THE CASE FOR LONG-RANGE STRIKE: 21ST CENTURY SCENARIOS

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Thinking Smarter About Defense

Center for Strategic and Budgetary Assessments

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Executive Summary

Since 2005, US Air Force (USAF) leaders have committed themselves to fielding a new land-based, penetrating, long-range strike system (LRSS) by 2018. In March 2008, then USAF secretary Mike Wynne announced that a LRSS program aimed at achieving an initial operational capability (IOC) in 2018 existed, but was classified. What sort of system is needed? Why is it needed? How urgent is that need? This report addresses these questions in light of the security environment confronting the United States in the early twenty-first century. Since the Air Force's new LRSS program remains classified, however, this analysis concentrates less on exactly *what* sort of system the United States ought to field than on *why* it seems unwise to defer IOC to the late 2030s or beyond, as earlier Air Force plans proposed.

The first question that needs to be considered in exploring the rationale for a next-generation bomber is how to think about the issue. Most fundamentally, is the proper context non-nuclear or conventional operations? Should the potential of a new LRSS to deter nuclear use also be taken into account, or should the United States be satisfied with a "conventional-only" design, meaning one without the hardening needed for nuclear employment? Because the American consensus on the need for nuclear weapons and the role they should play in US security has largely broken down since the Cold War ended, these questions are not easily answered. Nevertheless, the uncertainties of the future international security environment argue against limiting the 2018 bomber strictly to conventional operations. Sufficient hardening against the electromagnetic pulse (EMP) generated by a nuclear detonation to enable the LRSS to deliver a thermonuclear bomb without risking damage to its on-board electronics is far cheaper to emplace during production than later.

Taking this prudent step would not make the 2018 LRSS primarily a nuclear bomber. The overall argument in this report for moving forward

as rapidly as possible to field a follow-on to the B-2 for long-range strike is based on examining a range of "generic scenarios." In the case of conventional operations, these scenarios include:

(1) Situations requiring a sufficient radius of action from the last air-refueling point to reach targets deep in defended airspace;

(2) Conflicts in which there is a need to strike targets at intercontinental distances from the continental United States because in-theater bases are not available;

(3) Missions requiring the survivability to persist in defended airspace in order to prosecute time-sensitive targets;

(4) Operations in which US forces must have the radius of action to be able to home-base beyond the reach of anti-access/area-denial capabilities;

(5) Any campaign that that demands better matching of munitions to targets; and

(6) Circumstances requiring the ability to provide all-weather, round-the-clock/day-in-day-out indirect fire support to ground forces.

The central argument in this report is that need and urgency inherent in the first four of these six generic situations alone suffice to make a strong case for fielding a new LRSS in the early 2020s.

In addition, though, there are nuclear scenarios that not only merit consideration, but may strengthen the argument for both moving ahead with the 2018 LRSS and ensuring that it has adequate EMP hardening. These scenarios are far more speculative, and vastly more debatable, than the conventional ones. They hinge on the hypothesis that, in the case of small atomic arsenals in the hands of regional adversaries such as Iran, limited nuclear options may again be thinkable, just as they were from 1945 until the early 1950s. Whether the threat of nuclear use against a regional power with limited nuclear weapons and reach is used to deter or compel, manned bombers seem preferable to ballistic missiles because they give the president more time for second thoughts and allow the strike to be aborted at the last possible moment.

Of course, given the likely resistance to such ideas due to long-standing beliefs about nuclear deterrence and the catastrophic consequences of any nuclear use, the nuclear scenarios may not carry much weight in the eyes of some—or perhaps many—readers. For this reason, the primary case for the need and urgency to field a new LRSS between 2018 and the early 2020s hinges on the conventional scenarios, especially the first four of the six examined in this report. Of these four, the most important for the design of a next-generation, long-range strike system is adequate persistence and survivability in defended airspace to deal with time-sensitive targets. While this is an ambitious goal, investing the tens of billions of dollars that will be required to field a new LRSS while failing to provide this critical capability would seem to be a waste of taxpayers' money.

Introduction

> General Moseley likes to say, "the soul of an air force is range and payload." I would salt and pepper persistence in there as well.
>
> — Michael Wynne, 2006[1]

> The 2018 airplane [bomber] will have the signatures and the capability to survive day or night in any of those [high-threat air defense] environments. And we can make 2018 because we've asked industry to look at using the existing engines, existing sensors, existing weapons, weapons bays, just like we built the F-117 in the late '70s and early '80s.... This is doable by 2018.
>
> — General T. Michael Moseley, October 2007[2]

[1] Michael W. Wynne, "Cyberspace Dominance, the Information Mosaic and Precision Strike," remarks to the Precision Strike Association, Johns Hopkins University, Baltimore, MD, October 19, 2006; online at <http://www.af.mil/library/speeches/speech.asp?id=281>.

[2] Government Executive, "Air Force General T. Michael Moseley Transcript, Part One," October 31, 2007, available at <http://www.govexec.com/dailyfed/1007/103107g1.htm>. At a press conference on June 5, 2008, Defense Secretary Robert Gates announced that he had accepted the resignations of Wynne and Moseley due to recent incidents involving the Air Force's handling of nuclear weapons and related components.

> The soul of an air force is range and payload. It is the ability to hold hostage any point on the Earth. [The] USAF is on a quest to refurbish that range and payload capability.
> — Michael Wynne, April 2008[3]

The 2006 Quadrennial Defense Review (QDR) directed the US Air Force (USAF) to field a new land-based penetrating long-range strike capability by 2018 while modernizing the current bomber inventory of ninety-four B-52Hs, sixty-seven B-1Bs, and twenty B-2As.[4] Senior USAF leaders are now on record as having committed the Air Force to fielding a new long-range strike system (LRSS) by 2018. In so doing, they have apparently changed their minds about deferring the next LRSS to the late 2030s in order to incorporate advanced capabilities such as hypersonic cruise (that is, cruise speeds above Mach 4). The decision not to await a hypersonic cruiser appears prudent. The scramjet-engine technology that a hypersonic cruise vehicle would require still has a long way to go before incorporation in an operational combat system becomes feasible. There is also the practical question of how prompt a strike response over global distances need be. If the answer is thirty minutes or less, as opposed to a couple hours, then existing ballistic missiles with conventional warheads are the better choice.

The "2018 bomber" that Air Force leaders have recently begun discussing in public, then, appears to be the most likely candidate for a LRSS beyond the B-2A within the next ten to fifteen years. How did a 2018 date for the initial operational capability (IOC) of this aircraft emerge? As indicated, the Air Force's preference, especially during 1999–2001, was to make do with its existing bombers for the "next 35 years" and defer any follow-on to the B-2 until "revolutionary technology"

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[3] Douglas Barrie and Amy Butler, "Next-Generation Bomber Sets Stage for ISR Penetrator," *Aviation Week & Space Technology*, April 27, 2008, available at <http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news/aw042808p2.xml>). The numbers cited for the current bombers are inventory totals, not the numbers available in operational units. Currently sixty-two B-52Hs (including eight in a reserve status), fifty-one B-1Bs, and sixteen B-2As are considered combat ready (Anthony Murch, "The Next Generation Bomber, Background, Oversight Issues, and Options for Congress," Congressional Research Service, RL34406, March 7, 2008, p. CRS-4).

[4] Department of Defense, *Quadrennial Defense Review Report*, February 6, 2006, p. 46. The number of bombers available for various operations is smaller than the inventory. For example, B-2 wing at Whiteman AFB, MO, normally has an operational strength of sixteen B-2s, and none of the B-1s are available for nuclear operations.

had matured.[5] In November 2001, however, Edward C. "Pete" Aldridge (then undersecretary of defense for acquisition, technology and logistics) directed the Air Force to begin using funding provided by Program Budget Decision 803 "to position the department potentially to start an acquisition program [for a future long-range strike aircraft] in the 2012–2015 time frame."[6] Nevertheless, Air Force leaders did not show much inclination to rethink their desire to wait for hypersonic and other technologies to mature sufficiently to yield a genuinely revolutionary step beyond the B-2 until 2004–2005.[7] In the interim, they proposed a strike version of the F-22 fighter, the FB-22.[8] It took some time, including further pressure from the Office of the Secretary of Defense (OSD) in the form of the 2006 QDR, for the Air Force to accept the need to field the next LRSS some two decades earlier than 2037.[9]

How much might it cost to develop an interim bomber and deliver enough production articles to achieve IOC by the end of 2018? Air Force leaders hope to minimize the costs of developing the "2018 bomber" by using existing engines, sensors, munitions, and weapons bays along with what they have described as "soon-to-mature" technologies. Most observers put the likely development costs at a minimum of $8–10 billion, but it is not unreasonable to speculate that the bill might end up closer to $15 billion or even more.[10] Given all the other competing demands for Air Force resources (the F-35 Joint Strike Fighter, a new aerial refueling tanker, etc.), and the possibility that supplemental funds for operations in Iraq and Afghanistan may begin decreasing substantially following the 2008 presidential election, the 2018 bomber program may well be hard-pressed to meet both the cost and schedule currently projected. Beyond these prospective resource demands, the fact is that major defense programs have been experiencing increasing schedule slippage and cost growth in recent years. Based on comparing large portfolios of major defense acquisition programs in Fiscal Year

[5] See Department of the Air Force, *U.S. Air Force Long-Range Strike Aircraft White Paper,* November 2001, pp. 27–29.

[6] E. C. Aldridge, Jr., "Future Long-Range Strike Aircraft (LRSA-X)," memorandum for Secretary of the Air Force, November 2, 2001.

[7] See Robert S. Dudney, "Long-Range Strike in Two Jumps," *AIR FORCE Magazine*, June 2004, p. 2.

[8] See John A. Tirpak, "The Raptor as Bomber," *AIR FORCE Magazine*, January 2005, pp. 31–32.

[9] Adam J. Herbert, "The 2018 Bombers and Its Friends," *AIR FORCE Magazine*, October 2006, pp. 24–29; Rebecca Grant, *Return of the Bomber: The Future of Long-Range Strike* (Arlington, VA: Air Force Association, February 2007), pp. 16–20, 28–31.

[10] Murch, "The Next Generation Bomber," CRS RL34406, p. i.

(FY) 2000 and FY 2007, the Government Accountability Office (GAO) recently found that increases in total acquisition costs had grown from 6 to 26 percent, and that schedule slippage had increased from sixteen to twenty-one months.[11] The 2018 IOC, therefore, may be a stretch. Still, an IOC in the early 2020s would not be totally unsatisfactory if development costs can be kept under control and the new LRSS has the survivability to operate day or night in airspace defended by advanced surface-to-air missiles (SAMs), such as the Russian S-300 PMU-2 Favorit (North Atlantic Treaty Organization code name SA-20[12]) and the S-400 Triumf (NATO code name SA-21).[13] To give a sense of the capabilities of these systems, the Russians advertise that the SA-21 will be able to intercept and destroy airborne targets, including stealth aircraft and cruise missiles, at distances "of up to 400 kilometers (250 miles), or twice the range of the MIM-104 Patriot, and 2.5 times that of the S-300PMU-2."[14]

What sort of a LRSS is feasible by 2018? Why is it needed? And how urgent is that need? Because the program itself remains classified (or "black"), it is difficult to estimate costs or technical risks with any confidence.[15] Answers to the first question—about the feasibility of fielding a B-2 follow-on by 2018—are especially problematic because there is so little public information on the design goals or desired capabilities of the new aircraft. For example, in 2005 the Center for Strategic and Budgetary Assessments (CSBA) suggested that the baseline design goal for a new bomber in the 2018–2020 timeframe should be

[11] GAO, "Defense Acquisitions: Assessment of Select Weapon Programs," GAO-08-467SP, March 2008, p. 7. The GAO's FY 2000 portfolio contained 75 major programs, the FY 2007 portfolio 95.

