

26 January 2016

Foreign Affairs, Defence and Trade Committee
Joint Strike Fighter Inquiry
Department of the Senate
PO Box 6100
Parliament House
Canberra ACT 2600

Dear Chairman and Committee Members,

THE PLANNED ACQUISITION OF THE F-35 JOINT STRIKE FIGHTER

Please find attached my second submission to this Inquiry.

The Joint Strike Fighter's air combat capabilities are entirely dependent on the proper functioning of the mission systems software. In March 2014, the US Government Accounting Office released a report: *'Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities'*.

This GAO report was prescient and accurate. On 11 December 2015, Dr Michael Gilmore, in a memorandum (attached) to the Under Secretary of Defense Acquisition, Technology and Logistics, and Vice Chairman of the Joint Chiefs of Staff, officially advised of *'Concerns with Plans for F-35 System Development and Follow-On Development'*; here is the opening paragraph:

*The current "official schedule" to complete full development and testing of all Block 3F capabilities by 31 July 2017, is not realistic. It could be achieved only by eliminating a significant number of currently planned test points, tripling the rate at which weapons delivery events have historically been conducted, and deferring resolution of significant operational deficiencies to Block 4. In fact, I learned very recently that the program is currently considering reducing by two thirds the number of planned weapons delivery events (per the approved Test and Evaluation Master Plan) for weapons certification. **This course of action, if followed, constitutes a very high risk of failing Initial Operational Test and Evaluation (IOT&E).*** (My bolding)

Under US law, if a weapon system fails Initial Operational Test and Evaluation, it cannot legally go into full-rate production. The USA has cancelled large weapons system after failure to reach required operational capability; examples are the Navy A-12 Avenger II Stealth Fighter / Attack aircraft cancelled 7 January 1991 and the Army RAH-66 Comanche Attack Helicopter cancelled 24 February 2004.

Mission Systems Software development for the Joint Strike Fighter is said to be the largest project of its type in the world. In software development, increasing the size of the code-base presents an exponentially increasing risk of failure. For example, '*regression testing*' must prove that a sub-program for one operational function does not have adverse or unforeseen consequences to other operational sub-programs. Synchronising 'real time' computations across a complex multi-function platform such as the JSF aircraft is another substantial risk.

The consequences of the delays and failures in development of software for the Joint Strike Fighter advised by the Director of Operational Testing and Evaluation are described in detail by Aviation Week and Space Technology's reporter, Bill Sweetman. A copy of this article is also attached.

Each year, The Director of Operational Test and Evaluation makes a formal report to the US Congress, usually in January, of US Weapons Systems developments under his purview. The 2016 Annual Report on the Joint Strike Fighter will be of particular interest to the Committee and I will transmit a copy to the Secretariat when it is publically released.

The inexorable logic for the USA and its Allies is that if the JSF fails, for whatever reason, to deliver '*a sufficient margin of superiority to provide an acceptable likelihood of success in combat*' then like the US Navy A-12 Avenger II and the US Army RAH-66 Comanche, the program resources must be redirected to an alternative way of delivering the required capability.

Yours sincerely,

Chris Mills, AM, MSc, BSc

Attachments:

Memorandum from the Director of Operational Testing and Evaluation to the Under Secretary of Defense for Acquisition Technology and Logistics, and Vice Chairman of the Joint Chiefs of Staff; dated 11 December 2015

Aviation Week and Space Technology Article, Bill Sweetman, *Testing Chief Warns of Software Delays*; dated 2016-01-22

Transmitted by the Committee Upload Facility



OPERATIONAL TEST
AND EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE
1700 DEFENSE PENTAGON
WASHINGTON, DC 20301-1700

DEC 11 2015

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION,
TECHNOLOGY AND LOGISTICS
VICE CHAIRMAN OF THE JOINT CHIEFS OF STAFF

SUBJECT: Concerns with Plans for F-35 System Development and Follow-On Development

As the Joint Requirements Oversight Council (JROC) prepares to receive an F-35 update briefing, this memorandum provides my concerns with the ongoing and follow-on development programs; those concerns include the following:

