



OPERATIONAL TEST
AND EVALUATION

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MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION,
TECHNOLOGY AND LOGISTICS

SUBJECT: Concerns Regarding Progress and Readiness of the Joint Strike Fighter (JSF)
Program for Initial Operational Test and Evaluation (IOT&E)

The purpose of this memorandum is to document my continuing concerns regarding progress in the F-35 JSF program as you prepare to conduct the upcoming Defense Acquisition Board review. In a memorandum dated August 9, 2016, I identified concerns to you, the Secretary of the Air Force and the Chief of Staff of the Air Force that, in spite of the recent Initial Operational Capability (IOC) declaration by the U.S. Air Force, achieving full Block 3F combat capability is actually at substantial risk. The primary concerns were that the program appeared to be prematurely ending System Development and Demonstration (SDD) and was not taking the necessary steps to be ready for IOT&E, which will be conducted using realistic combat missions fully consistent with our war plans and threat assessments. The program's limited progress since the memorandum continues to indicate clearly the program will not be able to deliver the full Operational Requirements Document (ORD)-required combat capability within the planned remaining SDD schedule. The reasons I have reached this conclusion include the following:

- **Continued schedule delays.** According to the program's baseline mission systems software and capability release schedule, the planned release to flight test of Block 3FR6 mission systems software has slipped from February 2016 to December 2016, 10 months later than originally planned. This delay was caused in part by the need for multiple additional "Quick Reaction Capability" (QRC) software builds of Block 3FR5 to enable weapons testing to proceed and to reduce stability problems. However, since the program was funded to the baseline schedule, this 10-month delay in Block 3FR6 software indicates strongly that the program has shortfalls in funding and time to complete the planned testing of the remaining set of full Block 3F capabilities and necessary fixes. Moreover, releasing Block 3FR6 in December is another 3-month delay to the program's more recent estimate that this version of Block 3F software would be released to flight test in September.
- **Need to complete all planned and agreed-to developmental testing (DT).** The program's continued cost- and schedule-driven plan to truncate planned DT points and prematurely close-out SDD would shift significant risk to OT and the warfighter. This ill-advised action would also discard carefully planned build-up test content in the Test and Evaluation Master Plan (TEMP) that was not included as an optional throwaway, but rather was content the Program Executive Officer formally agreed was required when he signed the TEMP. The program's plan to "quarantine" build-up test points that were in the Joint Test Plan (JTP) and planned to be flown by the



test centers, skip ahead to complex mission effectiveness test points, and then delete the build-up test points as “no longer required” will only delay problem discoveries and increase the risk to IOT&E, as well as to the men and women who will use the F-35 in combat. Additionally, the program will need to allocate test points not in its current plans for characterization, root cause investigations, and correction of a large number of the open deficiencies and technical debt described later in this memorandum. The completion of the planned baseline test points from the Block 3F JTP, along with correction or mitigation of significant deficiencies, is necessary to ensure full Block 3F capabilities are adequately tested and verified before operational test and, more importantly, before they are fielded for use in combat.

- **Insufficient progress in F-35A, F-35B and F-35C flight sciences testing.** Although progress has been made in all variants, each is behind in planned test point completion for the year, as shown in the table below (data as of the end of September).

Variant	Planned Points thru Sep 30, 2016	Points Accomplished thru Sep 30, 2016	Planned Points for CY16
F-35A	1322	1080	1364
F-35B	1593	1580	2119
F-35C	1441	1354	1906