[12] So-called "double digit" SAMs like the S-300 PMU-2 and its predecessor, the S-300 PM/PMU-1, are quite expensive. For example, a typical S-300PM/PMU-1 battery (comprised of a 30N6E1 engagement radar, a 76N6 low-level early warning/acquisition radar and up to twelve 5P85S/5P85T transporter-erector-launchers (TELs), each with four 48N6 SAMs) is believed to cost around $100 million (Carlo Kopp, "Almaz S-300P/PT/PS/PMU/PMU-1/ZPMU-2; Almaz S-400 Triumf; Almaz S-400M Samoderzhets," last updated May 2008, online at <http://www.ausairpower.net/APA-Grumble-Gargoyle.html>.

[13] The S-400 has also been reported as the S-300 PMU-3.

[14] "Russia To Export S-400 Air Defense System from 2009," Russian News & Information Service Novosti, August 6, 2007, online at <http://en.rian.ru/russia/20070806/70416533.html>.

[15] Air Force Secretary Michael Wynne publicly confirmed that the 2018 bomber program is classified in March 2008 (Erik Holmes, "Wynne Discusses Next-Gen Bomber Publicly," *Air Force Times*, posted online March 9, 2008, online at <http://www.airforcetimes.com/news/2008/03/airforce_bomber_030608w/>).

the capability to loiter in defended airspace long enough for time-sensitive or emergent targets to reveal themselves.[16] The logic behind this suggestion stemmed from the simple fact that the precision strike capabilities US forces have repeatedly demonstrated in recent conflicts have made it clear to prospective adversaries that anything the Americans can find and track can be destroyed. Hence, any future military facing US forces will have powerful incentives to do everything possible to deny US surveillance systems the targeting information needed for precision strikes. Reducing target vulnerability through concealment, mobility, hardening, locations deep inside defended airspace, or limiting the amount of time key assets are exposed to attack are all ways of mitigating the formidable capabilities of US forces for precision strikes. In of this situation, US forces should expect to be confronted more and more with fleeting, elusive, time-sensitive, briefly emergent, deep, or hardened targets. Dwell or persistence in defended airspace, therefore, appeared in 2005 to be a desirable baseline performance goal for the next long-range strike system. Nevertheless, in January 2008 an independent assessment of USAF bomber modernization plans by the Center for Strategic and International Studies (CSIS) concluded that, while the "imperative to engage time-sensitive targets (TSTs)… has increased the value of range, persistence and payload," the report went on to question whether the persistence in highly defended areas to deal with fleeting, briefly emergent TSTs could be achieved with technologies likely to be available in a 2018 bomber at an affordable cost.[17] Systems like the SA-21 and advanced interceptors such as the Russian Sukhoi Su-37 might well be able to "lock out" any LRSS the United States could field by 2018 given the funding likely to be available.

The feasibility of persisting in defended airspace to wait for time-sensitive targets to reveal themselves hinges on a number of interrelated technical judgments. To begin with, how far might low-observability (LO) technologies be pushed? LO, of course, involves more than reducing radar signatures. Infrared, visual, and even acoustic signatures have to be taken into account, along with the platform's radar cross section (RCS) at various frequencies. In the case of RCS, however, the first ques-

[16] Barry D. Watts, *Long-Range Strike: Imperatives, Urgency and Options* (Washington, DC: Center for Strategic and Budgetary Assessments, 2005), pp. iii–iv, 51–53, 55–56, 75–76. Time-sensitive targets (TSTs) are those that need to be struck quickly, either because of the immediate threat they pose, or because they are high-value targets whose window of vulnerability is extremely limited.

[17] Clark A. Murdock, "U.S. Air Force Bomber Modernization Plans: An Independent Assessment," CSIS, January 25, 2008, pp. 2, 12.

tion is surely whether the new bomber's signature in the X- and Ku-bands (8.2-12.4 gigahertz and 12.4-18.0 gigahertz, respectively) could be reduced enough to decrease substantially the ranges at which it could be acquired by the various target-tracking radars associated with SA-20 and SA-21 SAMs. Next, what could be done from a signature standpoint against associated surveillance and early warning radars operating at lower frequencies? Also, could emissions from the LRSS's own sensors be controlled enough to preclude passive detection and tracking? And what about enemy fighters during daytime operations? A LRSS with supersonic dash speed would further shrink the envelopes within which the 2018 bomber could be engaged by enemy SAMs or air-to-air missiles from opposing interceptors, but higher speeds might also increase the platform's infrared signature.

These various considerations and design tradeoffs lead to further questions. What tradeoffs between radar and infrared signatures could produce a design able to persist in defended airspace—especially if the goal is to do so even in the daytime? To date, the Air Force has only been willing to operate the B-2 at night. The same was true of the F-117 before its retirement. Beyond reducing visual signatures by making the new bomber as small as possible—and most likely designing it to operate at very high altitudes—what else will be needed for a LRSS to have the survivability to operate in defended airspace during daytime? Can a subsonic design be survivable enough or might supersonic dash or cruise speeds be needed?[18] Since the platform would undoubtedly include an active electronically scanned array (AESA) radar, would survivability be enhanced by adding an air-to-air missile capability for self-defense against enemy fighters? Moreover, smaller platforms sacrifice payload. What are the right trades between size and payload?

[18] As recently as February 2007, Lockheed Martin was still suggesting that a speed approaching Mach 2.5-3.0 was necessary to reduce the number of lethal SAM shots to an acceptable level, assuming the best radar signature achievable (Frank Cappuccio, "Long Range Strike Weapons," briefing at the Precision Strike Association's winter roundtable, February 1, 2007, slide 12). Cappuccio heads Lockheed Martin's famed "Skunk Works."

Obviously there are many questions that will have to be answered in the Air Force's program for a new LRSS by 2018. However, as long as the program remains entirely classified, it is not possible for outside observers to offer confident answers to these questions, especially on design tradeoffs.[19] For this reason, the remainder of this report will focus on the broader reasons for fielding a follow-on to the B-2 no later than the early 2020s.

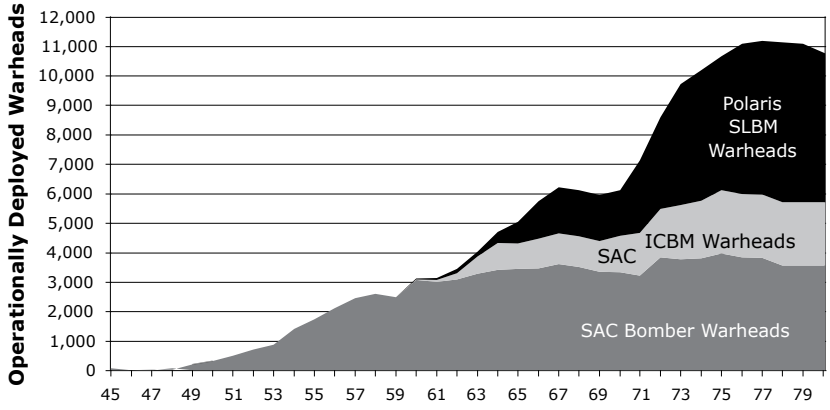
[19] For the latest press speculation on the Air Force's classified bomber program, see Bill Sweetman, "ULTRA STEALTH: Northrop Grumman Has a Secret: USAF's Next-Generation Bomber," *Defense Technology International*, June 2008, pp. 16, 18. Based on circumstantial evidence, Sweetman conjectures that Northrop Grumman has already won a classified contract to develop a prototype for the 2018 bomber based on the company's X-47C proposal for the Unmanned Combat Aircraft Demonstrator (UCAS-D) program.

Conventional and Nuclear Contexts

The first question that needs to be addressed in discussing a next-generation bomber is how to think about long-range strike in the international security environment of the early twenty-first century. What is the proper context for deciding what sort of system may be needed, why it is needed, and how urgently it is needed? This section seeks to outline a sensible context for thinking about a 2018 LRSS by reviewing how the US defense establishment has viewed bombers since the Second World War.

In March 1946, the US Army Air Forces re-designated the Continental Air Forces, which had been formed in 1944, as the Strategic Air Command (SAC) and gave the new organization the mission of strategic, long-range combat operations. In 1948 General Curtis E. LeMay assumed command of SAC and moved its headquarters from Andrews Air Force Base (AFB), Maryland, to Offutt AFB, Nebraska. By this time the USAF was an independent service and, under LeMay's command, SAC had begun the long process of evolving into an effective long-range atomic strike force. In these early days, atomic bombs were not only scarce but heavy and large.

Figure 1: US Operational Nuclear Warheads, 1945–1980[20]



President Harry Truman's decision to develop the hydrogen bomb in the aftermath of the Soviet Union's initial explosion of an atomic device in August 1949 set in motion advances that ushered in an era of nuclear plenty for both Cold War superpowers. Recognizing that all-out nuclear war would be an unprecedented catastrophe for both countries, in 1953 President Dwight Eisenhower's "New Look" chose to rely primarily on air power and SAC to provide the threat of a nuclear deterrent that could retaliate massively against the Soviet Union.[21] Subsequently, the first Atlas D intercontinental ballistic missiles (ICBMs) were deployed in 1959 and the first Polaris submarine launched ballistic missiles (SLBMs) the following year.

Nevertheless, SAC bombers provided the majority of America's operationally available nuclear warheads until the early 1970s (Figure 1). To reinforce former Air Force Secretary Mike Wynne's observation about the importance of range and payload, it is worth recalling that the B-36 was the Air Force's first intercontinental bomber, meaning that it was the first SAC aircraft capable of striking targets in the Soviet Union from North America. The B-36 was in SAC's inventory during the late 1940s and 1950s. Until the first B-52s began arriving in 1955, the B-36

[20] Natural Resources Defense Council (NRDC), accessed May 2008, online at <http://www.nrdc.org/nuclear/nudb/datainx.asp >. The data shown are from the force-loading tables, not those for nuclear stockpiles.

[21] Robert R. Bowie and Richard H. Immerman, *Waging Peace: How Eisenhower Shaped an Enduring Cold War Strategy* (Oxford: Oxford University Press, 1998), pp. 67, 97, 137, 179–180.

was also the only bomber capable of carrying the ten to fifteen megaton Mark-17 thermonuclear bomb. The Mark-17 was nearly twenty-five feet long, some five feet in diameter, and weighed 41,000 pounds.

Two other events regarding the development of US intercontinental nuclear forces during the Cold War warrant mention. First, even after the New Look became US strategy when Eisenhower approved National Security Council 162/2 ("Basic National Security Policy") in late 1953, the Joint Chiefs of Staff (JCS) continued to push for an interpretation of one particular paragraph that would give military commanders control over the release of nuclear weapons.[22] The chiefs' rationale was that if they could not count on being able to use nuclear weapons, then they would have to plan for a much larger conventional force structure. In January 1954, however, Eisenhower rejected the JCS push for release authority by approving a State Department memorandum that clarified the paragraph in question by stating that nuclear weapons would be used only by the decision of the president.[23] The chain of command from the president, through the secretary of defense, to unified and specified commanders was further clarified in the Defense Reorganization Act of 1958, which ended what Eisenhower called the "monstrosity" of uncoordinated forces.[24]

The other major development during the 1950s concerned who would control the targeting of US nuclear warheads. SAC, of course, had control over its bombers and, as time went on, its land-based ICBMs. But as the sea-based Polaris SLBMs began coming on line at the end of the 1950s, the Navy's natural inclination was to keep control over the targeting of these systems within the Navy. Not surprisingly, the SAC commander at the time, General Thomas S. Power, argued that Polaris should be assigned to Strategic Air Command. The disagreement was settled with the establishment of the Joint Strategic Target Planning Staff (JSTPS) in August 1960.[25] Augmented by Navy personnel,

[22] Ibid., p. 193.

[23] Ibid., pp. 194, 198. The Atomic Energy Act of 1946 had given the president, in his constitutional role as commander in chief of the US armed forces, "the ultimate say on nuclear weapons," and this statutory authority was reiterated in the 1954 Atomic Energy Act (David Alan Rosenberg, "The Origins of Overkill," *International Security*, Spring 1983, p. 9).

