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ON

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2017

AND

OVERSIGHT OF PREVIOUSLY AUTHORIZED PROGRAMS

BEFORE THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES
ONE HUNDRED FOURTEENTH CONGRESS

SECOND SESSION

SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES HEARING

ON

UPDATE ON THE F–35 JOINT STRIKE FIGHTER PROGRAM AND THE FISCAL YEAR 2017 BUDGET REQUEST

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UPDATE ON THE F–35 JOINT STRIKE FIGHTER PROGRAM AND THE FISCAL YEAR 2017 BUDGET REQUEST

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES,
Washington, DC, Wednesday, March 23, 2016.

The subcommittee met, pursuant to call, at 11:28 a.m., in room 2118, Rayburn House Office Building, Hon. Michael R. Turner (chairman of the subcommittee) presiding.

Mr. TURNER. The subcommittee will come to order to receive testimony concerning the F–35 Joint Strike Fighter, the JSF, program. I want to welcome our panel of distinguished witnesses, Dr. Michael Gilmore, Director of Operational Test and Evaluation [OT&E]; Dr. Michael J. Sullivan, Director of Acquisition and Sourcing, Government Accountability Office [GAO], and a good southwest Ohioan; the Honorable Sean Stackley, Assistant Secretary of the Navy for Research, Development, and Acquisition; and Lieutenant General Christopher C. Bogdan, F–35 Program Executive Officer.

Because we were held up for votes, I am going to enter my statement for the record, if there is no objection.

[The prepared statement of Mr. Turner can be found in the Appendix on page 31.]

Mr. TURNER. And we will also enter Ms. Sanchez's statement in for the record, and we will proceed right to the statements of our witnesses.

[The prepared statement of Ms. Sanchez can be found in the Appendix on page 33.]

Mr. TURNER. I believe we will start with Dr. Gilmore.

STATEMENT OF DR. J. MICHAEL GILMORE, DIRECTOR, OPERATIONAL TEST AND EVALUATION, OFFICE OF THE SECRETARY OF DEFENSE

Dr. GILMORE. Thank you, Mr. Chairman, members of the committee. In my opening statement I will focus on readiness for operational test and evaluation.

My estimate is the program won't be ready to begin IOT&E [initial operational test and evaluation] until mid-calendar year 2018 at the earliest. That would be about a 1-year delay relative to what the program is carrying currently as its objective dates and about 6 months relative to its threshold dates.

The reasons are the following. The most complex mission system testing remains, as does verification and fixes to significant problems, some of those fixes already having been identified and some not. Mission system stability, including the radar, still a problem.

Inadequate fusion of sensor information from sensors on the same aircraft, as well as among different aircraft, continues to be a problem. There are shortfalls in electronic warfare, electronic attack, shortfalls in the performance of the Distributed Aperture System, and other issues that are classified with regard to mission systems.

Stealth aircraft are not invisible. To achieve success against the modern stressing mobile threats we are relying on our $400 billion investment in F–35 to provide, mission systems must work, in some reasonable sense of that word. And we must provide every incentive to the contractors to make the mission systems work leading up to and after IOT&E, in my view.

The program has now changed its approach from schedule-driven software releases, which had overlaid old problems on top of new problems, to a capabilities-based approach. So now the program is addressing the significant deficiencies with a given version of software prior to proceeding with the next version, and I certainly commend that approach. And that should help work through and solve some of these problems that I have mentioned with mission systems.

Other reasons IOT&E is likely to be delayed include the need for weapons testing and certification. The rate at which that has been done in the past must triple in order to get all the events done. There has been talk of cutting the number of events by two-thirds. If that occurs, that would simply shift the work to IOT&E and make essentially certain late discoveries of problems requiring fixes during IOT&E.

The program is exploring ways to up the rate of testing, including using ranges at Eglin, and that would be a good decision, but decisions and action need to be taken soon.

There is also the issue of certification of full weapons usage throughout the full flight envelope. The most recent test community estimates are that that would occur in October 2017 for F–35A, February 2018 for F–35C, and May 2018 for F–35B. And we are looking at this. Some have proposed an incremental rolling start to occupational tests. That may not be practical, and it was certainly problematic when we tried it on F–22.

There are still problems with the Autonomics Logistics Information System [ALIS], which is critical to the combat operations of the aircraft. There are many resource-intensive workarounds still required. Under the program's current schedule, ALIS 3.0, the full capability version required for IOT&E, would not be released until the first quarter of 2018.

There is also the need for concurrency-driven extensive modifications required to early-lot aircraft bought for IOT&E when it was thought that IOT&E would begin in 2013. The current unmitigated—meaning no measures taken to correct the problem—schedule shows mods extending into third quarter calendar year 2019. The program is, however, working on a multipronged approach, including using later-production aircraft slated for operational use and taking hardware from recently delivered aircraft on the production line that could move the completion of those modifications into 2018, and a decision is needed now on that.

There are also inadequacies in the U.S. Reprogramming Lab that is used to generate the Mission Data Files, which are essential to

the success in combat and certainly success in operational testing of the aircraft.

The program's optimistic schedule for delivery of a validated—but, in my view, very possibly inadequate—Mission Data File for operational testing is the third quarter of 2017, but that date assumes the U.S. Reprogramming Lab receives a fully capable version of Block 3F by April 2016, next month, which we already know under the program's current plans will not happen until this summer at the soonest.

