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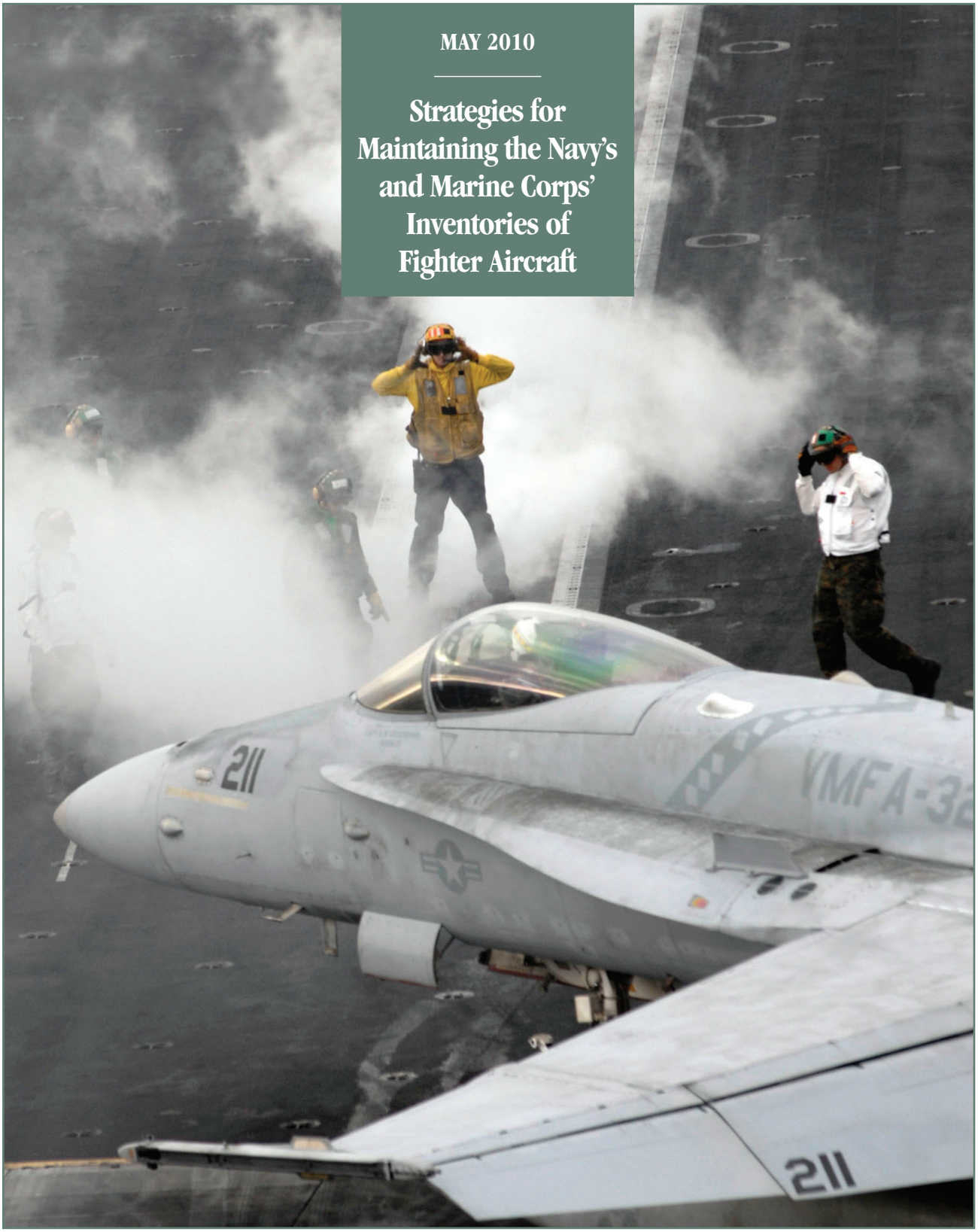
MAY 2010

Strategies for Maintaining the Navy's and Marine Corps' Inventories of Fighter Aircraft



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May 2010

The Congress of the United States ■ Congressional Budget Office

Notes

All costs are in fiscal year 2010 dollars.

The cover photograph shows an F/A-18C Hornet from the "Death Rattlers" of Marine Strike Fighter Squadron 323 as it prepares to take off from the Nimitz-class aircraft carrier USS *John C. Stennis.* The photograph, provided courtesy of the U.S. Navy, was taken by Mass Communication Specialist 2nd Class Christopher Dollar.

Preface

The United States Navy and Marine Corps operate a fleet of tactical fighter aircraft that provide air-to-air and air-to-ground combat capabilities. Although current procurement plans call for the purchase of about 700 new fighter aircraft over the next 15 years, the Department of the Navy is projecting that purchases planned for the next 5 to 10 years will be unable to keep pace with the retirement of today's F/A-18A-D Hornets as they reach the limit of their service life.

This Congressional Budget Office (CBO) report—prepared as directed by the House Armed Services Committee's Report on the National Defense Authorization Act for Fiscal Year 2010 (H. Rept. 111-166)—compares several alternatives for maintaining the Navy's and Marine Corps' fighter inventory levels. The alternatives include different combinations of extending the service life of Hornets and purchasing new aircraft in addition to those already planned. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations.

David Arthur of CBO's National Security Division prepared the report under the supervision of Matthew Goldberg. David Newman of CBO's Budget Analysis Division reviewed the cost estimates under the supervision of Sarah Jennings.

Christine Bogusz edited the report, and Loretta Lettner proofread it. Jeanine Rees prepared the report for publication, and Maureen Costantino designed the cover. Lenny Skutnik printed the initial copies of the report, Linda Schimmel handled the print distribution, and Simone Thomas prepared the electronic version for CBO's Web site (www.cbo.gov).

Douglas W. Elmendorf
Director

May 2010

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Strategies for Maintaining the Navy's and Marine Corps' Inventories of Fighter Aircraft

Summary and Introduction

The United States Navy and Marine Corps maintain a fleet of more than 1,100 tactical fighters that provide capabilities for air-to-air combat and air-to-ground attack. As of January 2010, that force consisted of about 640 F/A-18A/B/C/D Hornets, nearly 400 F/A-18E/F Super Hornets, and roughly 150 AV-8B Harriers. Current modernization plans call for replacing all of the Hornets and Harriers with about 100 more Super Hornets and 680 F-35B/C Joint Strike Fighters (JSFs). (See Box 1 for a brief description of those fighters.)