[24] Lieutenant Colonel Rita Clark, Dr. Vincent A. Giroux, Jr., and Dr. Todd White, *History of the United States Strategic Command* (Offutt AFB, NE: HQ USSTRATCOM/CSH, January 2004), p. 7.

[25] Clark, Giroux, and White, *History of the United States Strategic Command*, p. 10.

in December 1960 the JSTPS produced the first Single Integrated Operational Plan (SIOP), which went into effect on April 1, 1960. These arrangements concerning the release and targeting of the United States' strategic "triad" of bombers, land-based ICBMs, and sea-based SLBMs persisted until June 1, 1992, when SAC was inactivated and the JSTPS disestablished.[26] The US Strategic Command, headquartered at Offutt AFB, replaced SAC, but SAC's bombers and ICBMs were transferred to the Air Force's new Air Combat Command, which replaced the Tactical Air Command.

Because of this history, US heavy bombers were viewed, throughout the Cold War, first and foremost as nuclear delivery platforms. True, B-29s were employed with conventional bombs during the Korean War, and SAC's B-52s saw similar duty in Vietnam during 1965–1972, as well as in the 1991 Persian Gulf War. Nevertheless, as long as SAC existed, the bomber's primary role was nuclear deterrence, not conventional warfighting. In the early 1960s, for instance, SAC leaders strongly resisted committing either its B-52s or KC-135 tankers to Southeast Asia.[27] Similarly, in January 1992, when President George H. W. Bush announced his decision to cut the B-2 buy from 75 to 20 aircraft, his rationale was the greatly reduced need for strategic-nuclear forces due to the collapse of the Warsaw Pact and the Soviet Union.[28] Following this logic, the treaty on further reducing and limiting strategic-nuclear arms that Bush signed in 1993 with the Russian Federation included an article permitting both sides to reorient up to 100 heavy bombers, which had not been equipped with cruise missiles, to a conventional role. By October 1997, the B-1B had been withdrawn from the nuclear mission.

The break-up of the Soviet Union, therefore, began to change the nuclear-centric view of long-range bombers within the US defense establishment. NATO's 1999 air campaign against Serbia was a further step in this direction. While B-52Gs had flown from Louisiana to Iraq on the opening night of the 1991 Gulf War to deliver thirty-five Conventional Air Launched Cruise Missiles (CALCMs) —precision weapons that homed on Global Positioning System (GPS) coordinates—during the rest of the campaign the B-52s delivered unguided or "dumb" ordnance, just as

[26] Ibid., pp. 21–22.
[27] Michael Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership* 1945–1982 (Maxwell AFB, AL: Air University Press, March 1998), pp. 173–174.
[28] George H. W. Bush, "Third State of the Union Address to Congress," January 28, 1992.

they had done in Vietnam.[29] However, when the B-2s finally went to war in 1999, all of the 656 munitions they delivered were GPS-aided "smart" bombs that achieved accuracies less than ten meters.[30] Thus, Operation Allied Force (OAF) in 1999 not only underscored the growing association of US bombers with non-nuclear operations, but also signaled their shift toward employing guided bombs in lieu of dumb bombs.

Arguably, the conceptual transition of US heavy bombers from being viewed primarily as nuclear delivery systems to being seen more and more as conventional platforms armed with precision munitions culminated during the major operations phase of Operation Iraqi Freedom (OIF) in March–April 2003. Recall that due to teething problems, the B-1Bs did not see combat during Operation Desert Storm in 1991. Their initial combat sorties were flown in December 1998 during Operation Desert Fox, a series of strikes conducted over four nights against some one hundred targets aimed at degrading Iraq's programs for weapons of mass destruction (WMD) and other military capabilities. By this time the maintenance problems that had kept the B-1 out of the fight in 1991 had been mostly overcome by withdrawing twenty-one of the aircraft into "attrition reserve," and the conventional upgrade program for the rest of the fleet had been largely completed.[31]

The B-1B was next employed in OAF, again bombing targets with Mark-82 500-pound (lb) unguided munitions. Toward the end of NATO's air campaign against Serbia, though, the Air Force decided to take advantage of the aircraft's large payload and lengthy on-station time in order to deal more effectively with *time-sensitive targets* (TSTs). These are targets in which the paramount success criterion is being able to strike the enemy asset very quickly, either because of the immediate threat it poses to the friendly side, or because it is a high-value asset whose window of vulnerability to attack is extremely limited.[32] The operational concept that emerged at the end of OAF was to

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[29] For an account of this mission, see John Tirpak, "The Secret Squirrels," *AIR FORCE Magazine*, April 1994.

[30] 509th Bomb Wing, "Decade of Success," PowerPoint presentation on the B-2 in OAF, presented at an Air Force Association meeting, July 1, 1999, Slide 22. B-2s dropped 652 2,000-lb Joint Direct Attack Munitions (JDAMs) and four 5,000-lb GPS-Aided Munitions.

[31] David Noland, "The Bone Is Back," *Air & Space*, May 2008, p. 66.

[32] Robert P. Haffa, Jr., and Jasper Welch, "Command and Control Arrangements for the Attack of Time-Sensitive Targets," Northrop Grumman Analysis Center, November 2006, p. 5.

keep B-1s in the air as "roving linebackers" able to respond on demand to this class of targets.

In Afghanistan in late 2001, the B-1s were again employed in this new role, except they were now armed with Joint Direct Attack Munitions rather than dumb bombs. Arguably, this new role for the long-maligned B-1 achieved maturity during OIF in 2003.

> By the time of the initial 2003 air campaign against Iraq, the B-1 and its JDAMs had mastered precision-strike-on-demand. During the first month of the war, a tag-team of 11 B-1s was over Iraq virtually 24/7, hitting a wide variety of targets within minutes of getting the call.[33]

While the B-1's use in this precision-strike-on-demand role was especially valuable during the major-operations phase of OIF, its ability to loiter with a large, mixed load of 500-, 1,000- and 2,000-lb guided munitions has continued to be exploited on a less frequent basis in Iraq and Afghanistan even after both conflicts devolved into insurgent and sectarian fighting in urban areas. One caveat should be noted, however. From OAF to OIF, the B-1s have largely been operating in minimally defended—or undefended—airspace. But, as already mentioned, in the future adversaries will have every incentive to challenge US forces with TSTs in defended airspace. This likelihood, in turn, reinforces the urgency of the need to move ahead with the 2018 bomber.

The B-1's long journey from being primarily a nuclear strike system to being a conventional platform that has demonstrated its value even in ongoing American operations in Afghanistan and Iraq epitomizes how much American views of heavy bombers have changed since the 1950s. Granted, the remaining B-52Hs and the B-2As continue to have a residual nuclear mission; but neither aircraft is currently in a ground-alert status comparable to that SAC bombers began maintaining in 1952 to guard against a surprise nuclear attack by the Soviet Union. To the contrary, the evidence suggests that the Department of Defense (DoD) and the US government "as a whole are scarcely even interested in things nuclear."[34] In DoD's case, the decline of the nuclear mission

[33] Noland, "The Bone Is Back," p. 67.

[34] Clark A. Murdock, "The Department of Defense and the Nuclear Mission in the 21st Century," Center for Strategic and International Studies, 2008, pp. 24–25.

within the Air Force prompted Secretary of Defense Robert Gates to insist upon the resignations of the Air Force secretary and chief of staff. As Clark Murdock summarized the current situation in 2008, before the firings:

> The U.S. Army divested itself of nuclear forces entirely as a consequence of the U.S. decision in 1991 to unilaterally reduce tactical (that is, short-range) nuclear weapons. In January 1997, then chief of staff of the Air Force Ronald R. Fogelman created an office (AF/XON) headed by a two-star general in order to create a single button on the Air Staff for nuclear issues. Today, that office no longer exists and the highest-ranking Air Force officer in the Pentagon with responsibility for nothing but nuclear matters is a colonel. The Navy still has a two-star in charge of its nuclear programs, but that is largely driven by the Navy's nuclear-powered submarine program, not the nuclear mission. Members of the nuclear community within both services privately express the belief that both services would readily divest themselves of the nuclear mission in a heartbeat if they could do so without losing force structure. The Air Force's recent Bent Spear incident—in which six nuclear-armed cruise missiles were left unattended for 36 hours while being flown from one air base to another55—raises the disturbing issue of how much the nuclear mission's decline has eroded the "nuclear competence" of the military services.[35]

This ongoing neglect of nuclear forces and capabilities raises a fundamental question about the USAF's 2018 bomber. Should it follow the B-1B's post-Cold War trajectory and be conventional-only, or should the airframe be built with at least the potential to assume a nuclear mission should that become necessary? Unfortunately, no widespread consensus on this question is likely. In 2006, John Foster and Larry Welch co-chaired a Defense Science Board task force on US nuclear capabilities. Their foremost conclusion is worth quoting in full:

[35] Murdock, "The Department of Defense and the Nuclear Mission in the 21st Century," p. 26.

For the fifty years of the Cold War, there was a viable national consensus on the need for nuclear weapons and the role these weapons played in the security of the United States and its allies. Fifteen years after the end of the Cold War, this consensus no longer exists. Most American agree that as long as actual or potential adversaries possess or actively seek nuclear weapons (or other weapons of mass destruction), the United States must maintain a deterrent to counter possible threats and support the nation's role as a global power and security partner. Beyond that, there are sharp differences on the role and complexion of how the U.S. nuclear deterrent should shape the national security environment. On the one hand, there is an entrenched set of views held by an influential segment of the U.S. population that transforming the stockpile is the wrong way to shape the security environment and counter nuclear proliferation pressures. On the other hand, there are alternative views that this Task Force believed need to be much more widely understood in order to transform the nuclear enterprise to one effective in meeting the security threats we face today.

The result of this lack of consensus is an entrenchment of longstanding and strongly held views, with little genuine debated aimed at forging a new consensus. A new consensus would enable sensible and supportable choices on future nuclear capabilities and doctrine needed to move forward in providing the right nuclear weapons and nuclear enterprise for the 21st century. To begin to remedy this situation, senior leaders need to do more than reaffirm the need for a modern, safe, and reliable nuclear deterrent. They need to engage more directly to articulate the persuasive case for nuclear transformation...[36]

[36] Dr. John Foster and General (ret.) Larry Welch (co-chairs), *Report of the Defense Science Board Task Force on Nuclear Capabilities: Report Summary* (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, December 2006), p. 2.

The context in which the US defense establishment thinks about long-range bombers has changed dramatically since the end of the Cold War. The basic trend has been to see bombers increasingly as systems for conventional operations only. Not only is the role of nuclear forces an area of increasing neglect, but there is no longer any consensus on the place of bombers in nuclear deterrence despite growing evidence that weapons of mass destruction (WMD) may proliferate markedly in coming decades. If indeed they do, the chances will grow over time that the post-Nagasaki taboo against nuclear use will eventually be broken. This prospect poses a fundamental challenge for thinking about the USAF's next bomber.

The next two sections explore the requirements that should shape the design of the next generation of bombers, starting with the platform's use in non-nuclear or conventional operations. Given America's growing neglect of nuclear capabilities and lack of agreement on their role in US security, it may be tempting to make the next-generation bomber a conventional-only system. This temptation, however, should probably be resisted. Hardening against electromagnetic pulses as well as against non-nuclear high-powered-microwave weapons is best undertaken during design and production, not after the fact. To this extent at least, it may not be wise to think about the 2018 LRSS exclusively in terms of delivering guided munitions in non-nuclear strike operations.

Generic LRSS Scenarios for Conventional Operations

Compared to the nuclear issues raised in the previous section, the conventional warfighting requirements that a new LRSS ought to address appear relatively straightforward and less controversial. Again, specificity about the detailed design tradeoffs and technical feasibility underlying such key capabilities as daytime survivability in defended airspace are beyond the scope of this report. It is possible, however, to outline the broad kinds of capabilities one would want the platform to have—hopefully at an affordable cost and without the many schedule slips that accompanied the development of both the B-2 and F-22. The approach in this section, therefore, is to explore a series of what might be termed "generic scenarios."

