were accused of using bribes to generate sales.[531] This initiated a federal investigation into their business practices, whereupon a second scandal began over allegations of fraud on an Air Force nuclear missile contract.[532] Both of these issues made national news and were a stain on Northrop's image. The timing could not have been worse for the B-2 program and presented a major challenge for the incoming administration.

As Northrop did their best to respond to damning attacks, in early 1989, the George H.W. Bush administration took over the White House. The new administration and the

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527 Rick Atkinson "How Stealth's Consensus Crumbled: As Costs Became Clearer, Political Climate and Priorities Changed" *The Washington Post*, Oct 10, 1989.; Richard Halloran "Air Force Raises Cost Estimate of Stealth Bombers to $68.1 Billion." *New York Times,* Dec 17, 1988.; General Accounting Office. *Strategic Bombers: B-2 Program Status and Current Issues*. GAO/NSAID 90–120 (Washington, DC: Government Accounting Office, 1990), 12, https://www.gao.gov/assets/nsiad-90-120.pdf.

528 Atkinson "How Stealth's Consensus Crumbled.; Halloran "Air Force Raises Cost Estimate of Stealth Bombers to $68.1 Billion."; General Accounting Office. *Strategic Bombers: B-2 Program Status and Current Issues.*

529 Richard Halloran "Air Force Raises Cost Estimate of Stealth Bombers to $68.1 Billion" *New York Times*. December 17, 1988.

530 Halloran "Air Force Raises Cost Estimate of Stealth Bombers to $68.1 Billion."

531 Richard Stevenson, "Bribe Charges backed as Northrop Era Ends" *New York Times*, Sept 21, 1990.

532 Ralph Vartabedian. "Northrop a Company in Turmoil, *Los Angeles Times*, Dec 20, 1987.

American public began to contemplate what the recent Soviet withdrawal from Afghanistan signaled about Soviet strength. After years of attempts at economic reforms, many began to believe the withdrawal was tangible evidence of Soviet decline. This in turn caused many, especially those in Congress, to question the need for expensive weapons systems, particularly the B-2.

By the time President Bush's new Secretary of the Air Force, Dr. Donald Rice, came into office in early 1989, it was clear that he had his work cut out for him if he was going to keep the B-2 program alive. There were major concerns over the high costs of the program, the B-2's emergence from the black world went poorly and, the scandals at Northrop made worse an already bad problem.[533] Nevertheless, Rice, who became the Air Force Secretary, after working as the head of the RAND corporation, the Air Force's primary think tank, was a true believer in the long-range, stealthy B-2 bomber.

After poring over the history of the B-2 program—a program, which Rice noted was "very good at schedule slippages and cost overruns"—Rice flew to California to visit Northrop in the spring of 1989 to see what could be done.[534] In a private session with Northrop's Board of Directors, he pulled no punches, "I have reviewed this program and this program is in trouble because of its own performance. If it is going to keep performing like this, we are going to lose it, and we can't afford to lose it."[535]

Given the ongoing scandals, Northrop had already started to overhaul company management before Rice's visit, yet, once the Air Force Secretary made it clear how at risk the B-2 program was, the company took drastic actions. To that end, Northrop announced that Kent Kresa would replace Tom Jones as CEO by the end of the year.[536] Jim Kinnu, who had been on the B-2 program since its inception, was replaced by Ed Smith, a man whose strengths played to the shift from development to production.[537] While Kinnu's

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[533] On January 14, 2022, the author spoke to Dr. Donald Rice.

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[536] Roy J. Harris, "Northrop's Kresa Insists He Sees Blue Skies," *Wall Street Journal*, 25 April 1989.

[537] On October 8, 2021, the author spoke with Col (Ret.) Vinson Grosse.; Vinson Grosse in Griffin, *Pioneers of Stealth,* 182–183.

name will forever be intertwined with genesis of the B-2, he had been on the program for over eight years, and with the ongoing scandals it was time for a change. Finally, a new position—President and General Manager—was created to oversee the entire B-2 program, which was led by Ollie Boileau, a well-respected aerospace executive.[538] By the end of 1990, over 60% of Northrop's senior management had been replaced.[539] Still, whether the management overhaul would be enough to allay the concerns from Congress was not yet clear.

After addressing Northrop management issues, on July 12, 1989, Rice, and the Chief of Staff of the Air Force, General Larry Welch, made their first public pitch as to why the B-2 was worth its high price.[540] With annual cost estimates for peak production years around seven and eight billion dollars to complete all 127 production B-2s, the program was the most expensive defense acquisition at the time.[541] And with the recent scandals in Northrop, the clunky roll out of the B-2, and the peace dividend envisioned to be just around the corner, Rice and Welch had a tough sell.

Rice and Welch's testimony before the House Armed Services Committee was reminiscent of years gone by, as the Air Force's top brass stressed the strategic importance of penetrating bombers. General Welch stressed the B-2's ability to render obsolete what he claimed was 350 billion dollars of Soviet investment in air defenses.[542] He also stressed the B-2's ability to provide conventional firepower to the "entire global land mass," a mission that had been of only minor importance at the start of the program.[543] Welch went

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538 Ralph Vartabedian, "Former General Dynamics President Joins Northrop," *Los Angeles Times*, November, 16, 1989. https://www.latimes.com/archives/la-xpm-1989-11-16-fi-2233-story.html.

539 *B-2 Program Management and B-2 Contract Management*, Hearing before the Committee on Armed Services, Senate, 101st Cong. 2 (1990) (statement of Dr. Donald Rice), 19.

540 *National Defense Authorization Act for Fiscal Year 1990 and Oversight of Previously Authorized Programs*, *Hearing before the Committee on Armed Services*, House of Representatives, 101st Congress, 1. (1989).

541 H.R., National Defense Authorization Act, 270.; General Accounting Office. *Strategic Bombers: B-2 Program Status and Current Issues*. 16.

542 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by General Larry Welch) 192 & 199.

543 H.R., *National Defense Authorization Act for Fiscal Year 1990* (statement by General Larry Welch), 195, 215.

on to note that the bomber was "the best promise of attacking highly mobile targets."[544] While Welch noted that such a capability was not likely in the "near or midterm," the fact that it was brought up was a clear effort to differentiate the penetrating bomber from a standoff bomber with cruise missiles.[545] Finally, he argued that if the B-2 was not brought into the inventory, the Soviets could "concentrate" all of their countermeasures against only standoff weapons, which would lose their potency.[546] The Air Force argued if that were to happen, it "would eventually lead to a near total reliance on the two remaining strategic triad legs, both of which rely on ballistic missiles which were unrecallable for weapons delivery."[547]

Rice and Welch were followed the next day by Dick Cheney who took over as Secretary of Defense in the Bush administration. His recommendation aligned with the Air Force's testimony and trumpeted the merits of the bomber leg of the triad as "survivable," "recallable" and "flexible."[548] In addition to making his pitch for the general role of having a penetrating bomber in the triad, he noted that the B-1B's days as a penetrator were numbered, given what was known about Soviet air defenses at the time.[549] Knowing that the Committee was considering curtailing or cancelling the program due to its high price tag and unproven capability, he daringly put the responsibility on Congress for where the program was to date:

> The fact of the matter is, ladies and gentlemen, we have spent over 10 years developing this program. This committee has had jurisdiction over this program. I would point out the fact that this committee is probably more responsible for the B-2 program in its current state than I am…Most of you

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544 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by General Larry Welch), 232.

545 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by General Larry Welch), 194.

546 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by General Larry Welch), 217.

547 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by General Larry Welch), 260.

548 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by Secretary of Defense Dick Cheney), 269.

549 H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by Secretary of Defense Dick Cheney), 319–320, 325.

> on the back row have been here for 10 years…with jurisdiction and oversight responsibilities for the B-2. So if there is a fundamental problem—which I do not believe there is—but if there is a fundamental problem, then I think the focus has to be up on the collective decision of the Congress of the United States and previous administrations with respect to funding this program.[550]

Only time would tell whether Cheney's argument was convincing. Unlike in previous decisions related to appropriating funds for the B-2 that had been made in secret, from this point on all decisions would be made in full view of the public.

In the days that followed, the B-2 made its first flight from Northrop's Palmdale facility to Edwards Air Force Base on July 17, 1989. While a notable achievement, it did not stop growing concerns in Congress over the aircraft's exorbitant price tag, its uncertain performance, its unclear strategic necessity, and Northrop's questionable business practices. Just 8 days later, and after almost 23 billion dollars had already been spent on the program, the B-2 program was debated on the Senate floor.[551]

On July 24, 1989, Senators John Warner (D-VA) and Sam Nunn (D-GA) introduced an amendment that would reduce the B-2 program by $300 million, or from $4.7 billion to $4.4 billion in the Fiscal Years 1990 and 1991 NDAA.[552] It also specified various requirements for the program to accomplish before money could be obligated for additional procurement. For example, the amendment called for a minimum amount of initial flight testing to be accomplished and for the Defense Science Board to conduct a study to assure Congress that the aircraft would meet its promised low-observable characteristics—characteristics which had yet to be proven.[553] The amendment was followed by one from Senator Edward Kennedy (D-MA), which added the requirement for

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[550] H.R., *National Defense Authorization Act for Fiscal Year 1990* (Statement by Secretary of Defense Dick Cheney), 272.

[551] H.R., National Defense Authorization Act for Fiscal Year 1990 (Statement by General Larry Welch), 222.

[552] Congressmen Warner and Nunn, Amendment on B-2 program reduction on 24 July 1989, House of Representatives, *Congressional Record*, 15895-15896.

[553] Congressmen Warner and Nunn, Amendment on B-2 program reduction on 24 July 1989, House of Representatives, *Congressional Record*, 15895-15896.

the Secretary of Defense to conduct studies of the impacts of lower procurement numbers.[554] Both amendments passed.

On the 26th of July 1989, the House had its turn to debate the bomber. Three amendments were proposed. The first was sponsored by Ike Skelton (D-MO), whose district was home to Whiteman Air Force Base, the B-2's future home. Skelton proposed that the B-2 be fully funded pending performance guarantees.[555] Unconvinced of the need for the B-2, especially in view of less expensive stealth cruise missiles, Ron Dellums (D-CA) and John Kasich (R-OH) proposed to stop the program stop at the 11 aircraft already funded (6 FSD aircraft and 5 production models).[556] Finally, there was a middle ground amendment sponsored by Les Aspin (D-WI) and Mike Synar (D-OK), which proposed that the program slow down to allow time for further testing and for budgets to be recalibrated.[557] The Aspin/Synar amendment also offered time to contemplate what should be done on the program without making any long-lasting decisions.[558] As the program had only recently come out of the "black," the majority of Congress decided that more time and information was needed before long term decisions could be made, and the Aspin/ Synar amendment passed. For the moment, the B-2 program was safe and money for the next buy of five aircraft was appropriated.

Once the dust settled it was clear to the Air Force and Northrop that reaching the full planned buy of 132 would be highly unlikely. There was funding appropriated for 16 B-2s (six FSD aircraft and ten production aircraft), but all future production decisions would be subject to intense debate and demanding oversight. Then on November 9, 1989,

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554 Congressmen Kennedy, Amendment on B-2 program reduction on 25 July 1989, House of Representatives, *Congressional Record*, 16014.

555 Congressmen Skelton speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16353.

556 Congressmen Kasich speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16382.

557 Congressmen Synar speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16373.; Congressmen Aspin speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16354.

558 Congressmen Synar speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16373.; Congressmen Aspin speaking on 26 July 1989, House of Representatives, *Congressional Record,* 16354.

the Berlin Wall fell and the primary strategic requirement for which the B-2 was initially envisioned began to crumble alongside it.

In response to the changing strategic environment and congressionally legislated mandates, Secretary Cheney ordered a Major Aircraft Review to be conducted with the B-2 featured prominently. Meanwhile, the Air Force's Chief of Staff, General Welch, did his best to get ahead of growing costs and hosted a meeting at SAC Headquarters in Omaha, Nebraska.[559] Requirements were briefed with their associated program impacts and price estimates; and Welch decided what would survive.[560] While a noble attempt to get costs down to more acceptable levels, decisions to cut subsystems could only save money in the long-term.[561] Not to mention, efforts to delete existing requirements could actually add costs depending on how far along the activity had been in development—a by-product of the program's concurrency. According to Scofield, "While this effort didn't reduce program costs, it did eliminate some technological challenges to the program by eliminating immature subsystems that were proving to be not marginally effective; thus avoiding future program risk and cost growth."[562]

In April 1990, Secretary Cheney announced the results of the Major Aircraft Review and recommended that B-2 production be curtailed from 132 to 75.[563] Citing the changing geo-strategic situation and the shrinking defense budget, Cheney claimed that two wings of B-2s, 75 aircraft, would ensure the penetrating leg of the triad could be kept viable.[564] Cheney added that "the two wings will provide the minimum essential target coverage to capitalize on the penetrating bomber role."[565] Cheney testified that $9 billion

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559 On 7 October 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

560 On 7 October 2021, the author spoke to Lieutenant General (Ret.) Richard Scofield.

561 Lieutenant General (Ret.) Richard Scofield email message to author, 16 February 2022.

562 Lieutenant General (Ret.) Richard Scofield email message to author, 17 February 2022.

563 *Department of Defense Authorization for Appropriations for Fiscal Year 1991*, *Hearing before the Committee on Armed Services*, Senate, 101st Cong., 2. (1990) (Statement by Secretary of Defense Dick Cheney) 769.

564 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. Cheney, 832–833.

565 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. Cheney, 790.

would be saved, but the unit cost per aircraft would increase to $815 million.[566] Instead of five aircraft initially requested, Cheney cut his request down to two for Fiscal Year 1991 and five in Fiscal Year 1992.[567] Finally, Cheney noted that while the B-2 could serve in a conventional role, the prime reason for the bomber was to "help America deter a nuclear attack by providing the bomber leg of our strategic triad with an independent capability to penetrate likely Soviet air defenses well into the next century."[568]

The Congressional response to Cheney's request was also fueled by the shifting geo-strategic situation. Like the missile versus bomber debates in the 1960s and 1970s, many in Congress failed to understand why such an expensive weapons system was necessary when it was thought that the B-1Bs and B-52s armed with cruise missiles; and ballistic missiles fired from ground-based sites or sea going vessels, could hit the same targets envisioned for the B-2.[569] Further, there were concerns about the lack of testing before moving into production.[570] As a result, Congress hesitated to provide more funding until testing verified that the aircraft was, at the very least, low-observable, which had not yet been fully demonstrated.[571] Further, the fact that many in Congress viewed Northrop as "a bunch of crooks and rebels" according to Northrop's CEO Kent Kresa, certainly did not help.[572]

As Congress deliberated on how to move forward with the B-2 program, debates on whether the B-2 was necessary for the nation's defense played out in the popular media

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566 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. Cheney, 778, 801.

567 *National Defense Authorization Act for Fiscal Year 1991: Conference Report to Accompany H.R. 4739*, House Report 101–923, 101st Cong., 2 (Washington, D.C.: U.S. Government Printing Office, October 23, 1990), 482.

568 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. Cheney,790.

569 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. (Statement by Senator John Glenn) 806.

570 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. (Statement by Senator Jim Exon) 1208.

571 S., *Department of Defense Authorization for Appropriations for Fiscal Year 1991*. (Statement by Senator Jim Exon) 1210–1211.

572 Kent Kresa, interview by Peter J. Westwick, December 7, 2018, in Bel Air, California, transcript, The Huntington Library and University of Southern California Institute on California and the West Aerospace Oral History Project, https://hdl.huntington.org/digital/collection/p15150coll7/id/45047/rec/2.

and in the pages of academic journals. Secretary of the Air Force, Donald, Rice, even published in the journal *International Security,* and made his case for the B-2.[573] While it is uncommon for a sitting Secretary of the Air Force to pen such an article, analysis of media coverage prior to his article's release revealed that the B-2 was presented unfavorably at a rate of more than two to one.[574] With the program now being disproportionally criticized in the public discourse, it is clear that Rice was compelled to argue the Air Force's side.

In July 1990, Congressman John Dingell (D-MI) held a hearing as Chairman of the House of Representative's Energy and Commerce Subcommittee to examine the Northrop corporation's business practices.[575] With his unrelenting mistrust of "black" programs, and a mass of evidence going back three years, which he described as "a list misfeasance, malfeasance and nonfeasance that staggers the imagination," Dingell used the forum to assail Northrop.[576] He cited multiple ongoing federal investigations, and the fact that Northrop had recently plead guilty to falsifying testing data on both the Air Launched Cruise Missile and the AV-8B Harrier.[577] With the B-2 decision yet to be made, his hearing sought not only to influence it but also to consider if Northrop should be banned from government contracts.[578]

Motivated to discover whether Northrop's reprehensible activities had spread to the B-2 program, the Senate's Armed Services Committee held a hearing of their own as they prepared to vote on the 1991 defense bill. Shortly after it began, a letter sent to each of the Committee members from President Bush was read on the floor. Bush's letter strongly advocated for B-2 "production and deployment," noting that:

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573 Donald Rice. "The Manned Bomber and Strategic Deterrence: The U.S. Air Force Perspective." *International Security* 15, no. 1 (July 1, 1990): 100–128. https://doi.org/10.2307/2538983.

574 Virginia L. Sullivan, "An Assessment of Media Coverage of the B-2 Stealth Bomber" (master's thesis, University of Colorado, 1990), iii, 66.

575 *Northrop Corp. Investigation, Hearing before the Committee on Energy and Commerce*, House of Representatives, 101st Cong., 2. (1990), (Statement by Congressman John Dingell) 1.

576 H.R., *Northrop Corp. Investigation*. Dingell, 1.

577 H.R., *Northrop Corp. Investigation*. Dingell, 1.

578 H.R., *Northrop Corp. Investigation. Dingell*, 2.

> While we are witnessing truly historic changes in the international environment, these changes have not obviated the need for a credible and effective nuclear deterrent. Soviet strategic modernization continues, and there remains a fundamental requirement for the B-2.[579]

Bolstered by the president's support for the B-2, Secretary of the Air Force, Donald Rice, had the unenviable job of convincing Congress that Northrop had addressed or was in the process of addressing management and criminal allegations and that the B-2 program should continue. Rice argued that:

> Weapons systems must continue to be judged on the basis of the threat, the operational need, the substantive technical progress that is occurring in that specific program, the testing and how those results are coming, and the cost and affordability issues associated with each program.[580]

In Rice's view, those were the factors that should be the "basis" for decisions related to the B-2.[581] Northrop's issues of impropriety, fraud, and falsification should be treated separately—issues, which Rice testified that he felt Northrop was adequately addressing.[582]

Despite a forceful argument by Rice and support from Secretary Cheney, the House of Representatives voted against any further procurements of the B-2.[583] While the Senate believed the B-2 should progress, they failed to get additional B-2s added to the Fiscal Year 1991 NDAA.[584] For the second year in a row, funds would only be provided to complete already authorized procurements.