The high usage rate of fighters in military operations over the past decade coupled with delays in the development of the JSF, however, have raised concerns within the Department of the Navy that its inventory of fighters will drop significantly below the level needed for the planned force structure over the next 10 to 15 years.[1] In particular, in the absence of modifications to their airframe structure, Hornets are now projected to reach the end of their service life faster than they can be replaced with JSFs. To mitigate potential inventory shortfalls, the department is investigating ways to extend the service life of its Hornets as well as changes it could make to how the fleet is organized and employed to reduce the number of aircraft needed for operations. The Navy could also reduce projected inventory shortfalls by purchasing more Super Hornets than current plans call for until the JSF can be delivered in large numbers.

At the direction of the House Committee on Armed Services, the Congressional Budget Office (CBO) examined the funding required for four alternative plans that might be adopted to reduce the projected decline in the fighter inventory. CBO did not construct alternatives to satisfy a particular inventory objective, nor did it attempt to judge the adequacy of a particular objective. The alternative plans consist of different combinations of three approaches:

- Extend the service life of Hornets by up to 600 flight hours (roughly two additional years) beyond the current 8,000-hour limit by modifying and inspecting F/A-18A-D aircraft in the high-flight-hour (HFH) program (comprising a series of structural repairs and more-frequent inspections);
- Implement a service-life extension program (SLEP) of more-extensive modifications, which would enable Hornets to reach 10,000 flight hours; and
- Purchase more Super Hornets than current plans call for.

As of January 2010, the Navy had completed HFH modifications on about 25 Hornets, and Super Hornets are now in production. In contrast, research and planning for the Hornet SLEP is not expected to be complete until 2014, although the Navy has indicated that it may begin SLEP modifications on some aircraft as early as 2012. In this analysis, CBO did not explore the potential of fielding other types of systems (such as unmanned aircraft) in lieu of fighters.[2]

Of the four alternatives that CBO analyzed, the first two are limited to extending the service life of existing

1. The Navy and Marine Corps are the two military services within the Department of the Navy.

2. For a broader analysis of Navy, Marine Corps, and Air Force fighter inventories, see Congressional Budget Office, *Alternatives for Modernizing U.S. Fighter Forces* (May 2009).

Box 1.

Types of Fighter Aircraft Planned or in Use by the Navy and Marine Corps

The Department of the Navy's inventory of fighter aircraft includes Hornets, Super Hornets, and Harriers. (This analysis excludes the Navy's tactical fighter aircraft that specialize in airborne electronic attack—the EA-6B and the EA-18G.) The **F/A-18A/B/C/D Hornet** has been flown by both the Navy and Marine Corps since the 1980s. It can operate from air bases on land and aboard aircraft carriers. The **F/A-18E/F Super Hornet** is a newer and substantially larger version of the Hornet. In service since 2001, Super Hornets have greater flight range and can carry a larger weapons load than earlier versions of the F/A-18. Super Hornets incorporate today's most advanced radars and avionics in a conventional airframe that includes certain design features to help the aircraft avoid detection by an enemy's radars. The **AV-8B Harrier** is a short-takeoff vertical-landing aircraft primarily designed to attack ground targets. The Harrier has the flexibility to operate from tactical landing sites and amphibious ships.

Within the next few years, the Department of the Navy plans to add Joint Strike Fighters to its inventory. The **F-35B/C Joint Strike Fighter** is in its developmental test stage and will not enter operational service until 2012 at the earliest. (The F-35B is a short-takeoff vertical-landing aircraft, and the F-35C is carrier-capable.) The Joint Strike Fighter will incorporate advanced avionics and radars in a stealthy (designed to avoid detection by radar) airframe.

Hornets. They are generally consistent with various plans the Navy has proposed or is considering:

- **Alternative 1:** Execute the HFH program on the 509 Hornets suitable for those modifications;
- **Alternative 2:** Execute the HFH program on 220 Hornets and the more-extensive SLEP on 289 Hornets.

The third and fourth alternatives would combine some service-life extensions for Hornets with changes in planned purchases of new aircraft:

- **Alternative 3:** Implement the HFH program in the same way that Alternative 1 would, but also increase purchases of Super Hornets by 126 aircraft (beyond the planned total of 515) and decrease purchases of JSFs by 93 aircraft between 2018 and 2023;
- **Alternative 4:** Modify 509 aircraft through the HFH process and purchase 126 additional Super Hornets, as in Alternative 3, but do not reduce purchases of JSF aircraft.

CBO measured the increase in inventory offered by those alternatives and the funding that each would require relative to a base case under which the service life of Hornets would not be extended and additional aircraft would not be purchased.[3] The costs cited in this report are those that would be incurred to make available a larger number of aircraft. They do not include the higher costs (for more fuel, for example) associated with operating a larger fleet of aircraft.

Under Alternative 1, CBO found that executing the HFH program on the 509 Hornets would increase the Navy's and Marine Corps' fighter inventory by an average of 66 aircraft over the 2011–2025 period (see Table 1). Relative to the cost of the base case (in which none of the three approaches are undertaken), the cost of Alternative 1 would be about $2.2 billion higher (in fiscal year 2010 dollars).[4] That cost corresponds to

3. The base case essentially posits minimal action being taken to mitigate impending inventory shortfalls. CBO selected this as its reference case for comparing alternatives because the Department of the Navy's plans remain fluid.

4. Costs for the HFH and SLEP modifications are based on estimates from the Department of the Navy. The cost of additional Super Hornets is based on actual costs for planned purchases under annual production contracts.

Table 1.

Alternatives for Maintaining the Navy's and Marine Corps' Fighter Inventories

	Alternatives			
	1	2	3	4
	Number of Aircraft			
Hornets in High-Flight-Hour Program	509	220	509	509
Hornets in Service Life Extension Program	0	289	0	0
Additional Super Hornet Purchases	0	0	126	126
Change in Joint Strike Fighter Purchases	0	0	-93	0
Average Increase in Inventory, 2011 to 2025	66	106	128	148
Increase in Inventory Above Low Point from 2011 to 2025	71	135	174	191
	Additional Aircraft-Years of Service Relative to the Base Case			
Between 2011 and 2025	1,000	1,600	1,900	2,200
After 2025	0	0	-100	1,700
	Cost Above the Base Case (Millions of fiscal year 2010 dollars)			
Total, 2011 to 2015	1,100	3,700	10,300–11,300	10,300–11,300
Total, 2011 to 2025	2,200	7,700	3,800–4,800	11,600–12,600
Average per Aircraft-Year, 2011 to 2025	2.2	4.8	2.0–2.5	5.3–5.7
Average per Aircraft-Year, Lifetime	2.2	4.8	2.2–2.7	2.9–3.2

Source: Congressional Budget Office.

Notes: Under the base-case scenario, Hornets would be retired from service at 8,000 flight hours.

Aircraft-years are a measure of the service provided by an aircraft. One aircraft-year is equal to one year of service from one aircraft.

The additional costs are those incurred to make available a larger number of aircraft. They do not include the higher costs (for more fuel, for example) associated with operating a larger fleet of aircraft.