1. Sufficient Reach for Targets Deep in Defended Airspace

The most obvious situations demanding long range are those in which the targets themselves are located in defended airspace at distances from the last possible air-refueling point outside the reach of enemy air defenses that exceeds 1,000 nautical miles (nm).[37] No current or planned US tactical fighter or fighter-bomber offers an unrefueled combat radius greater 1,000 nm in a combat configuration on a realistic mission profile. Comparison of the combat radii for the F-22 and B-2 give an idea of why tactical fighters are judged to be short-range aircraft compared to heavy bombers. Without external fuel tanks or air refueling, the F-22 has a combat radius of around 620 nm on a subsonic

[37] While the possibility of a stealthy tanker has been raised now and again, there are no signs that the United States may actually field one within the next several decades.

mission profile; with only 50 nm of supercruise at Mach 1.5 inbound to and outbound from the target area, its combat radius drops to less than 500 nm.[38] By comparison, a reasonable estimate for the B-2A is an unrefueled combat radius in the vicinity of 2,170 nm on a high-low-high profile with sixteen 750-lb nuclear weapons (B-61s).[39]

In recent years, the People's Republic of China (PRC) has been used as an exemple of a country whose sheer size could present US forces with targets requiring unrefueled combat radii several times greater than those available from tactical fighters. For instance, the original PRC spaceport at Jiuquan is located in north-central China on the southern edge of the Gobi Desert. The great circle distance from Kadena AFB on the island of Okinawa to Jiuquan is over 1,600 nm, of which no more than the first 200–300 nm would be outside the reach of advanced surface-to-air missiles and Chinese interceptors. Making allowances for routing to avoid the greatest concentrations of air defenses, an unrefueled combat radius around 1,500–1,600 nm would probably be required to reach this target from Kadena, even if the aircraft refueled at altitude outside defended airspace.

Why might assets located this deep in a country such as China be potential targets in the event of a future conflict? In the case of the PRC, military theorists and planners in the People's Liberation Army (PLA) have made it clear in their writings that they understand how

[38] "Fighter-Bomber Derivative," PowerPoint slide comparing the F-22 and FB-22, prepared for the Air Force secretary, April 2002; Lockheed Martin provided the performance data on the slide. James G. Roche, then secretary of the Air Force, used a "something like 600 miles" figure for the (then redesignated) F/A-22's combat radius during an interview with WTOP Radio's Bruce Allen on February 19, 2003. The reason for documenting the F-22 combat radii cited above is that sources such as *AIR FORCE Magazine* have muddied this issue by citing a range of "more than 2,000 miles" for the aircraft (Susan H. H. Young, "Gallery of USAF Weapons," *AIR FORCE Magazine*, May 2007, p. 139). This figure, however, is a ferry range in which the aircraft is configured with external fuel tanks (OSD/PA&E, "F-22 and JSF Aircraft: Selected Characteristics (IDA Data Base)," Slide 6 "Mission Radius/Range", June 12, 2002). It is not wrong, but it is certainly misleading and somewhat exaggerated. As of April 2008, the USAF's fact sheet on the F-22 listed the plane's ferry range with two external drop tanks as "more than" 1,600 nm (online at <http://www.af.mil/factsheets/factsheet.asp?fsID=199>).

[39] Young, "Gallery of USAF Weapons," *AIR FORCE Magazine*, May 2007, p. 135. Guidance kits such as those used by JDAMs have never been added to nuclear bombs. However, this minor modification would enable a B-2 to employ them with precision accuracy from high altitude, thereby enabling the bomber to fly a high-high-high profile, which would give it a greater combat radius.

dependent the US military is on information from space.[40] In recent years the PLA has been exploring a wide range of options for exploiting this vulnerability. The most unambiguous evidence of this came in January 2007, when a Chinese medium-range ballistic missile, fired from a mobile transporter-erector-launcher (TEL), lifted off from the Xichang space facility in southern China and orbited a kinetic-kill vehicle that smashed head-on into an aging *Fengyun-1* weather satellite.[41] The impact destroyed the satellite and generated the worst debris field ever seen in low earth orbit. Spaceports such as Jiuquan and Xichang are, of course, fixed facilities. However, this demonstration raised the possibility that US forces might, in the event of a military encounter with China, find it necessary to hunt down PRC TELs located deep in the country's interior. After all, China's successful January 2007 antisatellite (ASAT) demonstration was not an isolated event. It had been preceded by three attempts between September 2004 and February 2006, all of which failed.[42]

Nor are spaceports and TELs for launching direct-ascent ASATs the only targets that might require long-range, highly survivable strike platforms in a US-PRC conflict. In 2006 it emerged that the Chinese had been firing high-powered lasers at US low-altitude reconnaissance satellites to see if they could be blinded when over PRC territory.[43] While the power needed to blind or interfere with electro-optical (or even radar) reconnaissance satellites is several orders of magnitude less than would be required to disable them, it is not difficult to envision future conflicts in which ground-based laser facilities deep inside the territory of a hostile power could become high-priority targets for US forces. In that case, long-range strike systems would certainly be required. China is simply the most obvious candidate in future decades for a military adversary with geographic depth. There are other countries, notably Russia, with

[40] Larrry M. Wortzel, "The Chinese People's Liberation Army and Space Warfare," American Enterprise Institute, 2007, p. 2 (online at <http://www.aei.org/doclib/20071017_spacewarfare.pd>); Ashley J. Tellis, "Punching the U.S. Military's 'Soft Ribs'; China's Antisatellite Weapon Test in Strategic Perspective, Carnegie Endowment for International Peace, Policy Brief 51, May 2007, pp. 2–4 (online at <http://www.carnegieendowment.org/publications/index.cfm?fa=view&id=19317&prog=zgp&proj=zsa>).

[41] Ashley J. Tellis, "China's Military Space Strategy," *Survival*, Autumn 2007, p. 41.

[42] Tellis, "China's Military Space Strategy," p. 43.

[43] Vago Muradian, "China Attempted To Blind U.S. Satellites with Laser," *Defense News*, September 28, 2006. As of June 2008, this article could still be found online at <http://www.infowars.com/articles/science/china_attempt_blind_us_satellites_with_lasers.htm>.

comparable geographic depth. Presumably any prospective competitor with the option to protect critical facilities by locating them in defended airspace beyond the reach of American tactical aircraft and other short-range systems will be inclined—indeed, highly motivated—to do so.

2. Sudden Demands and the Uncertainties of In-Theater Basing

The main argument underlying this second class of long-range-strike scenarios arises from differences between the rather staid security challenges that the risk-adverse leaders of the Soviet Union posed for the United States during the Cold War, and the more volatile security environment of the early twenty-first century. As Jasper Welch presciently observed after Operation Allied Force in 1999, the greater uncertainty as to whom (or where) the United States may fight next raises two interrelated problems. First of all, the need to strike specific targets "is likely to arise so unexpectedly, so ambiguously and with such uncertain political support that the long, steady build-up" of US forces in-theater may not be possible. Secondly, there are many actions that aggressors can take to interfere with such a build-up.[44] In the Cold War case of the Warsaw Pact's threat to Western Europe, the US military maintained forward-based forces in countries such as West Germany for decades, thereby assuring in-theater basing. The United States did the same in South Korea. The need to strike quickly from bases in the continental United States was minimal as long as any crisis or confrontation did not escalate to all-out nuclear war.

Today the United States' situation is quite different. The US force posture is increasingly expeditionary rather than forward-deployed for major combat operations. For example, prior to al Qaeda's attacks on the World Trade Center and the Pentagon on the morning of September 11, 2001 (9/11), who in the US government took seriously the possibility of conducting operations in land-locked Afghanistan? The requirement to strike targets there was a major surprise, even though, as things worked out, the United States did have a number of weeks to redeploy forces and gain some theater access before kicking off Operation Enduring Freedom. But consider the possibility of Pakistan's abrupt collapse

[44] Major General (USAF, ret.) Jasper Welch, "Why Kosovo Changes the Bomber Force Issue," unpublished, November 1999.

with the loss of government control over the country's nuclear arsenal.[45] The resulting "loose nukes" scenario could arise virtually overnight. In response, even if US leaders chose to utilize special-operations forces to secure some of the weapons, others might have to be struck from distant bases in a matter of hours. In that case, there would be little or no time for forward-deploying strike assets or negotiating in-theater bases with countries inclined to support American intervention. Time, presumably, would be at a premium, and the chances of arranging access to overseas bases not already being utilized by US forces would be minimal. One would hope that any loose weapons that had to be neutralized from the air, rather than secured on the ground, could be handled with conventional munitions or, preferably, with non-kinetic means. But regardless of the tactical and "weaponeering" details, the potential urgency of an effective response is clear.

Does the prospect of an abrupt need to strike some targets at intercontinental distances from the continental United States (CONUS) argue for a hypersonic cruise vehicle? Some have certainly thought so. In 2003, the Defense Advanced Research Projects Agency (DARPA), in conjunction with the Air Force, issued a broad area announcement for Phase I of what was labeled the Force Application and Launch from CONUS (FALCON) program. Among FALCON's objectives was developing a hypersonic cruise vehicle (HCV) that could be fielded around 2025. The mission of the HCV was to be able to deliver a 12,000-lb payload on a target 9,000 nm from CONUS in two hours or less.[46]

Some technical progress toward this goal has been made. By 2004 the National Air and Space Administration (NASA) had achieved Mach 9.6 at 110,000 feet with its X-43A test vehicle as part of an effort to explore alternatives to rockets for access to space.[47] The X-43, however, was carried to 40,000 feet by a B-52. The B-52 then released the Pegasus rocket to which the X-43 was attached, and the Pegasus boosted the X-43 to 100,000 feet and Mach 4 before releasing it for a brief hypersonic flight. The FALCON HCV, by contrast, is supposed to be able to operate in an "aircraft-like" manner—meaning that it needs to be able to take off on its own and accelerate to a Mach number high enough for its

[45] Estimates of Pakistan's nuclear arsenal vary from as few as 30–50 weapons to as many as 95–100.

[46] DARPA, "FALCON Force Application and Launch from CONUS: Broad Area Announcement (BAA): Phase I," July 29, 2003, p. 6.

[47] NASA, "NASA's X-43A Scramjet Breaks Speed Record," news release 04-59, November 16, 2004, online at <http://www.nasa.gov/missions/research/x43_schedule.html>.

scramjet to operate. The FALCON HCV is also supposed to provide the aircraft-like recovery and reusability of traditional aircraft. An operational HCV, therefore, would need two separate propulsion systems. In late 2007, successful ground testing of a Pratt & Whitney Rocketdyne hydrocarbon-fueled scramjet engine took place at NASA's Langley Test Center.[48] This test was part of a collaborative effort between DARPA, NASA, the Air Force, and Boeing to begin flight tests of the X-51A hypersonic vehicle in 2009. But even achieving a viable scramjet engine, much less integrating hypersonic propulsion into a vehicle that can be operated in an aircraft-like manner, appears to be a distant goal.

As for FALCON's 9,000 nm range requirement, the program's Common Aero Vehicle (CAV)—a maneuverable suborbital vehicle for re-entering the atmosphere and dispersing payloads—could be used to cover part of the distance. Moreover, the FALCON program addresses military uses other than long-range strike. It also aims to develop a space launch vehicle that would provide rapid, on-demand access to space, and funding for this program remains strong.[49] Still, fielding a hypersonic bomber that could strike a target 9,000 nm away in two hours or less appears, at best, to be a distant, technologically challenging goal unlikely to be met within the next fifteen years.

A further question is whether a Mach 4.5-6.5 bomber really makes sense militarily. As suggested in the introduction, the crux of this issue hinges on the answers to two questions. First, how prompt need a response to a sudden demand for strikes at intercontinental distances from CONUS bases be? Second, how large is the plausible target set requiring these prompt strikes? FALCON's stated goal is to have ordnance on targets in two hours or less. But existing ballistic missiles equipped with CAV re-entry vehicles could achieve the same goal in thirty minutes, roughly one-fourth that time. So if "prompt" means as quickly as possible, then a faster response can be achieved with existing ballistic missile technologies without the expensive and risky development of hypersonic cruise vehicles. In addition, the number of targets that would absolutely need to be struck in thirty minutes or even two hours, as opposed to within eight to sixteen hours, is likely to be very small. Fixed targets need not be hit so quickly—unless, of

[48] "Boeing, "Successful Design Review and Engine Test Bring Boeing X-51A Closer to Flight," June 1, 2007, on line at <http://www.boeing.com/news/releases/2007/q2/070601a_nr.html>.

