



F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress

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Summary

The largest procurement program in the Department of Defense (DOD), the F-35 Joint Strike Fighter (JSF), also called the Lightning II, is a new aircraft being procured in different versions for the United States Air Force, Marine Corps, and Navy. Current DOD plans call for acquiring a total of 2,456 JSFs. Hundreds of additional F-35s are expected to be purchased by several U.S. allies, eight of which are cost-sharing partners in the program.

The F-35 promises significant advances in military capability. Like many high-technology programs before it, reaching that capability has put the program above its original budget and behind the planned schedule.

The administration's proposed FY2011 defense budget requested about \$6.8 billion in procurement funding for the F-35 Joint Strike Fighter (JSF) program. This would fund the procurement of 22 F-35As for the Air Force (with an additional aircraft requested to be funded from the Overseas Contingency Operations account), 13 F-35Bs for the Marine Corps, and seven F-35Cs for the Navy.

The administration's proposed FY2011 defense budget also proposed terminating the F-35 alternate engine program, which is intended to develop the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt and Whitney F135 engine that currently powers the F-35. The F-35 alternate engine program emerged as a major item of debate on the FY2011 defense budget.

FY2011 defense authorization act: The report on the House-passed version of the FY2011 defense authorization bill included language limiting procurement to 30 F-35s pending certification that the F-35 had achieved certain testing parameters. The Senate Armed Services Committee-reported version of the bill required similar, but different achievements, but did not withhold funding.

As passed, H.R. 6523, the Ike Skelton National Defense Authorization Act For Fiscal Year 2011, did not include program-level detail, so no dollar amount or quantities are specified for the F-35 program.

Section 122 requires establishment of a system management plan and matrix for the F-35 program. Section 126 requires a feasibility study of integrating solid state laser systems into the F-35 (and other aircraft.) Section 802 designates the F-35 engine development and procurement program as a major subprogram.

FY2011 DOD appropriations bill: The Senate Appropriations Committee funded 32 F-35s, 10 fewer than the Administration requested. The House Appropriations Committee did not report out a separate defense appropriations bill. In lieu of a defense appropriations bill, Congress approved a resolution continuing FY2010 spending levels from October 1, 2010, through March 15, 2011, when an appropriation covering the remainder of FY2011 was enacted into law. That appropriation funded 35 F-35s (25 F-35As, 3 -Bs, and 7 -Cs).

Contents

Introduction	1
In General	1
Alternate Engine Program	1
Background	2
The F-35 in Brief	2
In General	2
Three Service Versions	3
Alternate Engine Program Summary	4
Recent Developments	5
Cost Growth	5
GAO Criticism of F-35 Program	5
Secretary Gates's January 2011 Program Restructure	6
Fleet Grounding	7
Deficit Reduction Commission Recommendation	7
JSF Program Origin and Milestones	8
Procurement Quantities	10
Planned Total Quantities	10
Annual Quantities	10
Program Management	11
Cost and Funding	11
Total Program Acquisition Cost	11
Prior-Year Funding	12
Unit Costs	12
LRIP-IV cost	12
Operating & Support Costs	12
Manufacturing Locations	13
International Participation	13
In General	13
International Sales Quantities and Schedule	15
Friction over Work Shares and Technology Transfer	16
Proposed FY2011 Budget	17
FY2011 Funding Request	17
Proposed Termination of Alternate Engine	19
Issues for Congress	19
Alternate Engine Program	19
Planned Total Procurement Quantities	19
Program Performance	20
Cost Increases and Nunn-McCurdy Breach	20
February 2010 Program Restructuring	20
OT&E Report on System Testing	21
March 2010 GAO Perspective	21
Testing Performance	22
Cost Tracking	23
Affordability and Projected Fighter Shortfalls	23
Future of Marine Corps Aviation	24
Implications for Industrial Base	24

Legislative Activity for FY2011	25
Summary of Quantities and Funding	25
FY2011 Defense Authorization Act (H.R. 5136/S. 3454)	26
House	26
Senate	27
Final Action	30
FY2011 Defense Appropriations Act (S. 3800)	30
Senate	30
Final Action	32
FY2011 DOD and Full-Year Continuing Appropriations Act	32

Tables

Table 1. F-35 Variant Milestones	9
Table 2. Annual F-35 Procurement Quantities.....	10
Table 3. FY2011 Funding Request for F-35 Program.....	18
Table 4. Summary of Action on FY2011 F-35 Quantities and Funding.....	25
Table A-1. Summary of Action on FY2010 F-35 Quantities and Funding.....	34
Table B-1. F-35 Key Performance Parameters (KPPs)	55

Appendixes

Appendix A. Legislative Activity for FY2010.....	34
Appendix B. F-35 Key Performance Parameters	55

Contacts

Author Contact Information	55
Acknowledgments	55

Introduction

In General

The F-35 Joint Strike Fighter (JSF), also called the Lightning II, is a new aircraft being procured in different versions for the Air Force, Marine Corps, and Navy. The F-35 program is DOD's largest weapon procurement program in terms of total estimated acquisition cost. Current Department of Defense (DOD) plans call for acquiring a total of 2,456 JSFs¹ for the Air Force, Marine Corps, and Navy at an estimated total acquisition cost (as of December 31, 2009) of about \$238 billion in constant (i.e., inflation-adjusted) FY2002 dollars. Hundreds of additional F-35s are expected to be purchased by several U.S. allies, eight of which are cost-sharing partners in the program.

The administration's proposed FY2011 defense budget requested a total of about \$10.4 billion for the F-35 program, including about \$2.5 billion in Air Force and Navy research and development funding and about \$7.9 billion in Air Force and Navy procurement funding. (Development and procurement of Marine Corps aircraft are funded through the Navy's budget.) The administration proposed to fund the procurement of 23 F-35As for the Air Force, 13 F-35Bs for the Marine Corps, and seven F-35Cs for the Navy in FY2011.²

The administration's proposed FY2011 defense budget also proposed terminating the F-35 alternate engine program, which is intended to develop the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt and Whitney F135 engine that currently powers the F-35.³ The F-35 alternate engine program emerged as a major item of debate on the FY2010 defense budget. The administration threatened to veto the FY2010 defense authorization or appropriation bill if either "would seriously disrupt" the F-35 program. In its consideration of the FY2010 budget, Congress authorized and appropriated \$430 million to continue alternate engine development, and appropriated \$35 million for alternate engine procurement.

Alternate Engine Program

A long-standing debate over whether the F-35 program should include funding for an alternate engine has potential implications for the program's budget, the number of aircraft acquired, and allied nations' willingness to participate in the program, among other issues. Introductory information on the F-35 alternate engine program is presented in the "Background" section of this report. Due to the significance of these issues and the pace of developments, the alternate engine debate is addressed separately in CRS Report R41131, *F-35 Alternate Engine Program: Background and Issues for Congress*.

¹ Thirteen of the aircraft will be acquired for flight testing through research and development funding.

² The request proposes funding one Air Force F-35A through Overseas Contingency Operations accounts rather than DOD procurement funds.

³ Successive administrations proposed terminating the alternate engine program in FY2007, FY2008, FY2009, and FY2010. Congress rejected these proposals and provided funding, bill language, and report language to continue the program.

Background

The F-35 in Brief

In General

The F-35 was conceived as a relatively affordable fifth-generation strike fighter⁴ that could be procured in three highly common versions for the Air Force, the Marine Corps, and the Navy, in order to avoid the higher costs of developing, procuring, and operating and supporting three separate tactical aircraft designs to meet the services' similar but not identical operational needs.⁵

All three versions of the F-35 will be single-seat aircraft with the ability to go supersonic for short periods and advanced stealth characteristics. The three versions will vary somewhat in their combat ranges and payloads (see the **Appendix B**). All three are to carry their primary weapons internally to maintain a stealthy radar signature. Additional weapons can be carried externally on missions requiring less stealth.

DOD states that the F-35 program “was structured from the beginning to be a model of acquisition reform, with an emphasis on jointness, technology maturation and concept demonstrations, and early cost and performance trades integral to the weapon system requirements definition process.”⁶

⁴ Fifth-generation aircraft incorporate the most modern technology, and are considered to be generally more capable than earlier-generation aircraft. Fifth-generation fighters combine new developments such as thrust vectoring, composite materials, supercruise (the ability to cruise at supersonic speeds without using engine afterburners), stealth technology, advanced radar and sensors, and integrated avionics to greatly improve pilot situational awareness.

Among fighters currently in service or in regular production, only the Air Force F-22 air superiority fighter and the F-35 are considered fifth-generation aircraft. Russia has flown a prototype fifth-generation fighter, and China reportedly has fifth-generation fighters under development. Regarding Russia's fifth-generation fighter project, see, inter alia, Tony Halpin, “Russia unveils its first stealth fighter jet - the Sukhoi T-50,” *TimesOnline*, January 29, 2010; and Alexei Komarov, “More Sukhoi T-50s To Fly In Next 12 Months,” *Aviation Week & Space Technology*, March 12, 2010. Regarding China's fifth-generation fighter project, see, inter alia, David A. Fulghum, “China Revs Up Pursuit Of Stealth Technology,” *Aerospace Daily & Defense Report*, November 20, 2009; and Ted Parsons, “China's Fifth-Generation Fighter To Fly ‘Soon,’” *Jane's Defence Weekly*, November 12, 2009.

Strike fighters are dual-role tactical aircraft that are capable of both air-to-ground (strike) and air-to-air (fighter) combat operations.

⁵ The program's operational requirements call for 70% to 90% commonality between all three versions. Many of the three versions' high-cost components—including their engines, avionics, and major airframe structural components—are common.

Secretary of Defense William Cohen stated in 2000 that the JSF's joint approach “avoids the three parallel development programs for service-unique aircraft that would have otherwise been necessary, saving at least \$15 billion.” (Letter from Secretary of Defense William S. Cohen to Rep. Jerry Lewis, June 22, 2000. The text of letter made available by *Inside the Air Force* on June 23, 2000.)

⁶ Department of Defense. *Selected Acquisition Report (SAR)[for] F-35 (JSF)*, December 31, 2007, p. 4.

Three Service Versions

From a common airframe and powerplant core, the F-35 is being procured in three distinct versions tailored to the needs of each military service. Differences among the aircraft include the manner of takeoff and landing, fuel capacity, and carrier suitability, among others. They include:

Air Force CTOL Version (F-35A)

The Air Force is procuring the F-35A, a conventional takeoff and landing (CTOL) version of the aircraft. F-35As are to replace Air Force F-16 fighters and A-10 attack aircraft, and possibly F-15 fighters.⁷ The F-35A is intended to be a more affordable complement to the Air Force's new F-22 Raptor air superiority fighter.⁸ The F-35A is not quite as stealthy⁹ nor as capable in air-to-air combat as the F-22, but it is more capable in air-to-ground combat than the F-22, and more stealthy than the F-16. If the F-15/F-16 combination represented the Air Force's earlier-generation "high-low" mix of air superiority fighters and more-affordable dual-role aircraft, the F-22/F-35A combination might be viewed as the Air Force's intended future high-low mix.¹⁰ The Air Force states that "The F-22A and F-35 each possess unique, complementary, and essential capabilities that together provide the synergistic effects required to maintain that margin of superiority across the spectrum of conflict.... Legacy 4th generation aircraft simply cannot survive to operate and achieve the effects necessary to win in an integrated, anti-access environment."¹¹

Marine Corps STOVL Version (F-35B)

The Marine Corps is procuring the F-35B, a short takeoff and vertical landing (STOVL) version of the aircraft.¹² F-35Bs are to replace Marine Corps AV-8B Harrier vertical/short takeoff and landing attack aircraft and Marine Corps F/A-18A/B/C/D strike fighters, which are CTOL aircraft. The Marine Corps decided to not procure the newer F/A-18E/F strike fighter¹³ and

⁷ Stephen Trimble, "Lockheed says F-35s will replace USAF F-15s," *Flight International*, February 4, 2010.

⁸ For more on the F-22 program, see CRS Report RL31673, *Air Force F-22 Fighter Program: Background and Issues for Congress*.

⁹ A November 13, 2009, press article states that "The F-22 had a -40dBsm all-aspect reduction requirement [i.e., a requirement to reduce the radar reflectivity of the F-22 when viewed from all angles by 40 decibels per square meter], while the F-35 came in at -30dBsm with some gaps in coverage." (David A. Fulghum and Bradley Perrett, "Experts Doubt Chinese Stealth Fighter Timeline," *Aerospace Daily & Defense Report*, November 13, 2009, pp. 1-2.)

¹⁰ The term high-low mix refers to a force consisting of a combination of high-cost, high-capability aircraft and lower-cost, more-affordable aircraft. Procuring a high-low mix is a strategy for attempting to balance the goal for having a minimum number of very high capability tactical aircraft to take on the most challenging projected missions and the goal of being able to procure tactical aircraft sufficient in total numbers within available resources to perform all projected missions.

¹¹ Department of the Air Force Presentation to the House Armed Services Committee Subcommittee on Air and Land Forces, United States House of Representatives, Subject: Air Force Programs, Combined Statement of: Lieutenant General Daniel J. Darnell, Air Force Deputy Chief Of Staff For Air, Space and Information Operations, Plans And Requirements (AF/A3/5) [and] Lieutenant General Mark D. Shackelford, Military Deputy, Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ) Lieutenant General Raymond E. Johns, Jr., Air Force Deputy Chief of Staff for Strategic Plans And Programs (AF/A8) May 20, 2009, pp. 7-8, 10.

¹² To permit STOVL operations, the F-35B has an engine exhaust nozzle at the rear than can swivel downward, and a mid-fuselage lift fan connected to the engine that blows air downward to help lift the forward part of the plane.

¹³ For more on the F/A-18E/F program, see CRS Report RL30624, *Navy F/A-18E/F and EA-18G Aircraft Procurement and Strike Fighter Shortfall: Background and Issues for Congress*.

instead wait for the F-35B in part because the F/A-18E/F is a CTOL aircraft, and the Marine Corps prefers aircraft capable of vertical operations. The Department of the Navy states that “The Marine Corps intends to leverage the F-35B’s sophisticated sensor suite and very low observable (VLO), fifth generation strike fighter capabilities, particularly in the area of data collection, to support the Marine Air Ground Task Force (MAGTF) well beyond the abilities of today’s strike and EW [electronic warfare] assets.”¹⁴

Navy Carrier-Suitable Version (F-35C)

The Navy is procuring the F-35C, a carrier-suitable CTOL version of the aircraft.¹⁵ The F-35C is also known as the “CV” version of the F-35, as CV is the naval designation for aircraft carrier. The Navy plans in the future to operate carrier air wings featuring a combination of F/A-18E/Fs (which the Navy has been procuring since FY1997) and F-35Cs. The F/A-18E/F is generally considered a fourth-generation strike fighter.¹⁶ The F-35C is to be the Navy’s first aircraft designed for stealth, a contrast with the Air Force, which has operated stealthy bombers and fighters for decades. The F/A-18E/F, which is less expensive to procure than the F-35C, incorporates a few stealth features, but the F-35C is stealthier. The Department of the Navy states that “the commonality designed into the joint F-35 program will minimize acquisition and operating costs of Navy and Marine Corps tactical aircraft, and allow enhanced interoperability with our sister Service, the United States Air Force, and the eight partner nations participating in the development of this aircraft.”¹⁷

Alternate Engine Program Summary

The F-35 is powered by the Pratt and Whitney F135 engine, which was derived from the F-22’s Pratt and Whitney F119 engine. The F135 is produced in Pratt and Whitney’s facilities in East Hartford and Middletown, CT.¹⁸ Rolls-Royce is a subcontractor to Pratt and Whitney for the vertical lift system for the F-35B.

Consistent with congressional direction for the FY1996 defense budget, DOD established a program to develop an alternate engine for the F-35. The alternate engine, the F136, is being developed by a team consisting of GE Transportation—Aircraft Engines of Cincinnati, OH, and

¹⁴ Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, Before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy’s Aviation Procurement Program, May 19, 2009, pp. 1-2.

¹⁵ Features for carrier suitability include, among other things, strengthened landing gear, a strengthened airframe, and an arresting hook so as to permit catapult launches and arrested landings, as well as folding wing tips for more compact storage aboard ship.

¹⁶ Some F/A-18E/F supporters argue that it is a “fourth-plus” or “4.5” generation strike fighter because it incorporates some fifth-generation technology, particularly in its sensors.

¹⁷ Statement of Vice Admiral David Architzel, USN, Principal Military Deputy, Research, Development and Acquisition, LTGEN George J. Trautman III, USMC, Deputy Commandant for Aviation, [and] RADM Allen G. Myers, USN, Director of Warfare Integration, before the Seapower and Expeditionary Warfare [sic: Forces] Subcommittee of the House Armed Services Committee [hearing] on [the] Department of the Navy’s Aviation Procurement Program, May 19, 2009, p. 1.

¹⁸ Pratt and Whitney’s parent firm is United Technologies.

Rolls-Royce PLC of Bristol, England, and Indianapolis, IN. The F136 is a derivative of the F120 engine originally developed to compete with the F119 engine for the F-22 program.

DOD included the F-35 alternate engine program in its proposed budgets through FY2006, although Congress in certain years increased funding for the program above the requested amount and/or included bill and report language supporting the program.

The George W. Bush administration proposed terminating the alternate engine program in FY2007, FY2008, and FY2009. The Obama administration did likewise in FY2010. Congress rejected these proposals and provided funding, bill language, and report language to continue the program.¹⁹

The F-35 alternate engine program emerged as a major item of debate on the FY2010 defense budget. The administration opposed further funding for the alternate engine program and threatened to veto the FY2010 defense authorization or appropriation bill if either “would seriously disrupt” the F-35 program. (See “Legislative Activity for FY2010,” **Appendix A.**)

Fuller details of the alternate engine program and issues for Congress arising from it are detailed in CRS Report R41131, *F-35 Alternate Engine Program: Background and Issues for Congress*.

Recent Developments

Cost Growth

The December 31, 2010, Selected Acquisition Report indicated that as of December 31, 2010, the total estimated acquisition cost of the F-35 program in constant FY2002 dollars was about \$270.6 billion.²⁰ Further details are included in “Cost and Funding,” below.

GAO Criticism of F-35 Program

An April 7, 2011, report from the Government Accountability Office (GAO) found that although restructuring had helped the F-35 program overall, some specific issues continued to lag. Most notably, GAO cited:

- The maturity of the F-35’s design: “The JSF program still lags in achieving critical indicators of success expected from well-performing acquisition programs. Specifically, the program has not yet stabilized aircraft designs—engineering changes continue at higher than expected rates long after critical design reviews and well into procurement.”²¹

¹⁹ Bill language since FY2007 includes Section 211 of the FY2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) and Section 213 of the FY2008 defense authorization act (H.R. 4986/P.L. 110-181 of January 28, 2008). (For the texts of these two provisions, see CRS Report R41131, *F-35 Alternate Engine Program: Background and Issues for Congress*.)