So for all these reasons, I suspect that we won't be ready for operational testing until mid-calendar year 2018.

Thank you.

[The prepared statement of Dr. Gilmore can be found in the Appendix on page 35.]

Mr. TURNER. Mr. Sullivan.

STATEMENT OF MICHAEL J. SULLIVAN, DIRECTOR, ACQUISITION AND SOURCING MANAGEMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. SULLIVAN. Good morning, Mr. Chairman, members of the subcommittee. It is a pleasure to be here to discuss the progress on the F–35 program today.

I have a written statement that I will submit for the record, and I just want to summarize five of the major points in that statement in my oral remarks.

First, the Department [of Defense] is now planning to add new capability, known as Block 4, to the F–35 beyond its baseline capability and is planning to manage that effort as part of the existing program, rather than establishing a separate business case and baseline for this new work.

This has significant implications as far as the Congress' role in oversight. This modernization effort is like a new program with estimated cost of about $3 billion over the next 6 years. That price tag alone would qualify it as a major defense acquisition program in its own right, and it should be managed as such, so that it is subject to the same statutory and regulatory reporting as any other program its size.

The F–22 provides precedent for this. It began its modernization effort as part of the existing baseline program and it eventually established a separate business case and developed into a major acquisition program with its own Milestone B in order to better track progress and cost changes.

Second, although the program has been managing costs very well since 2010, the Nunn-McCurdy breach back then, and cost estimates have actually decreased since then, it still poses significant affordability challenges for the Department and the Congress. As production begins to increase and the program begins procuring more aircraft each year, the Department is expected to spend about $14 billion per year over the next decade and will average about $13 billion per year over the next 22 years until all planned purchases are complete in 2038.

These annual funding challenges will compound as the program begins to stack its funding needs against other large acquisitions, such as the bomber program, the tanker program that is ongoing,

the *Ohio*-class submarine replacement, the new carrier, and many other very large programs.

It is important to note this is just the remaining acquisition cost for the F–35. As we all know, the cost to operate and maintain the F–35 across its entire life cycle is estimated now at about $1 trillion, which has added to that overall price tag.

My third point is software development and developmental flight testing of the F–35 are now nearing completion, but the program faces challenges in getting all of its development activity completed on time. I think Dr. Gilmore covered that pretty well. It is through with 80 percent of its developmental flight tests. It has completed the first three blocks of software, and it is now working to close out flight testing of its final block of software, Block 3F.

That is the critical block of software as it will provide the full warfighting capabilities required for the F–35. Program officials have stated that there would be as much as a 3-month delay. We have done our own analysis and we think it could be more in line with 6 months. And I think Dr. Gilmore's analysis indicates even longer than that.

Fourth, with regard to technical risks on the program, the program has most recently found fixes for its engine seal problem that we were talking about last year and the design of the helmet mounted display. And it has begun to retrofit aircraft with those fixes. They are not all in, but the solutions are there.

Two new challenges have recently been identified. One concerns the ejection seat and the other concerns the wing structure of the carrier variant. The program is working now to find solutions to each of those problems. I think on the ejection seat they have a pretty good concept figured out to solve that one.

It should also be noted that the Autonomic Logistics Information System, known as ALIS, continues to be challenging and has been cited as one of the most significant outstanding risks to the program today, and that has a lot to do with operations and maintenance, as you know.

Finally, manufacturing and production data continue to show a positive trend toward more efficient production. The amount of labor hours it is taking to build each aircraft continues to go down, quality is increasing, and engineering changes have been reduced significantly.

While there are still issues with late parts, this is consistently improving as well. Contractors are now delivering aircraft on time or ahead of schedule. We continue to track the measures for the aircraft's reliability and maintainability. And while they still fall short of expectations, they continue to improve, and there is still time to achieve the program's required goals at the right time.

I will close with that. I look forward to your questions.

[The prepared statement of Mr. Sullivan can be found in the Appendix on page 67.]

Mr. TURNER. General Bogdan.

STATEMENT OF LT GEN CHRISTOPHER C. BOGDAN, USAF, PROGRAM EXECUTIVE OFFICER, F–35 JOINT PROGRAM OFFICE

General BOGDAN. Thank you, Mr. Chairman.

Chairman Turner, distinguished members of the committee, thank you for the opportunity to address the committee regarding the F–35 program. My purpose here today is to provide you a balanced assessment of where the program stands. That means I will tell you the good, the bad, and the ugly about the program, and tell you what my team is doing to reduce costs on the program and improve the F–35's performance and meet our scheduled commitment.

Overall, the F–35 program is executing fairly well across the entire spectrum of acquisition, to include development and design, flight test, production, fielding, base stand-up, maintenance and support, and building a global sustainment enterprise. The program is at a pivot point and is now rapidly changing, growing, and accelerating. We will be finishing our 15-year development program in late 2017 and beginning to transition to a leaner, more efficient follow-on modernization program.

We will see production grow from delivering 45 aircraft in 2015 to delivering over 100 aircraft in 2018 and up to 145 aircraft by 2020. Additionally, in the next 4 years we will continue to stand up 17 new operating bases all over the world. We are also accelerating the creation of our heavy maintenance and repair capabilities, and supply chain, throughout the globe, including the Pacific, European, and North American regions.