- **Insufficient progress in F-35 mission systems testing.** As of the end of September, the program had only accomplished 2,069 mission systems test points against the goal of 3,189 and the plan of 3,709 for the year. Despite falling farther behind and carrying a significant number of open deficiencies, the program has decided to terminate testing of Block 3F software as scheduled in CY17 due to inadequate funding to complete the planned testing in the JTP. As a result of this decision and ongoing software delays, the program has deleted two full software releases from their mission systems schedule, removing Block 3FR8 and replacing 3FR7 with additional contingency QRC software builds of 3FR6, which will now be the last full developmental software release. The outcome of these decisions is that the remaining number of software releases to complete Block 3F development is currently insufficient to support adequate testing to identify and correct deficiencies prior to IOT&E and use in combat. Although the 3FR6 release in late 2016 is planned to have full Block 3F capabilities, some of those capabilities will be tested for the first time in that release and will certainly not be mature enough to be effective without additional testing and the necessary additional time and resources. In particular, additional builds of software to characterize and correct deficiencies, each of which will also require regression testing to verify fixes, will be needed. These problems are exacerbated by the proposal to quarantine test points described above. Despite these delays, and the fact that some of the “full” Block 3F capabilities are just beginning flight test or have not yet started (i.e., gun accuracy testing), the program still plans to terminate flight testing as scheduled in early 2017 and finalize Block 3F.

- Insufficient time and resources to conduct all required weapons delivery accuracy (WDA) events.*** The program completed a surge of weapons test events in August and is analyzing the results. While some of the events appear to have been successful, several WDAs unsurprisingly had significant issues that either required control room intervention or the employment of the weapon was likely unsuccessful. Despite making some progress, the program still has not completed the full set of planned test events for Block 3F weapons in the TEMP, with 13 WDAs remaining, excluding the multiple gun scoring events, which must also be completed. Due to the limited time and funding remaining in SDD, the program has prioritized completing testing of new and deficient Block 3F mission systems capabilities over completing the remaining WDAs. While completion of Block 3F mission systems is necessary, the WDAs are also an integral part of successfully completing required development and adequate testing of full Block 3F capabilities. Each of the planned WDA events is an essential end-to-end test of the full fire-control chain. Conducting all of the WDAs is the only way to discover problems that otherwise will be realized in operational test and/or combat. For example, one of the recent AIM-120 missile WDA events required control room intervention to direct the pilot when to launch, as there were no shoot cues or launch zone indications displayed to the pilot due to an outdated AIM-120 missile attack model within the mission systems software. Due to their importance and the distinct differences among them, all of the planned WDA events must be completed during DT; otherwise, these events will have to be completed before or during IOT&E, which will delay discovery of deficiencies and the completion of IOT&E while adding to its cost.
- Insufficient progress in gun testing.*** Planned gun testing continues to fall farther behind as the program works through design deficiencies, test discoveries, and the resulting modifications to the test aircraft. Despite the limited time remaining in SDD, the program still has not completed initial flight sciences testing of the F-35B gun pod, started ground testing of the F-35C gun pod, or attempted an aimed gunshot using the Helmet Mounted Display System (HMDS) on any variant. Based on discoveries during F-35A flight sciences gun testing, required changes to vehicle systems software are being added to Block 3FR6 to attempt to mitigate yaw induced by the gun firing in the F-35A, as well as expected pitching moments when the gun pod is fired under the F-35B and F-35C – this adds further to the substantial burden of problems 3FR6 is supposed to correct. The first flight testing of a properly modified F-35A gun from a mission systems aircraft with 3F software, aimed by the Gen III HMDS, was planned to start in October but will likely not begin until 2017 due to continued delays.
- Ineffective operational performance.*** The performance of earlier Block 3F versions during DT to date shows significant operational shortfalls. An assessment, based on OT pilot observations of DT missions, of the operational utility of Block 3FR5.03 software to support planned IOT&E missions, including Close Air Support, Destruction/Suppression of Enemy Air Defenses, Offensive and Defense Counter-Air, Air Interdiction, and Surface Warfare, rated each of the mission areas “red” and

unacceptable overall, with significant deficiencies in capabilities and/or performance shortfalls.

