



# **F-35 Alternate Engine Program: Background and Issues for Congress**

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May 24, 2010

**Congressional Research Service**

7-5700

[www.crs.gov](http://www.crs.gov)

R41131

## Summary

For four successive years, Congress has rejected administration proposals to terminate the program to develop the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt & Whitney F135 engine that currently powers the F-35 Joint Strike Fighter (JSF). The administration's FY2011 budget submission again proposes to terminate the program.

The alternate engine program began in FY1996, when defense authorization conferees directed the Department of Defense (DOD) to ensure that the JSF (then "JAST") program "provides for adequate engine competition." Through FY2009, Congress has provided approximately \$2.5 billion for the Joint Strike Fighter alternate engine program. The program is projected to need an additional \$1.9 billion-2.9 billion through 2017 to complete the development of the F136 engine.

Critics of the proposal to terminate the F136 alternate engine argue that termination was driven more by immediate budget pressures on the department than the long-term pros and cons of the F136 program. They argue that engine competition on the F-15 and F-16 programs saved money and resulted in greater reliability. Some who applaud the proposed termination say that single-source engine production contracts have been the norm, not the exception. Long-term engine affordability, they claim, is best achieved by procuring engines through multiyear contracts from a single source.

Canceling the F136 engine poses questions on the operational risk—particularly of fleet grounding—posed by having a single engine design and supplier. Additional issues include the potential impact this termination might have on the U.S. defense industrial base and on U.S. relations with key allied countries involved in the alternate engine program. Finally, eliminating competitive market forces for DOD business worth billions of dollars may concern those who seek efficiency from DOD's acquisition system and raises the challenge of cost control in a single-supplier environment.

Continuing F136 development raises issues of impact on the F-35 acquisition program, including possible reduction of the numbers of F-35s that could be acquired if program funds are used for the alternate engine. It also raises issues of the out-year costs and operational concerns stemming from the requirement to support two different engines in the field.

**FY2011 defense authorization bill:** In subcommittee markups, the House Armed Services Committee added \$485 million in funding for the alternate engine, along with language fencing F-35 spending pending a certification that all alternate engine funds had been obligated.

**FY2010 DOD appropriations bill:** 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.

**Latest Developments:** In markup on May 19, 2010, the House Armed Services Committee added \$485 million to continue the alternate engine program, and passed language that would limit F-35 procurement to 30 aircraft and prohibit DOD from spending 25% of its F-35 budget until all alternate engine funds had been obligated.

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## Introduction

The administration's proposal to terminate the alternate engine program for the F-35 Lightning II fighter is a significant issue for Congress in FY2011, with implications for the defense budget, military capability in the future, and the division of power between Congress and the executive branch.

The program is developing the General Electric/Rolls-Royce F136 engine as an alternative to the Pratt & Whitney F135 engine that currently powers the F-35. Successive administrations proposed terminating the alternate engine program in the FY2007 through FY2010 budgets. Congress rejected these proposals and provided funding, bill language, and report language continuing the program. The administration's FY2011 budget submission again proposes to terminate the program.

## Background

On October 26, 2001, the Department of Defense (DOD) selected the single-engine Lockheed Martin F-35, powered by the Pratt & Whitney F135 engine, as the winner of its Joint Strike Fighter (JSF) competition. DOD expects to buy 2,456 JSFs for the Air Force, Navy, and Marine Corps.<sup>1</sup>

In FY1996, Congress required development of an alternate engine for the F-35.<sup>2</sup> This became the F136, based on an engine created by the team of General Electric and Rolls-Royce for the unsuccessful McDonnell Douglas JSF candidate. The F135 and F136 engines were designed to be used interchangeably, without modification to the F-35 airframe.

In FY2007, the administration proposed terminating the alternate engine program "because development of the main engine was progressing well and analysis indicated that savings from competition would not be offset by high upfront costs."<sup>34</sup> Congress subsequently restored funding for the program, along with directive bill and report language requiring DOD to continue the program in future years. Administration-proposed terminations in FY2008, FY2009, and FY2010 were also rejected by Congress.

The administration's proposed FY2011 budget would again end the alternate engine program.

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<sup>1</sup> In-depth discussion of other issues associated with the JSF program can be found in CRS Report RL30563, *F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress*.

<sup>2</sup> In FY1996, defense authorization conferees expressed their concern over a lack of engine competition in the JAST (later re-named JSF) program and directed DOD to ensure that the program "provides for adequate engine competition" (H.Rept. 104-450, Sec. 213, p. 706.) In FY1998, authorization conferees directed DOD to certify that "the Joint Strike Fighter Program contains sufficient funding to carry out an alternate engine development program that includes flight qualification of an alternate engine in a joint strike fighter airframe" (H.Rept. 105-340, Sec. 213, p. 33).

<sup>3</sup> Office of Management and Budget, *Terminations, Reductions, and Savings, Budget of the U.S. Government, Fiscal Year 2010*, Washington, May 2009, p. 38.

<sup>4</sup> Office of Management and Budget. *Terminations, Reductions, and Savings, Budget of the U.S. Government, Fiscal Year, 2010*. Washington, May 2009. p. 38.

## Summary of Arguments

Supporters of the administration's proposal to terminate the alternate engine program argue the following:

- Developing and procuring a second engine for the F-35 would add billions of dollars to the cost of the F-35 program by roughly doubling engine development costs and halving engine production economies of scale. Such a cost increase would reduce the number of F-35s that could be procured within a given total amount of F-35 acquisition funding, forcing cuts in future capabilities and force structure. An official from the F-35 program office stated that the reduction in F-35 procurement over the next five years might total 50 to 80 aircraft.<sup>5</sup>
- Procuring a second engine would increase F-35 life-cycle operation and support (O&S) costs by requiring DOD to maintain two engine maintenance and repair pipelines. Supporting two engines on aircraft carriers would be particularly challenging due to limited space and facilities.
- Having a second engine is not needed to sustain international interest in the F-35, because the most significant potential foreign buyers are already committed to the F-35 program, and because committed and potential buyers already have several significant reasons to be interested in the F-35, starting with the aircraft's capabilities, procurement cost, and operating and support cost.
- Congress already accepts the risk of using single designs across fleets, both in power plants and airframes. Many other aircraft types in the U.S. inventory use one engine design across the fleet. Procurement of a single airframe design also carries the risk of fleet grounding if there is a flaw in the design (as has occurred in the past),<sup>6</sup> yet those risks are acceptable to Congress and DOD. The same risk logic should apply to F-35 engines.
- Development, testing, and production of the F135 have reached the point where it is no longer necessary to hedge against the possibility of technical problems in the F135 engine by pursuing an alternate engine program as a backup. The causes of F135 test failures in 2007 and 2008 have been identified and fixes are being implemented.

Opponents of the administration's proposal to terminate the alternate engine program argue the following:

- The administration's proposal to terminate the alternate engine program does not comply with Section 213 of the FY2008 defense authorization act (H.R.

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<sup>5</sup> Graham Warwick and Guy Norris, "Second Engine Could Force F-35 Production Cuts, PEO Warns," *Aerospace Daily & Defense Report*, June 1, 2009, p. 3.

<sup>6</sup> For example, the Air Force grounded all of its F-15 aircraft on November 3, 2007, following midair structural failure of an F-15C. The fleet was returned to service on November 21, 2007. ("Entire F-15 Fleet Returning to Flight," Air Combat Command News Service, November 21, 2007.) All C-5A aircraft were grounded in January 1970, due to cracks discovered in the wings, and again in October 1971, following the discovery of cracks in engine mounts. (Darrell Garwood, "Newest Air Force Planes Grounded," *UPI*, January 17, 1970, and Richard Witkin, "Entire C-5A Fleet Grounded By U.S.," *The New York Times*, October 13, 1971.) On a smaller scale, see Philip Ewing, "104 Hornets grounded after cracks discovered," *NavyTimes.com*, March 14, 2010.

4986/P.L. 110-181 of January 28, 2008), which states: “Of the funds appropriated pursuant to an authorization of appropriations or otherwise made available for fiscal year 2008 or any year thereafter, for research, development, test, and evaluation and procurement for the Joint Strike Fighter 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 2 options for the propulsion system for the Joint Strike Fighter in order to ensure the development and competitive production for the propulsion system for the Joint Strike Fighter.”

- Given that F-35s are to constitute the vast majority of the country’s strike fighters, it would be imprudent to have all those strike fighters powered by a single type of engine, since a problem with that engine could force the grounding of the entire F-35 fleet.
- Having a second engine in production (or ready for production) would permit DOD to use competition (or the threat of competition) in procuring and supporting F-35 engines, which could reduce F-35 engine procurement and O&S costs compared to what would be achievable in a sole-source procurement, offsetting the additional costs associated with developing, procuring, and supporting a second engine.
- Competition (or the threat of competition) would also promote better engine performance, increased engine reliability, and improved contractor responsiveness. Having two F-35 engine production lines in operation would also permit F-35 engine production to be more quickly surged to higher levels if needed to respond to a change in the strategic environment, and preserve a potential for maintaining effective competition in the development and procurement of future tactical aircraft engines, particularly if F-22 and F/A-18E/F production ends.
- Having a second engine in production would help sustain international interest in the F-35 program, maximizing F-35 exports. Potential foreign buyers would be more inclined to purchase the F-35 if they had a choice regarding the aircraft’s engine, and if they believed that competition (or the threat of competition) in engine production was holding down the engine portion of the F-35’s total cost.

## **Current Status of the Alternate Engine Program**

Pratt & Whitney, the incumbent engine maker, has received a total of \$7.3 billion in funding during the period FY1994-FY2009 for work relating to the F-35 program. This figure included funding for work performed for the Boeing concept for the JSF (a concept that was not selected to go forward.) The \$7.3 billion also includes \$6.1 billion received during the period FY2002-FY2009 for F135 System Development and Demonstration (SDD) work. The estimated cost of the F135 SDD contract increased from \$4.8 billion at contract award in 2001 to \$6.7 billion as of September 2009. Approximately \$0.8 billion of the increase is cost growth; the remaining \$1.1 billion or so reflects an increase in the scope of work to be performed.

The General Electric/Rolls-Royce alternate engine team received a total of \$2.4 billion during the period FY1995-FY2009. This total includes \$1.7 billion for SDD work for the F136 engine during the period FY2005-FY2009. The F136 team’s effort did not include design, development,

test, or delivery of STOVL Lift System components and exhaust systems, which were developed and provided under the F135 Pratt & Whitney SDD contract. The F136 SDD contract consequently included fewer test hours and fewer ground test engines.<sup>7</sup>

A discussion of technical issues follows in the “Engine Development Issues” section of the report.

## **Administration Perspectives**

### **Secretary of Defense**

At a February 3, 2010, hearing, Secretary of Defense Robert Gates testified:

I would just say, you know, from our standpoint, the Congress has added \$1.8 billion for this program. We see it costing us another \$2.9 billion over the next five years....

The reality is, the most optimistic analyses and models that we have run show that there is little advantage to the taxpayer of having a second engine. The truth is, almost none of the customers will buy two engines. If there's a European engine or a Rolls-Royce GE engine, the Europeans are probably going to buy—our European partners are probably going to buy that one. The Marine Corps and the Navy have both said they're only going to take one airplane, because of the limited logistics, space available on ships.

So, the only piece of this that could be competed would be the Air Force part of it. And so, you end up having two engines for the Air Force.

Look, the key is getting the F135 engine program. It's doing well. It's completed 13,000 hours of testing out of 14,700. The F136 has completed 50 hours of testing. There's no reason to believe that the second engine won't encounter the same development problems the first one has.<sup>8</sup>

### **Secretary of the Air Force**

At a February 23, 2010, hearing, Secretary of the Air Force Michael Donley stated:

It is a close enough call that we cannot see right now the benefits of a considerable—what we think is still a considerable remaining investment that would have to be made in a second engine, the logistics tail that goes with it, all the pre-production work, the remaining development, which may be understated in some quarters; the firm costs that are associated with those activities against the soft savings that might be out there in the future. We're just—it just looks too cloudy to us.<sup>9</sup>

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<sup>7</sup> DOD information paper on F-35 program dated September 24, 2009, provided to CRS by Air Force Legislative Liaison Office on September 29, 2009.

<sup>8</sup> Transcript of House Armed Services Committee hearing on Fiscal 2011 budget request for the Defense Department, February 3, 2010.

<sup>9</sup> Transcript of House Armed Services Committee hearing on Fiscal 2011 budget request for the Department of the Air Force, February 23, 2010.



## **Air Force Chief of Staff**

At the same hearing, in response to a question as to why the F-35 should not have an alternate engine when the F-15 and F-16 did, Air Force Chief of Staff General Norton Schwartz testified:

Because we're 20 years, 30 years later in technological progress on engine design and production. And fundamentally ... if having more engines results in less F-35s, that is not a good scenario for the Air Force or the Department of Defense.

Secondly, the reality is that the F-22 and the F-18E/F are single-engine airplanes.<sup>10</sup> And, you know, there's no dispute about that, and it's because we collectively in the defense community, I think, have become comfortable with the reliability and so on of those respective engines, one of which is a predecessor to the 135.<sup>11</sup>

## **Chief of Naval Operations**

Chief of Naval Operations Adm. Gary Roughead was quoted in a press report as saying, "I'm in the one engine camp.... On a carrier, space matters."<sup>12</sup>

## **Office of Management and Budget**

An Office of Management and Budget (OMB) document on proposed FY2010 program terminations, reductions, and savings stated that the Administration believed the alternative engine program was "no longer needed as a hedge against the failure of the main Joint Strike Fighter engine program," and that "financial benefits, such as savings from competition, have been assessed to be small, if they exist at all, because of the high cost of developing, producing and maintaining a second engine." OMB stated that cancellation "will result in estimated near-term savings of over a billion dollars."<sup>13</sup>

## **GAO Perspective**

At a May 20, 2009, hearing before the Air and Land Forces subcommittee of the House Armed Services Committee, GAO testified that "competitive pressures could yield enough savings to offset the costs of competition over the JSF program's life."<sup>14</sup>

The GAO testimony reaffirmed previous GAO work, including an estimate that "to continue the JSF alternate engine program, an additional investment of about \$3.5 billion to \$4.5 billion in

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<sup>10</sup> General Schwartz's reference to "single-engine airplanes" meant that the aircraft in question used only a single engine design from a single supplier, not that only one engine was installed in each airplane.