However, the program is not without risks and challenges, as these come with any program of this size and complexity. I am confident that the current risks and issues we face can be resolved and we will be able to overcome future problems and deliver the full capability that we have committed to.

I have often said that the mark of a good program is not that it has no problems, but rather that it discovers problems, implements solutions, improves the weapon system, and at the same time keeps the program on track. I believe we have been doing that for a number of years now.

Let me highlight a few of our recent accomplishments since our last hearing.

Last year, we began U.S. Air Force and partner pilot training at Luke Air Force Base, where a blend of U.S. and partner F–35 instructor pilots are helping train U.S. and other partner pilots. The Air Force is now receiving F–35As at Hill Air Force Base in Utah and training is underway to ready its first combat-coded squadron to be operational this year. Also, the United States Marine Corps successfully flying and deploying to austere sites for training, dropping and shooting live weapons with its F–35Bs.

In addition, industry is committed to and then successfully delivered 45 airplanes last year, including the first aircraft that was produced in Italy and assembled in their factory in Cameri. From a production perspective, we have delivered a total of 172 aircraft to our test, operational, and training sites.

On the cost front, the price of purchasing an F–35 continues to decline steadily, lot over lot. This is a trend I believe will continue for many years. I expect the cost of an F–35 with an engine and fee to decrease from about $108 million this year to about $85 million in 2019.

As I said before, the program is changing, growing, and accelerating, but it is not without issues, risks, and challenges. So let me highlight a few of those areas.

On the technical front we have a number of risks. At the top of my list are both software and our maintenance system, known as ALIS. On the software front we have seen stability issues recently with our Block 3 software and we are currently in the process of fixing and flight testing those fixes. We have also experienced issues with the development of our next version of ALIS, known as ALIS 2.0.2, and I am prepared to discuss these issues with you, as well as other risks and issues, such as our egress system, aircraft modifications, and our Reprogramming Labs.

I am also prepared to discuss Air Force IOC [initial operating capability], initial operational testing, recent U.S. Air Force and Marine Corps deployments, and the status of our partners and FMS [foreign military sales] customers.

In summary, the program is moving forward, sometimes slower than I would like, but moving forward and making progress nonetheless. We are nearing the completion of development and flight test in late 2017. We are ramping up production, standing up new bases, growing the global sustainment enterprise, and continuing to drive cost out of the program.

I intend to continue leading this program with integrity, discipline, transparency, and accountability. It is my intention to complete this program within the resources and the time I have been given, and I intend on holding my team and myself accountable for the outcomes on this program.

Thank you again for the opportunity to discuss the program. I look forward to your questions.

[The joint prepared statement of General Bogdan and Secretary Stackley can be found in the Appendix on page 87.]

Mr. TURNER. Thank you.

Mr. Stackley.

STATEMENT OF HON. SEAN J. STACKLEY, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, DEVELOPMENT AND ACQUISITION

Secretary STACKLEY. Chairman Turner, distinguished members of the subcommittee, thank you for the opportunity to appear before you today to testify on the F–35 Joint Strike Fighter program. I will provide brief opening remarks and submit a formal statement for the record.

One year ago, we discussed with the subcommittee the challenges facing the program at that time and our plans to address those challenges. In the course of this past year cost, schedule, and technical performance of the Joint Strike Fighter have steadily improved across each variant of the aircraft, in each phase of the program, development, production, and sustainment.

Known technical issues are being driven to closure and the aircraft's capabilities, measured in terms of flight envelope, mission systems, and weapons delivery, are being steadily expanded in support of each service's requirements for initial operating capability, or IOC.

As noted, production of F–35 aircraft and engines has improved from lot to lot in terms of unit cost, schedule performance, improved quality, reduced rework, and concurrency related costs. These positive trends are being sustained while also methodically increasing our rate of production.

The pacing activity on the program today is flight testing, which itself is being paced by the incremental release of warfighting capability and mission system software blocks, commonly referred to as Block 2B, 3i, and 3F. Block 2B testing completed in 2015 and provided the capability required to support the Marine Corps' declaration of IOC in July 2015.

The completion of Block 3i testing has been delayed pending correction of software stability issues. In the course of the next week, we commence flight testing what is planned to be the final build of Block 3i capability, designed to improve that stability, all in support of the Air Force IOC scheduled later this year.

Completion of the final block, Block 3F, poses the greatest remaining challenge to completion of system development. Block 3F includes the more complex functionality of the three software baselines, including what is referred to as sensor fusion.

Further coding and testing of Block 3F has been impacted by resource demands, software engineers, and lab facilities associated with supporting completion of earlier software builds. These factors add up to the program's estimate of 4 months schedule risk to completion of Block 3F developmental testing. This projection still supports the Navy IOC with Block 3F in 2018.

That said, we are wary that further technical issues are certain to emerge as we press on with testing, and it will be critical that the program rapidly correct these deficiencies while mitigating their impact on both test and production.

The program's commitment is to mitigate these risks going forward and to do so within the bounds of the program's budget while delivering the full capability defined by the Lightning II requirements document.

Meanwhile, the program's focus is increasingly shifting to operations in support of in-service aircraft. The program has accumulated 50,000 flight hours, and with 152 aircraft operating at 8 bases across the country, the warfighter's experience and feedback on the aircraft and support systems is beginning to shape the program's priorities.