- The current "official schedule" to complete full development and testing of all Block 3F capabilities by 31 July 2017, is not realistic. It could be achieved only by eliminating a significant number of currently planned test points, tripling the rate at which weapons delivery events have historically been conducted, and deferring resolution of significant operational deficiencies to Block 4. In fact, I learned very recently that the program is currently considering reducing by two-thirds the number of planned weapons delivery events (per the approved Test and Evaluation Master Plan) for weapons certification. This course of action, if followed, constitutes a very high risk of failing Initial Operational Test and Evaluation (IOT&E).
- Problematic Block 3F software which is the result of---
 - Schedule-driven decisions to field Block 2B before testing and resolution of significant deficiencies were complete.
 - Re-hosting the immature Block 2B software (with hundreds of unresolved deficiencies) into new processors to create Block 3i, which generated avionics instabilities and other new problems, resulting in poor performance during Block 3i developmental testing (DT).
 - A schedule-driven decision to add the final Block 3 capabilities on top of the existing deficient Block 3i software to create Block 3F which, like Block 3i, is demonstrating poor performance in DT.
- Block 3F development, especially incremental software releases to fix deficiencies, ends far too early on the program's current "System Development and Demonstration (SDD) Mission System Software Schedule." The final planned software release, Block 3FR8, is scheduled for mid-2016, at least two years prior to the completion of developmental testing (including demanding weapons and avionics testing), as well as operational testing. This is evidently a



schedule- and/or budget- driven decision. Additional incremental Block 3F releases will clearly be needed to address critical deferred deficiencies and the new discoveries which will inevitably occur between 2016 and the end of DT, as well as the discoveries occurring during operational testing.

- Required modifications to operational test aircraft that are extensive, the contents of which are still evolving due to ongoing discoveries in testing, and the needed modifications will not be complete in time for IOT&E.
- The Autonomic Logistics Information System (ALIS) continues to struggle in development with deferred requirements, late and incomplete deliveries, high manpower requirements, multiple deficiencies requiring work-arounds, and a complex architecture with likely (but largely untested) cyber deficiencies.
- The mission data reprogramming lab does not and will not have the required equipment in time to adequately develop and test the mission data loads for Block 3i Initial Operational Capability (IOC) and Block 3F IOT&E. The program office has still not completed the design and contracting actions to order, manufacture and install the signal generators and other needed upgraded equipment, a process that will take at least two years after the equipment is ordered. The result will continue to be limited and incomplete development and testing of the required mission loads for Block 2B, Block 3i IOC, Block 3F IOT&E and Block 3F fielding.
- The program's proposed "F-35 Modernization Planning Schedule" does not properly align with their current SDD software schedule mentioned above. There is a four-year gap between the final planned Block 3F software release and fielding of the first proposed modernization increment, Block 4.1, in late 2020. The proposed schedule also does not depict any incremental software releases to correct open Block 3F deficiencies and new discoveries prior to adding the proposed new modernization capabilities, which would greatly increase risk to development and testing of Block 4.
- Despite the significant ongoing challenges with F-35 development listed above, including the certainty of additional discovery, the proposed modernization schedule is very aggressive; it finalizes the content of Blocks 4.1 and 4.2 in early 2016. Then, during IOT&E, the program would award contracts to start simultaneous development of Blocks 4.1 and 4.2 in 2018, well prior to completion of IOT&E and full understanding of the inevitable problems it will reveal.
- Finally, the proposed Block 4 modernization plan and schedule do not clearly depict the schedule and resources for operational testing. Due to the cost and complexity of the proposed Block 4 capabilities, along with the likely deferred capabilities and fixes from Block 3F, the F-35 program and stakeholders must

plan adequate schedule and resources for rigorous operational testing of the appropriate increments of Block 4, as is being done with F-22.

/s/ Michael Gilmore
Director

cc:

Assistant Secretary of the Navy for Research, Development and Acquisition
Assistant Secretary of the Air Force for Acquisition
Joint Strike Fighter Program Executive Officer
Commander, Operational Test and Evaluation Force
Commander, Air Force Operational Test and Evaluation Center



Testing Chief Warns Of JSF Software Delays

[Aviation Week & Space Technology](#)

[Bill Sweetman](#)

Fri, 2016-01-22 04:00

Development of the Block 3F version of the [Lockheed Martin F-35](#) Joint Strike Fighter (JSF) cannot be completed on the current schedule—by July 31, 2017—without shortcuts that risk failure in the initial operational test and evaluation (IOT&E) program, according to Michael Gilmore, the Pentagon's director of OT&E ([DOT&E](#)). Block 3F is the culmination of the system development and demonstration (SDD) phase and conforms to the requirements set at the start of the program.

