



441 G St. N.W.  
Washington, DC 20548

April 25, 2018

The Honorable John McCain  
Chairman  
The Honorable Jack Reed  
Ranking Member  
Committee on Armed Services  
United States Senate

The Honorable Mac Thornberry  
Chairman  
The Honorable Adam Smith  
Ranking Member  
Committee on Armed Services  
House of Representatives

**Warfighter Support: DOD Needs to Share F-35 Operational Lessons Across the Military Services**

The Department of Defense (DOD) is increasing focus on the Pacific where potential adversaries including China and North Korea have made provocations. In January 2017, the Marine Corps began transferring F-35 aircraft to Iwakuni, Japan—representing the first overseas stationing of the F-35 since its development. DOD expects to use the F-35’s air combat capabilities, along with a basing strategy known as distributed operations—where, for example, aircraft disperse into smaller detachments to outmaneuver the enemy—to counter any regional threats.<sup>1</sup>

Reports accompanying the 2017 National Defense Authorization bills included provisions for us to review DOD’s initial stationing of the F-35 in Japan. In March 2018, we issued a classified report that addressed these provisions.<sup>2</sup> In that report, we (1) described the warfighting capabilities the F-35 brings to the Pacific and assessed any operational challenges the Marine Corps faces; (2) assessed the extent to which the Marine Corps is prepared to support distributed operations with the F-35 in the Pacific; and (3) determined the extent to which the Marine Corps records and DOD shares F-35 operational lessons learned across the Marine Corps, the Air Force, and the Navy. DOD deemed some of the information related to the first two objectives to be classified, which must be protected from loss, compromise, or inadvertent disclosure. DOD deemed the recommendations we made in the report to be unclassified. On the basis of our findings from our first two objectives, we recommended that (1) the F-35

<sup>1</sup>Distributed operations is a form of maneuver warfare where small, highly capable units spread across a large area of operations to create an advantage over an adversary through the deliberate use of separation and coordinated, independent tactical actions.

<sup>2</sup>GAO, (U) *Military Aircraft: F-35 Brings Increased Capabilities, but the Marine Corps Needs to Assess Challenges Associated with Operating in the Pacific*, GAO-18-79C (Washington, D.C.: March 28, 2018).

Program Executive Officer test operating the F-35 disconnected from its Autonomic Logistics Information System (ALIS) for extended periods of time in a variety of scenarios to assess the risks related to operating and sustaining the aircraft, and determine how to mitigate any identified risks;<sup>3</sup> (2) the Commandant of the Marine Corps assess the risks associated with key supply chain-related challenges related to operating and sustaining the F-35 in the Pacific, and determine how to mitigate these risks; and (3) the Commandant of the Marine Corps determine the F-35's ability to support distributed operations through the use of exercises and/or analyses. DOD concurred with these three recommendations. This report is a public version of our March 2018 classified report and focuses exclusively on the third objective, which DOD deemed unclassified: the extent to which the Marine Corps records and DOD shares F-35 operational lessons learned across the three services.

To determine the extent to which the Marine Corps records and DOD shares F-35 operational lessons learned across the Marines Corps, the Air Force, and the Navy, we reviewed available Marine Corps after action reports on F-35-related exercises conducted between December 2015 (the date of Marine Fighter Attack Squadron 121's first recorded operational exercise) and July 2017 (the most recent information available) to understand what types of operational lessons the Marine Corps had reported. We compared the intraservice distribution of these after action reports with the guidelines in DOD's *Joint Lessons Learned Program*. This document demonstrates the importance of capturing and communicating lessons learned through a range of mechanisms to properly institutionalize those lessons, effectively enable joint force capabilities, and enhance interagency and multinational coordination. We also interviewed officials from the F-35 Joint Program Office, as well as officials from the Marine Corps Forces Pacific; the Marine Corps Air Station Iwakuni, Japan; the Air Force Integration Office; and the Navy F-35 Fleet Integration Office to better understand how F-35 lessons learned are documented and shared among the services.