The Marines have two full squadrons in operation today and will stand up their third this June. They are building momentum as the service and the vanguard of the F–35 effort, gaining capability and confidence and employing it tactically every day. They have demonstrated operations from an austere forward operating base at Twentynine Palms in support of the Marine Corps combined arms exercise. They are training British pilots, as well as first tour Marine Corps pilots, in Beaufort, South Carolina.

They will deploy the Nation's first operational F–35 squadron less than a year from now to Marine Corps Air Station Iwakuni, Japan, in January 2017. Marine pilots love this plane and the capability it brings to the Marine Corps air-ground task force.

Meanwhile, delivery of Air Force F–35A aircraft at Eglin Air Force Base are completed, training for Air Force international part-

ner pilots at Luke Air Force Base continues to ramp up, and the Air Force first operational squadron is filling out at Hill Air Force Base with seven aircraft at Hill and remaining aircraft completing modifications to support IOC.

Separately, the Navy has gained extensive experience demonstrating launch, recovery, handling, and support of the F–35C during at-sea trial periods aboard the aircraft carriers *Eisenhower* and *Nimitz* and a third sea trial scheduled for later this year.

Two key points regarding operations and sustainment require mention. First, with particular regard to aircraft reliability, maintainability, and availability, or RM&A, one year ago we reported that overall performance in this area was poor and trending poor. Concerted efforts by the government/industry team have reversed those trends. And while we have much work remaining, improvements to design, parts availability, maintenance training and support, and tooling are yielding improved performance in the key metrics. RM&A will remain a principal focus area for the program in the years ahead.

Second, the program is working closely with the services, our international partners, and industry to formulate an operating and support strategy for the program including the business plan that will accompany this strategy and an overarching O&S [operations and support] war on cost.

A critical element of the O&S plan is the Autonomic Logistic Information System, or ALIS. ALIS continues to mature, improving with each version fielded. In the near term, we will be testing a new version, ALIS 2.0.2, which we expect to support the Air Force IOC. Additionally, to improve turnaround time for fixing issues highlighted by fleet maintainers, we have commenced delivery of service packs aimed to be more timely and responsive to a warfighter's immediate needs.

In the long term, however, ALIS has yet to meet its full promise, and we will need to go the full distance in that regard if we are going to succeed in meeting our goals for reducing the ownership cost and increasing the operational availability for this complex aircraft, and we are committed to that end.

In summary, the F–35 program is making solid progress across the full spectrum of development, production, testing, and fielding of capability. As known issues are retired, new issues will emerge, and these too will be wrestled to closure. The program's forecast for delivery of initial operating capability for each of the services, including risk, is largely unchanged from one year ago. Yet, the size and complexity of this program and the capability it represents is such that a great amount of work remains ahead, leading to each ensuing IOC and subsequent operations and sustainment and modernization of the aircraft.

We are careful to neither minimize our assessment of the inherent risks nor to avoid them, but rather to assess them realistically and manage them aggressively. The warfighter and our international partners deserve nothing less.

Mr. Chairman, again, thank you for the opportunity to testify today on the Joint Strike Fighter program. I look forward to answering your questions.

[The joint prepared statement of Secretary Stackley and General Bogdan can be found in the Appendix on page 87.]

Mr. TURNER. Thank you, gentlemen.

I want to start with a question that goes to the public's perception of this plane, the F–35. We all are very much aware of the difficulties that the F–35 has had both in development and in production and certainly in getting to operational capability. But I was surprised the other morning to wake up in my own hometown—Mr. Sullivan, you hail from Wright-Patterson Air Force Base, so you may have similarly seen a huge headline across the Dayton Daily News that says: "Ohio Voters Favor Canceling Jet Fighter." I thought it was kind of interesting for a couple of reasons. One, no one called me to ask me to quote for it, and it is my local newspaper. But it's a Washington bureau that quotes a University of Maryland study, that then quotes a response from a Washington think tank.

So I want to give you guys who actually know about the F–35 an opportunity to discuss what this article raises, because there is a fundamental flaw in the study that gives the screaming headline of Ohio voters favor canceling the jet fighter.

Apparently, they did an online poll, and we all know the liability of online polls of course, but there are 520 registered voters in Ohio. And it concludes that Ohio voters favor upgrading current fighters instead of going forward with the F–35 and resulting in a $97 billion savings to taxpayers by 2037.

Now, obviously, we have not done a very good job of communicating the importance of the F–35 and its capability and why it is necessary. But the article does, I do want to give Jack Torry, the author of the story, credit. He does end with Loren Thompson, chief executive officer of the Lexington Institute in suburban Washington, with this quote: "It is impossible to upgrade any of our Cold War fighters that would be as survivable as a stealth plane. That is the biggest single appeal of the F–35, is that most enemy radars simply can't see it. You can't shoot down what you can't see."

So the article concludes with an interesting point. But the fact that a poll is taken asking people would they rather upgrade something that is not upgradable rather than proceed with the F–35 probably is something that bears our discussion.

General Bogdan, help us here so we can give people some information so they can feel the importance of the investment in the F–35.

General BOGDAN. Yes, sir. I have to be a little bit careful because——

Mr. TURNER. I want to recognize—let me say it for you—I want to recognize that a portion obviously of the F–35 capabilities go into the classified realm and its adversaries' capabilities are in the classified realm. So some of the capabilities of the F–35, the need for the F–35 cannot be discussed. But certainly the concept that this is fifth generation and that we cannot merely just plug and play with our old generation is probably worthy of a discussion.

