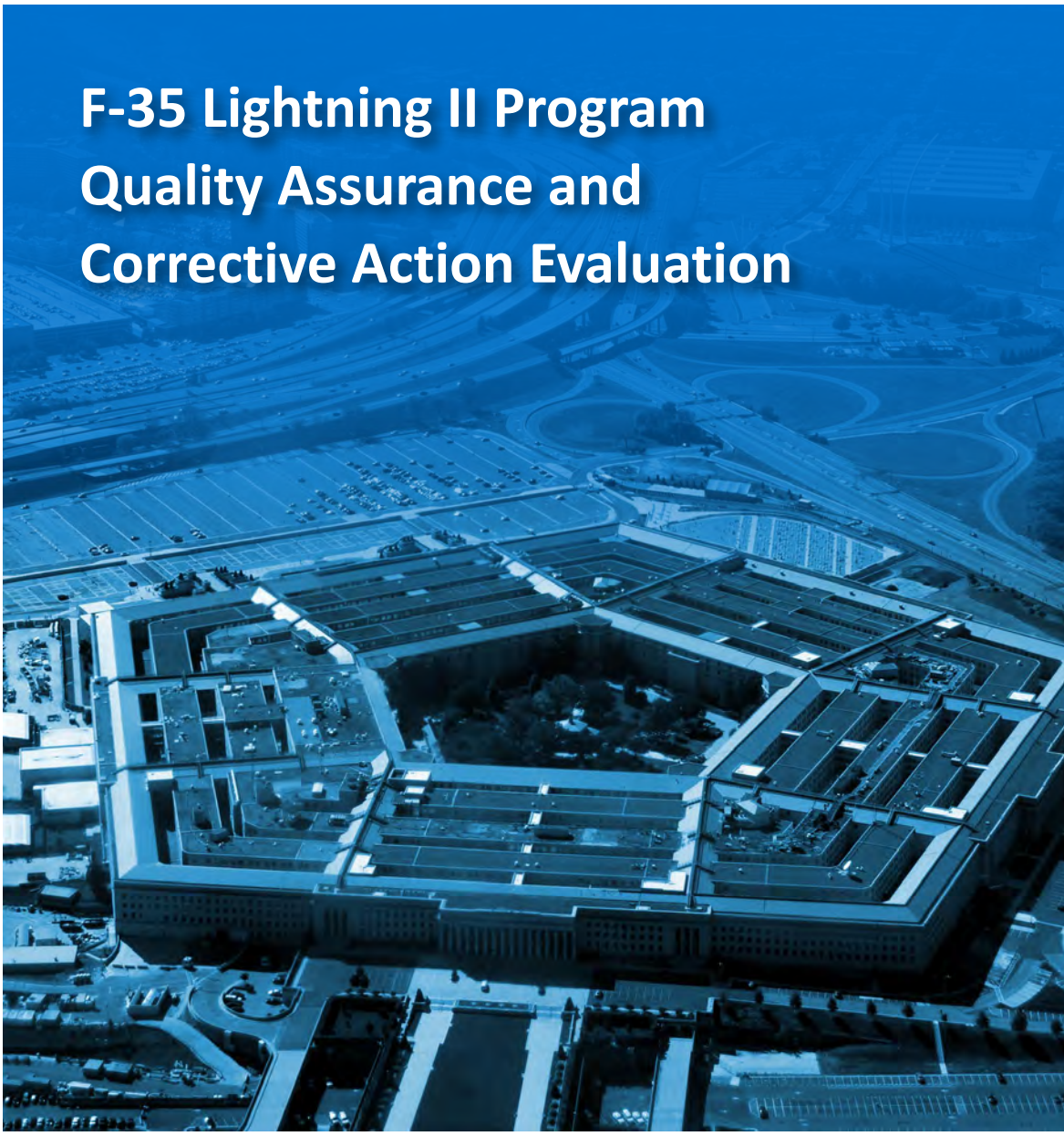
Report No. DODIG-2015-092

INSPECTOR GENERAL

U.S. Department of Defense

MARCH 11, 2015

F-35 Lightning II Program Quality Assurance and Corrective Action Evaluation



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Results in Brief

F-35 Lightning II Program Quality Assurance and Corrective Action Evaluation

March 11, 2015

Objective

We inspected the F-35 Lightning II Program (F-35 Program) at Lockheed Martin, Fort Worth, Texas, for conformity to the contractually required Aerospace Standard (AS)9100, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations." We also evaluated corrective actions taken in response to nonconformities, findings, and recommendations identified in DoD Inspector General (IG) Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," September 30, 2013, to determine whether the actions taken were appropriate.

Findings

The F-35 Program generally conformed to requirements and showed improvement in quality management system performance since our previous evaluation; however, challenges still remain, as evidenced by 57 nonconformities to the AS9100 standard and 4 opportunities for improvement.

The Joint Program Office (JPO) did not:

A. ensure the program made sufficient progress toward full compliance with Public Law 108-136, "National Defense Authorization Act for fiscal year 2004," Section 802, "Quality control in procurement of aviation Critical Safety Items (CSIs) and related services," and the Joint Service CSI Instruction (SECNAVINST 4140.2), "Management of Aviation Critical Safety Items,"

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Findings (cont'd)

B. ensure that all system level requirements and capabilities were realized and verified,

C. create an independent quality assurance organization, establish its roles and responsibilities, and ensure it was adequately staffed to perform effective oversight for the F-35 Program,

D. ensure that Lockheed Martin was taking necessary steps to reduce the assembly defect rate in order to meet the full rate production goals,

F. ensure that Lockheed Martin's software quality management processes were performed sufficiently to prevent software defects, and

G. ensure that Lockheed Martin flows down all contractual requirements to its subcontractors, evaluates deliverables for contract compliance, and allows minor nonconformances to be approved only by the proper authority.

In addition, the Defense Contract Management Agency (DCMA) did not:

E. escalate unresolved Corrective Action Requests (CARs) to the next higher level as appropriate and required by its policy, for effective resolution.

Recommendations

We recommend that the Joint Program Office:

A.1. ensure that the F-35 CSI Program is compliant with Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items";

A.2. conduct periodic CSI Program evaluations of Lockheed Martin and its suppliers to ensure compliance with public law and the Joint Service CSI Instruction;

Results in Brief

F-35 Lightning II Program Quality Assurance and Corrective Action Evaluation

Recommendations (cont'd)

B.1. clearly define contractual criteria for the acceptance of all future and fielded aircraft to ensure that aircraft capabilities are verified;

B.2. ensure that all 21 system-level requirements that may not be met, in addition to the risks associated with the failure to meet these requirements, are documented, tracked, and mitigated using the established risk management process;

C. realign the quality assurance organization to report directly to the Program Executive Officer, define the organization's roles and responsibilities, and staff the organization appropriately;

D.1. ensure that Lockheed Martin implements quality improvement initiatives to reduce the assembly defect rate to meet full rate production goals;

D.2. coordinate with DCMA to implement an effective root cause analysis and corrective action process in order to reduce assembly defect rate;

F. work with Lockheed Martin to ensure software quality management systems are improved; metrics should be reported on a periodic basis (for example, monthly) to evaluate process improvement; and

G.1. ensure that all minor nonconformances are evaluated and approved only by DCMA.

We recommend that the DCMA:

E.1. review all unresolved CARs and escalate those that meet the criteria established in DCMA policies and instructions,

E.2. assess all CARs that were not properly elevated and assess any impact on the product, and

G.2. ensure that Lockheed Martin flows down the appropriate technical requirements to its subcontractors and receives and evaluates contract deliverables within the required time frames.

Management Comments and Our Response

On January 20, 2015, JPO and DCMA provided comments on our findings and recommendations. The Joint Program Office agreed with six recommendations and partially agreed with three recommendations.

JPO partially agreed with the recommendation to track 21 system-level requirements, which it acknowledged will not be met. However, JPO does not consider the 21 system-level requirements as risks and did not agree to track them in its formal risk management process. We disagree with this approach because a final determination of performance has not been made and failure to track the risks in the formal risk management process prevents an identification of the plans necessary for closure.

Management Comments and Our Response (cont'd)

JPO partially agreed with the recommendation to work with DCMA to implement an effective root cause analysis and corrective action process to reduce assembly defects to meet full-rate production goals. However, JPO stated that no additional changes to corrective action processes were necessary. We disagree with JPO's response because additional quality initiatives are required to meet full-rate production goals and DCMA's involvement is necessary to ensure objectives are met. Our recommendation was for JPO to take actions to identify and correct the cause of the program's inability to reduce defect rates to support full-rate production.

JPO also partially agreed with our recommendation to ensure all minor nonconformances are evaluated and approved only by DCMA. The actions that JPO is planning to meet the intent of the recommendation.

DCMA agreed with all three of our recommendations. The actions that DCMA is planning to take meet the intent of the recommendations.

Please see the Recommendations Table on the following page.

Recommendations Table

Management	Recommendations Requiring Comment	No Additional Comments Required
Joint Program Office	A.1, B.1, B.2, C, D.1, D.2, and F	A.2 and G.1
Defense Contract Management Agency		E.1, E.2, and G.2

Please provide comments by April 13, 2015.

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

March 11, 2015

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER
DIRECTOR, DEFENSE CONTRACT MANAGEMENT AGENCY

SUBJECT: F-35 Lightning II Program Quality Assurance and Corrective Action Evaluation (Report No. DODIG-2015-092)

We are providing this report for review and comment. The DoD Office of Inspector General (OIG) conducted an evaluation of the F-35 Lightning II Program (F-35 Program) for conformity to the contractually required Aerospace Standard (AS)9100, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations," and to determine whether the program took appropriate actions on findings and recommendations identified in the DoD Inspector General Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," September 30, 2013.

We conducted this evaluation in accordance with the Council of Inspectors General on Integrity and Efficiency, "Quality Standards for Inspection and Evaluation."

Our evaluation determined that the F-35 Program generally conformed to requirements and showed improvement in its quality management system performance with respect to our previous evaluation; however, challenges still remain, as evidenced by 57 nonconformities to the AS9100 standard and 4 opportunities for improvement.

We considered management comments on the draft of this report when preparing the final report. DoD Instruction 7650.03 requires that recommendations be resolved promptly. Comments from the Defense Contract Management Agency were responsive, and do not require additional comments. Comments from the F-35 Joint Program Office were not fully responsive; therefore, we request further comments on Recommendations A.1, B.1, B.2, C, D.1, D.2, and F by April 13, 2015.

Please provide comments that conform to the requirements for DoD Instruction 7650.03. If possible, please send a PDF file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We cannot accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

cc: Under Secretary of Defense for Acquisition, Technology and Logistics
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Naval Inspector General
Auditor General, Department of the Navy

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Introduction

Objectives

Our objective was to evaluate and verify the implementation of the corrective actions taken by the F-35 Joint Program Office (JPO), Defense Contract Management Agency (DCMA), and the prime contractor—Lockheed Martin Aeronautics Company (Lockheed Martin), Fort Worth, Texas, in response to the findings identified in DoD Inspector General (IG) Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," September 30, 2013. As part of this project, we also reevaluated Lockheed Martin's implementation of the contractually required Aerospace Standard (AS)9100, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations," contractual quality assurance clauses, internal quality assurance processes and procedures, and public law. In addition, we evaluated JPO- and DCMA-assigned functions and responsibilities related to oversight and monitoring of F-35 contractors.

Background

The F-35 Lightning II Program (F-35 Program) is a joint, multiservice, multinational acquisition to develop and field a next-generation strike fighter aircraft for the Navy, Air Force, Marine Corps, and numerous international partners and foreign military customers. The F-35 has three variants; model F-35A—Conventional Takeoff and Landing (CTOL), F-35B—Short Takeoff and Vertical Landing (STOVL), and F-35C—Carrier-Suitable Variant (CV). In addition to hundreds of other suppliers worldwide, Lockheed Martin has two principal subcontractors/suppliers, Northrop Grumman Aerospace Systems (Northrop Grumman) and BAE Systems (BAE).

The F-35 Program entered the System Development and Demonstration (SDD) phase of the acquisition lifecycle in October 2001; however, after exceeding critical cost growth thresholds established by statute—a condition known as a critical[1] Nunn-McCurdy breach—the original Milestone B decision was rescinded in June 2010 and was not re-approved until March 2012, after program restructuring. As identified in the F-35 acquisition strategy, the F-35 Program uses development, production, and sustainment activities concurrently with 11 separate low-rate initial production (LRIP) lot deliveries. Each LRIP lot represents an increasing level of maturity and additional system capabilities are incrementally delivered as the program approaches full-rate production.

[1] Section 2433, title 10, United States Code defines a critical "Nunn-McCurdy" unit cost breach as an increase of at least 25 percent over the program acquisition unit cost (PAUC) or average procurement unit cost for the program (APUC) or subprogram as shown in the current baseline estimate or an increase of at least 50 percent over the PAUC or APUC for the program or subprogram as shown in the original baseline estimate.

As of September 2014, Lockheed Martin delivered a total of 106 aircraft including the majority of LRIP lot 5 aircraft and was planning to begin delivery of LRIP lot 6 aircraft. Lockheed Martin plans to deliver LRIP lots 6, 7, and 8 aircraft with Block 3I[2] software capabilities. LRIP lots 9 and beyond will be delivered with additional software block updates to enable full warfighting capabilities.

Summary of Previous Evaluation Results

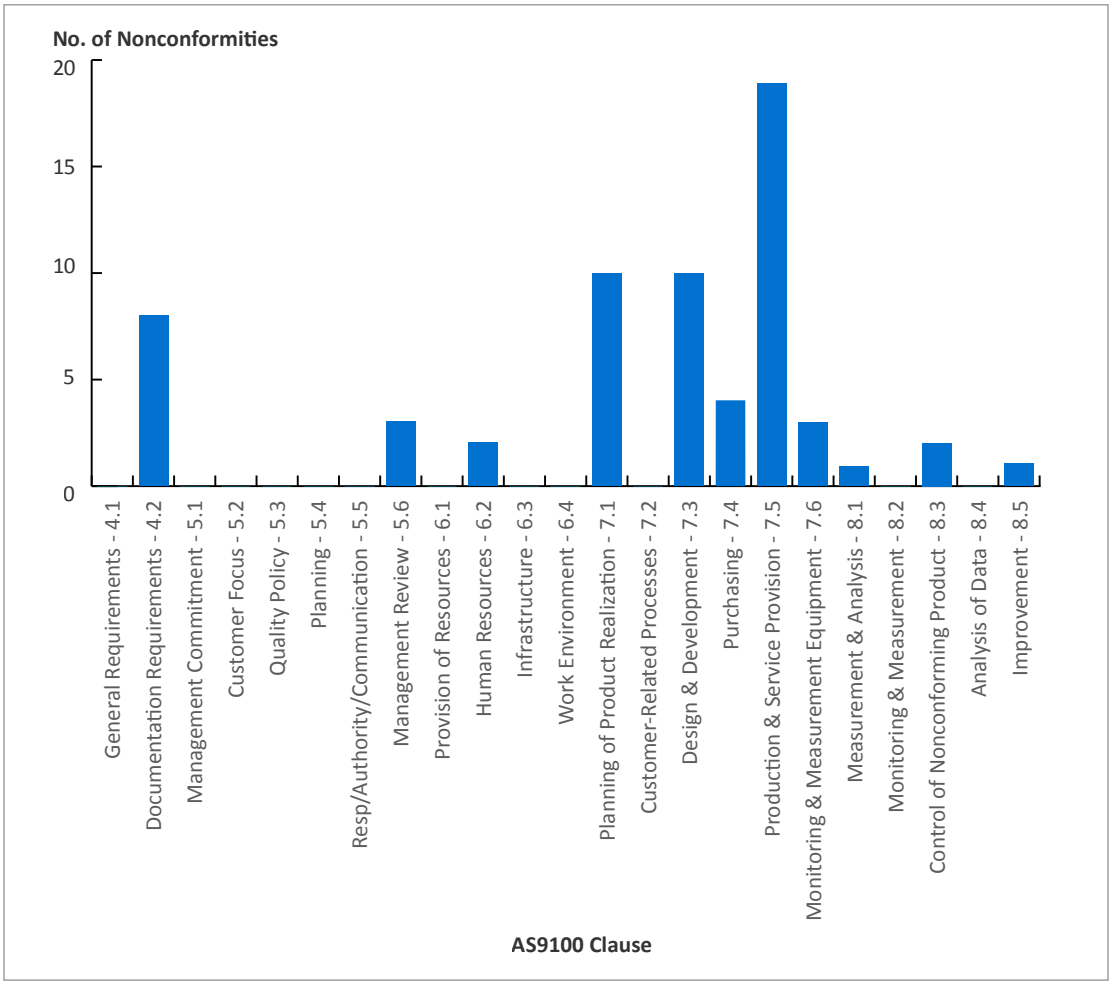
From mid-2012 until early 2013, the DoD Office of Inspector General (OIG) performed a quality management system evaluation of the F-35 Program at Lockheed Martin and its major subcontractors.[3] This evaluation resulted in 363 nonconformities[4] to the AS9100 standard. Eighty-seven of these nonconformities were written against Lockheed Martin; 63 were documented at Lockheed Martin, Fort Worth, Texas and 24 were documented at its subcontractor sites. The remaining 276 nonconformities documented during our previous evaluation were written against Northrop Grumman; BAE; Honeywell Aerospace; L-3 Display Systems; and United Technologies Corporation, Aerospace Systems (UTAS), and were not included in this evaluation. All nonconformities were categorized as major, minor, or an opportunity for improvement (OFI), in accordance with AS9101, "Quality Management Systems – Audit Requirements for Aviation, Space, and Defense Organizations." Of the 63 nonconformities that were directed to Lockheed Martin at its Fort Worth, Texas, facility, 23 were categorized as major and 40 were categorized as minor. These nonconformities were further categorized by the applicable top-level AS9100 clauses as shown in Figure 1.

[2] Initial training and warfighting capabilities were included in software blocks prior to Block 3I. Block 3I includes third generation helmet and night vision capabilities. Future software block upgrades will include full warfighting capabilities.