The higher costs shown for Alternatives 3 and 4 reflect prices consistent with annual procurement contracts for Super Hornets purchased in addition to those currently planned. The lower costs reflect prices consistent with a proposed multiyear procurement contract for Super Hornets that the Department of Defense plans to award.

approximately $2.2 million per aircraft-year of additional service made available to the fleet.[5] Alternative 1 has the lowest total cost of the alternatives examined by CBO, but it provides the smallest increase in inventory.

Alternative 2 would provide 220 HFH Hornets plus 289 SLEP Hornets, increasing the department's total inventory by an average of 106 aircraft over the 2011–2025 period, at a cost of about $7.7 billion. This alternative would provide the largest increase in inventory that can be achieved with the HFH and SLEP modifications currently being considered. At $4.8 million per aircraft-year, however, Alternative 2 is more than twice as costly per increment of additional service than is Alternative 1.

Alternative 3 is constructed to maintain an inventory of no less than that of Alternative 2 in any given year and to yield an inventory close to that of Alternatives 1 and 2 in 2025 (by shifting purchases of new aircraft to earlier years, when the inventory is projected to be the lowest). It would increase the average inventory by 128 aircraft through 2025 (see Figure 1).

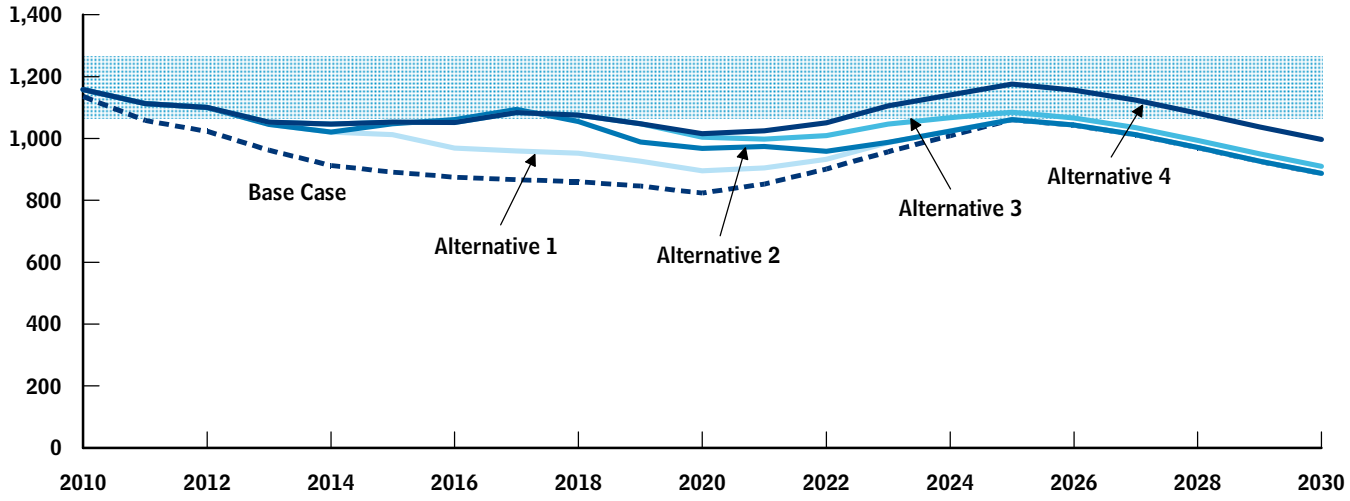
Alternative 3 would provide larger increases in inventory than would Alternatives 1 and 2. Moreover, each additional Super Hornet provided under Alternative 3 would offer improved performance (a more-capable radar, longer range, and the ability to carry more weapons) than

5. Aircraft-years are a measure of the service provided by an aircraft. One aircraft-year is equal to one year of service from one aircraft.

Figure 1.

The Navy's and Marine Corps' Inventories of Fighter Aircraft Under Alternative Plans

(Total aircraft inventory)



Source: Congressional Budget Office.

Notes: Under the base-case scenario, Hornets would be retired from service at 8,000 flight hours. Under Alternative 1, 509 Hornets would receive modifications under the high-flight-hour (HFH) program, which would extend their service life by 600 flight hours. Under Alternative 2, 220 Hornets would receive HFH modifications; another 289 Hornets would receive more-extensive modifications under the service-life extension program, which would increase their service life to 10,000 hours. Under Alternative 3, 509 Hornets would receive HFH modifications; also, the Department of the Navy would purchase 126 additional Super Hornets but 93 fewer Joint Strike Fighters (JSFs). Under Alternative 4, 509 Hornets would receive HFH modifications, and the Navy would purchase 126 additional Super Hornets (but not reduce the number of JSF aircraft.)

The dotted band indicates a range of inventory objectives derived from information provided by the Navy (see Box 2 for details).

Inventories are based on JSF purchase schedules as described in *Department of Defense 30-Year Aviation Plan* (February 2010).

would a SLEP Hornet. The reduction in JSF purchases would result in fewer of the most advanced aircraft after 2020, however.

At about $3.8 billion to $4.8 billion higher than the cost of the base case, the total cost of Alternative 3 would fall between the costs of Alternatives 1 and 2.[6] The cost per increment of additional service—$2.0 million to $2.5 million per aircraft-year over the 2011–2025 period—would be comparable to that of Alternative 1. In the near term, however, the cost would be substantially higher ($10.3 billion to $11.3 billion versus $3.7 billion for Alternative 2 over the 2011–2015 period, for example) because the savings from reducing JSF purchases would not offset the cost of new Super Hornet purchases until after 2017.

Under Alternative 4, the Department of the Navy would modify 509 Hornets and purchase 126 additional Super Hornets, as in Alternative 3, but would not reduce purchases of JSF aircraft. The increase in average inventory would be 148 aircraft between 2011 and 2025, 20 aircraft more than under Alternative 3. Alternative 4 would also provide increased inventory well beyond 2025, because additional purchases of Super Hornets would not be offset by fewer purchases of JSFs. (Unlike HFH and SLEP aircraft, which would be taken out of service by 2025, new Super Hornets could remain in the fleet for 25 years or longer.)

6. The upper end of the cost ranges for Alternatives 3 and 4 reflect F/A-18E/F purchases under annual procurement contracts at prices consistent with those assumed in the President's fiscal year 2011 budget request. The lower end of the range is based on prices consistent with those in a proposed multiyear procurement contract for F/A-18E/F aircraft that the Department of Defense plans to award by September 30, 2010.

The advantages of new aircraft provided in Alternative 4 would come at a cost of $12 billion to $13 billion more than under the base case (nearly all of which would be incurred in the next five years). At a cost of $5.3 million to $5.7 million per aircraft-year, Alternative 4 would be the most expensive per increment of additional service provided between 2011 and 2025. If the aircraft-years of service after 2025 are included, the cost would be $2.9 million to $3.2 million per aircraft-year. Super Hornet service after 2025 may not have the same military value as service between 2011 and 2025, however.