1991 began with just enough funding to keep the B-2 program alive, and multiple events further reduced the DOD's chances of getting anywhere close to 75 aircraft. First, came

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[579] S., *B-2 Program Management and B-2 Contract Management*, (1990) (Rice), 4.

[580] S., *B-2 Program Management and B-2 Contract Management*, (1990) (Rice), 6.

[581] S., *B-2 Program Management and B-2 Contract Management,* (1990) (Rice), 6.

[582] S., *B-2 Program Management and B-2 Contract Management*, (1990) (Rice), 6.

[583] H.R., National Defense Authorization Act for Fiscal Year 1991: Conference Report to Accompany H.R. 4739, 482.

[584] H.R., National Defense Authorization Act for Fiscal Year 1991: Conference Report to Accompany H.R. 4739, 482.; National Defense Authorization Act for Fiscal Years 1991, Pub. L. No. 101–510, Stat. 1485. (1990).

Cheney's decision to cancel the Navy's troubled A-12 stealth bomber after five billion dollars had been spent on the program.[585] The decision was a clear warning shot that no defense program was safe, though at that point $31.5 billion had been spent on the B-2 program, a sunk cost which made complete cancelation less likely.[586] Shortly after the A-12 cancellation, the B-2 program indirectly benefitted from the successful employment of the stealthy F-117 attack aircraft in major combat operations during the Gulf War.[587] In February, however, the official disbandment of the Warsaw Pact made calls for the peace dividend grow louder and the success of stealth in the Gulf War fade into the background.

With defense budgets not yet reflecting a peace dividend, the Air Force requested four new B-2s at a cost of 4.8 billion dollars in the 1992 defense budget.[588] Despite positive results from testing and favorable findings by the Defense Science Board, when the Soviet Union showed signs of an imminent collapse in the summer of 1991, the chances of getting 75 B-2s fell with it.[589] To keep production lines open, the Fiscal Year 1992 NDAA passed with enough funding to procure one additional B-2.[590] If there had been any hope that 75 B-2s would be produced, that hope was extinguished by the end of the year with the complete dissolution of the Soviet Union by late December 1991.[591]

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585 John Fialka and Rick Wartzman. "Cheney Ends Navy's A-12, Charges Contract Default: Move Eliminates Bailout for McDonnell Douglas and General Dynamics." *Wall Street Journal (1923-),* Jan 08, 1991.

586 General Accounting Office, *B-2 Bomber Cost Acquisition Estimates,* GAO/NSAID 93–48BR, (Washington: DC: General Accounting Office, 1993), 3.

587 While the F-117's first operational mission was to support Operation Just Cause in Panama in 1989, the mission did not allow for stealth technologies to reveal their unique capabilities.

588 *Department of Defense Appropriations for Fiscal Year 1992*, *Hearing before the Subcommittee on Appropriations*, Senate, 102nd Cong., 1 (1991), 858–859.

589 Defense Science Board Report, 20 February 1991, "Report of the Defense Science Board Review of the B-2 Block 2 Testing (U) – Information Memorandum (Unclassified Extract) in *Status of the B-2 Stealth Bomber Program*, *Joint Hearing before the Defense Policy Panel and the Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee of the Committee on Armed Services*, House of Representatives, 102nd Cong.,1, (1991), 4–7.

590 National Defense Authorization Act for Fiscal Years 1992 and 1993, Pub. L. No. 102–190, Stat. 1306. (1991).

591 By September 1991, President Bush ordered the standdown of SAC alert bombers due to the diminished threat of war with the Soviet Union. For more see: Susan Koch, "The Presidential Nuclear Initiatives of 1991–1992" National Defense University, Center of the Study of Weapons of Mass Destruction. September 2012, Appendix A. https://ndupress.ndu.edu/portals/68/documents/casestudies/cswmd_casestudy-5.pdf.

While ink on the Fiscal Year 1992 NDAA was still drying, the new Air Force Chief of Staff, General Merrill McPeak with Secretary Rice's concurrence, submitted the Air Force's Fiscal Year 1993 budget and recommended that production stop at 20. According to McPeak, after the Cold War ended and in the face of declining defense budgets—budgets that dropped by almost 20% during his tenure as Chief of Staff—"the Air Force could not afford airplanes at 2 billion dollars each"—a figure which was a close approximation of the per unit cost of 20 aircraft.[592] McPeak noted that Cheney was "disappointed" by his decision but didn't fight him on it.[593] On January 28, 1992, during President Bush' State of the Union address, he told the nation that "After completing 20 planes … we will shut down further production of the B-2 bombers."[594]

H. CONCLUSION

The B-2 program began with the Cold War-driven objective of penetrating Soviet airspace to deliver nuclear weapons. As long as the Soviet Union remained America's principal adversary, there was little debate over its strategic need. The existential nature of the threat and Reagan's two-bomber decision allowed the program to take on more risks, many of which would prove to be exceedingly costly. At the time of the B-2's genesis, there was no reason to prepare—nor were any actions taken to prepare—for a time when the Soviet Union might be no more.

Given the strategic importance of the B-2 program—a stealth bomber that could nullify hundreds of billions of dollars in Soviet air defenses and keep the bomber leg of the triad viable—the program enjoyed years of management freedom and mostly a blank check. Through 1986, billions of dollars were spent on the program at the recommendation of the program's SPO Director, the Air Force's top brass, and the Secretary of Defense.

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592 Merrill McPeak, *Roles and Missions* (Lost Wingman Press, 2017) 206.; United States Air Force, *Statistical Digest for Fiscal Year 1995*, (Washington, DC: Office of the Secretary of the Air Force), 22. https://media.defense.gov/2011/Apr/19/2001330023/-1/-1/0/AFD-110419-012.pdf.

593 On September 23, 2021 the author spoke to General (Ret.) Merrill McPeak.; Merrill McPeak, *Roles and Missions*, 206.

594 George Bush, State of the Union Address, 28 Jan 1992. The 1993 NDAA passed later in the year stipulated that "not more than 20 deployable B-2 bomber aircraft plus one test aircraft may be procured." Only 21 B-2s were produced.

There was no requirement to cultivate political support beyond the select few in Congress who could authorize the "black" budget's expenditures. As long as the money was spent on keeping the program secret and ensuring the B-2 would perform to its expectations, the funding spigot would be kept on.

By the late 1980s, Congress grew increasingly interested in understanding how swollen defense budget dollars were being spent. Given the B-2's rumored high costs, Congress trained its sights on the program. Instead of being given complete cost data and justification for such a technologically advanced program, the information they got from the Caspar Weinberger's office was so elementary that it was almost insulting.

Unsatisfied with the limited information they were given on the B-2 program but now aware that billions more were earmarked for the program, Congress ferociously pursued more data. With each request, they found that costs had risen, and milestones were further delayed. For such a technologically advanced program, the concomitant high costs and schedule delays might have been understood had support been sought earlier. But with no effort made to proactively manage political expectations, many in the wider Congressional body became so shocked at the amount spent on the program that many became its mortal enemies. The allegations of fraud and bribery against Northrop at the time certainly did not help.

As Congressional inquiries into the B-2 program grew, OSD and the Air Force realized the days of freedom they enjoyed in the "black" were no more. Attempts were made to justify the program and to bring costs down, but the efforts were too late. Had the issues been handled differently and sooner, it is conceivable to envision a future where more than 21 B-2s would have been authorized for production. But even so, once the Soviet Union collapsed, the presumptive strategic basis for the B-2 was removed and political support for expensive weapons system rapidly evaporated. The B-2's high price tag made it an easy target as the peace dividend appeared within grasp. The Air Force was forced to make tough budgetary decisions in turn, which resulted in the loss of bureaucratic support for the B-2 program. Put simply, the forces that were in alignment at the program's genesis were no longer in harmony at its end.

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VI. THE RISE AND FALL OF THE FOLLOW-ON BOMBER

After almost two decades of ambiguity, bureaucratic divergence, and iterative attempts to initiate a follow-on bomber to the B-2, on April 6, 2009, Secretary of Defense Robert Gates announced the termination of the Air Force's Next Generation Bomber (NGB) program. Citing confusion over "the need, the requirement, and the technology," Secretary Gates was not convinced that the NGB was an acquisition program ready to advance.[595] The termination portended a future where the manned bomber had lost its place in modern warfare.

The goal of this chapter is to examine the twisting path to Secretary Gates' decision—a path marked by resistance, differing bureaucratic perspectives, defense industry profit motives, political pressure, technological enticement, budget realities, and increasing geo-strategic threats. It covers the period from 1992, when the decision was announced to curtail B-2 production to 2009, when the NGB program was terminated. The chapter gives specific attention to the four common causal drivers found in the defense acquisition literature: bureaucratic politics; technology; political influences; and strategic need.

A. SETTING THE FOUNDATION: STUDIES, BUREAUCRATIC RESISTANCE, AND POLITICAL PRESSURE

Following the 1992 decision to stop B-2 production at 20 operational aircraft, and with the Cold War in the rear-view window, the Air Force took major steps to shift the bomber force towards a conventional focus. It was with that thought in mind that the Air Force officially changed the B-2's mission in 1992:

> The primary mission of the B-2 is to enable any theater commander to hold at risk and if necessary attack an enemy's warmaking potential, especially those time critical targets which, if not destroyed in the first hours or days

[595] Department of Defense, *Defense Budget Recommendation Statement* (Arlington, VA), As Prepared for Delivery by Secretary of Defense Robert M. Gates, Arlington, VA, Monday, April 06, 2009 excerpt from Jeremiah Gertler, Air Force Next-Generation Bomber; Background and Issues for Congress, CRS Report No. 7–5700 (Washington, D.C., Congressional Research Service, 2009).

> of a conflict, would allow unacceptable damage to be inflicted on the friendly side.[596]

According to Secretary of the Air Force, Donald Rice, the shift in thinking was only possible thanks to precision weapons technology—technology that he noted "gave big aircraft a whole new lease on life, which they would have never had if all they had was dumb bombs to drop."[597]

The Air Force further articulated its new strategy in June 1992 via *The Bomber Roadmap.* The *Roadmap* articulated the shift in the Air Force's thinking towards bombers, away from a focus "on nuclear war to a smaller, more sophisticated force equipped to perform a variety of conventional missions."[598] The *Roadmap* also added that the bomber force, in both size and composition, was adequate to meet "future requirements."[599] No timeline was given on when the Air Force might pursue a follow-on bomber.

To enable the *Bomber Roadmap* vision, the Air Force dissolved Strategic Air Command (SAC) and put all SAC bombers and ICBMs in the newly established Air Combat Command (ACC). The commander of ACC—which has always been a fighter pilot—would now control all combat air power from short-range fighters to long-range bombers and ICBMs. While the reorganization of forces was supposed to "break old stereotypes" and expand thinking about bomber force employment that would be capable of both strategic and conventional missions, it also meant that the Air Force would no longer have a four-star bomber General to advocate for long-range air power.[600]

Numerous studies were commissioned to make sense of the shift in thinking about the strategic bomber force. Questions such as whether the bomber force size was adequate, if the heavy bomber industrial base would be jeopardized, and what missions the bomber

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596 Department of the Air Force, *Global Reach—Global Power: The Evolving Air Force Contribution to National Security*, (Washington, D.C.: Department of the Air Force, December 1992), 5. https://apps.dtic.mil/sti/pdfs/ADA326700.pdf.

597 On January 14, 2022, the author spoke to Dr. Donald Rice.

598 Department of the Air Force, *The Bomber Roadmap: Enhancing the Nation's Conventional Bomber Force* (Washington, D.C.: Department of the Air Force, June 1992), 1.

599 Department of the Air Force, *The Bomber Roadmap,* 1, 6.

600 Department of the Air Force, *The Bomber Roadmap,* 3.

force could accomplish drove most of the studies. And with the impact of precision weapons becoming more understood—especially from their employment in the first Gulf War—many also sought to makes sense of what the technology aboard high-payload, long-range bombers could bring to modern combat.

The first of the major studies were sponsored or led by either the Office of the Secretary of Defense (OSD) or the Air Force. Given that the senior DOD and Air Force leadership supported the truncated B-2 procurement decision, the early studies concluded that the current bomber force was adequate.[601] None of the OSD or Air Force studies recommended that additional B-2s should be procured, nor did they provide a recommendation to initiate a follow-on bomber program.[602]

Concerned that the Air Force was insufficiently addressing the long-range strike mission, Congress stepped in.[603] Since the Air Force's birth, a bomber had always been in development, and some in Congress feared that long-range combat air power was being sidelined by short-range fighters.[604] As a result, Congress commissioned two independent studies that would prove to not only compel the Air Force to refine their bomber strategy but to make the service set a timeline for when they would initiate a follow-on bomber program.

The first Congressionally directed independent study on the bomber force was instigated by Congressman Duncan L. Hunter (R-CA), the Chairman of the Subcommittee

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601 For more studies see: 1994 *Nuclear Posture Review*, 1994 *Heavy Bomber Force Study*, 1995 *Heavy Bomber Industrial Capabilities Study*.

602 As an aside, one of the bomber studies in the period was part of the Commission on Roles and Missions (CORM), which Congress directed as a follow-up to the 1993 Bottom-Up Review (BUR). The final CORM report did not call for additional bomber forces, despite their subcommittee's recommendation on the future bomber force, which did just that, and for more B-2s specifically. See *Future Bomber Force* paper, Draft dated May 23, 1993.

603 Congressmen Duncan Hunter and Norm Dicks speaking before the House of Representatives, *Congressional Record* 143, no. 89, daily ed., (June 23, 1997): H4174.

604 Congressman Duncan Hunter speaking before the House of Representatives, *Congressional Record* 143, no. 89, daily ed., (June 23, 1997): H4174.,. Kurt Guthe, *Assessments of the Bomber Force: Lessons from the Past, Directions for the Future*. National Institute for Public Policy, Fairfax, VA, Jan 1998.

on Military Procurement.[605] Hunter enlisted Brent Scowcroft, a retired four-star Army General and President George H.W. Bush's National Security Advisor, to lead the study, which was known as the *Independent Bomber Force Review*. The study's goal was to assess the "adequacy of the nation's heavy bomber force."[606] Released in 1997, its conclusions were scathing:

> To put the matter simply, under current plans the bomber has no future. A de facto strategic choice has been made to rest the future of American air power on short-range fighters. Unless immediate corrective action is taken, the long-range heavy bomber will gradually disappear as a meaningful element of America's armed forces.[607]

The report went on to chastise the Air Force for its misguided single-mindedness on short-range fighters—an asset that the report noted would be significantly challenged in future conflicts, given the vast ranges and basing limitations that would likely be involved.[608] Not surprisingly, the Scowcroft study called for the additional procurement of B-2s and for the nation to adequately prioritize long-range air power.[609]

Given Scowcroft's rebuke of the Air Force's failure to prioritize long-range combat air power, many in Congress sought to add funding for additional B-2 procurement.[610] Others were not convinced on the matter, which prompted yet another independent review.[611] The second study was entitled the *Long-Range Air Power Panel* (LRAPP). Its

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605 Of note, since Northrop did not have any major business operations in Hunter's districts, there is no evidence to suggest that pork-barrel politics factored into his motivation to commission the *Independent Bomber Force Review.*

606 Letter to Congressman Duncan Hunter from General Brent Scowcroft in the *Congressional Record* 143, no. 89, daily ed., (June 23, 1997): H4176.

607 Brent Scowcroft, USAF (Ret.) et al., *Scowcroft Independent Bomber Force Review* (Washington, D.C.: Collins Group International, June 23, 1997) in Congressional Record 143, no. 89, daily ed., (June 23, 1997): H4176-H4181.

608 Scowcroft, *Scowcroft Independent Bomber Force Review*, H4180.

609 Scowcroft, *Scowcroft Independent Bomber Force Review*, H41800-H4181.

610 Guthe, *Assessments of the Bomber Force*, 51.; House of Representatives, National Defense Authorization Act for Fiscal Year 1998: Conference Report to Accompany H.R. 1119, House Report 105–340, 105th Cong., 1st sess. (Washington, D.C.: U.S. Government Printing Office, October 23, 1997), 25, 565.

611 Guthe, *Assessments of the Bomber Force*, 51.; National Defense Authorization Act for Fiscal Year 1998, Pub. L. No. 105–85 (1997).; 1651.; Department of Defense Appropriations Act for 1998, Pub. L. No. 105–56, (1997), 1249–1250.

authors were charged with evaluating "the adequacy of current planning for United States long-range air power and the requirement for continued low-rate production of B-2 stealth bombers."[612] Led by retired General Larry Welch, a former Chief of Staff of the Air Force and Commander of Strategic Air Command, the panel also included former Secretary of the Air Force, Donald Rice;[613] former Chief of Staff of the Air Force, General Merrill McPeak;[614] and the recently retired Senator from Nebraska and former member of the Senate Armed Services Committee, James Exon; among other distinguished members.[615] Much like the Scowcroft report, the panel found the Air Force lacking in the area of long-range strike:

> Current plans do not adequately address the long-term future of the bomber force. The lead time for the next generation aircraft is likely to be long, regardless of the approach selected. The Panel recommends that the Department develop a plan to replace the existing force over time. Alternatives for consideration are a variant of the B-2, incorporating upgrades suggested in this report and those that will emerge in the future; or development of more advanced technologies that might lead to a better solution for the next generation aircraft.[616]

Unlike the Scowcroft report, the panel recommended against additional B-2 procurement and argued instead that immediate funding should be directed towards upgrading the current bomber fleet.[617] And with that, talk of additional B-2 procurement was mostly muted. Nevertheless, with now two high-level studies reaching the same conclusion about the Air Force's lack of a long-range strike strategy, Congress directed the Air Force to

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612 Department of Defense Appropriations Act for 1998, Pub. L. No. 105–85, 1249, 111 Stat. 111, (1997).

613 While Secretary Rice previously supported the decision to curtail B-2 production in light of declining budgets at the end of the Cold War, he was an ardent supporter of long-range strike.

614 Like Rice, General McPeak supported long-range air power, but as was discussed in Chapter 5, he would not support the B-2 at the neglect of other Air Force needs (i.e., fighters and transports).

615 *Summary of the Principal Findings and Recommendations of the Panel to review Long-Range Air Power* in National Defense Authorization Act for Fiscal Year 1999 and Oversight of Previously Authorized Programs, Hearing before the Committee on National Security, House of Representatives, 105th Cong. 2 (1999), 576.