[3] DoD IG Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program."

[4] AS9101D defines a major nonconformity as "a non-fulfillment of a requirement which is likely to result in the failure of the quality management system or reduce its ability to assure controlled processes or compliant products/services" and a minor nonconformity as "a non-fulfillment of a requirement which is not likely to result in the failure of the quality management system or reduce its ability to assure controlled processes or compliant products/services."

Figure 1. Nonconformities Written Against Lockheed Martin at its Fort Worth, Texas, Facility Documented in Report No. DODIG-2013-140



Evaluation Criteria

We performed our evaluation based on the AS9100C standard, which the contractor is required to comply with in accordance with the F-35 contracts. Additionally, we evaluated the F-35 Program's compliance with applicable statutory and regulatory requirements to include the Federal Acquisition Regulation; Defense Federal Acquisition Regulation Supplement; DoD Instruction Interim 5000.02, "Operation of the Defense Acquisition System," enclosure 1; and DoD Manual 4140.01, "DoD Supply Chain Materiel Management Procedures: Materiel Sourcing," volume 3. Furthermore, we evaluated the F-35 Program's implementation of aviation critical safety item (CSI) requirements. Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 209.270, "Aviation and Ship Critical Safety Items" defines an aviation CSI as "a part, an assembly, installation equipment, launch equipment, recovery equipment, or support equipment for an aircraft or aviation weapons system" that contains a characteristic such that any failure, malfunction,

or absence of which could cause a catastrophic or critical failure resulting in the loss of life, permanent disability or major injury, loss of a system, or significant equipment damage. As part of this evaluation, we performed a quality assurance inspection for two weeks at Lockheed Martin, Fort Worth, Texas from late September 2014 through early October 2014. See Appendix A for more details on the criteria of this evaluation.

Quality Assurance Evaluation Process

To evaluate JPO's management of the F-35 quality assurance program and Lockheed Martin's implementation of corrective actions from the previous DoD IG report (Report No. DODIG-2013-140), we performed a quality assurance inspection for two weeks at Lockheed Martin, Fort Worth, Texas from late September 2014 through early October 2014. The results enabled us to evaluate the F-35 Program's conformity to the contractually required AS9100C quality management system standard, contractual quality assurance clauses, and internal Lockheed Martin quality assurance processes and procedures. It also allowed us to evaluate Lockheed Martin's progress on its quality management system performance. Additionally, we evaluated the corrective actions taken in response to the nonconformities discussed in the previous DoD IG evaluation report and verified whether the nonconformities were adequately resolved or on schedule for resolution.

We established teams of engineering and subject matter experts who evaluated the program based on the AS9100C quality management system standard. The subject matter expert teams consisted of quality assurance engineers, trained and certified in AS9100, who had an average of 17 years of quality assurance audit experience. Additionally, we included a team that evaluated the Lockheed Martin's aviation CSI Program.

Classification and Categorization of Nonconformities

As defined by the AS9101 standard, a major nonconformity is a nonfulfillment of a requirement that is likely to result in the failure of the quality management system or reduce its ability to ensure controlled processes or compliant products/services. A minor nonconformity is a nonfulfillment of a requirement that is not likely to result in the failure of the quality management system or reduce its ability to ensure controlled processes or compliant products or services. An OFI is an industry best practice where a specific requirement does not exist. This report focuses on the major nonconformities documented during this evaluation.

Organization of the Report

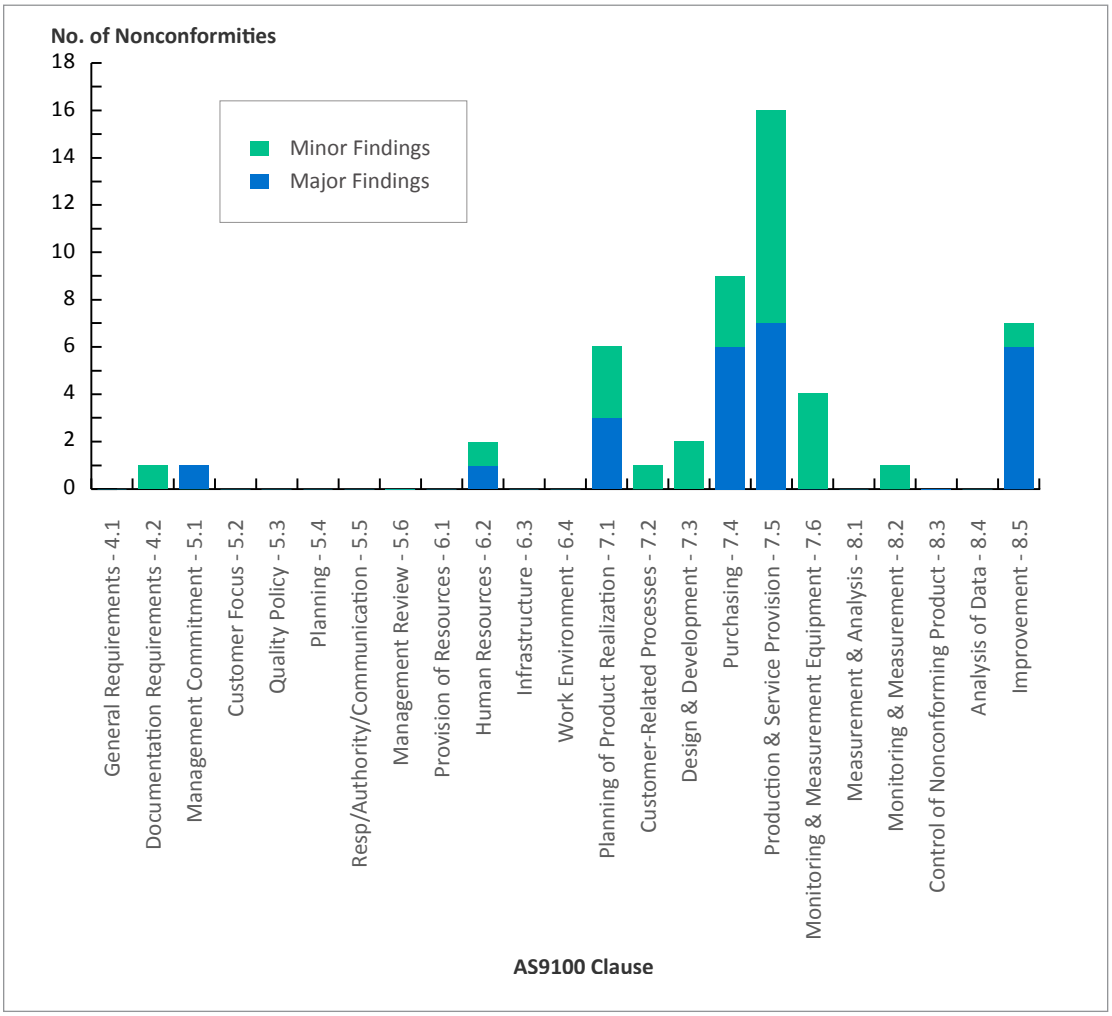
The remainder of this report is organized in three sections, the first of which discusses the results of our AS9100 inspection of Lockheed Martin conducted from September 22 to October 3, 2014, the second documents the results of our evaluation of the corrective actions taken in response to our previous report (DODIG-2013-140), and the third section provides a summary of the overall performance of the F-35 program quality management processes by comparing the results of this evaluation to the results of our previous evaluation. We conclude the report with a discussion of our overall findings and recommendations.

Current F-35 Program Quality Management Performance

Results of AS9100 Conformance Inspection at Lockheed Martin, Fort Worth, Texas

Our inspection at Lockheed Martin, Fort Worth, Texas from late September 2014 through early October 2014 resulted in 61 nonconformities that identified weaknesses in the F-35 Program's implementation of the AS9100 quality management system. Of these, 52 were written against Lockheed Martin and were categorized as 24 major, 26 minor, and 2 OFIs. Four nonconformities were written against JPO: two major and two OFIs. In addition, five were written against DCMA: one major and four minor.

Figure 2. Lockheed Martin Nonconformities Found During the Evaluation



Lack of Commitment to Quality Management Objectives

Management Commitment (5.1)

In accordance with the F-35 Program Quality Management Plan, a 90-percent reduction of the assembly defect rate is necessary by full-rate production in order to meet the goal of producing one aircraft per day.[5] At the time of our inspection, LRIP lot 5 should have demonstrated a 60-percent reduction in defect rate; however, the required progress toward this goal could not be determined because—in accordance with conflicting information contained in the quality management plan—Lockheed Martin was tracking the number of nonconforming material records rather than the number of assembly defects. Nonconformance data for LRIP lots 1 through 5 demonstrated only a 23-percent reduction of nonconforming material records. The lack of ability to accurately determine and reduce assembly defects in accordance with defined program objectives may negatively impact the full-rate production delivery schedule.

Insufficient Software Quality Management Rigor

Competence, Training, and Awareness (6.2.2)

We identified a systemic problem with Lockheed Martin's software engineer training program. Its Learning Management System and Training Requirements Matrix only captured training completion status and did not include F-35 project-specific training plans or training requirements for software developers. The development of software intensive systems, such as the F-35 Program, requires software development integrated product team members involved in the design, implementation, and testing of critical software to receive specific training applicable to their assigned tasks. Without a software development training program, software defects could increase and possibly degrade product performance, reliability, and maintainability.

Design and Development Verification (7.3.5)

Lockheed Martin was not conducting functional configuration audits (FCAs) and physical configuration audits (PCAs) of the Mission System and Vehicle System computer software configuration items (CSCIs). The intent of an FCA is to verify that a CSCI (or a hardware configuration item [HWCI]) meets the requirements documented in the associated specifications by examination of the test plans, procedures, and data. A PCA is formal evaluation of the as-built configuration of a HWCI or a CSCI against its technical documentation to establish the

[5] The F-35 Program Quality Management Plan defines the assembly defect rate reduction goal with respect to the SDD baseline and prescribes a 10-percent reduction per LRIP lot in order to achieve a 90-percent reduction by full rate production.

product baseline (as-built versus as-designed). Lockheed Martin required all of its software suppliers to verify their CSCIs by performing FCAs and PCAs; however, Lockheed Martin did not perform FCAs/PCAs for internally developed Mission System and Vehicle System CSCIs. Furthermore, the lack of complete software requirements definition of lower level software units such as Fire Control and Navigation hampered Lockheed Martin's ability to perform FCAs and PCAs. The absence of FCA and PCA requirements for internally developed software could result in software that is not verified and validated, leading to aircraft performance risks.

Verification of Purchased Product (7.4.3)

Lockheed Martin received software from suppliers without ensuring that known deficiencies were categorized and defined in accordance with its software development plan (SDP). For example, Northrop Grumman delivered Integrated Communications, Navigation, and Identification (ICNI) software to Lockheed Martin with 1 major, 12 minor, and 92 known open and uncategorized deficiencies. However, neither the ICNI SDP nor the F-35 Air System SDP defines software defect categories or severity as major and minor. Lockheed Martin instead categorizes software deficiencies as Severity 1 through 5 and does not allow the delivery of flight software with open deficiencies of Severity 1 or 2. Lockheed Martin did not determine the system performance impact and severity of these deficiencies. If software deficiencies are not categorized by severity as defined in the F-35 Air System SDP, then software could be released with open high-severity defects, which could result in performance degradation or even catastrophic failure of aircraft.

Preventive Action (8.5.3)

We found numerous examples of software problem anomaly reports (SPARs) identified with Severity 2 problems[6] that did not address root cause analysis or effective preventive action. The root cause identification and corrective action processes are critical for product improvement and reliability growth and the lack thereof may also result in design and quality escapes that impact product performance, reliability, and maintainability.

[6] Joint Strike Fighter Program: Air System Software Quantitative Management Plan, Document Number 2RXP00003, Revision D, defines Severity 2 software defects as "[a] software defect that adversely affects the accomplishment of an operational or mission essential capability and no work-around solution is known."

Unmanaged Performance Specification Risks

Risk Management (7.1.2)

JPO and Lockheed Martin jointly identified 21 out of 462 system-level requirements contained within the Joint Strike Fighter (JSF) Contract Specification (JCS) that were unlikely to be achieved by the end of the SDD phase of the program. Examples of these 21 requirements included: Reliability and Maintainability, Maneuverability, Payload Requirements, Ballistic Vulnerability, and CTOL Internal Gun Accuracy. However, Lockheed Martin did not consider these 21 requirements as risks and did not handle them in accordance with its risk management process. Fulfillment of these requirements may not be achieved if they are not appropriately tracked and managed as risks.

Weaknesses in Subcontract Management

Purchasing Process (7.4.1)

JPO requires Lockheed Martin to be AS9100 compliant. Lockheed Martin's internal procurement process flows down AS9100 or appropriate quality management systems to its suppliers based on product complexity and criticality. However, three of Lockheed Martin's approved suppliers were not AS9100 certified, as required by Lockheed Martin's internal supplier quality requirements. Therefore, those suppliers might not have the necessary quality management system processes in place to ensure product reliability.

DCMA is the only JPO-delegated authority to approve minor nonconformances. However, Lockheed Martin procurement requirements allowed minor nonconformances to be dispositioned and approved by suppliers who provide "seller-designed" items. Allowing subtier suppliers to disposition and approve minor nonconformances impedes the Government's ability to fulfill its responsibility to manage the risks associated with the acceptance of nonconforming products.

Purchasing Identification (7.4.2)

Lockheed Martin's procurement process did not ensure that its purchase orders identified the specific revisions of technical documentation required to produce, inspect, and test the item being purchased. We also found that when purchase orders were issued, Lockheed Martin relied on its suppliers to retrieve the most up-to-date technical requirements from their online technical data system rather than notifying the supplier when technical data had changed. These practices could result in products that are not compliant with the applicable technical requirements in order to achieve mission capabilities.

Verification of Purchased Product (7.4.3)

Our inspection identified that Lockheed Martin was not using its escalation process for delinquent supplier-generated data items to ensure its subcontractors delivered the required data items on time. Hundreds of delinquent supplier data items existed with an average delinquency of about 230 days. Many data items were more than 2 years delinquent, with one item exceeding 1,200 days. Examples of such delinquent data items included manufacturing plans, acceptance test plans and procedures, and diminishing manufacturing sources redesign and technology refresh plans. Many of these subcontractor data items contain information that must be included in Lockheed Martin's contractually required deliverables to JPO. Lockheed Martin has an escalation process to address delinquent subcontract data item submittals that includes withholding funds; however, no action was taken to use the escalation process for any of its suppliers. Manufacturing plans, acceptance test plans and procedures and other documentation discussed previously should be evaluated by the appropriate subject matter experts for adequacy. Failure to evaluate such deliverables could result in deficient manufacturing or validation processes and ultimately impact product performance and reliability.

Weaknesses in Production and Assembly

Our inspection of Lockheed Martin's manufacturing and assembly areas resulted in the identification of deficiencies in process discipline, process planning, process proofing, tool control and verification, and product protection.

Control of Production and Service Provision (7.5.1)

We identified a lack of process discipline in the manufacturing and assembly area. In one instance, multiple fasteners on the Radio Frequency Support Electronics assembly strut were not torqued in accordance with the applicable specifications. The manufacturing documentation, referred to as operational cards and work instructions, indicated that both the operator and quality inspector had verified that the torque operation was completed. However, we observed that the fasteners were loose and rotated freely. It was also identified that a mechanic in the final assembly area used sealant on an arresting gear assembly fasteners after the sealant's useful life had expired.

In another instance, we found that operational card or planning did not specify the required torque values for the mounting of a cabling connector to its bracket on the frame of the forward fuselage. Torque requirements for these fasteners were prescribed in a Lockheed Martin specification referenced by the assembly's engineering drawing. As a result, the mechanic installed the fasteners without the use of a torque wrench and was not aware of the torque requirement.

Lockheed Martin did not adequately perform process proofing of the automated drilling operations on the CTOL wing. Its proofing process released automated drilling software for production that was not programmed correctly to achieve full penetration of the wing edge in accordance with the applicable specifications. Verification operations failed to identify the improperly drilled holes before the product left the work center. These holes were identified at the next work station, and the corrective action taken was to rework the holes to meet the design requirements using a hand drill process.

We found no evidence of a formal process or management system to track the status and condition of critical lift fixtures. As a result, required periodic inspection and load testing of critical lift fixtures were not performed as a system, to include: lifting fixture, lifting strap, rings, clevises, and pins. We also noted that a production tool with an expired periodic inspection/verification tag was used in the wing assembly area.

We documented four minor nonconformities related to Lockheed Martin's measuring equipment control and calibration process that indicate the existence of a systemic problem. Examples of deficiencies include: calibration labeling, maintenance certification, and the availability of tools for use while outside the maintenance certification period.

Lack of adequate control in the area of manufacturing and assembly operations through the use of disciplined implementation, planning, process proofing, and tool control and verification could increase defect rates, prevent achievement of the planned production delivery schedule, and result in negative impacts to product performance and reliability.

Preservation of Product (7.5.5)

During our inspection of the production areas, we found one employee walking on an aircraft without the required shoe covers to protect aircraft surfaces and also walking on surface areas designated as "no-step" areas. Walking on no-step areas could stress, fatigue, or damage aircraft structures. In addition, required protective material was not used to minimize the risk of damage to the aircraft surfaces by automatic lifting work stands and platforms.

We also identified discipline issues with Foreign Object Debris (FOD) protection and housekeeping. FOD was detected at two FOD control areas in the final assembly area. FOD has continued to be a systemic discipline issue since our last evaluation, as evidenced by 41 Corrective Action Requests (CARs) issued by DCMA for FOD violations during 2013 and 2014. Additionally, Lockheed Martin did not adhere to housekeeping policies and practices for cleaning all work stations and auto drill centers of metal chips.

There is increased risk of latent defects and damage to the aircraft, if Lockheed Martin does not ensure procedures are followed and product protection measures are taken.