A [Dec. 11 memorandum](#) from Gilmore to Frank Kendall, undersecretary of defense for acquisition, technology and logistics, and Gen. Paul Selva, vice chair of the Joint Chiefs of Staff, also warns that the program is risking trouble by attempting to define Block 4, the first post-service-entry upgrade, early this year, when Block 3F and its predecessor, Block 3i, are still “problematic” and performing poorly in testing.

Also, the program office has yet to order essential equipment for specialized software laboratories that are needed to support operational testing and initial operational capability (IOC), with the result that there will not be enough capacity when it is required.

The JSF Program Office (JPO) acknowledges it has pulled tests out of the program and that each of the software blocks—including Block 3F—will enter service with deficiencies. In the case of Block 3F, these will have to be remedied as part of Block 4, JPO says, and it will be up to customers to decide whether all the deficiencies need to be fixed and when.

DOT&E Gilmore's Verdict on F-35 Software Demonstrations

Block 2F for [Marine Corps](#) F-35B IOC in 2015 delivered with “hundreds of deficiencies”

Block 3i for Air Force F-35A IOC in 2016 “problematic” and performing poorly in development testing

Block 3F to complete F-35 system development in 2017 “demonstrating poor performance”

Block 4, first post-service-entry upgrade, too aggressive and under-resourced

Gilmore's memo, a copy of which was obtained by Aviation Week, lists multiple problems that threaten the program's ability to deliver a reliable and mature product on schedule. Gilmore traces many of the issues to “schedule-driven decisions” made during the 2010-12 rebaselining of the program, under the leadership of current program director Lt. Gen. Chris Bogdan and his predecessor, Rear Adm. David Venlet.

Brought in after the previous program director, Marine Maj. Gen. David Heinz, had been fired, Venlet, Bogdan and a renewed leadership team defined a phased program to permit a limited, early IOC for the U.S. Marine Corps and Air Force, while meeting the program's full requirements later. This involved two interim IOC standards: Block 2B for the Marines and the Air Force's Block 3i.

Gilmore has warned of delays in this process since 2013, because 2B and 3i have consumed time and

resources to the detriment of 3F. To stay on schedule, the program allowed 2B to be delivered with “hundreds” of deficiencies, and eliminated tests, including an operational utility evaluation that was to have preceded Marine sea trials last May and—in a recent action—two-thirds of the weapon release events that were planned to support Block 3F.

The current Block 3F schedule is not realistic, Gilmore argues. “It could be achieved only by eliminating a significant number of currently planned test points, tripling the rate at which weapons delivery events have historically been conducted, and deferring resolution of significant operational deficiencies to Block 4.” He notes that the latest decision to cut weapon release trials—considered to be the “graduation exercise” in a fighter program—“constitutes a very high risk of failing IOT&E.”

The JPO says that it “recognizes about four months of potential risk” in the Block 3F schedule, that the “removal of test points occurs only after a thorough and disciplined review of what is required to deliver the promised capabilities,” and that “the objective is to deliver full Block 3F capabilities” at the end of SDD.

Also, “critical must-fix deficiencies” were remedied before Block 2B was delivered, the JPO says, and “the final determination whether to fix deficiencies immediately, fix them in later increments, or not fix them at all, rests with the warfighters.” (Blocks 2B and 3i are due to be retired after 3F is available.)

But Block 3F is buggy and expected to get worse, Gilmore says, and the schedule does not take account of this. Development of this critical software—which marks the end of the system development and demonstration program and delivery of the capabilities contracted for in 2001—“ends far too early,” with the planned release of Block 3FR8 in mid-2016. “Additional Block 3F releases will clearly be needed to address critical deferred deficiencies and the new discoveries which will inevitably occur between 2016 and the end of developmental testing, as well as the discoveries occurring during operational testing,” Gilmore writes.

The JPO disagrees on the need for more 3F releases, and says that it will be up to the customers to decide which “critical deficiencies” that might emerge during testing must be fixed, most likely in Block 4. “There is ample opportunity to correct deficiencies from Block 3F IOT&E in the early stages of Block 4,” says the JPO, adding that “safety-critical deficiencies will take priority.”