616 S*ummary of the Principal Findings and Recommendations of the Panel to review Long-Range Air Power.*

617 *Summary of the Principal Findings and Recommendations of the Panel to review Long-Range Air Power.*

submit a "long-term bomber forces structure plan…and a timeline for consideration of the acquisition of a follow-on bomber" by March 1999.[618]

Per Congressional direction, on March 1, 1999, the Air Force issued a *White Paper on Long Range Bombers*. It echoed much of what was said in the earlier *Bomber Roadmap*, which had concluded that the current force of B-52s, B-1Bs, and B-2s would be adequate to meet "future requirements." In chief addition was to satisfy Congress' request and set a date for when the Air Force expected to field a new bomber.[619] The date set was 2037.[620]

Just months after the Air Force released their *White Paper*, the B-2 made its combat debut in Kosovo. It was nothing short of remarkable. There were zero B-2 combat losses. And thanks to investments made in precision weapons years earlier, the stealthy B-2 was the only bomber capable of delivering precision weapons. Coupled with their high payload capacity, the B-2s hit 33% of the air-to-ground targets attacked during the war, while they flew only 3% of the sorties.[621] The B-2's performance put to rest years of concern over the aircraft's yet to be proven technology, and its utility in modern warfare. The question now was whether its performance was enough to convince the Air Force to revise its strategy with respect to long-range strike capabilities. At least to some in the defense industry, Kosovo made that a possibility.

B. STRIKE 1: THE B-2C CONVENTIONAL BOMBER

Northrop-Grumman (Northrop) sought to get ahead of what they forecasted as a likely increase of investment in long-range strike capabilities.[622] Northrop believed that the B-2's performance in Kosovo demonstrated the value of all weather, long range,

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618 National Defense Authorization Act for Fiscal Year 1999, Report of the Committee on National Security on H.R. 3616, House of Representatives, 105th Cong., 2 (1998), 95.

619 Department of the Air Force, *The Bomber Roadmap,* 6.

620 United States Air Force, *White paper on Long-Range Bombers*, March 1, 1999, p. 21.; Department of the Air Force, *The Bomber Roadmap: Enhancing the Nation's Conventional Bomber Force* (Washington, D.C.: Department of the Air Force, June 1992), 1.

621 *Performance of the B-2 Bomber in the Kosovo Air Campaign*, *Hearing before the Military Procurement Subcommittee of the Committee on Armed Services*, House of Representatives, 106th Cong. 1, (1999) Statement by General Richard Hawley). 33.

622 On January 7, 2022, the author spoke with Mr. Jim Tapp.

precision, conventional strike in hostile environments could lead to additional investment in additional B-2s at a price more affordable than starting a new bomber program.[623] Northrop called the offering the B-2C (C for "conventional") "to allow for unclassified discussions of the baseline aircraft capability with the understanding that the Air Force might very well want to make the new bombers nuclear capable."[624] But by taking advantage of "numerous manufacturing and performance improvements learned during the initial production run of the 21 B-2s" and by leaving out nuclear related components (i.e., nuclear communications, nuclear hardening, etc.), B-2Cs were estimated to cost far less than the original B-2.[625] Procurement of the B-2C would also keep the soon to be closed B-2 production line open. Northrop's leadership appointed Jim Tapp, a retired Air Force Colonel and Vice President for Business Development for Northrop's Airplane Sector, to lead the effort to sell it to the Air Force.[626]

According to Tapp, the Air Force was initially receptive to the B-2C.[627] After the B-2's performance in Kosovo, it was easy to envision what a larger force of B-2s could accomplish. Following a brief discussion on the matter with the General Michael Ryan, the Air Force's Chief of Staff, Ryan told Tapp that the idea was attractive if "affordability was prioritized."[628]

Tapp briefed the Air Force's Deputy Chiefs of Staff on the B-2C in early 2001.[629] Northrop's pitch was that by taking advantage of previous B-2 investments, new B-2Cs could be procured at a price of $2 billion in non-recurring performance improvements and production line modification costs.[630] The recurring unit cost was estimated to be $250

[623] On January 7, 2022, the author spoke with Mr. Jim Tapp.

[624] On January 7, 2022, the author spoke with Mr. Jim Tapp.

[625] On January 7, 2022, the author spoke with Mr. Jim Tapp.

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[628] On January 7, 2022, the author spoke with Mr. Jim Tapp.

[629] On January 7, 2022, the author spoke with Mr. Jim Tapp.

[630] On January 7, 2022, the author spoke with Mr. Jim Tapp.

million per airplane.[631] Again Tapp was cautioned about affordability but left the meeting thinking the Air Force was agreeable to the procurement and that the next step would be to negotiate the final price and the contract's terms and conditions.[632] That is not what happened.

Shortly after Tapp's meeting with the Air Force's brass, Dr. James G. Roche was appointed as Secretary of the Air Force. Roche had joined Northrop in 1984, after a career in the United States Navy, where he attained the rank of Captain and earned a Doctorate from Harvard's business school. At Northrop he rose to serve as president of the Electronics and Systems sector. When Roche left Northrop to become Secretary of the Air Force, many thought it signaled that the B-2C was a slam dunk.

Roche did not support the B-2C. He had been against it while at Northrop and his view remained unchanged when he became Secretary of the Air Force.[633] Roche believed the B-2's technology was far too outdated to consider buying more and that the bombers were optimized for fixed targets, when mobile targets were growing more threatening.[634] He also believed Northrop's cost estimates were wildly optimistic.[635] Most importantly, Roche believed the Air Force had more pressing needs than a new bomber, which was to "replenish our air superiority mission and medium attack force"—namely the F-22 and Joint Strike Fighter (i.e., F-35).[636]

Roche knew that the Air Force was "going to need a new bomber at some time," and since defense budgets were only slightly above Cold War valleys, it was clear that

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631 On January 7, 2022, the author spoke with Mr. Jim Tapp.

632 On January 7, 2022, the author spoke with Mr. Jim Tapp.

633 On January 28, 2022, the author spoke with Dr. James Roche.; James Roche "*Memorandum for the Secretary of Defense*, *Loren Thompson's diatribe RE: B-2*" (official memorandum, Washington, DC: Department of the Air Force, 17 August 2001).

634 James Roche Memorandum for the Secretary of Defense, *Loren Thompson's diatribe RE: B-2*, 17 August 2001. 2.

635 On January 28, 2022, the author spoke with Dr. James Roche. Due to the modifications that were needed, Roche knew that the B-2C would have to undergo a complete battery of testing before the airplane could be certified as combat ready. All of that would result in added time before the aircraft could be operationally ready.

636 James Roche Memorandum, 17 August 2001. 1.

tough decisions had to be made.[637] If Roche supported a new bomber program, the ongoing F-22 and F-35 programs would suffer as would other pressing requirements, such as a desperately needed new tanker.[638] Without a new fighter in the force since the 1970s-era F-15 and F-16, Roche believed it was time for the Air Force's scarce resources to prioritized to the modernization of its fighter force.[639] The Air Force's Chief of Staff, General Ryan, might have been open to the idea of procuring B-2Cs, but he allowed the Air Force's 2002 budget request to advance with no requests for a new bomber. And since the Air Force had dissolved Strategic Air Command, there was no four-star bomber advocate to contest the decision.

Critics quickly emerged to protest Roche's opposition to the B-2C procurement. The Bush administration's new Secretary of Defense, Donald Rumsfeld, received multiple letters to this effect from previous senior defense leaders and various defense-related editorial outlets. The list included former Secretary of the Air Force, Donald Rice and Donald Hicks, who had served as Under Secretary of Defense of Defense Research and Engineering under Caspar Weinberger, but it was an op-ed on the bomber debate by Loren Thompson that caught Rumsfeld's eye. Published by the Lexington Institute—a think tank funded in part by the defense industry—the piece criticized the Air Force for being too focused on short-range fighters at the expense of a weakening bomber force.[640] Thompson noted that basing challenges would plague short-range fighters in future conflicts and concluded with a strong recommendation to reopen the B-2 production line.[641] Wanting to know more, Rumsfeld requested Secretary Roche and his new Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L), Pete Aldridge, who had

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637 On January 28, 2022, the author spoke with Dr. James Roche.; United States Air Force, *Budget Digest for Fiscal Year 2009* (Washington, D.C.) https://www.afhistory.af.mil/Portals/64/Statistics/2009%20USAF%20Stat%20Digest.pdf?ver=2017-04-25-125736-437&timestamp=1493139550511.

638 James Roche Memorandum, 17 August 2001, 1.

639 James Roche Memorandum, 17 August 2001. 1.

640 Loren D. Thompson, "B1 Versus B-2: A Defining Moment for Donald Rumsfeld." *Lexington Institute*, August 14, 2001.

641 Thompson, "B1 Versus B-2".

served as Secretary of the Air Force from 1986–1988, provide their review. Was there truth in what Thompson wrote? Did the Air Force really have a strategy for long-range strike?

Roche assured Rumsfeld that the Air Force had adequately prioritized its resources to address the service's most immediate needs.[642] While he did not address Thompson's argument about basing challenges for short-range aircraft in future conflicts, Roche emphasized the need to counter mobile targets.[643] He argued that in that mission "big bombers are not as helpful as fast attack aircraft."[644] His contention was not only a direct argument for the F-22, but supported what would become his vision for long-range strike—a capability that could combine speed, stealth, and range.[645] Still, Roche assured the new Defense Secretary that the Air Force would "begin concept development studies of the future of long-range attack aircraft, which will exploit technology of this century."[646] He made no promises to accelerate the timeline for fielding a new bomber.

C. STRIKE 2: THE RISE AND FALL OF THE "BRIDGE BOMBER"

The 2001 Quadrennial Defense Review (QDR) was released shortly after the exchange between Roche and Rumsfeld on the issue of the B-2C and the Air Force's strategy for long-range strike. While the QDR was influenced by the September 11 attacks against the United States, its primary thrust was to lay a foundation for "transformation" across the DOD, an issue close to the Secretary's heart.[647] Rumsfeld's vision for the DOD was to "divest ourselves of legacy forces [to] move into new concepts, capabilities, and organizations that maximize our warfighting effectiveness and combat potential."[648]

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642 James Roche Memorandum, 17 August 2001.

643 James Roche Memorandum, 17 August 2001, 2.

644 James Roche Memorandum, 17 August 2001, 2.

645 James Roche Memorandum for the Secretary of Defense, *Loren Thompson's diatribe RE: B-2*, 17 August 2001. 2.; Speed and stealth seem to be part of the original conception of a next generation bomber around this time another idea that surfaced in the period was the B-X, which was designed to be a "a stealthy, supersonic bomber with a range of 5000 nautical mile unrefueled range." See: United States Air Force, *The U.S. Air Force Transformation Flight Plan*, November 2003, D-3.

646 James Roche Memorandum for the Secretary of Defense, *Loren Thompson's diatribe RE: B-2*, 17 August 2001.

647 Department of Defense, *Quadrennial Defense Review for 2001*. September 30, 2001.

648 Department of Defense, *Quadrennial Defense Review for 2001*. September 30, 2001, V.

While the 2001 QDR offered no specifics in the area of long-range strike, it emphasized it as a core capability—one that would need to adapt to anti-access and area-denial environments.[649] The security concern from a rising China was not called out specifically in the 2001 QDR, but it was clearly a motivation behind much of the guidance.[650]

Shortly after the QDR was released, Under Secretary for AT&L, Pete Aldridge, issued a memorandum to Secretary Roche titled "Long-Range Strike Aircraft-X (LRSA-X)." As a pivotal member of Rumsfeld's OSD staff, Aldridge directed the Air Force to be ready to start a new bomber program in the "2012-2015 timeframe."[651] It is not clear if he was inspired by the 2001 Quadrennial Defense Review's thrust for novel capabilities, but the timing of the memorandum does not seem coincidental.

The Air Force received Aldridge's memorandum just prior to the release of its updated long-range strike strategy. Accordingly, the Air Force plan included language from Aldridge's' memorandum, which specified they start the LRSA-X acquisition program in the 2012–2015 timeframe.[652] Yet they nonetheless held to the contention that the current bomber force would be adequate "for the next 35 years or more."[653]

Roche kept his word to Rumsfeld, and tasked ACC to examine options for the next long-range strike system.[654] The corresponding effort would also address Aldridge's proposed LRSA-X.[655] With the growing fervor around transformation and revolutionary technologies, the ACC-led effort explored myriad options to accomplish the long-range strike mission.[656] Even the Air Force's new Chief of Staff, General John Jumper, a career

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649 Department of Defense*, Quadrennial Defense Review for 2001*. September 30, 2001, 43.

650 Department of Defense, *Quadrennial Defense Review for 2001*. September 30, 2001. 4.

651 E. C. Aldridge, Jr., "Future Long-Range Strike Aircraft (LRSA-X)," memorandum for the Secretary of the Air Force, November 2, 2001 in Barry Watts, Barry D. Watts, *Long Range Strike: Imperatives, Urgency and Options*, Center for Strategic and Budgetary Assessments, April 2005, 15.

652 United States Air Force, *U.S. Air Force Long-Range Strike White Paper*, November 2001, 29.

653 United States Air Force, *U.S. Air Force Long-Range Strike White Paper*, November 2001, 29.

654 John A. Tirpak, "Long Arm of the Air Force," *Air Force Magazine*, October 2001. United States Air Force, *U.S. Air Force Long-Range Strike White Paper*, November 2001.

655 Tirpak, "Long Arm of the Air Force."

656 Tirpak.

fighter pilot, seemed to be caught up in the frenzy and told Congress that he wasn't sure if the next generation long-range strike capability would be "manned, unmanned or orbital or suborbital, but we ought to take advantage of the next generation."[657] With so many options to explore, the path forward grew much more complicated than a debate between bombers and missiles.

The remainder of 2002 was marked by numerous studies that sought to understand what modern technologies could yield when applied to long-range strike.[658] No idea was off the table. Air Force documents in the period even postulated that the future of long-range strike might be steel rods (i.e., "Rods from God") delivered from space.[659] While the studies and ideas were plentiful, by the start of 2003 no concrete action had been taken, which caused some in Congress to grow impatient.

Based on a perception that the Air Force had no actionable plan in the long-range strike arena, members of Congress publicly expressed their concerns in early 2003 during the defense budget hearings for Fiscal Year 2004. The Chairman of the House Armed Services Committee, Duncan L. Hunter (R-CA), and the ranking member, Ike Skelton (D-MO), were especially concerned. The Air Force's 2004 budget request arrived with no funding sought for the acquisition of more long-range bombers—either old or new.[660] Both Hunter and Skelton laid into the Air Force over their lack of attention to long-range air power, but Skelton's was particularly scathing:

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657 *National Defense Authorization Act for Fiscal Year 2003, H.R. 4546 and Oversight of Previously Authorized Programs*, *Hearing before the Committee on Armed Services*, House of Representatives, 107th Cong. 2 (2002) (Statement by General John Jumper testimony) 318.

658 Department of Defense, *B-52 Re-Engining Study*, Defense Science Board Task Force, June 2004, 15.; *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation, Hearing before the Committee on Armed Services and Subcommittee on Projection Forces*, House of Representatives, 108th Cong. 2, (2004) (Statement by Lieutenant General T. Michael Moseley) 60–61.

659 United States Air Force, *The U.S. Air Force Transformation Flight Plan*, November 2003, 66.

660 *National Defense Authorization Act for Fiscal Year 2004 and Oversight of Previously Authorized Programs. Hearing Before the Committee on Armed Services*, House of Representatives, 108th Cong. 1. (Statement by Congressman Ike Skelton) 420.; Department of the Air Force, "Fiscal Year (FY) 2005 Budget Estimates: Research, Development, Test and Evaluation (RDT&E) Descriptive Summaries," Volume II, February 2004. https://www.saffm.hq.af.mil/Portals/84/documents/FY05/AFD-070221-149.pdf?ver=2016-08-22-110146-960.

> Now, our chairman, Duncan Hunter, has realized, both publicly and privately, the need to increase the bomber fleet. And, yet, I find no recommendation anywhere this year or in previous years for an increase in the United States Air Force bomber fleet…But, conflicts do happen. Accidents do happen. A small bomber fleet—and you will have to admit that it is—cannot grow unless you recommend it and we pass it. And, it may very well be that under the chairmanship of our leader Duncan hunter on this committee, we may forge ahead…But, it would certainly help if you and your capacities would make recommendations and assist us in that effort.[661]

And while China was not specifically called out as a key reason behind the perceived need for long-range air power, analysis of Hunter's statements in the hearing revealed his concerns about the rising power.[662] In the end, the Air Force's brass refused to revise their budget request and Congress unilaterally injected $45 million in the Air Force budget for the sole purpose of initiating a new bomber program.[663]

In response, the Air Force immediately directed a summit to address the service's long-range strike strategy. Held in December 2003, the "Long-Range Strike Summit" sought to not only reexamine their strategy but to devise a plan for how to spend the $45 million budget item.[664] The results of the summit were announced in early 2004.[665]

Instead of waiting until a "revolutionary" capability could be acquired, the Air Force advanced a three-pronged strategy, as laid out by the Air Force's Vice Chief of Staff, General T. Michael Moseley. First, it would continue to modernize the existing bomber

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[661] H.R., *National Defense Authorization Act for Fiscal Year 2004* (Statement by Congressman Ike Skelton) 420.

[662] H.R., *National Defense Authorization Act for Fiscal Year 2004*. (Statement by Congressman Duncan L. Hunter) 815.

[663] Elizabeth Rees, "AF Long-Range Strike Summit Re-looks Future Bomber timeline," *Inside the Air Force*, Volume 15, No. 4 (Jan 23, 2004), 1, 5–6.; United States Air Force, Fiscal Year 2005 Budget Estimates, Research Development, Test, and Evaluation (RDT&E), February 2005, 641.

[664] Rees, "AF Long-Range Strike Summit Re-looks Future Bomber timeline."

[665] H.R., *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation*. (Statement by Moseley) 23.

fleet.[666] Second, it would develop a "bridge bomber" to bridge the gap until the revolutionary capability could be acquired.[667] The "bridge bomber," a medium-range bomber—presumably a bomber with a combat radius of about 1,500 nautical miles—would begin arriving in the 2012–2015 timeframe with "subsequent fielding in the 2025 – 2030 timeframe."[668] And, finally, the long-range strike transformational effort would continue with a planned fielding date of beyond 2025, and even out to 2050, depending on the desired system and technology available.[669]

The addition of the "bridge bomber" marked a major alteration to the Air Force's strategy. The Air Force hoped the bomber would temper growing pressure from Congress and OSD by providing a near-term hedge in long-range strike capacity while still allowing the Air Force to pursue a revolutionary capability. The "bridge bomber" also matched up nicely with Secretary Roche's earlier, yet not resourced, brainstorm of adding a regional bomber to the force—the FB-22.[670]

The idea of the FB-22 was first conceived in late 2001 by Secretary Roche and was one of the many solutions considered during the study years of 2002–2004. In line with his 2001 letter to Secretary Rumsfeld, Roche's FB-22 concept would leverage stealth and propulsion advances made in Lockheed-Martin's F-22, but the airframe would be enlarged for added range and payload.[671] The combat radius for the FB-22 was envisioned to be

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666 H.R., *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation* (Statement by Moseley) 128.

