Future Bomber Force

· **ISSUE:** Should the U.S. terminate bomber production or continue building long-range, tealth bombers?

2. ISSUE DESCRIPTION: Under the current DOD program the United States will stop building bombers in 1998. The B-2 has been the subject of controversy since the original aircraft roll-out. The driver of that controversy has been the aircraft's unit cost, which started high and rose steadily as the total buy was reduced from 132 to 75 to 20. The decision to stop the B-2 program at twenty aircraft resulted from budget constraints and changes in our nuclear force planning. However, this decision was not preceded by an examination of the B-2's potential in conventional force missions. The current status of B-2 production—nearing completion of the final funded aircraft—and the requirement for additional funding in the FY 96 budget to maintain B-2 production capability, suggests an informed judgment on halting or continuing B-2 production is needed now.

The Senate Armed Services Committee, in its report on the FY 95 Defense Authorization Bill, found current DOD bomber force posture and funding proposals "unacceptable." Congressional direction to the Commission includes: "...the conferees direct the Commission to specifically address this issue [the proper B–2 stealth bomber inventory] in its report, not only in the context of the preservation of the industrial base, but for the critical capability the B–2 provides to our national security." (HCR 103-747); "...consider tradeoffs between more stealthy aircraft and fewer support assets (in particular, the kinds of tradeoffs presented by the Air Force ng testimony on the Department of Defense Authorization Act for Fiscal Years 1992 and)." (SH 102-255); "...review thoroughly the capabilities of bombers and carrier–based air es in the early phases of a short–warning MRC." (SR 2182); "The independent Roles and Missions Commission is examining bomber force structure tradeoffs with other military forces." (SR 2182)

3. ISSUE PAPER PURPOSE: The paper synthesizes analytic support from the Institute for Defense Analyses (IDA), Center for Naval Analysis (CNA), RAND Corp, Synergy Corp and research conducted by the Commission staff. The paper presents a spectrum of options for consideration by the Commission. The paper focuses on Congressional direction, the leverage and utility of long-range stealth, and potential force trade-offs.

4. OPTIONS:

OPTION 1—Endorse termination of U.S. bomber production (current program)

OPTION 2—Recommend continued B-2 production without comment on total inventory or offsets

OPTION 3—Recommend additional B-2 production at a low rate (1.5 or 3 B-2s per year)

OPTION 4—Recommend a specific B-2 force size objective

5. OPTION EVALUATION:

The Commission on Roles and Missions (CORM) staff evaluation consisted of: 1) a review of recent bomber/force structure studies to include the recently completed Office of the Secretary of Defense (OSD) heavy bomber study conducted by IDA; 2) an analysis of the impact of stealth from the Gulf War; 3) an analysis of a spectrum of potential deep attack force structure capabilities and bomber trade-off options; and 4) a review of industrial base considerations.

B-2/Bomber/Force Structure Study/Analysis Review:

A list of the 25 studies that were reviewed (14 specifically addressing bomber force structure) is at appendix 1. The studies generally conclude that bombers, and the B-2 in particular, are cost-effective, and in some cases the only, means of rapidly projecting survivable power. Most of the bomber studies reviewed conclude that more than 20 B-2s would be useful in a two MRC strategy, and several recommend more B-2s. The recent OSD heavy bomber study did not recommend adding to the B-2 inventory.

The outcome of a particular study and associated recommendations are highly dependent on assumptions. Studies that presume little or no warning favor adding B-2s to hedge against surprise and provide an increase in warfighting options (such as the potential to stop armor invasions without deploying large ground forces). Studies that presume warning and assume that the U.S. acts on warning to deploy large numbers of aircraft generally conclude that while increasing the number of B-2s provides additional capability, that added capability is "modest" relative to the total available from all forces employed. Analyzing alternatives limited to the bomber force, and assuming that advanced precision weapons are not adequately funded commensurate with the number of delivery platforms available, the OSD bomber study concludes that procuring additional advanced munitions is more cost-effective than buying 20 more B-2s.[1]

The way the bomber study is portrayed by OSD illustrates a fundamental difficulty the Department has in making force structure decisions that optimize cost-effectiveness—it limits alternatives to 'stovepipes' restricted to similar platforms or within Service budgets rather than evaluating joint capability to achieve a particular effect across *the spectrum of possible contributors* regardless of Service of origin or what kind of system.

The bomber studies we reviewed raise additional factors affecting bomber quantity, mix, and funding issues. Those include: the uncertainty of where, when, and how future conflicts will occur (and the role of bombers in these conflicts); the performance of conventionally upgraded bombers in conventional combat operations; the requirements for precision weapon delivery upgrades and funding of adequate stocks of precision munitions; the near term focus of the Department's budget that gives more weight to procurement costs and less to life-cycle costs; the reluctance of the Department to consider offsets among weapons systems other than bombers, or

[1] USD (A&T), Heavy Bomber Force Study Brief, 3 May 1995.

from a joint perspective across Service boundaries; and the perceived threat that the combination of stealth, payload, and range pose to the Services' traditional force structure sizing approaches.

Gulf War Analysis of the Stealth Multiplier Effect:

Not until 1991 was stealth employed in large-scale combat operations. An analysis of the attack plans from the Gulf War reveals high leverage from the combination of stealth and precision. This leverage is not widely understood. Employment of non-stealth aircraft requires large numbers of support aircraft to suppress enemy air defenses, which limits the total number of targets that can be attacked at any one time. Stealth dramatically reduces and, depending on the threat, can eliminate the need for large numbers of expensive and highly specialized suppression and force protection aircraft. A comparison of a non-stealth attack during the Gulf War with a stealth attack at about the same time illustrates this point. The non-stealth joint force package consisted of 38 fighter/attack aircraft from the USAF, USN, USMC, and Royal Saudi Air Force: 4 A-6s, 4 Tornadoes (the 8 bomb droppers), 5 EA-6B electronic jammers, 17 F/A-18s and 4 F-4Gs to surpress surface to air missiles, and 4 F/A-18s to protect against air threats. A total of 38 aircraft were required so 8 could drop bombs on 3 aimpoints. At the same time twenty (20) stealth F-117s attacked 37 aimpoints in other areas with an equal or higher air defense threat—an over 1200 percent *increase* in target coverage using 47 percent *fewer* aircraft.

Targets may contain one or more aimpoints. The number of aimpoints per target will vary depending on the type of aircraft and weapons, but principally are a result of the desired effect against the target or system of which it is a part. An objective of achieving a specific effect on the larger target system, rather than individual target destruction allows expansion of the number of attacks possible. A target does not necessarily have to be destroyed to achieve a particular effect. [2] Since they do not require large numbers of support assets, stealth aircraft multiply the number of targets that can be struck in a short period of time. Combined with use of precision weapons this reduces the number of aircraft necessary to achieve a specific effect. Figure 1 illustrates the advantages of stealth and precision. This combination allowed a greater relative proportion of targets to be attacked than attainable with similar numbers of non-stealth aircraft. In other words, without the stealth F-117s, 76 target attacks could not have been planned.

This leverage results not only in freeing non-stealth assets to strike other targets but enables concepts of operation previously unachievable—a capacity for simultaneous attack on the entire array of high value targets with little or no need to suppress enemy air defenses. This enables tactical surprise, a larger span of influence, paralyzing effects, and shorter time to impose effective control over the enemy. It also reduces casualties.

Current modeling and simulation consists primarily of attrition-based algorithms that do not account for these kind of effects in design of attack strategy or in determining warfighting outcomes.

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[2] There is a risk to this approach however, as Rear Admiral (Ret) Jim Winnefield notes; "The essential hardware in making the risk acceptable was the F-117[stealth] (and to a lesser extent, cruise missiles). Their surprise value and the ability to apply small packages of resources in precision strikes against key targets made the difference between success and failure." James A Winnefeld, Preston Niblack, Dana J.Johnson, *A League of Airmen: U.S. Air Power in the Gulf War*, RAND, 1994, p. 43.

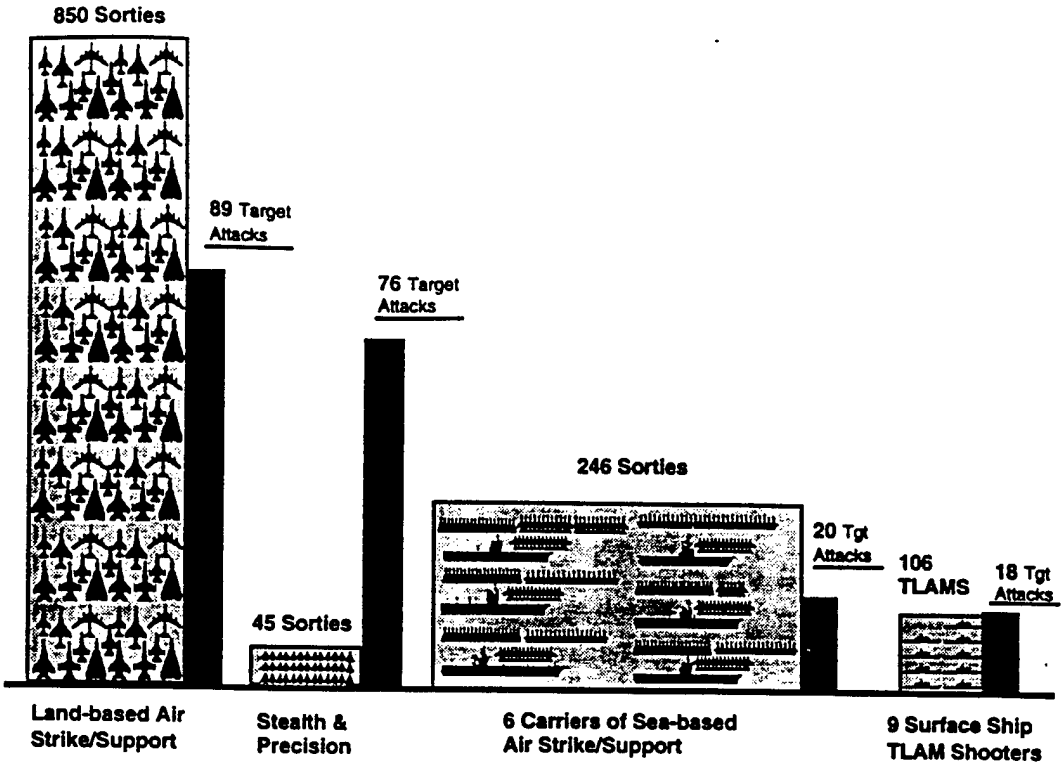

Figure 1—Stealth and Non-stealth Target Coverage 1st 24 Hours Gulf War[3]

A straightforward way of measuring the impact of the leverage of stealth is to compare the ratio of non-stealth aircraft sorties planned against targets (1202/127) with the ratio of stealth and associated aircraft sorties planned against targets (45/76)[4]. Calculating this value for the first 24 hours of the Gulf War results in a 'stealth multiplier of about 16 [(1202/127)/(45/76)]. Another way to look at this data is one (1) stealth sortie was 'worth' approximately 16 non-stealth sorties in *target* attack planning. Targets planned for F-117s generally had a single aimpoint per target, however. Targets for non-precision non-stealth aircraft generally had more than one aimpoint and required more than one aircraft or missile per target. Since F-117s carry two bombs per aircraft, the first 24 hour attack plan shows an average of 1.16 bombs per target—far fewer than required for 'dumb' bombs. The point remains that precision requires fewer bombs per aimpoint or target and stealth reduces or eliminates the support to get to a target, therefore less resources are required to attack a target. Hence, even if number of aimpoints were substituted for the number of target attacks, there would still be a stealth multiplier. In none of the studies reviewed was the multiplier effect of stealth taken into consideration as part of the modeling or simulation process.

Many people and analyses assume that stealth has limited effect when sufficient warning time exists to deploy fighter/attack aircraft into an area or after air superiority is achieved.

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[3]"Operations DESERT STORM Target List and Master Attack Plan," RAND, March 1992, and "Master Attack Plan: First 24 Hours," 2121, 16 January 1991. Information extracted is unclassified. 'Target Attacks' are the number of lines associated with an aircraft or force package attacking a target in one of the twelve JFACC target categories on the first 24 hour master attack plan. Height of bars in proportion to total measure of sorties or attacks.

[4]Of the 45 sorties listed three are EF-111 sorties that were planned as part of the second group of attacks against Baghdad.

Analysis of the Gulf War indicates that stealth is an attribute that retains its significance, and continues to leverage offensive operations after the attainment of air superiority and as offensive operations extend well beyond the opening phases of a theater campaign. In the Gulf War, stealth aircraft remained the singular force element to attack the most highly defended areas of Iraq throughout the war, and as shown in figure 2 attacked more targets per sortie than any other asset *throughout the war* as well.