<sup>11</sup> Ibid.

<sup>12</sup> Graham Warwick, "Navy Backs Single JSF Engine As F-35C Rolls Out," *Aerospace Daily & Defense Report*, July 29, 2009, pp. 1-2. See also Antonie Boessenkool, "Pratt & Whitney's Costs Parts-Reject Rate Too High: JSF Official," *Defense News*, August 3, 2009.

<sup>13</sup> Office of Management and Budget. *Terminations, Reductions, and Savings, Budget of the U.S. Government, Fiscal Year, 2010*. Washington, May 2009. p. 38.

<sup>14</sup> All GAO quotes in this section are from Government Accountability Office, *Joint Strike Fighter[:]Strong Risk Management Essential as Program Enters Most Challenging Phase*, Statement of Michael Sullivan, Director Acquisition and Sourcing Management. GAO-09-711T, May 20, 2009.

development and production-related costs, may be required,” and that “a savings of 9 to 11 percent would recoup that investment.”<sup>15</sup> GAO went on to assert that “a competitive strategy has the potential for savings equal to or exceeding that amount across the life cycle of the engine,” noting that the “Great Engine War” of the 1980s resulted in “(1) nearly 30 percent cumulative savings for acquisition costs, (2) roughly 16 percent cumulative savings for operations and support costs; and (3) total savings of about 21 percent in overall life cycle costs.” (For more on the “Great Engine War,” see **Appendix B**.)

GAO also noted that a number of nonfinancial benefits may result from competition, “including better performance, increased reliability, and improved contractor responsiveness.”

## Cost Issues

Cost has been a significant issue in the alternate engine debate. Proponents of the alternate engine point to cost growth in the F135 as evidence that a competitor is needed to control costs. The administration maintains that the benefits of a second engine do not outweigh its costs.

In July, 2009, Pratt & Whitney reported that the cost of an F135 had increased 24%, from \$6.7 million apiece to \$8.3 million.<sup>16</sup> In response, Secretary Gates said:

There is always cost growth associated with a developmental aircraft. It’s one of the reasons we have over \$4 billion in the FY ’10 budget to reduce the program risk [by allowing] for more engineers, more testing time, more airframes for testing. We think that fixing the problems we’ve encountered ... with the engine is something that’s quite manageable. And we don’t think it’s the best use of our money to fund a second engine.<sup>17</sup>

Also in July, 2009, DOD created a Joint Assessment Team (JAT) “to investigate and understand Pratt & Whitney’s cost structure and help the JSF office in its assessment of the company’s latest ... bid. The JAT also will look at scrap rates and other production issues.”<sup>18</sup> According to reporting on a memo from Under Secretary Ashton Carter, the JAT’s charter included “understanding the production cost, cost drivers, cost projections and long-term affordability of the F135” and developing “a plan to address F135 cost and affordability.”<sup>19</sup>

DOD has declined to give CRS access to the JAT results. A February 26, 2010, press report indicated:

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<sup>15</sup> The earlier work cited in GAO’s testimony include Government Accountability Office, *Joint Strike Fighter[:] Impact of Recent Decisions on Program Risks*, Statement of Michael Sullivan, Director Acquisition and Sourcing Management, Testimony before the Subcommittees on Air and Land Forces, and Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, GAO-08-569T, March 11, 2008; and Government Accountability Office, *Defense Acquisitions[:] Analysis of Costs for the Joint Strike Fighter Engine Program*, Statement of Michael Sullivan, Director Acquisition and Sourcing Management, Testimony before the Subcommittees on Air and Land Forces, and Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, GAO-07-656T, March 22, 2007.

<sup>16</sup> Tony Capaccio, “F-35 Engine Shows ‘Fairly Significant’ Cost Growth,” *Bloomberg.com*, July 27, 2009.

<sup>17</sup> “No Means No,” *Aerospace Daily & Defense Report*, August 24, 2009, p. 1. Ellipsis as in original.

<sup>18</sup> Bill Sweetman, “Government Sends F135 Tiger Team Into Pratt & Whitney,” *Aerospace Daily & Defense Report*, September 8, 2009, p. 3.

<sup>19</sup> John T. Bennett, “Team Must Complete F135 Engine Review by Nov. 20,” *DefenseNews.com*, September 9, 2009.

Adding a second engine to the F-35 Lightning II program would cost the same as hewing to the single-source plan, according to a new Pentagon study. Defense Department officials say that supports their decision to reject proposals to buy General Electric and Rolls-Royce's F136 engine....

'The estimated costs of a competitive engine acquisition strategy are projected to be approximately equivalent to a sole-source scenario, or at the break-even point,' reads a copy of a Pentagon memo explaining the JSF 'Alternate Engine Cost/Benefit Analysis' that was sent to lawmakers on Feb. 25.

The memo acknowledges that continued development work on the F136 has reduced the amount of money it would take to bring the second engine online.

Yet the "fundamental conclusion remains the same: The potential lifecycle cost savings from" two competing F-35 engine programs 'do not provide a compelling business case,' wrote Christine Fox, who directs Defense Department cost assessment and program evaluation.<sup>20</sup>

## **Independent Cost Analyses of the F-35 Alternate Engine**

Section 211 of the 2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) (see **Appendix A** for text) directed three independent cost analyses of the F-35 engine program. The studies were conducted by the Cost Analysis Improvement Group (CAIG) within the Office of the Secretary of Defense (OSD), the Institute for Defense Analyses (IDA), and GAO. The studies used the same data (which were provided by the JSF program office and contractors), and were completed in 2007.

The studies came to differing conclusions regarding the estimated financial break-even points for an alternate engine program. The studies all cited non-financial benefits that would be derived from an engine competition, including improvements in fleet readiness, contractor responsiveness, sustainment of industrial base, and stronger international relations.

### ***CAIG Study***

The CAIG study examined the results of the engine competition for the Air Force F-16 fighter program (also known as the Great Engine War—see "The "Great Engine War" of 1984-1994" in **Appendix B**), the engine competition for the Navy and Marine Corps F/A-18 strike fighter program,<sup>21</sup> and the sole-source procurement of the Pratt & Whitney F-119 engine for the F-22.

The CAIG study noted that, in light of their analysis of past cost performance in acquisition efforts using competition, the CAIG's baseline "assumptions [were] generally favorable to dual source case."<sup>22</sup> The study assumed that the second F-35 engine provider (General Electric/Rolls-Royce) would meet the initial provider (Pratt & Whitney) in pricing in 2014, the first year of

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<sup>20</sup> John Reed, "Study: No Cost Difference for F-35 Alternate Engine," *DefenseNews.com*, February 26, 2010.

<sup>21</sup> The competition for the F/A-18 engine differed from the Great Engine War in that both GE and Pratt & Whitney competed to build the same engine—the GE-designed F404. Although this did not permit a competition for engine design and development, it permitted a competition for production price and production quality.

<sup>22</sup> OSD Cost Analysis Improvement Group Report (v6), "F-35/JSF Alternate Engine Acquisition and Independent Cost Analyses," March 15, 2007, Slide 31.

competition. The study also assumed that competition would result in both an immediate 5% price decrease in engine procurement costs and steeper rate of reduction in cost for producing subsequent engines (i.e., a steeper slope on the production learning curve).<sup>23</sup>

The CAIG study estimated that an F-35 engine competition would need to achieve a 21.1% reduction in engine procurement costs in constant FY2002 dollars over the lifetime of the program to break even (i.e., to fully offset the costs associated with establishing and maintaining a second source). On a net-present-value (NPV) basis,<sup>24</sup> the study found the procurement-cost reduction required for break-even would be 25.6%. On that basis, the study estimated that DOD would be unable to recoup its initial investment in the alternate engine development program through procurement savings alone. The CAIG study stated that DOD would need to effectively compete engine operations and support (O&S) contracts to have a chance at attaining a 25.6% savings to reach a break-even point by 2040. The report seemed skeptical that, even with competition on O&S contracts, a 25.6% savings could be achieved.<sup>25</sup>

In addition to the non-financial benefits of engine competition cited by all three studies, the CAIG study discussed the issue of growth potential in the F-35 engine. The study estimated that a fourth- or fifth-generation fighter<sup>26</sup> would experience an average of 7.2% weight growth between Critical Design Review (CDR) and Initial Operational Capability (IOC) and an additional 0.3% of weight growth thereafter.<sup>27</sup> Such growth in aircraft weight would eventually require a commensurate growth in engine thrust. The CAIG study stated that Pratt & Whitney's F135 engine was already close to exceeding its designed engine temperature specifications, and would require modifications beyond those that would be needed in the F136 engine to allow for thrust growth.<sup>28</sup>

### *IDA Study*

The IDA study examined the engine competition for the Air Force F-16 fighter program (the Great Engine War) and the engine competition for the Navy and Marine Corps F/A-18 strike fighter program.

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<sup>23</sup> The shift to a steeper learning curve in these analyses is referred to as learning curve rotation. The CAIG study assumed that the learning curve would shift (i.e., rotate) five percentage points. As a notional example, a program might originally have a 90% learning curve, meaning that the second item requires 90% as much labor to build as the first, the fourth requires 90% as much as the second, the eighth requires 90% as much as the fourth, the 16<sup>th</sup> requires 90% as much as the eighth, and so on, with the quantities doubling each time to achieve the next 10% reduction in labor. A five-percentage-point learning curve rotation would mean that this notional learning curve would shift to an 85% slope, so that, for example, the fourth item might now require 85% as much labor to build as the second, and the eighth 85% as much as the fourth, and so on.

<sup>24</sup> An NPV estimate takes into account the real (i.e., above-inflation) investment value of money over time. Government cost-estimating regulations call for using NPV analysis in situations involving an expected stream of expenditures over many years.

<sup>25</sup> OSD CAIG Report, Slide 37.

<sup>26</sup> The F-15, F-16, and F/A-18 are considered "fourth-generation" fighters; due to stealth characteristics, system integration, and other factors, the F-22 and F-35 are "fifth-generation."

<sup>27</sup> The CAIG's estimated weight growth prior to IOC is greater than the F-35 Joint Program Office (JPO) estimate of 3%. The JPO also estimates that the F-35's weight will remain unchanged after IOC.

<sup>28</sup> Ibid., slides 25 and 26. Note: Since the F136 is earlier in its development cycle, analysts comment that its design is not as set as the F135 and could better incorporate engine growth requirements without major modifications.

The study estimated that an F-35 engine competition would result in a gross savings of 11% to 18%.<sup>29</sup> IDA concluded that past studies of various procurement competitions showed an average (un-weighted) savings of 14.6%.<sup>30</sup>

The IDA study estimated that an alternate engine program for the F-35 would incur direct and indirect investment costs of \$8.8 billion in constant FY2006 dollars.<sup>31</sup> The study concluded that it would not be feasible to recoup these investment costs through procurement-cost savings alone. The study determined that for the alternate engine program to break even on an NPV basis, the required amount of procurement-cost savings would be an “unrealistic” 40%, and that the required amount of savings would decline to 18% if engine O&S contracts were also competed.<sup>32</sup> The study stated that DOD “has not typically linked procurement and O&S costs in a single competition” and therefore had limited historical data on which to base an estimate of potential O&S savings.<sup>33</sup>

The IDA study states that contractor responsiveness was “the primary motivation for the Great Engine War.”<sup>34</sup> It stated that F-35s are to constitute 95% of the U.S. fighter/strike-fighter force by 2035, and that having an alternate engine could mitigate the risk of the entire F-35 fleet being grounded due to an engine problem. The study posited that enhanced industry responsiveness to engine upgrades and fixes resulting from competitive forces might have a significant effect on overall fleet readiness.

### *GAO Study*

The GAO study stated that procurement-cost savings of 10.3% to 12.3% would be required for the alternate engine program to break even on its investment costs.<sup>35</sup> The study stated that analyses of past engine competitions have shown financial savings of up to 20%.<sup>36</sup> The study concluded that it is reasonable to assume that savings generated from competing the engine would recoup the investment costs. Michael Sullivan, GAO’s director of Acquisition and Sourcing Management, stated in testimony that he believed the alternate engine program would reach its break-even point by the late 2020s.<sup>37</sup> The study stated that DOD’s program management advisory group recommended in 1998 and again in 2002 that the alternate engine program be continued due to its non-financial benefits, in spite of only finding marginal financial benefits.

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<sup>29</sup> Institute for Defense Analyses Report: “Joint Strike Fighter (JSF) Engine Cost Analysis: Summary of Results (Revised),” March 2007, p. S-3. Note: IDA determined a 11% savings from competition over the upgraded F100-220 Pratt & Whitney engine and an 18% savings from competition between the original Pratt & Whitney F100 and the GE F110 (p. 23).

<sup>30</sup> Ibid., p. 24. However, IDA noted “significant inconsistencies” with studies of past competitions, which need to be taken into consideration when evaluating potential savings.

<sup>31</sup> Ibid., p. 20.

<sup>32</sup> Ibid., p. S-3.

<sup>33</sup> Ibid., p. S-3.

<sup>34</sup> Ibid., p. 44.

<sup>35</sup> “Analysis of Costs for the Joint Strike Fighter Engine Program,” GAO-07-656T, March 22, 2007, p. 1.

<sup>36</sup> Ibid., p. 2.

<sup>37</sup> Transcript of March 2, 2007, hearing on DOD aircraft programs before the Air and Land Forces subcommittee and the Seapower and Expeditionary Forces subcommittee of the House Armed Services Committee.