We conducted this performance audit from February 2017 to April 2018 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Background

The F-35 Lightning II, also known as the Joint Strike Fighter, is a joint, multinational acquisition program intended to develop and field a family of next-generation strike fighter aircraft for the Air Force, the Navy and the Marine Corps, eight international partners, and foreign military sales customers.<sup>4</sup> There are three F-35 variants, and DOD intends for each to be a multirole, stealthy strike aircraft replacement for, or complement to, legacy fighter aircraft.<sup>5</sup> The F-35B variant will

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<sup>3</sup>The F-35's Autonomic Logistics Information System (ALIS) provides a comprehensive platform that collects and analyzes data (i.e., mission planning capabilities, maintenance activities, training plans, maintenance instructions, and parts orders) that keeps the aircraft ready for flight.

<sup>4</sup>The international partners are the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. In addition, the program currently has three foreign military sales customers--Israel, Japan, and South Korea--with the potential to add more foreign military sales customers in the future.

<sup>5</sup>The F-35A will be the most prevalent variant and will be used by the Air Force. It is the conventional takeoff and landing (CTOL) variant and is designed to operate from conventional runways. The F-35B will be used by the Marine Corps. It is the short take-off/vertical landing (STOVL) variant and is designed to operate from austere, short-field bases and air-capable ships. The F-35C will be used by the Navy. It is the carrier variant (CV) built explicitly for aircraft carrier operations.

be used primarily by the Marine Corps and utilizes a short take-off and vertical landing capability designed to operate from austere bases and air-capable ships (see fig. 1).

**Figure 1: F-35B at Marine Corps Air Station Iwakuni, Japan**



Source: Defense Video and Imagery Distribution System. | GAO-18-464R

DOD initiated the F-35 program in October 2001 with the prime contractor, Lockheed Martin.<sup>6</sup> The program is now nearing the end of system development and preparing for operational testing. DOD has also been concurrently fielding and operating a growing fleet of aircraft as part of low-rate initial production.<sup>7</sup> As of August 2017, more than 250 aircraft had been fielded and were flying from nine locations in the United States and three international locations. The Marine Corps and the Air Force declared initial operational capability in 2015 and 2016, respectively, and the Navy is scheduled to declare initial operational capability in 2018.<sup>8</sup> In 2019 DOD plans to begin full-rate production of the aircraft.<sup>9</sup>

On January 9, 2017, Marine Fighter Attack Squadron 121 (VMFA-121) arrived at Marine Corps Air Station Iwakuni, Japan, from Yuma, Arizona, marking the first time that an operational F-35 squadron had been stationed overseas. The squadron comprises 16 F-35B aircraft. According to the Marine Corps, the F-35 aircraft will eventually replace the F/A-18 Hornet aircraft currently based in Iwakuni, and as we reported in March 2018, the F-35 will bring increased warfighting capabilities to the Pacific (see table 1).<sup>10</sup> According to Marine Corps officials, while in Japan, VMFA-121 will contribute to the readiness of the Marine Aircraft Group-12, the 31<sup>st</sup> Marine

<sup>6</sup>Lockheed Martin is the prime contractor for the F-35 airframe; Pratt &Whitney is the contractor for the engine.

<sup>7</sup>Low-rate initial production establishes the initial production base for the system or capability increment, provides an efficient ramp up to full-rate production, and maintains continuity in production pending operational test and evaluation completion.

<sup>8</sup>Initial operational capability means that the service has enough operational aircraft, trained pilots, maintainers, and support equipment to conduct operational missions using program-of-record weapon and mission systems. In general, this signals that the aircraft are both deployable and ready for certain combat scenarios.

<sup>9</sup>The full-rate production is a decision, following the completion of operational testing, to scale up production and fielding. During full-rate production, the remaining production or deployment of the product is completed, leading to full operational capability or full deployment.

<sup>10</sup>GAO-18-79C.

Expeditionary Unit (MEU), and the III Marine Expeditionary Force. The squadron also plans to deploy on amphibious ships while in the Pacific as part of supporting the 31<sup>st</sup> MEU.