²⁰ Office of the Secretary of Defense, *Selected Acquisition Report (SAR): F-35*, December 31, 2010.

²¹ U.S. Government Accountability Office, *Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags*, 11-325, April 2011, p.15.

- Software development: “Officials underestimated the time and effort needed to develop and integrate the software.. each of the remaining three blocks—providing full mission systems and warfighting capabilities—are now projected to slip between 2 to 3 years compared to the 2006 plan.”²²
- Testing: “The JSF program established 12 clearly-stated goals in testing, contracting, and manufacturing for completion in calendar year 2010. It had mixed success, achieving 6 goals and making varying degrees of progress on the other 6.”²³ As a consequence of the failure to meet test goals, contractor Lockheed Martin forfeited \$28 million of a possible \$35 million in award fees for 2010.²⁴

Secretary Gates’s January 2011 Program Restructure

The director of the F-35 program completed a baseline technical review of the program in late 2010, “which was a technical, ‘bottoms-up,’ independent review of the air vehicle platform, sustainment, mission systems software, and test.”²⁵ Responding to issues detailed in the technical review, on January 6, 2011, Secretary of Defense Gates announced a change in the F-35 testing and production plan focused on the F-35B:

In short, two of the JSF variants, the Air Force version and the Navy’s carrier-based version, are proceeding satisfactorily.

By comparison, the Marine Corps’ short take-off and vertical-landing (STOVL) variant is experiencing significant testing problems. These issues may lead to a redesign of the aircraft’s structure and propulsion, changes that could add yet more weight and more cost to an aircraft that has little capacity to absorb more of either.

As a result, I am placing the STOVL variant on the equivalent of a two-year probation. If we cannot fix this variant during this time frame and get it back on track in terms of performance, cost and schedule, then I believe it should be canceled.

We will also move the development of the Marine variant to the back of the overall JSF production sequence.²⁶

Three major technical issues emerged for the F-35B.

The first was premature wear on hinges for the auxiliary inlet door feeding the F-35B’s lift fan, which caused the F-35B fleet to be grounded in September 2010. A technical fix was in place by January 2011.

Second, cracks were discovered in a bulkhead of an F-35B used for fatigue testing “after the airplane had been subjected to the equivalent of about 1,500 hours of flight time out of a total

²² Ibid., pp. 29-30.

²³ Ibid., p. 12.

²⁴ Amy Butler, “Lockheed Forfeited \$28 Mil of 2010 JSF Award,” *Defense Technology International*, April 25, 2011.

²⁵ Director, Operational Test & Evaluation, *FY 2010 Annual Report*, December 2010, p. 13.

²⁶ Office of the Assistant Secretary of Defense (Public Affairs), “DOD News Briefing with Secretary Gates and Adm. Mullen from the Pentagon,” press release, January 6, 2011, <http://www.defense.gov/transcripts/transcript.aspx?transcriptid=4747>.

16,000 hours planned.” Prime contractor Lockheed Martin has redesigned the bulkhead, and ““(o)ther locations of similar design are also being assessed,” company spokesman John Kent said in an e-mailed statement Jan. 11.”²⁷ The aluminum bulkhead is unique to the F-35B; “F-35A and F-35C bulkheads are still made of titanium, as are similar bulkheads on the F-22.”²⁸

Third, the driveshaft, lift-fan clutch, and actuator for the F-35B’s roll-post nozzles will be redesigned following discovery that the driveshaft contracts and expands more than expected, and that the other components experience more heat than anticipated during flight operations.²⁹

Moving F-35B development, which had been scheduled to lead the program, to the back of the queue should reduce the impact of F-35B issues on the schedule for the A and C models, which are encountering fewer development challenges.

The schedule changes Gates announced mean that “the Pentagon now plans to order 325 jets between 2012 and 2016, 124 fewer than anticipated a few months ago.... Of the money saved by buying fewer jets, \$4.6 billion would pay for continued development and testing. Another \$4 billion would be used by the Pentagon for other purposes, including acquiring more F/A-18 Super Hornets, one of the planes the F-35 is supposed to replace, for the Navy.”³⁰ The F/A-18 buy is reportedly 41 aircraft.³¹

While there are no specific criteria for the F-35B to meet in order to exit probation, “program officials have begun restructuring the program to hit four key goals ... maintaining propulsion levels while reducing aircraft weight, ensuring the aircraft’s ability to gain full flight clearance, proving the fighter’s suitability for ship operations and hitting the program’s key performance parameters.”³²

Fleet Grounding

All F-35s were grounded for approximately a week in March 2011, after the discovery of issues with onboard electrical generators. After discovering that improper maintenance, rather than a hardware issue, led to the problem, the fleet was returned to operation.³³

Deficit Reduction Commission Recommendation

On December 3, 2010, the National Commission on Fiscal Responsibility and Reform released its report on ways to decrease the United States’ national debt. The commission’s suggestions included canceling the F-35B outright, for a savings of \$17.6 billion, and substituting F-16s and

²⁷ Dave Majumdar, “Lockheed: One F-35B Problem Fixed,” *DefenseNews.com*, January 10, 2011.

²⁸ Bill Sweetman, “Major F-35B Component Cracks In Fatigue Test,” *AviationWeek/Ares blog*, November 17, 2010.

²⁹ Stephen Trimble, “New design changes raises pressure on future of F-35B variant,” *Flight International*, January 12, 2011.

³⁰ Bob Cox, “Defense Secretary Proposes Cutting 124 F-35 Purchases,” *Fort Worth Star-Telegram*, January 7, 2011.

³¹ Andrea Shalal-Esa, “Pentagon delays F-35, buys more Boeing fighters,” *Reuters*, January 6, 2011.

³² Carlo Munoz, “Venlet: No ‘Black And White’ Metrics To Evaluate Future of Suspended STOVL Program,” *Defense Daily*, February 16, 2011.

³³ Dave Majumdar, “Maintenance Procedure Led to F-35 Generator Failure,” *Defense News.com*, March 26, 2011.

F/A-18Es for half of the planned F-35A and C purchases. The commission estimated the new fighter mix would save \$9.5 billion through fiscal 2015.³⁴

Lockheed Martin chief financial officer Bruce Tanner “said the commission’s proposal is currently not viable... because Lockheed Martin’s Fort Worth fighter factory is now optimized for F-35 production and would only be able to build a maximum of four F-16s per month.”³⁵

JSF Program Origin and Milestones

The JSF program began in the early- to mid-1990s.³⁶ Three different airframe designs were proposed by Boeing, Lockheed, and McDonnell Douglas (the last teamed with Northrop Grumman and British Aerospace.) On November 16, 1996, the Defense Department announced that Boeing and Lockheed Martin had been chosen to compete in the Concept Demonstration phase of the program, with Pratt and Whitney providing propulsion hardware and engineering support. Boeing and Lockheed were each awarded contracts to build and test-fly two aircraft to demonstrate their competing concepts for all three planned JSF variants.³⁷

The competition between Boeing and Lockheed Martin was closely watched. Given the size of the JSF program and the expectation that the JSF might be the last fighter aircraft program that DOD would initiate for many years, DOD’s decision on the JSF program was expected to shape the future of both U.S. tactical aviation and the U.S. tactical aircraft industrial base.

In October 2001, DOD selected the Lockheed design as the winner of the competition, and the JSF program entered the System Development and Demonstration (SDD) phase. SDD contracts were awarded to Lockheed Martin for the aircraft and Pratt and Whitney for the aircraft’s engine.

³⁴ Jim Wolf, “Lockheed F-35 fighter in US deficit panel’s sights,” *Reuters.com*, November 10, 2010; John T. Bennett, “U.S. Debt Panel: Cut Weapon Programs,” *Defense News*, December 6, 2010.

³⁵ Marina Malenic, “Lockheed Martin Officials Defend F-35 As ‘Affordable,’” *Defense Daily*, December 3, 2010.

³⁶ The JSF program emerged in late 1995 from the Joint Advanced Strike Technology (JAST) program, which began in late 1993 as a result of the Clinton administration’s Bottom-Up Review (BUR) of U.S. defense policy and programs. The BUR envisaged the JAST program as a replacement for two other tactical aircraft programs that were being terminated (the A-12 program, which was intended to provide a stealthy new carrier-based attack plane to replace the Navy’s aging A-6 carrier-based attack planes, and the Multi-Role Fighter, which the Air Force had considered as a replacement for its F-16 fighters).

In 1995, in response to congressional direction, a program led by the Defense Advanced Research Projects Agency (DARPA) to develop an advanced short takeoff and vertical landing (ASTOVL) aircraft was incorporated into the JAST program. This opened the way for Marine Corps and UK participation in the JAST program, since the Marine Corps and the UK were interested procuring a new STOVL aircraft to replace their aging Harrier STOVL attack aircraft. The name of the program was then changed to Joint Strike Fighter (JSF) to focus on joint development and production of a next-generation fighter/attack plane.

A Joint Operational Requirements Document for the F-35 program was issued in March 2000 and revalidated by DOD’s Joint Requirements Oversight Council (JROC) in October 2001. On October 24, 2001, the Defense Acquisition Board (DAB) held a Milestone B review for the program. (Milestone B approval would permit the program to enter the SDD phase.) On October 25, 2001, the Secretary of Defense certified to Congress (in accordance with Section 212 of the FY2001 defense authorization act [H.R. 4205/P.L. 106-398 of October 30, 2000]) that the program had successfully completed the CDP exit criteria and demonstrated sufficient technical maturity to enter SDD. On October 26, 2001, the SDD contracts were awarded to Lockheed and Pratt and Whitney. A Preliminary Design Review (PDR) for the F-35 program was conducted in April 2003, and Critical Design Reviews (CDRs) were held for the F-35A, F-35B, and F-35C in February 2006 (F-35A and F-35B) and June 2007 (F-35C).

³⁷ Subsequent to the selection of the Boeing and Lockheed Martin designs, Boeing acquired McDonnell Douglas and merged the two firms’ JSF teams.

General Electric continued technical efforts related to the development of an alternate engine for competition in the program's production phase.

Table 1. F-35 Variant Milestones

	First flown	In testing	Original IOC goal	Current IOC estimate
F-35A	December 15, 2006	2 @ Edwards AFB	March 2013	2016
F-35B	June 11, 2008 First hover: March 17, 2010	3 @ NAS Patuxent River	March 2012	TBD
F-35C	June 6, 2010	1 @ NAS Patuxent River	March 2015	2016

Source: Prepared by CRS based on press reports and DOD testimony.

As shown in **Table 1**, the first flights of an initial version of the F-35A and the F-35B occurred in the first quarter of FY2007 and the third quarter of FY2008, respectively. The first flight of a slightly improved version of the F-35A occurred on November 14, 2009.³⁸ The F-35C first flew on June 6, 2010.³⁹

The F-35B's ability to hover, scheduled for demonstration in November, 2009, was shown for the first time on March 17, 2010.⁴⁰ The first vertical landing took place the next day.⁴¹

The F-35A, F-35B, and F-35C were originally scheduled to achieve Initial Operational Capability (IOC) in March 2013, March 2012, and March 2015, respectively.⁴² In March, 2010, Pentagon acquisition chief Ashton Carter announced that the Air Force and Navy had reset their projected IOCs to 2016, while Marine projected IOC remained 2012.^{43 44} Subsequently, the Marine IOC was delayed.⁴⁵

³⁸ "First Flight," *Defense Daily*, November 23, 2009, p. 3.

³⁹ Graham Warwick, "JSF Carrier Variant Meets Handling Goals On First Flight," *Aerospace Daily*, June 7, 2010.

⁴⁰ Graham Warwick, "F-35B Hovers for First Time," *Aviation Week/Ares* blog, March 17, 2010.

⁴¹ Graham Warwick, "STOVL F-35B Makes First Vertical Landing," *Aviation Week/Ares* blog, March 18, 2010.

⁴² The Navy had initially accelerated its estimated IOC for the F-35C to September 2014. Andrew Tilghman, "Joint Strike Fighter Timeline Moved Up," *NavyTimes.com*, September 18, 2009. In November 2009, Lockheed announced that the first flight of an F-35C test aircraft would be delayed from the final quarter of 2009 to the first quarter of 2010. (Dan Taylor, "Navy Joint Strike Fighter Carrier Variant Test Aircraft Will Not Fly Until 2010," *Inside the Navy*, November 9, 2009.)

⁴³ Testimony before the Senate Armed Services Committee, March 11, 2010.

⁴⁴ "Marine Corps IOC will include 15 aircraft for training at Eglin AFB, Fla., four in an operational test and evaluation detachment and the first operational squadron of 10 in Yuma, Ariz." Amy Butler, Robert Wall, Graham Warwick and Alon Ben-David, "F-35B Achieves Vertical Landing Milestone," *AviationWeek.com*, March 23, 2010.

⁴⁵ "The U.S. Marine Corps will scrap a December 2012 target to have its version of the Lockheed Martin Corp. F-35 Joint Strike Fighter ready for combat and isn't setting a new date, the service's commandant said. 'I'm really not wringing my hands over that,' General James Amos told reporters today at the Pentagon. 'It will be when it will be.'"—Tony Capaccio, "Marines to Delay Combat-Readiness Target for F-35 Jet," *Bloomberg.com*, December 14, 2010.

Procurement Quantities

Planned Total Quantities

The F-35 program includes a planned total of 2,456 aircraft for the Air Force, Marine Corps, and Navy. This included 13 research and development aircraft and 2,443 production aircraft: 1,763 F-35As for the Air Force and a total of 680 F-35Bs and Cs for the Marine Corps and Navy, with exact numbers of Bs and Cs not yet determined.⁴⁶

Annual Quantities

DOD began procuring F-35s in FY2007. **Table 2** shows actual F-35 procurement quantities through FY2010 and requested procurement quantities for FY2011. The figures in the table do not include 13 research and development aircraft procured with research and development funding. (Quantities for foreign buyers are discussed in the next section.)

Table 2. Annual F-35 Procurement Quantities

(Figures shown are for production aircraft; table excludes 13 research and development aircraft)

FY	F-35A (USAF)	F-35B (USMC)	F-35C (Navy)	Total
2007	2	0	0	2
2008	6	6	0	12
2009	7	7	0	14
2010	10	16	4	30
2011 (requested)	23	13	7	43

Source: Prepared by CRS based on DOD data.

Previous DOD plans contemplated increasing the procurement rate of F-35As for the Air Force to a sustained rate of 80 aircraft per year by FY2015, and completing the planned procurement of 1,763 F-35As by about FY2034. Past DOD plans also contemplated increasing the procurement rate of F-35Bs and Cs for the Marine Corps and Navy to a combined sustained rate of 50 aircraft per year by about FY2014, and completing the planned procurement of 680 F-35Bs and Cs by about FY2025.

On February 24, 2010, Pentagon acquisition chief Ashton Carter issued an Acquisition Decision Memorandum (ADM) restructuring the program. Although the ADM did not directly address maximum production rates or when they might be achieved, it did extend the SDD phase by 13 months, and slipped full-rate production to November, 2015.⁴⁷

⁴⁶ In 1996, preliminary planning estimated over 3,000 F-35s for DOD and the UK: 2,036 for the Air Force, 642 for the Marines, 300 for the U.S. Navy, and 60 for the Royal Navy. In May 1997, the QDR recommended reducing projected DOD procurement from 2,978 to 2,852: 1,763 for the Air Force, 609 for the Marines, and 480 for the Navy. (Quadrennial Defense Review Cuts Procurement in FY1999, 2000, *Aerospace Daily*, May 20, 1997, p. 280.) In 2003, the Navy reduced its planned procurement of 1,089 F-35s to 680 aircraft as part of the Navy/Marine Corps Tactical Aviation Integration Plan. (See CRS Report RS21488, *Navy-Marine Corps Tactical Air Integration Plan: Background and Issues for Congress*, by Christopher Bolkcom and Ronald O'Rourke.)

⁴⁷ *F-35 Lightning II Joint Strike Fighter (JSF) Program Restructure Acquisition Decision Memorandum (ADM)*, Under (continued...)

Program Management

The JSF program is jointly managed and staffed by the Department of the Air Force and the Department of the Navy. Service Acquisition Executive (SAE) responsibility alternates between the two departments. When the Air Force has SAE authority, the F-35 program director is from the Navy, and vice versa. The Air Force resumed SAE authority in April 2009.⁴⁸

On February 1, 2010, Secretary Gates announced that the JSF program manager had been dismissed, and that the program manager position would be upgraded from a 2-star to a 3-star billet. Vice Admiral David J. Venlet was nominated to be the new program manager on March 17, 2010,⁴⁹ and confirmed by the Senate on May 7, 2010.

Cost and Funding⁵⁰

Total Program Acquisition Cost

As of December 31, 2010, the total estimated acquisition cost (the sum of development cost, procurement cost, and military construction [MilCon] cost) of the F-35 program in constant (i.e., inflation-adjusted) FY2002 dollars was about \$270.6 billion, including about \$48.4 billion in research and development, about \$221.8 billion in procurement, and about \$457.4 million in MilCon.⁵¹

(...continued)

Secretary of Defense (Acquisition, Technology & Logistics), February 24, 2010.

⁴⁸ In 2004, appropriations conferees followed a House recommendation to direct DOD to review this alternative management arrangement. House appropriators believed that “management of program acquisition should remain with one Service, and that the U.S. Navy, due to its significant investment in two variants of the F-35 should be assigned all acquisition executive oversight responsibilities.” (H.Rept. 108-553 [H.R. 4613], p. 234) Conferees directed that DOD submit a report on the potential efficacy of this change. Prior to the release of the DOD report, former Air Force Chief of Staff General John Jumper was quoted as saying that he also supported putting one service in charge of JSF program acquisition. (Elizabeth Rees, “Jumper Supports Single Service Retaining JSF Acquisition Oversight,” *Inside the Air Force*, August 6, 2004.) However, General Jumper highlighted the significant investment the Air Force was making in the JSF program in response to the congressional language favoring the Navy. In DOD’s response to Congress, the report noted the current arrangement ensures one Service does not have a “disproportionate voice” when it comes to program decisions and that the current system is “responsive, efficient, and in the best interests of the success of the JSF program.” (U.S. Department of Defense, *Report to Congress on Joint Strike Fighter Management Oversight* [forwarded by] Michael W. Wynne, Under Secretary of Defense for Acquisition, Technology and Logistics, December 20, 2004.)

⁴⁹ Michael Bruno, “Navy Three Star Officially Nominated For JSF,” *AviationWeek.com*, March 17, 2010.