At the root of the problem, Gilmore says, is an incremental software development process. First, Block 2B—used exclusively on a single squadron of Marine Corps F-35Bs—was fielded with “hundreds” of operational deficiencies. Block 3i was then created by rehosting 2B capabilities on new processes, leading to “avionics instabilities and other new problems [and] poor performance during developmental

testing.” The JPO acknowledges deficiencies in 3i but says the latest version is being tested with “improved results” and that “future must-fix deficiencies” will be dealt with by porting changes back from 3F.

Finally, the JPO chose to develop 3F by adding capabilities incrementally to the deficient 3i software. Block 3F is already “demonstrating poor performance,” Gilmore says, bolstering his prediction that more changes and revisions will be needed.

Another overarching problem concerns the mission data reprogramming laboratory [which produces mission data file \(MDF\) software](#) that allows the F-35’s sensors and processors to identify and display threats and targets. “The lab does not and will not have the required equipment to adequately develop and test the mission data loads” to support the Air Force’s IOC configuration (Block 3i) and IOT&E of Block 3F.

This, Gilmore says, is because the JPO has not completed the work needed to order, build and install the specialized equipment that the labs need, “a process that will take at least two years after the equipment is ordered.” Gilmore has been highlighting the slow progress with the labs in reports since 2014: The delays can be traced to holdups in development, which meant that key software and hardware was three years late in being transferred from [Lockheed Martin](#) to the government.

The JPO responds by saying that one Block 3i MDF package will be delivered in time for the Air Force IOC objective date (August 2016) and that it has accelerated the development of MDF packages for Block 3F.

Planning for Block 4, the start of the intended rolling upgrade program, also comes in for criticism. For example, there is a four-year gap between the fielding of Block 3FR8 (intended to be the final Block 3 release) and the service entry of Block 4.1. Incremental Block 3 releases will be needed to smooth the transition, Gilmore suggests.

The Block 4 plan is at once too aggressive and underresourced, Gilmore writes. The content of 4.1 and 4.2 is due to be finalized in the first half of this year, with development contracts being issued in 2018 while IOT&E of Block 3F is still underway. This, Gilmore says, means that the first Block 4 packages will not fully reflect lessons learned from 3F development. At the same time, however, the Block 4 plan does not “accurately depict the schedule and resources for operational testing.”

Gilmore’s annual report on Pentagon development programs is due within weeks and is likely to include elements of this criticism, as well as recapitulating the DOT&E’s commentary during the year. In July, for example, Gilmore issued a scathing memo on the Marines’ at-sea Operational Test 1 that took place in May.

“The event was not an operational test in either a formal or an informal sense of the term,” Gilmore wrote. “It did not and could not demonstrate that the F-35B is operationally effective or suitable for use in any type of limited combat operation.” OT-1, according to Gilmore, relied on extensive contractor support, did not test weapons or many sensors, and did not use standard support equipment, and public Marine statements included unusual terminology in which, for example, one flight event, from engine start to shutdown, would have been counted as six sorties.

Blocks by the Numbers

Under the revised JSF schedule announced in 2013, there are three operational software blocks leading to the end of the system development and demonstration program.

Block 2B will be used exclusively on a single squadron of Marine Corps F-35Bs. It is hosted on an early processor configuration (Technology Refresh 1, or TR-1). It does not support external weapons or a gun,

and includes three internal weapons: the [AIM-120C](#) air-to-air missile, the GBU-32 [Joint Direct Attack Munition](#) and the GBU-12 Paveway. IOC was declared in July 2015.

Block 3i has the same functions and weapons as 2B (apart from supporting the 2,000-lb. GBU-31), but is hosted on the current standard TR-2 processor. It is due to reach IOC with the Air Force between August 2016 (the objective date) and December 2016 (the threshold date).

Block 3F includes external weapons and the gun (for all three versions). It is the IOC standard for the U.S. Navy and export customers and is due to be operational between August 2018 (objective) and February 2019 (threshold).

Block 4 is the first of a continuing series of upgrades. Early in 2015, it was announced that Block 4 would be divided into four segments, 4.1 through 4.4. Block 4.1, mostly software, arrives in late 2019, and will include fixes from Block 3F. Block 4.4 is due for IOC in mid-2025. The contents of the first two segments, 4.1 and 4.2, are to be defined by mid-2016.

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