667 H.R., *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation* (Statement by Moseley) 128.

668 H.R., *National Defense Authorization Act for Fiscal Year 2005 H.R. 4200 and Oversight of Previously Authorized Programs* (Statement by Moseley) 128.

669 H.R., *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation* (Statement by Moseley) 23, 61.; Medium-range combat radius approximated from Congressional Budget Office, *Alternatives for Long-Range Ground Attack Systems*, (Washington, DC: CBO, 2006), X. https://www.cbo.gov/sites/default/files/109th-congress-2005-2006/reports/03-31-strikeforce.pdf.

670 On January 28, 2022, the author spoke with Dr. James Roche.

671 H.R., *National Defense Authorization Act for Fiscal Year for 2005 on Authorization and Oversight. Hearing Before the Committee on Armed Services*, House of Representatives, 108th Cong. 2. (Statement by Dr. James Roche) 484.

around 1600 nautical miles compared to the B-2's 2200 nautical miles, and the FB-22's payload would be less than half as much as the B-2 (15,000 lbs vs 40,000 lbs).[672] As long as the FB-22 was procured in sufficient quantities, though, Roche believed a smaller bomber would bring much needed flexibility to the force.[673] Such a bomber could land at more bases and spread out across a large area of operations.[674] The envisioned FB-22 was planned to be optimized against mobile targets due to its speed and loiter time—a noted area of deficiency in the Air Force's arsenal.[675] The FB-22 would also be cross-compatible with the F-22, which meant cost savings and efficiencies, since the airplanes would share everything from avionics to low-observable designs.[676]

The FB-22 quickly emerged as a frontrunner for the role of the "bridge bomber." The first description given for the "bridge bomber" matched Roche's vision for the FB-22 perfectly:

> A new system [the "bridge bomber"] will take full advantage of today's available technology to provide a stealthy, persistent, responsive platform capable of defending itself against the full spectrum of advanced threats, day or night. This new system would have range, payload, and loiter capabilities somewhere between those of fighters and bombers, and would complement both.[677]

D. STRIKE 3: THE NEXT GENERATION BOMBER

The regional bomber concept did not long survive Roche's departure from his post as Secretary of the Air Force at the start of President George W. Bush's second term in 2005. Without his backing, Congress more forcefully questioned the Air Force's concept

672 John A. Tirpak, "The Raptor as Bomber" *Air Force Magazine*, January 1, 2005.; H.R., *National Defense Authorization Act for Fiscal Year 2004*. (Statement by Secretary James G. Roche) 432.

673 On January 28, 2022, the author spoke with Dr. James Roche.

674 On January 28, 2022, the author spoke with Dr. James Roche.

675 H.R., *National Defense Authorization Act for Fiscal Year for 2005 on Authorization and Oversight*. (Statement by Dr. James Roche) 484, 493.; Tirpak, "The Raptor as Bomber."

676 Tirpak, "The Raptor as Bomber."

677 H.R., *National Defense Authorization Act for Fiscal Year 2005 and Oversight of Previously Authorized Programs on Procurement, Research, Development, Test, and Evaluation*. (Statement by Moseley) 130–131.

of a regional bomber in favor of a long-range bomber.[678] Concerns also emerged over the Air Force awarding so many contracts to one defense company.[679] Not only did Lockheed-Martin have the F-22, but they had also won the contract for the F-35. The final nail in the "bridge bomber" coffin, however, came during the drafting of the 2006 QDR.

Guided by intelligence forecasts that concentrated on a fight in the Pacific, the OSD-led 2006 QDR team swiftly concluded that the United States was sorely lacking in their long-range strike capacity. What was needed according to Jim Thomas, the principal author of the 2006 QDR, was a combination of "missile trucks with standoff munitions plus penetrating bombers to balance the force composition." With an adequate force of B-52s and B-1Bs capable of launching standoff weapons, the small fleet of 20 B-2's—the nation's only penetrating long-range strike platform—was the area of most concern.[680]

After it was concluded that major investments were needed in long-range strike, the QDR team reviewed the Air Force's long-term strategy. And much like the small fleet of 20 B-2s, it was also found wanting. Not only was the Air Force's target fielding date (2025) too late, but their concept of a medium-range "bridge bomber" did not meet the requirements for a Pacific fight.[681]

In response to what they viewed as a strategically deficient long-range bomber plan, OSD proposed that corrective direction be added to the 2006 QDR. They sent a draft of their proposal to the Air Force's new Chief of Staff, General T. Michael Moseley, a fighter pilot, and the new Air Force Secretary, Michael Wynne for review, which called for the "development of a new land-based, penetrating long-range strike capability to be fielded by 2018."[682] Given the Air Force's recent ambiguity and opposition to shifting resources away from the F-22 and F-35, Thomas was concerned the Air Force would push back.

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678 *Department of Defense Appropriations for 2006*, *Hearing before the Subcommittee on Appropriations*, House of Representatives, 109th Cong. 1 (2006), (Statement by Congressman Norm Dicks) 602–603.; Congressional Budget Office, *Alternatives for Long-Range Ground Attack Systems*, X.

679 H.R., *National Defense Authorization Act for Fiscal Year 2005*, 485.

680 On February 15, 2022, the author spoke to Mr. Jim Thomas. This paragraph is attributed to that discussion.

681 On February 15, 2022, the author spoke to Mr. Jim Thomas.

682 Department of Defense, *Quadrennial Defense Review Report*, February 6, 2006. 46.

Much to his surprise, however, he found in Moseley and Wynne tremendous advocates of long-range air power and the QDR language returned without a stroke of red ink.[683] According to Major General Ronald Bath, who served as the Air Force's point-man on the 2006 QDR, the senior brass supported the decision because they believed the long-range strike decision had been delayed long enough and that if action wasn't taken soon, the Air Force would be stuck with "an aging bomber force that might come back to bite us."[684]

In response to the 2006 QDR guidance, the Air Force reprogrammed money in their Future Years Defense Plan (FYDP) and set out to accomplish the DOD's mandatory weapons system acquisition process as spelled out in the Joint Capabilities Integration and Development System (JCIDS).[685] With the requirement set by the QDR, the Air Force could advance to the next step in the JCIDS process: the Analysis of Alternatives (AoA) phase. In this phase, the capability need would be examined in view of the threat environment, costs, systems already in service or development, technology readiness levels, and so on.[686] The manner in which the AoA was conducted would have a major influence on the capability that was recommended.

The Air Force's AoA strategy was geared towards producing a final recommendation of a long-range, penetrating bomber.[687] To that end, the AoA prioritized capabilities such as survivability, persistence, and the flexibility to strike a variety of targets (e.g., time critical or deeply buried targets)—capabilities that would clearly skew the solution towards a heavy stealth bomber.[688] Yet, there was one major problem: not

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683 On February 15, 2022, the author spoke to Mr. Jim Thomas.

684 On January 6, 2022, the author spoke to Major General (Ret.) Ronald Bath.

685 *National Defense Authorization Act for Fiscal Year 2007 and Oversight of Previously Authorized Programs, Hearing before the Armed Services Committee*, Senate, 109th Cong. 2 (2006), 43.; United States Air Force, *Fiscal Year 2007 Budget Estimates, Research Development, Test, and Evaluation (RDT&E)*, February 2006, 693.

686 United States Air Force, *Operational Capability Requirements Developmen*t, AFI 10–601, 38. https://static.e-publishing.af.mil/production/1/af_a3_5/publication/afi10-601/afi10-601.pdf.

687 Elaine M. Grossman, "Air Chief Resists Combining Future Bomber, Prompt Strike Studies," *Inside Defense*, March 24, 2006. https://insidedefense-com.libproxy.nps.edu/inside-air-force/air-chief-resists-combining-future-bomber-prompt-strike-studies.

688 Grossman, "Air Chief Resists Combining Future Bomber, Prompt Strike Studies."

everyone agreed that the "long-range, penetrating strike capability" called for in the 2006 QDR meant the same thing.[689]

While the Air Force viewed the 2006 QDR language as a clear direction to start a new bomber program, since a "bomber" was not specified by name, the issue quickly surfaced for debate.[690] Notably, the Air Force quickly received pushback on their AoA plans from the Pentagon's Program Analysis and Evaluation (PA&E) office, and from STRATCOM. The Air Force could not start the AoA until these matters were resolved.

With the mission "to provide timely, insightful and unbiased analysis on resource allocation" Brad Berkson, the Director of PA&E, was charged with finding ways to save the DOD money and maximize efficiency.[691] As a result, Berkson requested that the Air Force's long-range strike AoA be combined with the mission of Prompt Global Strike (PGS)—a mission requirement that was also directed in the 2006 QDR.[692] While on face value combining the missions of long-range strike and PGS seems logical, the latter is a capability intended to hit targets anywhere on the globe in less than an hour.[693] The former does not have the same time constraint. Instead, long-range strike capabilities are envisioned to persist in a high threat environment with an ability to strike multiple targets—to include targets of opportunity—from the air.[694] Given the two distinct missions, the Air Force believed a combined AoA would result in an unwieldly effort.[695]

While the Air Force sought to articulate the important nuances in missions, they were also hit with concerns from the Commander of STRATCOM, General James "Hoss" Cartwright, a Marine fighter pilot. According to Cartwright, the Air Force was not even

689 Department of Defense, *Quadrennial Defense Review Report*, February 6, 2006. 46.

690 Department of Defense, *Quadrennial Defense Review Report*, 46.

691 Department of Defense Cost Analysis and Program Evaluation, *Mission Statement*, https://www.cape.osd.mil.

692 Grossman, "Air Chief Resists Combining Future Bomber, Prompt Strike Studies."

693 Grossman.

694 Grossman.

695 Grossman.

ready to initiate an AoA until additional "concept exploration" had been accomplished.[696] In Cartwright's view, the concepts for both missions needed to be fleshed out further before "we rush into platform alternatives."[697]

After close to six months of debate, the Air Force finally prevailed and was allowed to execute two separate AoAs.[698] The experience would prove to be just the start of the Air Force's bureaucratic challenges associated with what was now called the Next Generation Bomber (NGB).[699] Berkson and Cartwright would not soon forget the matter.

Instead of working to increase involvement from OSD and other commands to set the requirements for the nation's new bomber, the Air Force made the NGB an unacknowledged Special Access Program (SAP).[700] This meant that access to the program was extremely limited. Only a select few members of Congress and in OSD were even made aware of the program's existence.[701] By making this decision, the Air Force had mirrored the B-2 program's extreme level of secrecy that, in part, contributed to the B-2's early termination.

At the end of 2006, as the Air Force was working towards completion of its NGB AoA, Secretary Robert Gates was installed as Secretary of Defense. Committed to succeeding in the fights in Afghanistan and Iraq, Secretary Gates quickly became frustrated with the Air Force's brass perceived lack of commitment to that immediate goal. According to Gates, "Nearly every time Moseley and Air Force Secretary Wynne came to see me, it was about a new bomber or more F-22s. Both were important capabilities for the future, but neither would play any part in the wars we were already in."[702] Gates' frustration with

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696 Elaine M. Grossman, "Cartwright Wants to See Strike Studies Await 'Discovery' Process." *Inside Defense*, April 6, 2005.

697 Grossman, "Cartwright Wants to See Strike Studies Await 'Discovery' Process."

698 Elaine M. Grossman, "Concerns Linger Over Funds for New Bomber Vs. 'Prompt' Weapon." *Inside Defense*, November 3, 2006.

699 Note: The program was also known as the Next Generation Long Range Strike System or NGLRS.

700 On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

701 On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

702 Robert M. Gates. *Duty: Memoirs of a Secretary at War*. Alfred A. Knopf. (2014), 130.

the Air Force reached its zenith in by the summer of 2008 after multiple high-profile nuclear-related incidents, which resulted in his decision to fire the Secretary and the Chief of Staff.[703]

After the dismissal of Wynne and Moseley, Secretary Gates selected General Norton Schwartz, a career special operations pilot, to serve as the Air Force's Chief of Staff and Michael Donley, a seasoned defense professional, to serve as the Air Force's Secretary. Schwartz met with Secretary Gates shortly after his arrival and was given four mandates: "1.) Fix nuke; 2.) Get in the fight; 3). Don't backdoor me; and 4.) Repair your relationships on the Hill."[704] As if that was not challenging enough, Schwartz and Donley also had to manage tremendous internal pressure from within the Air Force to procure more than the 183 F-22s authorized by Congress and to resolve a Government Accountability Office protest that halted the contract for the Air Force's long-sought new tanker.[705] With so many immediate fires to manage, Schwartz and Donley let the follow-on bomber AoA continue through the remainder of 2008.[706]

2008 was also a year of a massive financial crisis, which would undoubtedly impact defense spending. The country had a new administration coming to the White House. To the surprise of many, the new president, Barack Obama, asked Gates to stay on as Secretary of Defense. After spending his first two years principally focused on the wars in Iraq and Afghanistan, Gates resolved that his "second" term would prioritize the modernization of America's conventional and strategic forces.[707] To that end, he would focus on "rebalancing" the defense budget and overhauling the defense acquisition by "weed [ing] out long-overdue, over-budget programs and those that were no longer needed."[708]

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703 Gates. *Duty,* 240–243.

704 On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

705 On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; Norton Schwartz, *Journey: Memoirs of Air Force Chief of Staff*, (New York: Skyhorse Publishing, 2018) 256–257.; U.S. Gordon, Daniel I., *Air Force Procurement: Aerial Refueling Protest*, GAO-08-991T, 3, https://www.gao.gov/assets/gao-08-991t.pdf.

706 On January 21, 2022, the author spoke to Secretary Michael Donley.; On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

707 Gates, 304.

708 Gates, 304.

Not wasting any time, Gates spent the first quarter of 2009 conducting extensive program and budget reviews. He conducted most of his analysis with what he called his "small group," which notably included his Deputy Secretary, Bill Lynn; the Chairman of the Joint Chiefs, Admiral Mike Mullen; the Vice Chairman of the Joint Chiefs, General James Cartwright; the Director of Cost Analysis and Program Evaluation (CAPE and previously known as PA&E), Brad Berkson and his deputy, Lt Gen Emerson Gardner; and a select few others of his senior staff.[709] CAPE was in charge of teeing up the programs for consideration.[710] Once a general consensus was gained on which programs to keep and which ones were candidates for reduction or cancellation, Gates held larger meetings with the Combatant Commanders, Service Secretaries, and Chiefs of Staff.[711] All were given a chance to voice their concerns.[712] It was in this budget and program review that the Air Force's NGB program was fully explained to Secretary Gates.

By 2009 the Air Force had mostly settled on what the NGB's requirements should be, and industry designs were showing promise, though some of the technologies would require significant development.[713] Holding to an earlier definition of long-range strike from a 2006-commssioned Air Force study, the NGB was envisioned as a long-range aircraft that could "penetrate alone and unsupported into heavily defended territory, deliver precision weapons onto fixed or moving targets, and return safely to base."[714] According to General Kevin Chilton, the Commander of Strategic Command (STRATCOM), the bomber should have been called the "Ginsu bomber because it suffered from requirements creep."[715] It would have a payload on par with the current fleet of bombers, while carrying

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709 Gates, 315.

710 On January 21, 2022, the author spoke to Secretary Michael Donley.

711 Gates, 315.

712 Gates, 315.

713 On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

714 National Academy of Sciences, *Future Air Force Needs for Survivability*. Published by the National Academies Press, Committee on Future Air Force Needs for Survivability, National Research Council, 2006, 16.

715 On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

air to air missiles to defend itself.[716] According to then Under Secretary of Defense for AT&L, Ash Carter:

> One of the NGB's problems was that it ended up being a bomber, but in order to have the right capability you needed the entire family of systems: a carrier of some kind, either penetrating or standoff, but also on board and off board sensors, long-haul comms, escort jammers, and weapons. The NGB had become the Battlestar Galactica, and too expensive, and from an engineering point of view, an attempt to do too much on a single platform.[717]

There was also a concern that many of the advanced technologies called for in the Air Force's NGB requirements were too immature, which would undoubtedly lead to exorbitant development costs.[718]

The members of Gates' small group were not convinced that a penetrating bomber was even necessary. In alignment with their previous stance, General Cartwright, in his new position as Vice Chairman of the Joint Chiefs of Staff; Brad Berkson, the Director of CAPE; and Ash Carter injected caution as to whether a penetrating bomber was the best system to meet the nation's long-range strike needs.[719] There was also a general concern that stealth aircraft were no longer viable in an era of advanced air defenses.[720] With his chance to articulate the Air Force's position on the possible cancellation or reduction of the NGB, Donley pushed back. Though he shared concerns about the NGB's "size, its complexity, and its out-year costs," he was resolute in his position that the nation needed a new bomber.[721]

After weighing the arguments on both sides, Gates believed there was far too much confusion over the requirements, costs, and technology to reasonably move forward.[722]

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716 On February 22, 2022, the author spoke to Dr. Michael Vickers.; Schwartz, *Journey*, 256–257

717 On January 27, 2022, the author spoke to Secretary Ashton Carter.

718 On December 8, 2021, the author spoke to Secretary Robert Gates.

719 On January 21, 2022, the author spoke to Secretary Michael Donley.; On February 22, 2022, the author spoke to Dr. Michael Vickers.

720 Mr. Robert Martinage email with the author, 2 March 2022.

721 On January 21, 2022, the author spoke to Secretary Michael Donley.

722 On December 8, 2021, the author spoke to Secretary Robert Gates.

And he wanted to be absolutely sure that if a acquiring a new bomber was in the country's best interest, that it would not be a "repetition of the B-2."[723] In April 2009, Gates announced the termination of the NGB program. With that, the entire funding line for the NGB was wiped clear.[724]

E. CONCLUSION

The path that led to Secretary Gates' termination of the NGB in 2009 was nothing short of shambolic. From bureaucratic resistance within the Air Force to external pressure from Congress and OSD to rifts over what the strategic requirement was for long-range strike forces, the path to initiate the NGB was far from straightforward. And, even when the NGB was finally initiated—a sign that that the defense acquisition forces were reaching alignment—Secretary Gates' cancellation decision revealed that the forces had yet to reach harmony.

From a bureaucratic perspective, the Air Force was initially highly resistant to calls to initiate a new bomber program. And despite the success of the B-2 in Kosovo, the Air Force refused defense industry efforts to get the service to add to its penetrating bomber fleet with the B-2C. Accordingly, from 1992 to the mid-2000s, the Air Force would not budge from their prioritization to modernize the short-range fighter fleet. It was also revealed that ideas to entertain a new long-range strike capability catered to the Air Force's penchant for advanced technologies with support for far off technologies such as hypersonic weapons and "rods from God." In the end, it took external pressure from Congress and OSD to finally get the Air Force to start a new bomber program much sooner than the service originally wanted.

With their fighter modernization efforts mostly secure, the Air Force's initial solution to starting a new bomber was to advance an interim, medium-range bomber (known as the "bridge or regional bomber") while keeping their pursuit of game-changing long-range strike technologies in play. In the Air Force's view, the "bridge bomber" would

[723] On December 8, 2021, the author spoke to Secretary Robert Gates.