CBO did not evaluate whether the inventories that would be realized under the various alternatives would be sufficient to meet the Navy's and Marine Corps' operational needs. A series of briefings since 2008 from the Department of the Navy to the Congress has explicitly or implicitly suggested sustained inventory objectives ranging from slightly more than 1,000 aircraft to as many as 1,240 aircraft (see the dotted band in Figure 1). None of the alternatives that CBO considered would provide inventories within that range of objectives for all years through 2025, although Alternatives 3 and 4 would come closest.

The inventories realized under all four alternatives would be lower, and any corresponding shortfall would be larger, if further delays were experienced with the JSF program. Under those circumstances, a greater increase in Super Hornet purchases could be incorporated into any of the alternatives if the Super Hornet production line was still in operation. Compensating for further delays in the JSF program by keeping Hornets in the fleet longer than envisioned with HFH or SLEP modifications would require much more extensive (and, probably, much more costly) modifications.

Inventory Implications of Current Plans

As of January 2010, the Department of the Navy's inventory of fighter aircraft included Hornets (382 in service in the Navy and 254 in the Marine Corps), Super Hornets (398 in service, all with the Navy), and Harriers (146 in service, all with the Marine Corps).[7] Within the next few years, the Department of the Navy plans to add two versions of the Joint Strike Fighter to its inventory. The Navy plans to operate the carrier-capable F-35C, whereas the Marine Corps prefers the short-takeoff vertical-landing F-35B, which can be flown from amphibious ships and small airfields ashore.[8]

Despite plans to spend an average of about $6.4 billion per year for new fighter aircraft over the next decade, the Navy projects that its fighter inventories will fall substantially as Hornets reach their service-life limit of 8,000 flight hours and are retired in large numbers. CBO also anticipates that the Harriers will be retired by 2020. As a result, in the absence of action to extend the life of existing aircraft or purchase new aircraft in addition to those currently planned, the Navy's and Marine Corps' combined fighter inventory would drop to roughly 800 aircraft in 2020, by CBO's estimation—about 30 percent lower than today's inventory—before rebounding through 2025 (see Figure 2).

On the basis of information from the Navy, CBO's projection includes a service life of 9,000 flight hours for Super Hornets. Although Super Hornets were designed for 6,000 flight hours, the Navy is confident that limit can be extended. (The Hornet was originally designed for 6,000 flight hours as well, and its limit has already been extended to as high as 8,600 hours.)

The assumption that AV-8B Harriers will be retired by 2020 is based on data provided by the Navy in November 2008. However, as CBO noted in its May 2009 report *Alternatives for Modernizing U.S. Fighter Forces*, Harriers could be maintained in the force longer, if necessary, because their scheduled retirement is based on deliveries of F-35Bs rather than structural service-life limitations like those facing the Hornets. In recent testimony before the Congress, the Navy has indicated that it is exploring

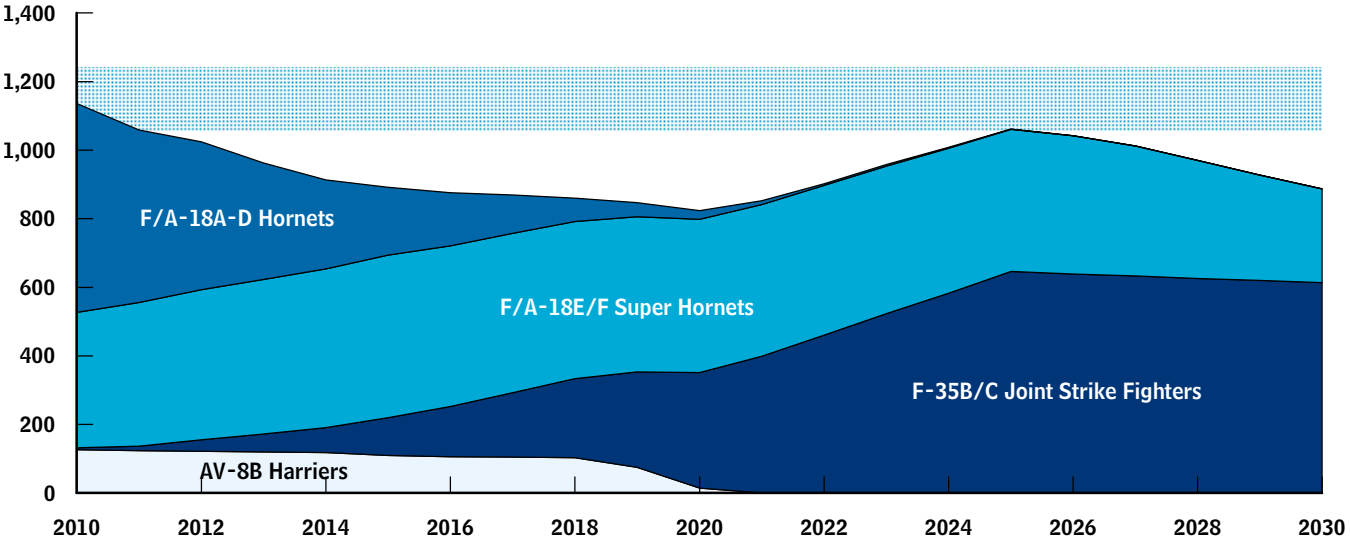
7. This paper does not consider tactical fighter aircraft specialized for airborne electronic attack—in particular, the EA-6B Prowler and its replacement, the EA-18G Growler—in its discussion of inventory goals.

8. The mix of F-35Bs and F-35Cs has not yet been decided. It will depend on the extent to which the Marines will be responsible for providing squadrons to augment Navy squadrons aboard aircraft carriers and whether F-35Bs will be suitable in that role. The Navy would prefer that the Marines provide squadrons equipped with F-35Cs, arguing that the longer range and heavier payload offered by the C model would be critical when flying from aircraft carriers that might be far out at sea and that the B model would require additional logistics support and equipment aboard ship. The Marines would prefer to operate only one type of fighter. Another version of the JSF, the F-35A, is being developed for the Air Force and does not figure into the current analysis.

Figure 2.

Base-Case Projection of the Navy's and Marine Corps' Inventories of Fighter Aircraft

(Total aircraft inventory)



Source: Congressional Budget Office.

Notes: Under the base case, Hornets would be retired at 8,000 flight hours, and Harriers would be taken out of service by 2020 (as they were replaced by Joint Strike Fighters). The Navy has begun extending the service life of Hornets to as much as 8,600 flight hours, and it is investigating options for maintaining Harriers in the fleet until 2022 (or beyond).