- ***Numerous remaining deficiencies and technical debt.*** The program's recent decision to eliminate two full software builds and delete TEMP- and JTP-required testing due to software schedule slips and funding shortages is inadequate to address the large number of significant open Deficiency Reports (DRs) remaining in SDD. This plan assumes no further significant discoveries in SDD; however, even in the unlikely event no additional discoveries are made, the program is running out of time and budget to properly test and verify the required fixes for the existing DRs. The program currently has 146 Category 1 and 1,033 Category 2 "active" open DRs, along with 16 new DRs, since the last deficiency review board on September 26, 2016. Of the 1,179 DRs, there are 528 that are being categorized as "Open Under Investigation" (OUI) and 385 categorized as "Open Awaiting Fix Verification" (OAFV). All of the 385 OAFV DRs require flight test activity by the Integrated Test Force (ITF), and a large percentage of the OUI will need flight test points to gather root cause data. None of these test points are currently allocated or accounted for in the ITF flight test priority. The scope of unaccounted-for DRs and the program's intention to terminate flight testing early demonstrate clearly the need for additional resources to complete SDD.
- ***Shortfalls in the Autonomic Logistics Information System (ALIS).*** The program continues to experience delays in the development and fielding of ALIS.
 - The latest version of ALIS in development – version 2.0.2 – was planned to be delivered by August 2016, as the Air Force had expected it to be fielded prior to their declaration of Initial Operational Capability (IOC), but it has yet to successfully complete testing and likely will not be fielded until early 2017. The key additional capabilities in ALIS 2.0.2 include propulsion integration, which will allow uniformed maintenance personnel to download and process engine data with the rest of the aircraft data in ALIS following flight. Currently, the propulsion data must be processed separately by Pratt & Whitney field service representatives.
 - Delays in ALIS 2.0.2 development have also delayed the development of ALIS 3.0, the planned final release of ALIS software for SDD. Because of these cascading delays and additional emerging service and partner requirements, including critical security enhancements, the program adjusted development and fielding of remaining capabilities and has moved content out of ALIS 3.0 into post-SDD releases. The cumulative effect of these deferrals and unresolved deficiencies on suitability will be evaluated during IOT&E.
- ***Inconsistencies between contract specifications and the ORD.*** The program has accepted numerous changes or deferrals to contract specifications, while not receiving formal relief from, or changes to, the associated requirements in the ORD. As an example, the program office, in coordination with the Services, determined that the

specification requirements for gun accuracy could not be met with the new ammunition planned to be used, the Frangible Armor Piercing (FAP) round for the F-35A and the Semi-Armor Piercing High Explosive Incendiary-Tracer (SAPHEI-T) round for the F-35B and F-35C. The program office completed a specification change to the contract to delete the old requirement for gun accuracy and lethality, but did not add the new planned specification values nor complete any requirements changes for the ORD. As a result, the program now apparently has no contract specifications for either air-to-air or air-to-ground lethality and engagement performance; however, the program still has approved air-to-ground ORD criteria that have not been adjusted or changed, which are not possible to achieve due to the change in ammunition. The JSF stakeholders, including the Services and Joint Staff, should immediately conduct a requirements review of the ORD versus the contract specifications to identify documentation or performance shortfalls as the program closes out SDD.