⁵⁰ The F-35 program receives (or in the past received) funding from the Air Force, Navy, and Defense-Wide research, development, test, and evaluation (RDT&E) accounts (the Defense-Wide RDT&E funding occurred in FY1996-FY1998); Non-Treasury Funds (i.e., financial contributions from the eight other countries participating in the F-35 program)—a source of additional research and development funding; the Air Force and Navy aircraft procurement accounts (the Navy and Marine Corps are organized under the Department of the Navy, and Marine Corps aircraft development and procurement costs are funded through the Navy’s RDT&E and aircraft procurement accounts); and the Air Force MilCon account and the Navy and Marine Corps MilCon account.

⁵¹ Office of the Secretary of Defense, *Selected Acquisition Report (SAR): F-35*, December 31, 2010. The procurement cost figure of about \$198.4 billion does not include the cost of several hundred additional F-35s that are to be procured other countries that are participating in the F-35 program. The \$198.4 billion figure does, however, assume certain production-cost benefits for DOD aircraft that result from producing F-35s for other countries.

In then-year dollars (meaning dollars from various years that are not adjusted for inflation), the figures are about \$379.4 billion, including about \$54.4 billion in research and development, about \$324.4 billion in procurement, and about \$551.2 million in MilCon.

Prior-Year Funding

Through FY2010, the F-35 program has received a total of roughly \$56 billion of funding in then-year dollars, including roughly \$41 billion in research and development, about 14.1 billion in procurement, and roughly \$227.8 million in MilCon.

Unit Costs

As of December 31, 2010, the F-35 program had a program acquisition unit cost (or PAUC, meaning total acquisition cost divided by the 2,456 research and development and procurement aircraft) of about \$154.4 million in constant FY2010 dollars, and an average procurement unit cost (or APUC, meaning total procurement cost divided by the 2,443 production aircraft) of \$132.8 million in constant FY2010 dollars.

LRIP-IV cost

On November 19, 2010, DOD announced the award of a contract for the fourth lot of low rate initial production (LRIP) F-35s. This \$3.9 billion contract for 31 aircraft is fixed-price-incentive (firm target), meaning that Lockheed Martin and the government “would equally share the burden of a cost overrun up to 40% over the fixed price. Any overage above 40% would be Lockheed’s responsibility. Based on the per-unit price of roughly \$126 million, the cost could go as high as about \$176 million, but the price paid by the government would be capped at around \$151 million.”⁵²

Based on the LRIP IV contract, the target prices of the three F-35 variants without engines are as follows: conventional takeoff and landing (CTOL)—\$111.6 million; Short takeoff and vertical landing (Stovl)—\$109.4 million and carrier variant (CVs)—\$142.9 million. Though Stovl appears to cost the least, the per-unit engine price is the highest. Also, this number is lower because the purchase includes 17 Stovls versus 11 CTOLs and only four CVs.⁵³

Operating & Support Costs

The December 31, 2010, Selected Acquisition Report projected lifetime operating and sustainment costs for the F-35 fleet at slightly over \$1 trillion.⁵⁴ Because that figure was based on experience with older fighters, it is being updated. “The Pentagon’s Cost Analysis and Program Evaluation group is updating its \$1 trillion figure for a major F-35 review next month intended to

⁵² Amy Butler, “Lockheed Says Latest F-35 Buy Following Predicted Cost Curve,” *Aerospace Daily*, December 3, 2010.

⁵³ Amy Butler, “Carter: Healthy JSF Development Worth A Slip In Production,” *Aerospace Daily*, December 22, 2010.

⁵⁴ Office of the Secretary of Defense, *Selected Acquisition Report (SAR): F-35*, December 31, 2010, p. 53.

revise all of the program's costs ... the program office will begin a so-called baseline review of the sustainment cost, similar to the F-35 design and production review conducted last year."⁵⁵

Manufacturing Locations

Current plans call for the F-35 to be manufactured in several locations. Lockheed will build the aircraft's forward section in Fort Worth, TX. Northrop will build the mid-section in Palmdale, CA, and the tail will be built by BAE Systems in the United Kingdom. Final assembly of these components will take place in Fort Worth. Program officials are considering the potential of establishing a second final assembly and checkout facility in Italy.⁵⁶

As mentioned earlier (see "Alternate Engine Program"), the Pratt and Whitney F135 engine for the F-35 is produced in Pratt and Whitney's facilities in East Hartford and Middletown, CT. The General Electric/Rolls-Royce team developing the F136 alternate engine for the F-35 includes GE Transportation—Aircraft Engines of Cincinnati, OH, and Rolls-Royce PLC of Bristol, England, and Indianapolis, IN.

International Participation

In General

The F-35 program is DOD's largest international cooperative program. DOD has actively pursued allied participation as a way to defray some of the cost of developing and producing the aircraft, and to "prime the pump" for export sales of the aircraft.⁵⁷ Allies in turn view participation the F-35 program as an affordable way to acquire a fifth-generation strike fighter, technical knowledge in areas such as stealth, and industrial opportunities for domestic firms.

Eight allied countries—the United Kingdom, Canada, Denmark, The Netherlands, Norway, Italy, Turkey, and Australia—are participating in the F-35 program under a Memorandum of Understanding (MOU) for the SDD and Production, Sustainment, and Follow-On Development (PSFD) phases of the program, although March, 2010 reports indicate Denmark may withdraw.⁵⁸ These eight countries have contributed varying amounts of research and development funding to the program, receiving in return various levels of participation in the program. International partners are also assisting with Initial Operational Test and Evaluation (IOT&E), a subset of SDD.⁵⁹ The eight partner countries are expected to purchase hundreds of F-35s, with the United Kingdom being the largest anticipated foreign purchaser.⁶⁰

⁵⁵ Tony Capaccio, "Lockheed Martin F-35 Operating Costs May Reach \$1 Trillion," *Bloomberg News*, April 21, 2011.

⁵⁶ "Eventually [Lockheed Martin] may want to open a second production line in Italy to better match demand, said Tom Burbage, executive vice president and general manager of the F-35 program." Christopher Hinton, "Lockheed Martin sees international demand growing for F-35," *MarketWatch.com*, June 17, 2009.

⁵⁷ Congress insisted from the outset that the JAST program include ongoing efforts by DARPA to develop more advanced STOVL aircraft, opening the way for UK participation in the program.

⁵⁸ See, inter alia, Bill Sweetman, "Denmark bails from JSF," *Aviation Week/Ares blog*, March 15, 2010.

⁵⁹ Currently, the UK, Italy, and the Netherlands have agreed to participate in the IOT&E program. UK, the senior F-35 partner, will have the strongest participation in the IOT&E phase. Italy and the Netherlands are contributing a far smaller amount and will take part only in the coalition concept of operations (CONOPS) validation testing. (Telephone conversation with OSD/AT&L, October 3, 2007.) Other partner nations are still weighing their option to participate in (continued...)

Two additional countries—Israel and Singapore—are security cooperation participants outside the F-35 cooperative development partnership.⁶¹ Israel has agreed to purchase 20 F-35s,⁶² and sales to Japan and additional countries are possible.⁶³ Some officials have speculated that foreign sales of F-35s might eventually surpass 2,000 or even 3,000 aircraft.⁶⁴

The UK is the most significant international partner in terms of financial commitment, and the only Level 1 partner.⁶⁵ On December 20, 1995, the U.S. and UK governments signed an MOU on British participation in the JSF program as a collaborative partner in the definition of requirements and aircraft design. This MOU committed the British government to contribute

(...continued)

the IOT&E program. The benefits to participation are expedited acquisition of aircraft, pilot training for the test cycle, and access to testing results.

⁶⁰ Debate continues in the United Kingdom over whether to base the design of its new carriers on availability of the STOVL F-35B, which would minimize the need for launch and arresting gear and a deck capable of landing CTOL aircraft, or to build them to a more conventional design. (See, inter alia, “Davies: both carriers will take JSF,” *DefenseManagement.com*, November 3, 2009.)

⁶¹ DOD offers Foreign Military Sales (FMS)-level of participation in the F-35 program for countries unable to commit to partnership in the program’s SDD phase. Israel and Singapore are believed to have contributed \$50 million each, and are “Security Cooperative Participants.” (Selected Acquisition Report, Office of the Secretary of Defense for Acquisition. December 31, 2005.)

⁶² Bob Cox, “Israeli government ok’s F-35 buy,” *Fort Worth Star-Telegram*, September 16, 2010. Yaakov Lappin, “Israel, US Sign F-35 Agreement,” *Jerusalem Post*, October 8, 2010.

⁶³ “Japan Mulls F-35 Purchase As Next Main Fighter Jet: Report,” Agence France-Presse, November 23, 2009. Obtained from *DefenseNews.com*, November 26, 2009. F-35 program officials have also discussed the F-35 with other prospective customers, including Germany, Greece, and Spain.

⁶⁴ Andrea Shalal-Esa, “Pentagon sees 6,000 possible F-35 sales,” *Reuters.com*, June 17, 2009. See also Marina Malenic, “F-35 Sales Could Double As Countries Look To Replace Aging Fleets, General Says,” *Defense Daily*, June 18, 2009: 6, and Marcus Weisgerber, “JSF Program Anticipates Nearly 700 F-35 Buys [For International Customers] Between FY-09 and FY-23,” *Inside the Air Force*, July 31, 2009.

⁶⁵ International participation in the F-35 program is divided into three levels, according to the amount of money a country contributes to the program—the higher the amount, the greater the nation’s voice with respect to aircraft requirements, design, and access to technologies gained during development. Level 1 Partner status requires approximately 10% contribution to aircraft development and allows for fully integrated office staff and a national deputy at director level.

Level II partners consist of Italy and the Netherlands, contributing \$1 billion and \$800 million, respectively. On June 24, 2002, Italy became the senior Level II partner. (“F-35 Joint Strike Fighter (JSF) Lightning II: International Partners,” <http://www.globalsecurity.org/military/systems/aircraft/f-35-int.htm>, accessed on October 3, 2007.) Italy wants to have its own F-35 final assembly line, which would be in addition to a potential F-35 maintenance and upgrade facility. The Netherlands signed on to the F-35 program on June 17, 2002, after it had conducted a 30-month analysis of potential alternatives.

Australia, Denmark, Norway, Canada, and Turkey joined the F-35 program as Level III partners, with contributions ranging from \$125 million to \$175 million. (“Australia, Belgium Enter Joint Strike Fighter Program as EMD Partners,” *Inside the Air Force*, April 21, 2000.)

Unlike the SDD phase, PSFD phase does not make any distinction as to levels of participation. Also unlike the bilateral SDD MOUs, there is a single PSFD MOU for all partner nations. In signing the PSFD MOU, partner nations state their intentions to purchase the F-35, including quantity and variant, and a determination is made as to their delivery schedule. PSFD costs will be divided on a “fair-share” based on the programmed purchase amount of the respective nation. So-called “offset” arrangements, considered the norm in defense contracts with foreign nations, usually require additional incentives to compensate the purchasing nation for the agreement’s impact to its local workforce. F-35 officials decided to take a different approach, in line with the program’s goal to control costs, to avoid offset arrangements and promote competition as much as possible. Consequently, all partner nations have agreed to compete for work on a “best-value” basis and have signed the PSFD MOU.

\$200 million toward the cost of the 1997-2001 Concept Demonstration Phase.⁶⁶ On January 17, 2001, the U.S. and UK governments signed an MOU finalizing the UK's participation in the SDD phase, with the UK committing to spending \$2 billion, equating to about 8% of the estimated cost of SDD. A number of UK firms, such as BAE and Rolls-Royce, participate in the F-35 program.⁶⁷

On October 18, 2010, the British government announced a significant revision to its F-35 acquisition. Following a major defense review, the British chose to reduce their planned buy "from 138 planes to as few as 40,"⁶⁸ and to withdraw from acquiring the F-35B short-takeoff-vertical landing model. "The British instead will buy the less costly F-35C model being developed for the U.S. Navy, and only enough planes to equip one small carrier around 2020."⁶⁹

International Sales Quantities and Schedule

The cost of F-35s for U.S. customers depends in part on the total quantity of F-35s produced. As the program has proceeded, some new potential customers have emerged, such as South Korea and Japan, mentioned above. Other countries have considered increasing their buys, while some have deferred previous plans to buy F-35s.

Norway has deferred its buy by two years.⁷⁰ Canada has reduced its projected buy from 80 aircraft to 65. "'One of the reasons there will be fewer of the new fighters is we anticipate the new fighters will have significantly greater capacity than existing fighters,' Prime Minister Stephen Harper told a news conference."⁷¹ ⁷² The Netherlands is considering reducing the quantity acquired as a consequence of unit cost growth.⁷³ On the other hand, Turkey may reportedly increase its buy from 100 to 120, and Israel from 20 to 40.⁷⁴ ⁷⁵ In the case of Australia:

⁶⁶ "U.S., U.K. Sign JAST Agreement," *Aerospace Daily*, December 21, 1995, p. 451.

⁶⁷ BAE is a major partner to Lockheed Martin and is providing the aft fuselage, empennage, and electronic warfare suite for the aircraft. Rolls-Royce is partnered with GE on the F136 engine and is a subcontractor to Pratt and Whitney for producing components for the F-35B's STOVL lift system. In October 2009, Rolls Royce broke ground on a new plant in Virginia to make parts for the F136 engine. (Rolls Royce press release, "Rolls-Royce expands US capability; begins construction on new manufacturing facility in Virginia," October 19, 2009, available at http://www.rolls-royce.com/investors/news/2009/091019_manufacturing_virginia.jsp.) Rolls Royce's 2001 contract with Pratt and Whitney for design and development of the STOVL lift components is valued at \$1 billion over 10 years. ("Rolls-Royce Finishes First JSF Propulsion System Flight Hardware," Rolls-Royce Media Room, available at http://www.rolls-royce.com/media/showPR.jsp?PR_ID=40243.) All F-35Bs, regardless of what engine they use, are to employ Rolls Royce components in their STOVL lift systems.

⁶⁸ Bob Cox, "Great Britain to delay, trim F-35 purchases," *Fort Worth Star-Telegram*, October 20, 2010.

⁶⁹ Ibid.

⁷⁰ Robert Wall, "Norway Delays Most F-35 Deliveries," *Aerospace Daily*, September 28, 2010.

⁷¹ Randall Palmer and David Ljunggren, "Canada to buy fewer F-35 fighters than thought," *Reuters.com*, May 12, 2008.

⁷² Daniel Leblanc, "Ottawa to spend \$9-billion in sole-source deal for U.S. fighter jets," *The Globe and Mail*, June 8, 2010. See also "Canada Commits \$8.5 Billion For 65 Lockheed Martin F-35s," *Defense Daily*, July 19, 2010; "Purchase Decision Allows Canada To Begin F-35 Planning," *Aerospace Daily*, July 19, 2010, and Dana Hedgpeth, "Lockheed In \$9 Billion Jet Deal With Canada," *Washington Post*, July 17, 2010.

⁷³ Robert Wall, "Netherlands Sees Big JSF Cost Jump," *Aerospace Daily*, December 3, 2010.

⁷⁴ Umit Enginsoy and Burak Ege Bekdil, "Fighter Buys Top Turkish Shopping List," *Defense News*, April 28, 2008.

⁷⁵ Gopal Ratnam and Viola Gienger, "Israel Seeks 20 Additional F-35s After Failure Of U.S. Swap For Peace Plan," *Bloomberg.com*, December 14, 2010.

... [W]ith the core U.S. program under intensive cost pressure, Australia held off until 2012 on a further commitment for 72 fighters to outfit the first three operational squadrons. By then, the government “will have much firmer cost estimates for the remaining aircraft and necessary support and enabling capability as part of the planned first multi-year buy that is expected to comprise over 1,000 aircraft for the U.S., Australia and other partners,” Defense Minister John Faulkner says.⁷⁶

Press reports indicate that Italy may follow the British lead and withdraw its requirement for F-35Bs. Although Italy had planned to buy 40 (and 69 F-35As), Defense Undersecretary Guido Crosetto said, “Italy wanted the STOVL for both Navy and Air Force.... The first thing we need to do is look closely at those we wanted for the Air Force, mainly because it costs 30 percent more and it is difficult to be the only one left sustaining it while other countries are making reductions and even the Americans are reconsidering it.”⁷⁷

Friction over Work Shares and Technology Transfer

DOD and foreign partners in the JSF program have occasionally disagreed over the issues of work shares and proprietary technology. Denmark, Italy, the Netherlands, Norway, and Turkey expressed dissatisfaction in 2003-2004 with the type and quantity of the work their companies had been awarded on the F-35.⁷⁸ These countries threatened to reduce their participation in the program, or to purchase European fighters instead of the F-35.

Israel announced that it had an agreement for \$5.3 billion in proposed offsets as part of its deal to acquire 20 F-35s, leading to Canadian objections that their much larger investment would yield a proportionally smaller share of offset work.⁷⁹

The governments of Italy and the United Kingdom have lobbied for F-35 assembly facilities to be established in their countries. In July 2010, Lockheed and the Italian firm Alenia Aeronautica reached an agreement to establish an F-35 final assembly and checkout facility at Cameri Air base, Italy, to deliver aircraft for Italy and the Netherlands beginning in 2014.⁸⁰ It was also reported that South Korean companies could bid for work on the F-35 if South Korea purchases the aircraft.⁸¹

In November 2009, it was reported that the Confederation of Danish Industries had demanded that the Danish government secure subcontract guarantees with Lockheed regarding Danish work

⁷⁶ Robert Wall, “Will Australian JSF Buy Avoid Delays?” *AviationWeek.com*, December 2, 2009. A similar story appeared in the print edition of *Aviation Week & Space Technology*, November 30, 2009.

⁷⁷ Tom Kingston, “Italian AF May Scrap STOVL F-35 Buy,” *Defense News*, December 13, 2010.

⁷⁸ “Norway Signs Industrial Partnership with Eurofighter Consortium,” *Defense Daily*, January 29, 2003. Joris Janssen Lok, “Frustration Mounts Among JSF Partners,” *Jane’s Defence Weekly*, March 24, 2004; Thomas Dodd, “Danish Companies Consider Quitting JSF Programme,” *Jane’s Defence Weekly*, January 9, 2004. Tom Kingston, “Unsatisfied Italy May Cut JSF Participation,” *Defense News*, May 10, 2004. Lale Sariibrahimoglu, “Turkey may withdraw from JSF program,” *Jane’s Defence Weekly*, November 10, 2004.

⁷⁹ Barbara Opall-Rome and David Pugliese, “Israeli Clarification Calms Canada’s Ire on Offsets,” *Defense News*, December 20, 2010.

⁸⁰ Amy Butler, “Deal For Italian JSF Assembly Facility Finally Set,” *Aerospace Daily*, July 20, 2010.