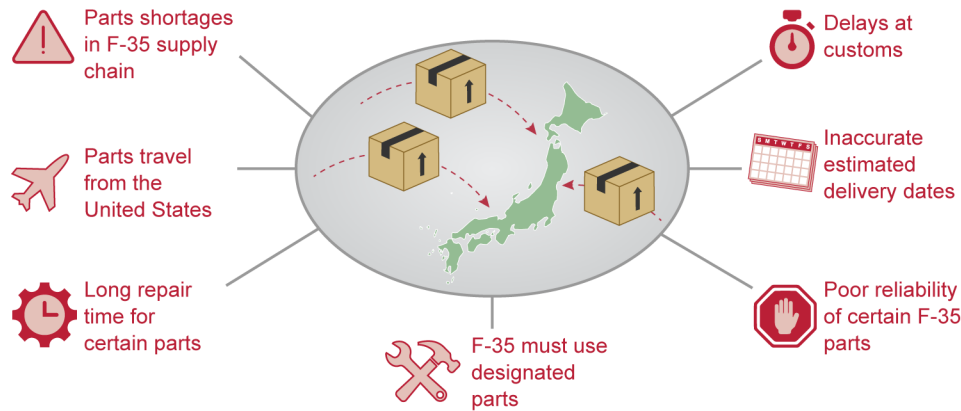
**Table 1: Unique Capabilities That the F-35 Is Designed to Have**

Capability	Description
Advanced stealth	The F-35's advanced stealth allows pilots to evade detection by enemy radar, infrared sensors, or emission interception. The F-35's shape, internal fuel and weapons carriage, mission-system sensors, and advanced stealth coating all play key roles in keeping the aircraft stealthy.
Seamless communication	The F-35's advanced sensor fusion will gather information from on-board sensors to create a single integrated picture of the battlefield and will be able to share this picture with other F-35 and legacy aircraft to improve operational awareness and survivability.
Laser precision	The F-35 possesses an Electro-Optical Targeting System that provides pilots with precise air-to-air and air-to-ground targeting capability that is not found in legacy platforms. The system enables aircrews to identify areas of interest, perform reconnaissance, and precisely deliver laser- and GPS-guided weapons.
Automated sustainment	The Autonomic Logistics Information System (ALIS) provides a comprehensive platform that collects and analyzes data (i.e., mission-planning capabilities, maintenance activities, training plans, maintenance instructions, and parts orders) that keep the aircraft ready for flight.
Virtual reality	The F-35 helmet uses the Distributed Aperture System to stream high-resolution, real-time images from six infrared cameras mounted around the aircraft to the pilot's visor. The visor also includes mission-critical information such as airspeed, altitude, targeting information, and warnings.

Source: GAO analysis of DOD and Lockheed Martin Information. | GAO-18-464R

As we reported in our March 2018 classified report, while the Marine Corps recognizes the advanced warfighting capabilities the F-35 will bring to the Pacific, it is facing challenges operating in the area. In particular, it is uncertain how long the F-35 can effectively operate if ALIS becomes disconnected from the aircraft. The Marine Corps has also encountered several challenges with the F-35's supply chain since beginning flight operations in January 2017 (see fig. 2). Further details are provided in our classified report as these topics pertain solely to objectives one and two, which are not covered in this report.

**Figure 2: Examples of the Types of Challenges Reported with the F-35 Supply Chain in Japan**



Source: GAO analysis of Department of Defense information and interviews. | GAO-18-464R

**The Marine Corps Records F-35 Operational Lessons Learned, but DOD Does Not Formally Share These Lessons across the Military Services**

The Marine Corps Documents F-35 Operational Lessons Learned

Following processes established in Marine Corps *Joint Lessons Learned Program* guidance, the Marine Corps documents lessons from its F-35-related operational activities in after action reports that are posted on its own, service-specific lessons learned website. Examples of key lessons learned include reports for the following activities:

- **Steel Knight (December 2015):** The Marine Corps’ participation in the Steel Knight exercise near Twentynine Palms in California marked the first time that the deployable version of ALIS (Standard Operating Unit Version 2 (SOU V2)) was tested in an operational environment. The Marine Corps documented the results of the exercise, including accomplishments and lessons learned. Some accomplishments included improvements in aircraft data transfer, and setting up the ALIS SOU V2 without contractor support. Lessons learned included issues related to the tents used to house the ALIS SOU V2 not meeting environmental requirements, the need for maintaining network connectivity, and the limited reach-back support for ALIS. Each of the lessons learned in the after action report had a corresponding recommendation for moving forward.
- **Red Flag (July 2016):** The Marine Corps’ VMFA-121 squadron participated in this joint training exercise for the first time in July 2016 at Nellis Air Force Base. It was an opportunity for the squadron to participate with the other services in a multidomain environment to prepare for joint operations. The Marine Corps documented accomplishments and lessons learned in an after action report. The report highlights accomplishments such as the F-35 using its sensors to share data with legacy platforms, and the aircraft’s stealth capability increasing its survivability as compared with that of legacy platforms. Lessons learned included the need for ensuring that classified facilities meet basic cooling and power requirements for housing the ALIS

servers, and the need for scheduling as many aircraft and pilots as are needed to support exercises.

- **Transfer to Iwakuni (January 2017):** The Marine Corps permanently transferred the VMFA-121 squadron from Yuma, Arizona, to Iwakuni, Japan, in January 2017. The after action report focused on the relocation of personnel and equipment in order to assist future F-35 squadrons with transoceanic movements and relocations. Lessons learned included the need for ensuring that frequency spectrum approval—which allows the squadron to use certain frequencies to communicate—is obtained in advance in applicable countries; and taking into consideration weather concerns when shipping ALIS equipment. While the aircraft were transferred to Japan through Alaska, ALIS was moved through Hawaii because of concerns about how the freezing temperature would affect the logistics system.
- **Northern Edge (May 2017):** The VMFA-121 squadron participated in the Northern Edge exercise at Joint Base Elmendorf-Richardson, Alaska. Similar to Red Flag, this was the first time that the F-35 had participated in this joint training exercise designed to enhance interoperability among the services. Other legacy platforms that participated included F/A-18s, F-16s, and F-15s. The after action report highlighted accomplishments that included the F-35's sensors being able to provide the pilots with a high degree of situational awareness regarding air-to-air and air-to-ground threats, and also to share that information with other aircraft. Lessons learned included the need for ensuring that a monitor with the appropriate video debriefing capabilities is brought to events so that the debriefing process can be accomplished more quickly, and the need for using higher fidelity data.

#### DOD Does Not Share or Make Available F-35 Operational Lessons Learned across the Services

While the Marine Corps records F-35 operational lessons learned on its own, service-specific website, these lessons are not currently shared or made available across the F-35 program. Instead, Marine Corps officials stated that they currently rely on personal relationships to share lessons learned with other services, through methods such as phone calls to colleagues in the Air Force or the Navy.

DOD has emphasized the need for the services to collect and share lessons learned not only at a service-specific level, but across all services, and it established the Joint Lessons Learned Program in 2000 to enhance joint capabilities through knowledge management in peacetime and wartime. *Joint Lessons Learned Program* guidance discusses the importance of not only capturing lessons learned, but communicating lessons learned through a range of mechanisms to properly institutionalize those lessons, effectively enable joint force capabilities, and enhance interagency and multinational coordination. The goal is to prevent lessons learned from being captured in a vacuum within each military service, but rather to have them captured and shared among the joint force to create, among other things, better doctrine, policy, training, and education. Air Force and Navy officials also told us that they document lessons learned from F-35 deployments in the form of after action reports or observational briefings. However, the F-35 program does not currently disseminate or make available lessons learned across all services, although program officials agreed that doing so would be beneficial.

The F-35 program plans to rapidly increase over the next few years and expand operations and deployments to the Pacific for the three services. Without the F-35 program office's sharing or

making available operational lessons learned through a new or existing communications mechanism, the services are at risk of not having access to key information that could affect their movements, exercises, operations, and sustainment of the aircraft in the Pacific and other areas where they operate.