[724] On January 21, 2022, the author spoke to Secretary Michael Donley.

meet the immediate strategic needs of the nation. With the Pacific theater in mind, Congress and OSD felt differently. In their mind, what was needed was a truly long-range penetrating bomber.[725]

After continued external pressure, in 2006, the Air Force finally agreed to not only accelerate the timeline for when they would field a new bomber, but to make it capable of flying at long-ranges—a capability viewed as critical to a fight in the Pacific. To be sure, there were still antagonists within OSD and STRATCOM that questioned the strategic need for a penetrating bomber, especially in view of missiles. Nevertheless, with the publication of the 2006 QDR—which explicitly called for a new long-range, penetrating bomber and the Air Force's support—it appeared that the defense acquisition forces were finally aligning.

Once the strategic need was mostly agreed to from Congress, the Air Force and OSD, the Air Force decided to make the NGB concept an unacknowledged SAP. Access was tightly controlled, and those that were even aware of the NGB's existence knew very little. This allowed the Air Force to partner with willing industry partners who conceived of a bomber that would push well beyond the state-of-the-art. It also allowed the Air Force to almost completely ignore the need to harvest outside support. And for what promised to be a very capable, yet expensive bomber that would consume large portions of the defense budget, the insulated strategy largely contributed to the NGB's demise.

Combined with OSD's reluctance to support the Air Force's expensive conception of the NGB during the open debates that followed Secretary Gates' budget review, the Air Force's poor standing with the Defense Secretary made matters worse. While Secretary Donley and General Schwartz had worked tirelessly to fix the Air Force's reputation after their predecessors were fired, they had only been on the job about six months at the time of Secretary Gates' cancellation decision. Such a short period proved not to be enough for the Air Force's preferences to overcome OSD's reluctance to support the new bomber.

[725] Presumably the range for the new bomber would be on par with the B-2.

The messy path that led to Secretary Gates's decision to cancel the NGB is one of bureaucratic resistance and internal division; divergent perceptions on the strategic need and the weapons required to meet it; a desire for advanced technologies tempered by budget realities; and a willing defense industry that found themselves along for the ride. With so many forces out of alignment, it is no wonder that Secretary Gates cancelled the program. If the Air Force was going to get a new bomber, something drastic needed to change.

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VII. THE BOMBER THAT GOT THROUGH

With Secretary of Defense Robert Gates' termination of the Next Generation Bomber (NGB) in 2009, almost three decades had passed since a bomber was in development. Without bureaucratic alignment on questions of strategic need, appropriate technology, and acceptable costs, it was uncertain if a new bomber would be pursued at all.

This chapter examines what happened between the decision to terminate the NGB in 2009 and the decision to award Northrop-Grumman a contract for a Long-Range Strike-Bomber (LRS-B) in 2015. It pays particular attention to issues of strategic need, bureaucratic politics, technology, and politics. Those forces were out of alignment in 2009, and for years before that. This chapter explores how they finally came together and achieved harmony.

A. THE GENESIS OF THE LONG-RANGE STRIKE-BOMBER

Gates' decision to terminate the NGB program was far reaching: the entire budget for a new bomber was brought to zero.[726] According to then Air Force Secretary Michael Donley, "the only thread that remained from that decision period was the Secretary's direction to examine whether the Air Force needed a new bomber, [which] meant it was back to the issue of do we have a requirement for a new bomber."[727]

The judgment to zero out all bomber development efforts came as a shock to the Air Force, which acted quickly to reprogram money in their current year budget to keep the industry teams that had been working on the NGB from completely dissolving. It was thought that if that were allowed to happen, starting from scratch (assuming they were allowed to) would be much more difficult. To that end, the Air Force reprogrammed approximately $130 million from its B-2 R&D account.[728] Still, beyond ensuring that its industry partner's lights were kept on, the issue of whether to restart a bomber program now rested with the Office of

[726] On January 21, 2022, the author spoke to Secretary Michael Donley.

[727] On January 21, 2022, the author spoke to Secretary Michael Donley.

[728] On January 21, 2022, the author spoke to Secretary Michael Donley.

the Secretary of Defense. In the words of Donley, the Air Force was no longer in "control of the stick."[729]

The analysis of whether a long-range bomber was needed was charged to Robert Martinage, who was asked to consider it in light of the forthcoming 2010 Quadrennial Defense Review (QDR). Martinage, who had spent almost fifteen years in defense think tanks, was new to the bureaucratic jungle of the Department of Defense (DOD). While his lack of DOD experience made him an unbiased judge of matters around which some hard feelings had accumulated, it also meant that he had to learn to navigate the "byzantine labyrinth of DOD bureaucracy."[730] He would report to the Under Secretary of Defense for Policy (USD-P), Michele Flournoy, her deputy, Jim Miller, and Martinage's immediate boss, Dr. Michael (Mike) Vickers, who served as the Assistant Secretary of Defense for Special Operations, Low Intensity Conflict, and Interdependent Capabilities (ASD SOLIC/IC).[731]

Knowing that a colossal task awaited him, Martinage established what was called the long-range bomber "tiger team" to help him with the analysis. Core members of the tiger team included a small group (6-12) of personnel from OSD policy and the Air Force. The analysis was to be completed within six months.[732]

While the tiger team would be responsible for the bulk of the analysis, Martinage also established a weekly working group to keep a variety of stakeholders up to date on the team's activities. These include representatives from the Joint Staff, OSD's Cost Analysis and Program Evaluation (CAPE) office, the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L), the Navy Special Access Programs Central Office (SAPCO), Strategic Command (STRATCOM), and Pacific Command (PACOM). A Senior Working Group (SWG) was also established to keep senior DOD leadership apprised of progress made and to receive guidance. The SWG was chaired by the Under Secretary of

729 On January 21, 2022, the author spoke to Secretary Michael Donley.

730 On January 13, 2021, the author spoke to Mr. Robert Martinage.

731 On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

732 On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

Defense for AT&L, Ash Carter, and also included the Vice Chairman of the Joint Chiefs of Staff, General James Cartwright (the former STRATCOM/CC); USD-P Michele Flournoy; ASD SO/LIC-IC Dr. Mike Vickers; the Director of CAPE, Christine Fox; the Secretary of the Air Force, Mike Donley; and the Chief of Staff of the Air Force, General Norton Schwartz.[733] Throughout the remainder of 2009, the SWG met about once a month for general update briefings.[734]

Given these arrangements and their desire to field a new bomber, the Air Force had two choices. They could attempt to wrest the effort back under Air Force control or they could help the tiger team succeed. According to then Brigadier General Charlie Lyon, Secretary Donley's and General Schwartz's guidance was clear: "The Air Force would supply the tiger team with whatever they needed and all Air Force resources to aid the effort would be at its disposal."[735] Lyon was appointed as the primary Air Force liaison and was tasked with ensuring that Martinage and his team had access to everything that could be helpful, from highly compartmentalized Special Access Program (SAP) information to capability analysis already accomplished on the original NGB program to air-centric intelligence forecasts.[736] The Air Force held nothing back.

Once Martinage grasped his objective and knew the Air Force would be a willing partner, he and his team pored over the intelligence forecasts to address Secretary Gates' concern over the "need" and "requirement" for a new bomber.[737] It became quickly apparent that there was an "intensifying threat environment characterized by the proliferation of better air defense radars; longer range, more lethal Surface to Air Missile Systems; and more capable interceptor aircraft."[738] According to then Under Secretary of the Navy Robert O. Work, China was of chief concern as they were rapidly approaching parity with the United States in

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[733] Of note, when the principals could not attend, their deputies would attend in their place. Martinage also noted that leaders from STRATCOM, PACOM and the Navy would also occasionally attend.

[734] On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

[735] On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

[736] On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

[737] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[738] On January 13, 2021, the author spoke to Mr. Robert Martinage.

"guided munitions-battle network warfare."[739] When the threat was matched with the antiquated bomber force—only a fraction of which could penetrate up-to-date air defense systems—it became very clear that if the United States was going to succeed in future conflicts, "some type of new bomber was needed."[740]

Consensus was quickly gained on this point, but not on the type of bomber that would meet the need. Some held to the belief that the next bomber should be a standoff "missile truck" while others were adamant that the next bomber should be a penetrator. Adjudicating this divergence would dominate the tiger team's efforts for the next two years.[741]

As was similarly the case in the earlier bomber debates, the standoff missile truck advocates believed that an expensive penetrating bomber was superfluous because cruise missiles could do the same job.[742] They also contended that stealth was dead, and that the days of an aircraft, no matter how good the stealth technology, flying near modern enemy air defenses were long gone.[743] In contrast, proponents of penetrating bombers believed that not only was stealth was still effective, but the costs of employing a penetrating bomber were considerably cheaper than standoff missiles.[744] According to Mike Vickers, "direct attack munitions are much cheaper and missiles do less well against mobile targets."[745] Still, the standoff missile proponents would need to be convinced of these assertions.

To address the penetrator versus standoff question, Martinage and his team threw themselves into evaluating the problem with a belief that solid analysis would point to a clear solution.[746] According to Martinage:

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[739] On December 9, 2021, the author spoke to Deputy Secretary Robert O. Work.

[740] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[741] On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

[742] On February 22, 2022, the author spoke to Dr. Michael Vickers.; Mr. Robert Martinage email with the author, 2 March 2022.

[743] On February 22, 2022, the author spoke to Dr. Michael Vickers.; Mr. Robert Martinage email with the author, 2 March 2022.

[744] On February 22, 2022, the author spoke to Dr. Michael Vickers.

[745] Dr. Michael Vickers email with the author, 24 May 2022.

[746] On January 13, 2021, the author spoke to Mr. Robert Martinage.

> Much of the work initially involved identifying capability and capacity gaps across the joint force. We identified the targets that the joint force would likely need to hold at risk in the future for conventional deterrence, and if that failed, to achieve U.S. objectives militarily. For various prospective adversaries, we determined where those targets were located and how many there were likely to be. We also characterized them in various ways—mobile/relocatable, fixed, soft, hard, defended, point vs area, etc. We then assessed the pros and cons of various elements of the joint force in neutralizing those targets. From that, we identified the highest priority targets that NGB would need to be able to neutralize. Once that was established, we began the very difficult (and far more contentious) work of trying to discern how the NGB might best neutralize those targets, and from that, derive what the key performance parameters for the aircraft should be. To help address those questions, we commissioned RAND to conduct analysis at the Special Access Program level, including modeling at both the platform level (comparing various NGB alternatives and associated weapon pairings) and the joint theater campaign level.[747]

In addition to leveraging RAND, the team also worked with analysts from the Institute for Defense Analysis, the defense industry (Lockheed Martin, Boeing, and Northrop-Grumman), the National Air and Space Intelligence Center, MIT's Lincoln Laboratories Counter Low-Observable Red Team, and others.[748]

By the fall of 2009, Martinage, his core tiger team, and the working group members believed that the analysis clearly indicated that a penetrating long-range bomber was the optimal solution.[749] Accordingly, Martinage delivered the analysis, along with a recommendation for the development of a new penetrating bomber, to his immediate supervisors: Michele Flournoy, Jim Miller, and Mike Vickers.[750] Confident that "compelling analysis alone would carry the day," Martinage thought his assignment complete.[751]

Flournoy recognized that any bomber recommendation put before Secretary Gates would need wide agreement, and she staffed the tiger team's recommendation around OSD

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747 On January 13, 2021, the author spoke to Mr. Robert Martinage.

748 Robert Martinage interview with the author, 13 January 2022.; On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

749 On January 13, 2021, the author spoke to Mr. Robert Martinage.

750 On January 13, 2021, the author spoke to Mr. Robert Martinage.

751 On January 13, 2021, the author spoke to Mr. Robert Martinage.

for feedback. Rather than lauding the team's analytic work and providing concurrence, senior stakeholders pushed back. Issues such as "the durability of stealth, what the payload requirement should be, and whether the aircraft should be 'unmanned' from the outset" promptly surfaced as areas of dispute. Without concurrence, Martinage's superiors felt the matter was resolved to a point where it was ready for Secretary Gates' approval. Martinage was sent back for round two.[752]

Martinage decided that achieving a consensus on a new bomber would require a change to his bureaucratic strategy. Instead of his original plan to rely solely on sound analysis from his tiger team, he would employ "by-with-and-through approach." To that end, his core team would no longer be primarily responsible for conducting the analytic efforts. Rather, tasks would be divided amongst all of the offices of all of the key stakeholders. Martinage also set up the working group and SWG meetings to discuss foundational issues, such as the durability of stealth, and the core debate about whether a mixed force of penetrating bombers and standoff missiles were superior to a purely standoff missile force.[753]

With some key players still of the opinion that stealth was no longer viable, MIT's long-standing Counter Low-Observable Red Team was tasked to explain how modern stealth technologies fared against advanced air defense and sensing systems.[754] The Red Team had been established in the early 1980s under then Colonel Paul Kaminski with the mission of identifying threats that could defeat stealth platforms. Its work made it crystal clear that modern stealth techniques and technologies could keep an aircraft survivable against modern air defenses.[755] Thanks to it and the countless lessons learned from the B-2 program, in

[752] On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

[753] On January 13, 2021, the author spoke to Mr. Robert Martinage. This paragraph is attributed to that discussion.

[754] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[755] On January 13, 2021, the author spoke to Mr. Robert Martinage.

addition to advances made in the F-22, F-35 and penetrating ISR aircraft, those who argued that stealth was dead were incrementally quieted.[756]

After convincing skeptics that stealth was still very much alive, the next major area of contention in need of resolution was the debate between a mixed force of penetrating bombers and standoff missiles or a purely standoff missile force.[757] To address this issue, Martinage leaned on RAND to examine the "relative cost of penetrating versus non-penetrating bombers based on the number of [projected] targets serviced."[758] When comparing single-use cruise missiles to a reusable, penetrating bomber that could employ inexpensive direct attack (gravity-based) weapons, the data was clear—reusable penetrating bombers offered tremendous cost advantages.[759] Given that cost was such an important factor, RAND's data could not be discounted. And if it were necessary, "penetrating bombers could also launch standoff weapons in a high threat environment."[760] Ash Carter, Chair of the SWG and a seasoned defense professional with a doctorate in theoretical physics from Oxford, found the data compelling and became impatient with "unsupported technical assertations" that appeared to be no more than matters of opinion.[761]

After gaining consensus that stealth technologies were effective and that penetrating bombers were more cost-effective than a purely standoff cruise missile force, the focus of the SWG shifted to defining what the requirements should be for such an aircraft. Secretary Gates had made it clear that any solution that came back to him had to be "an affordable, cost-

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[756] On January 13, 2021, the author spoke to Mr. Robert Martinage.; On February 22, 2022, the author spoke to Dr. Michael Vickers. According to Dr. Michael Vickers, the advanced stealth technologies—technologies beyond the capabilities inherent in the F-22 and F-35—that would be incorporated on the new bomber when combined with stand in jamming provided tremendous confidence in the new bomber's ability to penetrate even the most modern air defenses.

[757] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[758] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[759] On January 13, 2021, the author spoke to Mr. Robert Martinage.; Hamilton, Thomas, *Comparing the Cost of Penetrating Bombers to Expendable Missiles Over Thirty Years: An Initial Look.* Santa Monica, CA: RAND Corporation, 2011.; Hamilton, Thomas, Expendable Missiles vs. Reusable Platform Costs and Historical Data. Santa Monica, CA: RAND Corporation, 2012. A 2000 lb Joint Direct Attack Munition (JDAM) costs about $25,000 compared to about $2 million for a modern cruise missile.

[760] Mr. Robert Martinage email with the author, 12 May 2022.

[761] On January 13, 2021, the author spoke to Mr. Robert Martinage.

limited, achievable program that we can sell on the Hill, and that we [won't] make the same mistakes that we did with the F-35, the B-2, or anything else."[762] Requirements were, accordingly, extensive. The SWG addressed everything from range and payload to jammers, communication systems, and munitions—anything for which a precise definition might be demanded before a program could begin.[763]

Range was at the top of the list. STRATCOM was particularly vocal in its desire for the new bomber be capable of flying intercontinental ranges.[764] While adding more range would add to the bomber's capability, it would also add to its overall weight. One truth in the aerospace industry that has stood the test of time is that aircraft are "bought by the pound: the lighter the cheaper."[765] An aircraft capable of vast ranges would not only be heavier due to the airframe's size and materials; it would also require a larger fuel capacity and more powerful engines.[766] This is especially concerning for stealth aircraft, where higher power outputs and a larger airframe directly impact aircraft survivability.[767] Longer ranges could easily be entertained if costs were no object, but Gates mandated that the aircraft be affordable.[768] As of this writing, the bomber's exact range capability proposed by the SWG has not been made public, but the group sought, and believed it had achieved, a solution that balanced the bomber's mission needs with the consideration of the associated costs.

The question of payload was similarly caught between "the more the better" crowd and those that were concerned with aircraft size and concomitant costs.[769] According to Martinage and Vickers, the issue of payload became a major area of disagreement.[770] The

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[762] On December 8, 2021, the author spoke to Secretary Robert Gates.

[763] On January 27, 2022, the author spoke to Secretary Ashton Carter.

[764] On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

[765] Rich and Janos, 64.; On February 22, 2022, the author spoke to Dr. Michael Vickers.

[766] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[767] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[768] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[769] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[770] On January 13, 2021, the author spoke to Mr. Robert Martinage.; On February 22, 2022, the author spoke to Dr. Michael Vickers.

issue was complicated by the fact that, in contrast to the era of the B-1 and B-2, precision weapons were now the standard munitions. A 40,000 lb payload might have made sense in the late 1970s, so as to ensure a high probability of hit with multiple dumb bombs, but precision weapons meant that such redundancy was no longer required. But even so, the SWG had to decide whether the new bomber would be capable of carrying weapons such as the 30,000 lb Massive Ordnance Penetrator (MOP), the so-called bunker busting bomb.[771] It also had to account for STRATCOM's desire to have the new bomber be capable of launching cruise missiles.[772] Like its range specifications, the bomber's payload has not yet been publicly released, but it is clear that the SWG once again believed they had achieved the right balance between cost and capability.

Once the major characteristics of the new bomber were set—a penetrating bomber whose range and payload were balanced against cost—the SWG turned its attention to more specific capabilities. Whereas the first NGB was focused on operating "alone," Secretary Carter insisted that the new bomber be viewed as part of a family of systems.[773] Viewing the new bomber this way would prevent the bomber from having to have every capability needed to deliver a weapon on a target on board. This would not only drive the total costs down, but it also promised improvements in other DOD mission areas.[774] Accordingly, SWG meetings through the spring and summer of 2010 addressed a variety of specific capability questions, such as nuclear capabilities, on- and off-board sensor requirements, and whether the bomber should be manned or unmanned.