The dotted band indicates a range of inventory objectives derived from information provided by the Navy (see Box 2 for details).

Inventories of JSFs are based on purchase schedules as described in *Department of Defense 30-Year Aviation Plan* (February 2010).

ways to upgrade Harriers' capabilities and improve readiness, which could keep those aircraft in the force through at least 2022.

According to budget documents submitted by the Department of Defense in its fiscal year 2011 budget request, 48 more Super Hornets will be purchased through 2013, at a cost of $4.4 billion (in fiscal year 2010 dollars), bringing total Super Hornet purchases to 515 aircraft.[9] (That cost could decrease by about $300 million under a proposed multiyear procurement contract that the Defense Department plans to award by September 30, 2010.) Over the 2011–2015 period detailed in the 2011 budget request, the Navy would purchase 98 F-35Bs and 61 F-35Cs, at a cost of nearly $30 billion. After 2015, according to the *Department of Defense 30-Year Aviation Plan* submitted to the Congress in February 2010, another 283 F-35B/C aircraft would be purchased through 2020, with production reaching 66 aircraft in that year.[10] Under CBO's assumption that that rate of production is maintained, JSF procurement by the Department of the Navy would reach its planned total of 680 aircraft in 2023. According to estimates in the fiscal year 2011 budget request, procurement costs for F-35B/Cs would total about $78 billion (from 2011 through the end of production).[11]

9. That total includes aircraft in the inventory, aircraft that have been purchased but not yet delivered, and aircraft yet to be purchased, deducting aircraft that have been lost in combat or mishaps.

10. The plan provided details of quantities to be purchased between 2010 and 2020.

11. Cost estimates for the JSF are based on plans outlined in the President's fiscal year 2011 budget request. Near the end of March 2010, however, the Secretary of Defense notified the Congress that the JSF program had breached so-called Nunn-McCurdy cost-growth thresholds specified in section 2433 of title 10, U.S. Code, and that the program will probably be subject to changes in its cost and procurement schedules.

Box 2.

Inventory Objectives

The Department of the Navy has most frequently described the future of its fighter inventory in terms of a projected shortfall—a measure of the difference between the number of aircraft desired at a specific point in time and a projection of what the inventory will actually be at that time. Less frequently stated, however, are the inventory goals and inventory projections that are used to calculate the shortfall values. In the absence of a well-established definition of fighter inventory goals, the Congressional Budget Office (CBO) compares its projections of fighter inventories against a range of possible inventory goals that can be derived from various sources.

The top end of the range is **1,240 aircraft**. That value was identified in a February 2010 briefing by the department as the combined requirement for the Navy and Marine Corps. It includes 42 Navy squadrons and 24 Marine Corps squadrons. In that briefing, the department also quoted an "Existing TACAIR [Tactical Aircraft] Demand" of **1,154 aircraft** that is based on current operations and includes 37 Navy squadrons and 20 Marine Corps squadrons.

The lower end of the range of inventory objectives, **1,060 aircraft**, corresponds to CBO's projection of the Navy's and Marine Corps' Super Hornet and JSF inventory in 2025 (deducting estimated losses from attrition). That inventory is consistent with planned purchases, the retirement of the Harrier force by or before 2025, and the Navy's February 2010 projection of no shortfall in 2025.

Of course, the number of aircraft actually needed to support a given force can vary over time as, for example, the need for backup aircraft to replace aircraft lost in combat or mishaps varies or as the fraction of time spent in depot maintenance increases as aircraft age. Force structure requirements can vary as well. For example, the period of time in the next decade when the Navy's carrier force is projected to temporarily drop from 11 to 10 (between the retirement of the USS *Enterprise* and the commissioning of the USS *Gerald R. Ford*) could result in a temporarily reduced need for carrier aircraft. Information provided to CBO by the Navy in the past indicated that its objective did vary over time.

Approaches for Maintaining Inventories

The range of inventory objectives illustrated by CBO—1,060 to 1,240 aircraft—reflects different assumptions about future force structures and operational demands for aircraft. (See Box 2 for a description of how CBO derived that range of values for inventory objectives.) Under CBO's projection, if Hornets were retired at 8,000 flight hours and no new aircraft were purchased in addition to those currently planned, the number of fighter aircraft in the Navy and Marine Corps would drop below the range of inventory objectives after 2011 and would remain below that range until JSF deliveries were completed in about 2025.

Reducing or eliminating the gap between projected inventories and inventory objectives will require some combination of service-life extensions for existing aircraft, purchases of new aircraft beyond those already planned, or reductions in inventory objectives (either by improving efficiency through organizational and operational changes or by reducing the scope or number of missions the force will be expected to accomplish). To that end, the Navy is pursuing organizational changes, such as reductions in the number of aircraft assigned to squadrons that are not deployed. To maintain larger inventories, the Navy is carefully managing the factors that limit the life of each aircraft in the Hornet fleet. For example, aircraft on a pace to reach their limit of catapult launches or arrested landings before reaching their flight-hour limit might be transferred to a Marine Corps squadron operating from a land base.

This report considers three approaches that could be adopted to help maintain fighter inventories through 2025. Two of those approaches would combine structural repairs and modifications with increased inspections to allow Hornets to operate beyond 8,000 flight hours. A

third approach would increase purchases of Super Hornets. Although it might be possible to increase purchases of JSF aircraft in later years, that approach was not considered in this analysis because it appears unlikely that accelerating JSF purchases will be feasible during the years for which shortfalls are projected. The subsequent section details four alternative plans—comprised of combinations of those approaches—that would maintain higher Navy and Marine Corps fighter inventories through 2025.

This analysis does not examine the years after 2025, when the Navy's fighter inventories are projected to drop again as the service begins to retire its Super Hornets. To maintain inventory levels after 2025, the Navy will need to extend the service life of its Super Hornets, purchase additional JSFs, or field a new aircraft. Fielding a new aircraft will require funding for research and development beginning perhaps as early as 2015 and reaching substantial amounts by 2020. Those costs are not included in this analysis.

High-Flight-Hour Program for Hornets

Under one approach, the high-flight-hour program for extending Hornets' service life, the Navy would implement a series of structural repairs or modifications followed by an increased frequency of inspections, which would enable most of its Hornet aircraft to operate for up to 600 flight hours (roughly two additional years) beyond the current limit of 8,000 flight hours. Aircraft approaching 8,000 hours would be repaired and modified during their scheduled depot maintenance. Upon completion, the aircraft would be certified for 600 flight hours in addition to the flight hours already accrued.