## Size of F-35 Engine Production Run

The expected size of the F-35 production run can affect the potential for reaching a calculated break-even point for an alternate engine program. Other things held equal, the smaller the F-35 production run, the less potential might exist for reaching a break-even point, and vice-versa. The size of the F-35 production run will be influenced by both U.S. decisions on the number of F-35s to be procured for the U.S. military, by foreign governments' decisions on the numbers of F-35s they want to purchase for their own militaries, and which engine is installed in each. Such decisions can be made (and changed) multiple times over the course of many years, during which time there could be multiple changes in the international security environment and U.S. and foreign defense budgets, making it difficult to project now what the ultimate size of the F-35 production run—or that of any particular engine—might be.

## Contractor Offers of Fixed-Price Contracts

On September 1, 2009, the GE/Rolls-Royce team reportedly offered to build F136 engines for a firm, fixed price after the first few lots.<sup>38 39</sup> Two weeks later, Pratt & Whitney made an offer to reduce the price of the F135 after the first three lots. This proposal would be a cost-plus contract, although the company said an earlier offer of a fixed-price F135 contract had been declined by DOD.<sup>40</sup> GE/Rolls-Royce made a second fixed-price offer covering FY2012-FY2014 on April 27, 2010.<sup>41</sup>

On the concept of a fixed-price contract, General James Cartwright, vice chairman of the Joint Chiefs of Staff, said, "That's something we would like to have a look at."<sup>42</sup>

## Relations with Allies

A Memorandum of Understanding (MOU) between the United States and eight other countries on the production, sustainment, and follow-on development of the JSF that was signed by the United States on November 14, 2006, states in Section III, regarding Scope of Work (paragraph 3.2.1.1), that

The production work [of the JSF Air System] will include, but will not be limited to, the following...

Production of the JSF Air Vehicle, including propulsion systems (both F135 and F136).<sup>43</sup>

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<sup>38</sup> John T. Bennett, "GE Pitches Fixed-Price Deal For Alternate JSF Engine," *DefenseNews.com*, September 1, 2009.

<sup>39</sup> Guy Norris, "Alternate JSF Engine Team Puts Pressure On Pratt & Whitney," *Aerospace Daily & Defense Report*, September 3, 2009, pp. 1-2. See also Marina Malenic and Emelie Rutherford, "GE, Rolls-Royce Look To Align With Acquisition Reformers In Fixed Price Engine Offer," *Defense Daily*, September 3, 2009, p. 6.

<sup>40</sup> Marina Malenic, "Pratt Offers To Trim F135 Costs," *Defense Daily*, September 16, 2009, p. 1.

<sup>41</sup> GE/Rolls Royce press release, "GE and Rolls-Royce Propose Fixed Price Offer for F-35 Joint Strike Fighter Engine to Significantly Drive Down Costs," press release, April 27, 2010.

<sup>42</sup> "No Means No," *Aerospace Daily & Defense Report*, August 24, 2009, p. 1.

<sup>43</sup> Memorandum of Understanding among the Department of Defence of Australia and the Minister of National Defence of Canada and the Ministry of Defence of Denmark and the Ministry of Defence of the Republic of Italy and the State Secretary of Defence of the Kingdom of the Netherlands and the Ministry of Defence of the Kingdom of Norway and the Undersecretariat for Defense Industries on behalf of the Ministry of National Defense of the Republic (continued...)

In response to a question from CRS on whether this MOU has been superseded or changed, the Air Force states:

The Joint Strike Fighter (JSF) System Development and Demonstration (SDD) Memorandum of Understanding (MOU) scope of work includes development of JSF primary and alternate propulsion systems which—consistent with the provisions used in all Department of Defense development, acquisition, and support MOUs—is ultimately subject to the availability of U.S. and partner nation funds for such purposes. The PSFD MOU provision (para 3.2.1.1.) regarding cooperative production and procurement of F135 and F136 remains valid. The Department will continue to implement both its JSF SDD and PSFD MOU obligations subject to availability of U.S. and partner funds. We have engaged in consultations with our partners on the Administration’s decision not to include F136 in its RDT&E funding requests.... We do not plan to amend either the JSF SDD MOU or PSFD MOU regardless of the outcome of the U.S. FY10 authorization and appropriation process.<sup>44</sup>

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.<sup>45</sup> A member of the UK House of Commons reportedly stated in 2006 that a DOD decision to end the F136 would “invariably affect future procurement decisions, with seriously negative consequences that may not be fully appreciated on this side of the Atlantic.” He reportedly stated that “without doubt, cancellation of the program would play into the hands of those in Europe who are even now all too willing to suggest the U.S. cannot be relied on and that Britain should look instead to France and European institutions on defense.”<sup>46</sup>

Other European countries, such as the Netherlands, are home to firms that participate in both the F135 and F136 programs.<sup>47</sup> As European companies secure more F-35-related contracts, the position of each partner nation on the need for the second engine might evolve depending on their economic interest in each engine.

## Engine Development Issues

Both JSF engines have experienced development challenges typical of new engine programs, including failures during ground testing.

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(...continued)

of Turkey and the Secretary of State for Defence of the United Kingdom of Great Britain and Northern Ireland and the Secretary of Defense on behalf of the Department of Defense of the United States of America Concerning the Production, Sustainment, and Follow-on Development of the Joint Strike Fighter (Short Title—JSF PSFD MOU), p. 16. The MOU was provided to CRS on September 17, 2009, by the Air Force legislative affairs office.

<sup>44</sup> Untitled information paper on JSF PSFD MOU provided to CRS by Air Force legislative liaison office, September 21, 2009.

<sup>45</sup> 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.

<sup>46</sup> Rodney L. Pringle, “JSF Engine Rumbblings,” *Military Aerospace Technology*, October 8, 2006.

<sup>47</sup> Joris Janssen Lok, “Double Dutch; Pratt, Rolls Involve More Dutch Partners in F135, F136 Programs,” *Aviation Week & Space Technology*, February 11, 2008. On May 20, 2010, the Dutch parliament nonetheless voted to withdraw from the F-35 program. The withdrawal is not yet binding. Christina Mackenzie, “Dutch Cancel Order for F-35 JSF,” *Aviation Week/Ares blog*, May 21, 2010.

## Testing Incidents

On August 30, 2007, and February 4, 2008, the F135 engine experienced failures during ground testing. The JSF Joint Program Office stated that the engine failures in both cases were due to “high-cycle fatigue” resulting in the failure of a turbine blade.<sup>48</sup> A Navy official testified in 2008 that the second engine failure was as a result of ongoing testing to determine the causes of the first failure. DOD officials stated that these engine malfunctions delayed the expected first flight of the F-35B aircraft by a month or two. The engine failures and resulting delays may have contributed to a reported cost overrun of up to \$850 million in the F135 program.<sup>49</sup>

An F135 was damaged in a test on September 11, 2009. Pratt & Whitney attributed the damage to a worn bushing that led to damage to the tips of some fan blades.<sup>50</sup> The company said the damage occurred to a second generation of the engine, not the version on current flight-test aircraft, and that a “minor modification” would be incorporated immediately in all initial service release (ISR) production engines “with little or no impact on cost and schedule.”<sup>51</sup>

The F136 has encountered two test incidents. In September 2009, an F136 was reported to have ingested a test sensor, causing minor damage.<sup>52</sup> On October 2, 2009, impact damage was found on a number of blades in the high- and low-pressure turbines.<sup>53</sup> Investigation revealed that a nut had come loose and been ingested into the engine, leading to a minor redesign to better secure the nut.<sup>54</sup>

## Reported F135 Quality-Control Issues

In July 2009, then-JSF program manager Marine Corps Brigadier General David Heinz criticized Pratt & Whitney for quality control deficiencies reported to have led to the 24% growth in F135 costs. “There are portions of articles that I am building today that I throw away one for every one I build because the scrap and rework rate has not come up to a lean manufacturing process.... I believe, even at this point, that [the yield] should be eighty percent—where I’m scrapping one in five [parts] as opposed to one of every two.”<sup>55</sup>

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<sup>48</sup> Jason Simpson, “Davis: JSF Program Office Anticipated Early-Stage Engine Problems,” *Inside the Air Force*, February 15, 2008.

<sup>49</sup> Tony Capaccio, “United Technologies F-35 Engine Over Cost Estimate,” *Bloomberg.com*, July 21, 2008.

<sup>50</sup> Graham Warwick, “Pratt Identifies Probable Cause Of F135 Failure,” *Aerospace Daily & Defense Report*, September 21, 2009, p. 3.

<sup>51</sup> Graham Warwick, “F135 Engine Damaged In Ground Tests,” *Aerospace Daily & Defense Report*, September 15, 2009. A very similar version of this article was published on September 14, 2009, as Graham Warwick, “F135 Engine Damaged In Ground Tests,” *AviationWeek.com*, September 14, 2009.

<sup>52</sup> Guy Norris, “Alternate JSF Engine Team Puts Pressure On Pratt & Whitney,” *Aerospace Daily & Defense Report*, September 3, 2009, pp. 1-2. See also Marina Malenic and Emelie Rutherford, “GE, Rolls-Royce Look To Align With Acquisition Reformers In Fixed Price Engine Offer,” *Defense Daily*, September 3, 2009, p. 6.

<sup>53</sup> Jason Simpson, “F136 Engine Sustains Impact Damage in Test, Possible Cause IDed (Updated),” *InsideDefense.com (DefenseAlert—Daily News)*, October 8, 2009. Other press reports on the same incident include Graham Warwick, “Damage Discovery Halts F136 Engine Testing,” *Aerospace Daily & Defense Report*, October 9, 2009, p. 3, and Marina Malenic, “F136 Engine Testing Suspended After Discovery of ‘Dings and Nicks,’” *Defense Daily*, October 9, 2009, p. 1.

<sup>54</sup> Andrea Shalal-Esa, “GE, Rolls To Redesign Part Of F-35 Engine,” *Reuters.com*, November 2, 2009.

<sup>55</sup> Marina Malenic, “Heinz Raps Pratt On F-35 Engine Manufacturing Practices,” *Defense Daily*, July 29, 2009, p. 3. Material in brackets as in original.



Pratt & Whitney responded that only a few parts had a high scrap rate. “In the case of a couple of parts ... we’re at 70 to 80 percent [yield] rate, which at this point in the program is exactly where we should be,” William Begert, the vice president of business development said. “Overall, we’re doing very well on scrap rate ... we’re running 97 percent for the total engine. So to say that we have a 50 percent scrap rate ... is grossly inaccurate. It’s just not true.”<sup>56</sup>

## **FY2011 Legislative Actions**

### **FY2011 Defense Authorization Act (H.R. 5136)**

As reported by the House Armed Services Committee on May 19, 2010, H.R. 5136 included \$485 million for development of an alternate F-35 engine. The bill also included language that would prevent DOD from spending more than 75% of its F-35 budget until all alternate engine funds had been obligated.<sup>57</sup> The language states:

**SEC. 212. LIMITATION ON OBLIGATION OF FUNDS FOR F-35 LIGHTNING II AIRCRAFT PROGRAM.**

Of the amounts authorized to be appropriated by this Act or otherwise made available for fiscal year 2011 for research, development, test, and evaluation for the F-35 Lightning II aircraft program, not more than 75 percent may be obligated until the date that is 15 days after 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 2011 for the continued development and procurement of a competitive propulsion system for the F-35 Lightning II aircraft have been obligated.

The bill as reported also includes obligation of alternate engine funds as one of the criteria required before DOD can acquire more than 30 F-35 aircraft. In pertinent part:

**SEC. 141. LIMITATION ON PROCUREMENT OF F-35 LIGHTNING II AIRCRAFT.**

(a) **LIMITATION.**—Except as provided in subsection (c), of the amounts authorized to be appropriated by this Act or otherwise made available for fiscal year 2011 for aircraft procurement, Air Force, and aircraft procurement, Navy, for F-35 Lightning II aircraft, not more than an amount necessary for the procurement of 30 such aircraft may be obligated or expended unless—

(1) the certifications under subsection (b) are received by the congressional defense committees on or before January 15, 2011; and (2) a period of 15 days has elapsed after the date of such receipt.

**CERTIFICATIONS.**—Not later than January 15, 2011—

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<sup>56</sup> Marcus Weisgerber, “Pratt & Whitney: Allegations About F135 Engine Scrap Rates ‘Not True’ (Updated), *Inside the Air Force*, August 7, 2009.

<sup>57</sup> H.R. 5136, National Defense Authorization Act for Fiscal Year 2011, as passed by the House Armed Services Committee on May 19, 2010.

(1) the Under Secretary of Defense for Acquisition, Technology, and Logistics shall certify in writing to the congressional defense committees that—

...(F) advance procurement funds appropriated for the advance procurement of F136 engines for fiscal years 2009 and 2010 have either been obligated or the Secretary of Defense has submitted a reprogramming action to the congressional defense committees that would reprogram such funds to meet other F136 development requirements; and

...(E) six F136 engines have been made available for testing; and

(F) not less than 1,000 test hours have been completed in the F136 system development and demonstration program.

H.R. 5136 would also require the Secretary of Defense to include alternate engine funding in DOD's annual budget submission:

SEC. 213. 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 AIRCRAFT.

(a) ANNUAL BUDGET.—Chapter 9 of title 10, United States Code, is amended by adding at the end the following new section:

“§ 236. Budgeting for competitive propulsion system for F-35 Lightning II aircraft

“(a) ANNUAL BUDGET.—Effective for the budget for fiscal year 2012 and each fiscal year thereafter, the Secretary of Defense shall include in the defense budget materials 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 aircraft.

“(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 aircraft, 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 aircraft.

“(c) REQUIREMENT TO OBLIGATE AND EXPEND FUNDS.—Of the amounts authorized to be appropriated for fiscal year 2011 or any fiscal year thereafter, for research, development, test, and evaluation and procurement for the F-35 Lightning II aircraft 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 aircraft in order to ensure the development and competitive production for the propulsion system for such aircraft.