The Air Force originally envisioned the NGB as a conventional bomber and left out the nuclear mission entirely.[775] After getting word of this in 2007, the Commander of STRATCOM, General Kevin Chilton, made it crystal clear that he would not support a new

[771] On December 9, 2021, the author spoke to Deputy Secretary Robert O. Work.; On February 10, 2022, the author spoke to Lieutenant General (Ret.) Mark Shackelford.

[772] On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

[773] On January 27, 2022, the author spoke to Secretary Ashton Carter.

[774] On January 27, 2022, the author spoke to Secretary Ashton Carter.

[775] On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

bomber unless it was nuclear capable.[776] As a consequence, the nuclear mission was promptly added and remained a core capability thereafter. Hence, the issue for the SWG was not whether to incorporate a nuclear capability into the new bomber, but whether to make *all* of the bombers nuclear capable and if so in what order to do it.[777] Nuclear capability involved the addition of special wiring to employ nuclear weapons, nuclear-related communications, and nuclear hardening, among other things. These additions would add 10–15% of the program's cost if they were applied to every bomber.[778] But it was hard to imagine building a long-range bomber that was not capable of both nuclear and conventional missions, and on that basis, it was decided that all new bombers be nuclear ready.[779]

In regard to sensors, electronic warfare, and munitions, the family of systems concept was always front and center. In the case of sensors, on- and off-board sensors were considered, with the knowledge that anything added to the aircraft would add to its total price tag.[780] The same was true of electronic warfare where systems to "fool radars and complement the plane's basic stealthiness by blinding or fooling enemy radar systems and missiles…could be onboard, aboard separate vehicles flying near the stealth aircraft, or trailed on a wire behind the bomber."[781] Finally, on the issues of munitions, Secretary Carter noted that

> In today's air defense environment, you can't just drop a bomb out of the belly of an airplane and expect it to survive to the target. Defenders will shoot down the individual bombs or missiles fired from the airplane, so these, too, must be stealthy, as well as being smart, super accurate, and in, some cases, designed to penetrate buried targets.[782]

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[776] On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

[777] On January 27, 2022, the author spoke to Secretary Ashton Carter.; On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[778] On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

[779] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[780] On January 27, 2022, the author spoke to Secretary Ashton Carter.

[781] Ashton Carter, *Inside the Five-Sided Box*, 333.

[782] Carter, 333.

By viewing the bomber as part of a family of systems, Carter prevented the Air Force from falling into the "usual hole of building a bomber, running out of money, and forgetting about everything else and just keeping on building a bomber."[783]

The final issue that had to be answered was whether a bomber built in the 21st century needed a human in the cockpit at all. This proved to be an issue that only Secretary Gates could resolve as the SWG could not all agree.[784] Stakeholders within OSD judged that unmanned aerial vehicles had performed remarkably well to date, and in order "to reduce crew risk, increase platform endurance, and lower life cycle costs" the bomber should be unmanned.[785] In contrast, the Air Force and STRATCOM argued that the bomber should be "optionally-manned," to provide flexibility.[786] Generals Schwartz and Chilton were especially vocal in their opinion on the issue and argued that for some missions (e.g., long-duration, low risk missions) an unmanned platform might be the best answer while for other missions (e.g., in communications-degraded environments or missions requiring the release of nuclear weapons) a human in the cockpit was essential.[787] The matter of having a human in the cockpit during a nuclear weapons release was especially viewed as a critical requirement by Schwartz and Chilton.[788] In the end, Secretary Gates decided to go with the "optionally-manned" choice, which would allow the new bomber the flexibility to "adapt to different kinds of environments."[789]

By the summer of 2010, the requirements for the new bomber were mostly agreed upon by the major stakeholders. It would be a penetrating bomber with range and payload specifications that kept cost concerns in the fore; it would be nuclear capable and optionally-

783 On January 27, 2022, the author spoke to Secretary Ashton Carter.

784 On December 8, 2021, the author spoke to Secretary Robert Gates.

785 On January 13, 2021, the author spoke to Mr. Robert Martinage.

786 On January 13, 2021, the author spoke to Mr. Robert Martinage.; On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

787 On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

788On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; On January 5, 2022, the author spoke to General (Ret.) Kevin Chilton.

789 On December 8, 2021, the author spoke to Secretary Robert Gates.

manned; and as one part of a family of systems it would leverage both on and off board capabilities—it would not do everything by itself. Accordingly, the SWG made the decision to rename the bomber as the Long-Range Strike-Bomber (LRS-B).[790] This naming convention has not been publicly explained, but in the context of a "family of systems," it implies there might also be Long-Range Strike-Intelligence, Surveillance, and Reconnaissance platforms, and Long-Range Strike-Electronic Warfare systems, and so on.

The SWG fully accepted that costs were a central concern in the development program. For the first time, it mandated that Average Procurement Unit Cost (APUC) become a Key Performance Parameter (KPP) for development and production. Making the APUC a KPP was meant to force industry and the Air Force to remain disciplined as the program moved forward.[791] It was also thought that by capping the cost and making it public at the start, the new bomber would have a fighting chance on the Hill—one of Secretary Gates' primary directives.[792] To assist that goal further, the decision was made for the LRS-B to be an acknowledged SAP, a decision with the explicit purpose of increasing transparency.[793]

Based on Secretary Gates' direction that at least 100 bombers be acquired, the APUC was set at $550 million per aircraft in 2010-year dollars.[794] The amount was an estimate based on the agreed-to capabilities, and in light of analysis from CAPE and inputs from the contending prime contractors (i.e., Northrop-Grumman and a joint Lockheed-Martin and Boeing team).[795] While the amount did not include R&D costs, the LRS-B would still cost significantly less than the NGB program.[796]

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[790] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[791] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[792] On December 8, 2021, the author spoke to Secretary Robert Gates.

[793] On March 8, 2022, the author spoke to Major General (Ret.) Charles Lyon.

[794] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; On January 27, 2022, the author spoke to Secretary Ashton Carter.; On January 13, 2021, the author spoke to Mr. Robert Martinage.; On December 8, 2021, the author spoke to Secretary Robert Gates.

[795] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; On January 27, 2022, the author spoke to Secretary Ashton Carter.; On January 13, 2021, the author spoke to Mr. Robert Martinage.

[796] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

As the final LRS-B's capability requirements were set, the Air Force teed up a SWG session to debate the specifics of the acquisition strategy. Rather than directing the Air Force's Material Command (AFMC) to oversee the program, Donley and Schwartz made the pitch that the Air Force's Rapid Capabilities Office (RCO) should be in the lead.[797] RCO was a small, specialized acquisition organization that was familiar with advanced technology and could bypass the rigidity inherent in traditional defense acquisitions due to their familiarity with advanced technologies.[798] According to General Schwartz, the RCO had an "elegant oversight structure," where major program-related decisions could be made by three people: the Under Secretary of Defense for AT&L, the SECAF, and the CSAF.[799] It would also save $4 billion in administrative costs.[800] The SWG was in full agreement.[801]

With the basic acquisition strategy set, Secretary Donley; General Schwartz; the Under Secretary of the Air Force, Erin Conaton; and Colonel Tim Woods, who became the primary Air Force action officer in early 2010, sat down to strategize what needed to happen next.[802] While they were not in control of the overall bomber effort, they felt that enough had been agreed to and that it was time to get the matter before Secretary Gates.[803] To that end, the Air Force generated a proposal document that was titled "AF Recommendations for FY12 Decision on Long-Range Strike" so as to get the bureaucratic wheels turning.[804]

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797 On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz; On January 21, 2022, the author spoke to Secretary Michael Donley.; On February 10, 2022, the author spoke to Lieutenant General (Ret.) Mark Shackelford. AFMC is the Air Force's principal organization responsible for the oversight and execution of Air Force acquisition programs.

798 On January 21, 2022, the author spoke to Secretary Michael Donley.; On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.; United States Air Force, Rapid Capabilities Office Fact Sheet. https://www.af.mil/About-Us/Fact-Sheets/Display/Article/2424302/rapid-capabilities-office/.

799 On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

800 On February 10, 2022, the author spoke to Lieutenant General (Ret.) Mark Shackelford.

801 While the RCO would lead the overall LRS-B program, it should be noted that personnel from AFMC were integrated into the RCO to leverage their extensive expertise in advanced aircraft acquisition programs. On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

802 On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

803 On January 21, 2022, the author spoke to Secretary Michael Donley.

804 Department of Defense, Inspector General Report, "Audit of the Acquisition of the Long-Range Strike Bomber," September 8, 2015, DOD IG-2015-170. Appendix B.; Robert Martinage email with the author, 2 March 2022.; On January 21, 2022, the author spoke to Secretary Michael Donley.

With the Air Force's position being circulated around OSD, and the Fiscal Year 2012 budget being finalized, the SWG decided the bomber decision was finally ready to go before Secretary Gates. CAPE had the lead on putting the brief together, much like they did when the NGB program was put before Secretary Gates in 2009. This time, however, there was a unified front across the senior stakeholders. All concurred on the LRS-B program that was briefed to Secretary Gates.

Convinced that his concerns were adequately addressed and confusion over the "need, requirements, and technology" had been resolved, Secretary Gates gave his endorsement for the LRS-B program to move forward in December 2010.[805]

This left the issue of what exactly would happen next. Given the detailed analysis that had preceded the presentation to Secretary Gates, the Air Force wagered that he might support a non-standard acquisition start for LRS-B. To that end, the Secretary Donley and General Schwartz tasked Colonel Woods to generate a memorandum that captured the agreed upon requirements for the LRS-B.[806] The memorandum was also to include specific guidance for how to execute the program.[807] While it was not guaranteed that Secretary Gates would sign it, after two years of digging the Air Force out of the "reputational toilet," Secretary Donley and General Schwartz thought the gamble stood a solid chance at success.[808]

Not only had Secretary Donley and General Schwartz worked tirelessly to address Gates' initial concerns in their first two years on the job, they had done so in a way that built trust. They decided, for instance, that it was in the Air Force's long-term interests to stop fighting with Secretary Gates to procure more F-22s than the Defense Secretary thought necessary.[809] It was not that they did not desire more F-22s; however, they had to balance the entire needs of the force and concluded that "the F-22 debate had consumed enough oxygen

[805] On January 13, 2021, the author spoke to Mr. Robert Martinage.; On December 8, 2021, the author spoke to Secretary Robert Gates.

[806] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

[807] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

[808] On January 27, 2022, the author spoke to Secretary Ashton Carter.

[809] Gates. 257.

and it was time to move on."[810] They also focused their attention on getting the Air Force "in the fight," which was evidenced by the energy they put into increasing air support—notably in ISR aircraft—to the wars in Iraq and Afghanistan.[811] Through these and other related actions, by the start of 2011, the Air Force's top brass had put the service back in good standing with Defense Secretary.[812]

Given the Air Force's rehabilitated standing with Secretary Gates and with his recent approval on the LRS-B's requirements and acquisition strategy, Secretary Gates signed the unprecedented LRS-B requirements memorandum on February 18, 2011.[813] It would allow the Air Force to immediately start the acquisition program.[814] In addition to outlining the Key Performance Parameters (KPPs), it also provided specific direction for how to execute the program.[815] It included specific guidance to act as a hedge against any future effort that might make the program too costly or go against what was agreed to in December of 2010. For example, to prevent the pursuit of costly advanced technologies, the memorandum specified that the bomber would "leverage demonstrated, mature, integration-ready technologies and systems as much as possible."[816] It also directed that the bomber's requirements be kept "stable, manageable, and tradeable to ensure affordability."[817] This language was crafted by Secretary Donley and General Schwartz, to reassure Secretary Gates that his initial concerns

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[810] Gates. 257.

[811] Gates. 310.

[812] On January 27, 2022, the author spoke to Dr. Ashton Carter.

[813] The memorandum was entitled "Long Range Strike and Penetrating Bomber Capabilities."

[814] Department of Defense, Inspector General Report, "Audit of the Acquisition of the Long-Range Strike Bomber," September 8, 2015, DOD IG-2015-170. Appendix B.; Government Accountability Office, *Boeing Company Protest Decision*, B-412441 (Washington, DC: Government Accountability Office, 2001), 2–3.

[815] Department of Defense, Inspector General Report, "Audit of the Acquisition of the Long-Range Strike Bomber," September 8, 2015, DOD IG-2015-170. Appendix B.; Government Accountability Office, *Boeing Company Protest Decision*, 2–3.; Examples of the KPPs that have been made public are the requirement that the bomber would be nuclear capable, that it should have an APUC of $550 million in 2010-year dollars based on a fleet of 80–100 aircraft, and that it be capable of manned and unmanned operations.

[816] Government Accountability Office*, Boeing Company Protest Decision*, 2–3.

[817] On January 21, 2022, the author spoke to Secretary Michael Donley.

would be respected throughout the entirety of the program.[818] As far as the Air Force was concerned, the requirements as laid out were "sacrosanct."[819]

Armed with the Gates memorandum, the Air Force's RCO quickly got to work on initiating the new bomber program. Colonel Tim Woods was designated as the program's first director and immediately got to work to finalize the initial contract documents for the contending prime contractors.[820] Thanks to the Gates memorandum, Woods led his combined team from the RCO and AFMC to quickly advance through the JCIDS requirements process.[821] While the program would still be reviewed by the Joint Requirements Oversight Council (JROC), per DOD regulations, interactions were less about approval and more about collaboration and "ensuring continued alignment to the Gates memo."[822]

By November 2011, Woods and his team awarded technology development contracts to Northrop-Grumman, Boeing, and Lockheed-Martin.[823] Deemed the only defense contractors capable of developing the LRS-B, the three contractors were instructed "to reduce technical risk and to develop competing aircraft designs through completion of a Preliminary Design Review."[824]

Boeing and Lockheed-Martin decided to partner together, with Boeing as the prime contractor, which meant that two, rather three proposals were presented for review in the summer of 2014.[825] Since both the Boeing/Lockheed-Martin and Northrop-Grumman teams had designs that would provide desired capabilities at an acceptable level of risk, the Air Force could now finalize the formal Request for Proposal (RFP).[826] Prior to the PDR, Woods and

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[818] On January 21, 2022, the author spoke to Secretary Michael Donley.; On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[819] On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[820] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

[821] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

[822] On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

[823] Government Accountability Office, *Boeing Company Protest Decision*, B-412441, February 16, 2001. 3.

[824] Government Accountability Office*, Boeing Company Protest Decision*, 4

[825] Government Accountability Office*, Boeing Company Protest Decision*, 3.

[826] Government Accountability Office*, Boeing Company Protest Decision*, 3.

his team, had worked to outline exactly what the government wanted in the LRS-B.[827] With the PDR complete, they took the RFP to Frank Kendall, who had replaced Carter as Under Secretary of Defense for AT&L.[828] Kendall would serve as the LRS-B Milestone Decision Authority (MDA) and his approval had to be obtained before the RFP could be released.[829]

After a thorough review of the LRS-B's RFP, Kendall allowed the RFP to advance and on July 9, 2014, the Boeing/Lockheed-Martin and Northrop-Grumman teams were given the rules in the competition for a contract worth upwards of fifty billion dollars.[830] The RFP stressed the need to advance a capability that could successfully penetrate modern air defenses but at an affordable price. Hence, the RFP clearly stated that the winner would be selected "on the basis of two factors: technical capability and cost/price."[831] As an added hedge against high costs and to dissuade the contractor teams from offering capabilities beyond the stated minimums, the RFP clearly stated that "no additional credit will be assessed for exceeding the requirements."[832]

Boeing/Lockheed-Martin and Northrop-Grumman handed in their proposals to the Air Force on October 7, 2014.[833] The Boeing/Lockheed-Martin team had the benefit of recent experience in building advanced stealth aircraft. Lockheed-Martin was the prime contractor on both the F-22 and the F-35.[834] They had also recently introduced the RQ-170, a low-

827 On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

828 On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

829 On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.; Colin Clark, "Kendall, LaPlante Complete Long Range Strike Bomber Review: Exclusive." *Breaking Defense*, June 4, 2015. https://breakingdefense.com/2015/06/kendall-laplante-complete-long-range-strike-bomber-review-exclusive/.; DODI 5000.85.

830 Government Accountability Office*, Boeing Company Protest Decision*, 4; On March 18, 2022, the author spoke to Colonel (Ret.) Tim Woods.

831 Government Accountability Office*, Boeing Company Protest Decision*, 4.

832 Government Accountability Office*, Boeing Company Protest Decision*, 4.

833 Government Accountability Office, Boeing Company Protest Decision, 6.

834 United States Air Force, "RQ-170 Sentinel," https://www.af.mil/About-Us/Fact-Sheets/Display/Article/2796993/rq-170-sentinel/.; Joseph Trevithick, "Declassified Docs Offer New Details About A Growing RQ-170 "Wraith" Force." *The Drive*. https://www.thedrive.com/the-war-zone/40427/declassified-docs-offer-new-details-about-a-growing-rq-170-wraith-force.

observable unmanned aerial vehicle.[835] Boeing had years of experience as a major subcontractor responsible for critical portions of the airframe on the B-2 and F-22.[836] Northrop, on the other hand, had built the world's first and only stealth bomber, the B-2. And despite that aircraft's excessive price tag and checkered past, it was an engineering marvel to which Northrop still retained propriety data and experience. Northrop also had extensive familiarity building advanced radar systems that were employed in both the F-22 and F-35.[837] To boot, they had had just successfully developed and flown the X-47B—an advanced unmanned combat aircraft.[838] Nevertheless, Northrop had no current or forthcoming prime contracts.

While the specific details have not been made public, both proposals initially failed in the category of "technical capability" during source selection.[839] As a consequence, the Air Force had to work with the contractor teams to address the "deficiencies, and while weaknesses and related risks remained," the primary issues were able to be resolved.[840]

The Air Force then turned its attention cost estimates. Both offerors' estimates were initially deemed to not be "realistic for the work to be performed."[841] Knowing full well that the lower cost offeror would likely win the contract, both contractor teams were clearly motivated to advance the lowest cost possible. Given a chance to fix its estimates, Northrop resubmitted its proposal, which was found to be acceptable by the source selection team. The Boeing-led proposal remained problematic, however. Its cost estimates were based primarily

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835 United States Air Force, "RQ-170 Sentinel," https://www.af.mil/About-Us/Fact-Sheets/Display/Article/2796993/rq-170-sentinel/.; Trevithick, "Declassified Docs Offer New Details About A Growing RQ-170 "Wraith" Force."

836 Boeing, *F-22 Raptor*, https://www.boeing.com/history/products/f-22-raptor.page.; Griffin and Kinnu, *B-2 Systems Engineering Case Study*, 31.

837 Northrop-Grumman, *Active Electronically Scanned Array (AESA) Radars*, https://www.northropgrumman.com/what-we-do/air/active-electronically-scanned-array-aesa-radars/.