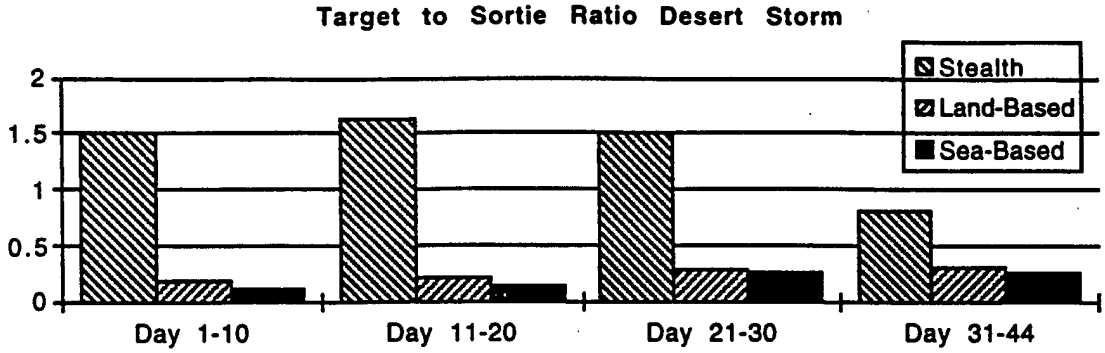

Figure 2—Stealth Versus Non-Stealth Target to Sortie Ratio Desert Storm[5]

Adversaries under attack tend to hide and defend very heavily those targets they hold of most value. Figure 3 shows that during Desert Storm suppression of enemy air defense sorties actually *remained constant* as the war progressed. This is due mostly to risk and attrition management. As a campaign progresses, locations previously avoided because of higher threat density are attacked as enemy air defenses are subdued to levels of acceptable risk. Stealth remains relevant. Also, during later stages of a theater campaign, risks taken by air forces increase as support to ground forces becomes paramount. This drives up the requirement for suppression of enemy air defense sorties or other alternatives such as stealth to evade or nullify enemy defenses.

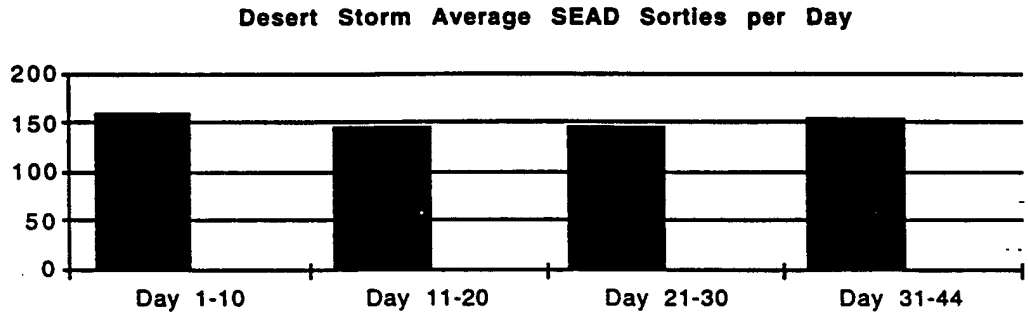

Figure 3—Suppression of Enemy Air Defense Requirements During Desert Storm[6]

As more and more of *any* particular force arrives in theater, the conventional wisdom—and many analysts—hold that incremental addition of that force element will increasingly dilute the significance of the force element. Comparing the Gulf War master attack plan for the air campaign as planned in September 1990 with the attack plan actually executed on January 17, 1991, we were able to discern the actual effects of force build-up for stealth aircraft. The

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[5]Operations DESERT STORM Target List and Master Attack Plan, RAND, March 1992, and "Master Attack Plans," D-Day to D+43, 16 Jan - 28 Feb 1991. Information extracted is unclassified.

[6]Ibid.

analysis shows that the effect of stealth was not diluted as a result of introducing more forces in the theater.[7] In particular:

• Stealth aircraft increased by 20 percent from September 1990 to January 1991. However, stealth aircraft decreased as a percentage of the total combat aircraft available for planning from 5.2 percent (30/580) to 3.3 percent (36/1088). Target coverage increased by 46.2 percent (from 52 to 76 targets) over the September plan.

• Carrier-based non-stealth aircraft increased by 96 percent from September 1990 to January 1991. Sea-based non-stealth aircraft increased as a percentage of the total combat aircraft available for planning from 29.1 percent (169/580) to 30.4 percent (331/1088). Target coverage increased by 42.9 percent (from 14 to 20 targets) over the September plan.

• Land-based non-stealth aircraft increased by 89 percent from September 1990 to January 1991. Land-based non-stealth aircraft increased as a percentage of the total combat aircraft available for planning from 65.7 percent (381/580) to 66.3 percent (721/1088). Target coverage increased by 64.8 percent (from 54 to 89 targets) over the September plan.

With respect to number of targets attacked, the impact of stealth aircraft *grew* as the percentage of total stealth aircraft became smaller as force build-up occurred. Only the impact of non-stealth aircraft became 'diluted' as additional forces were added. The experience of the Desert Shield build-up indicates that stealth aircraft become ***more*** rather than ***less*** important *as force build-up occurs*. Figure 4 graphically illustrates this effect.

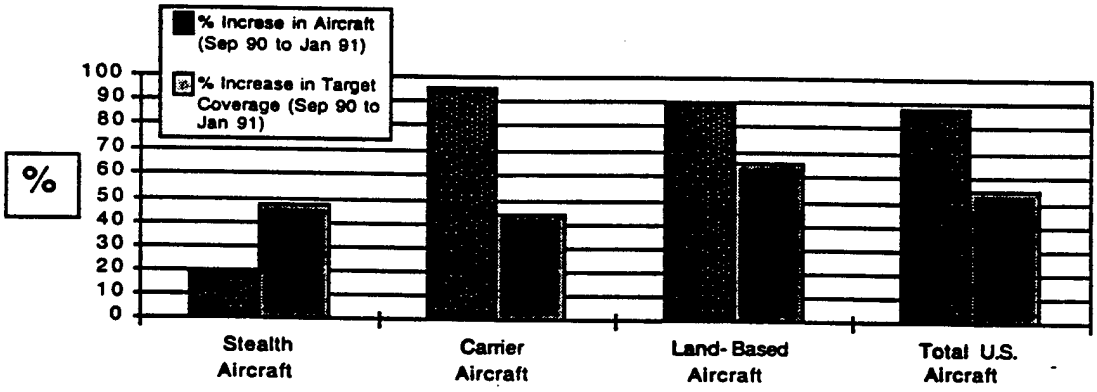

Figure 4—The Effect on Target Coverage as Force Build-Up Occurs (Stealth versus Non-Stealth)

Deep Attack Force Element/B-2 Options Trade-off Analysis:

A "capability" analysis of five B-2 force structure options and several potential force structure offsets was performed as part of the CORM deep attack issue analysis to comply with Congressional direction. A description of these options and potential offsets is at appendix 2. The analysis was led by IDA with CNA and RAND participating along with representatives

[7]Increase in target coverage from "Master Attack Plan," 1400, 13 September 1990, and "Master Attack Plan: First 24 Hours," 2121, 16 January 1991. Available U.S. combat aircraft for planning from "Offensive Campaign: Phase I," JFACC Director of Air Campaign Plans brief to CJCS, 13 September 1990, Gulf War Air Power Survey Volume 5, *Statistics*, and DOD *Conduct of the Persian Gulf War*, Report to Congress. Information extracted is unclassified.

from each of the Services. Synergy Corp ran additional excursions using the same methodology and assumptions as IDA. Two types of "MRC like" scenarios were considered, one of short duration with limited forces available and one of longer duration with substantial forces available. Cases were used to explore variations within each of the scenarios. To assure consistency in making comparisons, all costs in the evaluation and in this paper (except as otherwise noted) are 18 year life cycle costs in FY 95 dollars and were computed by IDA using the same methodology. Costs for each alternative along with the cost data and assumptions for these calculations are at appendix 3.

The focus of the short duration scenario—seven days of effort with minimal warning—is on responsiveness: the ability to respond quickly to a crisis. For this scenario eight cases were analyzed to reflect varying enemy defense levels (minimal or heavy), aircraft carrier availability (zero to two), warning time, and availability of land bases. The focus of the sustained firepower scenario—thirty days with warning time to deploy fighter assets—is on ability to deliver firepower with a fully deployed force. For this scenario four cases were analyzed to reflect situations where: 1) availability of land bases is plentiful; 2) availability of land bases is reduced by 50 percent; 3) Desert Storm sortie rates are applied; and 4) aircraft carrier-based air is flown at equal rates to land-based air (historically, land-based aircraft fly higher sortie rates than carrier-based air)[8].

The initial analysis was conducted using the following measures of merit: weapons delivered for the responsiveness scenario, and tons of ordnance delivered for the sustained firepower scenario. Neither analysis considered the effectiveness of the stealth multiplier. Payload measures of effectiveness show the impact of the F-117 as marginal—yet its value considering the effect of the stealth multiplier is well beyond that indicated simply by payload computations. Additionally, payload-only measures ignore the significance of range required to reach a target. The total costs of additional assets (e.g. tankers and carriers) and the associated assumptions (e.g. access to near-by land bases) necessary for aircraft to reach assigned targets are substantial and not accounted for in payload-only calculations. To overcome the range deficiencies in payload only calculations, the measure of merit of work—payload times range—was used to incorporate the value of range for the summary presentation in tables 1 and 2.

The data in tables 1 and 2 is an average of the results of the individual cases for each scenario run to account for variances in warning time available, basing availability, threat density, and availability of forces. For example, in table 1 the entry under the +20 B-2 option corresponding to the offset of reducing two carriers/air wings indicates that the result is a 19.6 percent increase in capability (dispenser-mile delivery potential). Descriptions of each of the cases, assumptions for each, sortie rates, payloads, and ranges are at appendix 4. An understanding of each of these cases and the assumptions and construction of each is required prior to drawing any conclusions from the combined results displayed. Some table results may not appear obvious without a complete understanding of the scenario and particular cases.[9]

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[8]John Birkler, David Perin, Chris Bowie, David Snlapak, James Winnefield, James Chiesa, *Roles and Functions of Land and Sea-Based Combat Air Forces: What Are the Issues in the Changed Security Environment?* CNA/RAND project memorandum, Washington, D.C. September 1994, p. 37.

[9]For example, in the responsiveness scenario the offset of reducing four F-16 wings indicates no change in munitions delivered. However, this short-warning scenario (C-Day=D-Day), presumes a relatively small number of

Table 3 shows the cost relationships among B-2 options and potential trade-offs. An entry in this chart shows the outcome (cost or saving amount) of buying a B-2 option combined with an offset. Table 4 is a summary of cost and capability for each force structure alternative analyzed in the evaluation. It shows differences in both raw payload measurements for both number of munitions dispensers and bomb tonnage as well as payload-range (work) for each scenario. At appendix 5 is a summary displaying each of the individual cases for the responsiveness scenario.

The analysis shows that additional B-2s increase force application capability. However, any further production of the B-2 will be expensive—unless considering offsets, some of which demonstrate that adding B-2s can increase capability while saving money (shaded options of table 3). None of the array of quantitative elements presented in the following tables capture all the elements required to make force structure decisions, however they do provide a relative order of magnitude comparison of major force elements whose primary purpose is force application.

Table 1: Responsiveness Scenario: Work Accomplished Against Mobile Targets in Seven Days (Change in Average Percentage of Dispenser-Miles)

B-2 Options / Offsets	Current Program (20)	+1.5/YR (+14 @ 2010)	+20 B-2s	+3.0/YR (+27 @ 2010)	+55 B-2s
No Offset	0	15.1	22.0	30.2	60.4
10 Carrier Force (-2) (5 /MRC BUR case)	-2.4	12.7	19.6	27.8	58.0
8 Carrier Force (-4) (4 /MRC BUR Case)	-4.8	10.3	17.1	25.4	55.5
0 B-1B Force (-4 BW) (Retire 95 B-1Bs)	-35.6	-20.5	-13.6	-5.4	24.8
16 AF FW Force (-4FW) (Retire 288 F-16s)	0.0	15.1	22.0	30.2	60.4
Replace FA-18E/F with new FA-18C/D	-4.4	2.9	6.2	10.1	24.7
Cancel FA-18E/F Use USMC FA-18C/D	-4.4	2.9	6.2	10.1	24.7

Table 2: Sustained Firepower Scenario: Work Accomplished in 30 Days (Change in Average Percentage of Ton-Miles)

B-2 Options / Offsets	Current Program (20)	+1.5/YR (+14 @ 2010)	+20 B-2s	+3.0/YR (+27 @ 2010)	+55 B-2s
No Offset	0.0	7.1	10.4	14.2	28.5
10 Carrier Force (-2) (5 /MRC BUR case)	-2.0	5.1	8.4	12.2	26.5
8 Carrier Force (-4) (4 /MRC BUR Case)	-4.0	3.1	6.3	10.2	24.5
0 B-1B Force (-4 BW) (Retire 95 B-1Bs)	-24.4	-17.3	-14.0	-10.2	4.1
16 AF FW Force (-4FW) (Retire 288 F-16s)	-2.0	5.1	8.3	12.2	26.5
Replace FA-18E/F with new FA-18C/D	-4.3	2.8	6.0	9.9	24.2
Cancel FA-18E/F Use USMC FA-18C/D	-4.3 (-5.9)	2.9 (1.2)	6.0 (4.5)	9.9 (8.4)	24.2 (22.6)

land-based fighters are deployed, and as a result even a significant change in the total land-based fighter force has no effect on the scenario outcome.