General BOGDAN. Yes, sir.

I agree with you. I have never been associated with a program in my 25-plus years of acquisition where the public perception and the reality are so different. Part of that is our problem for not tell-

ing the story, but part of it is because the program is so big that every minor issue becomes a big issue. We have had a past that has not been conducive to people believing in what we say. We have added years and billions of dollars to the program in the past. Even though that hasn't happened since 2010, people remember that.

And it sometimes is difficult to explain to the public how air warfare is changing and how it is not a turn-and-burn airplane that looks really cool at an air show that is going to win the fight for the United States when we go into combat in the next 20 or 30 years.

So we do have a perception problem and we do have an information gap there. What do we do about that?

First and foremost, I do want to thank the Congress for helping us. You do. And you do that in a number of ways. One, you help us by holding us accountable. And when people know that you are holding us accountable and we base what we do and say on our results, then people will start having a better understanding and a better trust in what this weapon system can do.

On the Department side—and this is where I have to be careful, because I shouldn't be necessarily a salesman for the F–35, you need me to be a little more balanced than that—but for our warfighters there is clearly a role for them to play in advocating for this airplane. And in the past we haven't done a great job of that, simply because the airplane was immature, we were only operating at a number of locations, and we are still developing it. So let me just give you a few things that are going to happen this year that might change that a little bit.

The Air Force has stood up an F–35 heritage flight, which means that the F–35 is now going to be publicly displayed in many, many places over the next year. In fact, they have 14 public events between now and the end of 2016, some of the places including Luke Air Force Base, Langley Air Force Base, Fort Lauderdale, New York City, Chicago, Baltimore, Reno, Las Vegas. So the Air Force is getting out there with the airplane to these air shows and is going to start talking to folks about the airplane.

The U.S. Marine Corps and the Navy, similarly, when they go to sea this year for their sea trials, will bring media with them so that they can tell their story. The Dutch, who are a partner on this program, are planning on bringing their two airplanes to the Netherlands in June for 2 weeks for the very thing that you just talked about, Congressman Turner, to introduce the airplane to their public, to talk about it, and to talk about why the airplane is needed for them. The U.S. Marines, the U.S. Air Force, and the U.K. will bring five airplanes to Farnborough and RIAT [Royal International Air Tattoo] this year in July at the U.K. Air Show.

So I think getting out there and telling the story is part of what we need to continue to do. I also think we need to continue to base things on fact. And when people out there don't have the facts, then it is my job and my team's job to correct the record for that.

Mr. TURNER. And, General Bogdan, in getting to the issue of facts, this poll asked people would they rather upgrade the current fighters instead of proceeding with the F–35. Loren Thompson said: It is impossible to do what they have asked, you cannot upgrade

our Cold War fighters. Would you agree with the statement of Thompson and would you want to elaborate?

General BOGDAN. Yes, sir. You can only do so much with our fourth-generation fighters today. You can only add so many upgrades and structurally improve them to last a certain period of time.

But what I will tell you from the knowledge I have on this program and the capabilities of the F–35, our legacy airplanes, now and in the future, will not survive the threat environments we know we are going to have to face. So no matter how much you upgrade them and how much you put into them, eventually they will not survive.

This airplane differently. It will survive——

Mr. TURNER. In combat.

General BOGDAN. In combat will survive for decades to come.

Mr. TURNER. I just want to point one thing before I ask Mr. Sullivan his comments on this. This poll asks people about sticking with our current fighters through 2037. I wonder what the poll would have been if they asked people would they be willing to drive their current car through 2037.

Mr. Sullivan, would you agree also that the poll is skewed in it gives people a false option, you can't upgrade our current fighters, as Loren Thompson says, in any way that would be as survivable as the F–35?

Mr. SULLIVAN. I think it is clear that this aircraft, fifth-gen aircraft, does things that the generations in the past can't do, won't ever be able to do. The stealthiness alone is a major part of this, but it is also probably more versatile. It is three different variants. It is replacing or complementing a number of different aircraft that are growing older every day as we sit here and are having service life extensions and things like that.

So, yeah, I would agree that the F–35 is going to be a more versatile and a more powerful threat than what we have existing. And I think probably a lot of this has just come from—the past is the past, I understand that, but people still see a lot of money being put forth for the F–35.

The other thing, I think, that you have to consider is that some of these aircraft, their production lines are shut down or they are not as hot as they used to be. And you can't, I think, as General Bogdan said, you can't plug and play these new technologies into those old aircraft anyway. So, yeah.

Mr. TURNER. Mr. Sullivan, I appreciate your comments on that because you being the Director of Acquisition and Sourcing for this program with the U.S. Government Accountability Office, you are responsible for giving us some of the most critical oversight information that we have on the program. I know you know its difficulties and the areas in which we struggle to try to make certain that the program is effective. So I appreciate your overarching statement.

Mr. SULLIVAN. Our beef has always just been with the acquisition strategy of this and many other programs. It takes way longer and costs more than they thought. But we have never really challenged the need for this or what its capabilities are eventually going to bring us.

Mr. TURNER. Excellent.

Mr. Stackley, Dr. Gilmore, do you wish to comment on this? Excellent.