[49] Walter Pincus, "Space Program Gets Extra Funding," *The Washington Post*, November 12, p. A19.

course, they are the source of offensive actions by the adversary. But even in that case, the number of targets is likely to be small because the opponent can usually launch those attacks within a couple hours. Similarly, mobile targets can be expected to relocate or move to a hide well inside of thirty minutes, let alone within two hours. If anything, these observations raise the need to be able to strike mobile or "relocatable" targets within minutes of their detection, which goes to the heart of the TST scenario discussed next. Thus, while a HCV able to operate like an aircraft may be desirable for other purposes, such as more responsive access to low-Earth orbit, there does not appear to be a persuasive justification for a hypersonic bomber unless it has some dwell or persistence in the immediate vicinity of fleeting or time-sensitive targets.

3. Persistence and Proximity for Time-Sensitive Targets

As mentioned, the Air Force began explicitly addressing the growing TST problem in 1999 toward the end of OAF. Again, time-sensitive targets are those that need to be struck quickly, either to eliminate the immediate threat they pose to the friendly side, or because they are high-value assets that are only briefly vulnerable to friendly attack. There are two other insights that should be kept in mind regarding this characterization. First, as Jasper Welch has long argued, militarily relevant targets do not really exist outside political and military interactions between opposing sides, which include the inevitable tensions between each side's objectives. In this sense, targets are "evoked" by interaction between the two sides, which means that many TSTs may be less predictable than the industrial targets that figured so prominently in the Combined Bomber Offensive against Germany in 1943–1945.[50] Second, it is usually preferable to think in terms of target *systems* rather than individual targets. Among other reasons, individual targets tend to concentrate on physical effects at the lowest tactical level, whereas target systems such as an adversary's integrated air defense system draw attention to operational- or higher-level effects.

While the Air Force's emphasis on TSTs as an explicit and growing operational challenge only dates back to 1999, the basic problem has a

[50] Barry D. Watts, "Where Targets Come From," notes from a telephone conversation with Jasper Welch, October 10, 1996.

considerably longer history. The most prominent time-sensitive targets during the 1991 Persian Gulf War were Iraqi mobile missile launchers, which fired some eighty-eight extended-range "Scud" ballistic missiles against cities and ports in Israel, Saudi Arabia and Bahrain. Of these eighty-eight missiles, forty-two came down in Israel and forty-three in Saudi Arabia. In hindsight, the aim of these attacks appears to have been to fracture the US-led coalition. At the outset of Operation Desert Storm, when many still feared that the Iraqi missiles might contain chemical warheads, the overriding concern of US leaders was that Iraq's missile attacks might draw Israeli forces into the fighting, which would certainly have put Arab participation in the military campaign in jeopardy. So while the Iraqi missiles, which were inaccurate and armed with high-explosive warheads, proved to be militarily insignificant, their political potential to wreck the coalition President Bush had put together after Saddam Hussein invaded Kuwait in August 1990 was substantial.

Among other things, the launches during the first few days of Desert Storm precipitated what came to be known as "The Great Scud Hunt." Because of the immediate threat these missiles posed to the coalition, there was a strong desire to destroy them before they could be launched. In addition, because the TELs spent most of the time in hides, only exposing themselves long enough to drive to pre-surveyed launch sites, set up, and fire, their vulnerability to air attack was fleeting. Not only did the Iraqis dispense with most of the telltale pre-launch procedures Soviet Scud units had long displayed in Eastern Europe, they were able to begin driving away from launch positions within minutes after firing. To give an idea of just how elusive these TELs were, US fighters on Scud patrol visually observed forty-two night launches, but in only eight of these instances were they able to prosecute actual attacks against the fleeing launchers.[51] Although strike sorties aimed at the Iraqi missile launchers and their infrastructure did reduce the weekly average of firings by the second week of the air campaign, Gulf War Air Survey researchers were subsequently unable to find hard evidence to confirm that a single TEL had been destroyed by attacks from fixed-wing coalition aircraft.[52] This finding was especially unsettling in light of the fact that fixed-wing aircrews claimed to have destroyed around one hundred TELs (and special operations forces claimed another six to eight), even

[51] Barry D. Watts and Thomas A. Keaney, *Effects and Effectiveness*, in Gulf War Air Power Survey, Vol. II, *Operations and Effects and Effectiveness* (Washington, DC: US Government Printing Office, 1993), Part II, pp. 335–336.
[52] Ibid., pp. 337–340.

though the total Iraqi inventory at the beginning of the campaign was probably less than thirty.[53]

Given this sort of experience, intelligent adversaries have every incentive to try to erode US capabilities for precision attack by making more and more of their critical or valued assets time-sensitive targets. Granted, the sensor capabilities of US aircraft to acquire TEL-size targets on the move have improved dramatically since Desert Storm. Today's AESA radars are far better at this target-acquisition task than were the sensors on the most capable fighter-bomber flown by coalition air forces in 1991, the F-15E. Nevertheless, limited mobility, reduced periods of vulnerability to attack, decoys, the ability to relocate, and outright mobility all offer effective ways of avoiding being found, fixed, tracked, and destroyed. TSTs, then, will increasingly be the targets of the future for the US military. To give an indication of the degree to which TSTs have proliferated, during OEF some 80 percent of the targets struck by US aircraft were "flex targets," meaning that the aircrews did not receive their targets until they were airborne on the way to their target areas.[54]

What these observations suggest is that fielding a 2018 LRSS that lacks the survivability, persistence, on-board sensors, and network connectivity to receive off-board targeting information to address TSTs makes little sense. It would be shortsighted and foolish to constrain the next long-range strike system to fixed targets only. In fact, doing so would fundamentally undermine the case for any new LRSS. After all, the primary reason Air Force leaders gave in 2002–2003 for deferring a next-generation bomber until 2037 was that existing bombers like the B-2 were very good at attacking fixed-point targets but "not so good" at

[53] Kill-claim inflation of this magnitude by aircrews has a long history that goes all the way back to World War I. During World War II, for example, B-17 and B-24 bomber crews, in the heat of air combat, exaggerated the numbers of German fighters they shot down by a factor of four. So the exaggeration of "Scud" kills in 1991 was hardly unprecedented, or even unusual. In the latter case, however, it is worth recalling that prior to Desert Storm, F-111F, LANTIRN-equipped F-16, and F-15E crews spent two nights trying to find a Soviet MAZ-543 TEL with their on-board sensors. Although the crews were given the precise coordinates of the MAZ-543 prior to takeoff, and the TEL did not try to flee, the crews found the vehicle "virtually impossible to find" when the missile was not erected (Watts and Keaney, *Effects and Effectiveness*, p. 335).

[54] Rebecca Grant, "Air War Like No Other," *AIR FORCE Magazine*, November 2002, p. 30.

dealing with relocatable or mobile ones.[55] The current bomber force, according to this view, gave the Air Force all it needed for "fixed-point targets," by which Air Force leaders meant things like buildings or abutments that do not move.[56]

At best, this was a rather ahistorical argument. In 1999 it was General John Jumper himself, then commander of US Air Forces in Europe, who had insisted that the B-2s alter their fixed-target focus and shift toward what he termed "flex targeting" in order to deal with mobile targets such as Serbian SA-3 SAMs. Indeed, General Jumper visited Whiteman AFB during the 78-day conflict to discuss flex targeting with the 509th Bomb Wing. The result of this four-star intervention was that the B-2s achieved some success toward the end of the campaign against some relocatable targets that had eluded other strike assets.[57] Moreover, as already discussed, the B-1s also began getting involved in TSTs during Operation Allied Force. In both instances, the ability to retarget JDAMs in the air was crucial to the ability of bombers to deal with relocatable and time-sensitive targets. Thus, the argument made by USAF leaders in 2002–2003 that the existing bomber force could only address fixed targets appears to fly in the face of the Air Force's own combat experience starting in 1999.

The final point to be made about time-sensitive targets is that the capability to persist near enough to them to be able to prosecute lethal attacks within minutes appears to be more than just a "nice to have" requirement for the next LRSS. When Air Force leaders endeavored in 2002–2003 to identify the TST mission with the F-22, proximity to these targets was portrayed as essential to being able to strike them quickly. Given the incentives of intelligent adversaries to present US forces with more and more TSTs, the next LRSS needs the survivability and persistence, even in defended airspace, to be able to address them.

Yes, there are those who doubt that this capability can be achieved at an affordable cost. The logical response to such doubts, however, is that

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[55] James W. Canan, "Conversations with James G. Roche," *Aerospace America*, February 2002, online at <http://www.aiaa.org/aerospace/Article.cfm?issuetocid=172&ArchiveIssueID=23>; also, Peter Grier, "The Strength of the Force," *AIR FORCE Magazine*, April 2002, p. 24.

[56] Transcript of Bruce Allen, interview with Secretary of the Air Force James G. Roche and General John P. Jumper, WTOP radio, February 19, 2003, 10:05 AM.

[57] Rebecca Grant, *The B-2 Goes to War* (Arlington, VA: IRIS Press, 2001), pp. 78–82.

investing the tens of billions that will be required to field a new LRSS while failing to provide this critical capability would seem to be a waste of taxpayers' money in the long run.

4. Anti-Access/Area-Denial Challenges

A fourth conventional scenario relevant to the next LRSS focuses on emerging anti-access/area-denial (AA/AD) capabilities designed to create "keep-out" zones in which US forces would find it difficult to operate, much less have reliable base access. Concern about this growing challenge dates at least back to the 1997 National Defense Panel (NDP).[58] Since the NDP surfaced this problem, it has become evident that PLA planners have recognized "the primacy of precision strike in modern warfare" as well as the considerable advantages the US military has gained from its early lead in this area.[59] In light of this perception, one of the PLA's long-term goals has become fielding AA/AD capabilities sufficient to hold at risk US airbases, ports, surface combatants (including aircraft carriers), air defense systems, and command-and-control facilities in the western Pacific, extending from the PRC's coastline out as far as the so-called second island chain running from southern Japan through the Mariana Islands, including Guam, to western New Guinea. Toward this end, China's "Second Artillery Corps" has deployed around one thousand CSS-6 and CSS-7 short-range ballistic missiles (SRBMs) opposite Taiwan, and the PLA is acquiring a variety of medium-range ballistic, land-attack cruise, and anti-ship cruise missiles, including the modern Russian-made SS-N-22 (code-named SUNBURN) and SS-N-27B (SIZZLER).[60] The growing sense within the US military is that these systems have rendered sustained US operations from forward bases such as Kadena AFB highly questionable in the event of scenarios such as a Chinese decision to take Taiwan by force.[61] US aircraft carriers

[58] National Defense Panel, *Transforming Defense: National Security in the 21st Century* (Arlington, VA: December 1997), pp. 12–13, 21.

[59] Office of the Secretary of Defense (OSD), *Annual Report to Congress: Military Power of the People's Republic of China* (Washington, DC: DoD, 2007), p. 16.

[60] Ibid.s, p. 17.

[61] For a good analysis of the vulnerability of forward bases like Kadena AFB, see John Stillion and David T. Orlesky, *Airbase Vulnerability to Conventional*

operating close to Taiwan also now appear to be at risk. The US Navy's fear that technological advances would eventually undermine the survivability of large surface combatants on the open seas—a concern that dates back to 1943 when German guided bombs sunk the Italian battleship *Roma*—may well finally be at hand.