Table 3: Cost Relationships (FY95 $Billion)—B-2 Options and Potential Offsets

B-2 Options / Offsets	Current Program (20)	+1.5/YR (+14 @ 2010)	+20 B-2s	+3.0/YR (+27 @ 2010)	+55 B-2s
No Offset	0	Costs 17-23	Costs 22-30	Costs 29-40	Costs 52-69
10 Carrier Force (-2) (5 /MRC BUR case)	Saves 23-38	Saves 0-21	Saves 16 to Costs 7	Saves 9 to Costs 17	Costs 14-46
8 Carrier Force (-4) (4 /MRC BUR Case)	Saves 46-64	Saves 28-47	Saves 16-42	Saves 6-35	Saves 6 to Costs 25
0 B-1B Force (-4 BW) (Retire 95 B-1Bs)	Saves 26	Saves 3-9	Saves 4 to Costs 4	Costs 3-14	Costs 26-43
16 AF FW Force (-4FW) (Retire 288 F-16s)	Saves 19	Saves 2 to Costs 4	Costs 3-11	Costs 10-21	Costs 33-50
Replace FA-18E/F with new FA-18C/D	Saves 15	Costs 2-8	Costs 7-15	Costs 14-25	Costs 37-54
Cancel FA-18E/F Use USMC FA-18C/D	Saves 50	Saves 27-33	Saves 20-28	Saves 10-21	Costs 2-19

Table 4: Summary of Costs/Savings and Capability Changes—All Cases Considered

		RESPONSIVENESS SCENARIO				SUSTAINED SCENARIO	
		FIXED TARGETS		MOBILE TARGETS		FIXED TARGETS	
Option	Cost/Saving (Billion 95 dollars)	% Ton Change	% Ton-Mile Change	% Mun. Disp. Change	% Disp-Mile Change	% Ton Change	% Ton-Mile Change
Add 1.5 B-2s per year (+14 at 2010)	Costs 17-23	8.0	12.3	7.3	15.1	2.2	7.1
Add 20 B-2s	Costs 22-30	11.6	17.8	10.5	22.0	3.2	10.4
Add 3 B-2s per year (+27 at 2010)	Costs 29-40	16.0	24.5	14.5	30.2	4.4	14.2
Add 55 B-2s	Costs 52-69	32.0	49.0	29.0	60.4	8.8	28.5
Add 2 Wings F15E	Costs 25	0.0	0.0	0.0	0.0	6.5	3.6
Reduce CVs by 2	Saves 23-38	-3.3	-2.5	-4.0	-2.4	-4.4	-2.0
Reduce CVs by 4	Saves 46-64	-6.8	-5.1	-8.1	-4.8	-8.9	-4.0
Retire 95 B-1Bs	Saves 26	-18.9	-23.3	-20.6	-35.6	-9.2	-24.4
Reduce 4F-16C/D Wings (288)	Saves 19	0.0	0.0	0.0	0.0	-5.4	-2.0
Replace F/A-18E/F	Saves 15	-6.9	-2.8	-10.2	-3.2	-6.1	-4.3
Cancel F/A-18E/F	Saves 50	-6.9	-2.8	-10.2	-3.2	-6.1 (-10.4)	-4.3 (-5.9)
Reduce F-22 Buy 50%	Saves 20	0.0	0.0	0.0	0.0	-2.1	-0.9
Reduce DDG-51 Buy 27%	Saves 16	0.0	0.0	0.0	0.0	-0.3	-0.3

NOTE: All costs above are 18 Year Life-Cycle in FY 95 dollars and were computed by IDA using the same methodology for each alternative. For factors included and assumptions for each alternative see appendix 3.

The results of the two capability-based analyses represent only a part of the many factors that need to be considered when assessing the effectiveness of alternative force structures. In addition to the work and cost calculations, a summary of contextual factors that highlight some of the unique contributions and shortcomings of the force components analyzed, but not captured in the 'trucking' calculations are shown in appendix 6.

With regard to options that increase B-2 inventory beyond current levels, the IDA led analysis summarized below concludes that additional B-2s:

- Increase capability in every scenario considered in the evaluation—demonstrating a wide range of potential force applications
- Proved very to extremely valuable when heavy defenses were present
- Contribution of total tonnage depends on size of additional increment of aircraft

In addition, the IDA led analysis summary listed the following B-2 "other factors:"

- Provides every dimension of force application (except mass and around the clock attack) including surprise, range, payload, precision, and penetration of defenses
- Increases viability of regional deterrence and U.S. ability to support two simultaneous MRCs
- Increases responsiveness in short-term contingencies
- Reduces dependence on warning time, local basing, airlift, and prepositioned supplies
- Reduces the need for support allowing some support aircraft to conduct strike missions
- Has capability to acquire mobile targets with Block 30 radar
- Increases capability against a well-defended adversary far from available land bases and carriers
- Significantly increase U.S. strategies available to rapidly counter a crisis anywhere in the world
- Stealth reduces, but does not eliminate, vulnerability to some modern threats
- Forward bases with prepositioned support increase sortie rates

Bomber Industrial Base Considerations:

The function of the defense industrial base is to design and produce military equipment in a timely manner, whether to maintain the military at its designated level, to replace unexpected equipment losses and expenditures, or to expand to a larger force. As part of this function, the defense industrial base must also maintain U.S. military-technological leads, and redress any deficiencies. These capabilities are required for every weapon system type deemed important to U.S. military strategy.

The Analytical Sciences Corporation (TASC) is currently conducting a detailed analysis of the B-2 industrial base. However, we can make some observations based on other studies and industrial experiences. The B-2 is the only bomber in production and the only bomber program at a meaningful level of activity. No other bomber is planned or expected through the foreseeable future. Consequently, the B-2 program and the bomber industrial base are virtually the same. Any future bomber built after 1998 from an industrial perspective would be built nearly from scratch. According to one recent study; "Given the unique requirements of the aircraft, its very low observable [VLO] characteristics, and its size, the B-2 bomber has demanded the development of a range of new technologies, components and sub components and manufacturing processes which are seriously threatened by the termination of the B-2 program at 20 aircraft. Should this industrial capability disappear, the United States will likely find it extraordinarily

difficult to quickly reassemble the elements necessary to construct large VLO aircraft in the future."[10]

Ultimately, the most important consideration of why B-2 production at any level is continued is whether the U.S. needs to maintain a bomber force. With no programmed replacements, the bomber force will decline and eventually disappear. Suggestions have been made that current threat levels may permit terminating production in the short term while maintaining the capability to restart at some time in the future. If bombers are required it is cheaper and faster to have some infrastructure to build upon in bomber manufacturing. Even so, applying B-1 cost growth history to the B-2 program suggests that large restart costs for both RDT&E and production would be encountered. If additional bomber force structure may be required in the next 10 to 20 years, based on the B-2 critical technologies and the experience in re-starting the B-1, continued low rate production is a much more cost-effective option than deferring production.

Additionally, the B-1 was restarted under conditions far more favorable than would be true of the B-2. This is partly because of the aircraft itself. While the B-1 is a technological advance over the B-52, it is not a "revolutionary" change. In contrast the B-2 is dramatically different than any other aircraft. It requires a level of precision in all aspects of its fabrication and assembly which is without parallel. A recent study identified five "unique B-2 production capabilities at the prime contractor level to be at high risk upon program termination. Most, if not all of these capabilities would expire shortly after termination of the program, greatly hampering America's ability to reproduce the bomber if needed. If the B-2 production team is allowed to disintegrate, the cost to rebuild it could be a far higher percentage than was true of the B-1. It will literally take years to hire and train a workforce capable of producing a new bomber—B-2 or B-3. And in like manner, if there are design changes, the cost and time required to engineer and validate changes will be much greater."[11]

The motivation to terminate the B-2 line and restart if necessary would only appear to be cost-effective if it was a near certainty that America will *never* need more bombers.

Summary of Findings

Capability-based attributes provided by bombers and specifically the B-2:

The synergy of advanced munitions with the range and payload of long-range bombers may be more important to the Department of Defense in the years ahead than at any time during the Cold War. Combined with the stealth of the B-2, precision munitions with long-range bombers have the potential to provide key capabilities ***not available from any other forces*** to meet critical future national security requirements. Specifically, these capabilities include:

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[10]DFI International, "The B-2 Industrial Base: A Survey of Critical Capabilities," Washington D.C. January 1995, p. 55.

[11]Similar considerations of shutting down production and restarting when needed or low-rate production as they apply to submarines can be found in John Birkler, et al, *The U.S. Submarine Production Base: An Analysis of Cost, Schedule, and Risk for Selected Force Structures*, RAND, 1994.

1) The potential to halt an armored force in a matter of days from long-range
2) The ability to survivably operate against an enemy from beyond reach of enemy weapons (particularly missiles armed with weapons of mass destruction).
3) Guaranteed responsiveness—independence from forward basing or carrier pre-positioning
4) The ability to achieve strategic or operational surprise quickly, imposing wide-spread attack and paralysis upon an aggressor with minimum exposure of friendly personnel
5) The ability to swing survivable and effective force from one MRC to another rapidly
6) The psychological impact of strike without notice
7) The ability to induce enough uncertainty in a potential aggressor to deter hostile activity conventionally while the U.S. is militarily engaged elsewhere
8) Greatly reduced support assets, personnel, and basing requirements to achieve equivalent effects with non-stealth and/or smaller payload, shorter range aircraft.

Economic and Personnel Leverage:

As defense spending becomes increasingly consumed by personnel costs, advanced technology weapons with low life-cycle cost can offset fewer military forces and declining defense budgets. Figure 5 is an example of how the B-2 may be economically cost-effective in addition to improving warfighting capability. Most of the focus on the issue of the B-2 has been on individual unit aircraft cost. What sometimes gets lost with that focus is return for the dollar invested. As General Horner, the overall air commander during Desert Storm noted in a statement to Congress, "...the bottom line is not dollars per aircraft, but overall capability per dollar."

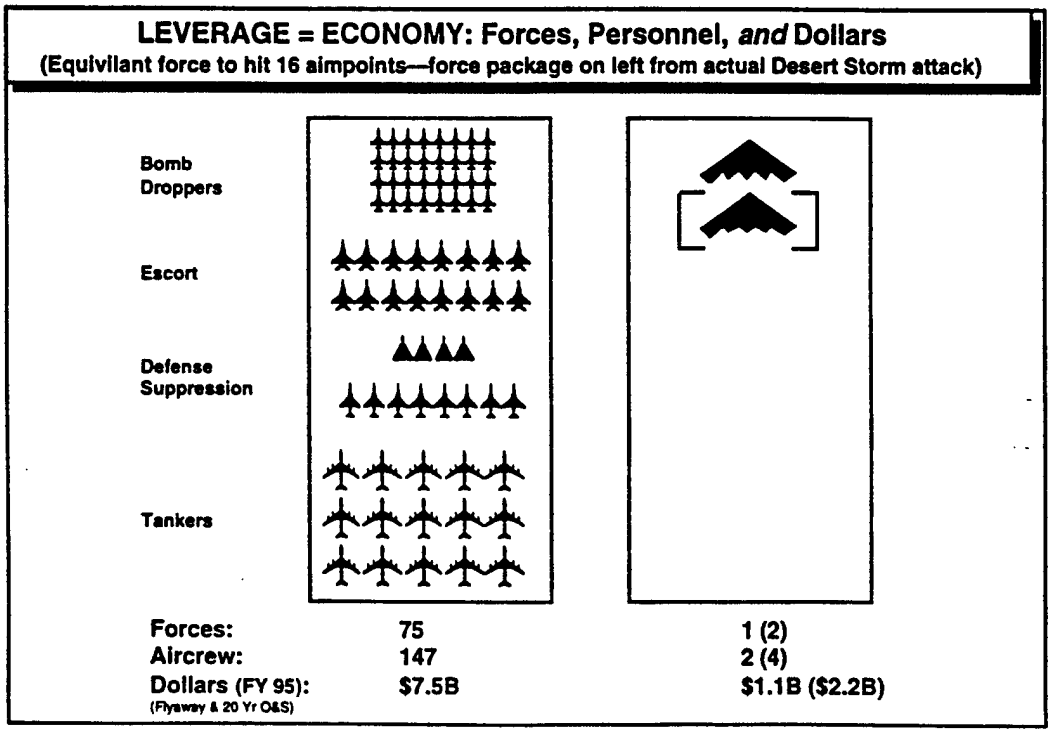

Figure 5—An Example of the Leverage of the B-2[12]

[12]From testimony of the Secretary and Chief of Staff of the Air Force to the Senate Armed Services Committee, 19 June 1991. Dollar figures adjusted to FY 95 amounts.