“(d) DEFINITIONS.—In this section:

“(1) The term ‘budget’, with respect to a fiscal year, means the budget for that fiscal year that is submitted to Congress by the President under section 1105(a) of title 31.

“(2) The term ‘defense budget materials’, with respect to a fiscal year, means the materials submitted to Congress by the Secretary of Defense in support of the budget for that fiscal year.”.

(b) CLERICAL AMENDMENT.—The table of sections at the beginning of such chapter is amended by at the end the following new item:

“236. Budgeting for competitive propulsion system for F–35 Lightning II aircraft.”.

(c) CONFORMING REPEAL.—Section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110–181) is repealed.

## **Issues for Congress**

Because the administration’s FY2011 budget again proposes terminating the alternate engine program, a fundamental issue for Congress is whether to continue the program or accept program termination. If the alternate engine program is continued, subsidiary questions include (but are not limited to) the following:

### **How the Alternate Engine Program Should be Funded**

Congressional appropriations have drawn on various sources of funds to support the alternate engine program. Some money came from existing F-35 program funds, and some from adding funds from within the DOD topline. Although the topline was increased in each year, it is not clear what portion of the increases were dedicated to the alternate engine program.

The source of funds has a direct effect on other DOD programs. If alternate engine funds are allocated within the existing F-35 budget lines, other F-35 activities may be curtailed in favor of the alternate engine program. For example, “[f]orcing the program to fund development of the General Electric/Rolls-Royce F136 from within the existing JSF budget would ‘take 50-80 tails out of the program’ over the next five years, says [then] program executive officer (PEO), Marine Corps Brig. Gen. David Heinz.”<sup>58</sup>

Similarly, increasing the F-35 program topline to account for the effects of increased alternate engine funding, without concomitantly increasing the DOD topline, could force the transfer of funds from other defense programs to F-35.

Congress may face a choice of whether the alternate engine program should be continued if doing so means reducing in the number of F-35s procured (either overall or in a given year); incurring other delays in the program; or reducing other defense capabilities to pay for it.

### **Credibility of Cost Estimates Showing Little Difference Between the Cost of One Engine Program and the Cost of Two**

As noted earlier, press accounts stated that DOD’s Joint Assessment Team found that fielding and support of two F-35 engines would cost about the same as just one, due in part to the effect of congressionally directed appropriations over the past four years. A February 2010 letter from DOD’s Director of Cost Assessment and Program Evaluation cited the need for an additional

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<sup>58</sup> Graham Warwick and Guy Norris, “Second Engine Could Cut F-35 Production,” *AviationWeek.com*, May 29, 2009.

“\$2.9 billion (TY\$) over the next six years” to develop the F136 to the point where competition would be possible.<sup>59</sup> CRS cannot provide further insight pending access to the report itself.

It may be useful to note that two very different costs are being discussed here: the up-front cost of developing the F136, which can have consequences in the current budget year, and the lifetime cost. Supporters of the F136 refer to GAO’s study showing that the up-front cost of developing the F136 may be balanced over the life of the program by savings from competition, a point on which point the CAIG and IDA studies disagreed. Assumptions regarding the effects of competition on cost are key to these analyses. Congress may have to choose which assumptions it believes.

## **Controls to Curb Cost Growth Absent Competition**

Competition is cited by GAO and advocates of alternate engine procurement as providing an inherent check on cost growth in either competitor’s product. Absent competition, DOD (and other government agencies) negotiate contracts based on experience with similar products to establish prices. Those contracts take different forms, but generally include incentives for the contractor to achieve certain cost targets and penalties for missing them.

## **Importance of the Potential Fleet-Grounding Issue Attributed to Procuring a Single Engine**

Congress may consider whether the fleet-grounding risk of a single engine type for F-35 represents a greater risk than is already accepted with other aircraft fleets, and whether the risk is sufficient to justify procurement of a second engine.

Those supporting an alternate engine note that F-35s are to constitute the majority of future U.S. fighters, and that using a single type of engine creates a risk of all F-35s being grounded in the event of a problem with that engine. The Marine Corps grounded 106 AV-8B Harriers in July 2000 after a faulty engine bearing was cited as the cause of a crash.<sup>60</sup> About 18% of Navy groundings from 1997 to 2006 were due to engine issues.<sup>61</sup> The Air Force stood down two fleets due to engine issues between 1990 and 2006.<sup>62</sup>

DOD officials argue that terminating the F136 alternate engine program poses little operational risk. Past decisions to pursue alternate engines for Air Force F-15s and F-16s and Navy F-14s, they state, were made at a time when the services were dissatisfied with the performance of existing engines (the F100 and TF30). DOD argues that these same conditions do not exist today.

In a briefing provided to Congress in 2006, DOD’s Office of Program Analysis and Evaluation (PA&E) stated the F135 engine was performing well. PA&E stated that the F-22’s F119 engine,

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<sup>59</sup> Christine Fox, “Information memorandum: Update of Joint Strike Fighter (JSF) Alternate Engine Cost/Benefit Analysis,” undated. Press reports and CRS sources indicate that the letter was received by the Congressional defense committees in February, 2010.

<sup>60</sup> Mark Oliva, “Pilots defend Harrier jet.” *Stars and Stripes*. (Pacific Edition), January 19, 2003.

<sup>61</sup> 66% were due to airframe-related issues. (“JSF Engine Second Source Executive Summary,” Whitney, Bradley, and Brown Consulting; December 2006, Slide 23.)

<sup>62</sup> Ibid. As noted above, during the same period the Air Force grounded the entire F-15 fleet due to airframe issues.

from which the F135 was derived, had performed well over roughly 18,000 flight hours. The briefing also noted that the F-22 and the F/A-18E/F each use a single, sole-sourced engine.<sup>63</sup> Skeptics might argue that 18,000 hours of operation—of which few are on the actual F135—is a relatively a modest foundation for making projections of the F119’s future performance, compared to the 2 million hours of operational service that had accumulated on the F100 engine by 1984, when the decision was made to divide F-16 engine production contracts between the F100 and F110.

DOD argues that advances such as computational fluid design for airflow prediction and advanced software for prognostic health monitoring reduce the operational risks of relying on a single engine type for an aircraft.<sup>64</sup> They argue that the advanced software will result in engines that can diagnose their own condition and notify the pilot of impending failure (as opposed to notifying pilots of a failure once it has occurred). Advanced warning of impending failures could give a pilot time to land prior to failure, and allow more efficient and cost-effective maintenance procedures.

## **The Operational and Logistical Impacts of Supporting Two Engines**

Even if the costs of supporting two engines are the same as supporting one, operational and logistical issues may complicate the use of multiple engines. The Navy, for example, has limited facilities to support multiple engines. As noted earlier, Chief of Naval Operations Admiral Gary Roughead was quoted in a press report as saying, “I’m in the one engine camp... On a carrier, space matters.”<sup>65</sup>

This was implicitly recognized by Air Force Chief of Staff Norton Schwartz in testimony before the House Armed Services Committee when he said, “[A] concern that I have is the reality that the alternate engine is not for anybody else but the Air Force. The Navy isn’t going to operate an alternate engine aboard ships. The European partners are not going to operate two engines. You’re talking about focusing this on your Air Force, which is problematic in my view.”<sup>66</sup> Nonetheless, the Air Force has considerable experience supporting multiple engine types for single-airframe fleets, having done so with the F-16 and F-15 for over 20 years.

Congress may be faced with the choice of whether to direct multiple engines for one service or the entire F-35 buy.

## **Impacts on the Military Turbine Industrial Base of Procuring One Engine Rather than Two**

Since Pratt & Whitney and General Electric are the only two U.S. manufacturers of fighter aircraft engines, a potential issue for policy makers is what effect terminating the F136 engine

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<sup>63</sup> “JSF Alternate Engine Decision” briefing. OSD/PA&E. February 27, 2006.

<sup>64</sup> Ibid.

<sup>65</sup> Graham Warwick, “Navy Backs Single JSF Engine As F-35C Rolls Out,” *Aerospace Daily & Defense Report*, July 29, 2009, pp. 1-2. See also, Antonie Boessenkool, “Pratt & Whitney’s Costs Parts-Reject Rate Too High: JSF Official,” *Defense News*, August 3, 2009.

<sup>66</sup> Transcript of House Armed Services Committee hearing on Fiscal 2011 budget request for the Department of the Air Force, February 23, 2010.

might have on General Electric's ability to compete for future fighter aircraft engines, assuming domestically owned and sourced competition is desirable.<sup>67</sup> "The engine debate is complex, but it boils down to whether the Pentagon should pay GE up to \$3 billion to compete with Pratt," stated a USA Today editorial.<sup>68</sup>

General Electric has a significant share of the market for commercial aircraft engines. It also builds and maintains F400 series engines for the Navy and Marine Corps F/A-18E/F strike fighters and EA-18G electric attack aircraft, and supports the F110 series of engines for domestic and international clients. The CAIG and IDA studies of 2007 noted General Electric's strong position in the commercial engine market. The CAIG study stated that General Electric produced 1,000 commercial engines in 2007, while Pratt & Whitney produced 220 commercial engines.<sup>69</sup> The CAIG study noted that General Electric derives about 15% of its business from military engines, while Pratt & Whitney derives about 50% of its business from military engines.<sup>70</sup>

A key question is how sufficient General Electric's work on engines other than the F136 (including the F400 and F110 series military engines) would be for preserving General Electric's ability to design and produce fighter engines if the F136 program were terminated. The CAIG study of 2007 stated that about 200 General Electric military jet engineers would be unable to transfer their skills to General Electric's commercial engines if the F136 engine were terminated, potentially reducing GE's ability to compete for future military engine contracts.

Ending the F136 program might lead to a reduction in the number of suppliers for F-35 engine spare parts, potentially increasing the vulnerability of the F-35 engine spare parts supply chain to disruptions caused by labor disagreements or natural disasters. Alternatively, maintaining a competition between the F135 and F136 for the production of F-35 engines could reduce the workload for individual F135 suppliers and create uncertainty for both F135 and F136 suppliers regarding annual business volumes. One defense consulting firm stated in 2006 that approximately 50% of each engine is procured in a competitive environment today, suggesting that multiple vendors could create parts for each of the engines.<sup>71</sup> The IDA study of 2007 examined the top F136 component suppliers and concluded that it is "unlikely that any supplier would exit the domestic industrial base because of F136 termination."<sup>72</sup>

Although the IDA study of 2007 concluded that the U.S. industrial base may not be "irreparably harmed" if the F136 engine is terminated, the study expressed reservations about DOD placing all of its fighter engine production with a firm that has a weak position in the commercial marketplace, because a firm with a relatively small presence in the commercial marketplace would have fewer resources that could be leveraged for use on DOD products.<sup>73</sup> As mentioned earlier, the IDA study of 2007 examined the top F136 component suppliers and concluded that it is "unlikely that any supplier would exit the domestic industrial base because of F136

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<sup>67</sup> Rolls-Royce is a co-developer of the F136, but does not currently supply its own engines for any U.S. fighter.

<sup>68</sup> "Our view on defense spending: It's time to put a hold on the Pentagon's blank check," *USA Today*, May 21, 2010.

<sup>69</sup> OSD Cost Analysis Improvement Group Report (v6), "F-35/JSF Alternate Engine Acquisition and Independent Cost Analyses," March 15, 2007, Slide 44.

<sup>70</sup> *Ibid.*, Slide 44.

<sup>71</sup> *Ibid.*, Slide 22. Note: See <http://www.wbbinc.com> on Whitney, Bradley, and Brown, their corporate profile, and their clients.

<sup>72</sup> IDA JSF Final Report, p. 165.

<sup>73</sup> *Ibid.*, p. 169.

termination.”<sup>74</sup> The IDA study concluded that, overall, the U.S. industrial base would be stronger as a result of an active F136 program.

Some of those who participated in or studied the Great Engine War argue that the competition between General Electric and Pratt & Whitney made Pratt & Whitney and General Electric better and “proved invaluable to future engine development.”<sup>75</sup>

Congress may consider whether such industrial policy implications add a non-monetary value to the choice of one or two engines, and an appropriate financial cost to achieve the benefits of competition.

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<sup>74</sup> Ibid., p. 165.

<sup>75</sup> Maj. John Nix and Maj. Riley Shelnett, “Behind the Alternate Fighter Engine Competition,” *Aerospace America*, May 1984.

## **Appendix A. Prior-Year Legislative Activity**

This appendix presents details from the legislative history of the F-35 alternate engine program for the period FY1996-FY2010. The appendix focuses on presenting final bill language and committee and conference report language. It omits bill language in House- or Senate-reported versions of bills, as well as numerous instances in which committee or conference reports recommended additional funding for the F-35 alternate engine program but did not otherwise discuss the program in report language. The F-35 program was known in FY1996 and FY1997 as the Joint Advanced Strike Technology (JAST) program.

### **FY1996**

#### **Defense Authorization Act (S. 1124/P.L. 104-106 of February 10, 1996)**

Section 213 of S. 1124/P.L. 104-106 authorized funds for the JAST program, required DOD to submit a report on the JAST program, and limited the obligation of JAST program funds until 30 days after the report is submitted. Subsection (b)(2) of Section 213 stated that \$7 million of the research and development funding authorized in the act “shall be available to provide for competitive engine concepts” for the JAST program. Subsection (d) required a report on requirements for the JAST program and other combat aircraft, and on certain planning assumptions that affect those requirements.

The conference report (H.Rept. 104-450 of January 22, 1996) on S. 1124 discussed Section 213 on pages 705-707, stating in part:

The Senate report (S.Rept. 104-112) questioned whether the program could fulfill the needs of the three services, and directed the Department to include two separate approaches in the JAST program to reduce program risk. The Senate amendment directed the Secretary of the Navy to:...