838 Northrop-Grumman, X-47B UCAS, https://www.northropgrumman.com/what-we-do/air/x-47b-ucas/.; United States Air Force, "*X-47B Performs First Flight at Edwards,*" Air Force Material Command, Februaryruary 7, 2011. https://www.afmc.af.mil/News/Article-Display/Article/153987/x-47b-performs-first-flight-at-edwards/.

839 Government Accountability Office, *Boeing Company Protest Decision*, 6.

840 Government Accountability Office, *Boeing Company Protest Decision*, 6.

841 Government Accountability Office, *Boeing Company Protest Decision*, B-412441, 45–46.

on non-low observable aircraft, which the Independent Government Estimate (IGE) deemed inadequate.[842] Boeing refused to change its submission.

On October 27, 2015, the Air Force announced that Northrop had won the LRS-B competition.[843] The full details of the source selection decision have not been fully released, but it has been announced that Northrop's "labor rate advantage and decision to absorb significant company investment…and significantly lower proposed prices for the Low Rate Initial Production phase created a near-insurmountable obstacle to Boeing's proposal achieving a best-value."[844] In the end, the lower cost submission—one based on realistic cost estimates—won the day.

With the Engineering, Manufacturing Development (EMD, previously known as FSD) contract estimated to cost $21.4 billion in and an APUC at $550 million per aircraft, the total program costs were estimated at upwards of $75 billion in 2010-year dollars.[845] If that estimate holds, the cost per airplane will be just under $1 billion a piece. The initial contract set Initial Operating Capability, presumably for a squadron of combat-ready bombers, for 2025.[846]

B. CONCLUSION

While many thought Secretary Gates' decision to terminate the NGB program was a mistake, it is doubtful that a truly broad-based consensus on a new bomber would have been achieved had he not made that decision. In this respect Secretary Gates' decision proved to be a boon for the Air Force.

The path to Secretary Gates' approval of the LRS-B program is one that highlights how important bureaucratic politics are to major weapons system acquisition decisions. While Robert Martinage sought to avoid the Air Force's failing in the NGB program, which had

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[842] Government Accountability Office*, Boeing Company Protest Decision*, 6.

[843] United States Air Force Press Release*, Air Force Awards LRS-B Contract*. Oct 27, 2015.

[844] Government Accountability Office, *Boeing Company Protest Decision*, 52.

[845] United States Air Force press release, *Air Force Awards LRS-B Contract*. Oct 27, 2015.

[846] Department of Defense, *Press Briefing on the Announcement of the Long-Range Strike Bomber Contract Award*, October 27, 2015.

made little effort to generate outside advocacy, his initial strategy of relying on sound analysis to speak for itself also failed. Despite compelling analysis that showed the strategic need for a penetrating bomber, the insulated manner in which it was conducted meant that it failed to gain the required support.

In recognizing the importance of bureaucratic participation, Martinage adopted a "by with and through approach" to achieve consensus. Divisions still arose, such as whether a penetrating bomber was necessary in an age of missiles and advanced air defenses, but facilitating an open discourse among stakeholders allowed such problems to be resolved. Had Martinage not changed his strategy to a participatory (though still analytic) approach, and instead attempted to argue that his team's analysis was simply correct, agreement would surely have remained elusive.

That the underlying analysis was in fact correct, in the sense that it was able to withstand such diverse and extensive scrutiny, is nonetheless of immense importance. RAND's cost and capability analysis, which compared penetrating bombers and cruise missiles was especially important as it blunted what had previously been regarded as strong arguments. It also put to rest (at least temporarily) long-standing presumptions about cost advantages.

Gaining bureaucratic concurrence on the technology to be integrated into the new bomber was also vital to gaining Gates' approval. New bomber development had historically endeavored to push beyond the technological frontier. The LRS-B would only "nudge" technology forward.[847] By having each capability decision debated by a senior committee that prioritized costs, the LRS-B's technological requirements resulted in capabilities based mainly on proven technologies. It was clear to everyone on the SWG that Secretary Gates would not support a program that required countless technological inventions at an extraordinary cost.[848] This was part of the B-2's legacy—arguably the part most responsible for its having finally found a successor.

[847] On January 13, 2021, the author spoke to Mr. Robert Martinage.

[848] On December 8, 2021, the author spoke to Secretary Robert Gates.

With the primary defense acquisition forces in alignment, and an acquisition strategy informed by the failings of the B-2 set, the LRS-B has the potential to be a hallmark defense acquisition. The path to the LRS-B was a major departure from previous weapon system starts in the Air Force, above all because of the crucial role of OSD leadership in getting bureaucratic alignment. Afterall, the Air Force's insular NGB was cancelled, and the OSD-led LRS-B program resulted in a program that survived through contract award in 2015. This is not to say that the Air Force could not have similarly succeeded had they taken a more inclusive approach in the original NGB program, but that was not the path they took. The LRS-B's success required unstinting support and skillful (and humble) actions of the Air Force's top brass, but these efforts bore fruit through the agency of a DOD-wide effort. Time will tell how well the cost-prioritized LRS-B will perform in the future but the process that finally brought the aircraft into existence already offers much to admire.

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VIII. CONCLUSION

> We were just way behind, and we needed to get a bomber program that is going to survive all of the bureaucratic challenges, cost debates, changes in administration, and all of that. We needed a solid bomber program that is going to start putting iron on the ramp.
>
> – Secretary of the Air Force Michael Donley
> on the genesis of the Long-Range Strike-Bomber[849]

Explaining how and why we buy the weapons we do is not a simple exercise. Investigation of the B-2 Spirit and the B-21 Raider have revealed that neither program could have been initiated until the basic forces that drive defense acquisition—bureaucratic politics, technological opportunity and ambition, political support, and the strategic need—were in harmony. Analysis of the B-2's turbulent history further suggests that those forces, having aligned in support of starting the B-21 program, must remain so if it is to reach its full potential.

The sections below provide a summary of how and why the B-2 and B-21 programs came to life. Collectively they offer a distillation of observed best practices in modern defense acquisitions.

A. THE GENESIS AND OUTCOMES OF THE B-2 AND B-21 PROGRAMS

Notwithstanding the much-debated effectiveness of strategic bombardment during World War II, the release of nuclear weapons over Japan elevated the manned strategic bomber as the United States' premier weapon: it was the only platform that could deliver a nuclear weapon. The Air Force was created in no small measure to wage nuclear war, and the first strategic bomber built for that purpose—the B-52—has always held a place of special reverence for the service.

Once it became possible to mate nuclear warheads to Intercontinental Ballistic Missiles (ICBM), the manned strategic bomber lost its standing as the nation's ultimate weapon. The novel capability of nuclear armed ICBMs presaged a future in which manned

[849] On January 21, 2022, the author spoke to Secretary Michael Donley.

bombers would no longer be necessary to wage nuclear war. For myriad budgetary and efficiency reasons, the civilian leadership of the military was strongly inclined to support this view.

While fully supportive of ICBMs and the military benefit they promised, the Air Force was reluctant, at first, to place its full confidence in the unproven technology. Strategic bombers were a tried-and-true weapon. Absent the test of combat, which the ICBM has (fortunately) never had to pass, Air Force leaders were reluctant to embrace it as the sole means for conducting strategic bombardment.

The issue came to came to a head in 1961 with Secretary of Defense Robert McNamara's decision to terminate the Air Force's first attempt to replace the B-52 with the B-70 Valkyrie. The B-70 was the Air Force's answer to new challenges presented by modern air defenses. It was intended to fly high and fast over Soviet air defenses to deliver its weapons, while retaining all the flexibility of a manned aircraft: the ability to change targets in air, recallability, high-payload capacity, an ability to conduct show of force missions, and its cost-effective reusability. ICBMs could not offer any of these advantages. Precisely because a manned bomber was so different from a ballistic missile, it would also prevent an enemy from focusing their countermeasure efforts against a single threat.

McNamara believed in the benefits of a mixed force but saw no reason to pursue them by means of a new bomber. In his view, strategic targets could be reliably hit via ICBMs. The existing force of B-52s and FB-111s would be just fine to reap the benefits of a mixed force. The high-altitude shoot down of Gary Powers' U-2 in 1960 also blew a hole through the Air Force's claim that the B-70 was invulnerable to modern air defenses by virtue of its speed and operational ceiling. Without the support of the Defense Secretary, the program was terminated. ICBMs had won the first round of the bombers-versus-missiles debate.

Undeterred by the failure to gain bureaucratic support from OSD for the B-70, the Air Force remained dogged in its pursuit of a new bomber. Rather than continuing to attempt to out-run or out-range modern age defenses, it proposed instead a new bomber that would penetrate at low altitudes to exploit gaps in radar coverage. The program would become

known as the B-1, which found support from McNamara's successor, Melvin Laird. Laird, who became Secretary of Defense in 1969, took a much less hands-on approach to managing the defense department that McNamara had done. In particular, he allowed the services to define their own weapons needs. The Air Force could not have been more pleased. In 1970, after almost twenty years of failed attempts, it awarded a prototype development contract for a new bomber to North American Aviation.

Even with the support of OSD, this new effort struggled to find Congressional support, in part because of the high numbers of aircraft lost in the Vietnam and Yom Kippur Wars. Congress allowed the program to advance, but only at a metered pace as committees assessed the situation. The introduction of Soviet look-down/shoot-down interceptor aircraft capabilities caused many to question the Air Force's low-altitude answer to survivability.

The challenge was compounded by the introduction of the Air Launched Cruise Missile (ALCM) in the mid-1970s. A high-speed missile that could be launched from an airborne platform outside the range of surface-to-air missiles, the ALCM presented yet another threat to the manned strategic bomber's primacy. Its arrival caused many in Congress to question why an expensive penetrating bomber program should be funded when the ALCMs could be launched from a safe distance and do the exact same job. In 1976, Congress decided that the final production decision should be made by the incoming Jimmy Carter administration.

Given the potential of ALCMs, and unsure of the B-1's ability to survive against modern air defenses, Jimmy Carter terminated the B-1 program in 1977. Not publicly revealed at the time, Carter was also influenced by another factor: stealth. By then, the nascent technology started by DARPA in the early 1970s had advanced to a point where it was all but certain that an operational stealth attack aircraft could be developed. Stealth had also a become a critical component of what became known as the "offset" strategy.

The offset strategy was the brainchild of Carter's Secretary of Defense, Harold Brown. It was the culmination of years of defense thinking to overcome Soviet numerical superiority in Eastern Europe, given their parity with the United States in nuclear weapons. Instead of competing soldier for soldier with the Russian Army, the United States would

offset superior manpower with technology. The core elements of the new approach were "stealth, smart weapons, and smart intelligence," which would enable U.S. and NATO forces to interdict Soviet forces before they could advance into Western Europe.[850]

By 1978, Lockheed's Have Blue program, which would produce the F-117 Nighthawk, was well underway, and Brown set his sights on application of that technology to a bomber adapted to the spirit of "offset." The opportunity to penetrate Soviet airspace and deliver nuclear payloads with a mixed force of aircraft and missiles promised to negate millions of dollars of Soviet investment in air defense systems. The manned penetrating bomber also offered a means of defeating a new threat: mobile nuclear missiles, which the Soviets were developing at this time. After receiving assurance that a stealth bomber was technologically feasible and operationally beneficial, the president gave his blessing. The Air Force formally initiated the Advanced Strategic Penetrating Aircraft (ASPA) program in 1978.

The default answer for the stealth bomber in the fall of 1978 was to enlarge the faceted Have Blue design to allow for more fuel and payload. After six months on that path, however, the Air Force grew frustrated with Lockheed's progress and invited Northrop into the hunt. Their addition was only possible because DARPA had the foresight to keep more than just Lockheed involved in the development of stealth technologies. While they didn't know it at the time, by awarding Northrop a contract to develop a low observable surveillance aircraft known as Tacit Blue shortly after Lockheed won the Have Blue competition, DARPA set the stage for Northrop and Lockheed to compete for the stealth bomber.

By 1980, the Air Force and OSD (with President Carter's support) were in alignment over the need for a stealth bomber. Since all stealth programs were hidden in the "black," the open debates of the B-1 and the B-70 programs could be avoided. As a result, the program would only need the backing of a few powerful leaders in Congress, notably John Stennis and Sam Nunn. With their support, the principal defense acquisitions forces were finally aligned, and source selection for what would become the B-2 began in the fall of 1980.

[850] Perry, interview, October 18, 2004.

With the arrival of Ronald Reagan in the White House in 1981, the question the new administration had to answer was not whether to continue with the stealth bomber program, but whether to also revive the B-1. There was no question in Reagan's mind what he would do. Still, he tasked his Defense Secretary, Caspar Weinberger, to conduct an inquiry into the matter. In the end, Reagan held to his campaign promise and announced in the fall of 1981 that he would support the development of not one but two new strategic bombers. The updated B-1B would serve as the interim bomber while the stealth bomber, now named the Advanced Technology Bomber (ATB), advanced to Full Scale Development (FSD). With the promise of adding 232 bombers to the force, the Air Force, and Strategic Air Command specifically, could not have been more pleased.

With the B-1B secured as the interim bomber, the Air Force assumed more risk in the award of the ATB contract. While it could have gone with Lockheed's less expensive Senior Peg and worked with a contractor that had plenty of experience as a prime contractor of highly secretive aerospace programs, the Air Force instead chose Northrop. Northrop's Senior Ice promised more range and almost twice the payload. Although Northrop did not possess the same level of experience as Lockheed, the extra capability was viewed as worth the risk. And with the B-1B scheduled to be operational by the mid-1980s, the Air Force could comfortably push out the development timeline for the ATB. Unconstrained by costs, secure with an interim bomber, and with the added benefit of preventing Lockheed from having a monopoly over stealth, the Air Force chose Northrop's riskier Senior Ice.

As a "black" program with little oversight and a blank check, the ATB program sought to push well beyond the state-of-the-art in its ambition. Hundreds of inventions would be made during the program. The goal was to develop an unrivaled capability that would allow the bomber to fly over Moscow and deliver nuclear weapons unmolested by Soviet air defenses. At the program's start, there was no question about the importance of its mission, nor were there concerns about spending the money necessary to get achieve it. Costs were the program's last priority. Security and performance were ranked over everything else.

Since the required oversight was limited to only the highest levels of leadership, as long as the Cold War remained hot and there was trust from Congress, this arrangement persisted. The arrangement allowed the Air Force to make rapid decisions, even to the tune

of billions of dollars. This kept the program moving along to pursue the myriad novel technologies demanded by the program's goals, but it also meant the situation could be taken advantage of.

The "black" program arrangement, and the ATB's program management prioritization, were boons for Northrop. The company had a monopoly over the nation's most expensive weapons system, and it knew progress would not be slowed down over concerns about costs. The first production buy in 1987 portended a future of massive profits.

This was an illusion. The freedom inherent in the B-2 program's management structure showed signs of crumbling soon after the first production buy in 1987. By then, "black" programs had become the targets of Congressional scrutiny for wasteful spending. Allegations against Northrop for bribery and fraud at the time made matters worse.

Thereafter Congress demanded that more information related to the B-2 be made public. Each time Congress requested information on the B-2 program, they were astonished by cost estimates that exceeded what they had been previously told. And with little effort made in the early years of the program to gain wide-Congressional support on the risks and high costs that would surely be associated with the pursuit of such a technologically aggressive program as the B-2, the program was met with shock rather than understanding. By the time these issues were made public, the B-2 program had few allies and an ever-expanding list of political enemies.

Going from bad to worse, the strategic requirement for the B-2 also began to dissipate in the late 1980s. This only served to embolden members of Congress who wanted to kill the technologically ambitious and expensive program. In response, the Air Force and the DOD attempted to rebrand the B-2 by focusing on its conventional mission—a mission made more potent thanks to precision weapons. The Air Force also attempted to cut program costs and pushed Northrop to make considerable changes in its management. The efforts would prove to be too late. The acquisition forces that were in alignment at the program's genesis had fallen out of harmony by the end of 1991. The program was cut to a mere 15% of its intended target of 132 stealth B-2s.

Following President George H.W. Bush's State of the Union address in 1992, which publicly announced the B-2 program's curtailment, the future for strategic bombers was uncertain. Was the current bomber force adequate? What missions would strategic bombers be asked to accomplish in the absence of the Soviet Union? Questions such as these pervaded defense thinking.

At least from the perspective of the Air Force, it was time to modernize other parts of its arsenal, specifically its fighter force. By 1990, almost all of the Air Force's senior brass came from fighter pilot backgrounds.[851] By 1992, all bombers and fighters were put under a new command—Air Combat Command—which was led by a fighter pilot. Strategic Air Command was dissolved at the same time and presaged a colossal shift in Air Force priorities.

From the early 1990s to the mid-2000s, the Air Force refused to put their bureaucratic support behind a new bomber program. Other than setting a date for 2037 for fielding a new bomber, it refused to reprogram money away from fighter modernization efforts. F-22, F-35 and mobility procurements were inviolable. Even the B-2's notable success in Kosovo would not entice the Air Force to divert funds to start new bomber program. New technologies (e.g., hypersonic missiles) also contributed to the Air Force's reluctance to start another costly bomber program. Nevertheless, with China on the rise, many in Congress and OSD believed the Air Force was wrongly neglecting long-range air power.

External pressure from these sources, rather than from within the Air Force, mounted to initiate a new bomber program in the early-2000s. After a series of failed responses to address Congressional calls to start a new bomber program (or purchase B-2Cs), the Air Force could not ignore China's rise and the associated need for long-range air power. Accordingly, by 2006, the Air Force's senior brass agreed to accelerate the timeline it set to field a new bomber—the Next Generation Bomber (NGB)—from 2037 to 2018. And unlike previous efforts, such as the FB-22 regional bomber, the NGB was to be a long-range, penetrating bomber—a worthy follow-on bomber to the B-52.

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851 Michael Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership 1945–1982* (Maxwell AFB, AL: Air University Press, 1988), 255.

Thinking that the NGB's operational imperative was cemented by the 2006 Quadrennial Defense Review (QDR), the Air Force led an insular effort to set the new bomber's requirements. It put extremely tight access controls on the program as an unacknowledged SAP. Doing so allowed the Air Force freedom to set the NGB's requirements to its liking, but it stifled wider bureaucratic and congressional support from being secured.