High unit cost of the B-2 has also generated questions regarding its actual use. "Would I have used a B-2 in Desert Storm? You bet I would—not only because of its enormous increase in conventional capability over any other attack system, but because we would be putting fewer lives at risk to accomplish the same mission," was General Horner's response. He went on to state; "Would I risk a B-2 in combat? Well, I didn't have any trouble risking the most expensive fighter in our inventory—the F-117—on a daily basis. And I was able to do that because we had confidence in the survivability provided by stealth. The B-2 would be no exception."[13]

Conventional Regional Deterrence:

The B-2 capabilities of stealth, long-range, high payload, and precision strike give the United States a *singular* ability among nations to respond in near-real time to short-notice contingencies using conventional force anywhere in the world. The B-2 has the possibility of extending deterrence from the nuclear to the conventional realm and may have great value in not only executing two simultaneous MRCs, but perhaps in deterring the second MRC from getting started. In a world arming with WMD (about 20 countries are developing this capability) there is great value in being able to fight from beyond the enemy's reach. This denies the enemy the ability to deter U.S. involvement in the crisis—possibly the primary reason for WMD development among hostile states. The importance of stealth, long-range, high payload, and precision strike was emphasized and embraced as critical in deterring regional states with WMD at a recent OSD sponsored gathering of experts dealing with WMD-capable adversaries.[14]

A recent study on regional deterrence strategy concluded that when regional adversaries resort to force they "...typically seek short, cheap wars. Therefore, those U.S. military forces that can credibly deny a quick, decisive victory will be most impressive to the opponent." The same study also noted; "Prompt denial, the capability to prevent the adversary from reaching an objective, is more deterring than a rollback capability to be employed after the adversary has captured his or her objective."[15] B-2s armed with advanced precision munitions have that potential.

Standoff Weapons Alternative to Bomber Modernization:

Some argue that arming older, non-stealth bombers with standoff weapons, in conjunction with surface launched cruise missiles could accomplish the same effects as penetrating stealth aircraft. Evaluation of such alternatives indicates the costs involved in attaining effectiveness equivalent to that required for even the opening phases of a MRC are prohibitive. It is also questionable—even if operationally attainable—in light of the current inability of standoff weapons to penetrate hardened targets or deal with mobile targets (e.g. tanks, SCUD launchers).[16] Another recent study demonstrates the high cost of standoff weapons and concludes that when

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[13]"Stealth and Desert Storm," Presentation to the Committee on Appropriations, Subcommittee on Defense, U.S. House of Representatives, 30 April 1991, p. 469.

[14]"Deterrence of Nuclear, Biological, and Chemical (NBC) Weapons in Regional Conflicts," workshop sponsored by the Office of the Assistant to the Secretary of Defense (Atomic Energy), Deputy for Counterproliferation, McLean, VA., April 21, 1995.

[15]Ken Watman and Dean Wilkening, *U.S. Regional Deterrence Strategies*, RAND, 1995, p. xii., 81.

[16] Jasper Welch, *Conventional Long Range Bombers—How Many of What Types Do We Need ?* Part I and II, 1992, 1994.

considering cost-effectiveness issues in operations, manned aircraft are much more attractive weapon systems.[17]

The standoff weapon argument is that such munitions like the Conventional Air Launched Cruise Missiles (CALCMs) employed by B-52Gs on the opening night of Desert Storm provide an adequate substitute for the B-2's ability to penetrate near or over targets and attack them with direct-attack weapons like the Joint Direct Attack Munition (JDAM). Because CALCM-class precision weapons allow B-1s and B-52s to fire from outside the reach of enemy air defenses, both older bombers can attain equivalent effectiveness to a B-2 during the critical opening phases of a Major Regional Contingency (MRC).

A fundamental difficulty with this view is the high per-round cost of standoff precision munitions compared to direct-attack precision munitions. At present, CALCM and comparable cruise missiles cost over $1 million a round. At these prices, precision standoff weapons with sufficient range to enable older bombers to have comparable survivability to a B-2 cost 15-25 times as much as direct-attack munitions. This cost differential means that for campaign-level tasks, the cost of a non-stealth bomber force relying primarily on standoff precision becomes excessive. Figure 6 is a hypothetical example that illustrates if only half the munitions expended by older bombers are standoff, the expenditure cost is near $15 billion after 30 days. Considering past DOD munitions funding priorities, this figure is so high that the likelihood of DOD purchasing sufficient quantities of standoff weapons for the campaign is low. During Desert Storm less than 8% of the some 230,000 munitions expended during 43 days of coalition air operations were precision guided. Yet the small percent of precision weapons accounted for around 80% of the estimated $2.5 billion for munitions expended by coalition air forces.[18] Standoff precision weapons usage was terminated relatively early during the Gulf War, due to high cost concerns, and stealth assets were used instead in the same areas.[19]

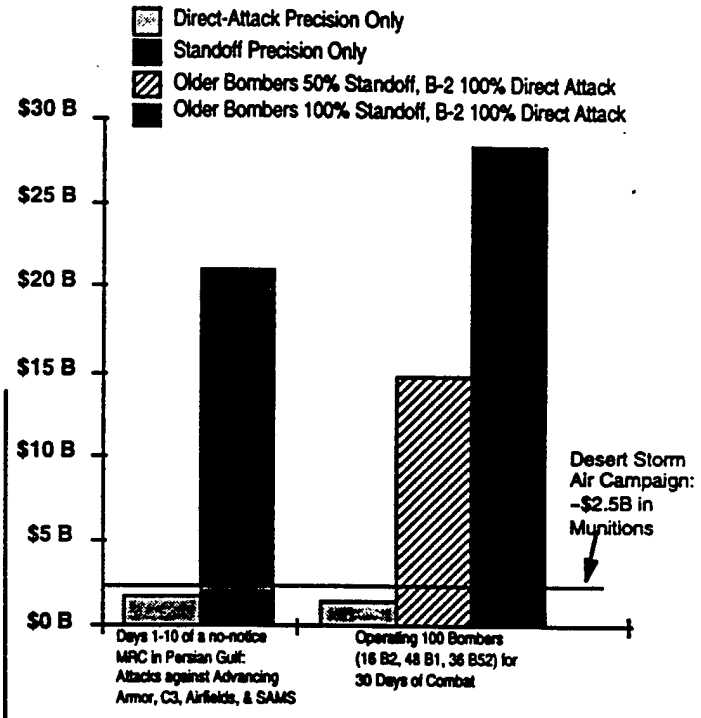

Figure 6—Standoff versus Direct-Attack Costs[20]

[17]Chris J. Bowie, K. Braich, Lory Arghavan, M. Agmon, M. Morris, *Trends in the Global Balance of Airpower*, RAND Corp, 1995, pp. 73-80.

[18]Data from *Gulf War Airpower Survey*.

[19]TLAM launches were suspended on 1 Feb 1991, with 28 days (65 percent) of the Gulf War remaining.

[20]Data from Jasper Welch, *Conventional Long Range Bombers, 1994*. Advanced precision anti-armor munitions are included in the first ten day no-notice case that are not included in the 30 days of combat example.

Technology can be expected to bring some decrease in the per-round cost of standoff precision weapons in the decades ahead. However, there are no technologies on the horizon that postulate or promise cost reductions large enough to erase the present 15 to 25-fold cost advantage of direct-attack precision weapons. In this regard it is sobering to note that when the Tri-Service Standoff Attack Missile (TSSAM) was canceled, the unit price had reached $2.5 million per round.[21]

Assumptions of acting on warning:

The DOD annual report states that "History shows that the location and timing of aggression often cannot be anticipated, even large scale attacks."[22] Theoretically, the U.S. could act on warning to deploy troops and carrier and land-based fighters to a rapidly unfolding crisis. However the U.S. record of timely taking action on strategic warning is poor. Pearl Harbor, Korea, the Suez Crisis, the Tet Offensive, the 1967 and 1973 Arab-Israeli wars, the fall of the Shah of Iran, the fall of the Berlin Wall, and the 1990 invasion of Kuwait are just some examples of instances where the U.S. was surprised. One noted scholar on the subject believes that, "For hedging against sudden attack, less promise lies in solutions aimed at reducing the probability of surprise than in those that make plans, strategies, and operational doctrines effective if surprise occurs."[23] Others agree with this view.

It is often difficult to sort out what is going on before a crisis occurs. And when a crisis situation is realized, our political process is not designed for swift action. Internal (congressional and popular support) and external coalitions must often be formed prior to deployment of large-scale forces to an area. Additionally, movement is often inhibited because of fear of escalation. Intelligent adversaries will capitalize on these realities by masking their intentions to reduce the amount of warning time the U.S. needs to conduct large force deployments. In the future these situations will be compounded by the proliferation of ballistic missiles and WMD, and potential aggressors' belief that they can seize their objectives before the U.S. would risk intervention with sufficient force to stop an invasion.

Deploying large numbers of land forces to respond on warning places great strain on declining military budgets for unforeseen contingency operations. Relying principally on land forces for contingency response also allows an adversary to 'pulse' U.S. response, driving up costs through personnel-intensive deployments and desensitizing the U.S. to the timing of actual hostile action in a manner similar to the Egyptians lulling the Israelis into a false sense of security prior to the October War of 1973. This was a concern surrounding the U.S. deployment in response to the 1994 Iraqi mobilization.

The probability of America's acting upon warning of overt aggression is diminishing. The U.S. could be hesitant to send troops into harm's way because of questions over the importance of our interests involved, because there is no certain counter to the WMD threat to deploying surface forces, or a variety of other concerns. Long-range stealth bombers with armor-stopping munitions provide a unique, cost-effective capability that can overcome these inhibitions that

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[21] Bradley Graham, "Missile Project Became a $3.9 Billion Misfire," *Washington Post*, 3 April 1995, p. A8.

[22] William J. Perry, Annual Report to the President and the Congress, February 1995.

[23] Richard K. Betts, *Surprise Attack: Lessons for Defense Planning*, The Brookings Institution, Washington, D.C., 1982, p. 4.

otherwise limit national security decision-making options. Availability of B-2s may actually increase the probability of acting on warning since large personnel movements are not involved. Because of its responsiveness, a B-2 force can be placed on alert to conduct operations without the elaborate, expensive and potentially escalatory arrangements needed to deploy short-range theater forces. B-2 readiness can be raised quietly (to minimize the potential for escalation) or overtly (to illustrate U.S. concern). This kind of crisis management potential provides decision-makers with national security options previously not available.

Sizing of Bomber Force Structure:

Analytically, there is no 'correct' number for bombers, or any other type of force. The bottom up review postulated a *minimum* warfighting requirement of 100 deployable bombers. However, this number is based on a strategy requiring bomber forces to 'swing' from one MRC to another in the event of conflict. The head of the Air Combat Command has labeled this untested strategy "risky."[24] Consequently many factors drive the sizing of the U.S. bomber force. Some of these include: suitability for regional employment; the value of being able to engage quickly (see figure 7); regional threat potential; reduced likelihood of sufficient forces in-place; future conventional forces; complementary use of force (early use of B-2, followed by non-stealth bombers, sea and land-based fighters, and ground forces.)

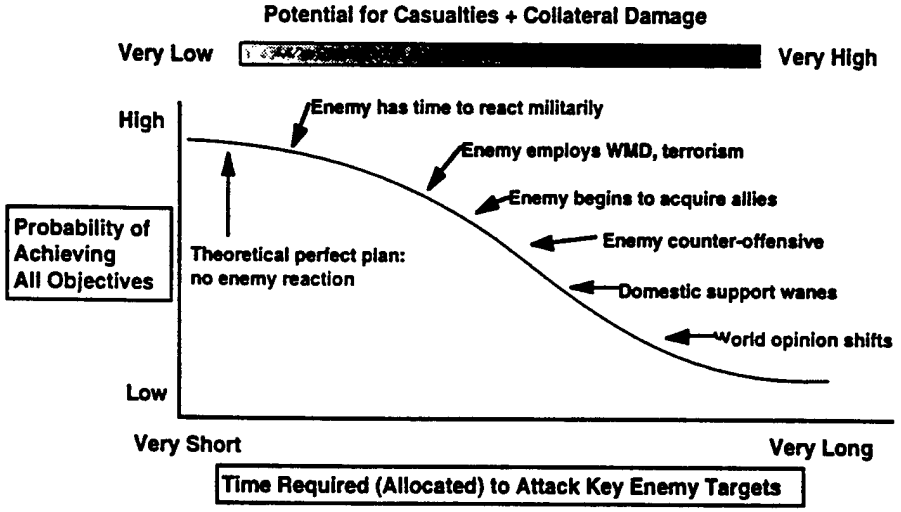

Figure 7—Time Value of War

Congress expressed an interest in the potential synergy of complementary use of aircraft carriers and long-range bombers. Neither bombers or carriers require land-bases in-theater to operate. Several potential combinations of bomber-carrier operations are possible. For example, B-2 bombers could provide suppression of enemy air defenses (SEAD) for non-stealthy carrier-based aircraft. Conversely, the use of carrier aviation to provide SEAD could enable use of non-stealth bombers to the extent that carrier-based air could reach targets of concern. Range limitations of carrier-based air without refueling will generally restrict providing SEAD for non-stealth bombers to distances much less than bombers are capable of reaching. In early stages of a

[24]John D Morrocco, "B-2s Future Hinges on Debate Over Cost," Aviation Week & Space Technology, April 17, 1995, p. 54.

conflict carrier-based air range limitations become more acute when concerns of fleet defense tend to keep carriers further away from potential land and sea-based threats (as demonstrated during the Gulf War and reaffirmed during recent joint exercises).[25] Land-based tankers are one means of extending sea-based air ranges. However, the presumption of land-based tankers generally means that land-based combat aircraft will also be available.