Government Quality Assurance Oversight Performance

Performance of DCMA

We evaluated DCMA's oversight of F-35 production and identified that DCMA was not following its process for escalating CARs. DCMA's policy is to escalate contractor CARs to the next higher level when repetitive CARs have been issued, when rejected Corrective Action Plans (CAPs) are not resubmitted within the 10-day requirement, or when corrective action validation is rejected. We found instances when DCMA failed to escalate CARs which exemplified each of these cases. The reoccurrence of FOD-related problems highlighted the ineffectiveness of DCMA's corrective action oversight. DCMA issued a CAR to Lockheed Martin in response to FOD control deficiencies documented during our previous evaluation. This CAR was subsequently closed based on the validation of completed corrective actions. During 2013 and 2014, since our previous evaluation, DCMA issued 39 Level II CARs for instances of FOD violations without escalating them to Level III. Failure to escalate CARs to the next higher level when appropriate undermines the effectiveness of the corrective action process. In addition, DCMA and JPO leadership may not be aware of problems until they adversely impact the cost, schedule, and performance of the program.

Performance of the Joint Program Office

As previously stated in report section Unmanned Performance Specification Risks, Risk Management (7.1.2), Lockheed Martin has been unable to achieve 21 system-level capability requirements. In accordance with the H-30, "Future Specification Changes," SDD contract clause issued in May 2013, JPO intend to change the 21 high-risk system-level JCS requirements to values mutually agreed upon by JPO and Lockheed Martin based on additional testing and analysis which is yet to be performed. As a result, delivered and future aircraft may not satisfy all system capability requirements and it is unclear to what extent these capabilities will be achieved by the completion of the SDD phase.

Results of Corrective Action Evaluation

As a part of this effort, we evaluated the actions taken by Lockheed Martin, JPO, and DCMA in response to the findings documented during the previous evaluation to determine whether the root causes were identified and the corrective actions were effective.

A total of 87 nonconformities were documented against Lockheed Martin during the previous evaluation; 63 were documented at Fort Worth, Texas, and 24 were documented at its subcontractor sites.

JPO stated that Lockheed Martin implemented corrective measures to resolve these nonconformities and considered 82 of them to be closed. However, we determined that only 76 of the 87 nonconformities were closed and we recommended further actions for the 11 remaining nonconformities; 5 were due to ongoing corrective action and 6 were due to inadequate corrective action. The criteria we used to determine whether previous nonconformities were still open included: ongoing corrective action efforts, ineffective corrective action to prevent finding reoccurrence, administrative closure of findings prior to assessment of corrective action effectiveness, and inadequate documentation of corrective actions taken. To ensure that all nonconformities requiring further action from the previous evaluation are properly tracked to closure, we documented each item as a new nonconformity during this evaluation. We consider the following issues still open.

Ongoing Corrective Action

Critical Safety Items

During our previous evaluation, we documented four CSI nonconformities related to the lack of a CSI Program. These nonconformities were considered open by JPO, DCMA, and Lockheed Martin due to incomplete implementation of corrective action. Since our previous evaluation, Lockheed Martin worked with JPO and DCMA to develop a plan to establish an F-35 CSI management program. Status and sufficiency of the plan is discussed in the Government Progress on Corrective Actions section of this report.

Capability Confirmation Criteria

We also documented a nonconformity regarding the lack of capability confirmation criteria for the acceptance of LRIP aircraft during our previous evaluation. This nonconformity was still considered open by JPO, DCMA, and Lockheed Martin due to incomplete implementation of the corrective action. Since our previous evaluation, Lockheed Martin worked with JPO and DCMA to develop a plan

to establish capability confirmation criteria. On LRIP contracts, the program developed a Configuration and Capability Description Document (CCDD) to identify specific configuration and representative/key capability attributes, such as warfighting capabilities available to the pilot and the maintainer, which would be present in a respective LRIP lot. However, at the time of this evaluation, Lockheed Martin and JPO were at a contractual impasse and were unable to implement the associated corrective actions. JPO and Lockheed Martin had no further plan or path forward to establish verifiable capability confirmation criteria for the acceptance of LRIP aircraft. The lack of clearly defined capability confirmation criteria in the CCDD resulted in acceptance of aircraft whose capabilities may not have been adequately verified and validated.

Ineffective Corrective Action

Foreign Object Debris

JPO, DCMA, and Lockheed Martin considered the systemic FOD issues to be resolved and the associated corrective actions closed. However, we identified that the corrective actions did not effectively prevent reoccurrence of FOD issues. In response to our recommendation from our previous report, Lockheed Martin implemented an 8-step CAP. Internal Lockheed Martin production assessment scorecard data for 2014 and DCMA Level II CARs for 2013 and 2014 indicated that the steps taken in the CAP had not been effective in preventing reoccurrence of FOD in manufacturing areas. An ineffective FOD control program could lead to damaged aircraft, degraded performance, catastrophic failure, loss of aircraft, and loss of life.

First Article Inspection

First article inspections are required to ensure that manufacturing processes are validated properly to reduce variability and nonconformances in delivered products. Our previous evaluation at L-3 Display Systems (L-3) identified that Lockheed Martin accepted hardware from L-3 for LRIP lots 1 through 5 without the performance of first article inspections. JPO, DCMA, and Lockheed Martin considered this issue to be resolved and administratively closed the CAP in December 2012; however, the documentation provided with the CAP stated that the sustainability or effectiveness of corrective actions taken could not be confirmed until the third or fourth quarter of 2013. We found no evidence that verification and validation efforts were performed for these corrective actions by JPO, DCMA, or Lockheed Martin.

Variance Approval Process

A nonconformity regarding Lockheed Martin's approval of variances that waived performance requirements for the electronics and display units was documented at L-3 during our previous evaluation. The variances did not contain documented corrective actions that would prevent the need for repeated variance requests. As part of the resolution of this deficiency, Lockheed Martin implemented a 3-step CAP and although JPO, DCMA, and Lockheed Martin considered this issue to be resolved and closed, our evaluation identified that Lockheed Martin's actions to resolve this nonconformity were ineffective. Specifically, Lockheed Martin's procedure and records indicated that integrated product team members were allowed to extend the variances to an unlimited number of units and extend commitment dates associated with corrective action completion without management approval. Because variance requests typically impact product performance—as documented in this case—the acceptance of product variances without adequate control, oversight, and corrective action could result in degraded aircraft capabilities.

Failure Reporting and Corrective Action

During our previous evaluation we documented that Lockheed Martin did not require UTAS to deliver Failure Reporting and Corrective Action System (FRACAS) data to determine the reliability of the products delivered. JPO, DCMA, and Lockheed Martin considered this issue to be resolved and closed. However, we identified that the corrective actions to resolve this issue did not prevent reoccurrence. Since our last evaluation, Lockheed Martin implemented a 4-step CAP to address identified deficiencies. UTAS delivered the FRACAS data for LRIP lot 5 after funding issues were resolved; however, funding constraints prohibited the delivery of FRACAS data for LRIP lots 6 and 7. Lockheed Martin cannot ensure that the F-35 meets all product reliability requirements if its engineering staff does not review and analyze subcontractor FRACAS data.

Annual Audit of Software Suppliers

We documented a nonconformity during our previous evaluation relating to Lockheed Martin's oversight of software suppliers. JPO, DCMA, and Lockheed Martin considered this nonconformity to be resolved and closed; however, our evaluation identified that the corrective action was inadequate. Lockheed Martin did not audit its software suppliers annually in accordance with the applicable internal operating instruction. We evaluated the records

of five software suppliers and noted that Lockheed Martin had not conducted required annual audits for any of the suppliers since we identified this issue during our last evaluation. Because much of the aircraft capability is reliant upon robust software, adequate control of software suppliers is necessary to minimize the risk of accepting defective software that can degrade product performance, reliability, and maintainability.

Calibration of Measuring Equipment

During our previous evaluation, we documented that Lockheed Martin granted temporary extensions of calibration due dates for measuring equipment whose calibration certifications had already expired. The associated CAP identified that the root cause of this nonconformity was the failure of the equipment owners to submit calibration extension requests prior to expiration with adequate justification. As a result, Lockheed Martin removed the requirement to request extension prior to calibration expiration. Based on this corrective action, JPO, DCMA, and Lockheed Martin considered the nonconformity resolved and closed; however, this could result in the increased risk of using un-calibrated tools, potentially leading to the manufacture of nonconforming product. We determined that the root cause analysis and corrective action should be reevaluated to prevent reoccurrence of the problem.

Inadequate Objective Evidence

Lockheed Martin was not always able to provide objective evidence to demonstrate that corrective actions taken to resolve nonconformities identified in our previous evaluation were completed. Lockheed Martin uses its Integrated Corrective Action (ICA) database to capture internal CARs, CAPs, and objective evidence to support CAR closure and CAP validation. The ICA database did not contain all objective evidence for numerous CAPs and their associated DCMA CARs to support verification of corrective actions. Closure of nonconformities without necessary objective evidence to support validation of CAP actions can lead to reoccurrence of the nonconformities.

Government Progress on Corrective Actions

We also evaluated DCMA's and JPO's actions taken in response to nonconformities documented against them during our previous evaluation to determine if root causes were identified and corrective actions were effective.

Defense Contract Management Agency

During the previous evaluation, we documented a total of six nonconformities against DCMA offices. These offices included: DCMA Fort Worth, Texas; DCMA Northern Europe, Samlesbury, United Kingdom; DCMA Atlanta, Georgia; and DCMA Cleveland, Ohio. We identified deficiencies in the delegation of authority, minor variance approval, material review board actions, issuance and execution of letters of delegation, and delivery of supplier reporting data between DCMA offices. Based on the information presented by DCMA, we determined that closure of these six findings was substantiated.

Joint Program Office

Previously Documented Nonconformities

We documented eight nonconformities against JPO during our previous evaluation. These nonconformities related to the CSI Program, documentation of F-35 risk management activities, F-35 diminishing manufacturing sources and materiel shortages (DMSMS) management and planning, and Block 2A test readiness review criteria. JPO considered three nonconformities closed; however, it did not provide any objective evidence for corrective actions taken in response to any of the eight nonconformities.

Status of Critical Safety Item Program Implementation

We documented in our previous evaluation that JPO and Lockheed Martin did not comply with Public Law 108-136, Section 802; DFARS Subpart 209.270; and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items." Since then, Lockheed Martin created an extensive CSI list and DCMA added the requirement for government source inspection for all CSIs on the list. Lockheed Martin also drafted a CSI Program Plan for submittal to JPO, which is expected to be included in a modification to the SDD contract to implement the CSI requirement. The draft CSI Program Plan erroneously describes the F-35 Program as "a legacy program with respect to CSI," and unfortunately, implementation of this plan would lead to less than full compliance with CSI requirements. At the time of our evaluation, JPO's plan was to contractually require implementation of a CSI program by February 2016. We determined that the draft CSI Program Plan, dated May 21, 2014, does not meet all the Joint Service CSI Instruction requirements and Lockheed Martin's production integrity program did not cover all identified CSIs and CSI requirements.

During this evaluation, we identified that Lockheed Martin's CSI Program Plan was still noncompliant with some of the deficiencies that we identified in our previous report. For example, the F-35 CSI Program Plan contained a section describing the identification and documentation of critical characteristics. Based on that section, it appeared that Lockheed Martin concluded that existing quality and integrity programs were sufficient. Furthermore, the plan did not require CSI critical characteristics to be defined. It also did not ensure CSI-specific training for personnel performing work on CSIs or put the necessary processes in place when operations affect critical characteristics. The CSI Program Plan still did not address limitations on material review board authority for nonconforming CSI assemblies and/or components or include scheduled internal and external CSI audits.

Status of Independent Quality Organization Establishment

In our previous report, we recommended that JPO establish an independent quality assurance organization. The intent of the recommendation was to improve the quality organization's authority and independence. JPO did initiate the establishment of a quality organization and assigned a Quality Lead; however, the organization reports to the Director of Production rather than directly to the F-35 Program Executive Officer (PEO). The F-35 Program also had not yet adequately staffed its quality organization to provide effective oversight, nor had it ensured roles and responsibilities of the organization were developed and followed to effectively impact the program. JPO's August 8, 2014, response to our previous report stated that the estimated date to have the quality organization developed and staffed would be 12 to 24 months from May 2014.

Status of Capability Confirmation Criteria Implementation

During this evaluation, we found that the capability confirmation criteria necessary to verify and validate LRIP aircraft capabilities during aircraft acceptance had not been defined in the CCDD, as documented in our previous evaluation. As a result, the acceptance of F-35 aircraft depended on the professional judgment of the individual JPO subject matter expert who reviewed the objective evidence provided to confirm the capabilities of the aircraft.

Since our previous evaluation, JPO worked with Lockheed Martin and DCMA to develop a plan to establish capability confirmation criteria for aircraft acceptance; however, at the time of this evaluation, JPO and Lockheed Martin were at a contractual impasse and, as a result, were unable to implement the associated corrective action. JPO and Lockheed Martin had no plan or path forward to establish capability confirmation criteria for the acceptance of aircraft.

Summary of the Evaluation

Based on our evaluation, we determined that the F-35 Program has made progress; however, some challenges still remain.

Although the quantity of major nonconformities documented during this evaluation remained relatively the same in comparison to our previous evaluation, the overall number of nonconformities decreased (see Table 1). We further categorized the nonconformities by major AS9100 section and compared the results with those of our previous evaluation (see Figures 3 and 4). Lockheed Martin's quality management system performance improved in the Human Resources, Planning of Product Realization, Design and Development, and Documentation Requirements focus areas of AS9100 compliance. We also noted improvement in the Production and Service Provision focus area; however, the abundance of major nonconformities in this area is still a cause for concern. Among the major nonconformities documented in this area, we observed the reoccurrence of a systemic FOD problem, indicating ineffective corrective actions. Although the overall trend demonstrated improvements in the majority of areas, the nonconformities related to the Purchasing and Improvement focus areas of AS9100 compliance increased.

Table 1. Comparison of Major and Minor Nonconformities Directed to Lockheed Martin from the previous report and this evaluation

	Major	Minor	Total
Previous Evaluation*	23	40	63
Current Evaluation	24	26	50

* DoD IG Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," documented 70 nonconformities at Lockheed Martin, Fort Worth, 63 of which were directed to Lockheed Martin and 7 of which were directed to JPO.

Figure 3. Comparison of Major Nonconformities Directed to Lockheed Martin (Previous Evaluation and Current Evaluation)

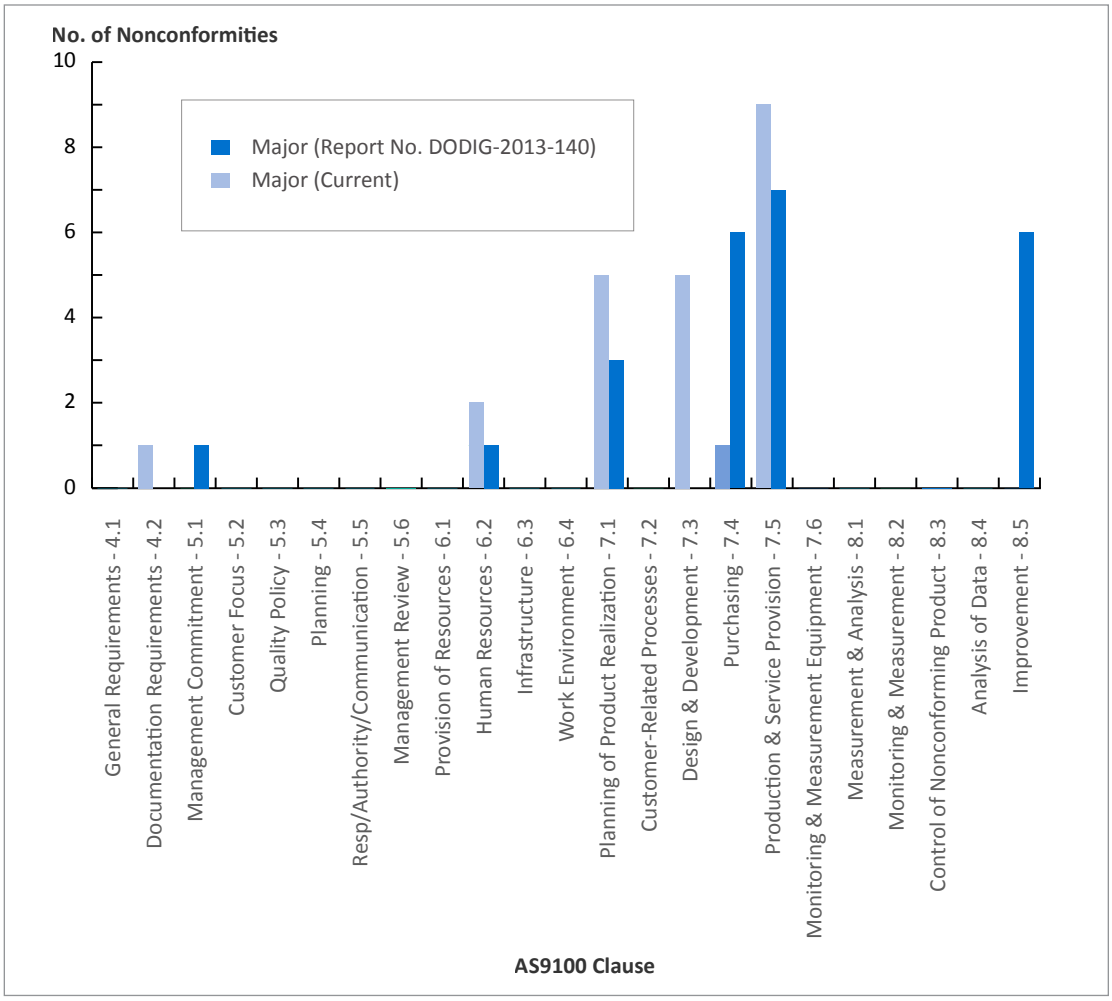
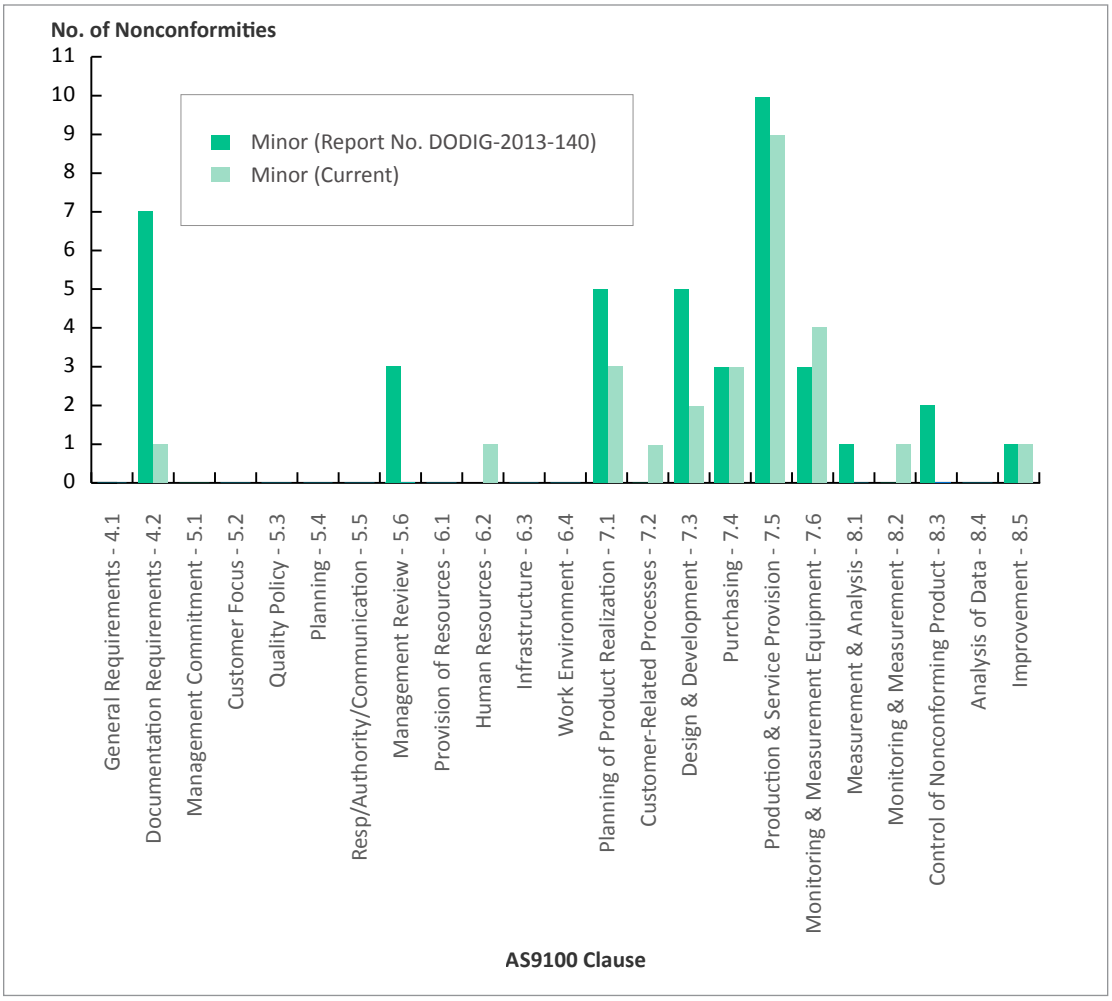