⁸¹ “Lockheed Martin Dangles F-35 Work Opportunities For S. Korea,” *Aerospace Daily & Defense Report*, October 21, 2009: 5.

on the F-35 program before the Danish government makes a selection to purchase the F-35 for Denmark's Combat Aircraft Replacement Program.⁸²

Some foreign partners in the F-35 program have argued that the United States has been too cautious regarding the transfer of JSF technologies. Following UK expressions in early 2006 of frustration regarding technology sharing,⁸³ Congress included a provision (Section 233) in the FY2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) expressing the sense of the Congress that the Secretary of Defense should share JSF technology between the U.S. and UK governments consistent with the national security interests of both nations.⁸⁴ However, a November 24, 2009, report indicated that the Pentagon had decided not to share critical technologies with the UK.^{85 86}

As of 2008, international content in the initial F-35 aircraft was approximately 20%, and Lockheed expected international content to potentially expand to about 30% as the program transitions to full-rate production and the supply base potentially diversifies.⁸⁷

Proposed FY2011 Budget

FY2011 Funding Request

Table 3 shows the administration's FY2011 request for Air Force and Navy research and development and procurement funding for the F-35 program, along with FY2009 and FY2010 funding levels. The funding figures shown in the table do not include procurement funding for initial spares, MilCon funding, or research and development funding provided by other countries.

⁸² Gerard O'Dwyer, "Danish Industry Pushes for F-35 Work Guarantees," *Defense News*, November 23, 2009: 23.

⁸³ The UK's top defense procurement official reportedly stated in 2006 that his country would cease participation in the F-35 program if the F136 engine were cancelled and technology transfer issues were not resolved to the UK's satisfaction. (Megan Scully, "British Demand Better Access To Fighter," *National Journal's Congress Daily AM*, March 15, 2006. George Cahlink, "U.K. Procurement Chief Warns Backup Engine Dispute Threatens JSF Deal," *Defense Daily*, March 15, 2006.)

⁸⁴ The text of the provision is as follows:

SEC. 233. SENSE OF CONGRESS ON TECHNOLOGY SHARING OF JOINT STRIKE FIGHTER TECHNOLOGY.

It is the sense of Congress that the Secretary of Defense should share technology with regard to the Joint Strike Fighter between the United States Government and the Government of the United Kingdom consistent with the national security interests of both nations.

⁸⁵ Jim Wolf, "U.S. to Withhold F-35 Fighter Software Code," *Reuters.com*, November 24, 2009.

⁸⁶ Rhys Jones, "UK confident U.S. will hand over F-35 fighter codes," *Reuters.com*, December 7, 2009.

⁸⁷ "F-35 International Program Content," JSF Joint Program Office paper, March 4, 2008.

Table 3. FY2011 Funding Request for F-35 Program

(Figures in millions of then-year dollars; FY2009 and FY2010 figures shown for reference)

	FY2009		FY2010		FY2011 (request)	
	Funding	Quantity	Funding	Quantity	Funding	Quantity
RDT&E funding						
Air Force	1,939.1	—	1,858.1	—	1,043.6	—
Dept. of Navy	1,848.9	—	1,741.3	—	1,376.0 ^a	—
Subtotal	3,788.0	—	3,599.4	—	2,419.6	—
Procurement funding						
Air Force	1,412.1	6	2,349.4	10	4,191.1	23 ^b
Dept. of Navy	1,223.6	6 ^c	4,478.0	20 ^d	3,956.9	20 ^e
Subtotal	2,635.7	12	6,827.5	30	7,891.0	40
TOTAL	6,423.7	12	10,426.9	30	8,817.0	43

Source: Prepared by CRS based on DOD data.

Notes: Figures shown do not include funding for initial spares, MilCon funding, or research and development funding provided by other countries. Air Force funding for initial spares was \$60.9 million in FY2009 and \$129.3 million in FY2010; \$263.6 million is requested for FY2011. Department of the Navy funding for initial spares was \$32.7 million in FY2009, and \$248.2 million in FY2010; \$107.0 million is requested for FY2011. Advance procurement requested in FY2011 for future years, \$257 million for the Air Force and \$286 million for the Navy, is included in the procurement amounts shown.

- a. DoN total includes \$708M in Navy R&D, \$668M in Marine Corps R&D.
- b. One aircraft is funded through 205M from Overseas Contingency Operations to replace a lost F-15E.
- c. All 6 aircraft are F-35Bs for the Marine Corps.
- d. Includes 16 F-35Bs for the Marine Corps and 4 F-35Cs for the Navy.
- e. Includes 13 F-35Bs for the Marine Corps (2,289.8M) and 7 F-35Cs (1,667.1M) for the Navy.

Procurement cost of the 23 F-35As requested for FY2011 in the Air Force budget is estimated at \$4,212.7 million, or an average of \$183.1 million each. These aircraft have received \$278.6 million in prior-year advance procurement (AP) funding, leaving another \$3,934.1 million to be funded in FY2011 to complete their estimated procurement cost. The FY2010 Air Force funding request for the F-35 program also includes \$257.0 million in advance procurement funding for F-35As to be procured in future years, and \$263.6 million for F-35A initial spares, bringing the total FY2010 Air Force procurement funding request for the program to \$4,454.7 million. (**Table 3** does not include funding for initial spares, which is why it shows a total of \$4,191.1 million.)

The 13 F-35Bs and seven F-35Cs requested for FY2011 in the Department of the Navy budget have a combined estimated procurement cost of \$4,436.4 million, or an average of \$221.8 million each. These aircraft have received \$479.5 million in prior-year AP funding, leaving another \$3,956.9 million to be funded in FY2011 to complete their estimated procurement cost. The FY2010 Department of the Navy procurement funding request for the F-35 program also includes \$506.2 million in advance procurement funding for F-35Bs and Cs to be procured in future years, \$154.1 million for F-35B initial spares, and \$107.0 million for F-35C initial spares, bringing the total FY2010 Navy procurement funding request for the program to \$4,724.2 million. (**Table 3** does not include funding for initial spares, which is why it shows a total of \$4,463.1 million.)

Proposed Termination of Alternate Engine

The administration's proposed FY2011 budget proposes terminating the F-35 alternate engine program and does not request any funding to continue the program.

Issues for Congress

Alternate Engine Program

Due to strong congressional interest in the administration's proposal to terminate the F-35 alternate engine program, this issue is fully examined in a separate publication, CRS Report R41131, *F-35 Alternate Engine Program: Background and Issues for Congress*.

Planned Total Procurement Quantities

Another potential issue for Congress concerns the total number of F-35s to be procured. As mentioned above, planned production totals for the various versions of the F-35 we left unchanged by the 2010 Quadrennial Defense Review (QDR). Since then, considerable new information has appeared regarding cost growth that may challenge the ability to maintain the expected procurement quantities. "I think we are to the point in our budgetary situation where, if there is unanticipated cost growth, we will have to accommodate it by reducing the buy," said Undersecretary of Defense Robert Hale, the Pentagon comptroller.⁸⁸

Some observers, noting potential limits on future U.S. defense budgets, potential changes in adversary capabilities, and competing defense-spending priorities, have suggested reducing planned total procurement quantities for the F-35. A September 2009 report on future Air Force strategy, force structure, and procurement by the Center for Strategic and Budgetary Assessments (CSBA), for example, states that

[A]t some point over the next two decades, short-range, non-stealthy strike aircraft will likely have lost any meaningful deterrent and operational value as anti-access/area denial systems proliferate. They will also face major limitations in both irregular warfare and operations against nuclear-armed regional adversaries due to the increasing threat to forward air bases and the proliferation of modern air defenses. At the same time, such systems will remain over-designed – and far too expensive to operate – for low-end threats....

Reducing the Air Force plan to buy 1,763 F-35As through 2034 by just over half, to 858 F-35As, and increasing the [annual F-35A] procurement rate to end [F-35A procurement] in 2020 would be a prudent alternative. This would provide 540 combat-coded F-35As on the ramp, or thirty squadrons of F-35s[,] by 2021[, which would be] in time to allow the Air Force budget to absorb other program ramp ups[,] like NGB [the next-generation bomber].⁸⁹

⁸⁸ Marina Malenic, "DoD Comptroller: Further F-35 Cost Growth Jeopardizes Buy Quantity," *Defense Daily*, March 4, 2010.

⁸⁹ Thomas P. Ehrhard, *An Air Force Strategy for the Long Haul*, Washington, Center for Strategic and Budgetary Assessments, 2009, pp. xii and xiv. The report was released on September 17, 2009, according to CSBA's website, and is available online at http://www.csbaonline.org/4Publications/PubLibrary/R.20090917.An_Air_Force_Strat/R.20090917.An_Air_Force_Strat.pdf. Subsequent to writing this report, the author became a special assistant to the Air (continued...)

Program Performance

The F-35 program is behind schedule and over budget. Congress may wish to review the causes of these issues, whether the plan put forward in February 2010 is sufficient to recover schedule and stabilize costs, and/or the credibility of projections by DOD, GAO, and others regarding the program's likely future performance.

Cost Increases and Nunn-McCurdy Breach

On March 20, 2010, DOD formally announced that the JSF program had exceeded the cost increases limits specified in the Nunn-McCurdy cost containment law, as average procurement unit cost, in FY2002 dollars, had grown 57% to 89% over the original program baseline. Simply put, this requires the Secretary of Defense to notify Congress of the breach, present a plan to correct the program, and to certify that the program is essential to national security before it can continue.⁹⁰

On June 2, 2010, the Under Secretary of Defense for Acquisition, Technology and Logistics issued an Acquisition Decision Memorandum (ADM) certifying the F-35 Program in accordance with section 2433a of title 10, United States Code. As required by section 2433a, of title 10, Milestone B was rescinded. A Defense Acquisition Board (DAB) was held in November 2010... No decision was rendered at the November 2010 DAB... Currently, cumulative cost and schedule pressures result in a critical Nunn-McCurdy breach to both the original (2001) and current (2007) baseline for both the Program Acquisition Unit Cost (PAUC) and Average Procurement Unit Cost (APUC). The breach is currently reported at 78.23% for the PAUC and 80.66% for the APUC against the original baseline and 27.34% for the PAUC and 31.23% for the APUC against the current baseline.⁹¹

This breach led to the January 2011 program restructuring described in "Recent Developments," above.

February 2010 Program Restructuring

In November 2009, DOD's Joint Estimating Team issued a report (JET II) stating that the F-35 program would need an extra 30 months to complete the SDD phase. In response to JET II, the then-impending Nunn-McCurdy breach and other developments, on February 24, 2010, Pentagon acquisition chief Ashton Carter issued an Acquisition Decision Memorandum (ADM) restructuring the F-35 program. Key elements of the restructuring included the following:

- Extending the SDD phase by 13 months, thus delaying Milestone C (full-rate production) to November 2015 and adding an extra low-rate initial production (LRIP) lot of aircraft to be purchased during the delay. Carter proposed to make up the difference between JET II's projected 30-month delay and his 13-month schedule by adding three extra early-production aircraft to the test program. It is

(...continued)

Force Chief of Staff.

⁹⁰ For a history of the Nunn-McCurdy law and options for its future, see CRS Report R41293, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, by Moshe Schwartz.

⁹¹ Office of the Secretary of Defense, *Selected Acquisition Report (SAR): F-35*, December 31, 2010, p. 4.

not clear how extra aircraft could be added promptly if production is already behind schedule.

- Funding the program to the “Revised JET II” (13-month delay) level, implicitly accepting the JET II findings as valid.
- Withholding \$614 million in award fees from the contractor for poor performance, while adding incentives to produce more aircraft than planned within the new budget.
- Moving procurement funds to R&D. “More than \$2.8 billion that was budgeted earlier to buy the military’s next-generation fighter would instead be used to continue its development.”⁹²

“Taken together, these forecasts result in the delivery of 122 fewer aircraft over the Future Years Defense Program (FYDP), relative to the President’s FY 2010 budget baseline,” Carter said.⁹³ This reduction led the Navy and Air Force to revise their dates for IOC as noted above.

OT&E Report on System Testing

In its annual report to Congress on DOD programs, the Office of Operational Testing & Evaluation (DOT&E) stated that due to late deliveries of 10 of 13 test aircraft, F-35 flight testing “accomplished only 16 of 168 flight test sorties planned for FY09,” and characterized the test plan as having substantial schedule risk. While giving credit for “a comprehensive, robust, and fully funded Live Fire test plan,” DOT&E also noted “the removal of shutoff fuses for engine fuel/hydraulics lines, coupled with the prior removal of dry bay fire extinguishers [to save weight], has increased the likelihood of aircraft combat losses from ballistic threat induced fires.”⁹⁴

March 2010 GAO Perspective

In March 2010, the Government Accountability Office (GAO) issued a report reviewing the F-35 program’s cost, schedule, and performance. Citing what it found to be deficiencies in the manufacturing process and test schedule, and noting the high level of concurrency in the program, GAO found that “JSF cost increases, schedule delays, and continuing technical problems ... increase the risk that the program will not be able to deliver the aircraft quantities and capabilities in the time required by the warfighter.”⁹⁵ DOD concurred with GAO’s recommendations concerning independent cost analysis and review of IOC requirements, noting that DOD had already taken corrective actions (such as the program restructuring) in advance of GAO’s report, and partially concurred with a recommendation to move toward fixed-price contracting.⁹⁶

⁹² Tony Capaccio, “Lockheed F-35 Purchases Delayed in Pentagon’s Fiscal 2011 Plan,” *Bloomberg News*, January 6, 2010.

⁹³ *F-35 Lightning II Joint Strike Fighter (JSF) Program Restructure Acquisition Decision Memorandum (ADM)*, Under Secretary of Defense (Acquisition, Technology & Logistics), February 24, 2010.

⁹⁴ DOD Office of Operational Test & Evaluation, *FY2009 DOT&E Annual Report to Congress*, pp. 21-25.

⁹⁵ U.S. Government Accountability Office, *Joint Strike Fighter[:] Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time*, GAO-10-382, March 2010.

⁹⁶ *Ibid.*, pp. 42-45.

Testing Performance

During 2010, the F-35 had a mixed test record. DOD's annual report on F-35 testing indicated:

The cumulative data for test sorties and points indicate progress slightly ahead of that planned. The test teams exceeded the goal of 394 total sorties for calendar year 2010 by early December 2010. However, progress in testing the Short Take-Off and Vertical Landing (STOVL) aircraft was less than planned... Immaturity of STOVL design and unexpected component deficiencies limited successful accomplishment of test points in areas critical to short take-off and vertical landing capability. Development of mission systems software continued to experience delays that affected flight test progress.⁹⁷

"Overall, F-35 flight testing ended 2010 close to its goal of more than 3,700 test points, but while the CTOL F-35A and F-35C CV were well ahead of plan, Stovl and mission-system testing fell short. More than half the test points required for Stovl RFT and ship clearance remain to be accomplished in 2011."⁹⁸

Robert Stevens, CEO of F-35 contractor Lockheed Martin, "said ... that several parts on the most complex version of its F-35 Joint Strike Fighter were failing more often than expected ... includ[ing] a fan that cools the engine and the hydraulic devices that open air-flow panels to provide the vertical thrust. He said valves, switches and power system components had also been unreliable."⁹⁹ As a consequence, "The U.S. may withhold from Lockheed as much as \$614 million in fees because of delays on the warplane, pending improvements in flight tests, Defense Secretary Robert Gates has said."¹⁰⁰

"Since March, F-35 BF-1, the only jet instrumented for vertical landings in the initial test phase, has accomplished about half as many vertical landings as scheduled, performing a dozen flights."¹⁰¹ Also, "The short-takeoff-and-vertical-landing (Stovl) F-35B Joint Strike Fighter is unlikely to conduct initial at-sea testing on schedule in March 2011 because of delays in clearing the vertical-landing envelope ... [t]he delay could affect U.S. Marine Corps plans to declare initial operational capability (IOC) with the F-35B in late 2012."¹⁰² "Originally set for March, ship trials are now slated between August and November."¹⁰³

Although the F-35 program overall was running ahead of the test plan, with 427 test flights (against a plan of 390) by the end of 2010, the F-35B had flown only 216 of a planned 254 flights. As a result, "The US Marine Corps could declare initial operational capability with the Air Force's F-35A variant of the Joint Strike Fighter, as delays and a major review cast more doubt on the feasibility of meeting a late-2012 IOC date with the F-35B short take-off, vertical landing variant... Lockheed Martin F-35 general manager Tom Burbage said."¹⁰⁴ Further, "[w]hile the program exceeded its year-end target of 394 flights, the objectives of clearing the conventional-

⁹⁷ Director, Operational Test & Evaluation, *FY 2010 Annual Report*, December 2010, p. 13.

⁹⁸ Graham Warwick, "F-35 Begins Year With Test Objectives Unmet," *AviationWeek.com*, January 4, 2011.

⁹⁹ Christopher Drew, "Lockheed Says Several Parts For F-35s Are Failing," *The New York Times*, July 28, 2010.

¹⁰⁰ Tony Capaccio and Gopal Ratnam, "Lockheed F-35's Parts to Get More Scrutiny Amid Test Delays, Pentagon Says," *Bloomberg News*, August 3, 2010.

¹⁰¹ Bill Sweetman, "Marines Could Fly CTOL JSF," *Aviation Week/Ares blog*, September 14, 2010.

¹⁰² Graham Warwick, "STOVL F-35B To Miss Initial At-Sea Test Date," *Aerospace Daily*, September 17, 2010.

¹⁰³ Graham Warwick, "F-35 Begins Year With Test Objectives Unmet," *AviationWeek.com*, January 4, 2011.

¹⁰⁴ Sweetman, op. cit.

takeoff-and-landing (CTOL) variant to begin pilot training, and the short-takeoff-and-vertical-landing (Stovl) version for training and initial ship trials, were not accomplished as planned in 2010.”¹⁰⁵

The entire F-35 test fleet was grounded from October 1-5, 2010, to address fuel pump issues. To help regain schedule, the first two production aircraft have been retasked to flight test, although this will delay the start of Air Force flight training.¹⁰⁶

Cost Tracking

On October 5, 2010, DOD decertified the system used by contractor Lockheed Martin to track the cost performance of the F-35 program.

De-certification of the Fort Worth-based unit’s “earned value management system” was intended to “help ensure Lockheed Martin devotes the needed attention to complete” corrective actions “in a timely manner,” Pentagon spokeswoman Cheryl Irwin said in a statement via e-mail.¹⁰⁷

Affordability and Projected Fighter Shortfalls

An additional potential issue for Congress for the F-35 program concerns the affordability of the F-35, particularly in the context of projected shortfalls in both Air Force fighters and Navy and Marine Corps strike fighters.