(2) evaluate at least two propulsion concepts from competing engine companies as part of those demonstrations....

The conferees share the concerns expressed in the Senate report (S.Rept. 104-112) regarding the lack of engine competition and the size of flying prototypes. The conferees direct the Under Secretary of Defense (Acquisition & Technology) (USD (A&T)) to ensure that: (1) the Department’s JAST program plan provides for adequate engine competition in the program; and (2) the scale of the proposed demonstrator aircraft is consistent with both adequately demonstrating JAST concepts and lowering the risk of entering engineering and manufacturing development (EMD). The conferees direct the Secretary of Defense to include in the report required by section 213(d) the Department’s plan for competitive engine programs and demonstrator aircraft.

The conferees recommend authorization of funds reflecting these changes, and agree to a provision (sec. 213) that would:...

(4) authorize \$7.0 million for competitive engine concepts.



The Senate Armed Services Committee report (S.Rept. 104-112 of July 12, 1995) on S. 1026, an earlier version of the FY1996 defense authorization bill, discussed the JAST program on pages 95-97, stating in part:

Further, the committee believes supporting competitive propulsion programs would help reduce risk and lead to higher confidence of achieving more affordable life cycle costs. The committee fears that the current JAST approach may lead to selecting one power plant manufacturer prematurely. Therefore, the committee directs the Secretary to evaluate at least two propulsion concepts from competing engine companies as part of the full scale, full thrust aircraft demonstrators. (Page 96)

### **DOD Appropriations Act (H.R. 2126/P.L. 104-61 of December 1, 1995)**

The House Appropriations Committee report (H.Rept. 104-208 of July 27, 1995) on H.R. 2126 discussed the JAST program on page 150, stating in part:

The history of recent fighter engine propulsion plants demonstrates that development of new engines is difficult. The Navy has generally been dissatisfied with the engine performance of early model F-14s, and it eventually upgraded later model F-14s with an Air Force engine. The Air Force in the late 1970s and early 1980s was dissatisfied with both the performance and cost of engines on early models of the F-15 and the F-16, and it spent over a billion dollars to bring a second engine manufacturer into a position where competition could be conducted between two companies for future Air Force fighter aircraft. The new engine for the F-22 has suffered technical problems and is undergoing a redesign.

The Joint Advanced Strike Technology (JAST) program envisions building a common aircraft to satisfy the needs of the Air Force, Navy and Marine Corps for fighter aircraft in the next century. Yet, it has selected a single power plant design, a derivative of the F-22 engine which has yet to be proven. Given the engine performance difficulties experienced over the last two decades, this is unwise. To cede the manufacture of all jet engines for three services' future aircraft without any additional competition is not likely to be cost effective. For these reasons, the Committee believes it is imperative for the JAST program to actively pursue an engine design from a second manufacturer and has provided an additional \$20,000,000 only for this purpose.

## **FY1997**

### **Defense Authorization Act (H.R. 3230/P.L. 104-201 of September 23, 1996)**

The Senate Armed Services Committee report (S.Rept. 104-267 of May 13, 1996) on S. 1745, the companion bill to H.R. 3230, discussed the JAST program on page 181, stating in part:

The committee is persuaded that the benefits of engine competition will outweigh any near-term investment. Accordingly, the committee directs that remaining competition funds be rebaselined to guarantee integration into the preferred weapons system concept at the earliest practical point.

## **DOD Appropriation Act (H.R. 3610/P.L. 104-208 of September 30, 1996)**

H.R. 3610/P.L. 104-208 was an omnibus appropriations act that included the DOD appropriations act. The House Appropriations Committee report (H.Rept. 104-617 of June 11, 1996) on H.R. 3610 discussed the JAST program on page 151, stating in part:

The Committee recommends \$602,100,000, an increase of \$13,000,000 in the Navy account only to accelerate development of an alternate engine in order to have it available at the beginning of the engineering and manufacturing development phase of the program. This increase should be part of a program to develop a demonstrator engine and integrate it into the selected weapon systems contractor concepts.

## **FY1998**

### **Defense Authorization Act (H.R. 1119/P.L. 105-85 of November 18, 1997)**

Section 213 of H.R. 1119/P.L. 105-85 states in part:

#### **SEC. 213. JOINT STRIKE FIGHTER PROGRAM.**

(a) REPORT.—Not later than February 15, 1998, the Secretary of Defense shall submit to the congressional defense committees a report on the options for the sequence in which the variants of the joint strike fighter are to be produced and fielded.

(b) CONTENT OF REPORT.—The report shall contain the following:...

(4) A certification that the Joint Strike Fighter Program contains sufficient funding to carry out an alternate engine development program that includes flight qualification of an alternate engine in a joint strike fighter airframe....

The House Armed Services Committee report (H.Rept. 105-132 of June 16, 1997) on H.R. 1119 discussed the JSF program on pages 189-190, 212, and 243. The discussion on pages 189-190 states in part:

The committee is also concerned that the 1997 FYDP does not reflect adequate funding within the JSF program to continue development of the alternative fighter engine (AFE) beyond the current demonstration/validation phase. The committee continues to believe that a fully developed and flight tested AFE is essential to reduce risk to the JSF program and to provide credible competition necessary for controlling program cost. Therefore, the committee directs the Secretary of Defense to provide a report to the Congressional defense committees no later than February 15, 1998, detailing the level of funding within the JSF program that is identified to fund full development and flight test of the AFE.

The Senate Armed Services Committee report (S.Rept. 105-29 of June 17, 1997) on S. 924, the companion bill to H.R. 1119, discussed the JSF program on pages 119-120, stating in part:

The budget request included funds for the continuation of a program to establish an alternative engine for the joint strike fighter, but omitted funds for fiscal year 1998. The committee is persuaded that there is a need for an alternative engine for the JSF, but expects the Department to program sufficient funds in the future years for a robust, accelerated profile. Accordingly, the committee recommends an increase in the budget request of \$28.0

million to accelerate the alternative engine program, with the understanding that the Department will provide for the accelerated program in fiscal year 1999 and beyond.

## **FY1999**

### **Defense Authorization Act (H.R. 3616/P.L. 105-261 of October 17, 1998)**

The Senate Armed Services Committee report (S.Rept. 105-189 of May 11, 1998) on S. 2060, the companion bill to H.R. 3616, discussed the JSF program on pages 168-169, stating in part:

Section 213 of the National Defense Authorization Act for Fiscal Year 1998 (Public Law 105-85) required a report on the order of fielding the variants of the JSF, and that specifically addressed the acceleration of the naval variant. The report included a certification that the JSF program contains sufficient funding to carry out an alternate engine program that includes flight qualification of an alternate engine in a JSF airframe.

While not in total agreement with the report, the committee notes the timely submission and clear presentation of the Department of Defense priorities and plans. The certification of a funded program for an alternate engine is a positive commitment to cost-effective program management. However, the actual demonstration of the alternate engine in a JSF airframe has been continuously shifted to the “out years,” an action that threatens to invalidate the whole initiative. If the alternate engine is not completed for use for the most stressing of the JSF requirements (the short takeoff/vertical landing variant), then it may be too late to provide a major benefit to the program. Accordingly, the committee recommends an increase of \$15.0 million to the budget request to accelerate the development of an alternative engine for the JSF.

## **FY2000**

### **Defense Authorization Act (S. 1059/P.L. 106-65 of October 5, 1999)**

The House Armed Services Committee report (H.Rept. 106-162 of May 24, 1999) on H.R. 1401, the companion bill to S. 1059, discussed the JSF program on pages 236-237, stating in part:

The committee continues its strong support for the development of an alternate engine to ensure sustainment of critical industrial base capabilities, control of engine cost growth, and reduction of risk to the reliability and maintainability of the planned fleet of 3,000 JSF aircraft. The committee is concerned that while the Department now states a commitment to development of an alternative engine for JSF, the planned funding levels outlined to support that commitment do not enable cost-efficient and timely completion of the effort.

Meanwhile, the Department is also conducting other jet engine development efforts in PE 27268F as part of the aircraft engine CIP. The committee notes that requested funding for this level of effort program has increased by \$66.6 million, over 40 percent, from the level projected for fiscal year 2000 just last year. The justification for the requested increase is to reduce backlog of proposed engineering tasks for currently fielded engines. While supportive of the CIP, the committee does not consider the proposed increase to this program to be of higher priority than development of a new state-of-the-art alternative engine for JSF. The committee notes that full development of a flight qualified jet engine also provides opportunities to migrate proven new technologies to existing engines.

Therefore, the committee recommends \$130.2 million in PE 27268F, a decrease of \$30.0 million, and \$265.4 million in PE 63800F, an increase of \$30.0 million, and directs that this increase in JSF funding be used only for acceleration of alternate engine development.

The Senate Armed Services Committee report (S.Rept. 106-50 of May 17 [legislative day May 14], 1999) on S. 1059 discussed the JSF program on page 204, stating in part:

The budget request included \$476.6 million (\$241.2 million in Navy research and development and \$235.4 million in Air Force research and development) for continued development of the joint strike fighter (JSF). Within that total, \$33.0 million is included for the alternate engine program. The committee remains concerned that development of an alternate engine for the JSF will not proceed to a point where it represents a viable alternative and reduces risk for the vertical and short take off and landing (V/STOL) JSF variant. The committee recommends an additional \$15.0 million in PE 63800F to reduce risk and accelerate development of the alternate engine, a total Air Force authorization of \$250.4 million.

## **FY2001**

### **Defense Authorization Act (H.R. 4205/P.L. 106-398 of October 30, 2000)<sup>76</sup>**

The conference report (H.Rept. 106-945 of October 6, 2000) on H.R. 4205 discussed the JSF program on pages 677-678, stating in part:

The conferees are also concerned about the apparent pattern of additional contractor funding required to sustain the current DEMVAL activities of the program. Since the JSF program is potentially one of the largest acquisition programs in the Department of Defense, both competing contractors in this winner-take-all competition realize the significance of winner selection. However, the conferees are opposed to the requirement for industry to make additional, unreimbursed investments in the JSF program beyond existing contractual agreements. The conferees view the additional DEMVAL funding as necessary to provide for the execution of those projects presented in the budget request on the extended schedule. The conferees expect that risk mitigation projects, including the alternate engine, will be funded to the levels presented in the budget request.

The House Armed Services Committee report (H.Rept. 106-616 of May 12, 2000) on H.R. 4205 discussed the JSF program on pages 252-253, stating in part:

Additionally, while the Department is currently reviewing the planned JSF “winner take all” strategy to ensure that aircraft industrial base concerns are addressed, the committee notes that no specific concern has been stated with respect to the future stability of the fighter aircraft engine industrial base. The committee supports continuation of the JSF alternate engine program (AEP) as directed in section 211 [sic: 213] of the National Defense Authorization Act for Fiscal Year 1998 (P.L. 105–85) and recommends that the Department specifically address measures to ensure the health of the fighter aircraft engine industrial base in any proposed restructure of the acquisition program for JSF.

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<sup>76</sup> H.R. 5408, the FY2001 defense authorization act, is incorporated in H.Rept. 106-945, the conference report on H.R. 4205. The text of H.R. 5408 is included in the conference report.

The committee also notes that the JSF AEP, as currently funded, will not be capable of completing development and flight qualification of the alternate engine until after award of lot five of the JSF production program. In order to reduce risk to JSF production and aircraft fielding, the Committee supports acceleration of AEP development to ensure that the alternative engine completes configuration compatibility for the JSF airframe.

The committee recommends \$299.5 million in PE 64800F, \$131.6 million in PE 63800N, and \$296.0 million in PE 64800N, the requested amounts. The committee also recommends \$144.5 million in PE 63800F, an increase of \$15.0 million, to accelerate the JSF AEP.

### **DOD Appropriations Act (H.R. 4576/P.L. 106-259 of August 9, 2000)**

The Senate Appropriations Committee report (S.Rept. 106-298 of May 18, 2000) on S. 2593, the companion bill to H.R. 4576, discussed the JSF program on pages 116-177, stating in part:

The Committee also continues to support the Alternate Engine Program (AEP) for JSF and expects that the recommended changes in overall JSF funding will not impact the current AEP schedule and that no funds will be diverted from the existing AEP plan.

### **FY2002**

### **Defense Authorization Act (S. 1438/P.L. 107-107 of December 28, 2001)**

The conference report (H.Rept. 107-333 of December 12, 2001) on S. 1438 discusses the JSF program on page 574, stating in part:

The conferees remain concerned about the technical risks associated with the JSF aircraft engine and expect the Department to develop and integrate the JSF alternate engine within the EMD program. The conferees believe that the Department should execute the alternate engine program with a goal of having that engine integrated into the JSF prior to full rate production.

The House Armed Services Committee report (H.Rept. 107-194 of September 4, 2001) on H.R. 2586, the companion bill to S. 1438, discussed the JSF alternate engine program on page 220, stating:

The budget request contained \$769.5 million in PE 64800F to begin the engineering and manufacturing development phase of the JSF program, but included no funds to reduce development schedule risk of the alternate engine common hardware components.

The JSF program will develop and field a family of aircraft that meets the needs of the Navy, Air Force, Marine Corps, and allies with commonality among the variants to minimize life cycle costs. The committee notes that the JSF joint program office (JPO) has encouraged two engine manufacturers to work together on the co-development of propulsion components which are common to both the JSF's current F-119 engine and the F-120 alternate engine<sup>77</sup> and understands that this effort will develop two interchangeable propulsion systems while preserving the proprietary interests of each manufacturer. The committee also understands

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<sup>77</sup> These were earlier designations for the F135 and F136 engines, respectively. The F135 engine is a derivative of the F119 engine, which is the engine for the F-22 fighter.

that the JPO supports production of the F-120 alternate engine as part of the low-rate initial JSF production scheduled for fiscal year 2009 but believes that increased funding in fiscal year 2002 is required to reduce development schedule risk of the common hardware components.