To stop an armored invasion of moderate size in about two weeks from a cold start, current bombers require varying degrees of upgrading and higher inventories of advanced conventional munitions. How well these upgrades will perform and how much cueing they will need from theater reconnaissance, including JSTARS, is a matter of development and testing. Moreover, the older bombers' lack of stealth limits their usefulness and their survivability in areas of high enemy air defenses—regardless of what stage of the war is on-going. Aircraft carrier deployment speed and numbers of strike aircraft may restrict their ability to halt MRC-size armored invasions by themselves. Carrier strike aircraft are non-stealth (until JAST comes on-board) and require large support packages to penetrate well-defended airspace, further reducing aircraft available for strike.[26] Land-based fighters require access to in-theater bases and non-stealth fighters also require large support packages to penetrate well-defended airspace. These realities suggest that the size of the bomber force is crucial to successfully performing the task of stopping armor movements, SEAD, strategic attack, and destruction of an enemy's WMD delivery capability early in an intervention.

If procuring and upgrading B-2s is more cost-effective over the next 20 years than other means of projecting *effective* force early in a conflict, then continued low-rate production of the B-2 may be the best investment path. Some B-52s with standoff weapons, and B-1s for direct delivery in low to moderate threat areas could serve as the backup to a growing B-2 force. How large the B-2 force should eventually become depends upon the evolving threat potential, the effectiveness of programmed and future B-2 upgrades, and the anticipated size of the target base. For example, by 2001 the planned DOD B-2 force will be able to attack the complete anticipated time-critical target base for an MRC in 3 to 4 nights.[27]

Total inventory numbers on the order of 50 to 60 B-2s would significantly reduce the risk of underestimating the enemy target base or unanticipated enemy threats, and have the potential to provide the U.S. greatly enhanced strategic and operational alternatives.[28] Evaluation of offsets indicate that this may also be a cost-effective alternative, and in some cases may result in a significant increase in force application capability with significant budget savings (see tables 3, 4 and appendix 2).

Balance of major force elements:

Bombers, land-based and carrier-based fighters each have a set of unique attributes. Some of these qualities are shared by other elements of this airpower "triad" while others remain

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[25]Planning Guidance on Carrier and Carrier Air Wing Employment in Joint Fleet Exercise 95-2, February 1995.

[26]SEAD/EW accounted for about 20 percent of Gulf War carrier-based theater, maritime strike, and SEAD sorties. *Statistics of Carrier Fixed-Wing Flight Operations During Operation Desert Storm*, CNA report CIM 166, 1991.

[27]DIA target data base and Air Force Operational Issues Group (AF/XOI).

[28]See *Providing an Effective Bomber Force for the Future*, Rand, 1994, and Jasper Welch, *Conventional Long Range Bombers—How Many of What Types Do We Need ?* Part I, 1992 and II, 1994.

unique. Fighters and bombers are both major force elements available to meet the emerging challenges of the future security environment as are the other major force elements displayed below.

Major Conventional Force Elements (2000)[29]

1 Stealth Bomb Wing (16 aircraft)	1 Stealth Fighter Wing (36 aircraft)
5 Non-Stealth Bomb Wings (138 aircraft)	35 Fighter Wings (2226 aircraft)
22 Divisions	12 Aircraft Carrier Battle Groups
21 Independent Brigades/ACRs	11 Amphibious Ready Groups
55 Attack Submarines	59 Aegis Surface Ships (more programmed)

The uncertainties involved in any combat operation require that we maintain a mix of robust capabilities from an increasingly smaller force structure. Given the current trend of reduced military forces and lower defense budgets, common sense would suggest adjusting the balance of major force elements in favor of those providing equivalent or greater combat capability with lower life-cycle cost. Figure 8 shows the make up of life cycle costs for some major force elements. The best insurance for an uncertain future lies in a balance of forces—our current plans are heavy with traditional forces and light in capitalizing on the value and capability of long-range, high-payload, stealth. It is clear that as weapon system modernization occurs, the systems that the DOD should procure and improve are those that provide the greatest addition to deterrence and warfighting capability for their investment.

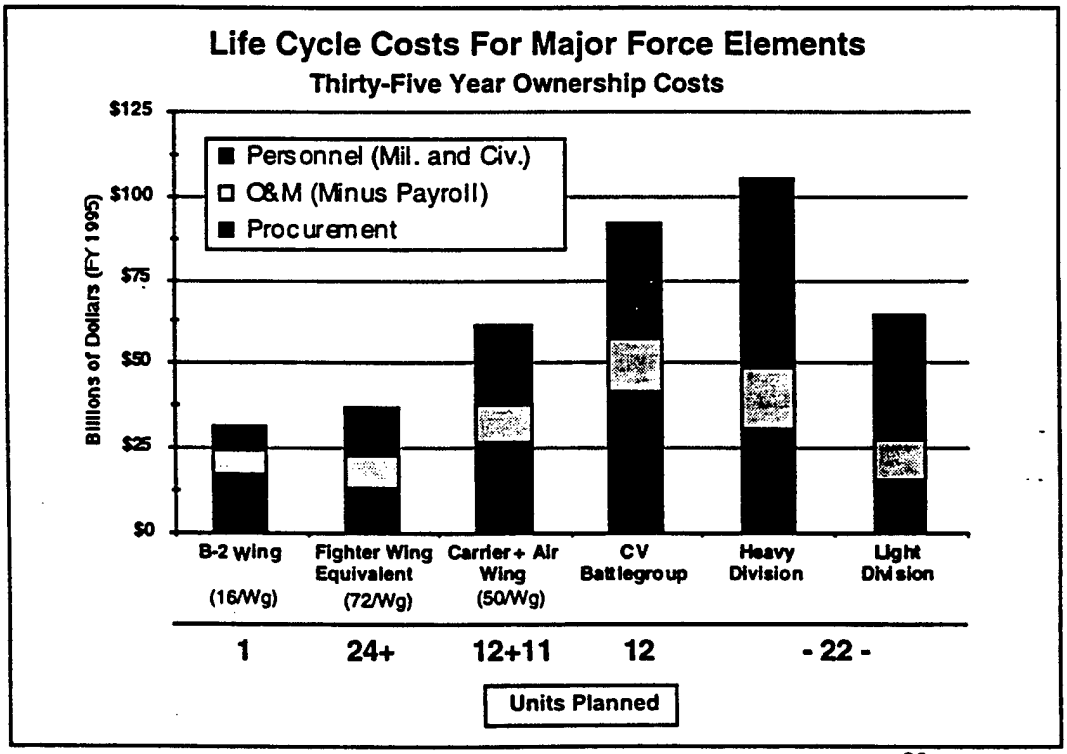


Figure 8—Life-Cycle Costs of Some Major Force Elements[30]

[29]Aggregations of forces include all Services where applicable, for example fighter wings include Air Force, Navy, and Marine aircraft. Divisions include Army and Marine. Totals include active and reserve components.

[30]Data from "Military Force Structure Planning Study," Lockheed Analytical Group, 1994; SecDef Annual Report FY 1995; B-2 cost data from USAF cost estimates.

As part of the Commission staff study, investment priorities in the current FYDP were reviewed. The current DOD investment plan for aircraft modernization is illustrated in figure 9.

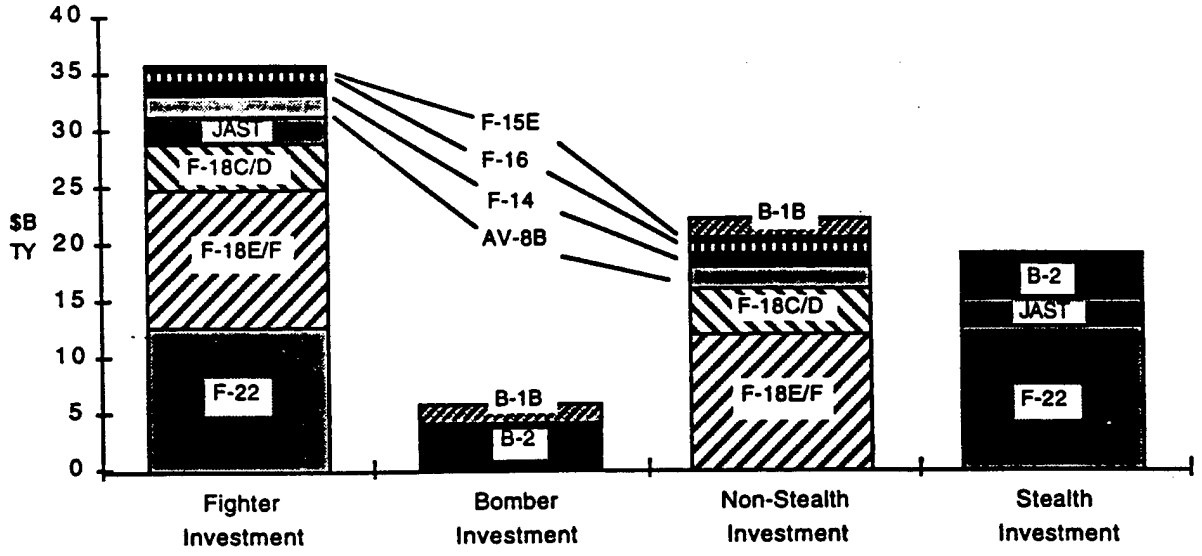


Figure 9—Aircraft Investment Priorities in FY95 FYDP[31]

It appears that current DOD investment priorities are still affected by decisions made prior to the emergence of new security realities and require adjustment if the attributes embraced by the Commission are accepted as relevant for shaping DOD's future. *Following the FYDP, no new bomber procurement is currently planned. Furthermore, over the FYDP we are spending slightly more on non-stealthy, current generation fighters than we are on stealthy fighters and bombers combined.* In short, the administration plans almost by default to rely on fighter aviation to replace the bomber force. Under current plans the bomber force will inevitably erode in both size and capabilities.

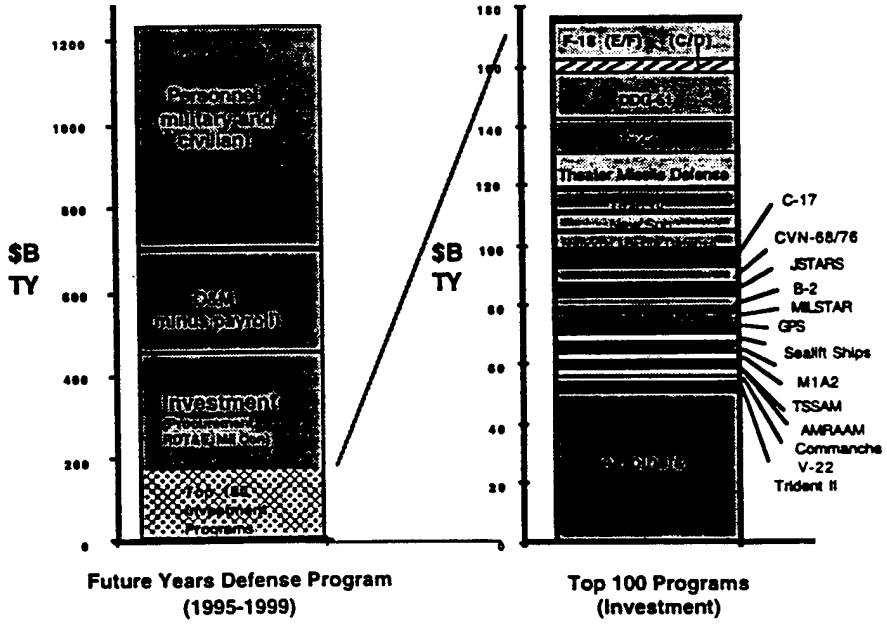


Figure 10—FY 95 FYDP and Top Investments[32]

[31] Selected Weapons Costs from the Presidents 1995 Program, Congressional Budget Office, 1994.
[32] Ibid.