Figure 4. Comparison of Minor Nonconformities Directed to Lockheed Martin (Previous Evaluation and Current Evaluation)



We also noted that the F-35 Program made progress with respect to its corrective actions in response to nonconformities documented during our previous evaluation. In response to the 87 nonconformities documented against Lockheed Martin that we identified in our previous report, Lockheed Martin developed and implemented corrective action plans and considered 82 of them resolved and closed. Lockheed Martin identified and documented root cause, corrective action plans, and provided adequate evidence to support closure of the majority of the nonconformities documented against them. However, we determined that only 76 of these 87 nonconformities were closed and we recommended further actions for the 11 remaining nonconformities. JPO's lack of effective oversight to ensure timely and efficient resolution of deficiencies identified in our previous report is demonstrated by the following:

- limited commitment to a fully functional and independent quality oversight organization,
- lack of ability to produce objective evidence for the closure of previous findings and nonconformities,
- failure to comply with public law in fulfilling the CSI Program requirements,
- lack of progress in defining the acceptance criteria for each LRIP lot,
- lack of adequate commitment to ensure that the program fulfills all system level requirements, and
- lack of leadership to ensure defect rate reduction necessary to meet the planned full-rate production delivery goals.

In addition, while DCMA has demonstrated improvement, they are not following the established DCMA CAR escalation process to manage Lockheed Martin's corrective action activities appropriately.

Based on our quality management system inspection and evaluation of corrective actions, we documented the following systemic findings.

Finding A

Insufficient Progress Had Been Made Toward Implementation of the Critical Safety Item Program

The F-35 Program had not made sufficient progress toward full compliance with Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items," by February 2016. This was caused by the lack of CSI requirements on the F-35 contracts, as required by public law and the Joint Service CSI Instruction. This lack of compliance with CSI public law and implementing instructions may impose an increased safety of flight risk on delivered aircraft.

Discussion

As identified in our previous report JPO had not flowed down a contractual requirement to Lockheed Martin to implement a CSI Program in accordance with Public Law 108-136, Section 802 and the Joint Service CSI Instruction. The CSI public law has been imposed since 2003.

JPO and Lockheed Martin have taken initial steps to establish a CSI Program; however, the program was still not fully compliant with applicable laws and regulations. JPO was planning to contractually require implementation of a CSI Program by February 2016. However, the current draft of the CSI Program Plan prepared by Lockheed Martin did not sufficiently address requirements described in the Joint Service CSI Instruction including the need to define critical characteristics for all CSIs and the proper limitations and delegations for the material review board authority for nonconforming CSI critical characteristics.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendations, Management Comments, and Our Response

Recommendation A

We recommend that the F-35 Joint Program Office:

1. **Ensure that the F-35 CSI Program is compliant with Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items."**

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

- Contract actions for both SDD and LRIP that address the Joint Service CSI Instruction, "Management of Aviation CSIs" are in work or in place to implement the full F-35 CSI Program
    - SDD RFP for CSI NRE [non-recurring engineering] efforts to initiate F-35 CSI Program released Oct 2013 and resulted in a LM delivered Draft CSI Program Plan coordinated with F-35 JPO for approval of the CSI implementation approach and go ahead for delivery of the SDD proposal expected; go ahead date for proposal development expected 2QFY15
        - After the SDD CSI NRE efforts are completed, the full scope of the F-35 CSI program will be included in future production and sustainment contracts.
    - LRIP Production contracts (LRIP 1-8) currently cover explicit CSI tasks for 'limited' compliance for several CSI 'gaps' from the Joint Service CSI Instruction, "Management of Aviation CSIs."
        - Maintain / update the DOE [Director of Engineering] approved CSI list for configuration control
        - Use existing recurring processes: Material Review (MR), Variance, Item Acceptance, New Suppliers, Process Metrics, and Minor & Major Change processes for CSIs
        - Provide CSI notification to affected suppliers via contracts letter
        - Provide notification if any identified non-conformances results in a safety impact

- Report MR actions & QARs [Quality Assurance Reports] associated with CSI once per month
- Use existing disposal processes to destroy scrapped CSIs that render part nonfunctional

- DCMA-LM FW [Fort Worth] Integrated CSI Surveillance Strategy developed Jan 2014 and covers CSI Delegations to ensure appropriate DCMA process surveillance of CSI parts, and imposed Government Source Inspection (GSI) on all parts that have been identified as CSIs per the Joint Service CSI Instruction.

Our Response

The comments from JPO partially meet the intent of our recommendation. Based on JPO's response, the F-35 program appears to be making progress in establishing a CSI program. However, the comments do not include a timeline for the implementation of the "full" F-35 CSI Program. We request that JPO provide a timeline for the implementation of the "full" F-35 CSI Program and update the current draft CSI Program to fully comply with applicable laws and regulations.

2. Conduct periodic CSI Program evaluations of Lockheed Martin and its suppliers to ensure compliance with public law and the Joint Service CSI Instruction.

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

> F-35 JPO & LM [Lockheed Martin] conducted a CSI TIM [Technical Interchange Meeting] in Nov 2014 following completion of the DoD IG Quality Assurance & Corrective Action Evaluation to address DoD IG "Opportunity For Improvement" comments issued for CSIs and CSI Program Plan.
>
> F-35 JPO, DCMA & LM are conducting bi-weekly telecoms and periodic TIMs on-site at LM until SDD contract agreement is reached to implement the full scope CSI Program infrastructure and processes.
>
> After F-35 full scope CSI implementation is underway, the F-35 JPO will transition to a monitoring phase with periodic reviews, which will leverage or combine with other JPO/DCMA activities (joint audits, Production Readiness Reviews, quality reviews, metrics, etcetera).

Our Response

The comments from JPO meet the intent of our recommendation. No further comments are required.

Finding B

Oversight of Product Development and Realization of Requirements Was Inadequate

JPO was not adequately managing the F-35 Program to ensure that all system-level requirements and capabilities defined in the JSF JCS were realized and verified. As a result, delivered and future aircraft may not satisfy all system capability requirements and it is unclear to what extent these capabilities will be achieved by the completion of the SDD phase.

Discussion

The JCS document identifies more than 400 system-level requirements that define performance characteristics. JPO and Lockheed Martin jointly identified 21 system-level requirements contained within the JCS that were unlikely to be achieved by the end of the SDD phase of the program. However, JPO and Lockheed Martin did not consider these 21 requirements as risks and did not handle them in accordance with their risk management process.

In addition, JPO still has not defined objective and measureable aircraft acceptance criteria for each LRIP lot. The confirmation criteria defined in the CCDD did not include clearly measurable and verifiable acceptance criteria that were clearly traceable back to the JCS. This was documented in our previous evaluation and continues to be a challenge.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendations, Management Comments, and Our Response

Recommendation B

We recommend that the F-35 Joint Program Office:

1. **Clearly define contractual criteria for the acceptance of all future and fielded aircraft to ensure that aircraft capabilities are verified.**

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

> F-35 JPO is progressively refining acceptance criteria with each LRIP lot. The use of CCDDs will continue to be used for LRIP 7 and LRIP 8. These CCDD items require positive verification activity to occur, often with dedicated flight test evaluations; and they provide a means to ensure the weapons system meets warfighter expectation for that production lot. However, the use of these documents does not negate the responsibility to document any known JCS non-compliances at the time of aircraft acceptance. This will continue to occur as it has occurred in the past. As SDD progresses F-35 JPO does expect more qualification evidence to be available which will allow for more robust documentation of JCS non-compliance at the time of aircraft acceptance. This will be done in addition to requiring positive verification for all CCDD items.
>
> Beginning with LRIP 9, the next lot to be negotiated, F-35 JPO will require full JCS compliance. F-35 JPO will assess LRIP 9+ product acceptance against the SDD specification. For future full-rate production contracts, there is planned a separate production specification that will leverage the final SDD specification.

Our Response

The comments from JPO do not meet the intent of our recommendation. JPO has not identified the actions that it will take for verification and validation of aircraft already delivered or still in production for LRIP lots 1 through 8. JPO needs to ensure all aircraft delivered are tested and verified using clear and measurable capability criteria. We request that JPO provide further comments in response to the final report.

2. **Ensure that all 21 system-level requirements that the F-35 Program has acknowledged may not be met, in addition to the risks associated with the failure to meet these requirements, are documented, tracked, and mitigated using the established risk management process.**

F-35 Joint Program Office Comments

F-35 Joint Program Office partially agreed and stated:

> F-35 JPO sees merit in tracking to closure the contractually defined 21 system level requirements that may not be fully met. F-35 JPO agrees the high-level visibility of a formal tracking Action Item to periodically status these requirements to closure will ensure resolution of them in an expeditious manner.
>
> However, F-35 JPO DISAGREES with the recommendation to track these 21 system level requirements through the risk management process. These 21 requirements are not risks – they are a subset of requirements where the program has jointly acknowledged that the level of specified performance will not be met. Conversely, the purpose of risk management is to highlight

and take proactive actions to avert a potentially bad outcome, such as a specification miss. Within the F-35 risk management process, risks are managed via a series of funded mitigation steps and technical gates to eliminate or reduce the likelihood and/or consequence of each risk. With these 21 requirements, F-35 JPO has already acknowledged the specification misses and has a contractual agreement to spend no more money to improve the design – using the cost as an independent variable principle for the requirements. The only remaining program resources associated with these 21 requirements is for gathering qualification evidence to verify the capability of the design as is. When qualifications are complete, F-35 JPO will reset the specification requirements to the achieved performance and negotiate consideration for each of the shortfalls.

A closure tracking / status Action Item for these 21 system level requirements would regularly assess progress toward reconciliation and closure of the specification to realized performance: qualification actions, coordination of verification evidence, draft specification change request engineering review, Configuration Steering Board approval, Change Control Board approval and contract negotiations / contract modifications. However, for these 21 system level requirements, neither risk mitigations nor design changes are funded within the remaining scope of the System Design and Development contract. As an aside, several of the 21 system level requirements are separately tracked as Program Technical Performance Measures.

Our Response

The comments from JPO do not meet the intent of our recommendation. Although JPO stated that the requirements will not be met, the undetermined extent to which the 21 system-level requirements will not be met poses a risk to the F-35 Program. These 21 system-level requirements should be tracked as program-level risks either until the requirements have been satisfied or relief has been granted by the appropriate authority. We request that JPO provide further comments in response to the final report.

Finding C

The Quality Assurance Organization Was Not Independent and Not Adequately Staffed

JPO had not defined its quality assurance organization's roles and responsibilities and had not provided adequate staffing to perform effective oversight of the F-35 Program. Also, the quality assurance organization reports to the Director of Production rather than directly to the F-35 PEO. The JPO quality assurance function did not have the necessary independence to implement the quality management mission for development, production, and sustainment of the system. A quality assurance organization that lacks independence or the inherent authority to enforce quality management requirements may not effectively mitigate cost, schedule, and performance risks to the F-35 Program.

Discussion

Our previous evaluation recommended that JPO establish an independent quality assurance organization. JPO initiated the establishment of a quality organization, assigned a Quality Lead, and plans to further develop and staff the organization. But, the organization reports to the Director of Production rather than directly to the F-35 PEO. Because the desire to meet production schedules can often prevent adequate or sufficient root cause analysis and corrective action, a quality assurance organization that is independent and reports to the PEO ensures greater influence in program decisions. The current organizational structure may limit the quality assurance organization's ability to objectively report program quality management performance.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendations, Management Comments, and Our Response

Recommendation C

We recommend that the F-35 Joint Program Office realign the quality assurance organization to report directly to the PEO, define the organization's roles and responsibilities, and staff the organization appropriately.

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

> Efforts to establish an independent quality organization are on track. As documented in F-35 JPO's August 2014 response and reiterated during presentations and discussions with DODIG team members, a quality organization will be in place 12-24 months from the May 2014 decision.

Our Response

The comments from JPO do not meet the intent of our recommendation. JPO has proposed inconsistent approaches. JPO's response letter addressing the recommendation in our previous evaluation to establish an independent quality organization stated, "[t]he F-35 JPO will establish an independent quality organization reporting to the Program Executive Officer." However, during this evaluation, JPO presented a quality organization that has a direct reporting line to the Director of Production, which we do not consider to be independent. In addition, it is not clear from JPO's response whether the quality organization will be fully functional 12 to 24 months from the referenced May 2014 decision. Timely establishment of the quality organization is essential to provide necessary oversight, monitor the program performance, and take proactive measures to prevent significant risks to the program. We recommend that JPO provide an update to the schedule and milestones associated with the development of the quality organization, including a current and proposed quality organization structure. We request that JPO provide further comments in response to the final report.

Finding D

Reduction of the Assembly Defect Rate Was Inadequate

JPO and DCMA management were not committed to ensuring that assembly defect rate objectives and goals were realized. Lack of ability to reduce defects and the scrap, rework, and repair rate in accordance with defined program objectives will negatively impact program cost and schedule.

Discussion

JPO was not ensuring that Lockheed Martin was fulfilling its commitment to a 90-percent assembly defect rate reduction per aircraft to meet the full-rate production goal of completing one aircraft per day. We were not able to determine Lockheed Martin's progress in meeting its commitment to a 90-percent reduction in the assembly defect rate because it was not tracking its progress using the correct data for SDD or LRIP lot deliveries. In accordance with conflicting information contained in the quality management plan, Lockheed Martin was tracking the number of nonconforming material records rather than the number of assembly defects. Lockheed Martin demonstrated a 23-percent reduction in nonconforming material records compared to the 60-percent defect rate reduction that should have been realized after LRIP lot 5. In addition, JPO and DCMA did not ensure that corrective actions for product nonconformances were adequately implemented to reduce the assembly defect rate. At the time of our evaluation, we were not aware of any initiatives or value engineering change proposals specifically aimed at the reduction of the assembly defect rate in accordance with the program quality management plan goals.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendations, Management Comments, and Our Response

Recommendation D

We recommend that the F-35 Joint Program Office:

1. **Ensure that Lockheed Martin implements quality improvement initiatives to reduce the assembly defect rate to meet full-rate production goals.**

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

> As presented, Lockheed Martin has initiated several initiatives to reduce nonconformances of all types both within their facilities and throughout their supply chains. The F-35 JPO is committed to ensuring quality objectives and goals are realized, therefore monitors progress closely with monthly and quarterly quality metrics reviews and Production Readiness Reviews. Additionally F-35 JPO production operations and quality subject matter experts attend Systems Engineering Technical Reviews to assure designs are producible and encompass quality objectives. Additional improvement incentives are being realized through the program's Blueprint for Affordability which provides a cost share between the contractor and government to fund the improvements, while not solely dedicated to quality and producibility improvements the majority of projects achieve savings through defect reduction by focusing on producibility. F-35 JSPO [Joint Strike Fighter Program Office] is satisfied with the methodology LM is using to monitor SRR in lieu of a ratio to production hours. Additional metrics are being evaluated by F-35 JPO, DCMA and the contractors independently and jointly to continue driving discovery of nonconformances at their source (eliminate escapes) as well as facilitating correction. The mutually agreed to quality goals are part of the Joint Program Commitments, which the F-35 JPO may consider implementing in contracts, though they are not currently.