It does not take deep thought or extensive analysis to recognize that long-range strike systems are a natural response to anti-access/area-denial capabilities. By and large, AA/AD capabilities have been associated most closely over the last decade with Chinese military modernization. In the long run, however, there are other militaries that undoubtedly aspire to acquire similar capabilities, even if on a less ambitious geographic scale. The Iranians, for example, certainly aspire to acquire the ability to exercise air and sea control over the eastern end of the Persian Gulf. As various guided-missile and advanced SAM capabilities proliferate, this goal will be increasingly attainable even within the resources of countries such as the Iranian republic. So the AA/AD challenge is by no means limited to China.

5. Matching Munitions to Targets

Jasper Welch began writing about the need to improve the fit between warheads and targets as early as 1996. At the time there was still considerable skepticism about his projection, based on success with LGBs during Desert Storm, that the Air Force would move over time to mostly precision air campaigns. In 2001–2002, however, over half the munitions dropped were guided, and during the major-operations phase of OIF the guided share grew to almost 65 percent.[62] Moreover, in the United States the trend toward guided munitions is no longer dominated by air and naval forces. With the fielding of Guided MRLS (Mobile Rocket

Cruise-Missile and Ballistic-Missile Attacks (Santa Monica, CA: RAND, 1999), especially pp. 5–28. More recent work by RAND's Project Air Force indicates that Anderson AFB on Guam may eventually become untenable as well unless considerable investments are made in hardening the facilities there and providing active defenses.

[62] In 1991, less than 8 percent of the munitions delivered during the air campaign were guided. In March–April 2003, nearly 65 percent of the munitions employed were guided. For details, see Barry D. Watts, *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects* (Washington, DC: Center for Strategic and Budgetary Assessments, March 2007), pp. 19–21, 176–178.

Launcher System) in 2005, even the US Army's artillery community has started moving toward increasing reliance on guided munitions.

Jasper Welch's basic point in 1996 about warhead-target fit was that targets such as hardened aircraft shelters and groups of armored fighting vehicles have generally required a lot more ordnance to be dropped than was really necessary.[63] For example, each Sensor Fuzed Weapon is designed to dispense forty Skeet submunitions over a group of vehicles. Each Skeet, in turn, uses an infrared sensor to aim a self-forging projectile at a heat source within its field of view. However, even if area surveillance assets have acquired precise GPS coordinates on each of the targeted vehicles, there is no way to communicate this information to the individual Skeets, and the submunitions themselves do not communicate their target choices to each other or back to the attacking aircraft. Hence, some targets are killed more than once and others missed. Because vehicles and hardened facilities tend to comprise a large fraction of the individual targets attacked in air campaigns, Welch's projection in 1996 was that as much as an order-of-magnitude reduction in the amount of ordnance dropped could be achieved by exploiting sensor and communications technologies to better match weapons to targets.

The inherent value of long-range strike systems in this regard is, of course, that they offer a large payload capacity on each sortie. As a result, bombers like the B-1B have been increasingly employed with a mix of munitions, thus enabling the aircraft to achieve a better target-weapon fit against unplanned or pop-up targets encountered during the course of the mission. Even in kinds of stability operations that have increasingly occupied US forces in Iraq and Afghanistan since the spring of 2003, the capability to tailor the munition to the target has value in minimizing collateral damage. If the target in an urban area can be taken out with a 500- or 250-lb munition, the smaller weapon is preferable to a 2,000-lb one in terms of collateral damage and civilian casualties. Both should be minimized.

Beyond the greater payload of long-range platforms, there is also the fact that range can be converted into loiter or persistence. The "roving linebacker" use of the B-1 illustrates this tradeoff. Both in terms of mixed payloads to better match weapons to targets and persistence,

[63] Major General (USAF, ret.) Jasper Welch, "Prospects for Improvements in Lethality-to-Weight for Air-to-Ground Ordnance," unpublished, August 19, 1996, pp. 4–6.

bombers have inherent advantages over short-range fighters. The design implication that arises from these conclusions for the next LRSS is that its payload should be large enough to accommodate a range of weapons, including hard-target penetrators of at least the 5,000-lb class. The internal payload capacity of the platform, therefore, should probably be somewhere in the range of 10,000–20,000 lbs. Given the increasing miniaturization of munitions, bomber payloads of 40,000 lbs or more are probably no longer necessary. At the same time, smaller payloads mean a smaller platform, and smaller platforms, in turn, contribute to low observability. Better matching munitions to targets together with the need for weapons large enough to attack hardened or deeply buried targets suggest, however, that a LRSS payload below 10,000 lbs is too small.

6. "24/7" Fire Support

One of the most depressing periods for the Iraqi military in 2003 started when a *shamal* (sandstorm) blew in from the west, plunging Iraq into a gritty brownout from March 24 to 26.[64] Saddam Hussein and his chief lieutenants calculated that the weather would incapacitate American air power, much as it had done in 1991, thereby allowing them to move forces forward to engage coalition troops without fear of air attack. This time, though, Joint Surveillance and Target Attack Radar System (JSTARS) E-8Cs and Unmanned Air Vehicles (UAVs) pushed deep enough into Iraq's airspace to be able track these movements and began passing target coordinates to orbiting B-1s and fighters.[65] The result was that after the storm had abated and coalition ground forces had resumed their advance through the Kabala Gap and along the Tigris River toward Baghdad, they found their routes littered with the burning hulks of Republican Guard vehicles.[66]

The capacity of airborne surveillance systems, all-weather precision munitions, and fixed-wing strike aircraft orbiting overhead to provide 24/7 fire support force to US ground forces has improved con-

[64] Williamson Murray and Major General Robert H. Scales, Jr., *The Iraq War: A Military History* (Cambridge, MA, and London: Belknap Press of Harvard University Press, 2003), p. 110.
[65] Murray and Scales, *The Iraq War*, p. 171.
[66] Ibid., p. 172; Rebecca Grant, "Hand In Glove," *AIR FORCE Magazine*, July 2003, p. 34.

siderably in recent conflicts. So much so, in fact, that David Johnson has argued that the fundamental relationship between air and ground power has changed. US Army deep attack systems—especially Apache helicopters and the Army Tactical Missile System—were intended to provide capabilities for deep battle comparable to those provided by fixed-wing aircraft with guided munitions. But in actual combat experience, these Army deep-battle systems "have not shown themselves to be as effective as fixed-wing aircraft;" instead, the operational level of warfighting against large, conventional enemy forces has been increasingly "dominated by flexible, all-weather, precision strike air power, enabled by ISR [intelligence, surveillance, and reconnaissance]."[67] Whether one agrees with Johnson or not, the kind of 24/7 fire support American ground forces have received from fixed-wing aircraft is most easily provided by bombers due to their large payloads and long on-station times. Thus, needing 24/7 fire support of ground forces is another conventional scenario in which bombers not only have value, but seemingly increasing value.

To what extent does the need for 24/7 support of ground forces provide additional support for moving rapidly ahead with a new LRSS? Compared to the other generic scenarios discussed so far, this one is not as compelling. So long as US bombers are able to operate in undefended airspace, as has generally been the case in Afghanistan and Iraq, existing B-1s and B-52s are quite capable of providing this support. Here, the most that can be offered in the way of justifying a new LRSS is that, in the unlikely event that American ground forces have to operate—even if only for a day or two—under skies still contested by enemy SAMs and interceptor, then a LRSS able to survive in the presence of these defenses could have critical value, even if only temporarily. Perhaps a loose-nukes scenario might be one such possibility if special operations forces have also been inserted to secure some of the nuclear weapons. This scenario, however, seems a fairly weak reed on which to try to justify a new LRSS.

[67] David E. Johnson, *Learning Large Lessons: The Evolving Roles of Ground Power and Air Power in the Post-Cold War Era* (Santa Monica, CA: RAND, 2007), pp. xi–xii, 140.

Bottom Lines on Conventional Scenarios

Insofar as foreseeable US requirements for conventional operations make a strong case for fielding a new LRSS no later than between 2018 and the early 2020s, that case rests primarily on the first four scenarios examined. Better matching of weapons to targets is mainly an efficiency argument, although the need to minimize collateral damage is not something to ignore. And 24/7 fire support does not lend much strength to the overall justification. In fact, the most compelling arguments for moving aggressively ahead to field a follow-on to the B-2 by the early 2020s lie in the first four conventional scenarios discussed:

(1) situations in which US strike aircraft would need to be able to reach deep targets from the last refueling point,

(2) scenarios that give rise to more or less overnight demands for striking targets at intercontinental distances from North America,

(3) operations in which prospective adversaries increasingly confront US forces with time-sensitive targets, and

(4) conflicts in which adversaries employ robust anti-access/area-denial capabilities.

There is one important caveat that must be appended to this assessment bearing on the need and urgency for a new long-range strike system. As has been mentioned more than once, prosecuting time-sensitive targets in defended airspace is an especially challenging task. In the past, F-117 and B-2 pilots have generally used meticulous mission-planning to plot routes through enemy airspace that would keep them far enough from threat radars to avoid detection. Flying the so-called "blue line" has been the heart of the employment tactics that, combined with a low-observable aircraft, have produced sufficient stealth for survivability in defended airspace (at least at night). TST missions, however, are likely to preclude pilots from remaining steadfastly on pre-planned blue lines throughout the mission. In addition, there is always the possibility of pop-up threats, whether SAMs or enemy interceptors. These prospects argue that a particularly critical technical requirement for the next-generation bomber will be a passive sensor system that can detect, locate, and characterize threat radars. The F-22, for example, has the capability to use its AESA radar, which is an active sensor, to

search automatically for enemy fighters, identify them, and even display to the F-22 pilot whether any of them can detect the F-22.[68] For the TST mission, though, the next LRSS will need a *passive* emitter location system that can perform these tasks with high reliability and permit dynamic, on-the-fly re-computation of the plane's blue line.[69] Deep in enemy airspace, this capability may be as important as the aircraft's RCS.

[68] Eric Hehs, "North to Alaska: F-22 Deploys to Northern Edge Exercise," Code One, Third Quarter 2006, Vol. 21, No. 3, online at <http://www.codeonemagazine.com/archives/2006/articles/jul_06/alaska/index.html>; also, Carlo Kopp, "Just How Good Is the F-22 Raptor?" *Air Power International*, September 1998, online at <http://www.ausairpower.net/API-Metz-Interview.html>, which was an interview with Paul Metz, then the chief F-22 test pilot.

[69] The emitter location system would probably need to be integrated with the on-board radar for certain tasks such as non-cooperative target recognition of airborne targets.

Nuclear Scenarios

> The United States has never adhered to a doctrine of mutually assured destruction. Indeed, by any reasonable definition of the word, the U.S. has never *had* a strategic nuclear doctrine.... At the risk of oversimplifying, it seems clear that U.S. strategic doctrine, such as it is, has always contained two different strands. One is 'assured destructionist' in coloration and emphasizes the importance of the countervalue deterrent, the dangers of regarding nuclear forces as ordinary weapons of war, the risks of threatening the enemy's nuclear capabilities, the value of stability and the necessity for indices of 'sufficiency'. The other strand is more traditional, arising as it does from some universal and time-honored principles of military action. It focuses on war outcomes, on the importance of preparing to achieve sensible objectives should deterrence fail and therefore on the necessity for defeating the enemy by denying him his objectives and destroying his willingness and ability to wage war.
>
> — Aaron Friedberg, 1980[70]

The initial discussion of contexts for thinking about long-range strike pointed out that, a decade and a half after the end of the Cold War, there is no consensus in the United States on the need for nuclear weapons or their role in US security. Consider the recent advocacy by George Shultz, Bill Perry, Henry Kissinger, and Sam Nunn of the imperative for a global effort to "ultimately end" the threat of nuclear weapons by moving

[70] Aaron Friedberg, "A History of the U.S. Strategic 'Doctrine'—1945 to 1980," *The Journal of Strategic Studies*, December 1980, p. 39.

toward a "nuclear-free world."[71] This eminently desirable goal emerged from an October 2007 conference sponsored by Stanford University's Hoover Institution and the Nuclear Threat Initiative.[72] Yet, as appealing as the vision of a nuclear-free world may be, nuclear weapons cannot be "uninvented" and countries like Iran have strong incentives to acquire nuclear weapons to ensure they will not become victims of regime change by US conventional forces. As Kissinger observed in 2005, Iran seeks nuclear weapons as "a shield to discourage intervention by outsiders in its ideologically based revolutionary foreign policy."[73] Moreover, with respect to practical steps toward reducing the threat of nuclear weapons, the Shultz-Perry-Kissinger-Nunn editorial was followed two days later by dissention from the Hoover Institution's Henry Rowen. His concern was that the editorial's nuclear fuel assurances to countries like Iran would be more likely to bring about further nuclear proliferation rather than a nuclear-free world.[74] When this sort of objection is placed in the context of Aaron Friedberg's earlier assessment of the ambivalence and ambiguity of US nuclear strategy even at the height the Cold War, one begins to get a sense of how unsettled American views on things nuclear really are in the early twenty-first century.