Dr. GILMORE. The fourth-generation aircraft that we have and the systems that they have, and even with upgrades, wouldn't be able to handle the threats that we have already seen being deployed by our potential enemies for over half a decade. Those are very challenging air defense threats that are mobile, so you can't count on knowing where they are. The F–35, with mission systems that work as I alluded to in my opening statement, will provide capability that we don't have in any other platform to dynamically sense that very stressing mobile threat environment you can't know ahead of time with certainty and deal with it.

So that is why it is so important that we get the F–35, including its mission systems, to work. It will provide us capability that we otherwise won't have and can't get in upgraded systems.

Mr. TURNER. Mr. Stackley.

Secretary STACKLEY. Sir, let me just add, our operational planning for major combat operations, first and foremost, relies upon air superiority, air dominance. The F–35 is not being designed and built for the fight today, it is being designed and built for the fight in the future against the high-end threat. So we are not willing to take risk in terms of maintaining air superiority that we will need in the 2020s, 2030s, and beyond. And the capabilities that are being brought to this aircraft are what we envision today as that necessary to overcome the threat in the future.

I agree with Loren Thompson here that somebody is offering a false choice when they say we can just upgrade the existing fighters to get that level of capability. You cannot. The Navy/Marine Corps does have a mixed fleet in the future of fourth- and fifth-generation aircraft. We will continue to have a mixed fleet at least through the mid-2030s. But we cannot enter high-end fight without the fifth-generation capability that the JSF brings. That is why we are so committed to this capability.

Mr. TURNER. Thank you. Very important discussion.

Now turning, however, to some of the issues and difficulties that we have in making certain that this plane reaches its full potential.

General Bogdan, Dr. Gilmore, and Mr. Sullivan's testimony indicate that significant challenges still do remain in completing the final software block, Block 3F. As you know, this is the version of software that gives the F–35 a full wartime capability, so it is very important. You also indicated in your testimony that Block 3F software is likely to be delivered 4 months late.

What is the operational significance if this software is delivered 4 months late? Could it impact the current scheduled initial operational test and evaluation, IOT&E test? And what risk-mitigation actions are you taking to be able to fix this?

General BOGDAN. Thank you, sir.

The issue today with the Block 3 software—and we see the problem in both our 3i, or 3 initial, software and in our 3F software—has to do with stability.

And just very quickly, what the pilots are seeing is, when they take off and they need to use the sensors, particularly the radar,

there are some instances where the communication between the radar and the main computers in the airplane are mistimed.

And that mistiming builds up little delays. And eventually those delays get to be big enough where the radar shuts off. Okay? And the radar will recover, but it will recover and take a few minutes to regain the picture that it had. Some of the other sensors experience the same thing. That is not good.

We are experiencing that kind of problem about once every 4 hours of flight time. We need the system to be much more stable in that, something on the order of once every 8 to 10 hours.

So what we did when we found this problem out in the last few months is we went back and did a root cause analysis. As I just talked about, we know it is a timing issue. Lockheed Martin has a number of fixes in the software that we are about to flight test, starting next week in our next version of 3i software. In the next month or so we will know if those fixes work.

If those fixes work, the stability fixes and some of the other software fixes, then the impact of this problem to Air Force IOC will be minimal. The impact to the remaining testing of 3F, as I said, will probably just delay the end of flight test about 4 months. That does not impact Navy IOC because we had some margin there, but it clearly would impact how ready the airplanes are for IOT&E.

So we are looking forward to the flight tests that we are going to do in the next month or so to see if we have this solved. If we do have it solved, again, no impact to Air Force IOC, no impact to Navy IOC, but probably an impact overall to the end of testing, and that would eventually impact the start of IOT&E.

Mr. TURNER. Mr. Bogdan, I must have misunderstood. You were describing a problem with the software that you said would occur one time every 4 hours, but it would be okay if it occurred every 8 to 10 hours. Isn't that still a problem with the software?

General BOGDAN. With 8 million lines of code in the airplane, it is not unusual for both legacy airplanes and modern fifth-generation airplanes every now and then to have to reset one of the sensors in flight or have an automatic reset. That is not an uncommon situation.

What we find is, if that happens more frequently and it happens at critical times, then that impacts the pilot's ability to get the mission done. But over time and historically we have seen that somewhere between 8 and 10 hours is probably about what we can expect and that, according to the warfighters, is good enough.

Mr. TURNER. Thank you for clarifying that.

Mr. Sullivan, Dr. Gilmore, would you like to clarify on the 3F software.

Dr. GILMORE. Well, the rate at which these instability incidents were occurring with Block 2B was one every 30-plus hours, and now it is one every 4 hours. And the initial versions of Block 3i don't provide any more combat capability than Block 2B, it was supposed to be rehosting of Block 2B with the new processor.

So with regard to whether 8 to 10 hours is sufficient, what you want is a low probability that during a combat mission, which comprise several hours, you want a low probability that one of these upsets that takes time to reset—and several minutes in the middle of a fight is not acceptable—you want the time between these in-

stability incidents to be long enough that you have a very low probability it would occur in a multi-hour combat mission.

Whether 8 hours would be sufficient is something that we will certainly be looking at in IOT&E. It was much better than once every 8 hours with the Block 2B software. And again, 3i initially provided no more capability than Block 2B.