Although the F-35 was conceived as a relatively affordable strike fighter, some observers are concerned that in a situation of constrained DOD resources, F-35s might not be affordable in the annual quantities planned by DOD, at least not without reducing funding for other DOD programs. As the annual production rate of the F-35 increases, the program will require more than \$10 billion per year in acquisition funding at the same time that DOD will face other budgetary challenges. The issue of F-35 affordability is part of a larger and long-standing issue concerning the overall affordability of DOD’s tactical aircraft modernization effort, which also includes procurement of F/A-18E/Fs (through FY2012, at least).¹⁰⁸ Some observers who are concerned about the affordability of DOD’s desired numbers of F-35s have suggested procuring upgraded F-16s as complements or substitutes for F-35As for the Air Force, and F/A-18E/Fs as complements or substitutes for F-35Cs for the Navy.¹⁰⁹ F-35 supporters argue that F-16s and F/A-18E/Fs are less capable than the F-35, and that the F-35 is designed to have reduced life-cycle costs.

The issue of F-35 affordability occurs in the context of a projected shortfall of up to 800 Air Force fighters that was mentioned by Air Force officials in 2008,¹¹⁰ and a projected shortfall of

¹⁰⁵ Graham Warwick, “F-35 Begins Year With Test Objectives Unmet,” *AviationWeek.com*, January 4, 2011.

¹⁰⁶ “Test Reset,” *Aerospace Daily*, November 8, 2010.

¹⁰⁷ “Lockheed Warned On Cost-Tracking,” *The Washington Post*, October 6, 2010, p. 16.

¹⁰⁸ For more on this issue, see CRS Report RL33543, *Tactical Aircraft Modernization: Issues for Congress*.

¹⁰⁹ See, inter alia, George Wilson, “Kill the F-35?” *CongressDaily AM*, March 22, 2010.

¹¹⁰ Testimony of Lieutenant General Daniel Darnell, Deputy Chief of Staff, Air, Space and Information Operations, Plans and Requirements, before an April 9, 2008, hearing on Air Force and Navy aviation programs before the Airland subcommittee of the Senate Armed Services Committee. (Source: Transcript of hearing.)

more than 100 (and perhaps more than 200) Navy and Marine Corps strike fighters.¹¹¹ In the interim, “in light of delays with the F-35 Lightning II Joint Strike Fighter, the U.S. Air Force is set to begin looking at which of its newer F-16s will receive structural refurbishments, avionics updates, sensor upgrades or all three....”¹¹²

Future of Marine Corps Aviation

Britain’s decision to withdraw from purchasing the F-35B leaves the U.S. Marine Corps as the only customer for that variant. The possibility of increasing unit cost due to lower quantities, coupled with the testing and development challenges unique to the STOVL B model, have led some commentators¹¹³ to question whether the Marine Corps will or should continue to acquire the F-35B. Marine Corps doctrine states that the Marine Air Ground Task Force (MAGTF) must include organic tactical aviation assets. Some note that advances in threat make forward operation of STOVL aircraft increasingly impractical, and that Navy or Marine F-35Cs flown from carriers could provide air capability for forces ashore, as the British have chosen to do. Although conscious of the threat to forward operating bases, Under Secretary of the Navy Robert Work

said that the Marine Corps’ short take-off vertical-landing version of the Joint Strike Fighter, which has faced the most troubles in the turbulent JSF program, will still provide a vital capability... ‘Having the flexibility of a short take-off vertical-landing aircraft that’s supersonic, that’s stealthy, that works in tandem with longer-range Navy systems off a wide variety of ships really provides us with a lot of capability,’ Work said.¹¹⁴

Implications for Industrial Base

Another potential issue for Congress regarding the F-35 program concerns its potential impact on the U.S. tactical aircraft industrial base. The award of the F-35 SDD contract to a single company (Lockheed Martin) raised concerns in Congress and elsewhere that excluding Boeing from this program would reduce that company’s ability to continue designing and manufacturing fighter aircraft.¹¹⁵

Similar concerns regarding engine-making firms have been raised since 2006, when DOD first proposed (as part of the FY2007 budget submission) terminating the F136 alternate engine program. Some observers are concerned that if the F136 were cancelled, General Electric would not have enough business designing and manufacturing fighter jet engines to continue competing in the future with Pratt and Whitney (the manufacturer of the F135 engine). Others argued that General Electric’s considerable business in both commercial and military engines was sufficient to sustain General Electric’s ability to produce this class of engine in the future.

¹¹¹ For more on the projected Navy-Marine Corps strike fighter shortfall, see CRS Report RL30624, *Navy F/A-18E/F and EA-18G Aircraft Procurement and Strike Fighter Shortfall: Background and Issues for Congress*.

¹¹² John Reed, “JSF Woes Push AF to F-16s,” *DoD Buzz*, November 4, 2010.

¹¹³ See, *inter alia*, Bill Sweetman, “The Next JSF Debate,” *Aviation Week/Ares blog*, October 25, 2010.

¹¹⁴ Cid Standifer, “Joint Amphibious Assaults Will Be Phased, Count On Air Force And Army,” *Inside the Navy*, August 9, 2010.

¹¹⁵ For more information, see CRS Report RL31360, *Joint Strike Fighter (JSF): Potential National Security Questions Pertaining to a Single Production Line*, by Christopher Bolcom and Daniel H. Else.

Exports of the F-35 could also have a strong impact on the U.S. tactical aircraft industrial base through export. Most observers believe that the F-35 could potentially dominate the combat aircraft export market, much as the F-16 has. Like the F-16, the F-35 appears to be attractive because of its relatively low cost, flexible design, and promise of high performance. Competing fighters and strike fighters, including France's Rafale, Sweden's JAS Gripen, and the Eurofighter Typhoon, are positioned to challenge the F-35 in the fighter export market.

Some observers are concerned that by allowing foreign companies to participate in the F-35 program, DOD may be inadvertently opening up U.S. markets to foreign competitors who enjoy direct government subsidies. A May 2004 GAO report found that the F-35 program could "significantly impact" the U.S. and global industrial base.¹¹⁶ GAO found that two laws designed to protect segments of the U.S. defense industry—the Buy American Act and the Preference for Domestic Specialty Metals clause—would have no impact on decisions regarding which foreign companies would participate in the F-35 program, because DOD has decided that foreign companies that participate in the F-35 program, and which have signed reciprocal procurement agreements with DOD to promote defense cooperation, are eligible for a waiver.

Legislative Activity for FY2011

Summary of Quantities and Funding

Table A-1 summarizes congressional action on F-35 FY2011 procurement quantities and procurement and research and development funding levels.

Table 4. Summary of Action on FY2011 F-35 Quantities and Funding

Funding figures in millions of dollars, rounded to nearest tenth

	Authorization (H.R. 6523/S. 3454)				Appropriations (S. 3800/H.R. 1473)		
	Request	HASC report	SASC report	Conference report (did not include program-level funding numbers)	HAC report	SAC report	Conference report
Procurement quantities							
F-35As (Air Force)	23 ^a	22 ^b	22 ^b	N/A	N/A	16 ^b	25
F-35Bs (Marine Corps)	13	13	13	N/A	N/A	10	3
F-35Cs (Navy)	7	7	7	N/A	N/A	6	7
Total	43	42	42	N/A	N/A	32	35

¹¹⁶ General Accountability Office, *Joint Strike Fighter Acquisition: Observations on the Supplier Base*, GAO-04-554, May 2004.

Authorization (H.R. 6523/S. 3454)					Appropriations (S. 3800/H.R. 1473)		
Procurement funding							
Air Force procurement funding	4,191.1 ^c	3,986.2 ^b	3,986.2 ^b	N/A	N/A	3,028.7 ^{bd}	4,064.4 ^e
Air Force advance procurement funding	257.0	257.0	257.0	N/A	N/A	257.0	257.0
Navy procurement funding	4,243.1 ^f	4,243.1	4,243.1	N/A	N/A	3,186.9 ^g	2,208.8 ^h
Navy advance procurement funding	219.9	219.9	219.9	N/A	N/A	219.9	219.9
Research and development funding							
Air Force	883.8	1,287.2 ⁱ		N/A	N/A	1,051.2 ^k	TBD
Navy	1,375.7	1,560.2 ^j		N/A	N/A	1,267.7 ^l	TBD

Source: Prepared by CRS based on committee reports, bill text, and floor amendments.

- a. One F-35A was proposed to be funded from Overseas Contingency Operations (OCO) accounts.
- b. All committee reports recommended deleting \$204.0 million for the one OCO-funded aircraft.
- c. \$204.9 million of this amount was proposed to come from OCO accounts for one aircraft.
- d. The SAC cut \$730.2 million for 6 F-35As.
- e. Cut \$608.5M for 5 aircraft; added 974M transfer from F-35B; cut 60M for production support carryover; transferred \$29.7M from F-35A modification line per AF request.
- f. \$1,667 million for F-35Cs; 2,576.1 million for F-35Bs.
- g. The SAC cut \$209.6 million for one F-35C, and \$560.4 million for 3 F-35Bs.
- h. \$1.667 million for 7 F-35Cs, \$555.7 million for 3 F-35Bs.
- i. The HASC added \$160.9 million transfer from F-35 squadron funds as requested by the Air Force, and \$242.5 million for the F-35 alternate engine program.
- j. The HASC cut \$58.1 million for Block 4 software and added \$242.6 million for the F-35 alternate engine program.
- k. Includes \$159.8 million transfer from F-35 squadron funds and \$7.6 million transfer from Aircraft Procurement, Air Force for Auto GCAS (both requested by the Air Force).
- l. The SAC cut \$50.0 million for underexecution of the test program and \$58.0 million to defer development of Block 4 software.

FY2011 Defense Authorization Act (H.R. 5136/S. 3454)

House

H.Rept. 111-491, accompanying H.R. 5136, recommended several changes to the F-35 program, including:

SECTION 141—LIMITATION ON PROCUREMENT OF F-35 LIGHTNING II AIRCRAFT

This section would limit the obligation or expenditure of amounts necessary for the procurement of F-35 aircraft to an amount necessary for the procurement of 30 such aircraft unless the Under Secretary of Defense for Acquisition, Technology, and Logistics and the Director of Operational Test and Evaluation submit certifications to the congressional defense committees, not later than January 15, 2011, that specified items pertaining to the F-35 program have been accomplished. The section would also allow the Secretary of Defense to waive the full achievement of some items if the Under Secretary of Defense for Acquisition, Technology, and Logistics certifies that the failure to fully achieve some items would not delay or otherwise negatively affect the F-35 aircraft test schedule for FY2011, impede production of 42 F-35 aircraft in such fiscal year, and otherwise increase risk to the F-35 aircraft program.

Under Items of Special Interest in Aircraft Procurement, Air Force, the House report stated:

F-35 modifications

The budget request contained \$94.2 million for F-35 modifications, of which \$86.6 million was included to procure 25 kits to retrofit 25 low-rate initial production (LRIP) F-35A aircraft to the block three configuration.

Under the recently-revised F-35 schedule, the committee notes that development of block three hardware and software components will not be complete until 2015, and believes that the request to procure kits to retrofit 25 LRIP F-35A aircraft to the block three configuration is premature.

Accordingly, the committee recommends \$7.6 million, a decrease of \$86.6 million for F-35A modifications.

Senate

The SASC report's¹¹⁷ main discussion of F-35 issues was included under Title XV, concerning Overseas Contingency Operations:

Joint Strike Fighter

The budget request included \$1,887.0 million in Aircraft Procurement, Navy (APN), to purchase 7 Joint Strike Fighter (JSF) aircraft for the Navy (F-35C), \$2,576.1 million in APN for 13 JSF aircraft for the Marine Corps (F-35B), and \$3,986.2 million in Aircraft Procurement, Air Force (APAF) for 22 JSF for the Air Force (F-35A). In addition, the budget request for Overseas Contingency Operations (OCO) include \$204.9 million in APAF for 1 F-35A to replace one legacy aircraft lost in combat operations.

Since last year, the Department found significant problems in the performance of the F-35 contractor team in conducting the elements of the system development and demonstration (SDD) phase of the program, which have led to delays in developmental testing of the aircraft. The Department restructured the program in conjunction with submitting the fiscal year 2011 budget by taking a number of actions, including: (1) extending the development test schedule to March 2015; (2) adding additional research, development, testing, and

¹¹⁷ S.Rept. 111-201, accompanying S. 3454.

evaluation (RDT&E) funds to pay for mitigating known risks; (3) buying another carrier variant developmental test aircraft and add another software integration line to the program; (4) using up to three aircraft procured under low-rate initial production (LRIP) contracts for developmental testing; (5) reducing procurement quantities over the future-years defense program (FYDP) to slow the planned production ramp up in later years and offset added funding for developmental testing; and (6) installing a new fee structure that would provide incentives for the contractor team to achieve key performance events and cost goals.

Last year, Congress approved funding for 30 aircraft. This year, the budget request is for a total of 43 F-35 aircraft of all types. The number of 43 aircraft matches what had been the planned production rate for the F-35 aircraft 2 years ago before any of these problems and delays became evident. The FYDP for fiscal year 2009 included a plan to buy 43 JSF aircraft in 2011, although the mix of F-35A and F-35C aircraft changed by one aircraft each.

The committee understands that the Department would prefer to get JSF aircraft sooner. However, the fact that the production changes recommended by the Department in this restructuring only affect production plans later in the FYDP means that the concurrency in the program for fiscal year 2011 has actually increased.

The committee believes that a more modest ramp up in production to a total of 42 aircraft in the near-term would lessen that concurrency, while increasing the production rate from 30 aircraft to allow the program to demonstrate that the production processes and management systems will support growing to higher levels later in the FYDP.

Therefore, the committee recommends a reduction of \$204.9 million in the APAF account within OCO.

Also, Section 141 of the Senate report stated:

System management plan and matrix for the F-35 Joint Strike Fighter Aircraft Program

The committee recommends a provision that would require that the Secretary of Defense establish a system management plan and matrix for the F-35 Joint Strike Fighter (JSF) program that would be used to measure progress in gaining maturity for the system during the remainder of the system development and demonstration (SDD) program.

The committee believes that the F-35 represents an essential national capability. However, it remains concerned about whether the F-35 Joint Strike Fighter program will deliver required capability required by each of the services when the services need it and at prices the Department can afford.

The basis for that concern arises principally from several reviews that were conducted late last year at the direction of the Secretary of Defense, including reviews by the Joint Estimating Team, an Industry Manufacturing Review Team, and a Joint Assessment Team. In their annual assessments of the program, the Director, Operational Testing and Evaluation and the Government Accountability Office (GAO) also conveyed troubling information about the program's ability to perform as promised.

Based on the reviews he directed, the Secretary of Defense fundamentally restructured the program to: (1) extend the development test schedule to March 2015; (2) add additional research, development, testing, and evaluation funds to pay for mitigating known risks; (3) buy another carrier variant developmental test aircraft and add another software integration line to the program; (4) use up to three aircraft procured under low-rate initial production (LRIP) contracts for developmental testing; (5) reduce procurement quantities over the

future-years defense program to slow the planned production ramp up and offset added funding for developmental testing; and (6) install a new fee structure that would provide incentives for the contractor team to achieve key performance events and cost goals. While the Marine Corps may delay its initial operational capability date for a few months in 2012, the Navy and the Air Force extended theirs several years to 2016.

The committee supports the Secretary's plan to restructure the F-35 JSF program. However, the committee believes that greater insight into it for Congress and others outside the Department is warranted. To achieve that goal, the committee believes that the Defense Department needs to establish milestones against which we can measure progress of the program.

Therefore, in accordance with the goals set forth by the Program Executive Officer for the program, the committee expects the Department of Defense to manage the F-35 Joint Strike Fighter aircraft program so as to achieve the following milestones by the end of this calendar year:

- (1) achieve first flight of the F-35C (carrier variant);
- (2) install and operate Block 1.0 software on all flight test aircraft to be delivered this year;
- (3) fully implement those recommendations of the Independent Manufacturing Review Team, reflected in its October 2009 report and its follow-on assessment of the Production Integrated Transition Plan, that address manufacturing issues affecting initial production (in particular, those recommendations relating to the global supply chain; parts shortages and change management; first article inspections; test and evaluation; quantitative management metrics; the reduction of unit recurring flyaway costs; an integrated management plan/integrated management schedule; the completion of an independent schedule risk assessment by the government; and assessments of producibility);
- (4) deliver all LRIP Lot I aircraft and all remaining developmental aircraft (except for the additional F-35C test aircraft to be bought with fiscal year 2011 funds) in flyable status with software in Block 1.0 configuration;
- (5) deliver 11 test aircraft in flyable status with software in Block 1.0 configuration to Patuxent River Naval Air Station and Edwards Air Force Base;
- (6) conduct test flights at a rate of 12 flights per aircraft per month;
- (7) complete a minimum of 400 test flights;
- (8) deliver at least 3 training aircraft to Eglin Air Force Base; and
- (9) capture real-time data from the flight testing of all F-35 JSF developmental aircraft and training aircraft using the F-35 Autonomous Logistics Information System. Such data collection shall be sufficient to support the Department's development of a revised operations and sustainment estimate in the second quarter of fiscal year 2012.

If the program reaches each of those milestones, the committee believes that the program will be in a position to award a fixed-price incentive fee contract no later than the fiscal year 2011 procurement.

The Acting Program Executive Officer in the Joint Program Office and the prime contractor both stipulated that the foregoing milestones are achievable.

The committee expects that the program will achieve these milestones and that, if they are not, the Department of Defense will undertake appropriate action to correct any reason for delays, including (but not limited to) withholding fees.

The recommended provision would look prospectively to measure progress during the remainder of the SDD program. As GAO recommended in its most recent report, “Joint Strike Fighter: Additional Costs and Delays Not Meeting Warfighter Requirements on Time,” such a plan should provide criteria and conditions for comparing documented results to expected progressive levels of demonstrated weapon system maturity in relationship to planned increases in future procurement quantities.

The committee believes that the system management plan and matrix required under this section will serve as a useful tool by which Congress can require the Department to explain how increasing levels of demonstrated, quantifiable knowledge about the Joint Strike Fighter program’s maturity at annual procurement decision-points justify increased procurement funding and quantities, as the program proceeds to a full-rate procurement decision.

Final Action

As passed, H.R. 6523, the Ike Skelton National Defense Authorization Act For Fiscal Year 2011, did not include program-level detail, so no amount was specified for the F-35 program.

In lieu of a conference report, the House and Senate Armed Services Committees issued a joint explanatory statement regarding H.R. 6523. The joint explanatory statement included the Senate management matrix language shown above.