When the NGB was finally advanced for Secretary of Defense Robert Gates' approval in 2009, however, it was clear that it no longer enjoyed the bureaucratic support it once did. The bomber promised to push well beyond the technological frontier and had a price tag to prove it. With many in Secretary Gates' inner circle not even convinced that a penetrating bomber was necessary, its exorbitant costs and the Air Force's desire to chase exotic technologies made it easy for them to resist it. It certainly didn't help that in 2009 the Air Force's reputation was in poor shape with the Defense Secretary, owing to nuclear mismanagement. When the NGB decision made it to Secretary Gates, the Air Force's new Secretary and Chief had only been on the job for less than six months and were still in the process of putting the service back into Gates' good graces. Given the confusion over "need, the technology, and the requirement," Secretary Gates decided the NGB program was not ready to move forward and subsequently terminated it.[852]

After the Air Force's failed NGB effort, the decision of whether there was a need for a new bomber, and if there was, what its capabilities should be, was given to OSD. Robert Martinage was responsible for leading the effort on behalf of OSD. Knowledgeable of the reasons behind Secretary Gates' termination decision, Martinage established a combined OSD and Air Force team to conduct analysis on whether a new bomber was needed. After almost a year of effort, and with a solution in hand that pointed to the need for a penetrating bomber, Martinage discovered that sound analysis would not be enough to win sufficient

[852] Department of Defense, Defense Budget Recommendation Statement (Arlington, VA), As Prepared for Delivery by Secretary of Defense Robert M. Gates, Arlington, VA, Monday, April 06, 2009 excerpt from Jeremiah Gertler, Air Force Next-Generation Bomber; Background and Issues for Congress, December 22, 2009.

bureaucratic support. Unlike the B-2 program, where OSD and the Air Force were in violent agreement on the need for a stealth bomber, that was not the case in by the end of 2009.

After realizing *how* he conducted his analysis mattered just as much as *what* his analysis concluded, Martinage reengineered his analytic process in 2010 to include all key stakeholders in its development. He then orchestrated senior leader forums to address the core issues head-on: whether it was more cost-effective to use missiles instead of penetrating bombers and whether stealth was still viable against modern air defenses.

Martinage also structured the principals meetings to define the new bomber's capabilities with cost-effectiveness in mind. Unlike the Air Force's B-2 and NGB programs, which proceeded with little concern for costs, each capability decision was made with costs at the fore. It was known by all that Secretary Gates would not support a program unless it could reasonably result in an acquisition of at least 100 new bombers.[853] To do that, costs would need to be controlled to insulate the program from political attack.

The solution was to make the new bomber part of larger "family of systems," which eliminated the need to have all required mission capabilities on board the bomber itself. Design options were also limited to proven, rather than "bleeding edge," technologies, which kept R&D costs to a minimum. And the new bomber's range and payload were set to specifications, which would meet its envisioned core mission needs while not becoming so large that its concomitant price tag would be politically unsupported.

By the summer of 2010 the capabilities for the newly named Long-Range Strike-Bomber (LRS-B) were set. There was bureaucratic consensus and support from Congress on the strategic need for a new penetrating bomber. By designing the bomber with political, and not just its operational survival in mind, and by tempering the level of technological advance required to proceed, Secretary Gates was satisfied with what he saw.

Gates approved the LRS-B program in late 2010, and followed up, at the Air Force's urging, with an unprecedented requirements memorandum that he signed himself. The memorandum allowed the Air Force to move forward with source selection quickly. And

[853] On December 8, 2021, the author spoke to Secretary Robert Gates.

with the Secretary of Defense's signature on the requirements for the new bomber, bureaucratic alignment was all but guaranteed.

By 2015, when the Full Scale Development contract was awarded to Northrop Grumman, the political, strategic, technological, and bureaucratic forces that aligned at its genesis were even more firmly aligned by China's continued rise, and the United States' quest to rebalance to the Pacific.[854] OSD and the Air Force for their parts had worked diligently to ensure political support was retained.[855] The Air Force and OSD have been overly transparent in providing updates on the newly named B-21's status to Congress, which has resulted in terrific bi-partisan support.[856] The Air Force and Northrop have also shown no signs of chasing exotic technologies and have held firm to Secretary Gates' guidance. These actions are a clear signal that institutional learning—learning that came directly from the B-2 program—has occurred.

B. RESEARCH FINDINGS AND SIGNIFICANCE

In addition to its historical contribution to the defense studies literature, the primary thesis advanced in this study contends that before the B-2 and LRS-B/B-21 programs could begin, the principal defense acquisition forces (i.e., bureaucratic politics, technology, politics, and strategic need) had to be in alignment. And in the case of the B-2, it found that when those forces fell out of alignment, the program was subsequently terminated. While it cannot be known how successful the B-21 program will be, thus far, the program has exhibited signs of institutional learning from the B-2 program's early demise, which portends a different outcome.

Consistent with this study's framing and thesis, the following is a list of key findings that have been gleaned from this research. Indeed, not all defense acquisition programs are the same, but the intricate history of how these two weapons systems came to life and how

854 Department of Defense, *Quadrennial Defense Review for 2014*. March 4, 2014, V.

855 On April 18, 2022, the author spoke to Mr. Randal Walden.

856 On April 18, 2022, the author spoke to Mr. Randal Walden.; Paul McLeary, "B-21 A Good News Story; DOD Acquisition 'Getting Better:' HASC Chair." *Breaking Defense*. April 22, 2021. https://breakingdefense.com/2021/04/b-21-a-good-news-story-hasc-chairman/.

they fared can most certainly serve as a guide to illuminate the complex nature of modern defense acquisitions. These findings will be of particular interest to defense acquisition professionals, military elites, Congress, scholars, and students of history, among others.

(1) Open and transparent communication is critical to the political survival of major weapons acquisition programs.

The B-2 program was initiated with the view that the Cold War would never end and "black" defense budgets would remain flush. By not factoring in a possible change in the strategic environment, the B-2 program was forced to justify its high costs in the absence of the threat that had originally justified them, in a political context in which a much higher level of transparency was required than had been true in the past. Instead of working to explain the program and its high costs to Congress, the DOD, and the Air Force attempted to keep the details of the program hidden for as long as they could, perhaps imagining that they could create a kind of fait accompli once development reached a certain stage. The approach undermined Congressional support.

In contrast, the B-21 program was designed to shield it from political attack by prioritizing transparency, keeping its costs low, avoiding technologies so unfamiliar as to invite unthinking skepticism, and ensuring the program's strategic need was publicly articulated. Unlike decision-making in the B-2 program, which was mostly kept hidden from Congress and guided by the highly classified Program Management Directive (PMD), the B-21 program has been overly transparent with Congress. B-21 program managers have gone to great lengths to ensure members of Congress and their staffers have been kept up to date and are clear about how program decisions are prioritized.[857] To that end, the 2011 Gates memorandum has become the de facto PMD for the B-21.[858] Efforts to ensure transparency and program discipline have been intended to help the B-21 retain its political support, which as of this writing has not waivered.

[857] On April 18, 2022, the author spoke to Mr. Randall Walden.; On 5 May 2022, email message with the author with a senior B-21 acquisition official.

[858] On April 18, 2022, the author spoke to Mr. Randall Walden.; On 5 May 2022, email message with the author with a senior B-21 acquisition official.

(2) Strategic need is not an objective reality; it is subject to bureaucratic interpretation.

At the time of the B-2's conception, the strategic need—the requirement for a penetrating bomber to penetrate Soviet airspace and deliver nuclear weapons—was perceived as the same by all stakeholders (i.e., OSD, the Air Force, and Congress). By the end of the program, however, the strategic need was viewed differently by the Air Force and members of Congress. The Air Force believed the B-2's high costs were justified by its ever-present nuclear mission and an expanding conventional mission aided by precision munitions. On the other hand, after the Soviet Union fell the majority in Congress no longer saw the need for an expensive stealth bomber to deliver nuclear weapons and turned its attention to reaping the fruits of the peace dividend. The difference in views over the strategic need was partly responsible for the decision to terminate the program in 1992.

In the case of the B-21's genesis, the Air Force was initially reluctant to invest in long-range air power as they were chiefly focused on the modernization of its fighter and mobility forces. Given China's quickening rise in the early 2000s, Congress and OSD believed the challenges in the Pacific, notably the vast ranges and limited basing options, meant that long-range air power needed more investment than the Air Force was prepared to give—especially in the initiation of a new bomber program. Hence, in 2003 Congress unilaterally injected funding into the Air Force for the express purpose of starting a new bomber program. While the Air Force had to respond to the pressure from Congress, they would not embrace the start of a new bomber program until after almost three more years. Only then did the Air Force finally align with Congress and OSD over the quickening strategic need for additional long-range air power, given the projected needs for a fight in the Pacific. And only then did the Air Force take steps to initiate a new bomber program.

Despite the alignment that was reached between Congress, OSD, and the Air Force to start the NGB program in 2006, by 2009 that alignment had fallen out of sync. This time, however, it was OSD and the Air Force who were in discord. OSD was not satisfied with the Air Force's proposal for an expensive penetrating bomber as key OSD stakeholders believed standoff weapons were the more cost-effective and capable weapon. Despite the Air Force's preferences, the program could not advance until OSD agreed on the strategic need. It would

take almost two years of skillful bureaucratic maneuvering to bring OSD and the Air Force into accord on the strategic need for a new penetrating bomber.

(3) Stakeholder-inclusive approaches work better than exclusive approaches.

As was exemplified in the NGB program, the Air Force's insular approach to setting the requirements for a new bomber failed miserably. So, too, however, did Robert Martinage's intended remedy: an analysis-based approach whose results would speak for themselves. Instead, what was needed was an approach that included key stakeholders *in the generation of analysis*, and a forum to openly address areas of concern head on. This is not to suggest that OSD is inherently better suited, or better situated, than the Air Force at leading new weapons system programs. It is simply that Martinage was working for OSD when he arrived at the superior approach that finally succeeded.

(4) Preventing monopolies in new technologies is a good thing.

Had DARPA not interceded and given Northrop the contract to develop Tacit Blue, it is unlikely that the revolutionary curved stealth design used in the B-2 would have been invented when it was. Competition between defense contractors can thus serve as a catalyst to develop new technologies that can provide great military benefit.

(5) The Defense industry lobby is not powerful enough by itself to cause weapons procurement decisions.

The failed attempt by Northrop to sell the Air Force the B-2C reveals the limited power commanded by the defense lobby. Despite Northrop's attempt, the Air Force refused to alter its priorities to procure the B-2C. To be sure, there was a compelling case to be made for the purchases of B-2Cs following the B-2's successful combat debut in Kosovo, but without the support of the Air Force, it would not succeed.

(6) Revolutionary technology itself does not result in the genesis of a new weapons system.

Despite the remarkable invention of stealth technologies that would prove to revolutionize air warfare by abating potent air defenses, the technology itself was not causal in the origin of the B-2. To be sure, the development of stealth technologies breathed new

life into the Air Force's rapidly deteriorating strategic bombardment mission. Yet, without bureaucratic accord on the strategic need to penetrate Soviet airspace, the technology alone would not have been enough to bring the program to life.

(7) Scar tissue matters in subsequent weapons system acquisition decisions.

The B-2 acquisition program ultimately failed in its mission to become the 132-bomber fleet that was envisioned at its genesis. Nevertheless, the program succeeded in fielding the world's first stealth bomber. Countless lessons were learned as the stealth pioneers navigated novel and complex technological and manufacturing landscapes in a world that was in constant change.

The influence of the B-2 on the B-21 is strong. From lessons on how to manufacture and care for stealth technologies in a variety of operating environments to the need to cultivate political support via transparent communication and to keep requirements stable, the B-2 has clearly played a major role in the B-21 program.[859] Secretary Gates' guidance to keep costs low and leverage proven technologies were also clearly in response to his understanding of why the B-2 program failed to reach its full potential. His direction to the team was clear: "You gotta come back with an affordable, cost limited, achievable program that we can sell on the hill and that we can argue that we aren't going to make the same mistakes that we did with the B-2."[860]

(8) Early and sustained agreement between Congress, OSD, and the Air Force on the level of technological ambition that will be pursued is of critical importance to the long-term success of major defense acquisition programs.

It is impossible, at the start of a process designed to produce a complex, multi-mission system like a manned bomber, to anticipate all of the operational and technical requirements that may prove necessary or desirable. But early recognition and agreement on the scale of the R&D enterprise such a system will require is important to achieving stable support. Pushing technological frontiers, as the B-2 program did, imposes increased risks to the

[859] On April 18, 2022, the author spoke to Mr. Randall Walden.

[860] On December 8, 2021, the author spoke to Secretary Robert Gates.

maintenance of bureaucratic and political support, which must be cultivated with particular care as a consequence. Under the cover of its status as a "black" program, the B-2 program's leadership did not foresee the eventual need to manage the technological expectations of Congress early on. When the Air Force finally did attempt to gain Congressional support for the costs associated with pursuing the many advanced technologies required for the B-2, it proved far too late. Still, as the nation's first attempt to take the advanced design of a long-range heavy stealth bomber from the drawing board to the battlefield, the B-2 is a remarkable achievement.

In the case of the B-21, on the other hand, great strides have been made to reach accord between the Air Force, OSD, and Congress on the metered level of technological ambition that will be pursued.[861] Direction to use proven technologies was explicit in Secretary Gates' 2011 memorandum. So too, was the resolution to keep requirements stable and bake-in program discipline.[862] The decision to make the Average Procurement Unit Cost (APUC) a Key Performance Parameter (KPP) is a key example of this in practice, which was clearly aimed at preventing the kind of technological risk and monopolistic practices that occurred in the B-2 program and elsewhere.[863] As long as the RCO continues to enforce discipline in this regard, which to date has resulted in the program being "on time and on budget," the B-21 stands a good chance at being a model defense acquisition program.[864]

[861] On 5 May 2022, email message with the author with a senior B-21 acquisition official.

[862] On January 21, 2022, the author spoke to Secretary Michael Donley.; On December 16, 2021, the author spoke to General (Ret.) Norton Schwartz.

[863] On October 13, 2021, the author spoke to Lieutenant Colonel (Ret.) Dr. Bud Baker about Northrop's business practices in the period that could be described as "monopolistic."

[864] On April 18, 2022, the author spoke to Mr. Randall Walden.

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APPENDIX. INTERVIEW LIST

- Lieutenant Colonel (Ret.) Bud Baker, USAF
  - B-2 Production Manager, 1986–1987
  - B-2 Program Integration Division Chief, 1987–1989
  - Executive Officer to then Major General Richard Scofield, 1989–1991
- Major General (Ret.) Ronald Bath, USAF
  - USAF Director for 2006 QDR, 2005–2006
- Lieutenant General Thomas Bussiere, USAF
  - Deputy STRATCOM/CC, 2020-Present
- Dr. Christopher Bowie
  - Secretary of the Air Force Staff Group, 1989–1991
  - Northrop Executive, 1994–2002 & 2005–2021
  - Deputy Director for Strategic Planning, HQ USAF, 2002–2005
- Honorable (Dr). Ashton (Ash) Carter
  - 25th Secretary of Defense, 2015–2017
  - Deputy Secretary of Defense, 2011–2013
  - Under Secretary of Defense for Acquisition, Technology and Logistics, 2009–2011.
- General (Ret.) Kevin Chilton, USAF
  - STRATCOM/CC, 2007–2010
- Lieutenant General (Ret.) David Deptula, USAF
  - Dean of the Mitchell Institute for Aerospace Studies, 2013-Present
  - Deputy Chief of Staff for ISR, 2006–2010
  - USAF Director for 2001 QDR, 2000–2001
  - Principal Author for Commission on Roles and Missions Heavy Bomber Force Study, 1993
- Honorable Michael (Mike) A. Donley
  - 22nd Secretary of the Air Force, 2008–2013
- Colonel (Ret.) Fred Frostic, USAF
    - Deputy Assistant Secretary of Defense, Requirements and Plans, 1994–1998
    - Member, Long-Range Air Power Panel, 1998
- Honorable Robert M. Gates
  - 22nd Secretary of Defense, 2006–2011
- Brigadier General (Ret.) Joseph Keith Glenn, USAF
  - B-2 Program Director, 1981–1983
- John M. Griffin, USAF
  - B-2 Chief Engineer, 1983–1989
  - ASPA Source Selection Chief Engineer, 1980–1981
- Colonel (Ret.) Vinson Grosse, USAF

    - B-2 Director of Manufacturing and Production, 1985–1989
- Honorable (Dr.) Paul Kaminski
    - Under Secretary of Defense for Acquisition and Technology, 1994–1996
    - Special Assistant to Dr. William Perry, 1977–1981
- Major General (Ret.) Charles Lyon, USAF
    - Director for Joint Integration, Directorate of Operational Capability Requirements, Deputy Chief of Staff for Operations, Plans and Requirements, Headquarters U.S. Air Force, 2008–2010
- General (Ret.) Merrill McPeak, USAF
    - 14th Chief of Staff of the Air Force, 1990–1994
- Major General (Ret.) Mark Matthews, USAF
    - Director, Requirements Air Combat Command, 2007–2009
    - Director, Plans and Programs Air Combat Command, 2006–2007
- Robert Martinage
    - NGB/LRS-B Tiger Team Lead, 2009–2011
- Lieutenant General (Ret.) Dick Reynolds, USAF
    - B-2 System Program Director, 1994–1996
- Honorable (Dr.) Donald Rice
    - 17th Secretary of the Air Force, 1989–1993
    - President of RAND Corporation, 1972–1989
    - Member, Long-Range Air Power Panel, 1998
- Honorable (Dr.) James Roche
    - 20th Secretary of the Air Force, 2001–2005
    - Northrop/Northrop-Grumman Executive, 1984–2001
- Kevin Rumble, USAF
    - B-2 Contract Officer, 1981–1984
    - ASPA Source Selection Contractor Officer, 1980–1981
- Lieutenant General (Ret.) Mark Shackelford, USAF
    - Military Deputy to the Assistant Secretary of the Air Force for Acquisition, 2008–2011
- General (Ret.) Norton Schwartz, USAF
    - 19th Chief of Staff of the Air Force, 2008–2012
- Lieutenant General (Ret.) Richard Scofield, USAF
    - B-2 System Program Director, 1983–1991
- Colonel (Ret.) Jim Tapp, USAF
    - Associate Director for Legislative Affairs for the Secretary of the Air Force, 1989–1994
    - Northrop-Grumman Executive, 1995–2011
- Jim Thomas
    - Principal Author of the 2006 QDR, 2005–2006
- Honorable (Dr.) James Tegnelia
    - Director, Defense Threat Reduction Agency, 2005–2009

    - Deputy Director and Acting Director, Defense Advanced Research Projects Agency, 1976–1986
- Honorable (Dr.) Michael (Mike) Vickers
    - Under Secretary of Defense for Intelligence, 2011–2015
    - Assistant Secretary of Defense for Special Operations, Low-Intensity Conflict, and Interdependent Capabilities, 2007–2011
- Randall Walden, USAF
    - Director, Air Force Rapid Capabilities Office, 2014-Present
    - Director, Air Force Test and Evaluation, 2013–2014
    - Director, Information Dominance Programs, 2009 – 2013
    - Technical Director, Air Force Rapid Capabilities Office, 2003–2009
- Colonel (Ret.) Tim Woods, USAF
    - LRS-B System Program Director, 2011–2015
- Honorable Robert O. Work
    - 32nd Deputy Secretary of Defense, 2014–2017
    - 31st Under Secretary of the Navy, 2009–2013

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