Accordingly, the committee recommends \$779.5 million in PE 64800F, an increase of \$10.0 million, to reduce development schedule risk of the JSF alternate engine common hardware components.

## **FY2003**

### **DOD Appropriations Act (H.R. 5010/P.L. 107-248 of October 23, 2002)**

The conference report (H.Rept. 107-732 of October 9, 2002) on H.R. 5010 states on page 279:

The conferees have included an additional \$29,750,000 for the Joint Strike Fighter Interchangeable Engine Program only to continue the current effort to develop and maintain two, competing, interchangeable engine programs for the Joint Strike Fighter.

## **FY2004**

### **Defense Authorization Act (H.R. 1588/P.L. 108-136 of November 24, 2003)**

The SENATE ARMED SERVICES COMMITTEE report (S.Rept. 108-46 of May 13, 2003) on S. 1050, the companion bill to H.R. 1588, notes on page 4 the recommendation for \$56 million in additional funding for the JSF program. The report discussed the JSF program on page 185, stating in part:

The committee believes that the interchangeable engine should be made available for competitive procurement as early as possible. The result of a reduction to this program would be to delay the interchangeable engine by at least two years.

Therefore, the committee recommends an increase of \$56.0 million in PE 64800N to continue the F136 interchangeable engine development on its original schedule. The committee believes that the Department of Defense should make the financial adjustments to the Future Years Defense Program that are necessary to restore the original interchangeable engine schedule.

### **DOD Appropriations Act (H.R. 2658/P.L. 108-87 of September 30, 2003)**

The Senate Appropriations Committee report (S.Rept. 108-87 of July 10, 2003) on S. 1382, the companion bill to H.R. 2658 discussed the JSF program on page 157, stating:

The Committee is dismayed that the Joint Strike Fighter program office was permitted to take a reduction for inflation savings disproportionately against the F136 Interchangeable Engine. This cut resulted in a \$56,000,000 reduction to this engine's research and development effort in fiscal year 2004.

The Committee has been supportive of this engine development program for several years and has, in fact, increased funding to accelerate this engine's development. This cut to the program flies in the face of longstanding Committee support.

The Committee, therefore, recommends a total cut of \$56,000,000 to the Joint Strike Fighter program which is to be taken equally from the Navy and the Air Force Joint Strike Fighter programs with the exception of the F136 engine program. The Committee also recommends that the fiscal year 2004 cut to the F136 Interchangeable Engine be restored to the original program with an appropriate adjustment for the inflation cut.

Finally, the Committee has added \$20,000,000 to this program only for risk reduction to the F136 Interchangeable Engine program.

## **FY2005**

### **Defense Authorization Act (H.R. 4200/P.L. 108-375 of October 28, 2004)**

The House Armed Services Committee report (H.Rept. 108-491 of May 14, 2004) on H.R. 4200 discussed the JSF program on page 183, stating in part:

In order to maintain competition for the engine for the JSF, Congress has mandated the funding of an alternate engine program and the JSF Joint Program Office (JPO) is working with the contractor propulsion teams to provide for completely interchangeable engines.

The committee believes that the earliest possible engine production lot competition is beneficial to the JSF program. The committee directs the JSF JPO plan to compete, at the earliest possible date, engine common hardware as well as the turbomachinery, while maintaining PW F135 and GE F136 engine interchangeability.

## **FY2006**

### **Defense Authorization Act (H.R. 1815/P.L. 109-163 of January 6, 2006)**

The House Armed Services Committee report (H.Rept. 109-89 of May 20, 2005) on H.R. 1815 discussed the JSF program on pages 92-93, stating in part:

Additionally, the committee understands that during the preparation of the fiscal year 2006 budget request that there were efforts by some within the military services to eliminate planned budgets for the JSF competitive engine development program. Despite those views, the committee also understands that the Secretary of Defense ensured that the engine program was nominally funded. The committee believes that a two-engine source for the single-engine JSF would be the most cost effective and operationally effective engine solution during the JSF's service life, and therefore expects that the Secretary, along with Department of the Navy and the Department of the Air Force, will remain committed to the development of competitive engines for the JSF.

## **FY2007**

### **Defense Authorization Act (H.R. 5122/P.L. 109-364 of October 17, 2006)**

Section 211 of H.R. 5122/P.L. 109-364 states:

**SEC. 211. ACQUISITION OF, AND INDEPENDENT COST ANALYSES FOR, THE JOINT STRIKE FIGHTER PROPULSION SYSTEM.**

**(a) ACQUISITION.—**

(1) **IN GENERAL.**—The Secretary of Defense shall provide for the development and procurement of the propulsion system for the Joint Strike Fighter aircraft through the continued development and sustainment of two interchangeable propulsion systems for that aircraft by two separate contractors throughout the life cycle of the aircraft.

(2) **MODIFICATIONS PROHIBITED.**—Except as provided by paragraph (3), the Secretary may not carry out any modification to the acquisition program for the Joint Strike Fighter aircraft that would result in the development or procurement of the propulsion system for that aircraft in a manner other than that required by paragraph (1).

(3) **MODIFICATIONS ALLOWED.**—Notwithstanding paragraph (1), a modification described in paragraph (2) may be carried out to the extent that each of the following requirements is met:

(A) The Secretary of Defense has notified the congressional defense committees of the modification.

(B) Each of the reports required by subsection (b) has been submitted.

(C) Funds are appropriated for that purpose pursuant to an authorization of appropriations.

**(b) INDEPENDENT COST ANALYSES.—**

(1) **IN GENERAL.**—A comprehensive and detailed cost analysis of the Joint Strike Fighter engine program shall be independently performed by each of the following:

(A) The Comptroller General.

(B) A federally funded research and development center selected by the Secretary of Defense.

(C) The Secretary of Defense, acting through the Cost Analysis Improvement Group of the Office of the Secretary of Defense.

(2) **MATTERS COVERED.**—Each such cost analysis shall cover—

(A) an alternative under which the Joint Strike Fighter aircraft is capable of using the F135 engine only;

(B) an alternative under which the program executes a one-time firm-fixed price contract for a selected propulsion system for the Joint Strike Fighter aircraft for the life cycle of the aircraft following the Initial Service Release of the propulsion system in fiscal year 2008;



(C) an alternative under which the Joint Strike Fighter aircraft is capable of using either the F135 engine or the F136 engine, and the engine selection is carried out on a competitive basis; and

(D) any other alternative, whether competitive or sole source, that would reduce total life-cycle cost, improve program schedule, or both.

(3) **REPORTS.**—Not later than March 15, 2007, the Secretary of Defense, the Comptroller General, and the chief executive officer of the federally funded research and development center selected under paragraph (1)(B) shall independently submit to the congressional defense committees a report on the cost analysis carried out under paragraph (1). Each such report shall include each of the following matters:

(A) The key assumptions used in carrying out the cost analysis.

(B) The methodology and techniques used in carrying out the cost analysis.

(C) For each alternative required by paragraph (2)—

(i) a comparison of the life-cycle costs, including costs in current and constant dollars and a net-present-value analysis;

(ii) estimates of—

(I) supply, maintenance, and other operations manpower required to support the alternative;

(II) the number of flight hours required to achieve engine maturity and the year in which that is expected to be achieved; and

(III) the total number of engines expected to be procured over the lifetime of the Joint Strike Fighter program; and

(iii) an evaluation of benefits, other than cost, provided by competition, to include an assessment of improved performance, operational readiness and warfighting capability, risk reduction, technology innovation, and contractor responsiveness.

(D) A description of the acquisition strategies (including development and production) that were used for, and experience with respect to cost, schedule, and performance under, past acquisition programs for engines for tactical fighter aircraft, including the F-15, F-16, F-18, and F-22 aircraft.

(E) A comparison of the experiences under past acquisition programs carried out on a sole-source basis with respect to performance, savings, maintainability, reliability, and technical innovation.

(F) The impact that canceling the F136 competitive engine would have on the high-performance military engine industrial base, and on the Department of Defense's ability to make competitive engine choices for future combat aircraft systems beyond the Joint Strike Fighter.

(G) Conclusions and recommendations.

(4) **CERTIFICATIONS.**—In submitting the report required by paragraph (3), the Comptroller General and the chief executive officer of the federally funded research and

development center shall also submit a certification as to whether the Secretary of Defense provided access to sufficient information to enable the Comptroller General or the chief executive officer, as the case may be, to make informed judgments on the matters required to be included in the report.

(c) LIFE-CYCLE COSTS DEFINED.—In this section, the term “lifecycle costs” includes—

(1) those elements of cost that would be considered for a life-cycle cost analysis for a major defense acquisition program, including procurement of engines, procurement of spare engines, and procurement of engine components and parts; and (2) good-faith estimates of routine engine costs (such as performance upgrades and component improvement) that historically have occurred in tactical fighter engine programs.

The House Armed Services Committee report (H.Rept. 109-452 of May 5, 2006) on H.R. 5122 discussed the JSF program on pages 105-106 and 220-221. The discussion on pages 220-221 states in part:

The budget request contained \$2.0 billion in PE 64800F for the Department of the Air Force’s development of the joint strike fighter (JSF), also known as the F-35, but included no funds for research and development of a second aircraft tire source for the JSF and other existing combat aircraft, or for development of an alternate JSF engine. The committee notes that the budget request also includes \$2.0 billion in PE 64800N for the Department of the Navy’s development of JSF....

The JSF alternate engine program is developing the F136 engine which would provide an alternative to the currently-planned F135 engine. In the committee report (H.Rept. 109-89) accompanying the National Defense Authorization Report for Fiscal Year 2006, the committee expressed its belief that a two-engine source for the single-engine JSF would be the most cost effective and operationally effective engine solution during the JSF’s service life, and is disappointed that the budget request did not include funds for development of an alternate JSF engine beyond fiscal year 2006. During a hearing held by the Subcommittee on Tactical Air and Land Forces on March 16, 2006, the Under Secretary of Defense for Acquisition, Technology, and Logistics testified, “While the benefits of a second supplier are undeniable, our judgment is that those benefits are not worth the substantial financial cost of a second supplier.” To confirm those judgments, the committee requested that the Government Accountability Office (GAO) witness at the hearing review and report on the Department of Defense’s analysis that resulted in the judgment to terminate the JSF alternate engine program. On April 12, 2006, the GAO witness reported to the committee that the “Department of Defense’s quantitative analysis focuses only on potential savings for engine acquisition and does not appear to fully examine potential savings that may be possible when competition exists for providing support for maintenance and operations over the lifecycle of the engine.” The committee concurs with GAO’s observation, and believes that the JSF alternate engine program should continue until the Department of Defense fully analyzes potential costs and savings resulting from competition over the JSF engine’s lifecycle.

Accordingly, the committee recommends an increase of \$408.0 million to continue the JSF alternate engine program for fiscal year 2007. Additionally, the committee recommends a provision (section 211) that would require that the Department of the Navy and the Department of the Air Force obligate not less than \$408.0 million, of the funds authorized to be appropriated for the system development and demonstration program for the Joint Strike Fighter, for continued development of an alternate engine for the Joint Strike Fighter. The committee also recommends a provision (section 215) that would require both the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group,

and the Comptroller General to conduct independent analyses of the JSF alternate engine program and provide a report to the congressional defense committees by March 15, 2007.

The Senate Armed Services Committee report (S.Rept. 109-254 of May 9, 2006) on S. 2766, the companion bill to 5122, states on page 6:

In order to confront irregular warfare threats, the Department must modernize and transform the armed forces. Since 2001, the Department has undergone significant modernization and transformation even during a time of war. The committee supported the Department's transformational activities, including authorizing funds for the construction of eight ships, for a total of \$12.1 billion; including a provision to promote coordinated joint development, procurement, and operation of unmanned systems; adding funds for the continued development of the Joint Strike Fighter interchangeable engine during fiscal year 2007; authorizing the budget request of \$3.7 billion for the Army's Future Combat Systems program; and authorizing an increase of nearly \$365.0 million over the President's budget request of \$11.1 billion for science and technology programs.

The report states on page 7:

Increasingly, the committee has emphasized the importance of developing capabilities to plan and conduct coalition operations. Ten years ago, the committee expressed concerns regarding the lack of engine competition in the Joint Strike Fighter program. As a result, the committee included a provision in the National Defense Authorization Act for Fiscal Year 1996 (Public Law 104-106) that directed the Secretary of Defense to evaluate at least two propulsion concepts from competing engine companies. Recently, the committee held hearings to review the Department's unilateral proposal, despite legislative direction to maintain a two-engine program, to eliminate the development of the F136 alternate interchangeable engine from the Joint Strike Fighter program. The committee remains concerned that relying on one engine provider to perform multiple missions, for multiple services and multiple nations presents an unnecessary operational and financial risk to the United States. Accordingly, the committee authorized provisions adding \$400.8 million for the continued development of the interchangeable engine during fiscal year 2007; and directing the Secretary of Defense to continue the development and sustainment of the Joint Strike Fighter program with two competitive propulsion systems throughout the life of the aircraft or enter into a one-time, firm-fixed-price contract for a single propulsion system throughout the life of the aircraft.

The report discussed two proposed legislative provisions on pages 129-131, stating:

**Development of the propulsion system for the Joint Strike Fighter (sec. 254)**

The committee recommends a provision that would direct the Secretary of Defense to continue the development and sustainment of the Joint Strike Fighter (JSF) program with two competitive propulsion systems throughout the life cycle of the aircraft, or enter into a one-time firm-fixed-price contract for a selected propulsion system for the life cycle of the aircraft following the initial service release of the JSF F135 propulsion system in fiscal year 2008.