Now, as we add capability and more complexity in Block 3F, you might see the numbers come down again. Ultimately, operational testing will tell us what is sufficient.

Mr. TURNER. Mr. Sullivan.

Mr. SULLIVAN. Yeah, I think, depending on the mission scenarios and things like that, it is certainly a critical thing. I don't know if I would want to be a pilot and watch the screen go blank. But it is a spec, I assume, it is a spec that the contractor has, they are in development. We have talked to the contractor and the program office about this and it is a very serious problem. But 2B had issues and they worked through those and I would hope they can do the same with 3i. And I think probably they will be the same thing with 3F.

So eventually I would hope that they will work that out and get it to whatever the spec is, which I would hope would support the warfighter. And if they do that—that is why the timing is so critical, because you would want that done by IOCs obviously, you would want to be able to go to IOT&E with problems like that under your belt as opposed to adding that to the burden of the operational testers.

Mr. TURNER. I am going to ask Mr. Stackley to follow up, but I have a few other questions that I am going to have to get through, but considering this is our last day for votes, I want to be sensitive to members who might need to leave. Since I am the only one on this side, I am going to ask unanimous consent if I let Mr. Stackley respond. And then the order is Mr. Johnson, Gallego, and Ms. Graham.

What I will do is I will let each of you ask your questions, and then I will go back to my next question, and then we will finish up, and that way you can exit, if that is okay.

Mr. Stackley.

Secretary STACKLEY. Yes, sir, very briefly. The 2B software is performing very stably and I think everybody is satisfactory with its performance. The rehosting of that software into the new what is referred to as tech refresh on the JSF, the complexity of that rehosting should not be understated. We went through that on this tech refresh. We don't anticipate as large a leap in future tech refresh. But that complexity should not be understated.

That did create a reset in terms of stability and now with each such successful build of software going back at building back up the degree of stability that we require. General Bogdan's reference to an 8 to 10 hours at this stage of the program, that probably is satisfactory. In the longer haul, Dr. Gilmore is correct, we want to get this up to a low probability of occurrence such that the pilot does not have to worry about resetting his mission systems mid-flight.

Mr. TURNER. Mr. Johnson.

Mr. JOHNSON. Thank you, Mr. Chairman.

To follow up on your questions about the need for our country to invest in a fifth generation of aircraft to take over from the legacy aircraft that have been flying for decades now, the F/A–18, the A–10, and the AV–8B, would all be replaced by our investment in the F–35 fifth generation.

And it is important to note that other nations are investing in fifth-generation aircraft—the Russians, the Chinese—and that is what we mean by a changing threat environment, which America must step up to the plate. And if it intends to remain superior in the air, we must step up to the plate and invest and prepare for the long term. And that is what the F–35 enables us to do.

With respect to those who may have participated in the poll that Chairman Turner referred to and were of the opinion that we should extend the legacy fleet and rely on it for our future protection, isn't it—and I assume they want to do that because it saves money. So penny-wise, pound-foolish, that would apply in this kind of a situation here.

Isn't it a fact that if America were to do what some prefer, which is to extend the life of the legacy fleet, isn't it a fact that operations and supply costs to extend the legacy fleet would cost approximately four times what operations and support costs would be for the F–35 over the next 50 years? Isn't it a fact?

Secretary STACKLEY. Well, let me start with responding to that. I don't know about the four times number, but what we do know is that——

Mr. JOHNSON. Approximately.

Secretary STACKLEY [continuing]. As our aircraft age, for example the early versions of the F–18 that the F–35 Bs and Cs are going to be replacing, the A through D version, as they age, the cost of sustaining them, the cost of keeping them flying, the availability rates for those aircraft, they are, frankly, hurting us in terms of our strike fighter inventory for today.

So we have got to get this next version, generation of aircraft, not just the capability, but also to retire the legacy aircraft that are costing us today. So as that timeline extrapolates out, all the legacy aircraft could be running into similar costs associated with sustaining a fleet that is not just old, but a lot of the sustainment is dealing with obsolete parts and capabilities that fall short of what we require for the warfighter.

Mr. JOHNSON. Anyone else want to add to that?

Mr. SULLIVAN. I would just say that I wouldn't focus as much on the cost for O&S. The Joint Strike Fighter is going to be very costly with sustainment too. It is more about the capability. They need that greater capability. The fifth-generation aircraft is really just far superior.

I think O&S costs, it would cost a lot to keep these legacy aircraft in the air—I know the Harriers are really old—and eventually they just won't be able to fly them, I would think, after a while.

So there is just nothing out there. The F–16 is another aircraft that the F–35 is going to replace. So there is an awful lot of aircraft it replaces.

Mr. JOHNSON. Thank you.

Lieutenant General Bogdan and Secretary Stackley, the Marine Corps declared initial operational capability last year for the F–35B

and the Air Force is planning to do the same this year. This, to me, demonstrates a program that is maturing and reaching a point where it would benefit from increased production. Do you agree? And if so, what are some of the benefits and increased production rates for the F–35 program?

Secretary STACKLEY. Let me start. First, it clearly reflects a program that is maturing. It was mentioned earlier that back in 2010 we restructured the program and within months we are holding to that restructured program's schedule here in 2016 and our costs at the same time are coming down in terms of production while we hold the line on development.