## **Conclusions**

The Marine Corps has internally documented lessons learned from its F-35-related operational activities, but DOD does not formally share these lessons learned across all services participating in the F-35 program. Given that the F-35 program plans to rapidly expand over the next few years and that all three services plan to deploy and operate in the Pacific, now is the time for DOD to make sure that lessons learned are communicated effectively across all services. Without a communications mechanism, the services are at risk of not having access to key information that could affect their movements, exercises, operations, and sustainment of the aircraft in the Pacific and in other areas where they operate.

## **Recommendation for Executive Action**

We are making one recommendation to DOD.

The F-35 Program Executive Officer should formally share or make available, through a new or existing communications mechanism, F-35 operational lessons learned across the services. (Recommendation 1)

## **Agency Comments**

We provided a draft of our classified report (GAO-18-79C)—which included the finding and recommendation related to sharing lessons learned—to DOD for review and comment. DOD concurred with the recommendations in our March 2018 classified report, including the recommendation in this report. The department's comments are reprinted in the enclosure.

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We are sending copies of this report to appropriate congressional committees, the Secretary of Defense, the F-35 Program Executive Officer, the Secretaries of the Air Force and the Navy, and the Commandant of the Marine Corps. In addition, this report is available at no charge on the GAO website at: <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-5431 or [russellc@gao.gov](mailto:russellc@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Staff members making key contributions to this report include Alissa Czyz (Assistant Director), Vincent Buquicchio, Pat Donahue, Jeffrey Hubbard, Amie Lesser, Walter Vance, Cheryl Weissman, and Delia Zee.

A handwritten signature in black ink that reads "Cary Russell". The signature is written in a cursive style with a large initial "C" and "R".

Cary Russell  
Director, Defense Capabilities and Management

Enclosure



**Enclosure: Comments from the Department of Defense**



LOGISTICS AND  
MATERIEL READINESS

**OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE**

3500 DEFENSE PENTAGON  
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NOV 22 2017

Mr. Cary Russell  
Director, Defense Capabilities and Management  
U.S. Government Accountability Office  
441 G Street, N.W.  
Washington, DC 20548

Dear Mr. Russell:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report GAO-18-79C, "classified title," dated October 5, 2017 (GAO Code 101520). Detailed comments on the report recommendations are enclosed.

Sincerely,

A handwritten signature in cursive script that reads "Kristin K. French".

Kristin K. French  
Principal Deputy  
Performing the Duties of the ASD(L&MR)

Enclosure:  
As stated

**GAO Draft Report Dated October 5, 2017  
GAO-18-79C (GAO CODE 101542)**

**“CLASSIFIED TITLE”**

**DEPARTMENT OF DEFENSE COMMENTS  
TO THE GAO RECOMMENDATIONS**

**RECOMMENDATION 1:** The F-35 Program Executive Officer should test operating the F-35 disconnected from ALIS for extended periods of time in a variety of scenarios to assess the risks related to operating and sustaining the aircraft, and determine how to mitigate the risks.

**DoD RESPONSE:** Concur. While the department has already tested and operated F-35 disconnected from the ALIS server during exercises, the department agrees that additional testing is worthwhile. The department will continue to evaluate F-35 disconnected from ALIS operations during future tests and exercises.

**RECOMMENDATION 2:** The Commandant of the Marine Corps should assess the risks associated with key supply-chain related challenges related to operating and sustaining the F-35 in the Pacific, and determine how to mitigate these risks.

**DoD RESPONSE:** Concur. The department established a Global Support Strategy and continuously assesses the supply chain related challenges operating and sustaining F-35 in the Pacific. For example, Marine Corps squadron VMFA-121, currently in the Pacific, is assessing the availability of both on-station repair parts, and the delivery times for off-station repair parts, to mitigate future risks. The department will continue to assess supply chain challenges during future theater exercises in the Pacific.

**RECOMMENDATION 3:** The Commandant of the Marine Corps should determine the F-35's ability to support distributed operations through the use of exercises and/or analyses.