Operational Modeling and Analysis:

Review of the variety of analyses conducted regarding air operations in general and bomber forces in particular indicate that the analytic community and most military force planners have not adequately modified their modeling and simulation tools to account for the multiplier effect of the combination of stealth and precision or for the potential of an effects-based targeting methodology. For the most part the significance of the combination of stealth and precision is under appreciated and analysts are still captured by the traditional attrition-based approach to campaign modeling. Using traditional destruction-based measures of effectiveness, modeling of F-117 performance shows its payload contribution marginal in a large deployment of fighters (relatively small payload and few numbers). Yet during our latest MRC it was the most effective and highly leveraged aircraft participating, and a key element of our success.

During the Commission evaluation no analytic models or simulations were encountered that incorporate targeting to achieve systemic effects against particular target systems. This is a serious deficiency in state-of-the-art campaign modeling and analysis and may have severe consequences in limiting the evaluation and production of innovative technologies, systems, and concepts with the potential for dramatically leveraging DOD capabilities for the future. We need to make sure we correctly analyze what best contributes capability to accomplish desired effects in the future, and not revert to outmoded, but convenient analytic tools of input-based rather than output-based measures of effectiveness.

Option Evaluation Summary

OPTION 1—Endorse termination of U.S. bomber production (current program)

PRO: Does not require near-term additional funding or offsets.

CON: Terminating production of bombers as a major force element of American defense strategy halts modernization and limits a ***singular*** U.S. capability. By 2011 bombers will be the oldest major force element in the U.S. inventory.[33] A decision not to build more B-2s foregoes American aerospace competitive advantage in long-range, high payload stealth. The B-2 possesses all the attributes the Commission has found relevant to shaping America's defense needs for the future. Stopping production of the B-2 limits America's future ability to project influence around the world. This limits strategic and operational national security options, and it could cost money if production of the B-2 or a similar aircraft is resumed before about 2005.

OPTION 2—Recommend continued production of the B-2 without comment on size or offsets

PRO: This option allows the Commission to provide specific comment on a system that encompasses all the attributes it finds desirable for forces and operational concepts in the 21st Century without getting into DOD's business of force sizing or trade-off selection (see figure

[33]"Defense in the Late 1990s: Avoiding the Train Wreck," The Center for Strategic & International Studies, Washington, D.C., 1995, p9.

11). The B-2 is the key to the future of the U.S. bomber force and enhances our ability to rapidly project power anywhere in the world. Seven former Secretaries of Defense believe the B-2 is the single most cost-effective means of rapidly projecting force over great distances, and have stated so to the President.[34] The preponderance of bomber studies and analyses reviewed, and the Commission staff evaluation suggests that more B-2s are a cost-effective way to enhance our future national security needs in an uncertain security environment. This option articulates what the Department of Defense may be institutionally hesitant to do considering that a long-range stealthy bomber with all weather precision capability provides a means of force application that challenges *all four* Services' traditional institutional force structure sizing mechanisms, and much of the existing force structure.

CON: Takes a position different from current DOD plans. Implies additional funds or offsets must be identified.

OPTION 3—Recommend additional B-2 production at a low rate (1.5 or 3 B-2s per year)

PRO: Low rate production of the B-2 provides the U.S. a hedge against uncertainty until the security environment becomes more defined, preserves America's aerospace technological leadership, bomber industrial base, and sustains U.S. responsive power projection capability by gradually replacing older bombers with newer ones providing much greater force, personnel, and economic leverage. A decision on the ultimate size of the B-2 force can be made when U.S. understanding of the post-Cold War security environment becomes clearer. Additionally, the benefits of low-rate production include continued capitalization on B-2 research and development investment, maintenance of a stable, skilled, and efficient work force, and keeps annual funding low enough to allow other modernization programs to remain on track. Studies of the sustained acquisition of capital ships and submarines show that low-rate production can provide a robust, modern, and affordable force. Additional inventory in the year 2010 as a result of a 1.5/yr. and 3.0/yr. production rate are 14 additional/11 combat coded, and 27 additional/22 combat coded respectively.

CON: Not programmed in current DOD budget plan. Requires funding and affects budgets for 1996 and beyond. Future means for long-range stealth high payload force application may not feature large bombers.

OPTION 4—Recommend a specific B-2 force size objective

PRO: As U.S. overseas bases close and more forces are withdrawn, our response to unpredictable regional conflicts will come increasingly through power projected from the U.S.. Capitalizing on a cost-effective means of rapidly projecting force from the U.S. through a high rate production buy of a specific number of B-2s is an economical option over the long-term. Increasing the balance of major force elements away from high life-cycle cost systems to lower life-cycle cost systems with greater combat capability allows the U.S. to obtain more combat power from reduced budgets. The most analytically rigorous and complete studies to date on B-2 force sizing, suggest that the planned force of 20 B-2s are not adequate to meeting the demands

[34]Melvin Laird, James Schlesinger, Donald Rumsfeld, Harold Brown, Caspar Weinberger, Frank Carlucci, Dick Cheney, Letter to the President of the United States, January 4, 1995.

of a two MRC strategy. A total force of 40 to 60 B-2s facilitate a two MRC strategy and meet the demands of the current and emerging security environment. Evaluation of offsets indicate that alternatives are available that cover B-2 buys up to 55 additional aircraft resulting in significant increases in force application capability along with significant budget savings.

CON: Providing specifics on force sizing is a difficult and uncertain process particularly in a climate of change. Current planned and programmed force will require offsets to fund additional bombers within current budget levels. High individual unit B-2 procurement cost. (Approximate 18 year total cost estimates corresponding to an additional 14 to 55 B-2s are: 17 to 69 B$FY 95.)

CRITERIA / OPTION	18YR Cost (1995 $B)	Resp-onsive-ness	Robust-ness	Innov-ation	Comp-etition	Coop-eration	Effici-ency
Baseline: Terminate U.S. Bomber Production	0	—	—	0	0	0	0
Recommend continue B-2; no comment on inventory size	?	+	+	+	+	+	+
Recommend low-rate B-2 production (1.5 or 3.0/yr)	17 to 40	++	++	+	+	+	++
Recommend specific force size increment (20-55)	22 to 69	++	+++	+	+	+	+++

Figure 11—OPTION EVALUATION SUMMARY

Responsiveness—Enables U.S. to respond to more locations/crises simultaneously.
Robustness—Enables rapid shift of increasing amount of effective force facilitating 2 MRC strategy, improves ability to quickly halt armor invasions, enhances effects of conventional regional deterrence, improves overall warfighting capability, and reduces enemy options.
Innovation—Allows increased exploitation of innovative warfighting strategies, expands conventional regional deterrence and alternatives for conventional presence. Increases ability to surprise at operational and strategic levels.
Competition—Provides incentives to develop alternative means to attain similar levels of effectiveness at less cost per unit.
Cooperation—Multiplies force effectiveness through complementary use with non-stealthy assets such as providing suppression of enemy air defenses for carrier-based aircraft allowing more carrier aircraft to conduct strikes.
Efficiency—As production rate/amount increases, unit cost and unit support cost decreases. Allows operations with fewer personnel, reduced personnel exposed to combat, resources required, and less cost to achieve equivalent effects with non-stealth aircraft.

APPENDIX 1: Bomber and Force Structure Studies Reviewed as Part of CORM Deep Attack Evaluation

A. 2 MRC SCENARIO: FORCE CAPABILITY STUDIES

1. The Bottom–Up Review (BUR): *Forces for a New Era*, Secretary of Defense, 1993
2. Portions of (S) *Nimble Dancer—CJCS's 2 MRC Wargame*, Conventional Forces Analysis Division, J–8, Nov 1994
3. (S) *Two Nearly Simultaneous Major Regional Conflict (MRCs) Warfighting Analysis*, PA&E, General Purpose Programs, 1994
4. (S) *Air Power in Two Nearly Simultaneous Major Regional Contingencies*, AF Studies and Analyses Agency (AFSAA), Aug 1994
5. (S) *Land-Based Airpower (Two Major Regional Conflicts)*, HQ ACC, 1994
6. (S) *Contribution of Land and Sea-Based Air Power to a MRC*, AFSAA, May 1994
7. *U.S.A.F. Force Structure Studies*, McDonnell Douglas, 1992–1994

B. BOMBER FORCE STRUCTURE STUDIES

8. (S) *OSD Heavy Bomber Study*, IDA, May 1995
9. (S) *Bomber Flexibility Study*, Rand, Feb 1995
10. (S) *Near Simultaneous MRC; Assessing the Contributions of the Bomber Force – 2014*, BDM Federal Inc., 1995
11. *The B-2 Bomber, A Study in Future Strategic Utility*, National Institute for Public Policy, 1995
12. *Combined Arms Study Force Structures*, Boeing Defense and Space Group, 1995
13. (S) *SWA Thunder Campaign Analysis*, Rockwell Aerospace, 1995
14. *Conventional Long Range Bombers—How Many of What Types Do We Need ?* Part I and II, Jasper Welch, 1992, 1994
15. (S) *Future bomber Force Study*, Rand, 1994
16. *B-1B IDA Review*, Rockwell, 9 Nov 1994
17. (S) *Bombers in the 21st Century*, (AFSAA), Sep 1994
18. *Force Size and Structure: The Bomber Mix*, Burdeshaw Associates, Ltd., 18 July 1994
19. (S) *Whither the Bomber Force? the Budget Crunch and the "New World Order,"* Rand, 1993
20. *The Need for Bomber Forces*, ANSER, 1992
21. *Comparisons Between STR and J. Welch Bomber Analyses*, Leon Goodson, 1995

C. GENERAL FORCE STRUCTURE STUDIES

22. (S) *Assessment of the Tactical Effectiveness of Baseline Strike Systems in the Joint Land Battle*, CNA 1995
23. (S) *Sea–Based Firepower for the Joint Land Battle: Profiling the 2005-2010 Leading-Edge Forces*, CNA, 1994
24. *Military Force Structure Planning Study*, Lockheed, Fort Worth, 1994
25. *The New Calculus, Analyzing Airpower's Changing Role in Joint Theater Campaigns*, Rand, 1993

APPENDIX 3: COST ASSUMPTIONS

(18-year life cycle costs for FY1996-2013, in billions of FY 95 dollars)

DESCRIPTION	COST	ASSUMPTIONS
Add 20 B-2s	+22-30* (ACQ: 17-22, O&S: 5-8)	Costs include direct plus indirect O&S, R&D, and Procurement First buy assumed to occur in FY96
Add 55 B-2s	+52-69 (ACQ: 40-50, O&S: 12-19)	Actual Cost will depend on the following factors: Production rate, Deployment plans, Basing plan, Cost to restart production, Aircraft maintenance
Add 2 F-15E Wings	+25 (ACQ: 13, O&S: 12)	Costs include direct plus indirect O&S, R&D, and Procurement First buy assumed to occur in FY96, last in FY01 Procurement costs are based on: "Cost Estimate for Future Tactical Aircraft Forces," IDA Document D-1430, Draft, August 1994 Procurement factor = 1.4 Lead Time = 2 years
Reduce CVs by 2	-23 (ACQ: -4, O&S: -19)	Reduce carrier force from 12 to 10. Retire one CV with air wing per year starting in FY96 Costs include direct plus indirect O&S, R&D, and Procurement. Forces include F-14D, F-18C, E-2C, S-3B, SH-60, HH-60
Reduce CVBGs by 2 and postpone CV-77 indefinitely	-38 (ACQ: -10, O&S: -28)	Each CVBG eliminated contained 2 Ticonderoga-class AEGIS Cruisers 2 Arleigh Burke-class AEGIS Destroyers 2 Spruance-class Destroyers 2 Los Angeles-class Submarines
Reduce CVs by 4	-46 (ACQ: -15, O&S: -31)	Reduce carrier force from 12 to 8. Retire one CV per year starting in FY96. Reduce air wings from 10 to 7. Costs include direct plus indirect O&S, R&D, and Procurement Forces include F-14D, F-18C, FA-18C (N&R), FA-18E/F, E-2C, S-3B, SH-60, HH-60. Postpone CVN-77 indefinitely. First new start CVN replacement occurs after 2013
Reduce CVBGs by 4	-64 (ACQ: -17, O&S: -47)	Each CVBG eliminated contained: 2 Ticonderoga-class AEGIS Cruisers, 2 Arleigh Burke-class Destroyers,2 Spruance-class Destroyers, 2 Los Angeles-class Submarines
Retire B-1B Fleet	-26 (ACQ: -6, O&S: -47)	Costs include direct plus indirect O&S, R&D, and Procurement CMUP R&D from DPP (PB FY96)
Reduce F-16C/D Wings by 4	-19 (ACQ: -6, O&S: -17)	Costs include direct plus indirect O&S, R&D, and Procurement. Two active and two reserve wings retired over 4 years
Reduce the F-22 buy by 50%	-20 (ACQ: -21, O&S: +1)	Costs include direct plus indirect O&S, R&D, and Procurement F-15Cs substituted 1-for-1 for the F-22 ~36 additional F-15Cs bought to maintain force structure
Replace F-18E/F buy with new F-18C/D	-15 (ACQ: -13, O&S: -2)	Costs include direct plus indirect O&S, R&D, and Procurement Marines retain F-18Cs Included R&D costs may not have captured all F-18E/F aircraft F-18C substituted 1-for-1 for the F-18E/F to maintain force structure
Cancel F-18E/F	-50 (ACQ: -40, O&S: -10)	Marine F-18Cs fully integrate into carrier deployment cycles to maintain carrier air wing structure until JAST can replace. May require extension of service life on some USN F-18Cs
Reduce DDG-51 by 50%	-16 (ACQ: -14, O&S: -2)	15 Ships (based on lead time of 3 years) Costs include direct plus indirect O&S, R&D, and Procurement DPP procurement to 55 ships reflected in this estimate 15 FFG-7s maintained to replace deleted DDG-51s Includes $0.4 B to add VLS to 8 DD-963 Spruance Class Destroyers

*NOTE 1: B-2 cost figures are highly dependent upon the list of factors included in their calculation. For comparison to the IDA figures, Air Force figures for adding 20 B-2s run from $12.8 B (Recurring Flyaway $FY95) to $25.7 B (20 Year Life Cycle). Northrop Grumman cost proposals are less.