What follows is not advocacy for the future use of nuclear weapons by the United States or any other nation or group. Rather it simply describes generic scenarios in which such use might be contemplated by an American president—presumably as the "least-awful" of the available choices, and as a last resort. The underlying motivation is to explain why it would be short-sighted to limit the next LRSS to conventional operations only. If for no other reason than to deter countries like Iran from risking nuclear use, it seems best for US nuclear forces to be perceived as modern, ready and capable, which is to say as forces to be taken seriously

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[71] George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "Toward a Nuclear-Free World," *The Wall Street Journal*, January 15, 2008, p. A13.

[72] The Nuclear Threat Initiative is a non-profit organization dedicated to reducing the risk of use and preventing the spread of nuclear, biological and chemical weapons. It is currently co-chaired by Sam Nunn and Ted Turner. The Hoover Institution, which was founded in 1959, views its mission as recalling the voice of experience against the making of war, remembering man's endeavors to make and preserve peace, and calling on the past to sustain the constitutional and private enterprise safeguards of the American way of life.

[73] Henry A. Kissinger, "Iran: A Nuclear Test Case," *The Washington Post*, March 8, 2005, p. A15.

[74] Henry S. Rowen, "This 'Nuclear-Free' Plan Would Effect the Opposite," *The Wall Street Journal*, January 17, 2008, p. A15.

and feared. The fact that in June 2008 Defense Secretary Robert Gates felt obligated to fire the Air Force secretary and chief of staff over their Service's handling of nuclear weapons conveys precisely the opposite impression to US allies and prospective adversaries alike.[75] Ensuring that a next-generation LRSS has enough EMP hardening for nuclear use is one highly visible way of reversing this unfortunate perception.

Since the Manhattan Project detonated the first atomic device at the Trinity site in New Mexico on July 16, 1945, there have been two distinct nuclear revolutions. The first was a brief period of American monopoly and scarcity in the numbers and yields of the atomic weapons available to the United States. This period of what might be termed "atomic scarcity and monoply" continued into the early 1950s. As Marc Trachtenberg has observed, it had two fundamental features. First, the strategic-bombing framework developed during World War II remained valid and underwrote early American planning for an atomic campaign against the USSR.[76] Second, as important as atomic weapons were, they were not yet powerful enough to enable either Cold War rival to destroy the other.[77] An initial American "atomic blitz" against the USSR "could not be counted upon to destroy the war-making power of the Soviet Union," and a Soviet atomic attack on the United States in late 1950s employing a handful of Tu-95 Bear bombers would have had "only a limited effect on the American war economy."[78]

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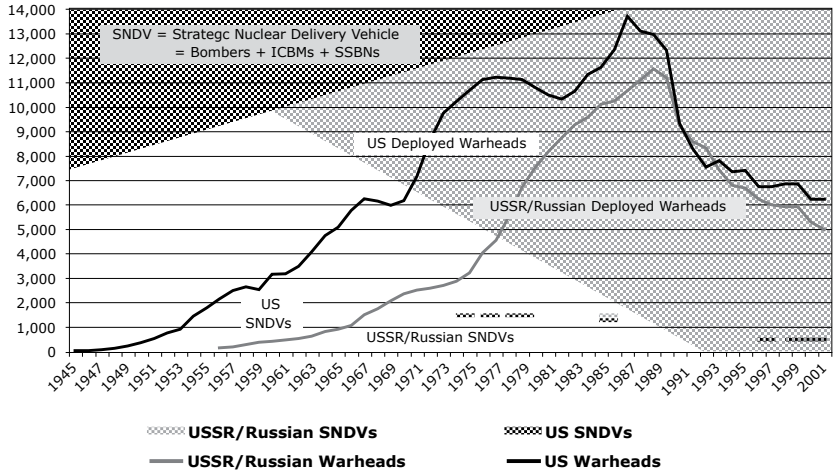
[75] In the press conference during which Gates announced that he had, after consulting with the president, accepted the resignations of USAF secretary Wynne and chief of staff Moseley, he stated that the safety, security and reliability of the United States' nuclear deterrent remained "of paramount importance." However, investigation of two recent incidents involving USAF handling of nuclear components and weapons had revealed that "the overall mission focus of the Air Force" had shifted away from the nuclear mission. Moreover, responses to these incidents had required Gates' personal intervention rather than being initiated by the Air Force. The transcript of Gates' June 5, 2008, press conference on these decisions can be found at <http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=4236>.

[76] Marc Trachtenberg, *History and Strategy* (Princeton, NJ: Princeton University Press, 1991), pp. 4–5.

[77] For example, the assessment of the May 1949 review, headed by Lieutenant General H. R. Harmon, on the likely results of a strategic air campaign against the Soviet Union for the Joint Chiefs of Staff concluded that, with the available atomic weapons, only 30–40 percent of the USSR's industrial capacity would be destroyed and that the effects would not be permanent—Thomas H. Etzold and John Lewis Gaddis (eds.), *Containment: Documents on American Policy and Strategy*, 1950 (New York: Columbia University Press, 1978), pp. 361–362.

[78] Trachtenberg, *History and Strategy*, p. 119.

Figure 2: US and Soviet Nuclear Forces, 1945–2002[79]



The second nuclear revolution, which led to "thermonuclear plenty" (if not overkill) for both the United States and the USSR, was precipitated by the Soviet detonation of a nuclear device in August 1949. After US intelligence confirmed that the detonation had occurred, President Harry Truman took two momentous steps. In October 1949 he directed the first expansion of the US capacity to produce fissile materials since World War II, and in January 1950 he decided to proceed with development of the hydrogen bomb.[80] In the long run, the pursuit of thermonuclear weapons and intercontinental ballistic missiles gave both Cold War rivals the capacity to destroy the other's society in a matter of hours. As Figure 2 makes clear, the United States probably achieved this capability in the 1960s, with the Soviet Union following suit in the early 1970s, which was the point during the Cold War when both sides acknowledged that the USSR had achieved rough nuclear parity.

[79] NRDC databases at <http://www.nrdc.org/nuclear/nudb/datainx.asp>. Figure 2 also suggests that while arms-control agreements may have limited strategic nuclear delivery vehicles during the Cold War, it had much less success limiting deployed warheads.

[80] Robert R. Bowie and Richard H. Immerman, *Waging Peace: How Eisenhower Shaped an Enduring Cold War Strategy* (Oxford: Oxford University Press, 1998), pp. 16, 24–25.

One way of conveying the enormity of the differences between the atomic and thermonuclear eras is to compare the total yields in megatonnage available from fully generated US strategic-nuclear forces at the end of the Truman and Eisenhower administrations. In 1953, the American nuclear deterrent relied entirely on SAC bombers. Save for the B-36, all those bombers were medium-range aircraft (B-29s, B-50s, and B-47s) that required forward bases to reach Soviet targets. The total yield available from these systems at the end of the Truman administration was around seventy-five megatons (the equivalent of seventy-five million tons of TNT).[81] By 1961, the first US ICBMs and SLBMs had come on line and the total yield of deployed US strategic-nuclear forces, had SAC's bomber force been fully generated, exceeded ten thousand megatons, more than a 130-fold increase in destructive power compared to 1953.[82]

American leaders and strategists, of course, saw mutual vulnerability arising from the thermonuclear revolution coming long before both sides acknowledged strategic parity. Bernard Brodie's oft-quoted assertion that, henceforth, the chief purpose of the forces shown in Figure 2 can no longer be to win the nation's wars but "to avert them" stemmed from the thermonuclear revolution rather than the earlier atomic one.[83] Modern notions of deterrence, massive retaliation, assured destruction, strategic stability, and so forth largely derive from anticipation of the second of these two revolutions.[84] The body of thought created in response to this situation—largely by civilian rather than military strategists—"was very different from anything that had come before."[85]

During the late 1940s and early 1950s, the prospect that the United States would soon lose its atomic monopoly and face a rapidly expanding Soviet nuclear arsenal led to discussions at RAND, within the military (especially the Air Force), and even in the Truman and Eisenhower administrations of initiating a preventative war against

[81] David M. Kunsman and Douglass B. Lawson, *A Primer on U.S. Strategic Nuclear Policy* (Albuquerque, NM: Sandia National Laboratories, 2001), pp. 19–20.
[82] Ibid., pp. 32–33. The total yield of US strategic-nuclear forces peaked in 1960 at over 20,000 megatons.
[83] Bernard Brodie, "The Development of Nuclear Strategy," *International Security*, Spring 19878, p. 65. Brodie originally articulated this view in *The Absolute Weapon* in 1946.
[84] For evidence, see B. Brodie, C. J. Hitch, and A. W. Marshall, "The Next Ten Years," RAND, December 30, 1954, especially pp. 3-16.
[85] Trachtenberg, *History and Strategy*, p. 3.

the USSR. Nevertheless, Trachtenberg's historical judgment is that no American government ever "came close to implementing a preventive war strategy" before the US nuclear advantage, for all intents and purposes, wasted away.[86] Dwight Eisenhower's administration was the first to think through the implications of mutual thermonuclear plenty for US national security strategy in a careful and systematic way. Eisenhower himself ruled out further exploration of a preventative war strategy during the May 1953 meeting that led to the Solarium exercise during the summer and, by the end of October, produced National Security Council (NSC) 162/2, "Basic National Security Policy." NSC 162/2 based the US Cold War strategy of containment on nuclear retaliation rather than on an across-the-board military build-up aimed at rolling back Soviet power, which was the variant of containment envisioned by the Truman administration's core strategy document, NSC 68.[87] Eisenhower's view was that any strategy that raised the risk of general nuclear war with the USSR was unacceptable because he doubted "whether any nations as we now know them would continue to exist at the end of this war."[88]

What does this early Cold War history imply for the next LRSS? Simply put, the United States' situation relative to a country such as Iran with a small number of atomic weapons and little capability to employ them over intercontinental distances is more akin to situation that the Soviet Union posed for the United States following the first of the two nuclear revolutions. During this "atomic" period, American presidents were willing to threaten limited nuclear use to achieve political ends in crises and limited conventional conflicts. During the 1948–1949 Soviet blockade of ground access to West Berlin, President Truman quietly, but not undetectably, deployed B-29s—aircraft known to the Russians to be capable of carrying atomic bombs—to bases in Great Britain.[89] This deployment was a bluff since the planes brought no atomic bombs with them, nor were they even configured to carry them. Whether the bluff helped to settle the crisis was disputed even at the time, but later the Tru-

[86] Trachtenberg, *History and Strategy*, p. 100.
[87] Bowie and Immerman, *Waging Peace*, p. 126. "The risk of Soviet aggression will be minimized by maintaining a strong security posture, with emphasis on adequate offensive retaliatory strength and defensive strength. This must be based on massive atomic capability…" (NSC 162/2, October 30, 1953, p. 19).
[88] Trachtenberg, *History and Strategy*, p. 141.
[89] Walter Isaacson and Evan Thomas, *The Wise Men: Six Friends and the World They Made* (New York: Simon & Schuster, 1986), p. 458.

man administrations looked back to this initial use of atomic diplomacy as a way of bringing the Korean War to an end.[90]

The Korean War produced two attempts to influence events by brandishing America's atomic power. In July 1950, Truman repeated the Berlin Blockade bluff, sending B-29s configured to carry atomic bombs first to England and then across the Pacific to Guam.[91] The deployment to Guam was reported in the press, and included the transfer of non-nuclear bomb components to the Pacific. As in the earlier case of the Berlin Blockade, the effects of these overseas deployments by SAC B-29s on the fighting in Korea was unclear, then or later.