Our Response

The comments from JPO partially meet the intent of our recommendation; however, we disagree with JPO's position that Lockheed Martin's approach satisfies the F-35 program's quality objectives as defined by the F-35 Program Quality Management Plan. According to the quality management plan, analysis of assembly defects and Quality Assurance Reports per aircraft is necessary to determine the progress in meeting the objectives. JPO needs to work with Lockheed Martin to identify quality metric(s) that could be used contractually to ensure that quality issues per aircraft are reduced to meet program goals. We request that JPO provide further comments in response to the final report.

2. Coordinate with DCMA to implement an effective root cause analysis and corrective action process in order to reduce assembly defect rate.

F-35 Joint Program Office Comments

F-35 Joint Program Office partially agreed and stated:

> There are effective Corrective Action processes already in place within Lockheed Martin and the supply chain. DCMA and F-35 JPO quality organizations focus heavily on continually improving these systems and process to assure cause analysis leads to true root cause and does not stop with direct cause. This includes areas outside production, including work instructions, tooling, design, facilities, human resources and even within the government should government furnished equipment property or direction be a contributor. Lockheed Martin has also implemented internal corrective action processes for non-shop floor continual improvement opportunities. While F-35 JPO agrees effective root cause and corrective action are essential to improvement, beyond continuous high priority focus through Corrective Action Board meetings, metrics reviews, DCMA issuance of requests for corrective action no additional changes are necessary at this time.

Our Response

The comments from JPO do not meet the intent of our recommendation. Our intent was for JPO to take actions to identify and correct the cause of the program's inability to meet established quality goals and objectives for full-rate production as stated in the F-35 Program Quality Management Plan. JPO should work with DCMA and Lockheed Martin to reduce the number of assembly defects per aircraft though quality improvement initiatives. We request that JPO provide further comments in response to the final report.

Finding E

Corrective Action Request Escalation Was Inadequate

DCMA Fort Worth was not escalating unresolved CARs to the next higher level as required by the applicable DCMA instruction. If DCMA does not escalate CARs as required, deficiencies may continue to occur and DCMA and JPO leadership may not be aware of problems until they adversely impact the cost, schedule, and performance of the program.

Discussion

DCMA was not following its policy to escalate CARs to the next higher level when repetitive Level II CARs have been issued, when CAPs were rejected and not resubmitted within the 10-day requirement, or when the corrective action validation is rejected. We identified instances when multiple CARs were documented for the same violation, but none were escalated to the next level. We also noted instances when CAPs were rejected and were not resubmitted within the 10-day requirement, but did not result in DCMA escalating the CAR to the next level.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendations, Management Comments, and Our Response

Recommendation E

We recommend that the Defense Contract Management Agency:

1. **Review all unresolved CARs and escalate those that meet the criteria established in DCMA policies and instructions.**

DCMA Comments

DCMA agreed and stated:

> DCMA agrees we did not execute to DCMA Instruction #1201 as interpreted by the DoD IG team. We agree that DCMA Instruction 1201 requires clarification. It is currently under revision to address clarification to the CAR elevation process. DCMA Headquarters will provide an updated policy with an estimated completion date of early 2015. Upon policy update approval, DCMA LMFW [Lockheed Martin, Fort Worth] will review all open CARS to determine if any warrant elevation to the next level as recommended.

Our Response

The comments from DCMA meet the intent of our recommendation. No further comments are required.

2. **Assess all CARs that were not properly elevated and assess any impact on the product.**

DCMA Comments

DCMA agreed and stated:

> DCMA LMFW will assess all open CARs based on new policy guidance to identify, analyze, and assess any impacts to F-35 product.

Our Response

The comments from DCMA meet the intent of our recommendation. No further comments are required.

Finding F

Software Quality Management Was Insufficient

JPO and Lockheed Martin were not ensuring software quality management processes such as configuration management, failure reporting and corrective action, nonconformance root cause and analysis, and training were performed sufficiently to prevent delayed mission capability, software rework, and possibly additional program costs. In addition, undiscovered software defects could result in performance degradation or even catastrophic failure of aircraft, subsequently resulting in loss of aircraft and death.

Discussion

Lockheed Martin's software development methodology did not facilitate the performance of physical and functional configuration audits. The majority of new aircraft capability is based on additional software builds; therefore, it is necessary to perform functional and physical configuration audits. These types of audits ensure that CSCIs exist and are configured, tested, and documented in accordance with software specifications and requirements to mitigate aircraft performance and reliability risks. In addition, deficiencies in Lockheed Martin's software development training program may lead to knowledge gaps which could result in software development process failures and software defects. Additionally, the classification of the severity of software deficiencies identifies the level of verification and corrective action required. Lockheed Martin's failure to ensure software subcontractors, such as Northrop Grumman, were categorizing software deficiencies in accordance with the F-35 Air System Software Development Plan does not provide confidence in delivered software. Allowing open deficiencies, especially those whose severities are not characterized and understood, can result in performance degradation or catastrophic failure during operation. JPO needs to ensure that rigorous software processes exist at Lockheed Martin.

Management Comments on the Finding and Our Response

Summaries of management comments on the finding and our response are in Appendix C.

Recommendation, Management Comments, and Our Response

Recommendation F

We recommend that the F-35 Joint Program Office work with Lockheed Martin to ensure software quality management systems are improved; metrics should be reported on a periodic basis (for example, monthly) to evaluate process improvement.

F-35 Joint Program Office Comments

F-35 Joint Program Office agreed and stated:

> The F-35 JPO has been and will continue to work with Lockheed Martin to ensure the adequacy and improvement of software quality management processes and practices. Metrics reflecting software quality and quality improvement objectives have been developed and are being reported and assessed at both the vehicle systems and mission systems team levels on a monthly basis, as well as at the air vehicle level and production quality on a monthly basis.

Our Response

The comments from JPO partially meet the intent of our recommendation. JPO does not give the impression that any changes and/or improvement will be made to the software quality management process as a result of the finding. We request that JPO, in response to the final report, provide additional information regarding the types of improvements that have been implemented to show that critical software verification processes are implemented at various levels to ensure software product integrity.

Finding G

Subcontract Management Procedures Were Still Inadequate

JPO, DCMA, and Lockheed Martin were not ensuring that contract requirements were adequately flowed down, contract deliverables were evaluated, and minor nonconformances were approved by the proper authority. Lack of sufficient subcontract management activities may result in the acceptance of products that do not meet intended performance and reliability requirements.

Discussion

DCMA and Lockheed Martin were not ensuring that the purchase orders identified the specific revisions of the technical requirement documentation necessary for the production, testing, and inspection of each item being purchased and changes to technical requirements were contractually documented. They also did not ensure that contractually required supplier-generated data items were delivered by subcontractors when required. We found no evidence of any appropriate actions taken when subcontractors did not comply with these requirements. In addition, JPO and Lockheed Martin were not ensuring that disposition and approval of minor nonconformances were approved only by DCMA, who has the delegated authority for approval of minor nonconformances.

Recommendations, Management Comments, and Our Response

Recommendation G

1. **We recommend that the F-35 Joint Program Office ensure that all minor nonconformances are evaluated and approved only by DCMA.**

F-35 Joint Program Office Comments

F-35 Joint Program Office partially agreed and stated:

> F-35 JPO will work with DCMA to assure compliance with regulation and direction. As part of an existing effort to validate requirements flow down accuracy, minor nonconformance approval will be included. Scrap and rework-to-design-definition (so called rework to blue-print) dispositions ultimately result in conforming product being presented to the government for acceptance and alleviate the requirement of further DCMA review. DCMA has and will continue to intercede in repetitive scrap and rework. In the case of repair or use-as-is disposition, DCMA reviews these in accordance

> with regulation and instruction as it results in nonconforming product being tendered for acceptance. The F-35 JPO will work with DCMA to assure nonconformance evaluations are properly reviewed in accordance with requirements and action plans put in place by March 31, 2015.

Our Response

The comments from JPO meet the intent of the recommendation. No further comments are required.

2. **We recommend that the Defense Contract Management Agency ensure that Lockheed Martin flows down the appropriate technical requirements to its subcontractors, and receives and evaluates contract deliverables within the required time frames.**

DCMA Comments

DCMA agreed and stated:

> DCMA LM will assess current functional surveillance strategies to determine system/process surveillance gaps regarding Subcontract Management Procedures. DCMA LM surveillance strategies will be revised as necessary to ensure LM processes are adequate to provide appropriate flow down of requirements and execution of those requirements are achieved by their subcontractors.

Our Response

The comments from DCMA meet the intent of the recommendation. No further comments are required.

Appendix A

Scope and Methodology

We conducted this evaluation from August 2014 through December 2014 in accordance with the Council of the Inspectors General on Integrity and Efficiency, "Quality Standards for Inspection and Evaluation." Those standards require that we plan and perform the evaluation to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our evaluation objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our evaluation objectives.

The scope of this evaluation was to determine the F-35 Program conformity to the contractually required AS9100, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations," standard and whether the F-35 Joint Program Office (JPO), Defense Contract Management Agency (DCMA), and the prime contractor—Lockheed Martin Aeronautics Company took appropriate actions on findings and recommendations identified in the DoD IG Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," September 30, 2013. We performed a two-week AS9100 inspection at Lockheed Martin Aeronautics Company, Fort Worth, Texas, from September 22, 2014 to October 3, 2014.

The AS9100C standard breaks down quality assurance requirements into five major clauses:

- Quality Management System,
- Management Responsibility,
- Resource Management,
- Product Realization, and
- Measurement, Analysis, and Improvement.

The first three major AS9100 clauses, Quality Management System, Management Responsibility, and Resource Management, require the organization to have a quality assurance management organization that has all the resources and authority to affect the end-item quality of the product. In addition, it requires the organization to have a quality assurance manual and strict control over all documentation, data, and procedures that affect the quality of the product.

The fourth major AS9100 clause, Product Realization, covers the activities and processes necessary to bring a product into existence. It is broken down further by the AS9100 standard as follows:

- Planning of Product Realization,
- Customer-Related Processes,
- Design and Development,
- Purchasing,
- Production and Service Provision, and
- Control of Monitoring and Measuring Equipment.

Planning of Product Realization requires the organization to develop processes needed for design and development of product and includes elements such as procedures, quality assurance records, resource requirements, safety and reliability programs, and inspection and test. The Customer-Related Processes section requires the organization to determine all applicable requirements specified by the customer, understand those requirements and associated risks, and implement arrangements for communication with the customer. Design and Development includes requirements that cover planning, inputs, outputs, review, verification, validation, and control of changes as related to design and development. Purchasing requires the organization to ensure the purchased product conforms to specified purchase requirements and all products purchased from suppliers are verified against these requirements. Production and Service Provision requires the organization to ensure that production is accomplished under controlled conditions using drawings and specifications, work instructions, production tools and software programs, and provide evidence that all production and inspection/verification operations have been completed as planned. Control of monitoring and measuring equipment requires the organization to establish, implement, and maintain a process for managing, monitoring, and measuring equipment that requires calibration or verification.

The last major AS9100 clause, Measurement, Analysis, and Improvement, requires the organization to ensure the product continuously improves. This clause includes customer satisfaction, internal audit, monitoring and measuring processes and product, and control of nonconforming products to ensure continual improvement.

Statutory and Regulatory Requirements

Additionally, we evaluated the F-35 Program's compliance with applicable statutory and regulatory requirements to include the Federal Acquisition Regulation; Defense Federal Acquisition Regulation Supplement; Interim DoD Instruction 5000.02,[7] "Operation of the Defense Acquisition System," enclosure 1; and DoD 4140.01, "DoD Supply Chain Materiel Management Procedures: Materiel Sourcing," volume 3.

Aviation Critical Safety Items Requirements

Furthermore, we evaluated the F-35 Program's implementation of aviation CSI requirements. Special attention should be paid to CSIs to prevent the potential catastrophic or critical consequences of failure. CSIs require special handling, engineering, manufacturing, and inspection documentation to control and ensure safety of flight.

Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," requires the DoD to prescribe a quality control policy for the procurement of aviation CSIs. The Joint Service CSI Instruction, "Management of Aviation Critical Safety Items," implements the DoD CSI Program and establishes the policies, procedures, and responsibilities to manage CSIs. The Joint Aeronautical Commanders Group (JACG), "JACG Aviation Critical Safety Item Handbook," supplements the Joint Service CSI Instruction and provides implementation guidance which describes the technical and quality assurance requirements for a prime contractor CSI Program.

Use of Computer-Processed Data

We did not use computer-processed data to perform this evaluation.

Use of Technical Assistance

We obtained assistance from quality assurance engineers and quality assurance specialists with a background in defense and aerospace systems. We established teams of subject matter experts who evaluated the F-35 Program to the AS9100C, "Quality Management Systems – Requirements for Aviation, Space and Defense Organizations," standard. The subject matter expert teams consisted of 17 quality assurance engineers, trained and certified in AS9100, who had an average of 17 years of quality assurance, audit experience. Additionally, our teams included a subject matter expert in military aviation CSI.

[7] At the time of our evaluation, DoDI 5000.02 was in interim status. The final DoDI 5000.02 was issued on January 7, 2015.

Appendix B

Prior Coverage

The Government Accountability Office (GAO) and the Department of Defense Inspector General (IG) have issued 32 reports discussing the F-35 Joint Strike Fighter. Unrestricted GAO reports can be accessed at http://www.gao.gov. Unrestricted DoD IG reports can be accessed at http://www.dodig.mil/pubs/index.cfm.

GAO

Report No. GAO-14-778, "F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates," September 23, 2014

Report No. GAO-14-340SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 31, 2014

Report No. GAO-14-468T, "F-35 Joint Strike Fighter: Slower Than Expected Progress in Software Testing May Limit Initial Warfighting Capabilities," March 26, 2014

Report No. GAO-14-322, "F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities," March 24, 2014

Report No. GAO-13-690T, "F-35 Joint Strike Fighter: Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain," June 19, 2013

Report No. GAO-13-500T, "F-35 Joint Strike Fighter: Program Has Improved in Some Areas, but Affordability Challenges and Other Risks Remain," April 17, 2013

Report No. GAO-13-294SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 28, 2013

Report No. GAO-13-309, "F-35 Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability Is a Major Concern," March 11, 2013

Report No. GAO-12-437, "Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks," June 14, 2012

Report No. GAO-12-400SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 29, 2012

Report No. GAO-12-525T, "Joint Strike Fighter: Restructuring Added Resources and Reduced Risk, but Concurrency Is Still a Major Concern," March 20, 2012

Report No. GAO-11-903R, "Joint Strike Fighter: Implications of Program Restructuring and Other Recent Developments on Key Aspects of DOD's Prior Alternate Engine Analyses," September 14, 2011

Report No. GAO-11-677T, "Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging," May 19, 2011

Report No. GAO-11-325, "Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags," April 7, 2011

Report No. GAO-11-450T, "Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall," March 15, 2011

Report No. GAO-11-323R, "Tactical Aircraft: Air Force Fighter Force Structure Reports Generally Addressed Congressional Mandates, but Reflected Dated Plans and Guidance, and Limited Analyses," February 24, 2011

Report No. GAO-11-171R, "Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter," December 16, 2010

Report No. GAO-10-1020R, "Joint Strike Fighter: Assessment of DOD's Funding Projection for the F136 Alternate Engine," September 15, 2010

Report No. GAO-10-789, "Tactical Aircraft: DOD's Ability to Meet Future Requirements is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions," July 29, 2010

Report No. GAO-10-388SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 30, 2010

Report No. GAO-10-478T, "Joint Strike Fighter: Significant Challenges and Decisions Ahead," March 24, 2010

Report No. GAO-10-382, "Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time," March 19, 2010

Report No. GAO-10-520T, "Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program," March 11, 2010

Report No. GAO-09-711T, "Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase," May 20, 2009

Report No. GAO-09-326SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 30, 2009

Report No. GAO-09-303, "Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk," March 12, 2009

Report No. GAO-08-782T, "Defense Acquisitions: Better Weapon Program Outcomes Require Discipline, Accountability, and Fundamental Changes in the Acquisition Environment," June 3, 2008

Report No. GAO-08-467SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 31, 2008

Report No. GAO-08-569T, "Joint Strike Fighter: Impact of Recent Decisions on Program Risks," March 11, 2008

Report No. GAO-08-388, "Joint Strike Fighter: Recent Decisions by DOD Add to Program Risks," March 11, 2008

DoD IG

Report No. DODIG-2013-140, "Quality Assurance Assessment of the F-35 Lightning II Program," September 30, 2013

Report No. DODIG-2013-031, "Audit of the F-35 Lightning II Autonomic Logistics Information System (ALIS)," December 10, 2012

Appendix C

Management Comments on the Findings and Our Responses

Finding A – Insufficient Progress Had Been Made Toward Implementation of the Critical Safety Program

F-35 Joint Program Office Comments

F-35 Joint Program Office disagreed and stated:

> The F-35 JPO places the safety of aircrew and maintainers foremost within all program priorities. Working with DCMA and Lockheed Martin to bring the management of CSI into compliance with requirements, progress is being made toward the dates provided to the DODIG. This is not however, as implied, a simple matter of 'flowing down' this highly complex requirement. This contractual change constitutes an increase in scope, incorporating non-recurring and recurring effort into multiple F-35 contracts, and must be done in accordance with contract law, federal regulation and fiscal responsibility.
>
> Military aviation programs that existed before the CSI requirement was created have faced similar challenges implementing the CSI law based on wide interpretation of its intricate and far reaching mandate. The F-35 Lightning II System Design and Development Contract was signed October 26, 2001, by 2003 the basic design was nearly complete and fabrication beginning, with first rollout in February 2006. Even recognizing aircraft design changes for weight reduction in 2004, when the CSI public law was issued it constituted a new requirement to the existing contract. Also, implementing such a requirement without department instruction or guidance could have incurred significant risk in implementing it incorrectly. The first issuance of the Joint Aeronautical Logistics Commanders (JALC) Aviation CSI handbook was August 12, 2005 and the Joint Service Instruction was not issued until January 25, 2006.
>
> As was objectively demonstrated in explicit detail to the DODIG the F-35 JPO and Lockheed Martin jointly developed F-35 integrity programs based on several decades of military aircraft design and development for the United States armed forces. The integrity policies and procedures form one of the cornerstones for rigorous qualification of designs to ensure safety and functionality that progressively moves designs from engineering analysis (including flight safety critical aircraft parts) through production fabrication, testing, and lifecycle management before incorporation into the aircraft. Additionally, designs are secondarily analyzed by government subject matter experts for airworthiness and certified to standards developed specifically for this purpose. Next, the qualified parts are assembled to constitute an aircraft which moves into a series of reviews and certifications before first flight of a severely restricted flight envelope that is progressively opened through carefully monitored flight testing conducted by the contractor and government.