FY2011 Defense Appropriations Act (S. 3800)

Senate

The Senate Appropriations Committee report accompanying S. 3800¹¹⁸ discussed the F-35 program at length. Under Procurement Programs, it stated:

F-35 Joint Strike Fighter [JSF]- The Committee supports the F-35 aircraft program and believes that it is an important capability for the Department of Defense and many partner nations. The fiscal year 2011 budget requests \$7,686,100,000 for 42 low-rate initial production aircraft. The 42 aircraft in Lot 5 are: 22 Conventional Take Off and Landing [CTOL] aircraft for the Air Force; 13 Short Take Off and Vertical Landing [STOVL] aircraft for the Marine Corps; and 7 Carrier Variant [CV] aircraft for the Navy. The budget also requests \$763,200,000 in advance procurement funding for Lot 6, which will include 45 aircraft for the United States and 8 for partner nations.

Realizing that JSF development was taking longer and costing more than planned, the Department of Defense undertook a comprehensive program review last fall. This in-depth evaluation led to the program being restructured in February 2010. The revised plan extends

¹¹⁸ S.Rept. 111-295.

the development phase by 13 months, adds a CV aircraft to the test program, and moves the full rate production decision to fiscal year 2016. The Government-contractor relationship has changed and the production contract for Lot 4 will be a fixed price incentive fee rather than a cost-plus contract vehicle. An Independent Manufacturing Review Team [IMRT], created to evaluate manufacturing, discovered a number of production process weaknesses. The program office and contractor team are working through the IMRT's recommendations to help achieve and sustain production ramp-up. The Committee believes that the Department has moved in the right direction to bring more realistic schedules and costs into focus.

Concerns about progress in the test program and the maturation of the manufacturing process persist. In his June 2010 letter accompanying the Nunn-McCurdy certification documentation, the Under Secretary of Defense (Acquisition, Technology and Logistics) stated that the test program continues to encounter difficulties and has fallen behind the level of performance projected just a few months ago. These challenges to the test program are of particular note for testing of the F-35B STOVL aircraft, which has been set back by late delivery of aircraft to Government test and failures to meet the number of planned test flights.

A recent 'quick look' by the IMRT found significant improvements in risk management plans, change management and global supply but that additional progress was needed in a number of manufacturing areas. Parts shortages, change management processes and first article inspections are the key areas where further steps forward are needed. The Committee is aware that production has not moved as quickly as previously planned and has not kept pace with scheduled ramp rate increases. With Lot 5, the Department will buy its 100th aircraft—yet none of the production aircraft ordered to date have been delivered. The first delivery from Lot 1 (fiscal year 2007) was scheduled for delivery in September 2009; it now appears that it will deliver in December 2010.

The Committee recommends a reduction of 10 aircraft from the fiscal year 2011 (Lot 5) procurement (6 Air Force CTOL, 3 Marine Corps STOVL, and 1 Navy CV). This adjustment reduces the concurrency of development and production, provides time to mature manufacturing processes and institute supply chain improvements, and stabilizes production at the fiscal year 2010 rate for 1 year. The Advance Procurement request is fully funded to sustain the supplier base and implement manufacturing improvements. The budget adjustments are a decrease of \$770,000,000 in Aircraft Procurement, Navy and a decrease of \$730,200,000 in Aircraft Procurement, Air Force.

In discussion of Research, Development, Testing, and Evaluation, the SAC report continued:

Joint Strike Fighter.—The budget request includes \$2,477,041,000 number for development and test of the F-35 Joint Strike Fighter. As a result of the schedule delays and cost increases in the program, the Department of Defense has conducted exhaustive reviews of the program, culminating in a restructuring of the program in February 2010 and a Nunn-McCurdy certification in June 2010. The Committee is encouraged by the addition of aircraft into the flight test program, the revisions to the test schedule, and new fee structures to incentivize contractor performance.

However, the Committee is circumspect on the ability of the Department to complete the revised test program on schedule. Just months after the program restructure, the Under Secretary of Defense (Acquisition, Technology, and Logistics) notified the congressional defense committees on June 1, 2010, that the 'JSF test program continues to encounter difficulties and has fallen behind the level of performance projected' by the Joint Estimating Team II.

Between February and June of this year, for example, the estimated ferry date—the time at which an aircraft becomes available for Government testing—has been delayed for 8 out of 14 test aircraft by as much as 2 months. In addition, the Marine Corps' short take-off and landing variant has not met the scheduled ramp-up of flight testing due to maintenance and other issues. Due to the under-execution of test flights, the Committee recommends a reduction of \$50,000,000 to the Research, Development, Test and Evaluation, Navy account.

The Department has also requested a total of \$115,724,000 for development of Block 4 software. This software is intended to have enhancements beyond the Block 3 build, which will be installed on all operational aircraft after completion of the developmental test program in fiscal year 2014. In light of the considerable risk remaining in the test schedule, the Committee recommendation defers all funds requested for initiating development of Block 4 software.

The overall performance of the F-35 program was also discussed in a section of the SAC report entitled "Restoring Budget Discipline":

Most disturbing perhaps is the Joint Strike Fighter [JSF]. For the last 3 years in conference, this Committee has insisted on fully funding the JSF in conjunction with providing funds to develop a second engine for the program. This approach was in accord with the stated position of the administration that it would not object to Congress supporting the second engine if its funding did not come at the expense of the overall JSF program. While the second engine program has continued its development on track, with the program being awarded 17 straight performance awards in the past 8 years with an average approval rating of 93.5 percent, the JSF has seen cost increases and significant delays. In fact at the end of June 2010, 9 months after the start of the fiscal year, the program maintained unobligated balances of \$6,500,000,000. This amount for 1 year's production funding of this program is more than the budgets of many entire Federal agencies.

Despite the nearly unwavering congressional support of the JSF program, the delivery of the first two production aircraft has slipped by an additional year, and the cost of the program has continued to increase. It is clear that the aircraft sought for fiscal year 2011 will not begin production until at the earliest the end of the coming fiscal year. The importance of the JSF program and the urgent need to replace aging fighters is the sole reason why the Committee is only scaling back production and not recommending eliminating all funding for this program for fiscal year 2011. The incongruence of the insistence on canceling the second engine program which has been a near model program and which most analysts expect would curtail long-term costs of the entire JSF program with equal insistence on the need to fully fund the JSF program is hard to rationalize.

Final Action

In lieu of a defense appropriations bill, the House and Senate passed a series of continuing resolutions maintaining spending at FY2010 levels from October 1, 2010, through April 15, 2011.

FY2011 DOD and Full-Year Continuing Appropriations Act

The FY2011 Department of Defense and Full-Year Continuing Appropriations Act (H.R. 1473), signed into law on April 15, 2011, provided DOD funding for the remainder of FY2011. Significant changes in F-35 funding in the Act include:

- Cutting 10 F-35Bs, saving \$1.7 billion, of which \$974 million was transferred to Aircraft Procurement, Air Force for eight additional F-35As.
- Cutting \$608.5M for five F-35As, for a net increase of three aircraft over the Administration request.
- Cutting a total of \$116.5M from all F-35 models for funding carryovers.
- Transferring \$29.7M from the F-35A modification line to F-35A procurement per Air Force request.

Taken in sum, F-35-related actions in the FY2011 Department of Defense and Full-Year Continuing Appropriations Act totaled a reduction of \$2.16 billion from the Administration request.

Appendix A. Legislative Activity for FY2010

Summary of Quantities and Funding

Table A-1 summarizes congressional action on F-35 FY2010 procurement quantities and procurement and research and development funding levels.

Table A-1. Summary of Action on FY2010 F-35 Quantities and Funding

Funding figures in millions of dollars, rounded to nearest tenth

	Authorization Bill (H.R. 2647/S. 1390)					Appropriations Bill (H.R. 3326)		
	Request	HASC report	SASC report	As amended on Senate floor	Conference report	HAC report	SAC report	Conference report
Procurement quantities								
F-35As (Air Force)	10	9	10	10	10	10	10	Not specified
F-35Bs (Marine Corps)	16	15	16	16	16	14	16	Not specified
F-35Cs (Navy)	4	4	4	4	4	4	4	Not specified
Total	30	28	30	30	30	28	30	30
Procurement funding								
Air Force procurement funding	2,048.8	2,115.8	2,048.8	2,048.8	2,178.8	2,067.4	2,048.3	2,083.8
Air Force advance procurement funding	300.6	313.6	300.6	300.6	278.6	278.6	278.6	278.6
Navy procurement funding	3,997.0	3,875.0	3,997.0	3,997.0	3,997.0	3,576.4	3,997.0	3,997.0
Navy advance procurement funding	481.0	486.0	481.0	481.0	481.0	481.0	481.0	481.0
Research and development funding								
Air Force	1,858.1	2,011.6	1,999.5	1,858.1	2,073.1	2,073.1	1,780.1	2,073.1
Navy	1,741.3	1,894.8	1,882.7	1,741.3	1,956.3	1,956.3	1,663.3	1,956.3

Source: Prepared by CRS based on committee reports, bill text, and floor amendments.

FY2010 Defense Authorization Act (H.R. 2647/P.L. 111-84)

Conference

Quantities and Funding

The conference report (H.Rept. 111-288 of October 7, 2009) on the FY2010 defense authorization act (H.R. 2647/P.L. 111-84 of October 28, 2009) authorizes funding for procuring a total of 30 F-35s in FY2010, as requested (pages 933 and 948). The report authorizes \$215 million in Air Force research and development funding (page 1017) and \$215 million in Navy research and development funding (page 1005) for continued development of the F136 alternate engine, and \$130 million in Air Force advance procurement funding to begin procurement of F136 engines (page 948).

Legislative Provisions

Section 131 of the act requires a report on the procurement of “4.5”-generation fighters that is to include, among other things, “a discussion regarding the availability and feasibility of procuring F-35 aircraft to proportionally and concurrently recapitalize the Air National Guard during fiscal years 2015 through fiscal year 2025.” Section 217 requires future DOD budgets to provide separate line items for the F-35B and F-35C within the Navy aircraft procurement account and the Navy research and development account. Section 244 requires, for the period 2010-2015, an annual GAO report on the status of the F-35 program.

Section 131 states:

SEC. 131. REPORT ON THE PROCUREMENT OF 4.5 GENERATION FIGHTER AIRCRAFT.

(a) **IN GENERAL.**—Not later than 90 days after the date of the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on the procurement of 4.5 generation fighter aircraft. The report shall include the following:

- (1) The number of 4.5 generation fighter aircraft needed to be procured during fiscal years 2011 through 2025 to fulfill the requirement of the Air Force to maintain not less than 2,200 tactical fighter aircraft.
- (2) The estimated procurement costs for those aircraft if procured through annual procurement contracts.
- (3) The estimated procurement costs for those aircraft if procured through multiyear procurement contracts.
- (4) The estimated savings that could be derived from the procurement of those aircraft through a multiyear procurement contract, and whether the Secretary determines the amount of those savings to be substantial.
- (5) A discussion comparing the costs and benefits of obtaining those aircraft through annual procurement contracts with the costs and benefits of obtaining those aircraft through a multiyear procurement contract.

(6) A discussion regarding the availability and feasibility of procuring F-35 aircraft to proportionally and concurrently recapitalize the Air National Guard during fiscal years 2015 through fiscal year 2025.

(b) 4.5 GENERATION FIGHTER AIRCRAFT DEFINED.—In this section, the term “4.5 generation fighter aircraft” means current fighter aircraft, including the F-15, F-16, and F-18, that—

(1) have advanced capabilities, including—

(A) AESA radar;

(B) high capacity data-link; and

(C) enhanced avionics; and

(2) have the ability to deploy current and reasonably foreseeable advanced armaments.

Section 217 states:

SEC. 217. SEPARATE PROCUREMENT AND RESEARCH, DEVELOPMENT, TEST, AND EVALUATION LINE ITEMS AND PROGRAM ELEMENTS FOR THE F-35B AND F-35C JOINT STRIKE FIGHTER AIRCRAFT.

In the budget materials submitted to the President by the Secretary of Defense in connection with the submission to Congress, pursuant to section 1105 of title 31, United States Code, of the budget for fiscal year 2011, and each subsequent fiscal year, the Secretary shall ensure that within the Navy research, development, test, and evaluation account and the Navy aircraft procurement account, a separate, dedicated line item and program element is assigned to each of the F-35B aircraft and the F-35C aircraft, to the extent that such accounts include funding for each such aircraft.

Section 244 states:

SEC. 244. ANNUAL COMPTROLLER GENERAL REPORT ON THE F-35 LIGHTNING II AIRCRAFT ACQUISITION PROGRAM.

(a) ANNUAL GAO REVIEW.—The Comptroller General shall conduct an annual review of the F-35 Lightning II aircraft acquisition program and shall, not later than March 15 of each of 2010 through 2015, submit to the congressional defense committees a report on the results of the most recent review.

(b) MATTERS TO BE INCLUDED.—Each report on the F-35 program under subsection (a) shall include each of the following:

(1) The extent to which the acquisition program is meeting development and procurement cost, schedule, and performance goals.

(2) The progress and results of developmental and operational testing and plans for correcting deficiencies in aircraft performance, operational effectiveness, and suitability.

(3) Aircraft procurement plans, production results, and efforts to improve manufacturing efficiency and supplier performance.

Report Language

The conference report states:

F-35 and alternate propulsion system program

The Senate amendment contained a provision (sec. 211) that would: (1) increase in funding for procurement of UH-1Y/AH-1Z rotary wing aircraft and for management reserves for the F-35 Joint Strike Fighter program; and (2) prohibit the obligation of funds authorized to be appropriated for development or procurement of an alternate propulsion system for the F-35 until the Secretary of Defense certifies in writing to the congressional defense committees that development and procurement of the alternate propulsion system would: (a) reduce life cycle costs of the F-35; (b) improve operational readiness of the fleet of F-35 aircraft; (c) will not disrupt the F-35 research, development, test, and evaluation (RDT&E) and procurement phases of the program; and (d) will not result in the procurement of fewer F-35 aircraft during the life cycle of the program.

The House bill contained a provision (sec. 218) that would limit obligations for the F-35 RDT&E program to 75 percent until 15 days after the later of the dates on which: (1) the Under Secretary of Defense for Acquisition, Technology, and Logistics certifies in writing to the congressional defense committees that all fiscal year 2010 funds for the F-35 competitive propulsion system have been obligated; (2) the Secretary of Defense submits the report on F/A-18 multiyear procurement costs required by section 123 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 (Public Law 110-417); and (3) the Department submits the 30-year aircraft procurement plan required by section 231a of title 10, United States Code.

The House bill also contained a provision (sec. 242) that would require the Secretary of Defense to include in annual budget requests submitted to the President, beginning in 2011, such amounts as are necessary for the full funding of continued development and procurement of a competitive propulsion system for the F-35.

Both the House and Senate recede from their respective provisions.

The conferees agree to authorize the budget request for 30 F-35 aircraft in Aircraft Procurement, Navy, and Aircraft Procurement, Air Force. The conferees also agree to authorize an increase of a total of \$430.0 million in RDT&E, Navy, and RDT&E, Air Force for continued F136 engine development; and \$130.0 million in Aircraft Procurement, Air Force, for F136 engine procurement. The conferees expect that the Secretary of Defense will comply with the direction in section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181), and ensure that sufficient annual amounts are obligated and expended, in each fiscal year, for the continued development and procurement of two options for the F-35 propulsion system in order to ensure the development and competitive production of the F-35 propulsion system. (Pages 706-707)

House

Quantities and Funding

The House Armed Services Committee's report (H.Rept. 111-166 of June 18, 2009) on H.R. 2647 recommends the following:

- procuring 19 F-35Bs and Cs for the Marine Corps and Navy—a reduction of one aircraft from the requested figure of 20 (page 57);
- procuring nine F-35As for the Air Force—a reduction of one aircraft from the requested figure of 10 (page 93);
- a net reduction of \$122 million in Navy aircraft procurement funding for the procurement of F-35Bs and Cs for the Marine Corps and Navy, consisting of a reduction of \$164 million for the one-aircraft reduction and an addition of \$42 million for the F136 alternate engine (page 57; line 006);
- an increase of \$5 million in Navy aircraft advance procurement funding for the F136 alternate engine (page 57, line 007);
- a decrease of \$4 million in procurement funding for F-35 spares, and an increase of \$2 million in procurement funding for F136 spares (page 60, line 057);
- a net reduction of \$67 million in Air Force procurement funding for the procurement of F-35As for the Air Force, consisting of a reduction of \$131 million for the one-aircraft reduction, a reduction of \$9 million for F-35 initial spares, an increase of \$57 million for the F136 alternate engine, an increase of \$21 million for spares for the F136 alternate engine, and an increase of \$129 million for F-35 spares and support equipment (page 93; line 001);
- an increase of \$13 million in Air Force advance procurement funding for the F136 alternate engine (page 93; line 002);
- a net increase of \$153.5 million in Navy research and development funding for the F-35 program, consisting of an increase of \$231.5 million for the F136 alternate engine and a reduction of \$78 million for “program excess” (page 169); and
- a net increase of \$153.5 million in Air Force research and development funding for the F-35 program, consisting of an increase of \$231.5 million for the F136 alternate engine and a reduction of \$78 million for “program excess” (page 190).

As discussed below in the section on report language, the recommended one-aircraft reduction in the number of F-35Bs and Cs to be procured is for an F-35B, making for a recommended procurement of 15 F-35Bs and 4 F-35Cs.

Legislative Provisions

H.R. 2647 contains four sections relating directly to the F-35 program—Section 214, which concerns the display of funding for F-35Bs and Cs in budget materials; Section 218, which limits the obligation of FY2010 F-35 research and development funds until certain conditions (including one related to the alternate engine program) are met; Section 232, which requires an annual GAO report on the F-35 program; and Section 242, which concerns the alternate engine program.

A fifth provision—Section 133—requires a report on the procurement of “4.5”-generation aircraft. The report is to include, among other things, “a discussion regarding the availability and feasibility of F-35s in fiscal years 2015 through fiscal year 2025 to proportionally and concurrently recapitalize the Air National Guard.”

The texts of these five provisions appear below.

Section 214 states:

SEC. 214. SEPARATE PROCUREMENT AND RESEARCH, DEVELOPMENT, TEST AND EVALUATION LINE ITEMS AND PROGRAM ELEMENTS FOR THE F-35B AND F-35C JOINT STRIKE FIGHTER AIRCRAFT.

In the budget materials submitted to the President by the Secretary of Defense in connection with the submission to Congress, pursuant to section 1105 of title 31, United States Code, of the budget for fiscal year 2011, and each subsequent fiscal year, the Secretary shall ensure that within the Navy research, development, test, and evaluation account and the Navy aircraft procurement account, a separate, dedicated line item and program element is assigned to each of the F-35B aircraft and the F-35C aircraft, to the extent such accounts include funding for each such aircraft.