On the basis of estimates provided by the Navy, CBO assumed that the cost for each HFH aircraft would be about $4.5 million, distributed over the additional life of the aircraft. Although the HFH program would only modify or repair structural components of the aircraft, other potentially life-limiting factors (such as engine service life) are not expected to prevent HFH-modified Hornets from realizing their extended life. Consequently, most Hornets in the force would be candidates for the HFH modifications.

Through the end of 2009, the Navy had completed HFH modifications on about 25 Hornets and had begun modifying about 25 more. Because those 50 aircraft had accrued an average of 7,800 flight hours when they entered the program, CBO's inventory projections assume that HFH Hornets will achieve an average of 8,400 flight hours. Although the HFH program could be considered to be part of the base-case plan, CBO treated it as an alternative (instead of assuming that all Hornets would have HFH modifications as part of the base case) because the number of aircraft that receive HFH modifications could be varied depending on what other actions are taken to maintain inventory levels.

Service-Life Extension Program for Hornets

Another approach would involve the Hornets' service-life extension program: The Navy would implement more-extensive structural repairs or modifications followed by an increased frequency of inspections, enabling many of its Hornet aircraft to operate for up to 10,000 flight hours. On the basis of estimates provided by the Navy, CBO projected that the cost for each SLEP Hornet would be about $23 million: $13 million up front (for modifications) and $10 million distributed over the remaining life of the aircraft (for further modifications and inspections).[12] Considerable uncertainty underlies that cost estimate, however, because the details of the necessary modifications and inspections have not been finalized.[13] Consequently, there is a greater risk of cost growth with SLEP modifications than with HFH modifications.

Because the SLEP modifications would be much more extensive than the HFH modifications, fewer Hornets would be suitable for the program. In particular, aircraft that were likely to reach other life-limiting conditions before a significant portion of their additional 2,000 flight hours could be expended would not be worth the up-front expense of SLEP modifications. Under the assumption that a SLEP Hornet should be operable for at least three additional years—a condition established by the Navy—CBO estimates that slightly fewer than 300 Hornets would be suitable for SLEP modifications. The

12. The funding spread over the additional service life of SLEP- and HFH-modified Hornets would provide for additional inspections and for other activities related to operating an aircraft well beyond its design service life.

13. The planning schedule for developing the SLEP Hornet described in an October 2009 briefing from the Navy indicated that a "40% Total SLEP Solution" could be in hand by 2012, 80 percent by 2013, and 100 percent by 2014. On the basis of that information, CBO assumes that Hornets could begin undergoing SLEP modifications as early as 2012.

remainder could be suitable for HFH modifications, however.

Additional Purchases of Super Hornets

The Navy and Marine Corps could also increase their fighter inventories through 2025 by purchasing additional Super Hornets. CBO's cost estimates for the alternatives that include additional Super Hornets are presented as a range reflecting the possibility that those aircraft could be purchased either under annual procurement contracts or, at a lower cost, under a multiyear procurement contract.

For costs under annual procurement contracts, CBO assumed that Super Hornet production could continue at prices similar to those described in the President's budget request for fiscal year 2011 (released in February 2010). CBO based its cost estimates for purchases under a multiyear contract on the details of a proposed contract described in a May 2010 letter from the Defense Department to the Congress. CBO assumed that savings resulting from cost-reduction initiatives undertaken as part of a multiyear contract for planned Super Hornets could also be obtained for Super Hornets purchased in addition to those currently planned.

Alternative Plans for Maintaining Fighter Inventories

CBO examined four ways in which combinations of service-life extensions to existing aircraft and purchases of new aircraft (in addition to those currently planned) could mitigate the drop in fighter inventories predicted for the Navy and Marine Corps over the next 15 years. Alternatives 1 and 2 include only service-life extensions, whereas Alternatives 3 and 4 combine service-life extensions with purchases of new aircraft.

Alternative 1: Extend Hornets' Service Life with High-Flight-Hour Modifications

Under this alternative, the Navy would subject all suitable Hornets to HFH service-life extensions. Modifications would continue through 2022, ultimately yielding 509 HFH Hornets, at a total cost of about $2.2 billion. The additional aircraft would increase the inventory by an average of 66 aircraft over the 2011–2025 period (see the upper left panel in Figure 3). The inventory of HFH aircraft would reach a maximum of 119 aircraft in 2015.

The primary advantages of Alternative 1 are its lower cost relative to the other alternatives—about $2.2 million per aircraft-year of additional service—and the fact that its effects are concentrated during the years of projected inventory shortfalls (see Table 1). The aircraft-years of additional service are illustrated by the area labeled "HFH Hornet" in Figure 3.

The primary disadvantage of Alternative 1 is the limited increase in inventory that can be achieved with HFH modifications alone. Total inventories under Alternative 1 would decline to fewer than 900 aircraft in 2020, CBO projects, about 25 percent below today's inventory. Those amounts are well below the range of inventory objectives that CBO derived from Navy briefings.

Alternative 2: Extend Hornets' Service Life with SLEP and HFH Modifications

Under Alternative 2, the Navy would implement SLEP modifications on all qualified Hornets (289 aircraft) and conduct the more limited HFH service-life extensions on the remainder (220 aircraft), at a total cost of about $7.7 billion. Fighter inventories would increase by an average of 106 aircraft between 2011 and 2025 (see the upper right panel in Figure 3). The inventory increase would be highest—225 aircraft—in 2017.

As with Alternative 1, the inventory increase achieved under Alternative 2 would be realized during the years when inventories were lowest. Although Alternative 2 would provide a larger increase in inventory than Alternative 1, that increase would come at a substantially higher cost per aircraft-year of increased inventory (about $4.8 million), more than double the cost per aircraft-year under Alternative 1. The higher cost is a result of the more substantial structural work needed to achieve 10,000 flight hours plus the cost of additional inspections for SLEP aircraft that would remain in the force for a longer time.