> The CSI requirement establishes policy, procedure and assigns responsibility for the lifecycle management of replenishment items (spare parts, support equipment and repairs) critical to safety. The primary methodology is to assure spare parts and services are procured from approved sources and manufactured to correct standards and processes. The public law, department and service instructions do not specify that CSI is to be incorporated during the development phase of aircraft systems, though it has been recognized within DoD that the intrinsically necessary failure mode analysis, documentation of characteristics, development of quality assurance above and beyond standard practice with primary difference being removal of likelihood as analysis criteria should be done in parallel with other safety, airworthiness and integrity scrutiny. To incorporate CSI in this manner it would have to be done during a contract's initial proposal which in the case of F-35 was several years before the CSI law's inception. Therefore the F-35 JPO has used department instruction to interpret the program and existing drawings as legacy. The F-35 JPO engineering support activity considers there to be sufficient protections in place to assure safety through existing quality assurance, integrity, qualification, airworthiness, and flight test programs until full CSI compliance is reached. Currently all F-35 Lightning II spares and repairs are procured from their original equipment manufacturers with inherent quality, integrity, airworthiness and safety assured.

Our Response

JPO is planning to implement the CSI Program by February 2016; however, the draft CSI Program prepared by Lockheed Martin that we evaluated did not sufficiently address requirements described in the Joint Service CSI Instruction. The F-35 Program has not made sufficient progress toward full compliance with CSI Public Law since it was issued in 2003. NAVAIR Instruction 4200.25C, September 1999, had been established and in use prior to the SDD contract award in 2001. NAVIAR Instruction 4200.25D, which was issued in June 2002, contains very similar CSI requirements as SECNAVINST 4140.2, which was released in January 2006. There are many other DoD instructions and guidelines such as DoD Regulation 4140.1-R, May 2003 and the prior version, which was issued in January 1993; JALC CSI, August 2005; the Joint Service Instruction, January 2006; and JACG Aviation CSI Management Handbook, March 2011; which were available to be used for the F-35 CSI Program. These requirements could have been implemented in either the SDD or LRIP contracts, starting with LRIP lot 1. JPO was aware of the existence of NAVAIRINST 4200.25D as it was put in the LRIP lot 1 contract for F-35 engine development awarded in April 2006.

JPO believes that the F-35 integrity programs, which are jointly developed by Lockheed Martin and JPO, address all the CSI requirements; however, JPO was not able to provide any evidence to show that it had performed a gap analysis between the F-35 integrity programs and CSI requirements. We identified gaps during our last evaluation, which showed that the F-35 integrity program did not cover all CSI requirements.

JPO stated, "[t]he public law, department and service instructions do not specify that CSI is to be incorporated during the development phase of aircraft systems…" Contrary to JPO's claim, JACG Aviation CSI Management Handbook, section 2.3.2 states:

> [t]he basis of CSI determinations on repairable and consumable parts and maintenance concepts underscores the importance of effective working relationships among logistics and engineering communities. Logisticians are responsible for life cycle support concepts that ultimately define spare parts and for providing these concepts to engineers who are then responsible for identifying CSIs and approving their sources. This relationship is particularly meaningful during the acquisition, development, and initial production stages of new platforms.

Section 2.9.3 of JACG Aviation CSI Management Handbook further states, "[t]herefore, a requirement for prime contractor/OEM's to identify critical characteristics for every new CSI should be included in the System Development and Demonstration Statement of Work for new systems and major platform modifications."

JPO's decision to postpone the implementation of CSI requirements may increase cost, schedule, and safety risks. Significantly more efforts and resources will be required to accommodate CSI requirements if they are implemented in the later stages of the acquisition lifecycle: such as performing engineering analysis, identifying critical characteristics, updating drawings, and creating a logistics process to support the changes. JPO did not explain how it is more fiscally responsible to delay incorporating contractual CSI requirements. In addition, JPO had many opportunities to implement CSI requirements during program restructuring, which took place in December 2003, again in March 2007, and most recently in March 2012.

Finding B – Oversight of Product Development and Realization of Requirements was Inadequate

F-35 Joint Program Office Comments

F-35 Joint Program Office disagreed and stated:

> The F-35 JPO has progressively made improvements to aircraft acceptance criteria. In LRIP 6, as in previously LRIPs, known JCS non-compliances were documented. It is true that at aircraft acceptance F-35 JPO does not require LM to positively verify compliance to every JCS requirement. This is due to the concurrent nature of SDD and Production schedules. The SDD schedules identify when each JCS requirement is expected to meet compliance criteria. The vast majority of compliance occurs in the 2016 and 2017 timeframe. If F-35 JPO were to impose JCS compliance assessments in production, prior to expected SDD JCS compliance dates, the assessments would be based on subjective rather than objective criteria because proper SDD certification evidence would not be available. The F-35 JPO deemed that subjective, premature JCS compliance assessments were not value add for the program. Additionally, these subjective assessments would negatively impact SDD resources (people, labs and flight test assets) and schedules.

Our Response

Acquisition strategy (concurrent development) should not prevent JPO from establishing objective and measurable aircraft acceptance criteria. The lack of objective and measurable aircraft acceptance criteria in the CCDD was documented during our last evaluation. This nonconformity was agreed to by Lockheed Martin and JPO; however, JPO still has not addressed it adequately. This same deficiency was documented again during this evaluation. Our report states "…JPO and Lockheed Martin are at an impasse to perform implementation of corrective action due to a breakdown in contract negotiations." As a result, there has not been sufficient progress in defining objective and measureable aircraft acceptance criteria. Our finding does not state that the F-35 LRIP aircraft need to be tested at full JCS compliance. Rather, the CCDD acceptance criteria for a specific LRIP lot should be measurable and testable. We understand that production and development efforts are concurrent; however, it does not relieve JPO of the responsibility for identifying clear and measureable acceptance criteria for the LRIP aircraft.

Finding C – The Quality Assurance Organization Was Not Independent and Not Adequately Staffed

F-35 Joint Program Office Comments

F-35 Joint Program Office partially agreed and stated:

> The F-35 JPO does not place schedules ahead of quality. Further, the F-35 JPO has withheld delivery of aircraft to assure quality issues are addressed. Although the F-35 JPO deems the current reporting structure adequate to meet program needs, it has agreed to create a more robust quality organization to ensure quality management is objectively measured and reported.

Our Response

The F-35 Program quality assurance organization still resides under the Director of Production and is not a direct report to the F-35 PEO. We recommend that JPO work toward the organizational structure defined in JPO's response letter to the DODIG-2013-140 report dated August 8, 2014. The response letter stated, "[t]he F-35 JPO will establish an independent quality organization reporting to the Program Executive Officer." However, during the 2014 evaluation, JPO's planned quality organization reported to the Director of Production, which we do not consider to be independent. JPO should realign its quality organization in accordance with its August 8, 2014, response.

Finding D – Reduction of the Assembly Defect Rate Was Inadequate

F-35 Joint Program Office Comments

F-35 Joint Program Office disagreed and stated:

> The program quality 90% objective the DODIG references was a ratio of Scrap Rework and Repair (SRR) to production labor hours (hence a 'rate'). This is a normalization technique to assess levels of SRR relative to volume of work in a given area. This normalization is a valuable metric; however, it is not the only metric. In the current case of F-35 the production line which is still experiencing significant production labor hour reductions as a result of progressing down predictable learning, the ratio of declining SRR hours to declining production labor hours has remained relatively steady. The F-35 JPO, DCMA and LM have worked to understand this phenomenon and analyzed other metrics to evaluate the program's progress toward reductions necessary to reach high production rates by increasing efficiency and flow.
>
> - Factory SRR hours have decreased 65% since the first production lot. Supplier responsible SRRs have been reduced 80% and the program is setting a goal to reduce the current level by another 25% again this year.
> - Quality Escapes to the field are another measure, which have decreased 75% since 2011.

Our Response

We appreciate the additional clarification on the full rate production objective identified in the F-35 Program Quality Management Plan. However, the Quality Management Plan does not provide any reference to the use of SRR to determine the assembly defect rate. Rather, it depicted a reduction in the number of quality assurance reports per aircraft per LRIP lot as a reduction in the defect rate, which is not equivalent.

Finding E – Corrective Action Request Escalation Was Inadequate

DCMA Comments

DCMA agreed and stated:

> DCMA agrees we did not execute to DCMA Instruction #1201 as interpreted by the DoD IG team. We agree that DCMA instruction 1201 requires clarification. It is currently under revision to address clarification to the CAR elevation process.
>
> DCMA believes this risk is mitigated based on a comprehensive program quality strategy between DCMA, F-35 JPO, and LM. There is a monthly metrics cadence in which the DCMA Quality organization provides independent CAR analysis. The data presented in these meetings provides insight of non-compliances identified through DCMA and LM Quality surveillance activities.

Our Response

Comments from DCMA meet the intent of the finding.

Finding F – Software Quality Management Was Insufficient

F-35 Joint Program Office Comments

F-35 Joint Program Office disagreed and stated:

> The F-35 JPO considers F-35 software quality management is sufficient, specifically the air vehicle software quality referenced in the draft DOD IG audit report. The F-35 JPO is confident current air vehicle software configuration management, failure reporting and corrective action, root cause analysis, and training are sufficient and adequate to support program mission capability and cost objectives. The F-35 JPO is confident in the current air vehicle software, systems engineering, and airworthiness certification processes will ensure no undiscovered software defects will be delivered with the air vehicle that could result in performance degradation or even catastrophic failure of aircraft.

Specific DoD IG Finding Responses:

1. DoD IG Finding: Lockheed Martin's software development methodology did not facilitate the performance of physical and functional configuration audits. The majority of new aircraft capability is based on additional software builds; therefore, it is necessary to perform functional and physical configuration audits. These types of audits ensure that CSCIs exist and are configured, tested, and documented in accordance with software specifications and requirements to mitigate aircraft performance and reliability risks.

   F-35 JPO Response: In accordance with the F-35 program Software Development Plan and Configuration Management Plan, physical and functional configuration audits of the type referenced by the DOD IG report are conducted against the air vehicle Software Data Load, which is a compilation of vehicle and mission systems components. The program is conducting FCA/PCAs in accordance with the F-35 CM Plan, 2YZA00002, on all CIs and CSCIs identified in the F-35 CI List, 2YZA00941, approved by the F-35 JPO. This finding erroneously presumes that certain software items which are not identified in the CI list are CSCIs and therefore must be subject to FCA/PCA requirements. Mission System and Vehicle System computer programs are elements which contribute to the composition of the aircraft Software Data Load. It is the aircraft Software Data Load which is identified in the F-35 CI List as a CSCI, and it is this software product on which FCA/PCA activity will be conducted. This practice is consistent with software development practices on all weapon systems developed at the Fort Worth facility, including the F-16 and F-22, in accordance with the DoD required Single Process Initiative for the Fort Worth Facility. The F-35 program has a very rigorous and structured verification and validation process for software enabled systems capabilities, including the identification and management of all software components that contribute to safety critical functions. In addition, F-35 air vehicle software undergoes extensive independent reviews by external airworthiness agencies from the United States Air Force and Navy in the context of MIL-HDBK-516, as well as the Ministries of Defense of the United Kingdom and Australia. These agencies have independently confirmed the adequacy of the physical configuration and functional ability of the air vehicle software for safe operation in the delivered operational envelope. The F-35 program does not intend to modify existing functional and physical configuration audit practices for F-35 air vehicle software based on this finding.

2. DoD IG Finding: Deficiencies in Lockheed Martin's software development training program may lead to knowledge gaps which could result in software development process failures and software defects.

   F-35 JPO Response: Lockheed Martin has a structured and accountable training program for all software engineers in the LM aeronautical division, documented in PM-4002 (Software Engineering Training). In addition, the LM F-35 program has a structured and accountable training program for F-35 specific software development environments and tools. Training history for both LM Aero and F-35 specific training were provided to the IG team, as well as learning plans for specific classes of software engineering disciplines. Air vehicle software engineers on the F-35 program comprise a body of world class talent – they are industry experts in the development of hard real time embedded flight and mission critical software, and have in most cases decades of experience in vehicle and mission systems software development on other 4th and 5th generation fighter programs. They are sought after by industry to provide instruction to other engineers in their discipline areas, and work directly with the developers of the software tools and environments they are using to incorporate additional enhancements and features to increase productivity and efficiency. The F-35 JPO does not intend to pursue any additional training initiatives for the LM software development team based on this finding.

3. DoD IG Finding: The classification of the severity of software deficiencies identifies the level of verification and corrective action required. Lockheed Martin's failure to ensure software subcontractors, such as Northrop Grumman, were categorizing software deficiencies in accordance with the F-35 Air System Software Development Plan does not provide confidence in delivered software. Allowing open deficiencies, especially those whose severities are not characterized and understood, can result in performance degradation or catastrophic failure during operation.

   F-35 JPO Response: System and software deficiency severity classification and tracking is managed and maintained at the air vehicle system level, in accordance with F-35 program systems engineering, software engineering, and system verification plans. The DoD IG team assumed subcontractors would independently classify and track their anomalies using the same criteria as the air vehicle teams, which is not the defined process or practice. Subcontractor deficiencies are reported against the specification requirements levied to the subcontractors, but cannot be categorized by the subcontractor team in terms of air vehicle severity, as only the air vehicle systems engineering teams in the vehicle systems and mission systems functional areas have the required breadth and scope of system functionality and safety criticality to adequately classify the severity of component anomalies in the context of air vehicle operations. The F-35 JPO reviewed the specific concerns highlighted by the DoD IG with Northrop Grumman

failure reporting, and found the reporting practice consistent with the documented air vehicle software, systems engineering, and air vehicle verification plan. There are no open deficiencies delivered with the air vehicle that are not characterized by hazard severity and understood within the context of mission and safety criticality, and which have not been adjudicated with the F-35 JPO, airworthiness authorities, and operational users. The F-35 JPO does not plan to modify the existing software, systems engineering, and system verification process or practices based on this finding.

Our Response

We do not agree that the F-35 Program's software quality management program sufficiently meets the requirements of AS9100 and that no further corrective action is required.

At the Air Vehicle Software Data Load (SDL) level, the FCA/PCA does not include all prime mission software configuration items such as: Fusion Software, Pilot System Software, Fire Controls/Navigation/Stores (MSFCS), Mission Domain (MSMIS), Data Collection Software, External Communication Software (MSXCM), and Core Processing Software. Eliminating the FCA/PCA program at the software level prevents the critical verification process and significantly impacts software product integrity. The intent of FCA/PCA cannot possibly be met at the Air Vehicle SDL level.

Although Lockheed Martin's training program did include position specific training requirements, we did not find any evidence that Lockheed Martin's software integrated product teams identified and included project-specific training requirements within software engineer training curriculums. We also did not find any evidence that Lockheed Martin Integrated Product Team leads had reviewed training curricula annually as required by Lockheed Martin's command media.

Finally, we agree with JPO's statement that F-35 Air System software deficiency severity levels may not apply directly to software defects within lower level software components. However, the Air System SDP stated "[p]roduct-level SDPs must be created or updated to conform to processes identified in this version of the AS [Air System] SDP." This identifies that the subcontractors SDP must comply with Air System SDP processes, which would include the categorization of software deficiencies to alleviate translation conflicts of the F-35 Air System software deficiency severity levels.

Management Comments

F-35 Joint Program Office and Defense Contract Management Agency Comments

F-35 LIGHTNING II JOINT PROGRAM OFFICE
200 12th Street South, Suite 600
Arlington, Virginia 22202-5402

JAN 20 2015

From: Program Executive Officer, F-35 Lightning II Joint Program Office (JPO) and Director, Defense Contract Management Agency (DCMA)

To: Department of Defense (DoD) Deputy Inspector General (IG) for Policy and Oversight

Subj: RESPONSE TO F-35 LIGHTNING II PROGRAM QUALITY ASSURANCE AND CORRECTIVE ACTION EVALUATION (Project No. D2014-DT0TAD-0004)

Thank you for the opportunity to comment on your draft report, "Quality Assurance Assessment of the F-35 Lightning II Program", dated 23 December 2014.

Both the F-35 Lightning II Joint Strike Fighter Program Office (JPO) and the Defense Contract Management Agency (DCMA) take very seriously the findings and recommendations offered in the report. As noted in Enclosure 1, F-35 JPO and DCMA Response to Findings and Recommendations, our team has aggressively addressed DoD IG findings since receipt of the first report in September 2013. The implementation of these corrective actions has led to significant progress in delivering a quality, timely, and cost-effective weapon system to the United States and its allies.

Enclosure 1 provides a detailed response to each finding and recommendation. Enclosure 2 is a copy of a Lockheed Martin letter provided to the F-35 JPO detailing the quality improvement made since issuance of the September 2013 report.