Section 218 states:

SEC. 218. LIMITATION ON OBLIGATION OF FUNDS FOR F-35 LIGHTNING II PROGRAM.

Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II program, not more than 75 percent may be obligated until the date that is 15 days after the later of the following dates:

- (1) The date on which the Under Secretary of Defense for Acquisition, Technology, and Logistics submits to the congressional defense committees certification in writing that all funds made available for fiscal year 2010 for the continued development and procurement of a competitive propulsion system for the F-35 Lightning II have been obligated.
- (2) The date on which the Secretary of Defense submits to the congressional defense committees the report required by section 123 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 (P.L. 110-417; 122 Stat. 4376).
- (3) The date on which the Secretary of Defense submits to the congressional defense committees the annual plan and certification for fiscal year 2010 required by section 231a of title 10, United States Code.

Section 232 states:

SEC. 232. ANNUAL COMPTROLLER GENERAL REPORT ON THE F-35 LIGHTNING II AIRCRAFT ACQUISITION PROGRAM.

- (a) Annual GAO Review- The Comptroller General shall conduct an annual review of the F-35 Lightning II aircraft acquisition program and shall, not later than March 15 of each of 2010 through 2015, submit to the congressional defense committees a report on the results of the most recent review.
- (b) Matters to Be Included- Each report on the F-35 program under subsection (a) shall include each of the following:
 - (1) The extent to which the acquisition program is meeting development and procurement cost, schedule, and performance goals.

(2) The progress and results of developmental and operational testing and plans for correcting deficiencies in aircraft performance, operational effectiveness, and suitability.

(3) Aircraft procurement plans, production results, and efforts to improve manufacturing efficiency and supplier performance.

Section 242 states:

SEC. 242. INCLUSION IN ANNUAL BUDGET REQUEST AND FUTURE-YEARS DEFENSE PROGRAM OF SUFFICIENT AMOUNTS FOR CONTINUED DEVELOPMENT AND PROCUREMENT OF COMPETITIVE PROPULSION SYSTEM FOR F-35 LIGHTNING II.

(a) Annual Budget- Chapter 9 of title 10, United States Code, is amended by adding at the end the following new section:

‘Sec. 235. Budget for competitive propulsion system for F-35 Lightning II

‘(a) Annual Budget- Effective for the budget of the President submitted to Congress under section 1105(a) of title 31, United States Code, for fiscal year 2011 and each fiscal year thereafter, the Secretary of Defense shall include, in the materials submitted by the Secretary to the President, a request for such amounts as are necessary for the full funding of the continued development and procurement of a competitive propulsion system for the F-35 Lightning II.

‘(b) Future-Years Defense Program- In each future-years defense program submitted to Congress under section 221 of this title, the Secretary of Defense shall ensure that the estimated expenditures and proposed appropriations for the F-35 Lightning II, for each fiscal year of the period covered by that program, include sufficient amounts for the full funding of the continued development and procurement of a competitive propulsion system for the F-35 Lightning II.

‘(c) Requirement to Obligate and Expend Funds- Of the amounts authorized to be appropriated for fiscal year 2010 or any year thereafter, for research, development, test, and evaluation and procurement for the F-35 Lightning II Program, the Secretary of Defense shall ensure the obligation and expenditure in each such fiscal year of sufficient annual amounts for the continued development and procurement of two options for the propulsion system for the F-35 Lightning II in order to ensure the development and competitive production for the propulsion system for the F-35 Lightning II.’.

(b) Clerical Amendment- The table of sections at the beginning of such chapter is amended by at the end the following new item:

‘235. Budget for competitive propulsion system for F-35 Lightning II.’.

(c) Conforming Repeal- The National Defense Authorization Act for Fiscal Year 2008 (P.L. 110-181) is amended by striking section 213.

Section 133 states:

SEC. 133. REPORT ON 4.5 GENERATION FIGHTER PROCUREMENT.

(a) In General- Not later than 90 days after the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on 4.5 generation fighter aircraft procurement. The report shall include the following:

(1) The number of 4.5 generation fighter aircraft for procurement for fiscal years 2011 through 2025 necessary to fulfill the requirement of the Air Force to maintain not less than 2,200 tactical fighter aircraft.

(2) The estimated procurement costs for those aircraft if procured through single year procurement contracts.

(3) The estimated procurement costs for those aircraft if procured through multiyear procurement contracts.

(4) The estimated savings that could be derived from the procurement of those aircraft through a multiyear procurement contract, and whether the Secretary determines the amount of those savings to be substantial.

(5) A discussion comparing the costs and benefits of obtaining those aircraft through annual procurement contracts with the costs and benefits of obtaining those aircraft through a multiyear procurement contract.

(6) A discussion regarding the availability and feasibility of F-35s in fiscal years 2015 through fiscal year 2025 to proportionally and concurrently recapitalize the Air National Guard.

(7) The recommendations of the Secretary regarding whether Congress should authorize a multiyear procurement contract for 4.5 generation fighter aircraft.

(b) Certifications- If the Secretary recommends under subsection (a)(7) that Congress authorize a multiyear procurement contract for 4.5 generation fighter aircraft, the Secretary shall submit to Congress the certifications required by section 2306b of title 10, United States Code, at the same time that the budget is submitted under section 1105(a) of title 31, United States Code, for fiscal year 2011.

(c) 4.5 Generation Fighter Aircraft Defined- In this section, the term '4.5 generation fighter aircraft' means current fighter aircraft, including the F-15, F-16, and F-18, that—

(1) have advanced capabilities, including—

(A) AESA radar;

(B) high capacity data-link; and

(C) enhanced avionics; and

(2) have the ability to deploy current and reasonably foreseeable advanced armaments.

Report Language

Regarding Air Force research and development funding for the F-35 program, the committee's report states:

The budget request contained \$1.9 billion in PE 64800F, and \$1.7 billion in PE 64800N, for development of the F-35, but contained no funds for development of a competitive F-35 propulsion system. The committee notes that the aggregate amount requested for F-35 development is \$1.4 billion higher than projected last year, and that \$476.0 million of that amount conforms to increases recommended by a recent joint estimating team, and understands this amount will be used primarily for management reserve. The budget request also contained \$2.0 billion for procurement of 10 F-35As and \$300.6 million for F-35 advance procurement in Aircraft Procurement, Air Force, but contained no funds for either procurement of competitive F-35 propulsion systems or for advance procurement of competitive F-35 propulsion system long-lead components. Additionally, the budget request contained \$4.0 billion for the procurement of 16 F-35Bs and four F-35Cs and \$481.0 million for F-35 advance procurement in Aircraft Procurement, Navy, but contained funds for neither procurement of competitive propulsion systems nor advance procurement of competitive F-35 competitive F-35 propulsion systems long-lead components. The Aircraft Procurement, Navy budget request also contained \$1.3 billion for spares and repair parts.

The competitive F-35 propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. For the past three years, in the committee report (H.Rept. 109-452) accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007, in the committee report (H.Rept. 110-146) accompanying the National Defense Authorization Act for Fiscal Year 2008, and in the committee report (H.Rept. 110-652) accompanying the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, the committee recommended increases for the F-35 competitive propulsion system, and notes that in all cases, the other three congressional defense committees also recommended increases for this purpose. Despite section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181), which requires the Secretary of Defense to obligate and expend sufficient annual amounts for the continued development and procurement of a competitive propulsion system for the F-35, the committee is disappointed that the Department of Defense (DOD) has, for the third consecutive year, chosen not to comply with both the spirit and intent of this provision by opting not to include funds for this purpose in the budget request.

The committee notes that the F135 engine development program has experienced cost growth since the engineering and manufacturing development (EMD) program began in fiscal year 2002. At the beginning of EMD in fiscal year 2002, the F135 engine development program was expected to cost \$4.828 billion in then-year dollars. The F-35 program manager reports that as of the end of 2008, development costs have grown to \$6.7 billion in then-year dollars, an increase of \$1.872 billion, or 38 percent. Additionally, the committee notes that the F-35 program manager has reported an increase of approximately 38 to 43 percent in F135 engine procurement cost estimates between December 2005 and December 2008, in the annual selected acquisition reports for the F-35C and F-35A variants. Between December 2005 and December 2008, engine procurement cost estimates for the F-35B have grown approximately 47 percent, but the F-35B engine procurement cost growth is attributable to both the F135 engine and the F-35B's lift fan. Conversely, the F136 engine program has not experienced any cost growth since its inception. The F136 pre-EMD contract, which began in 2002 and was completed in 2004, was for \$411.0 million and did not experience cost growth. The F136 EMD contract was awarded in 2005, and the cost estimate, at \$2.486 billion, has been stable since contract award. Given the F135 development and procurement cost increases, the committee is perplexed by the Department's decisions over the past three years to not include an F-35 competitive propulsion system program in its budget requests. Based on the F135 cost growth, F135 test failures noted in the committee report (H.Rept. 110-652) accompanying the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, and resultant schedule delays due to F135 engine test failures, the committee remains steadfast in its belief that the non-financial factors of a two-engine competitive program such as better engine performance,

improved contractor responsiveness, a more robust industrial base, increased engine reliability and improved operational readiness, strongly favor continuing the F-35 competitive propulsion system program.

The committee also notes that the Office of the Secretary of Defense's Director of Portfolio Acquisition testified before the Air and Land Forces Subcommittee on May 20, 2009, and stated that the Department planned a 75 percent higher year-over-year production rate for the F-35 program for fiscal year 2010 and that this rate, "seems to be an achievable rate." The committee further notes that the production rate for fiscal year 2009 is 17 aircraft, of which 14 are for the Department of Defense and 3 are international aircraft. A 75 percent higher production rate for fiscal year 2010 would total 30 aircraft, and the committee notes that 2 international aircraft are planned, leaving 28 DOD aircraft in fiscal year 2010 necessary to achieve the 75 percent year-over-year production rate, two less than the 30 F-35s contained in the Department of the Navy and Department of the Air Force budget requests. Therefore, the committee recommends a reduction of one F-35B in Aircraft Procurement, Navy and one F-35A in Aircraft Procurement, Air Force, and report.

The committee understands that \$320.0 million of the \$476 million recommended by the recent joint estimating team would meet requirements for sufficient management reserve, and therefore recommends an aggregate reduction of \$156.0 million in PEs 64800N and 64800F as noted in the tables elsewhere in this report.

For continued development of the competitive F-35 propulsion system program, the committee recommends a total increase of \$463.0 million in PEs 64800F and 64800N as noted in the tables elsewhere in this report. The committee also recommends an aggregate increase of \$140.0 million as noted in the tables elsewhere in this report in Aircraft Procurement, Navy and Aircraft Procurement, Air Force for the procurement of four F136 engines, F136 spare parts, and advance procurement of F136 long-lead components to continue F136 procurement in fiscal year 2011. (Pages 201-203)

In the section on the operation and maintenance account, the report states:

The committee is concerned that the lessons learned regarding the prevention and management of corrosion in the F-22 Raptor aircraft have not been fully applied to development and acquisition of the F-35 Joint Strike Fighter aircraft. The committee's desire to have corrosion prevention and management addressed early in weapons system development and acquisition prompted inclusion of a provision in the Weapons Systems Acquisition Reform Act of 2009 (Public Law 111-23) requiring the development of systems engineering master plans for major defense acquisition programs that include considerations of lifecycle management and sustainability.

Therefore, the committee directs the Director of Corrosion Policy and Oversight (as designated by section 2228 of title 10, United States Code) to evaluate the F-35 Joint Strike Fighter program. The evaluation should include, but not be limited to, information obtained from floor inspections and examination of program documentation and should involve any and all manufacturing and engineering processes. The Director of Corrosion Policy and Oversight is directed to consult with the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics to determine the appropriate level of access necessary to conduct an effective and comprehensive evaluation of the F-35. The committee directs that the findings of the evaluation be reported to the congressional defense committees within 180 days after the date of enactment of this Act. The evaluation report should also include implications for existing and future weapons systems based on the findings of the F-35 evaluation. The committee directs the Comptroller General of the United States to provide an assessment to the congressional defense committees of the completeness of the evaluation

within 60 days of the evaluation's delivery to the congressional defense committees. (Pages 289-290)

The report discusses the project Navy-Marine Corps strike fighter shortfall on pages 61-62. The report discusses the projected Air Force fighter shortfall, and requires a report on the topic, on page 101. The report summarizes Sections 133, 214, 218, 232, and 242 on pages 125, 240, 241, 243-244, and 244-245, respectively.

Statement of Administration Policy

A June 24, 2009, statement of administration policy on H.R. 2647 states the following regarding the F-35 program:

F-35 Joint Strike Fighter Program: The Administration strongly objects to the addition of \$603 million for development and procurement of the alternative engine program, and the requirement for the Department to fund the alternative engine program in future budget requests to the President. These changes will delay the fielding of the Joint Strike Fighter (JSF) capability and capacity, adversely impacting the Department's overall strike fighter inventory. In addition, the Administration objects to provisions of the bill that mandate an alternative engine program for the JSF. The current engine is performing well with more than 11,000 test hours. Expenditures on a second engine are unnecessary and impede the progress of the overall JSF program. Alleged risks of a fleet-wide grounding due to a single engine are exaggerated. The Air Force currently has several fleets that operate on a single-engine source. The Administration also objects to the limit on the obligation of overall JSF development funding to 75% of the amount authorized until Department of Defense (DOD) has obligated all funds provided in FY 2010 for the alternative engine program. *If the final bill presented to the President would seriously disrupt the F-35 program, the President's senior advisors would recommend a veto.*¹¹⁹

Senate (Committee Markup)

Quantities and Funding

In the FY2010 defense authorization bill (S. 1390) as reported by the Senate Armed Services Committee (S.Rept. 111-35 of July 2, 2009), Division D presents committee's detailed the line-item funding recommendations. Division D does the following:

- approves the administration's request to procure 20 F-35Bs and Cs for the Marine Corps and Navy, and approves the administration's request for procurement and advance procurement funding for these aircraft (page 613 of the printed bill);
- approves the administration's request to procure 10 F-35As for the Air Force, and approves the administration's request for procurement and advance procurement funding for these aircraft (page 629);
- recommends a net increase of \$141.45 million in Navy research and development funding for the F-35 program, consisting of an increase of \$219.45 million for

¹¹⁹ Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, H.R. 2647 - National Defense Authorization Act for Fiscal Year 2010*, June 24, 2009, pp. 1-2. Emphasis as in the original.

- the F136 alternate engine and a reduction of \$78 million for excess management reserves (page 678); and
- recommends a net increase of \$141.45 million in Air Force research and development funding for the F-35 program, consisting of an increase of \$219.45 million for the F136 alternate engine and a reduction of \$78 million for excess management reserves (page 687).

Legislative Provisions

Section 211 of S. 1390 states:

SEC. 211. CONTINUED DEVELOPMENT OF COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER PROGRAM.

Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II aircraft program, not more than 90 percent may be obligated until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for fiscal year 2010 for the continued development of a competitive propulsion system for the F-35 Lightning II aircraft to ensure that system development and demonstration continues under the program during fiscal year 2010.

Report Language

Regarding Section 211, the committee's report states:

The committee recommends a provision that would require the Department to obligate sufficient funds for fiscal year 2010 for the continued development and procurement of the F136 competitive propulsion system for the F-35 Lightning II to ensure that the Department continues the system development and demonstration (SDD) program during fiscal year 2010. The committee understands that current plans for the F136 Joint Strike Fighter (JSF) propulsion system would complete the development in sufficient time to conduct a first competitive contract award in fiscal year 2012, concurrent with the award for the sixth lot of low-rate initial production aircraft.

The budget request included \$1,741.3 million in PE 64800N, and \$1,858.1 million in PE 64800F for continued development of the JSF program, but included no funds for continuing the SDD phase of the F136 program.

The committee continues to believe that, in light of studies performed by the Department of Defense, the Institute for Defense Analyses, and the Government Accountability Office, it is in the best interests of the Nation to continue the development of the F136. Though the results of these studies were, in the aggregate, inconclusive on whether there would be a financial benefit to the Department in continuing to develop a competitive propulsion system for the JSF program, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program. These included better engine performance; improved contractor responsiveness; a more robust industrial base; increased engine reliability; and improved operational readiness. The committee believes that the benefits, which could be derived from the non-financial factors, favor continuing the JSF competitive propulsion system program.

Therefore, the committee recommends an increase of \$438.9 million for continuing F136 SDD, with half that amount added to PE 64800N and the other half added to PE 64800F.
(Page 35)

The committee's report states that the recommendation to include additional Navy and Air Force research and development funding for the F-35 alternate engine was approved in full-committee markup by a vote of 12–10, with the votes as follows: "In Favor: Senators Levin, Kennedy, Byrd, Nelson of Florida, Bayh, Webb, McCaskill, Hagan, Begich, Thune, Wicker, and Vitter. Opposed: Senators Lieberman, Reed, Akaka, Nelson of Nebraska, Udall of Colorado, Inhofe, Sessions, Chambliss, Martinez, and Collins." (Page 276)

Regarding funding for management reserves within Air Force and Navy research and development funding for the F-35 program, the committee's report states:

The budget request included \$1,741.3 million [Navy research and development funding] in PE 64800N, and \$1,858.1 million [Air Force research and development funding] in PE 64800F for continued development of the Joint Strike Fighter (JSF) program, including \$476.0 million for management reserves to cover unforeseen problems that may arise during the system development and demonstration (SDD) phase of the program.

The Department conducted a review of JSF program costs and schedules last year. The group conducting the review, called the Joint Estimating Team (JET), recommended, among other things, that the management reserves available to the program executive officer (PEO) be increased throughout the remainder of SDD program. As a result of the JET recommendations, the Department increased management reserves to the level requested in the budget.

The Department has informed the committee that the PEO now believes that he can fully execute the fiscal year 2010 SDD program with only \$320.0 million, or \$156.0 million less than was included in the request.

Therefore, the committee recommends a decrease of \$78.0 million in PE 64800N and a decrease of \$78.0 million in PE 64800F to eliminate these excess management reserves.
(Page 82)

The report discusses the project Navy-Marine Corps strike fighter shortfall on pages 20-22.