- ***Inadequate preparations for IOT&E.*** The program office and some other JSF stakeholders have proposed a “phase-start” for IOT&E, based on the assumption that the modification schedule for the fleet of OT aircraft will provide some aircraft earlier with which testing could begin. Besides the modifications to the OT aircraft being substantially late to need to start IOT&E (see immediately below), the full Block 3F flight envelope and weapons clearances, along with a verified Block 3F mission data file, will not be available before May 2018, according to the program’s most recent schedule estimates. DOT&E will not approve a “phased start” for IOT&E that violates the spin-up and test entrance criteria, as outlined in the TEMP (list of criteria attached), which was signed and approved by the F-35 stakeholders, including the JSF Program Executive Officer. (Note that these criteria include a detailed and definitive definition of the agreed composition of full Block 3F combat capability.) This includes the requirement for all 18 U.S. OT aircraft and the 5 partner OT aircraft to be in the Block 3F production-representative configuration. The full fleet of OT aircraft, with the full Block 3F capabilities including envelope and weapons, is required for the efficient and effective execution of spin-up mission rehearsals and for successful execution of the complex IOT&E plan, which includes four-ship and eight-ship test trial missions. These are common-sense, long-agreed-to criteria that must be satisfied to conduct a realistic and rigorous test of the Block 3F capabilities that will actually be fielded so that our warfighters will know what the aircraft truly can and cannot do in combat – the inviolate reason for the test.
- ***Late plans for modification of OT aircraft.*** The TEMP requirement to provide production-representative Block 3F OT aircraft for IOT&E has been well known for more than seven years; however, the program has not adequately planned nor contracted for the necessary modifications, including the Technical Refresh 2 (TR2) processor upgrades. This failure to develop an adequate plan for providing modified OT aircraft does not relieve the program of the IOT&E spin-up and test entrance criteria. Late discovery of issues during development – such as those requiring the extensive modifications to provide an operational gun system or the ability to carry the AIM-9X missile throughout the employment envelope on the

F-35C – are continuing and should be expected for a program as complicated as the JSF that is experiencing significant development and testing delays. However, these issues must still be addressed with modifications to the OT aircraft. Expecting DOT&E to allow IOT&E to start without a full complement of fully production representative aircraft, as agreed to and documented for years, is a recipe for a failed test, especially in light of the aircraft availability issues mentioned later. Failure to meet the TEMP entrance criteria means not only that the program is unready for operational test – it means JSF is not ready for combat and, therefore, certainly not ready for a Block (i.e., Multi-Year) Buy or full-rate production.

- **Inadequate aircraft availability (AVA).** Although AVA is not an entrance criteria, if the program is only able to achieve and sustain its goal of 60 percent AVA, the length and cost of IOT&E will increase significantly because the expected combat-ready availability of 80 percent was planned for in the TEMP and is needed to efficiently accomplish the open-air mission trials with the number of aircraft planned for IOT&E. The fleet of operational test aircraft, currently consisting of 8 F-35A and 7 F-35B aircraft, averaged an AVA of approximately 50 percent over the last 6 months (through the end of September), as shown in the table below. Although slightly better than average AVA of all of the Lot 3 through Lot 5 aircraft – from which the OT aircraft were produced – this is well short of the 60 percent objective and not adequate to support the flight rate of test trials planned for IOT&E. The table below also shows the maximum and minimum monthly average AVA over the last 6 month period, for reference, and indicates the wider variance in the OT fleet, as would be expected from a smaller sample size. Over the same six-month period there has been no readily discernable trend of increasing or decreasing availability for any of the groups of aircraft, supporting the assertion that availability has flat-lined and will not improve significantly prior to the start of IOT&E.

Aircraft	Average	Maximum	Minimum
F-35A OT (8 A/C)	51.2%	64.5%	39.8%
F-35B OT (7 A/C)	50.4%	64.2%	34.6%
Lots 3 thru 5 (76 A/C)	44.5%	49.0%	40.8%

- **Insufficient progress in air-to-air range instrumentation (AARI).** AARI has not yet been tested in the F-35. In fact, the required DT of AARI has not yet been planned. Despite the limited time remaining in SDD, the AARI DT must be completed in time to support a fly-fix-fly correction cycle so this TEMP-required system is ready in time to support and not delay IOT&E.
- **Inadequate Fusion Simulation Model (FSM).** Corrections to this model, which is currently too unrealistic to be used for IOT&E, are required and must be put on contract to ensure FSM can support IOT&E requirements.