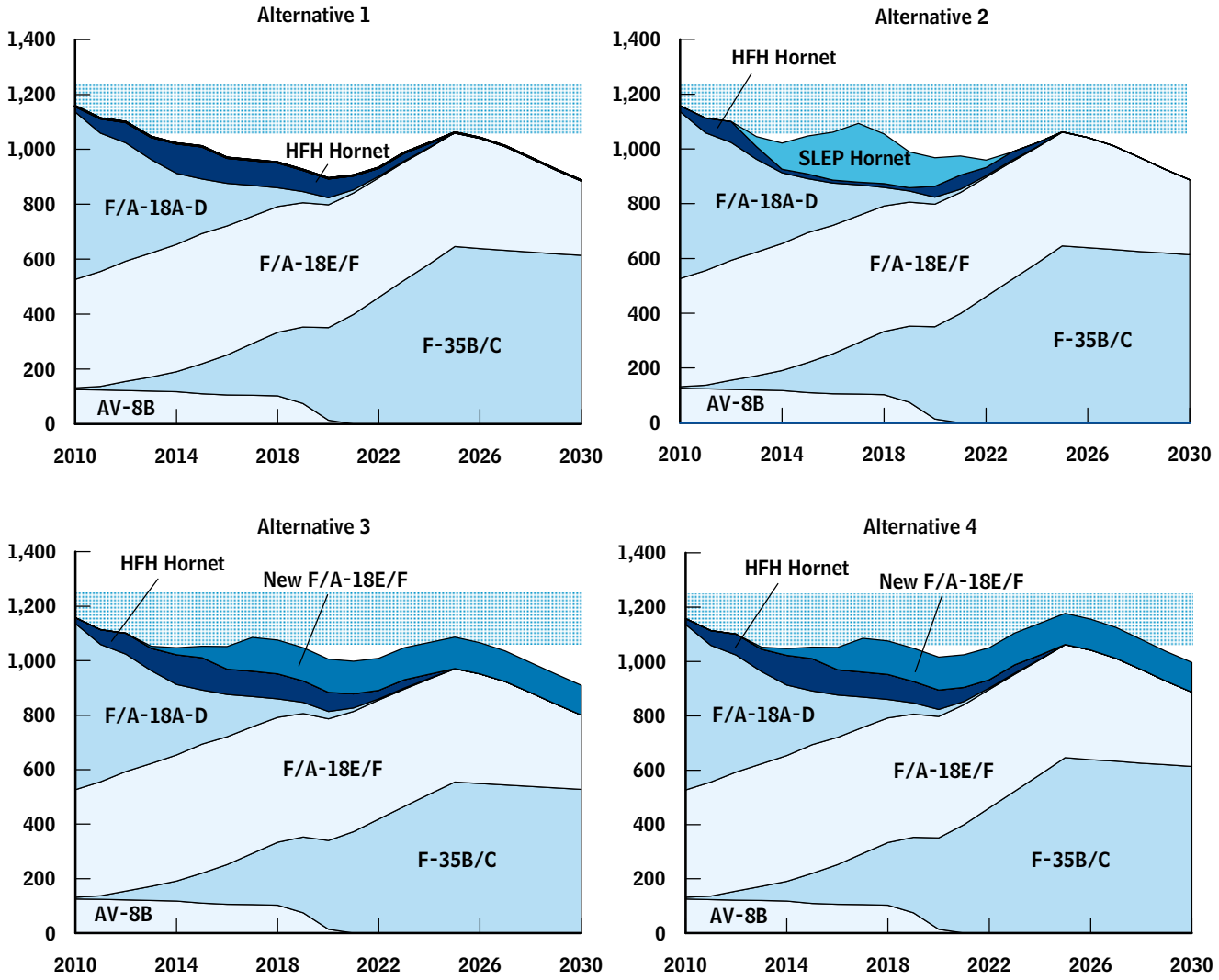
Under Alternative 2, inventories could be maintained at or close to the range of inventory objectives through about 2018. Inventories would then drop somewhat before climbing again after 2023, when JSF deliveries would begin to outpace retirements of old aircraft.

Alternative 2 is similar to a Navy proposal that would include 206 HFH and 280 SLEP Hornets. The Navy is also examining plans that would extend the service life

Figure 3.

Composition of the Navy's and Marine Corps' Fighter Forces Under Alternative Plans

(Total aircraft inventory)



Source: Congressional Budget Office.

Notes: Under the base-case scenario (not shown), Hornets (F/A-18A-D) would be retired from service at 8,000 flight hours, and Harriers (AV-8B) would be taken out of service by 2020 as they were replaced by Joint Strike Fighters (JSFs). Under Alternative 1, 509 Hornets would receive modifications under the high-flight-hour (HFH) program, which would extend their service life by 600 flight hours. Under Alternative 2, 220 Hornets would receive HFH modifications; another 289 Hornets would receive more-extensive modifications under the service-life extension program (SLEP), which would increase their service life to 10,000 hours. Under Alternative 3, 509 Hornets would receive HFH modifications; also, the Department of the Navy would purchase 126 additional Super Hornets (F/A-18E/F) but 93 fewer Joint Strike Fighters (F-35B/C). Under Alternative 4, 509 Hornets would receive HFH modifications, and the Navy would purchase 126 additional Super Hornets (but not reduce the number of JSFs).

The dotted band indicates a range of inventory objectives derived from information provided by the Navy (see Box 2 for details).

Inventories of JSFs are based on purchase schedules as described in *Department of Defense 30-Year Aviation Plan* (February 2010).

of fewer Hornets. In particular, the Navy has cited a proposal that would add SLEP modifications to150 Hornets. By modifying a smaller number of aircraft, the Navy would be able to reduce its costs and have greater flexibility to select for modification only aircraft that were in the best condition. Fewer aircraft would be made available to the force in that case, however.

Alternative 3: Extend Hornets' Service Life with HFH Modifications and Purchase More Super Hornets and Fewer JSFs

Under Alternative 3, the Navy would purchase 126 additional Super Hornets over the next several years, when the fighter inventory is projected to be at its lowest, and partially offset those additional aircraft by decreasing its purchases of Joint Strike Fighters by 93 aircraft in later years. This alternative would yield an inventory that was equal to or greater than that of Alternative 2 in each year and slightly greater than the base case (and Alternatives 1 and 2) in 2025 (see the lower left panel inFigure 3).[14] The total cost of Alternative 3 would be $3.8 billion to $4.8 billion more than the base case (under multiyear and annual procurement contracts, respectively) and would be between the costs of the first two alternatives. However, the cost would be disproportionately shifted to earlier years: Alternative 3 would cost about $10.3 billion to $11.3 billion more than the base case over the 2011–2015 period and then $6.5 billion less than the base case from 2016 to 2023.

The 126 additional Super Hornets would be purchased through 2015. (Specifically, 8 would be purchased in 2011, 17 each in 2012 and 2013, and 42 each in 2014 and 2015.) That pace would result in a steady production rate of 42 aircraft per year when it was combined with planned purchases of F/A-18E/Fs and EA-18Gs.[15] Reductions in JSF purchases would be made between 2018 and 2023. Purchases of B- and C-model JSFs would be capped at 50 aircraft per year between 2018 and 2023 instead of the rate of more than 65 aircraft per year that was indicated in the *Department of Defense 30-Year Aviation Plan.* CBO did not assume specific reductions in quantities of B- and C-model JSFs because the Navy and Marine Corps have not yet specified what the B/C mix will be for the 680 JSFs they plan to purchase.