Next, in the grim weeks of December 1950, after the PRC had intervened to stop the American drive to the Yalu River, Truman and his most senior advisors reversed direction. They neither seriously considered atomic use nor made further bluffs as they had earlier in the year.[92] The motivations behind this increased restraint appear to have included domestic politics and the realization that the B-29 deployments in July had not dissuaded the Chinese from intervening.

Finally, in April 1951, the prospects of a major Chinese offensive and possible Soviet intervention prompted Truman to go a step further. This time he sent B-29s with complete atomic bombs to Guam.[93] Again, it was unclear what impact (if any) either the deployments, or Secretary of State George Marshall's warning that the United States could set back PRC development by decades, had on Chinese decisions to enter negotiations.[94] In any case, the B-29s and their atomic weapons returned to the United States at the end of June 1953.

The other alleged episode of atomic diplomacy during the Korean War did not surface until January 1956, when *Life* magazine published an article purportedly revealing how the Eisenhower administration had ended the conflict. Secretary of State John Foster Dulles revealed that he had conveyed an "unmistakable warning" to Beijing that the United States would use atomic weapons against China unless there

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[90] Roger Dingman, "Atomic Diplomacy during the Korean War," *International Security*, Winter 1988–1989, p. 54.
[91] Ibid., pp. 59–60.
[92] Dingman, "Atomic Diplomacy during the Korean War," p. 68.
[93] Ibid,, pp. 73–74.
[94] Ibid., p. 78.

was progress toward a negotiated settlement of the conflict.[95] Review of the Eisenhower administration's internal discussions in 1953 suggests, however, that no attempt to use atomic arms for coercive diplomacy actually occurred.[96]

From the standpoint of whether the next LRSS ought to have enough hardening to deliver a nuclear weapon or two without adverse effects on the aircraft's electronics, the decisive issue is not whether nuclear deterrence or coercion worked during 1948–1953 but that they were thinkable choices for the US government before the Soviet nuclear arsenal acquired the capability to wreak catastrophic destruction on the United States. The huge nuclear arsenals that began emerging on both sides in the late 1950s are what made general war ever more suicidal as the Cold War unfolded. However, the situation regarding countries such as Iran or Syria looks much more like the atomic period than the thermonuclear one that followed. In extremis and as a last resort, limited nuclear use against such countries is thinkable. Indeed, this very fact could be exploited as part of a long-term US strategy to bolster deterrence against authoritarian regimes with small atomic arsenals and less than intercontinental reach.

The key step in underwriting deterrence of nuclear use by authoritarian regimes inclined to support terrorism against the United States or its allies, however, is for their rulers to be persuaded that American presidents have credible nuclear options. In this regard, the argument for ensuring that the follow-on to the B-2 can conduct limited nuclear strikes hinges on a simple psychological point. In extremis, any American president will surely want to have the greatest capacity possible to recall a nuclear strike even at the very last moment. A *survivable* manned bomber satisfies this criterion better than a ballistic missile. A ballistic missile, once launched, cannot be recalled, and any LRSS that the United States is capable of fielding by 2018 will most likely cruise at speeds under Mach 2.0, which means the aircraft will take hours to reach an overseas target from North America. Once inside defended airspace, though, and given the potential consequences of having a nuclear-armed bomber downed by enemy air defenses, the platform must be highly survivable.

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[95] Ibid., p. 50.

[96] Ibid., pp. 88–89; also Rosemary J. Foot, "Ending the Korean War," *International Security*, Winter 1988–1989, pp 99–107. Dulles' claim about using nuclear diplomacy to end the Korean War came, of course, at the beginning of a presidential election year.

What kinds of scenarios might provoke an American president into seriously considering even a very limited nuclear response against a regional adversary with a small atomic arsenal and non-intercontinental delivery means? Immediately after the Cold War, RAND's Project Air Force ran a series of policy exercises aimed at exploring US options against a regional adversary with a small but survivable nuclear arsenal. The outcome was that most participants in these exercises were reluctant to use even conventional force against such an opponent:

> In the face of an aggressor equipped with a small, survivable nuclear arsenal—particularly one based on survivable mobile ballistic missiles—most participants judged that U.S. force projection plans on the order of Desert Shield placed too much at risk. *Put simply, several of the exercises indicated that a nation with a small, survivable nuclear arsenal has the potential to undermine current U.S. national military strategy for dealing with regional conflicts—the central foundation of current U.S. force structure plans* [*italics* in original].[97]

Much has changed since these words were written. Especially in the wake of regime change in Iraq, the incentives for nations like Iran to acquire nuclear weapons as a way of neutralizing US superiority in large-scale conventional operations have intensified. If the United States ever had a genuine opportunity to preclude the Iranian theocracy from acquiring nuclear weapons by non-military means, that opportunity probably occurred in mid-2003, immediately after Saddam Hussein's regime fell. But that opportunity, if it existed, was ignored. More recently, evidence that in September 2007 Israeli warplanes destroyed a Syrian reactor, which, with help from North Korea, was only weeks away from beginning to produce plutonium, only underscores the prospect that the Cold War nonproliferation regime is fraying badly.[98] And in the aftermath of 9/11, the possibility of a crude nuclear device being detonated in an American city is far more real than it was in 1993, as is the probability that, sooner or later, the US military will be forced

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[97] Marc Dean Millot, Roger Molander, and Peter Wilson, " 'The Day After...': Nuclear Proliferation in the Post-Cold War World," RAND issue paper, February 1993, p. 2.

[98] Robin Wright, "U.S. Details Reactor in Syria: American Push Damascus. N. Korea To Admit Collusion," *The Washington Post*, April 25, 2008, p. A12; also, "Oh What a Tangled Web They Weave," *The Economist*, May 3, 2008, p. 69.

to confront a choice between staying its hand or intervening overseas against a nuclear-armed regional adversary. Yet even RAND's "The Day After…" study acknowledged that if truly vital American interests were at stake, US decision-makers might make different choices regarding the use of military force than they would for lesser stakes. One suspects that the detonation of even a crude atomic device in lower Manhattan would create a mindset regarding "thinkable" responses rather different from those that dominated "The Day After…" exercises.

One could attempt to go beyond what has already been said and develop nuclear scenarios in greater detail. As has been stressed, though, there is far greater uncertainty today about when and where the United States may next consider using military force than there was in 1993. Insofar as more detailed predictions as to the precise circumstances that might lead an American president to consider using nuclear weapons are concerned, the Arabs got it right: *He who predicts the future lies, even if he tells the truth*. What does seem clear, though, is that incorporating sufficient EMP hardening for limited nuclear operations into the next LRSS is a prudent hedge against the uncertainties of the future security environment in the early twenty-first century.

Conclusions

Figure 3: US Nuclear-Tasked Bombers, 1945–2007[99]

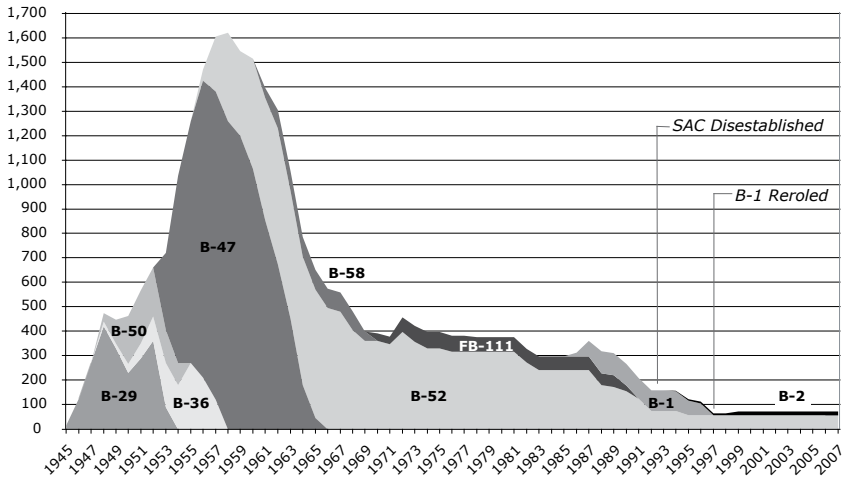

Figure 3 depicts the numbers and types of US bombers deployed in operational units with nuclear missions from 1945 to 2007. Until the disestablishment of Strategic Air Command in 1992, nuclear commitments were the primary mission of these aircraft. Today, however, conventional scenarios provide the bulk of the case for making every effort to field a new long-range strike system no later than between 2018 and the early 2020s. The principal non-nuclear "generic scenarios" underlying this judgment are:

(1) situations requiring a sufficient radius of action from the last air-refueling point to reach targets deep in defended airspace;

[99] NRDC database at <http://www.nrdc.org/nuclear/nudb/datab7.asp>.

(2) conflicts in which there is a need to strike targets at intercontinental distances from the continental United States because in-theater bases are not available;

(3) operations requiring the survivability to persist in defended airspace in order to prosecute time-sensitive targets; and

(4) scenarios in which US forces must have the radius of action to be able to home base beyond the reach of anti-access/area-denial capabilities.

There are other conventional scenarios favoring a new LRSS: (5) matching munitions to targets and (6) providing 24/7 fire support for US surface forces. But these last two do not seem nearly as persuasive as the first four.

The *sine qua non* for the next LRSS should be the capability to persist in defended airspace, day or night, long enough to deal with time-sensitive targets. One key to meeting this requirement is a reliable passive-emitter-location system that, if combined with other onboard sensors and off-board information, will permit dynamic "blue-line" replanning. Again, some observers see daytime persistence in defended airspace as a "bridge too far"—at least at an affordable cost and with an eye toward making a 2018 IOC. The counterargument is that investing the tens of billions that will be required to field a new LRSS while failing to provide this critical capability would, in the long run, be a waste of taxpayers' money. Thus, backing off on this design goal to any great extent would appear to be a serious mistake.

Also worth reiterating is the point that one is hard-pressed to come up with a large set of targets that absolutely need to be hit in less than two hours at intercontinental distances. Again, fixed targets need not be hit this quickly—unless, of course, they are in the process of mounting attacks against friendly forces. Even then, though, the number of targets is likely to be small because attacks can usually be launched well within a couple hours. As for mobile targets, they can relocate or move to a hide within thirty minutes, much less within the two-hour window associated with the FALCON program's hypersonic cruise vehicle. And for the small number of targets that require "iron on target" in less than two hours, a ballistic missile with a conventional warhead is four times

faster. The rest of the targets can be covered adequately with a subsonic LRSS. Thus, there appears to be no operational case for devoting the resources to develop a hypersonic bomber.

Although the principal reasons for moving ahead with a follow-on to the small inventory of B-2s (twenty airframes since one crashed at Guam in February 2008) lie in conventional scenarios, a case can be made for not completely ignoring the nuclear role. Against regional adversaries with small nuclear arsenals and lacking intercontinental reach, the threat of nuclear use for deterrence and compellence is conceivable—in extremis and as a last resort—much as it was during the late 1940s and early 1950s. However, from a psychological perspective, manned bombers seem preferable to ballistic missiles because they permit more time for second thoughts or last-minute changes of the president's mind. Additionally, the B-2 was designed in the 1980s whereas the SA-21 is just now being fielded; if the US military is to maintain a penetrating bomber among its nuclear forces, a follow-on to the B-2 will eventually be required. The point is not to advocate increased reliance on nuclear use. Breaking the post-Nagasaki taboo against employing nuclear weapons is clearly a threshold US decision-makers would prefer not to cross. Rather, the point is just to argue that the next LRSS should be sufficiently hardened against EMP during production to permit limited nuclear operations in the event that the United States is forced to cross the nuclear threshold.

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Assessments

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