During the 1970's and early 1980's, Pratt & Whitney was the sole source provider of engines for the F-14, F-15, and F-16 aircraft. Because of persistent engine problems that resulted in the loss of aircraft and degraded readiness, Congress directed the Department of Defense to develop and produce an engine to compete with Pratt & Whitney engines on these aircraft. The benefits that resulted from this competition included improved performance, reduced risk, increased readiness, lower cost of ownership, improved contractor responsiveness to

customer needs, and over \$4.0 billion of cost savings. Congress once again directed the Department to provide for an engine competition for the JSF in 1996 out of concerns for a lack of competition expressed in the National Defense Authorization Act for Fiscal Year 1996 (P.L. 104–106). Congress has consistently supported a competitive engine program for the Joint Strike Fighter for the past 10 years.

The JSF program is the largest acquisition program, in terms of funding, in Department of Defense history. Total JSF deliveries may well exceed 4,000 aircraft worldwide, with a resultant level of propulsion business in the tens of billions of dollars. The committee is concerned that relying on a sole engine supplier for a single-engine aircraft to do multiple missions for multiple services and multiple nations presents an unnecessary operational and financial risk to our nation.

The committee is also concerned that the Department's analysis provided to the committee, as justification for the termination of the F136 interchangeable engine, accounted for only 30 percent of the engine costs over the life cycle of the aircraft and failed to comply with the Department's policy on economic analysis that would have required the inclusion of the total life cycle cost. If the Department had conducted a full life cycle analysis, the committee believes that the results of the analysis would show significant cost savings that could be achieved through a competitive engine strategy. The committee believes that through the enduring value of competition, sufficient savings will be generated from a series of competitive engine procurements over the life cycle of the aircraft that will more than offset the cost of completing the F136 engine development. In order to ensure that the Congress has the complete picture of the full life cycle costs, the committee has recommended another provision described elsewhere in this report that would require the Secretary of Defense and the Comptroller General to conduct independent life cycle cost analyses addressing this issue.

#### **Independent cost analyses for Joint Strike Fighter engine program (sec. 255)**

The committee recommends a provision that would direct the Secretary of Defense, a federally-funded research and development center (FFRDC) chosen by the Secretary, and the Comptroller General to conduct independent life cycle cost analyses of the development and sustainment of the Joint Strike Fighter (JSF) program with two competitive propulsion systems throughout the life cycle of the aircraft, versus terminating the alternate engine development and proceeding with only one engine.

The provision would also require that the Comptroller and the FFRDC certify that they had access to sufficient information upon which to make informed judgments on the life cycle costs of the two alternatives.

As noted elsewhere in this report, the committee is concerned that the Department of Defense analysis provided as justification for the termination of the F136 interchangeable engine did not account for all of the costs over the life cycle of the aircraft.

The report discussed the JSF program on pages 95-96 and 179. The discussion on page 179 states:

#### **F136 Interchangeable Engine**

The budget request included \$1,999.0 million in PE 64800F and \$2,031.0 million in PE 64800N for the continued development of the Joint Strike Fighter, but included no funding for the development of the F136 interchangeable engine. The committee believes supporting competitive propulsion systems would help reduce operational risk and lead to higher

confidence of achieving more affordable life cycle costs. The committee expects that the Secretary of Defense, along with the Department of the Navy and the Department of the Air Force, will remain committed to the development and sustainment of competitive propulsion systems for the Joint Strike Fighter.

The committee recommends an increase of \$200.4 million in PE 64800F and an increase of \$200.4 million in PE 64800N for the continued development of the F136 interchangeable engine.

## **DOD Appropriations Act (H.R. 5631/P.L. 109-289 of September 29, 2006)**

The conference report (H.Rept. 109-676 of September 25, 2006) on H.R. 5631 discussed the JSF program on pages 205 and 228. The discussion on pages 228 states:

The conferees recommend an additional \$170,000,000 in Research, Development, Test and Evaluation, Air Force and \$170,000,000 in Research, Development, Test and Evaluation, Navy for continuing development of the F-136 engine for the Joint Strike Fighter program. The conferees direct the Under Secretary of Defense for Acquisition, Technology and Logistics to sponsor a comprehensive independent cost analysis of the Joint Strike Fighter engine program. The conferees strongly encourage the analysis be conducted by the Institute for Defense Analyses (IDA). This analysis shall include but not be limited to: (1) a comparison of costs associated with the development of the F-135 and F-136 engines; (2) an evaluation of potential savings achieved by eliminating or continuing the development and production of an alternate engine over the program's life cycle; and (3) the potential effects on the industrial base of eliminating or continuing the development and production of an alternate engine over the program's life cycle. This analysis shall be transmitted to the congressional defense committees not later than March 15, 2007.

The conferees in no way intend for this analysis to be an excuse for the Department of Defense not to fully fund the development of both the F-135 and the F-136 engines in fiscal year 2008. All evidence suggests that the development of two alternate engines will lead to cost savings through competition, increased capabilities for the warfighter, and a strengthened industrial base. Accordingly, the conferees direct the Department of Defense to fund the continued development of both the engines in the fiscal year 2008 budget submission while this cost analysis is ongoing.

The House Appropriations Committee report (H.Rept. 109-504 of June 16, 2006) on H.R. 5631 discusses the JSF program on page 163 and 266. The discussion on page 266 states:

The budget request provided no funding for development of the F-136 engine for the Joint Strike Fighter program. The Committee recommends an additional \$200,000,000 for continued development of this alternate engine source. The Committee directs the Under Secretary of Defense for Acquisition, Technology and Logistics to sponsor a comprehensive independent cost analysis of the Joint Strike Fighter engine program to be conducted by a federally funded research and development center (FFRDC) with demonstrated competence in this area. This analysis shall include but not be limited to: (1) a comparison of costs associated with the development of the F-135 and F-136 engines; (2) an evaluation of potential savings achieved by eliminating or continuing the development and production of an alternate engine over the program's life cycle; and (3) the potential effects on the industrial base of eliminating or continuing the development and production of an alternate engine over the program's life cycle. This analysis shall be transmitted to the congressional defense committees not later than March 15, 2007.

The Committee is supportive of required studies included in the House-passed version of the National Defense Authorization Act, 2007, and intends that this cost analysis be complementary to those studies.

The Senate Appropriations Committee report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631 discusses the JSF program on pages 76-77 and 157. The discussion on page 157 states:

The Committee is disappointed that the Department of Defense did not include funding for the F-35 Joint Strike Fighter 2<sup>nd</sup> Engine Source in the fiscal year 2007 budget request. Although the Committee recognizes that the Department of Defense faces difficult budget challenges, the Committee also believes it is premature to cancel the second engine source. Experience with the F-16 Fighter program engine competition led to a more reliable, better performing and lower cost engine. The Committee believes that competition for the F-35 engine is critical to procuring the best value engine at the lowest price and that competition will likely lead to an overall savings across the life cycle of the fighter program. Therefore, the Committee recommends an additional \$170,000,000 to each of the Navy and Air Force Research, Development, Test and Evaluation accounts. The Committee also directs the Department of Defense to fund the continued development of both engines in future budget submissions.

## **FY2008**

Section 213 of H.R. 4986/P.L. 110-181 states:

SEC. 213. REQUIREMENT TO OBLIGATE AND EXPEND FUNDS FOR DEVELOPMENT AND PROCUREMENT OF A COMPETITIVE PROPULSION SYSTEM FOR THE JOINT STRIKE FIGHTER.

Of the funds appropriated pursuant to an authorization of appropriations or otherwise made available for fiscal year 2008 or any year thereafter, for research, development, test, and evaluation and procurement for the Joint Strike Fighter 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 2 options for the propulsion system for the Joint Strike Fighter in order to ensure the development and competitive production for the propulsion system for the Joint Strike Fighter.<sup>78</sup>

H.R. 4986 is a revised version of H.R. 1585, which was vetoed on December 12, 2007. The House Armed Services Committee report (H.Rept. 110-146 of May 11, 2007) on H.R. 1585 discussed the JSF program on pages 213-214, stating:

The budget request contained \$1.8 billion in PE 64800F, and \$1.7 billion in PE 64800N, for development of the Joint Strike Fighter (JSF), but contained no funds for development of a competitive JSF propulsion system.

The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. In the committee report (H. Rept. 109-452) accompanying the National Defense Authorization Act for Fiscal Year 2007, the committee recommended an increase for the JSF competitive propulsion system, and notes that the other three congressional defense committees also

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<sup>78</sup> In the conference report (H.Rept. 110-477 of December 6, 2007) on H.R. 1585, the text of section 213 reads “two options” rather than “2 options.”

recommended increases for this purpose. Section 211 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109–364) required that the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group, the Comptroller General, and a federally funded research and development center each provide an independent lifecycle cost analysis of the JSF propulsion system, which would include a competitive engine program by March 15, 2007. On March 22, 2007, the Subcommittees on Air and Land Forces and Seapower and Expeditionary Forces held a hearing, which included witnesses from the Department of Defense, the Institute for Defense Analyses, and the Government Accountability Office (GAO), to receive testimony regarding their findings on the JSF propulsion system. The committee believes 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. However, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program, which include: 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, and recommends an increase of \$480.0 million for this purpose.

The committee recommends \$1.8 billion in PE 64800N, an increase of \$115.0 million, and directs that \$240.0 million of the recommended funds be used for the competitive JSF propulsion system program; and \$1.9 billion in PE 64800F, an increase of \$115.0 million, and directs that \$240.0 of the recommended funds be used for the competitive JSF propulsion system program.

Additionally, the committee recommends a provision (section 213) that would require the Secretary of Defense to obligate sufficient annual amounts to develop and procure a competitive propulsion system for the JSF program, in order to conduct a competitive propulsion source selection, from funds appropriated pursuant to an authorization of appropriations or otherwise made available for research, development, test, and evaluation, and procurement for the JSF program. The committee notes that current plans for the competitive JSF propulsion system would complete the development of the competitive propulsion system so that a competition for the JSF propulsion would occur in fiscal year 2012 with the sixth lot of low-rate initial production aircraft.

The Senate Armed Services Committee report (S.Rept. 110-77 of June 5, 2007) on S. 1547, the companion bill to H.R. 1585, discussed a proposed legislative provision on pages 139-140, stating:

The committee recommends a provision that would require the Secretary of Defense to obligate sufficient annual amounts to develop and procure a competitive propulsion system for the Joint Strike Fighter (JSF) program, in order to conduct a competitive propulsion source selection, from funds appropriated pursuant to an authorization of appropriations or otherwise made available for research, development, test, and evaluation, and procurement for the JSF program. The committee notes that current plans for the competitive JSF propulsion system would complete the development of the competitive propulsion system so that a competition for the JSF propulsion system would occur in fiscal year 2012 with the sixth lot of low-rate initial production.

The budget request contained \$1.7 billion in PE 64800N, and \$1.8 billion in PE 64800F for development of the JSF, but contained no funds for development of a competitive JSF propulsion system.

The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the current baseline F135 engine. Section 211 of

the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109–364) required that, by March 15, 2007, the Secretary of Defense, acting through the Department of Defense Cost Analysis Improvement Group, the Comptroller General, and a federally funded research and development center, each provide an independent life cycle cost analysis of the JSF propulsion system, which would include a competitive engine program. The committee has been briefed on the results of these reviews and believes those results were, in the aggregate, inconclusive on whether there would be a financial benefit to the Department of Defense in continuing to develop a competitive propulsion system for the JSF program.

However, the committee notes that all studies identified significant non-financial factors of a two-engine competitive program that should be considered in deciding between the alternatives. These factors include: better engine performance; improved contractor responsiveness; a more robust industrial base; increased engine reliability; and improved operational readiness. The committee believes that the potential benefits from the non-financial factors favor continuing the JSF competitive propulsion system program. Therefore, the committee recommends an increase of \$480.0 million for this purpose, including \$240.0 million in PE 64800N, and \$240.0 million in PE 64800F.

### **DOD Appropriations Act (H.R. 3222/P.L. 110-116 of November 13, 2007)**

The House Appropriations Committee report (H.Rept. 110-279 of July 30, 2007) on H.R. 3222 discussed the JSF program on page 6, stating:

The success of the Department's Joint Strike Fighter (F-35) program is critical to our Nation's ability to field a modern, capable fighter aircraft fleet for decades to come. To maintain stability in this program—and limit the potential for cost increases over time—the Committee recommends an increase of \$200,000,000 for F-35 production enhancements. These funds are to be used to outfit facilities with the latest in production line equipment and work-flow technology. In addition, the Committee recommends including \$480,000,000 to continue development of an alternative engine for this aircraft, thereby ensuring a competitive base for engine production.

The report discussed JSF the program again on pages 161-162, 211, and 360. The discussion on page 360 states in part:

The fiscal year 2008 budget request includes no funding for development of the F-136 as an alternate engine within the Joint Strike Fighter program. The Committee recommends \$480,000,000 for this effort. These funds have been added to the Air Force and Navy's respective Joint Strike Fighter development lines.

The statement of the managers accompanying the conference report on the Defense Appropriations Act for fiscal year 2007 directed the Department of Defense to fund the continued development of both the F-135 and F-136 engines in the fiscal year 2008 budget request. The Committee notes that this direction was disregarded by the Office of the Secretary of Defense. In exercising its power of the purse, the Committee made the necessary program adjustments to the fiscal year 2008 budget request to fully fund the requirement for this engine development program. The fiscal year 2009 requirement for the F-136 is estimated to be \$350,000,000. The Committee again directs the Department of Defense to fully fund this development program in the fiscal year 2009 budget submission.

The Senate Appropriations Committee report (S.Rept. 110-155 of September 14, 2007) on H.R. 3222 discusses the JSF program on page 191, stating:



The Committee is disappointed that the Department of Defense did not continue funding to support the development of an alternative engine for the F-35 Joint Strike Fighter in the fiscal year 2008 budget request. Although the Committee recognizes that the Department of Defense faces difficult budget challenges, the Committee also believes it is premature to cancel the second engine source. Experience with the F-16 Fighter program demonstrated that engine competition led to a more reliable, better performing and lower cost engine. The Committee believes that competition for the F-35 engine is critical to procuring the best value engine at the lowest price and that competition will likely lead to an overall savings across the life cycle of the fighter program. Therefore, the Committee recommends an additional \$240,000,000 in both the Navy and Air Force Research, Development, Test and Evaluation accounts. The Committee also directs the Department of Defense to fund the continued development of both engines in future budget submissions.