NOTE 2: Procurement takes into account spares as well as new system acquisition costs.

DRAFT

DESCRIPTION OF CASES

RESPONSIVENESS SCENARIO

(7 Days of Combat)

(8 Cases)

WARNING	FORCES	DEFENSES: MINIMAL (Support Packages Not Needed)	DEFENSES: HEAVY (Conventional Bombers Need Escort/SEAD Support)
MINIMAL C-DAY = D-DAY	BOMBERS ONLY	A • INITIAL STRIKE ORIGINATES AT CONUS BASES WITH RECOVERY AT FORWARD BASES • STRIKE FORCE: 100 BOMBERS	E • ONLY STEALTH BOMBERS (B-2s) CAN BE USED • EITHER CARRIER UNAVAILABLE OR TARGETS BEYOND RANGE OF CARRIER STRIKE AIRCRAFT • STRIKE FORCE: 16 B-2s
	ADD ONE CARRIER	B • PROBABILITY CARRIER IS PRESENT DEPENDS ON NUMBER OF CARRIERS IN FLEET • LAND BASES NOT AVAILABLE • STRIKE FORCE: 100 BOMBERS AND 50 F/A-18s	F • IF CARRIER IS PRESENT IT IS USED TO SUPPRESS DEFENSES AND ESCORT BOMBERS; NO NAVY STRIKE MISSIONS • B-1Bs AND B-52Hs AVAILABLE FOR STRIKE IF CARRIER PRESENT • STRIKE FORCE: 16 OR 100 BOMBERS
	ADD LAND-BASED FIGHTERS	C • F-15E, F-16C, F-117 BEGIN DEPLOYING ON D-DAY. ASSUME WEAPONS, FUEL, AND CREWS AVAILABLE ON ARRIVAL • STRIKE FORCE: 100 BOMBERS, 50 F/A-18s, AND 112 AF FIGHTERS (70 F-16Cs, 30 F-15Es, and 12 F-117s)	G • 50 PERCENT OF F-16Cs USED TO FLY ESCORT AND SUPPRESS DEFENSES • ALL TLAMS AND 50 PERCENT OF CARRIER STRIKE AIRCRAFT USED FOR SEAD AND AIR ESCORT • STRIKE FORCE: 100 BOMBERS, 25 F-18s, AND 77 AF FIGHTERS
EXTENDED (NO LAND AIR BASES MADE AVAILABLE IN COMBAT AREA)	BOMBERS AND TWO CARRIERS	D • TWO CARRIERS, EACH AUGMENTED WITH AN F/A-18 SQUADRON ARE PRESENT • BOMBERS FORWARD DEPLOYED PRIOR TO D-DAY • STRIKE FORCE: 100 BOMBERS, 124 F-18s	H • ALL TLAMS AND ONE HALF OF CARRIER STRIKE AIRCRAFT USED EXCLUSIVELY FOR DEFENSE SUPPRESSION AND AIR ESCORT • ALL REMAINGING F/A-18s USED FOR STRIKE • STRIKE FORCE: 100 BOMBERS, 62 F/A-18s

NOTES:

1. [A] REFERS TO CASE A
2. STRIKE FORCE IS SPECIFIED FOR THE CURRENT PROGRAM. IT WILL CHANGE AS A FUNCTION OF OPTION. FOR EXAMPLE, OPTION A WILL ADD 16 B-52s TO EVERY STRIKE FORCE.
3. TWO NOMINAL WEAPON LOADS MEASURED IN
   - NUMBER OF 1000 LB CLASS SUBMUNITION DESPENSERS (E.G., WCTMDs) DELIVERED IN 7 DAYS
   - NUMBER OF TONS DELIVERED IN 7 DAYS
4. SURGE SORTIE RATES USED FOR FIGHTERS

RESPONSIVENESS SCENARIO
(RANGE/PAYLOAD ANALYSIS)

AIRCRAFT TYPE	MOBILE TARGETS			FIXED TARGETS		
	WEAPON LOAD (SUBMUN [a])	UNREFUELED MISSION RADIUS (NM)	NUMBER OF TANKS/SIZE	WEAPON LOAD (TONS)	UNREFUELED MISSION RADIUS (NM)	NUMBER OF TANKS/SIZE
F-15E	12	350	1 / 610 gal	4	730	2 x 610 gal
F-16C	8	250	1 / 610 gal	2	540	2 x 370 gal
F-117 (HHH)	2	570	0	2	570	0
F/A-18E/F	12	215	0	3	540	3 / 480 gal
F/A-18C (N)	8	115	0	2	420	3 / 330 gal
B-2 (HHH)	36	~3,000	0	16	~3,000	0
B-1B	30	2,550	0	16	2,550	0
B-52H	24 ~~16~~	2,650	0	19	2,650	0

[a] 1000 lb class munition dispenser containing munitions such as CEBs and SFWs (e.g., WCTMD)

Assumptions:

1. H-L-H mission with low altitude leg of 100 nm (exceptions: F-117 and B-2 fly HHH).
2. Standard day, no winds.
3. Retain tanks (if used).
4. Fuel reserves: 20 minutes (except F/A-18C: 1,500 lb/30 min)
5. Low level velocity assumptions

F-15E: 480 knots
F-16C (Block 40): 480 knots
F/A-18E: 480 knots
F/A-18C: 480 knots
B-1B: 540 knots
B-52H: 380 knots

SORTIE RATES AND WEAPON LOADS

SUSTAINED FIREPOWER SCENARIO

AIRCRAFT TYPE	DESERT STORM EXPERIENCE		EQUAL SORTIE RATES	
	SORTIES/ AIRCRAFT/ DAY	WEAPON LOAD (TONS)	SORTIES/ AIRCRAFT/ DAY	WEAPON LOAD (TONS)
F-15E	1.08	4	1.3	7
F-16C	1.29	2	1.3	4
F-117	0.74	2	1.3	2
F-22	1.44	1	1.3	5
A-10	1.45	4	1.3	8
F/A-18E	1.31	3	1.3	5
F/A-18C (N)	1.19	2	1.3	4
F/A-18C/D (MC)	1.51	2	1.3	4
AV-8B	0.95	2	1.3	4
B-2	0.69	16	0.6	16
B-1B	0.69	16	0.6	24
B-52H	0.69	19	0.6	19

ASSUMPTIONS FOR DESERT STORM EXPERIENCE
1) SORTIE RATES FOR EXISTING AIRCRAFT DERIVED FROM GWAPS DATABASE
2) F-22 SORTIE RATE 10 PERCENT BETTER THAN F-18E
3) F/A-18E SORTIE RATE 10 PERCENT BETTER THAN F/A-18C
4) B-1B CARRIES TWO BAYS OF BOMBS
5) INTERNAL CARRIAGE ONLY FOR F-22

SOME ASSUMPTIONS USED IN "TRUCKING" CALCULATIONS

- YEAR: 2010-2015 (ALL PROCUREMENT COMPLETED)
- TO SIMPLIFY THE CALCULATIONS, IT IS ASSUMED THAT ALL AIRCRAFT CARRY THE SAME CLASS OF WEAPON. TWO SITUATIONS ARE PRESENTED
  - Aircraft Attack Mobile Targets Like Advancing Armies. The Measure of Merit is the Number of 1,000 lb Class Submunition Dispensers Delivered (SFWs, CEBs, ...). An Example of Such a Weapon is the Wind Corrected Tactical Munitions Dispenser (WCTMD)
  - Aircraft Attack Fixed Targets. Unitary Weapons Are Used and the Measure of Merit is the Number of Tons Delivered.
- AIRCRAFT WEAPON CARRIAGE
  - Two Payloads Used
    - -- Near Maximum Capability
    - -- Similar To Desert Storm Experience
  - Not Limited by Current Program
    - -- E.g., B-2 Bomb Rack Wired To Carry 36 WCTMDs
    - -- All A/C Assumed Certified for 1,000 lb Class Submunition Dispenser Like the WCTMD
- NO LIMIT ON THE NUMBER OF WEAPONS AVAILABLE
- LOGISTICS SUPPORT ASSUMED TO BE AVAILABLE WHEN NEEDED
- ALL AIRCRAFT ASSUMED TO FIND THEIR TARGETS
- DEPLOY/USE 100 FROM CURRENT BOMBER FORCE (TAI 181)
  - Sixteen B-2s, 70 B-1Bs, and 14 B-52Hs
  - Remaining Combat Coded Bombers Are Held In Reserve In CONUS for Contingency Operations and SIOP Withhold
  - All PAA Aircraft Resulting From New Bomber Buy Are Added To Deployed Force (e.g., 20 B-2 Buy Increases Deployed Bomber Force To 116)

Area	Stealth Bomber	Conventional Bomber	Sea-Based Fighters	Land-Based Fighters
Responsiveness / Projectability				
Ability to respond quickly	Excellent -- may need prepositioned tanker support and country overflight clearances	Same	Excellent if CVBG on location or able to quickly move within range. Can move forward on warning.	Excellent if permanent forward bases nearby. Today in SWA, Korea, Europe. Otherwise depends on availability of bases and rapid commitment decision.
Dependence on Local Basing	None -- but forward basing can significantly increase sortie rates	Same	Depends on status relative to last underway replenishment. Range to targets may require land-based tanker support	Critical -- currently good in SWA, Korea, Europe, and Mediterranean
Enroute Access	No special needs	Some Limitations	Some limitations (e.g. Suez)	Bases and/or tankers may be needed to forward deploy
Dependence on Prepo an/or Airlift	None -- but needed if forward deployed (e.g., to Guam or Diego Garcia)	Same	Limited for sustained operations	Limited if permanent forward bases nearby, otherwise substantial
Relevancy				
Access to Targets	Excellent due to long range	Same	Needs nearby deep water and/or tankers -- e.g., limited capability in Central Asia, Europe, and parts of SWA. Threats may force CV to operate far from coast.	Needs nearby land bases -- long-range fighters and tankers increase basing and targeting options
Show of Force	Good -- can forward deploy to Guam/Diego Garcia	Same	Excellent when threat is within range, and CV near area of interest. Otherwise limited.	Excellent when local basing permits deployment, otherwise limited
Ability to Achieve Surprise	Excellent	Limited	Limited	Excellent for F-117/F-22, limited for other aircraft
Flexibility				
Availability for 2nd MRC	Able to swing quickly to 2nd MRC	Same	Limited by speed of CVBG and distance between MRCs. Plan to use CVBGs not already fighting in MRC 1	Limited by 1st MRC needs -- few fighters available to swing between MRCs. 2nd MRC will primarily use local assets (SWA, Korea, Europe) and new deployments from CONUS
Ability to do Other Combat Missions	Somewhat --SEAD, sea control (Harpoon), nuclear strike	Limited	Good -- air defense SEAD, escort, sea control...Requires two to three CVs for continuous operations.	Good -- air defense, SEAD, escort...
Ability to Influence	Excellent anywhere in the world	Same	Excellent if in area near deep water	Excellent in areas where bases are available
Survivability				
Capability in Heavy Defense Environment	Excellent	Limited to standoff weapons or support	Limited -- needs SEAD and escort support	Excellent for F-117/F-22 Limited for non-stealth aircraft-- needs SEAD and escort support
Survivability of Bases	Very good -- particularly as range of bases increases beyond range of enemy	Same	Good with CVBG air defenses. Varying location reduces risk. Critical if hit, may be down for extended time. Potentially vulnerable to sea-based WMD attacks.	Good: Air superiority reduces air-to-ground threat. Potentially vulnerable to TBMs, particularly those with WMD warheads. Hit may not be critical—runways are easy to repair.