The action officers for this response are [redacted]

CHRISTOPHER C. BOGDAN
Lieutenant General, USAF
Program Executive Officer

WENDY M. MASIELLO
Lieutenant General, USAF
Defense Contract Management Agency

Enclosures:
1. F-35 JPO and DCMA Response to Findings/Recommendations
2. LM Letter to F-35 JPO on Quality Improvements

cc:
Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
Assistant Secretary of the Navy for Research, Development and Acquisition
Assistant Secretary of the Air Force (Acquisition)

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations

Finding A

Insufficient Progress Had Been Made Toward Implementation of the Critical Safety Item Program

The F-35 Program had not made sufficient progress towards full compliance with Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items," by February 2016. This was caused by the lack of CSI requirements on the F-35 contracts, as required by public law and the Joint Service CSI Instruction. This lack of compliance with CSI public law and implementing instructions may impose an increased safety of flight risk on delivered aircraft.

Discussion

As identified in our previous report JPO had not flowed down a contractual requirement to Lockheed Martin to implement a CSI Program in accordance with Public Law 108- 136, Section 802 and the Joint Service CSI Instruction. The CSI public law has been imposed since 2003.
JPO and Lockheed Martin have taken initial steps to establish a CSI Program; however, the program was still not fully compliant with applicable laws and regulations. JPO was planning to contractually require implementation of a CSI Program by February 2016.
However, the current draft of the CSI Program prepared by Lockheed Martin did not sufficiently address requirements described in the Joint Service CSI Instruction including the need to define critical characteristics for all CSIs and the proper limitations and delegations for the material review board authority for nonconforming CSI critical characteristics.

F-35 JPO Response: Disagree
The F-35 JPO places the safety of aircrew and maintainers foremost within all program priorities. Working with DCMA and Lockheed Martin to bring the management of CSI into compliance with requirements, progress is being made toward the dates provided to the DODIG. This is not however, as implied, a simple matter of 'flowing down' this highly complex requirement. This contractual change constitutes an increase in scope, incorporating non-recurring and recurring effort into multiple F-35 contracts, and must be done in accordance with contract law, federal regulation and fiscal responsibility.

Military aviation programs that existed before the CSI requirement was created have faced similar challenges implementing the CSI law based on wide interpretation of its intricate and far reaching mandate. The F-35 Lightning II System Design and Development Contract was signed October 26, 2001, by 2003 the basic design was nearly complete and fabrication beginning, with first rollout in February 2006. Even recognizing aircraft design changes for weight reduction in 2004, when the CSI public law was issued it constituted a new requirement to the existing contract. Also, implementing such a requirement without department instruction or guidance could have incurred significant risk in implementing it incorrectly. The first issuance of the Joint Aeronautical Logistics Commanders (JALC) Aviation CSI handbook was August 12, 2005 and the Joint Service Instruction was not issued until January 25, 2006.

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

As was objectively demonstrated in explicit detail to the DODIG the F-35 JPO and Lockheed Martin jointly developed F-35 integrity programs based on several decades of military aircraft design and development for the United States armed forces. The integrity policies and procedures form one of the cornerstones for rigorous qualification of designs to ensure safety and functionality that progressively moves designs from engineering analysis (including flight safety critical aircraft parts) through production fabrication, testing, and lifecycle management before incorporation into the aircraft. Additionally, designs are secondarily analyzed by government subject matter experts for airworthiness and certified to standards developed specifically for this purpose. Next, the qualified parts are assembled to constitute an aircraft which moves into a series of reviews and certifications before first flight of a severely restricted flight envelope that is progressively opened through carefully monitored flight testing conducted by the contractor and government.

The CSI requirement establishes policy, procedure and assigns responsibility for the lifecycle management of replenishment items (spare parts, support equipment and repairs) critical to safety. The primary methodology is to assure spare parts and services are procured from approved sources and manufactured to correct standards and processes. The public law, department and service instructions do not specify that CSI is to be incorporated during the development phase of aircraft systems, though it has been recognized within DoD that the intrinsically necessary failure mode analysis, documentation of characteristics, development of quality assurance above and beyond standard practice with primary difference being removal of likelihood as analysis criteria should be done in parallel with other safety, airworthiness and integrity scrutiny. To incorporate CSI in this manner it would have to be done during a contract's initial proposal which in the case of F-35 was several years before the CSI law's inception. Therefore the F-35 JPO has used department instruction to interpret the program and existing drawings as legacy. The F-35 JPO engineering support activity considers there to be sufficient protections in place to assure safety through existing quality assurance, integrity, qualification, airworthiness, and flight test programs until full CSI compliance is reached. Currently all F-35 Lightning II spares and repairs are procured from their original equipment manufacturers with inherent quality, integrity, airworthiness and safety assured.

Recommendations

A. We recommend that the F-35 Joint Program Office:
1. Ensure that the F-35 CSI Program is compliant with Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," and the Joint Service CSI Instruction, "Management of Aviation Critical Safety Items."

F-35 JPO Response: Agree

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

- Contract actions for both SDD and LRIP that address the Joint Service CSI Instruction, "Management of Aviation CSIs" are in work or in place to implement the full F-35 CSI Program
  - SDD RFP for CSI NRE efforts to initiate F-35 CSI Program released Oct 2013 and resulted in a LM delivered Draft CSI Program Plan coordinated with F-35 JPO for approval of the CSI implementation approach and go ahead for delivery of the SDD proposal expected; go ahead date for proposal development expected 2QFY15
    -- After the SDD CSI NRE efforts are completed, the full scope of the F-35 CSI program will be included in future production and sustainment contracts.
  - LRIP Production contracts (LRIP 1-8) currently cover explicit CSI tasks for 'limited' compliance for several CSI 'gaps' from the Joint Service CSI Instruction, "Management of Aviation CSIs."
    -- Maintain / update the DOE approved CSI list for configuration control
    -- Use existing recurring processes: Material Review (MR), Variance, Item Acceptance, New Suppliers, Process Metrics, and Minor & Major Change processes for CSIs
    -- Provide CSI notification to affected suppliers via contracts letter
    -- Provide notification if any identified non-conformances results in a safety impact
    -- Report MR actions & QARs associated with CSI once per month
    -- Use existing disposal processes to destroy scrapped CSIs that render part nonfunctional
- DCMA-LM FW Integrated CSI Surveillance Strategy developed Jan 2014 and covers CSI Delegations to ensure appropriate DCMA process surveillance of CSI parts, and imposed Government Source Inspection (GSI) on all parts that have been identified as CSIs per the Joint Service CSI Instruction

2. Conduct periodic CSI Program evaluations of Lockheed Martin and their suppliers to ensure compliance with public law and the Joint Service CSI Instruction.

F-35 JPO Response: Agree

F-35 JPO & LM conducted a CSI TIM in Nov 2014 following completion of the DoD IG Quality Assurance & Corrective Action Evaluation to address DoD IG "Opportunity For Improvement" comments issued for CSIs and CSI Program Plan.

F-35 JPO, DCMA & LM are conducting bi-weekly telecoms and periodic TIMs on-site at LM until SDD contract agreement is reached to implement the full scope CSI Program infrastructure and processes.

After F-35 full scope CSI implementation is underway, the F-35 JPO will transition to a monitoring phase with periodic reviews, which will leverage or combine with other JPO/DCMA activities (joint audits, Production Readiness Reviews, quality reviews, metrics, etcetera).

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

Finding B

Oversight of Product Development and Realization of Requirements Was Inadequate

JPO was not adequately managing the F-35 Program to ensure that all system-level requirements and capabilities defined in the JSF JCS were realized and verified. As a result, delivered and future aircraft may not satisfy all system capability requirements and it is unclear to what extent these capabilities will be achieved by the completion of the SDD phase.

Discussion

The JCS document identifies more than 400 system-level requirements that define performance characteristics. JPO and Lockheed Martin jointly identified 21 system level requirements contained within the JCS that were unlikely to be achieved by the end of the SDD phase of the program. However, JPO and Lockheed Martin did not consider these 21 requirements as risks and did not handle them in accordance with their risk management process.
In addition, JPO still has not defined objective and measureable aircraft acceptance criteria for each LRIP lot. The confirmation criteria defined in the CCDD did not include clearly measurable and verifiable acceptance criteria that were clearly traceable back to the JCS. This was documented in our previous evaluation and continues to be a challenge.

F-35 JPO Response: Disagree
The F-35 JPO has progressively made improvements to aircraft acceptance criteria. In LRIP 6, as in previously LRIPs, known JCS non-compliances were documented. It is true that at aircraft acceptance F-35 JPO does not require LM to positively verify compliance to every JCS requirement. This is due to the concurrent nature of SDD and Production schedules. The SDD schedules identify when each JCS requirement is expected to meet compliance criteria. The vast majority of compliance occurs in the 2016 and 2017 timeframe. If F-35 JPO were to impose JCS compliance assessments in production, prior to expected SDD JCS compliance dates, the assessments would be based on subjective rather than objective criteria because proper SDD certification evidence would not be available. The F-35 JPO deemed that subjective, premature JCS compliance assessments were not value add for the program. Additionally, these subjective assessments would negatively impact SDD resources (people, labs and flight test assets) and schedules.

Recommendations

B. We recommend that the F-35 Joint Program Office:
1. Clearly define contractual criteria for the acceptance of all future and fielded aircraft to ensure that aircraft capabilities are verified.

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

F-35 JPO Response: Agree
F-35 JPO is progressively refining acceptance criteria with each LRIP lot. The use of CCDDs will continue to be used for LRIP 7 and LRIP 8. These CCDD items require positive verification activity to occur, often with dedicated flight test evaluations; and they provide a means to ensure the weapons system meets warfighter expectation for that production lot. However, the use of these documents does not negate the responsibility to document any known JCS non-compliances at the time of aircraft acceptance. This will continue to occur as it has occurred in the past. As SDD progresses F-35 JPO does expect more qualification evidence to be available which will allow for more robust documentation of JCS non-compliance at the time of aircraft acceptance. This will be done in addition to requiring positive verification for all CCDD items.

Beginning with LRIP 9, the next lot to be negotiated, F-35 JPO will require full JCS compliance. F-35 JPO will assess LRIP 9+ product acceptance against the SDD specification. For future full-rate production contracts, there is planned a separate production specification that will leverage the final SDD specification.

2. Ensure that all 21 system-level requirements, in addition to the risks associated with these capabilities, are documented, tracked, and mitigated using the established risk management process.

F-35 JPO Response: Partially Agree
F-35 JPO sees merit in tracking to closure the contractually defined 21 system level requirements that may not be fully met. F-35 JPO agrees the high-level visibility of a formal tracking Action Item to periodically status these requirements to closure will ensure resolution of them in an expeditious manner.

However, F-35 JPO DISAGREES with the recommendation to track these 21 system level requirements through the risk management process. These 21 requirements are not risks – they are a subset of requirements where the program has jointly acknowledged that the level of specified performance will not be met. Conversely, the purpose of risk management is to highlight and take proactive actions to avert a potentially bad outcome, such as a specification miss. Within the F-35 risk management process, risks are managed via a series of funded mitigation steps and technical gates to eliminate or reduce the likelihood and/or consequence of each risk. With these 21 requirements, F-35 JPO has already acknowledged the specification misses and has a contractual agreement to spend no more money to improve the design – using the cost as an independent variable principle for the requirements. The only remaining program resources associated with these 21 requirements is for gathering qualification evidence to verify the capability of the design as is. When qualifications are complete, F-35 JPO will reset the specification requirements to the achieved performance and negotiate consideration for each of the shortfalls.

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

A closure tracking / status Action Item for these 21 system level requirements would regularly assess progress toward reconciliation and closure of the specification to realized performance: qualification actions, coordination of verification evidence, draft specification change request engineering review, Configuration Steering Board approval, Change Control Board approval and contract negotiations / contract modifications. However, for these 21 system level requirements, neither risk mitigations nor design changes are funded within the remaining scope of the System Design and Development contract. As an aside, several of the 21 system level requirements are separately tracked as Program Technical Performance Measures.

Finding C

The Quality Assurance Organization Was Not Independent and Not Adequately Staffed

JPO had not defined its quality assurance organization's roles and responsibilities and had not provided adequate staffing to perform effective oversight of the F-35 Program. Also, the quality assurance organization reports to the Director of Production rather than directly to the F-35 PEO. The JPO quality assurance function did not have the necessary independence to implement the quality management mission for development, production, and sustainment of the system. A quality assurance organization that lacks independence or the inherent authority to enforce quality management requirements may not effectively mitigate cost, schedule, and performance risks to the F-35 Program.

Discussion

Our previous evaluation recommended that JPO establish an independent quality assurance organization. JPO initiated the establishment of a quality organization, assigned a Quality Lead, and plans to further develop and staff the organization. But, the organization reports to the Director of Production rather than directly to the F-35 PEO. Because the desire to meet production schedules can often prevent adequate or sufficient root cause analysis and corrective action, a quality assurance organization that is independent and reports to the PEO ensures greater influence in program decisions. The current organizational structure may limit the quality assurance organization's ability to objectively report program quality management performance.

F-35 JPO Response: Partially Agree
The F-35 JPO does not place schedules ahead of quality. Further, the F-35 JPO has withheld delivery of aircraft to assure quality issues are addressed. Although the F-35 JPO deems the current reporting structure adequate to meet program needs, it has agreed to create a more robust quality organization to ensure quality management is objectively measured and reported.

Recommendation

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

C. We recommend that the F-35 Joint Program Office realign the quality assurance organization to report directly to the PEO, define the organization's roles and responsibilities, and staff the organization appropriately.

F-35 JPO Response: Agree
Efforts to establish an independent quality organization are on track. As documented in F-35 JPO's August 2014 response and reiterated during presentations and discussions with DODIG team members. A quality organization will be in place 12-24 months from the May 2014 decision.

Finding D

Reduction of the Assembly Defect Rate Was Inadequate

JPO and DCMA management were not committed to ensuring that assembly defect rate objectives and goals were realized. Lack of ability to reduce defects and the scrap, rework, and repair rate in accordance with defined program objectives will negatively impact program cost and schedule.

Discussion

JPO was not ensuring that Lockheed Martin was fulfilling its commitment to a 90-percent assembly defect rate reduction per aircraft to meet the full-rate production goal of completing one aircraft per day. We were not able to determine Lockheed Martin's progress in meeting its commitment to a 90-percent reduction in the assembly defect rate because it was not tracking its progress using the correct data for SDD or LRIP lot deliveries. In accordance with conflicting information contained in the quality management plan, Lockheed Martin was tracking the number of nonconforming material records rather than the number of assembly defects. Lockheed Martin demonstrated a 23-percent reduction in nonconforming material records compared to the 60-percent defect rate reduction that should have been realized after LRIP lot 5. In addition, JPO and DCMA did not ensure that corrective actions for product nonconformances were adequately implemented to reduce the assembly defect rate. At the time of our evaluation, we were not aware of any initiatives or value engineering change proposals specifically aimed at the reduction of the assembly defect rate in accordance with the program quality management plan goals.

F-35 JPO Response: Disagree
The program quality 90% objective the DODIG references was a ratio of Scrap Rework and Repair (SRR) to production labor hours (hence a 'rate'). This is a normalization technique to assess levels of SRR relative to volume of work in a given area. This normalization is a valuable metric; however, it is not the only metric. In the current case of F-35 the production line which is still experiencing significant production labor hour

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

reductions as a result of progressing down predictable learning, the ratio of declining SRR hours to declining production labor hours has remained relatively steady. The F-35 JPO, DCMA and LM have worked to understand this phenomenon and analyzed other metrics to evaluate the program's progress toward reductions necessary to reach high production rates by increasing efficiency and flow.

- Factory SRR hours have decreased 65% since the first production lot. Supplier responsible SRR has been reduced 80% and the program is setting a goal to reduce the current level another 25% again this year.
- Quality Escapes to the field are another measure, which have decreased 75% since 2011.

Recommendations

D. We recommend that the F-35 Joint Program Office:
1. Ensure that Lockheed Martin implements initiatives to reduce the assembly defect rate of the product to meet planned full rate production goals.

F-35 JPO Response: Agree
As presented, Lockheed Martin has initiated several initiatives to reduce nonconformances of all types both within their facilities and throughout their supply chains. The F-35 JPO is committed to ensuring quality objectives and goals are realized, therefore monitors progress closely with monthly and quarterly quality metrics reviews and Production Readiness Reviews. Additionally F-35 JPO production operations and quality subject matter experts attend Systems Engineering Technical Reviews to assure designs are producible and encompass quality objectives. Additional improvement incentives are being realized through the program's Blueprint for Affordability which provides a cost share between the contractor and government to fund the improvements, while not solely dedicated to quality and producibility improvements the majority of projects achieve savings through defect reduction by focusing on producibility. F-35 JSPO is satisfied with the methodology LM is using to monitor SRR in lieu of a ratio to production hours. Additional metrics are being evaluated by F-35 JPO, DCMA and the contractors independently and jointly to continue driving discovery of nonconformances at their source (eliminate escapes) as well as facilitating correction. The mutually agreed to quality goals are part of the Joint Program Commitments, which the F-35 JPO may consider implementing in contracts, though they are not currently.

2. Coordinate with DCMA to implement an effective root cause analysis and corrective action process in order to meet assembly defect rate goals.

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

F-35 JPO Response: Partially Agree
There are effective Corrective Action processes already in place within Lockheed Martin and the supply chain. DCMA and F-35 JPO quality organizations focus heavily on continually improving these systems and process to assure cause analysis leads to true root cause and does not stop with direct cause. This includes areas outside production, including work instructions, tooling, design, facilities, human resources and even within the government should government furnished equipment property or direction be a contributor. Lockheed Martin has also implemented internal corrective action processes for non-shop floor continual improvement opportunities. While F-35 JPO agrees effective root cause and corrective action are essential to improvement, beyond continuous high priority focus through Corrective Action Board meetings, metrics reviews, DCMA issuance of requests for corrective action no additional changes are necessary at this time.

Finding E

Corrective Action Request Escalation Was Inadequate

DCMA Fort Worth was not escalating unresolved CARs to the next higher level as required by the applicable DCMA instruction. If DCMA does not escalate CARs as required, deficiencies may continue to occur and DCMA and JPO leadership may not be aware of problems until they adversely impact the cost, schedule, and performance of the program.