## **FY2009**

### **Defense Authorization Act (S. 3001/P.L. 110-417 of October 14, 2008)**

The House Armed Services report (H.Rept. 110-652 of May 16, 2008) on H.R. 5658, the companion bill to S. 3001, discussed the JSF program on pages 227-228, stating:

The budget request contained \$1.5 billion in PE 64800F, and \$1.5 billion in PE 64800N, for development of the Joint Strike Fighter (JSF), but contained no funds for development of a competitive JSF propulsion system. The budget request also contained \$136.9 million for F-35 advance procurement in Aircraft Procurement, Air Force for the long-lead components necessary to procure 12 F-35A aircraft in fiscal year 2010, but contained no funds for advance procurement of competitive JSF propulsion system long-lead components.

The competitive JSF propulsion system program is developing the F136 engine, which would provide a competitive alternative to the currently-planned F135 engine. In the committee report (H.Rept. 109-452) accompanying the John Warner National Defense Authorization Act for Fiscal Year 2007, and once again in the committee report (H. Rept. 110-146) accompanying the National Defense Authorization Act for Fiscal Year 2008, the committee recommended increases for the JSF competitive propulsion system, and notes that in both cases, the other three congressional defense committees concurred. 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 JSF, the committee is disappointed that the Department of Defense (DOD) chose 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.

On March 11, 2008, the Subcommittees on Air and Land Forces and Seapower and Expeditionary Forces held a hearing at which the Undersecretary of Defense for Acquisition, Technology and Logistics (USD (AT&L)) and the Government Accountability Office's (GAO) Director of Acquisition Sourcing and Management testified. Witnesses were asked to provide an update to the independent lifecycle cost analysis of the JSF propulsion system required by section 211 of the John Warner National Defense Authorization Act for Fiscal Year 2007 (Public Law 109-364) based on the obligation of an additional \$480.0 million authorized and appropriated for fiscal year 2008, performance of the competitive engine program to date, and the additional year of development. The GAO Director of Acquisition and Sourcing Management complied with the subcommittees' request and testified that the Department of Defense would recoup its initial investment costs with program savings of between 9 and 11 percent, or about 1.3 percent less than the GAO reported in 2007. He also

testified that at least that amount of savings could be achieved in the long run based on analysis of actual data from the F-16 engine competition. Opting not to comply with the committee request, the USD (AT&L) testified that the Department did not direct the Office of the Secretary of Defense's Cost Analysis and Improvement Group to update its analysis from the previous year, and that there had been no significant changes to the program that would have resulted in any changes to their findings. Based on this testimony, the committee believes that a competitive propulsion system for the JSF offers the promise of long-term savings.

The committee also notes that in August 2007, the currently planned F135 engine experienced a hardware failure during test stand operations with the short take-off and vertical land (STOVL) lift fan engaged, and that a similar failure occurred again in February 2008, and that these engine failure will result in a currently projected delay to the first flight of the F-35 STOVL variant by 30 to 60 days. While the committee understands that the F135 engine is still in development and test failures may occur, the committee believes that, over the long-term, a competitive JSF propulsion program will result in improved engine performance for all JSF variants. These test failure events and the subcommittees' hearing testimony cause the committee to remain 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 competitive propulsion system program.

For continued development of the competitive JSF propulsion system program, the committee recommends \$1.8 billion, an increase of \$247.5 million in PE 64800F, and \$1.8 billion, an increase of \$247.5 million in PE 64800N. The committee also recommends \$167.9 million, an increase of \$31.0 million for advance procurement of competitive JSF propulsion system long-lead components, for F-35 advance procurement in Aircraft Procurement, Air Force. Additionally, the committee strongly urges the Department of Defense to comply with the spirit and intent of section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181) by including the funds necessary for continued development and procurement of a competitive JSF propulsion system in its fiscal year 2010 budget request.

The Senate Armed Services Committee report (S.Rept. 110-335 of May 12, 2008) on S. 3001 discussed the JSF program on pages 99-100, stating:

The budget request included \$136.9 million in Aircraft Procurement, Air Force (APAF) for advanced procurement for the F-35 Joint Strike Fighter (JSF) program. In section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181), Congress explicitly directed the Department of Defense to (1) develop a competitive propulsion system for the JSF aircraft; and (2) continue competition for the propulsion system throughout the production phase of the JSF program.

In order to follow through on that direction and begin competition with the F-135 engine in 2012, the Department of Defense must begin funding for long lead items for the F-136 production line in 2009.

Therefore, the committee recommends an increase of \$35.0 million in APAF for long lead items for the F-136 engine.

The report further discussed the JSF program on pages 123-124 and 197. The discussion on page 197 states:

The budget request included \$1,532.7 million in PE 64800N and \$1,524.0 million in PE 64800F for the F-35 Joint Strike Fighter (JSF) program. In section 213 of the National Defense Authorization Act for Fiscal Year 2008 (Public Law 110-181), Congress explicitly directed the Department of Defense to (1) develop a competitive propulsion system for the JSF aircraft; and (2) continue competition for the propulsion system throughout the production phase of the JSF program.

The committee is disappointed that the administration chose to ignore the law by failing to fund the competitive propulsion system. Accordingly, the committee recommends an increase of \$215.0 million in PE 64800N and \$215.0 million in PE 64800F for development of the F-35 JSF competitive propulsion system.

The report further discusses the JSF program on page 222, stating:

The budget request included \$1,524.0 million in PE 64800F for the F-35 Joint Strike Fighter (JSF) program. Over the past 2 years, Congress has added \$820.0 million to continue funding of the F136 engine, a competitive propulsion source, to ensure there is fair and full competition for the propulsion system of the JSF.

The Department of Defense froze the technology baseline of the F135 engine several years ago when the JSF and the engine began system development and demonstration (SDD). To ensure that both engines incorporate the best configuration and most recent technology available, the Department should invest in and direct a program for the F135 and F136 engine programs that would drive technology insertion and provide potential customers with the best performing, most efficient engines possible. For example, the committee believes that the potential application of new composite materials in the F135 engine program could result in life cycle cost savings. Because no funds were set aside for the F136 engine in the administration's budget request, elsewhere in this report the committee has recommended an increase of \$430.0 million for the development of the F-136 engine.

In order to maintain a level playing field, the committee recommends an increase of \$35.0 million in PE 64800F for F135 engine technology development.

### **Consolidated Appropriations Act (H.R. 2638/P.L. 110-329 of September 30, 2008)**

The FY2009 DOD Appropriations Act is Division C of H.R. 2638/P.L. 110-329. In lieu of a conference report for H.R. 2638, there was an explanatory statement that was printed as a House Appropriations Committee print dated October 2008 (print 44-807). The committee print discussed the JSF program on page 215, stating:

The FY2009 budget request included no funding for the continued development of the F-136 engine as an alternate engine within the Joint Strike Fighter program. The bill includes \$430,000,000 for the continued development of this engine within the Navy and Air Force's Joint Strike Fighter development programs and \$35,000,000 for advance procurement items within the Aircraft Procurement, Air Force appropriation. The Secretary of Defense is once again directed to fully fund the F-136 engine development and procurement efforts in the FY2010 budget submission.

## **FY2010**

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

The conference report accompanying H.R. 2647 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)

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

- 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).

H.R. 2647 contains two sections relating directly to the F-35 alternate program: 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, and Section 242, which concerns the alternate engine program.

The texts of these two provisions appear below.

**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 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.

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

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...

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)

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.*<sup>79</sup>

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:

- 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 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).

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.

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.

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<sup>79</sup> 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 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)

### *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.<sup>80</sup>

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

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<sup>80</sup> 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.

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 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).<sup>81</sup>

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

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<sup>81</sup> See page 93 of the conference report on H.R. 2346 (H.Rept. 111-151 of June 12, 2009).

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 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)**

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.

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.

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

- 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);
- 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).

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)

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.<sup>82</sup>

The Senate Appropriations Committee, in its report (S.Rept. 111-74 of September 10, 2009) on H.R. 3326, recommends no funding for F-35 alternate engine development.

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<sup>82</sup> 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.

## Appendix B. The “Great Engine War” of 1984-1994

Congress’s interest in establishing and funding an F-35 alternate engine program may have been informed by “the Great Engine War”—an annual competition from 1984 to 1994 between Pratt & Whitney and General Electric to produce and maintain engines for Air Force F-16 fighters.<sup>83</sup> Pratt & Whitney’s engine for the F-16 was the F100, which was originally developed for the Air Force F-15 fighter. General Electric’s alternate engine for the F-16 was the F110.

Historians trace the Air Force’s interest in pursuing an alternate engine for the F-16 to Air Force frustrations in the 1970s with Pratt & Whitney’s management of the effort to develop the F100 and to Air Force concerns about using a single type of sole-sourced engine to power their entire fighter fleet of F-15s and F-16s.<sup>84</sup> After a number of contentious hearings in 1979, Congress provided funding through the Engine Model Derivative Program (EMDP), a congressionally directed program, for General Electric to develop its F101 engine (which later became the F110) as an alternate engine for the F-16. DOD spent more than \$376 million to develop the F110 to compete with the F100 and \$600 million to improve the F100’s durability and reliability to make it a stronger competitor.

The use of annual competitions for procuring engines for an aircraft procurement program was unprecedented and controversial. Proponents believe it produced better engines, on better terms, for less money than would purchasing from a single company facing no competition. Other observers believed it “unjustifiably jeopardized combat effectiveness and pilot survivability.”<sup>85</sup> Most studies have concluded that contractor responsiveness—not dollar savings—was the primary benefit of the competition. Testimony presented at a 1984 hearing suggested that requiring General Electric and Pratt & Whitney to compete for annual production and O&S work generated benefits for DOD in areas such as better contract terms and conditions, better warranties to assure engine quality, consistency, and long term stability of support.<sup>86</sup> A 1987 assessment stated that after competition was introduced, the incumbent (Pratt & Whitney) offered “engine improvements to the Air Force earlier than the Air Force had been led to expect without the competition.”<sup>87</sup>

The benefits of the Great Engine War have been attributed in part to the particulars of how the engine competition was managed. Prior to the first contract award, for example, the Air Force demanded that General Electric and Pratt & Whitney provide six years of cost projections to include the production of engines, support equipment, spare engines, technical data and dual

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<sup>83</sup> After 1994, Pratt & Whitney and GE continued to compete for engine business among foreign air forces that operated the F-16 and F-15.

<sup>84</sup> The F100 was the most advanced engine ever developed at that time, and its development was rushed to meet a deadline for initial fielding of the F-15. In addition, one report notes that “[t]he F100 engine was so powerful and the F-15 so maneuverable that pilots began pushing the aircraft to the edge of the performance envelope in ways that stressed the engine far more than had been anticipated.” (Karl G. Amick, *The Next Great Engine War: Analysis and Recommendations for Managing the Joint Strike Fighter Engine Competition*, Naval Postgraduate School, Monterey, CA. 2005, p. 8.) Mounting frustrations over Pratt & Whitney’s reluctance to fully address the F100’s shortcomings without additional funding resulted in the Air Force, Navy, and Congress working in concert to fund work on an alternate engine. (Ibid., p. 92-98.)

<sup>85</sup> Robert W. Drewes, *The Air Force and the Great Engine War*, NDU Press, Washington, DC, 1987.

<sup>86</sup> U.S. Congress, House, Committee on Armed Services, Air Force Alternative Fighter Engine, Hearings before the Subcommittee on Procurement and Military Nuclear systems, 98<sup>th</sup> Cong. 2<sup>nd</sup> Sess., March 8, 1984.

<sup>87</sup> Robert W. Drewes. *The Air Force and the Great Engine War*. NDU Press, Washington, DC, 1987.



sourcing data and second sourcing data for operations and support (O&S). The contractors were held to these cost projections for six years: the Air Force let six years of firm-fixed price, or “not-to-exceed” contracts from the first production lot. Prior to the Great Engine War, government had succeeded in negotiating firm-fixed price contracts only after the engine had been operating in the field for several years. Never before had contractors agreed to provide cost projections into the future, and contracts were typically for production only, not O&S work. To avoid potential disruptions in production, and to protect itself against price gouging, DOD “required (each contractor) to provide his plan for providing dual sources of critical parts. These separately priced options in the proposals would allow the Government to reprocure spare parts from sources other than the prime contractors.”<sup>88</sup>

**Table B-1. “Great Engine War” Procurement Quantities**

<b>FY</b>	<b>Pratt &amp; Whitney F100-PW-220</b>	<b>General Electric F110-GE-100</b>	<b>Pratt %</b>	<b>GE %</b>
85 <sup>a</sup>	40	120	25%	75%
86	159	184	46%	54%
87	160	205	44%	56%
88	181	147	55%	45%
89	159	100	61%	39%
90	70	39	64%	36%
<b>Total</b>	<b>769</b>	<b>795</b>	<b>49%</b>	<b>51%</b>

**Source:** Armed Services Board of Contract Appeals, *Appeals of United Technologies Corporation*, ASBCA Nos. 51410, 53089, and 53349 under Contract No. F33657-84-C-2014, February 27, 2004.

- a. Under the preceding sole-source contract, DoD had already awarded P&W an FY1985 contract for 120 engines. The numbers shown here are for the subsequent competitive bid only.

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## Acknowledgments

Significant portions of this report present, in edited form, material from archived CRS Report RL33390, *Proposed Termination of Joint Strike Fighter (JSF) F136 Alternate Engine*, by Christopher Bolkcom.

<sup>88</sup> Prepared Statement of Hon. Thomas Cooper. *Air Force Alternative Fighter Engine, Hearings*, op cit.