The additional aircraft purchased in earlier years would result in an average increase in inventory of about 128 aircraft between 2011 and 2025. The total inventory would be maintained at close to or well above 1,000 aircraft over that period. In addition, each Super Hornet purchased under Alternative 3 would be more capable than the Hornet it replaced, shifting the aggregate technological capability of the fleet upward (see Figure 4). By 2020, for example, the fleet under Alternative 3 would include almost 20 percent more aircraft equipped with active electronically scanned array radars than the force under Alternatives 1 and 2 would have. The force under Alternative 3 would have fewer stealthy aircraft after 2020, however.

Alternative 3 also would present a lesser technical and cost risk than Alternative 2 because it would involve purchasing the proven Super Hornet in lieu of SLEP Hornets, for which modifications and inspection schedules have yet to be finalized. Additionally, keeping Super Hornet production open for several more years could provide a hedge against further development or production problems that might arise for the JSF.

Alternative 4: Extend Hornets' Service Life with HFH Modifications and Purchase Additional Super Hornets

Under Alternative 4, the Navy would modify 509 Hornets under the high-flight-hour program and purchase an additional 126 Super Hornets, but it would not decrease its JSF purchases. As a result, fighter inventories would be greater than or equal to those of Alternative 2 in each year

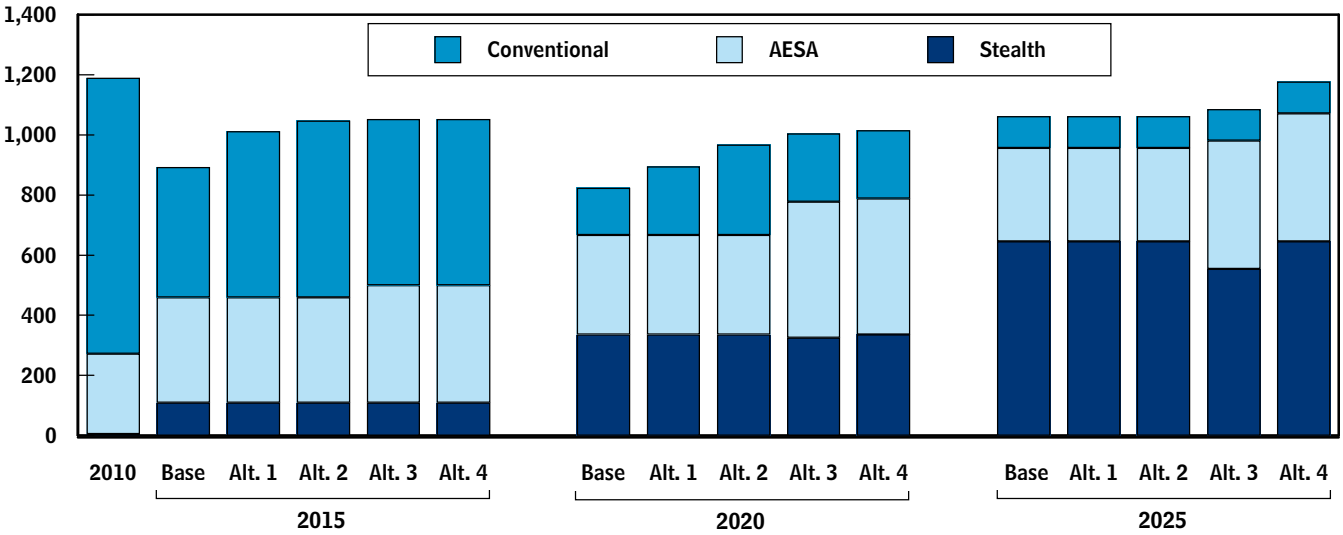
14. The inventory in 2025 under Alternative 3 would be about 40 aircraft higher than under Alternatives 1 and 2. A larger reduction in procurement of F-35B/Cs could have yielded a closer match, but it would introduce the potential of substantial changes in unit cost resulting from a lower rate of production. A detailed estimate of that effect was not possible because the number of F-35Bs versus F-35Cs has not been established. Consequently, CBO assumed a rate of 50 F-35B/Cs per year (the same rate as was used in earlier plans from the Department of the Navy) as a floor for F-35B/C procurement.

15. The additional Super Hornets in 2011, 2012, and 2013 could be purchased under the multiyear contract that the Department of Defense is considering for the remaining planned Super Hornets (and Growlers) because the proposed contract would allow the Defense Department to increase purchases up to a maximum of 54 aircraft per year. Those terms could change before the contract is awarded, however.

Figure 4.

Capabilities of the Navy's and Marine Corps' Fighter Fleets Under Alternative Plans

(Total aircraft inventory)



Source: Congressional Budget Office.

Notes: Under the base-case scenario, Hornets would be retired from service at 8,000 flight hours. Under Alternative 1, 509 Hornets would receive modifications under the high-flight-hour (HFH) program, which would extend their service life by 600 flight hours. Under Alternative 2, 220 Hornets would receive HFH modifications; another 289 Hornets would receive more-extensive modifications under the service-life extension program, which would increase their service life to 10,000 hours. Under Alternative 3, 509 Hornets would receive HFH modifications; also, the Department of the Navy would purchase 126 additional Super Hornets but 93 fewer Joint Strike Fighters (JSFs). Under Alternative 4, 509 Hornets would receive HFH modifications, and the Navy would purchase 126 additional Super Hornets (but not reduce the number of JSF aircraft.)

The "conventional" category includes F/A-18A-D Hornets and the earliest production (Block 1) F/A-18E/F Super Hornets, which are not equipped with active electronically scanned array (AESA) radars. The "AESA" category includes the remaining (Block 2) Super Hornets, which are equipped with AESA radars. The "stealth" category includes F-35B/C Joint Strike Fighters (which also carry AESA radars).

Inventories of JSFs are based on purchase schedules as described in *Department of Defense 30-Year Aviation Plan* (February 2010).

and significantly larger after 2018 (see the lower right panel in Figure 3). Over the 2011–2025 period, the average inventory would increase by 148 aircraft and would remain above 1,000 aircraft. Alternative 4 would have the highest cost of the alternatives that CBO examined—about $11.6 billion to $12.6 billion more than the base case. As with Alternative 3, nearly all of that additional cost would occur over the next five years.

The improvements that would be realized under Alternative 4 would come at a cost per aircraft-year of inventory of about $5.3 million to $5.7 million from 2011 to 2025, an amount higher than the cost of the other three alternatives considered by CBO. However, if the 1,700 aircraft-years of inventory provided *after* 2025 are included, the cost would be $2.9 million to $3.2 million per aircraft-year purchased, which is between the costs of Alternative 1 and Alternative 2. It is not clear, however, whether an aircraft-year of inventory after 2025 would be of equal operational value to one before 2025 because inventory demands may be different and other, more advanced, aircraft may be beginning to enter the force at that time. Nevertheless, the additional inventory that would be provided after 2025 could serve as a hedge against a future need to increase force structure or against delays in whatever system the Navy might pursue to replace the Super Hornet.

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