Discussion

DCMA was not following its policy to escalate CARs to the next higher level when repetitive Level II CARs have been issued, when CAPs were rejected and not resubmitted within the 10-day requirement, or when the corrective action validation is rejected. We identified instances when multiple CARs were documented for the same violation, but none were escalated to the next level. We also noted instances when CAPs were rejected and were not resubmitted within the 10-day requirement, but did not result in DCMA escalating the CAR to the next level.

DCMA Response: Agree
DCMA agrees we did not execute to DCMA Instruction #1201 as interpreted by the DoD IG team. We agree that DCMA instruction 1201 requires clarification. It is currently under revision to address clarification to the CAR elevation process.

DCMA believes this risk is mitigated based on a comprehensive program quality strategy between DCMA, F-35 JPO, and LM. There is a monthly metrics cadence in which the DCMA Quality organization provides independent CAR analysis. The data presented in these meetings provides insight of non-compliances identified through DCMA and LM Quality surveillance activities.

Recommendations

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

E. We recommend that the Defense Contract Management Agency:
1. Review all unresolved CARs and escalate those that meet the criteria established in DCMA policies and instructions.

DCMA Response: Agree
DCMA agrees we did not execute to DCMA Instruction #1201 as interpreted by the DoD IG team. We agree that DCMA instruction 1201 requires clarification. It is currently under revision to address clarification to the CAR elevation process. DCMA Headquarters will provide an updated policy with an estimated completion date of early 2015. Upon policy update approval, DCMA LMFW will review all open CARS to determine if any warrant elevation to the next level as recommended.

2. Assess all CARs that were not properly elevated and assess any impact on the product.

DCMA Response: Agree
DCMA LMFW will assess all open CARs based on new policy guidance to identify, analyze, and assess any impacts to F-35 product.

Finding F

Software Quality Management Was Insufficient

JPO and Lockheed Martin were not ensuring software quality management processes such as configuration management, failure reporting and corrective action, nonconformance root cause and analysis, and training were performed sufficiently to prevent delayed mission capability, software rework, and possibly additional program costs. In addition, undiscovered software defects could result in performance degradation or even catastrophic failure of aircraft, subsequently resulting in loss of aircraft and death.

Discussion

Lockheed Martin's software development methodology did not facilitate the performance of physical and functional configuration audits. The majority of new aircraft capability is based on additional software builds; therefore, it is necessary to perform functional and physical configuration audits. These types of audits ensure that CSCIs exist and are configured, tested, and documented in accordance with software specifications and requirements to mitigate aircraft performance and reliability risks. In addition, deficiencies in Lockheed Martin's software development training program may lead to knowledge gaps which could result in software development process failures and software defects. Additionally, the classification of the severity of software deficiencies identifies the level of verification and corrective action required. Lockheed Martin's failure to ensure software subcontractors, such as Northrop Grumman, were categorizing software deficiencies in accordance with the F-35 Air System Software Development Plan does not provide confidence in delivered software. Allowing open deficiencies, especially those whose severities are not characterized and understood, can result in performance degradation or

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

catastrophic failure during operation. JPO needs to ensure that rigorous software processes exist at Lockheed Martin.

F-35 JSPO Response: Disagree
The F-35 JPO considers F-35 software quality management is sufficient, specifically the air vehicle software quality referenced in the draft DOD IG audit report. The F-35 JPO is confident current air vehicle software configuration management, failure reporting and corrective action, root cause analysis, and training are sufficient and adequate to support program mission capability and cost objectives. The F-35 JPO is confident in the current air vehicle software, systems engineering, and airworthiness certification processes will ensure no undiscovered software defects will be delivered with the air vehicle that could result in performance degradation or even catastrophic failure of aircraft.

Specific DOD IG Finding Responses:

1. DOD IG Finding: Lockheed Martin's software development methodology did not facilitate the performance of physical and functional configuration audits. The majority of new aircraft capability is based on additional software builds; therefore, it is necessary to perform functional and physical configuration audits. These types of audits ensure that CSCIs exist and are configured, tested, and documented in accordance with software specifications and requirements to mitigate aircraft performance and reliability risks.

   F-35 JPO Response: In accordance with the F-35 program Software Development Plan and Configuration Management Plan, physical and functional configuration audits of the type referenced by the DOD IG report are conducted against the air vehicle Software Data Load, which is a compilation of vehicle and mission systems components. The program is conducting FCA/PCAs in accordance with the F-35 CM Plan, 2YZA00002, on all CIs and CSCIs identified in the F-35 CI List, 2YZA00941, approved by the F-35 JPO. This finding erroneously presumes that certain software items which are not identified in the CI list are CSCIs and therefore must be subject to FCA/PCA requirements. Mission System and Vehicle System computer programs are elements which contribute to the composition of the aircraft Software Data Load. It is the aircraft Software Data Load which is identified in the F-35 CI List as a CSCI, and it is this software product on which FCA/PCA activity will be conducted. This practice is consistent with software development practices on all weapon systems developed at the Fort Worth facility, including the F-16 and F-22, in accordance with the DoD required Single Process Initiative for the Fort Worth Facility. The F-35 program has a very rigorous and structured verification and validation process for software enabled systems capabilities, including the identification and management of all software components that contribute to safety critical functions. In addition, F-35 air vehicle software undergoes extensive independent reviews by external airworthiness agencies from the United States Air Force and

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

Navy in the context of MIL-HDBK-516, as well as the Ministries of Defense of the United Kingdom and Australia. These agencies have independently confirmed the adequacy of the physical configuration and functional ability of the air vehicle software for safe operation in the delivered operational envelope. The F-35 program does not intend to modify existing functional and physical configuration audit practices for F-35 air vehicle software based on this finding.

2. DoD IG Finding: Deficiencies in Lockheed Martin's software development training program may lead to knowledge gaps which could result in software development process failures and software defects.

   F-35 JPO Response: Lockheed Martin has a structured and accountable training program for all software engineers in the LM aeronautical division, documented in PM-4002 (Software Engineering Training). In addition, the LM F-35 program has a structured and accountable training program for F-35 specific software development environments and tools. Training history for both LM Aero and F-35 specific training were provided to the IG team, as well as learning plans for specific classes of software engineering disciplines. Air vehicle software engineers on the F-35 program comprise a body of world class talent – they are industry experts in the development of hard real time embedded flight and mission critical software, and have in most cases decades of experience in vehicle and mission systems software development on other 4^{th} and 5^{th} generation fighter programs. They are sought after by industry to provide instruction to other engineers in their discipline areas, and work directly with the developers of the software tools and environments they are using to incorporate additional enhancements and features to increase productivity and efficiency. The F-35 JPO does not intend to pursue any additional training initiatives for the LM software development team based on this finding.

3. DoD IG Finding: The classification of the severity of software deficiencies identifies the level of verification and corrective action required. Lockheed Martin's failure to ensure software subcontractors, such as Northrop Grumman, were categorizing software deficiencies in accordance with the F-35 Air System Software Development Plan does not provide confidence in delivered software. Allowing open deficiencies, especially those whose severities are not characterized and understood, can result in performance degradation or catastrophic failure during operation.

   F-35 JPO Response: System and software deficiency severity classification and tracking is managed and maintained at the air vehicle system level, in

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

accordance with F-35 program systems engineering, software engineering, and system verification plans. The DoD IG team assumed subcontractors would independently classify and track their anomalies using the same criteria as the air vehicle teams, which is not the defined process or practice. Subcontractor deficiencies are reported against the specification requirements levied to the subcontractors, but cannot be categorized by the subcontractor team in terms of air vehicle severity, as only the air vehicle systems engineering teams in the vehicle systems and mission systems functional areas have the required breadth and scope of system functionality and safety criticality to adequately classify the severity of component anomalies in the context of air vehicle operations. The F-35 JPO reviewed the specific concerns highlighted by the DoD IG with Northrop Grumman failure reporting, and found the reporting practice consistent with the documented air vehicle software, systems engineering, and air vehicle verification plan. There are no open deficiencies delivered with the air vehicle that are not characterized by hazard severity and understood within the context of mission and safety criticality, and which have not been adjudicated with the F-35 JPO, airworthiness authorities, and operational users. The F-35 JPO does not plan to modify the existing software, systems engineering, and system verification process or practices based on this finding.

Recommendation

F. We recommend that the F-35 Joint Program Office work with Lockheed Martin to ensure software quality management systems are improved; metrics should be reported on a periodic basis (for example, monthly) to evaluate process improvement.

F-35 JPO Response: Agree
The F-35 JPO has been and will continue to work with Lockheed Martin to ensure the adequacy and improvement of software quality management processes and practices. Metrics reflecting software quality and quality improvement objectives have been developed and are being reported and assessed at both the vehicle systems and mission systems team levels on a monthly basis, as well as at the air vehicle level and production quality on a monthly basis.

Finding G
Subcontract Management Procedures Were Still Inadequate

JPO, DCMA, and Lockheed Martin were not ensuring that contract requirements were adequately flowed down, contract deliverables were evaluated, and minor nonconformances were approved by

F-35 Joint Program Office and Defense Contract Management Agency Response to Findings/Recommendations (cont'd)

the proper authority. Lack of sufficient subcontract management activities may result in the acceptance of products that do not meet intended performance and reliability requirements.

Discussion

DCMA and Lockheed Martin were not ensuring that the purchase orders identified the specific revisions of the technical requirement documentation necessary for the production, testing, and inspection of each item being purchased and changes to technical requirements were contractually documented. They also did not ensure that contractually required supplier-generated data items were delivered by subcontractors when required. We found no evidence of any appropriate actions taken when subcontractors did not comply with these requirements. In addition, JPO and Lockheed Martin were not ensuring that disposition and approval of minor nonconformances were approved only by DCMA, who has the delegated authority for approval of minor nonconformances.

Recommendations

G.1. We recommend that the F-35 Joint Program Office ensure that all minor nonconformances are evaluated and approved only by DCMA.

F-35 JPO Response: Partially Agree
F-35 JPO will work with DCMA to assure compliance with regulation and direction. As part of an existing effort to validate requirements flow down accuracy, minor nonconformance approval will be included. Scrap and rework-to-design-definition (so called rework to blue-print) dispositions ultimately result in conforming product being presented to the government for acceptance and alleviate the requirement of further DCMA review. DCMA has and will continue to intercede in repetitive scrap and rework. In the case of repair or use-as-is disposition, DCMA reviews these in accordance with regulation and instruction as it results in nonconforming product being tendered for acceptance. The F-35 JPO will work with DCMA to assure nonconformance evaluations are properly reviewed in accordance with requirements and action plans put in place by March 31, 2015.

G.2. We recommend that the Defense Contract Management Agency ensure that Lockheed Martin flows down the appropriate technical requirements to its subcontractors and receives and evaluates contract deliverables within the required time frames.

DCMA Response: Agree
DCMA LM will assess current functional surveillance strategies to determine system/process surveillance gaps regarding Subcontract Management Procedures. DCMA LM surveillance strategies will be revised as necessary to ensure LM processes are adequate to provide appropriate flow down of requirements and execution of those requirements are achieved by their subcontractors.

Lockheed Martin Letter to F-35 Joint Program Office on Quality Improvements

LOCKHEED MARTIN

Dr. Alexander Eksir
Vice President, Quality & Mission Success
Lockheed Martin Aeronautics

DATE: 13 January 2015

TO: F-35 Joint Strike Fighter Program Office
ATTN: [redacted]

SUBJECT: Update and Follow Up to 2014 Department of Defense Inspector General Quality System Review at Lockheed Martin Aeronautics

REFERENCE: Discussion with Department of Defense Inspector General; Please Consider for Inclusion with Response to F-35 Lightning II Program Quality Assurance and Corrective Action Report

To the F-35 Joint Strike Fighter Program Office:

As noted during the latest IG review in September, much progress is being made at Lockheed Martin Aeronautics on the F-35 program. The company continues to work the issues while launching initiatives to ensure an enduring focus on process excellence and zero defects. Following the recent review in 2014, the company quickly took action to address the concerns identified by the audit team. Lockheed Martin Aeronautics in partnership with DCMA and the JPO documented observations made by the audit team with internal Corrective Action Requests (iCARs). A Formal Corrective Action Plan (CAP) was developed for each iCAR allowing Subject Matter Experts (SMEs), in collaboration with local DCMA and JPO representatives, to drive robust root-cause analysis, close systemic gaps, and jointly validate effectiveness for each finding. In addition to these corrective actions, the JPO continues to evolve and strengthen management oversight to ensure our momentum continues. Added oversight methods include multiple quality system reviews, metrics reviews, joint audits and other regularly scheduled events that are planned one-year in advance and tracked monthly.

The JPO and Lockheed Martin Aeronautics have leveraged the IG reviews to improve the company Quality Management System with several changes including the following:

1. Review formats, content, and accountabilities were reshaped while ensuring broader inclusion of DCMA and other programmatic stakeholders. In 2014 alone over 20 enhanced quality reviews were held between DCMA, JPO, Lockheed Martin Aeronautics, and key suppliers/ co-producers. Many of these events will continue to be conducted weekly and monthly to drive improvements while collecting the real-time status of quality performance and addressing program quality challenges.

2. The Global Quality Council (GQC) was created to support supply chain improvements and share best practices between industry partners. The GQC is chaired by the Lockheed Martin Aeronautics Vice President of Q&MS and represents the top seventeen mission

Lockheed Martin Letter to F-35 Joint Program Office on Quality Improvements (cont'd)

critical major suppliers and co-producers for F-35. The GQC is actively engaged in improvement and quality transformations across the supply chain. During 2014, the council facilitated joint engagements to address common problem sub-tier suppliers, offer training exchanges between GQC members, improved response times to address challenges between companies, and execute resource exchanges to address technical and quality issues.

3. The Aeronautics Quality Transformation (AQT) was established to further Lockheed Martin Aeronautics' focus on quality improvement. Championed by the business president and sponsored by senior executives, the focus of the AQT is on cultivating systematic accountability to quality across the company and value chain. AQT challenges each section of the company to identify areas of improvement and investments that will drive out defects. Many of the improvements noted during the DoD IG audit and positive changes at Lockheed Martin Aeronautics are directly tied to the corporate sponsored AQT efforts and projects.

4. Fort Worth's FOD Prevention Center was erected as a state-of-the-art, hands-on learning clinic for FOD detection and prevention. The center has provided an excellent venue for training including FOD detection and retrieval, enhanced specialized equipment training, and a new simulation trainer. The annual compliance training "Fundamentals of FOD Prevention" has been refreshed to deliver improved learning. Process compliance assessments are performed by the FOD prevention team across all factory build areas. Although FOD continues to be a challenge for Lockheed Martin Aeronautics and industry, real improvements have been established and are yielding results across the enterprise.

5. Learning and development of human capital continue to be key investments toward continuous improvement. Investments including the Mission Success Development Training initiative (MSDTi), training and certification by external institutes, and the quality engineering transformation, were instituted to strengthen employee understanding and ability in Quality Management and Science across Lockheed Martin Aeronautics. MSTDi is a twelve month training curriculum applying the principles of quality. More than 200 students from various functions at the company and its suppliers have completed the MSTDi program and 40 percent of quality engineers are certified by the American Society for Quality. 100 percent (154) of Q&MS leadership and salaried employees have completed AS9100 training, and 100 percent of inspectors have completed a "Q101" training course.

The focus areas mentioned are just a few examples of the work underway. These efforts are yielding results with a more mature Quality Management System, product quality improvements, and program momentum. Examples of the key indicators of quality improvement include the following:

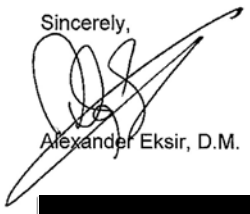
1. A 50 percent reduction in defects from the top 22 F-35 suppliers during 2014;
2. 80 percent reduction in supplier Scrap, Rework, and Repair (SRR) since LRIP 1;
3. Factory SRR hours have decreased 65 percent between LRIP 1 and LRIP 6;
4. Production-caused escapes to the field are down 75 percent since 2011;
5. Zero FOD defects at delivery in 2014;
6. Flight test performance continues to accelerate and validate the capability of the platform.

Lockheed Martin Letter to F-35 Joint Program Office on Quality Improvements (cont'd)

Difficult early program technical challenges are being resolved in partnership with Lockheed Martin Aeronautics, the JPO, and program suppliers. Contracting challenges are being diligently worked and resolved. Affordability continues to be a focus area with multiple efforts resulting in reduced costs as evident in LRIP over LRIP price reductions.

The Lockheed Martin Aeronautics continuous improvement strategy is being realized in a way that is benefiting the F-35 program as well as the other platforms and sites that make up the business. The assessments by the DoD IG have further validated those improvements and areas of needed focus.

Sincerely,



Alexander Eksir, D.M.

[redacted]

Acronyms and Abbreviations

APUC	Average Procurement Unit Cost
AS	Aerospace Standard
CAP	Corrective Action Plan
CAR	Corrective Action Request
CCDD	Capability Description Document
CSCI	Computer Software Configuration Item
CSI	Critical Safety Item
CTOL	Conventional Takeoff and Landing
CV	Carrier-Suitable Variant
DCMA	Defense Contract Management Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DMSMS	Diminishing Manufacturing Sources and Material Shortages
FCA	Functional Configuration Audit
FOD	Foreign Object Debris
FRACAS	Failure Reporting, Analysis, and Corrective Action System
HWCI	Hardware Configuration Item
ICA	Integrated Corrective Action
ICNI	Integrated Communications, Navigation, and Identification
IG	Inspector General
JCS	JSF Contract Specification
JPO	Joint Program Office
JSF	Joint Strike Fighter
LRIP	Low-Rate Initial Production
OFI	Opportunity for Improvement
PAUC	Program Acquisition Unit Cost
PCA	Physical Configuration Audit
PEO	Program Executive Officer
SDD	System Development and Demonstration
SDP	Software Development Plan
SPAR	Software Problem Anomaly Report
STOVL	Short Takeoff and Vertical Landing
UTAS	United Technologies Corporation, Aerospace Systems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