**DoD RESPONSE:** Concur. The department assessed F-35's ability to support distributed operations during the Agile Lightning portion of the First Marine Expeditionary Force Steel Knight exercise in December, 2015. The Marine Corps conducted the Agile Lightning exercise again in January-February 2017, focusing on F-35's ability to support distributed operations in an Anti-Access Area Denial (A2AD) environment with near-peer competition. The department will continue to assess F-35's ability to support distributed operations through future theater exercises in preparation for real world operations.

**RECOMMENDATION 4:** The F-35 Program Executive Officer should formally share or make available, through a new or existing communications mechanism, F-35 operational lessons learned across the Services.

**DoD RESPONSE:** Concur. The F-35 Enterprise (U.S. Services, International Partners, Industry and the Joint Program Office) shares technical, programmatic and operational lessons learned through the Operational Advisory Group (OAG) and the Supportability Advisory Group (SAG). As F-35 operational experience grows, the department will continue to share lessons learned through the existing OAG and SAG, using a new electronic forum or repository.

## Related GAO Products

*Military Aircraft: F-35 Brings Increased Capabilities, but the Marine Corps Needs to Assess Challenges Associated with Operating in the Pacific.* [GAO-18-79C](#). Washington, D.C.: March 28, 2018.

*F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency.* [GAO-18-75](#). Washington, D.C.: October 26, 2017.

*F-35 Joint Strike Fighter: DOD's Proposed Follow-on Modernization Acquisition Strategy Reflects an Incremental Approach Although Plans Are Not Yet Finalized.* [GAO-17-690R](#). Washington, D.C.: August 8, 2017.

*F-35 Joint Strike Fighter: DOD Needs to Complete Developmental Testing Before Making Significant New Investments.* [GAO-17-351](#). Washington, D.C.: April 24, 2017.

*F-35 Joint Strike Fighter: Continued Oversight Needed as Program Plans to Begin Development of New Capabilities.* [GAO-16-390](#). Washington, D.C.: April 14, 2016.

*F-35 Sustainment: DOD Needs a Plan to Address Risks Related to Its Central Logistics System.* [GAO-16-439](#). Washington, D.C.: April 14, 2016.

*F-35 Joint Strike Fighter: Preliminary Observations on Program Progress.* [GAO-16-489T](#). Washington, D.C.: March 23, 2016.

*F-35 Joint Strike Fighter: Assessment Needed to Address Affordability Challenges.* [GAO-15-364](#). Washington, D.C.: April 14, 2015.

*F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates.* [GAO-14-778](#). Washington, D.C.: September 23, 2014.

*F-35 Joint Strike Fighter: Slower Than Expected Progress in Software Testing May Limit Initial Warfighting Capabilities.* [GAO-14-468T](#). Washington, D.C.: March 26, 2014.

*F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities.* [GAO-14-322](#). Washington, D.C.: March 24, 2014.

*F-35 Joint Strike Fighter: Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain.* [GAO-13-690T](#). Washington, D.C.: June 19, 2013.

*F-35 Joint Strike Fighter: Program Has Improved in Some Areas, but Affordability Challenges and Other Risks Remain.* [GAO-13-500T](#). Washington, D.C.: April 17, 2013.

*F-35 Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability Is a Major Concern.* [GAO-13-309](#). Washington, D.C.: March 11, 2013.

*Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks.* [GAO-12-437](#). Washington, D.C.: June 14, 2012.

*Joint Strike Fighter: Restructuring Added Resources and Reduced Risk, but Concurrency Is Still a Major Concern.* [GAO-12-525T](#). Washington, D.C.: March 20, 2012.

*Joint Strike Fighter: Implications of Program Restructuring and Other Recent Developments on Key Aspects of DOD's Prior Alternate Engine Analyses.* [GAO-11-903R](#). Washington, D.C.: September 14, 2011.

*Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging.* [GAO-11-677T](#). Washington, D.C.: May 19, 2011.

*Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags.* [GAO-11-325](#). Washington, D.C.: April 7, 2011.

*Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall.* [GAO-11-450T](#). Washington, D.C.: March 15, 2011.

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