Notes: 1. All forces rely on timely targeting materials and threat location.
2. All forces will need tankers for some scenarios.

APPENDIX 2: List of Options and Potential Offsets

1. Low rate production of B-2 @ 1.5 per year.
   - Based on a decision in FY 96 to begin buying more B-2s (first delivery 2001)
   - Results in 14 total aircraft inventory (TAI) by 2010, 11 combat coded (CC)

2. Buy 20 B-2s (resulting total B-2 inventory = 40)
   - Number of TAI bombers eventually increase from 181 to 201
   - Rate of production 1.5-3.0 per year starting in 1998

3. Low rate production of B-2 @ 3.0 per year.
   - Based on a decision in FY 96 to begin buying more B-2s (first delivery 2001)
   - Results in 27 total aircraft inventory (TAI) by 2010, 22 combat coded (CC)

4. Buy 55 B-2s (resulting total B-2 inventory = 75)
   - Number of TAI bombers eventually increase from 181 to 236
   - Rate of production 5.0 per year starting in 1998

5. Add 2 wings of F-15Es
   - Number of total (active and reserve) Air Force FWEs increase from 20 to 22

- Year	98	99	00	01	02	03	Total	
Quantity		12	24	36	36	24	12	144

6. Reduce 2 Aircraft Carriers (total carriers go from 12 to 10)
   - Equates to 5 carrier per MRC BUR requirement
   - Reduce carrier wings from 10 to 8
   - Adjust F/A-18E/F procurement accordingly
   - Excursion was also costed that retires 8 other ships in the associated carrier battle group and postpones CVN-77 indefinitely.

7. Reduce 4 Aircraft Carriers (total carriers go from 12 to 8)
   - Equates to 4 carrier per MRC BUR requirement
   - Reduce carrier wings from 10 to 6
   - Adjust F/A-18E/F procurement accordingly
   - Excursion was also costed that retires 8 other ships in the associated carrier battle group-and postpones CVN-77 indefinitely.

8. Retire Entire B-1B Force (95 B-1Bs)
   - Number of total bombers decrease from 181 to 86
   - Accomplished over two years starting in 1996

9. Reduce 4 F-16 C/D fighter wings (288 F-16s)
   - Total Air Force fighter wings go from 20 to 16
   - Over four years starting in 1996
   - Two wings from active force (13 to 11), two wings from national guard (7 to 5)

10. Adjust planned F/A-18E/F program:
    A. Replace planned F/A-18E/Fs with new F/A-18C/Ds
    - Keep F/A-18C/D line open instead of replacing it with a new F/A-18E/F production line in 1998
    B. Use USMC F/A-18Cs to fill USN carrier requirements per USN/USMC agreement until JAST
    - Use money saved to accelerate JAST to provide Navy a stealth capability sooner

11. Cut F-22 buy 50 percent (from 442 to 221 total aircraft)
    - Reduce quantity purchased each year by 50 percent
    - Maintain force structure by retaining 2 wings of F-15 Cs
    - Buy approximately 36 F-15Cs to maintain force.

12. Cut DDG-51 buy 27 percent (15 ships—50 percent of buy remaining)
    - Maintain 15 FFG-7 frigates in the fleet through 2013
    - Add VLS capability to 8 DD-963 Spruance class destroyers

NOTE: Both the F-22 and the DDG-51 are primarily anti-air warfare platforms with a secondary capability of deep attack. They are included as a result of Service representative inputs but do not have deep attack as a primary purpose as do the other options.

APPENDIX 4: Description of Cases, Sortie Rates, Aircraft Ranges, and Costs Used in B-2 Option and Potential Offset Evaluation

SORTIE RATES AND WEAPON LOADS

RESPONSIVENESS SCENARIO

AIRCRAFT TYPE	SORTIES/ AIRCRAFT/ DAY	WEAPON LOAD	
		1000 LB CLASS MUNITION DISPENSERS	TONS
F-15E	2.0	12	4
F-16C	2.0	8	2
F-117	0.90	2	2
F/A-18E/F	2.0/1.71 [a]	12	3
F/A-18C (N)	2.0/1.71 [a]	8	2
B-2	0.4/0.6 [b]	36	16
B-1B	0.4/0.6 [b]	30	16
B-52H	0.4/0.6 [b]	24	19

[a] IF TWO CARRIERS ARE ON STATION, THEN BOTH CAN MAINTAIN A 2.0 F/A-18 SORTIE RATE. IF A SINGLE CARRIER IS ON STATION, THEN THE F/A-18s CAN MAINTAIN A 2.0 SURGE SORTIE RATE FOR 3 DAYS AND A 1.5 SORTIE RATE FOR THE OTHER 4 DAYS. THUS, THE AVERAGE SORTIE RATE FOR ONE CARRIER IS 1.7 FOR THE 7 DAY PERIOD.

[b] CONUS BASED/FORWARD BASED ON D-DAY.

DESCRIPTION OF CASES
SUSTAINED FIREPOWER SCENARIO
(30 Days of Combat)
(4 Cases)

	SORTIE RATES AND PAYLOAD	
BASING	DESERT STORM SORTIE RATES AND NOMINAL WEAPON LOADS (BASED ON GWAPS DATA)	EQUAL SORTIE RATES FOR FIGHTERS AND WEAPON LOADS APPROACHING MAXIMUM CAPABILITY
PLENTIFUL	I • INTERNAL CARRIAGE ONLY FOR F-22	K • FIGHTERS HAVE SORTIE RATE OF 1.3, BOMBERS 0.6 • F-22 CARRY WEAPONS EXTERNALLY
LIMITED	J • DEPLOYMENT PREFERENCE -- F-15E -- A-10 -- F-117 -- F-22 -- F-16C	L • DEPLOYMENT PREFERENCE -- F-15E -- A-10 -- F-22 -- F-117 -- F-16C

NOTES:

1. MEASURE OF MERIT IS TONS DELIVERED IN 30 DAYS.
2. U.S. AIR FORCE IS ASSUMED TO DEPLOY 10 FWEs TO THE COMBAT AREA IN THIS NOTATIONAL MRC SCENARIO. THIS REQUIRES A ROBUST LOCAL BASING INFRASTRUCTURE. TO ACCOUNT FOR SITUATIONS WITH LIMITED LOCAL BASING, CASES ARE DEFINED THAT REDUCE LOCAL BASING TO 50% OF THE BASING NEEDED FOR THE FULL FORCE. FOR THESE CASES, ONE HALF OF EACH MARINE AIR WING AND FIVE AIR FORCE FWEs ARE ASSUMED TO DEPLOY.
3. HOW SORTIE RATES VARY AMONG AIRCRAFT IS THE SUBJECT OF MUCH DEBATE. FOR THIS ANALYSIS TWO CASES ARE CONSIDERED, ONE USING DESERT STORM SORTIE RATES (SEE NEXT TWO CHARTS) AND ONE USING EQUAL SORTIE RATES.

RANGE/ YLOAD ANALYSIS

SUSTAINED FIREPOWER SCENARIO

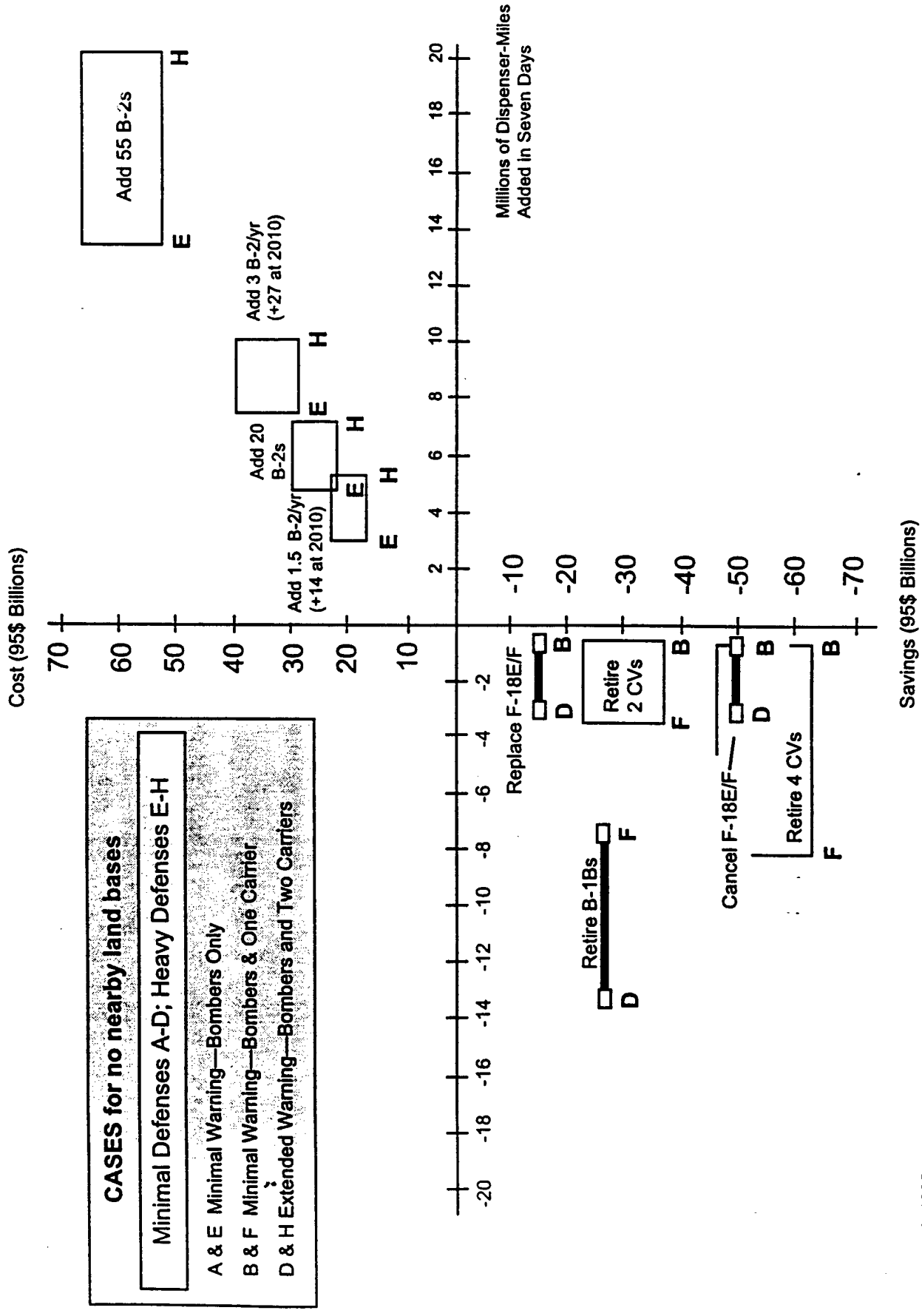
AIRCRAFT TYPE	DESERT STORM EXPERIENCE			EQUAL SORTIE RATES		
	WEAPON LOAD (TONS)	UNREFUELED MISSION RADIUS (NM)	NUMBER OF TANKS/SIZE	WEAPON LOAD (TONS)	UNREFUELED MISSION RADIUS (NM)	NUMBER OF TANKS/SIZE
F-15E	4	730	2 X 610 gal	7	350	1 / 610 gal
F-16C	2	540	2 X 370 gal	4	250	1 / 610 gal
F-117 (HHH)	2	570	0	2	570	0
F-22	1	classified		5	classified	
A-10	4	420	0	8	375	0
F/A-18E/F	3	540	3 / 480 gal	5	350	1 / 480 gal
F/A-18C (N)	2	420	3 / 330 gal	4	290	1 / 330 gal
F/A-18C/D (MC)	2	420/360	3 / 330 gal	4	290/230	1 / 330 gal
AV-8	2	225	0	2	430	2 / 300 gal
B-2 (HHH)	16	~3,000	0	16	~3,000	0
B-1B	16	2,550	0	24	2,550	0
B-52H	19	2,650	0	19	2,650	0

Assumptions:

1. H-L-H mission with low altitude leg of 100 nm (exceptions: F-117 and B-2 Fly HHH).
2. Standard day, no winds.
3. Retain tanks (if used).
4. Fuel reserves: 20 minutes (except F/A-18C: 1,500 lb/30 min)
5. Low level velocity assumptions

F-15E: 480 knots
F-16C (Block 40): 480 knots
A-10: 300 knots (no loiter)
F/A-18E: 480 knots
F/A-18C: 480 knots
F/A-18C/D: 480 knots
AV-8B: 480 knots
B-1B: 540 knots
B-52H: 380 knots

APPENDIX 5: Summary Results—Responsiveness Scenario (Work (Dispenser-Miles) Accomplished in Seven Days)



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