- ***Inadequate Virtual Threat Insertion (VTI)***. The task of adding missing threats required for IOT&E to the VTI-associated reference table must also be put on contract as soon as possible. This will ensure threat messages from AARI for required threats can be recognized and displayed by FSM on the F-35 cockpit displays during IOT&E.
- ***Inadequate United States Reprogramming Lab (USRL)***. Upgrading the USRL to the necessary Block 3F configuration is late to need to enable the USRL to begin the development of Block 3F mission data files (MDF); the latest projection is that the USRL will not be able to start building basic Block 3F MDFs until February 2017. However, because of the inadequate tools provided to the USRL and the complexity of the MDFs, the USRL estimates that it will take approximately 15 months to create, optimize and validate the MDF for IOT&E. Also, because the program failed to order the required signal generators, the Block 3F MDFs will not be optimized against several fielded threats of significant concern. The inadequately equipped USRL increases the likelihood of failure in operational test, and, more importantly, in combat.
- ***Substantial Risks to Follow On Modernization (FoM)***. Despite the significant ongoing challenges with F-35 development listed above, including the certainty of additional problem discoveries, the proposed modernization schedule is not executable. Even with the significant ongoing SDD delays and problems delivering full Block 3F capabilities, the program still plans to award contracts to start simultaneous development of Blocks 4.1 and 4.2 in 2018, well prior to completion of IOT&E (and possibly before it has even started for the reasons detailed above), and therefore lacking understanding of the inevitable problems it will reveal. Also, the proposed aggressive modernization plan and overlapping schedule for Block 4 increments do not depict adequate schedule and resources for formal operational testing. In addition, due to the cost and complexity of the proposed additional capabilities in Block 4, sufficient test resources, including enough test aircraft, will need to be available. Furthermore, because of program concurrency resulting in the fielding of multiple configurations, (i.e., different avionics processors) additional configurations of test fleet aircraft will be needed. For example, enhancements and fixes of mission systems software for aircraft with TR2 processors will be needed while capabilities are developed and tested simultaneously for aircraft with new open-architecture Technical Refresh 3 (TR3) processors. Due to the hundreds of aircraft that will already have been produced, the program and Services will be sustaining aircraft with TR2 processors with versions of Block 4 software for 10 to 15 years before all aircraft can be modified to the TR3 configuration.

For all the reasons stated above and described in my previous memoranda, the F-35 program clearly lacks sufficient time and resources to deliver full combat capability and be ready for operational testing and deployment to combat if it is unwisely constrained to operate within its currently planned budget and schedule. The program should now be provided the additional resources required to deliver full Block 3F combat capability; i. e. to complete all the testing (including regression) needed to rectify a substantial number of existing critical deficiencies as

well as the new deficiencies that will inevitably be discovered during the remaining Block 3F testing.

Failure to adequately finish SDD will result in far greater risks and costs than completing it now. First, since the program clearly will not be able to start IOT&E in August 2017, as indicated in their program of record, the program's plan to draw down staffing and test infrastructure in CY17 to close out SDD would occur at a time when the program should be aggressively using the full capacity of the current test resources and experienced personnel to complete testing, address deficiencies, and ensure full Block 3F capability is delivered and ready for IOT&E and combat. Second, if the program continues with plans to close out SDD prematurely, it will carry the high risk of failing and having to repeat the approximately \$300-million operational test, and failing for many years to provide the full combat capability Block 3F has long been meant and claimed to provide. Third, the unresolved technical debt will spill into FoM, where it will take longer to fix and cost more to address than if rectified now. Finally, the combination of unfinished SDD work and the likely follow-on operational test would significantly delay, and increase the cost of, achieving the important FoM capabilities which are urgently needed to counter current and emerging threats.

I therefore recommend very strongly that the program be restructured now and provided the additional resources it clearly requires to deliver its long-planned and sorely needed full Block 3F combat capability.


J. Michael Gilmore
Director

Attachment:
As stated

cc:
Members of the Defense Acquisition Board