Statement of Administration Policy

A July 15, 2009, statement of administration policy on S. 1390 states the following regarding the F-35 program:

F-35 Joint Strike Fighter (JSF) Program: The Administration strongly objects to the addition of \$438.9 million for development of the alternative engine program. The Administration also objects to provisions of the bill that mandate an alternative engine program for the JSF. The current engine is performing well with more than 11,000 test hours. In addition, the risks associated with a single engine provider are manageable as evidenced by the performance of the F-22 and F/A-18E/F, Air Force and Navy programs supplied by a single engine provider. Expenditures on a second engine are unnecessary and impede the progress of the overall JSF program. The Air Force currently has several fleets that operate on a single-engine source. The Administration also objects to the limit on the obligation of overall JSF development funding to 90 percent of the amount authorized until the Secretary of Defense submits a written certification that sufficient funds have been obligated in FY 2010 for the alternative

engine program. If the final bill presented to the President would seriously disrupt the F-35 program, the President's senior advisors would recommend a veto.¹²⁰

Senate (Floor Consideration)

Summary

On July 23, 2009, as part of its consideration of S. 1390, the Senate rejected by a vote of 38 to 59 (Record Vote 240) an amendment (S.Amdt. 1767) that would have modified Section 211 as reported by the Senate Armed Services Committee so as to preserve the additional research and development funding for the alternate engine program, but make that funding available through an offset taken from a place in the defense budget other than what was recommended in the Senate Armed Services Committee markup.

Following its rejection of S.Amdt. 1767, the Senate adopted by voice vote another amendment (S.Amdt. 1627) that rewrites Section 211 so as to remove the research and development funding that was added in committee markup for an alternate engine program. The amendment also prohibits the obligation or expenditure of FY2010 funding on an alternate program until the Secretary of Defense makes certain certifications regarding its cost effectiveness. As amended by S.Amdt. 1627, S. 1390 is now generally consistent with the Administration's proposal to terminate the alternate engine program.

S.Amdt. 1767 (Not Agreed To)

S.Amdt. 1767 would have:

- preserved the language from Sec. 211 as reported by the Senate Armed Services Committee that would prohibit DOD from obligating more than 90% of FY2010 F-35 research and development funds until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for FY2010 for the continued development of a competitive propulsion system for the F-35 to ensure that system development and demonstration continues under the program during FY2010;
- preserved the additional research and development funding for the alternate engine program that was added in the Senate Armed Services Committee markup;
- restored reductions to the UH-1Y/AH-1Z helicopter program and to F-35 program management reserves that were made so as to make available the funding that was added for the alternate engine program; and
- instead reduced funding for the HC/MC-130 aircraft program—a program that received \$504 million in procurement funding in the FY2009 supplemental appropriations act (H.R. 2346/P.L. 111-32 of June 24, 2009).¹²¹

¹²⁰ Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, S. 1390 – National Defense Authorization Act for Fiscal Year 2010*, July 15, 2009, pp. 1-2. Emphasis as in the original.

¹²¹ See page 93 of the conference report on H.R. 2346 (H.Rept. 111-151 of June 12, 2009).

The text of S.Amdt. 1767 is as follows:

SEC. 211. CONTINUED DEVELOPMENT OF COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER PROGRAM.

(a) In General.—Of the amounts authorized to be appropriated or otherwise made available for fiscal year 2010 for research, development, test, and evaluation for the F-35 Lightning II aircraft program, not more than 90 percent may be obligated until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for fiscal year 2010 for the continued development of a competitive propulsion system for the F-35 Lightning II aircraft to ensure that system development and demonstration continues under the program during fiscal year 2010.

(b) Additional Amount for UH-1Y/AH-1Z Rotary Wing Aircraft.—The amount authorized to be appropriated by section 102(a)(1) for aircraft procurement for the Navy is hereby increased by \$282,900,000, with the amount of the increase to be allocated to amounts available for the procurement of UH-1Y/AH-1Z rotary wing aircraft.

(c) Restoration of Management Reserves for F-35 Joint Strike Fighter Program.—

(1) NAVY JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby increased by \$78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800N) for management reserves.

(2) AIR FORCE JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby increased by \$78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800F) for management reserves.

(d) Offset.—The amount authorized to be appropriated by section 103(1) for aircraft procurement for the Air Force is hereby decreased by \$438,900,000, with the amount of the decrease to be derived from amounts available for airlift aircraft for the HC/MC-130 recapitalization program.

S.Amdt. 1627 (Agreed To)

S.Amdt. 1627 would:

- eliminate the language from Sec. 211 as reported by the Senate Armed Services Committee that would prohibit DOD from obligating more than 90% of FY2010 F-35 research and development funds until the Secretary of Defense submits to the congressional defense committees a written certification that sufficient funds have been obligated for FY2010 for the continued development of a competitive propulsion system for the F-35 to ensure that system development and demonstration continues under the program during FY2010;
- replace the eliminated language with new language that prohibits the obligation or expenditure of FY2010 funding on an alternate engine program until the Secretary of Defense makes certain certifications regarding cost effectiveness of such a program;

- eliminate the additional research and development funding for the alternate engine program that was added in the Senate Armed Services Committee markup;
- restore reductions to the UH-1Y/AH-1Z helicopter program and to F-35 program management reserves that were made so as to make available the funding that was added for the alternate engine program.

The text of S.Amdt. 1627 is as follows:

SEC. 211. LIMITATION ON USE OF FUNDS FOR AN ALTERNATIVE PROPULSION SYSTEM FOR THE F-35 JOINT STRIKE FIGHTER PROGRAM; INCREASE IN FUNDING FOR PROCUREMENT OF UH-1Y/AH-1Z ROTARY WING AIRCRAFT AND FOR MANAGEMENT RESERVES FOR THE F-35 JOINT STRIKE FIGHTER PROGRAM.

(a) Limitation on Use of Funds for an Alternative Propulsion System for the F-35 Joint Strike Fighter Program.—None of the funds authorized to be appropriated or otherwise made available by this Act may be obligated or expended for the development or procurement of an alternate propulsion system for the F-35 Joint Strike Fighter program until the Secretary of Defense submits to the congressional defense committees a certification in writing that the development and procurement of the alternate propulsion system—

(1) will—

(A) reduce the total life-cycle costs of the F-35 Joint Strike Fighter program; and

(B) improve the operational readiness of the fleet of F-35 Joint Strike Fighter aircraft; and

(2) will not—

(A) disrupt the F-35 Joint Strike Fighter program during the research, development, and procurement phases of the program; or

(B) result in the procurement of fewer F-35 Joint Strike Fighter aircraft during the life cycle of the program.

(b) Additional Amount for UH-1Y/AH-1Z Rotary Wing Aircraft.—The amount authorized to be appropriated by section 102(a)(1) for aircraft procurement for the Navy is increased by \$282,900,000, with the amount of the increase to be allocated to amounts available for the procurement of UH-1Y/AH-1Z rotary wing aircraft.

(c) Restoration of Management Reserves for F-35 Joint Strike Fighter Program.—

(1) NAVY JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby increased by \$78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800N) for management reserves.

(2) AIR FORCE JOINT STRIKE FIGHTER.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby increased by \$78,000,000, with the amount of the increase to be allocated to amounts available for the Joint Strike Fighter program (PE # 0604800F) for management reserves.

(d) Offsets.—

(1) NAVY JOINT STRIKE FIGHTER F136 DEVELOPMENT.—The amount authorized to be appropriated by section 201(a)(2) for research, development, test, and evaluation for the Navy is hereby decreased by \$219,450,000, with the amount of the decrease to be derived from amounts available for the Joint Strike Fighter (PE # 0604800N) for F136 development.

(2) AIR FORCE JOINT STRIKE FIGHTER F136 DEVELOPMENT.—The amount authorized to be appropriated by section 201(a)(3) for research, development, test, and evaluation for the Air Force is hereby decreased by \$219,450,000, with the amount of the decrease to be derived from amounts available for the Joint Strike Fighter (PE # 0604800F) for F136 development.

FY2010 DOD Appropriations Bill (H.R. 3326)

Final Version

In lieu of a conference report, the House Appropriations Committee on December 15, 2009, released an explanatory statement on a final version of H.R. 3326. This version was passed by the House on December 16, 2009, and by the Senate on December 19, 2009, and signed into law on December 19, 2009, as P.L. 111-118.

The explanatory statement states that it “is an explanation of the effects of Division A [of H.R. 3326], which makes appropriations for the Department of Defense for fiscal year 2010. As provided in Section 8124 of the consolidated bill, this explanatory statement shall have the same effect with respect to the allocation of funds and the implementation of this as if it were a joint explanatory statement of a committee of the conference.”

The explanatory statement provided \$2,083.8 million for Air Force F-35 procurement. This represented a \$35 million increase over the Administration request, with the additional funds designated for the F-35 alternate engine program.

The explanatory statement also provided \$278.6 million in Air Force advance procurement funds for F-35, \$22 million below the Administration request, noting that advance procurement funding for two aircraft requested in FY2010 had already been provided in FY2009.

In the explanatory statement, Air Force research and development funding for the Joint Strike Fighter program was \$2.073.1 million, an increase of \$215 million over the Administration request, with the additional funds designated for the F-35 alternate engine program.

The explanatory statement set Navy research and development funding for the Joint Strike Fighter program at \$1,956.3 million, an increase of \$215 million over the Administration request, with the additional funds designated for the F-35 alternate engine program.

The explanatory statement also included this text:

JOINT STRIKE FIGHTER

Concerns persist regarding the progress of the F-35 Joint Strike Fighter (JSF) program. Last year, the Department of Defense established a Joint Estimating Team (JET) to evaluate this program. The JET reported that the program would cost significantly more and take longer to

fully develop and test than the Department was then projecting. Although the JET has yet to officially report out for 2009, the initial indications are that cost growth and schedule issues remain. Nevertheless, the Department insists that the program is on track to achieve both the cost and schedule currently reflected in the program of record.

Therefore, the JSF procurement program is provided \$6,840,478,000, and the JSF program is designated as a congressional special interest item. The Secretary of Defense is directed to ensure that all 30 aircraft be procured as requested in the budget. The Under Secretary of Defense for Acquisition, Technology and Logistics is directed to provide the findings of the JET along with recent studies on the test program and causes of cost growth to the congressional defense committees no later than January 15, 2010.

House

Quantities and Funding

The House Appropriations Committee, in its report (H.Rept. 111-230 of July 24, 2009) on H.R. 3326, recommends the following:

- procuring 18 F-35Bs and Cs for the Marine Corps and Navy—a reduction of two aircraft from the requested figure of 20 (page 148);
- procuring 10 F-35As for the Air Force—the requested figure (page 184);
- a reduction of \$420.6 million in Navy aircraft procurement funding for the procurement of F-35Bs and Cs for the Marine Corps and Navy, consisting of a reduction of \$300 million for “Reduction of two aircraft – no FY 2009 advance procurement,” and a reduction of \$120.6 million for non-recurring equipment execution” (page 151, line 6);
- a net increase of \$18.6 million in Air Force procurement funding for the F-35 program, consisting of a reduction of \$111.4 million for “Reduction to non-recurring engineering” and an increase of \$130 million for the alternate engine (page 187, line 1);
- a reduction of \$22 million in Air Force advance procurement funding for the F-35 program for “Reduction of 2 aircraft previously funded in fiscal year 2009” (page 187, line 2);
- an increase of \$215 million in Navy research and development funding for the F-35 alternate engine (page 258, line 127); and
- an increase of \$215 million in Air Force research and development funding for the F-35 alternate engine (page 273, line 84).

As discussed below in the section on report language, the recommended two-aircraft reduction in the number of F-35Bs and Cs to be procured is for F-35Bs, making for a recommended procurement of 14 F-35Bs and 4 F-35Cs.

Report Language

Regarding procurement funding for the F-35 program, the committee’s report states:

F-35 LIGHTNING II JOINT STRIKE FIGHTER

Last year, the Congress appropriated advance procurement funding for 14 fiscal year 2010 F-35 Short Take-Off and Vertical Landing (STOVL) aircraft [i.e., F-35Bs]. However, this year's request contains full funding for the procurement of 16 STOVL aircraft. Without the proper advance procurement funding, two of the fiscal year 2010 aircraft will not execute until fiscal year 2011. Since these aircraft will execute as fiscal year 2011 aircraft, they should be funded in fiscal year 2011. Therefore, the recommendation removes \$300,000,000, the cost of two STOVL aircraft, from the program. This adjustment is consistent with the Navy's own adjustments to other aircraft procurement programs. (Pages 153-154)

The report also states:

JOINT STRIKE FIGHTER NON-RECURRING EQUIPMENT

The Joint Strike Fighter program budgets for and procures equipment and tooling to outfit the manufacturing facility with sufficient capacity to produce aircraft in larger quantities as the production program ramps up. Since the program began production in fiscal year 2007, the Congress has appropriated over \$900,000,000 for this effort. However, in actuality, the program has executed just over \$700,000,000, largely because the production ramp up has been lower than originally predicted. Therefore, the recommendation reduces the request for non-recurring equipment by \$232,000,000 to fund this activity at a level consistent with historical execution. (Page 119)

Regarding administration proposals to terminate programs, including the F-35 alternate engine program, the report states:

The Committee also seeks to reverse a recent and increasing trend to curtail the development of systems before such efforts realize any benefit to the taxpayer. The Committee strongly supports realistic budgeting that matches available funding to overall programs. Indeed, many of the program terminations proposed in the fiscal year 2010 budget request are supported in this bill. Nevertheless, the Committee is concerned that the proposal to terminate some programs is premature, and believes that continuing certain efforts may yield significant payback. The Committee believes that this is clearly the case for the presidential helicopter, wherein five aircraft have been purchased that could be pressed into service. Similarly, in the Committee's view, there is potential for significant payback associated with the Joint Strike Fighter alternative engine and certain missile defense activities provided in this recommendation. (Page 4)

The report also states:

JOINT STRIKE FIGHTER ALTERNATE ENGINE

The F-35 Lightning II Joint Strike Fighter program truly represents the Nation's future with respect to tactical aviation. The Navy, Marine Corps and Air Force plan to procure over 2,500 of these fifth generation stealthy aircraft and will fly them well into the future. The Department's original plan for the F-35 propulsion engine was to have two engine variants. Cost growth in other areas of the development program resulted in the Department abandoning the alternate engine program. Currently, all three variants of the F-35 aircraft will be powered by the same propulsion engine. Although this will make the logistics for the aircraft less complex, this practice presents problems. The Committee is extremely concerned that in the near future when the F-35 will comprise the majority of the Nation's tactical aircraft inventory any technical problems with the engine could theoretically ground

the entire fleet of aircraft. If this situation were to arise in a time of crisis, the Commander-in-Chief's flexibility would be severely limited.

Another area of concern for the Committee is the lack of competition for the Joint Strike Fighter engine program. With over 2,500 aircraft envisioned for this program, the potential for cost savings through an engine competition is enormous. The Committee is aware that the Department conducted a business case analysis that compared the cost of the program of record (sole source engine provider) to a program using a dual source strategy for the engine program. The business case concluded that the costs of the two programs were essentially the same. Since the Congress has put several hundred million dollars into the development of an alternate engine program since this business case was published, the Committee is puzzled by the Department's decision to not fund the alternate engine. With the majority of the upfront development cost having been sunk into the program, it seems clear that from this point forward the dual source strategy is the most cost effective method to acquire the propulsion engine for the Joint Strike Fighter. Therefore, the recommendation provides an additional \$430,000,000 for the continued development of the alternate engine and \$130,000,000 for alternate engine production costs for a total of \$560,000,000 above the request for the alternate engine program. Further, since a dual source engine strategy is the most cost effective method for acquiring engines from this point forward, the Secretary of Defense is directed to include funding for the alternate engine program in future budget requests. (Pages 215-216)

Statement of Administration Policy

A July 28, 2009, statement of administration policy on H.R. 3326 as reported in the House states the following regarding the F-35 program:

Joint Strike Fighter (F-35) Alternate Engine. The Administration strongly objects to the addition of \$130 million to produce, and \$430 million to continue the development of, the Joint Strike Fighter (JSF) alternate engine, which was proposed for termination by the President. Expenditures on an alternate engine for the JSF are unnecessary and divert resources from the overall JSF program. The current engine is performing well, and the risks associated with a single engine provider are manageable. If the final bill presented to the President would seriously disrupt the F-35 program, the President's senior advisors would recommend that he veto the bill.¹²²

Senate

Quantities and Funding

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends the following:

- procuring 20 F-35Bs and Cs for the Marine Corps and Navy—the requested figure (page 101);
- procuring 10 F-35As for the Air Force—the requested figure (page 129);

¹²² Executive Office of the President, Office of Management and Budget, *Statement of Administration Policy, H.R. 3326 – Department of Defense Appropriations Act, 2010*, July 28, 2009, p. 2. Emphasis as in the original.

- a reduction of \$22 million in Air Force advance procurement funding for the procurement of F-35As in a future fiscal year for “Reduction of two aircraft” (page 133, line 2);
- a reduction of \$78 million in Navy research and development funding for the F-35 program for “Excess to need” (page 184, line 127);
- a reduction of \$78 million in Air Force research and development funding for the F-35 program for “Excess to need” (page 197, line 84); and
- an increase of \$3 million in Air Force research and development funding for the Aerospace Propulsion and Power Technology program for “Silicon Carbide Power Modules for the F-35 Joint Strike Fighter” (page 196; line 22).

The committee’s report recommends no funding for F-35 alternate engine development.

Report Language

The committee’s report mentions the F-35 program on page 257 as part of a discussion of its recommendation for procurement of Navy F/A-18E/F strike fighters, stating: “The Committee is concerned about the shortfall in the Navy’s strikefighter inventory created by the aging of the older F/A-18 models and the fact that the F-35 Joint Strike Fighter program will not start delivering carrier aircraft in significant numbers for several years.”

Appendix B. F-35 Key Performance Parameters

Table B-1 summarizes key performance parameters for the three versions of the F-35.

Table B-1. F-35 Key Performance Parameters (KPPs)

Source of KPP	KPP	F-35A Air Force CTOL version	F-35B Marine Corps STOVL version	F-35C Navy carrier- suitable version
Joint	Radio frequency signature	Very low observable	Very low observable	Very low observable
	Combat radius	590 nm Air Force mission profile	450 nm Marine Corps mission profile	600 nm Navy mission profile
	Sortie generation	3 surge / 2 sustained	4 surge / 3 sustained	3 surge / 2 sustained
	Logistics footprint	< 8 C-17 equivalent loads (24 PAA)	< 8 C-17 equivalent loads (20 PAA)	< 46,000 cubic feet, 243 short tons
	Mission reliability	93%	95%	95%
	Interoperability	Meet 100% of critical, top-level information exchange requirements; secure voice and data		
Marine Corps	STOVL mission performance – short-takeoff distance	n/a	550 feet	n/a
	STOVL mission performance – vertical lift bring-back	n/a	2 x 1K JDAM, 2 x AIM-120, with reserve fuel	n/a
Navy	Maximum approach speed	n/a	n/a	145 knots

Source: F-35 program office, October 11, 2007.

Notes: PAA is primary authorized aircraft (per squadron); vertical lift bring back is the amount of weapons with which plane can safely land.

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