The program is methodically increasing its production rates to today in terms of both the U.S. and our international partners and foreign military sales customers joining in that production. So the production rate is methodically increasing. And what we are seeing in terms of benefit is we are accelerating the learning curve on the production floor, it is driving down our costs. And as described earlier, we are seeing positive trends by every measure as it relates to both airframe and engine manufacturing.

The longer term, when we complete IOT&E and getting to the full-rate production decision, I think we are on track for that, again, within months, within a budget cycle. And as we march in that direction, we are looking forward to such vehicles as block buying contract and ultimately multiyear contracting to, again, further leverage the benefits of a stable design, mature production lines, and then let's buy it as efficiently as possible.

Mr. JOHNSON. Thank you.

I will yield back, Mr. Chairman.

Mr. TURNER. Thank you, Mr. Johnson.

Turning back to the initial operating capability concerns and the requirements for later this year, General Bogdan, in attention to software development I understand that General Welsh is closely watching the progress of the Autonomic Logistics Information System, known as ALIS, as well as challenges facing aircraft software stability which is affecting the radar. As you know, ALIS was a significant area of concern raised by maintainers during our visit to the Eglin Air Force Base last year.

Please provide us with a short update on these two issues and what your concerns are concerning the IOC later this year.

General BOGDAN. Yes, sir. As I said before, within the next 30 days we ought to know if the fixes we have put into the software on stability will take hold. And if that is the case, then we will incrementally upgrade the Air Force's airplanes at Hill Air Force Base with that version of software and the software stability issue will not impact their ability to declare IOC.

That is not the case with ALIS. ALIS, the next increment of capability we are delivering, as you know, is 2.0.2, and we were supposed to have that fielded by August of this year. I am estimating that that delivery of that system is probably about 60 days late now. I am not sure if we will be able to pull that schedule back any. If that is the case, then it will be up to the U.S. Air Force to decide what to do in August when it comes to ALIS 2.0.2 if it is going to be about 60 days late.

Mr. TURNER. Does anyone else wish to comment?

Mr. SULLIVAN. I would only say that we have another team within GAO that is looking and specifically kind of looking at ALIS. And I believe they have a draft report over on the Hill right now. That might be helpful, to look for that. In fact, I can probably make sure that the committee gets a draft copy of that.

[The report referred to, GAO–16–439, is retained in the subcommittee files; it can be found online at http://gao.gov/products/GAO-16-439.]

Mr. TURNER. That would be great. We should, because we had significant concerns for the maintenance group.

Mr. SULLIVAN. Yeah. So this team is focused really on O&S and ALIS and things like that.

Mr. TURNER. Thank you.

General BOGDAN. Can I make one other comment, sir, about ALIS, very quickly? If you went to Eglin Air Force Base today or if you went to Luke Air Force Base, what you would find over the past year is not all, but many of the maintenance workarounds and burdens that we placed on the maintainers over the last few years are systematically getting improved.

We are not anywhere near where we need to be with ALIS, but I think what you would get from the maintainers if you talked to them today is the fact that they do indeed see an improvement each and every time we put out a new version of software, which means the trending is going in the right direction, we just have a long way to go.

Mr. TURNER. Thank you, General.

One thing we know is that consumers weren't given iPhones until they were done. You have to, however, put planes in pilots' hands while you are still developing them. And so we all get to look over your shoulder as you are doing it, and we appreciate both the work of the GAO and others to ensure that we have the right to-do list, but your diligence to try to make certain we complete it.

Mr. Gallego.

Mr. GALLEGO. Thank you, Mr. Chair.

General Bogdan, the original concept of the F–35 platform was to retain about 70 percent similarity between the three variants in order to keep costs down on the budget. But as we know, this has not been achieved, which calls the original concept into question.

Knowing this, would you support programs in the future that aim for commonality between platforms for the services or do you think these efforts would also have too many cost and schedule overruns?

General BOGDAN. Congressman, what I have said before about joint programs is that they are hard, they are neither good nor bad, and it really depends on how you manage them. But they are indeed hard, and they are hard because when you bring together a number of different customers that may have varying requirements, it is sometimes hard to meet all those requirements without going to the least common denominator.

And so what I would tell you is a decision to move forward on any platform in the joint arena would depend on how much overlap the services see in the requirements that they have. There are opportunities outside of a joint program to benefit from commonality, using similar engines, using similar flight control systems. But to

embody that in the same airplane that would try and meet the requirements of varied customers is a really hard thing to do.

Mr. GALLEGO. I hope we will remember that in the future.

Moving on to pilots, though. An October subcommittee hearing discussed the problems with the ejection process for pilots. Two solutions you talked about were developing lighter helmets and managing parachute timing after ejection. However, today we find out the GAO report notes that the helmet weight was not the root cause of neck injuries during ejection.

What is the status of the efforts to protect our pilots, one? And with certainty, can you say that we've identified all the problems related to this issue?

General BOGDAN. Yes, Congressman. One point of clarification. There are two technical issues as to why a pilot less than 136 pounds has an added risk of injury during ejection. One of them is indeed because the helmet is too heavy, but the other is a technical issue having to do with the way the seat fires up and the center of gravity of a light pilot. But both of those problems contribute.

We have three fixes in place to remedy this. The first is an ejection seat switch. That will be set by the pilot based on his or her weight. We have tested that. We are in the design phase of it. And that fix will be cut into production on our lot 10, and we will start retrofitting airplanes with that fix in November of this year.

We also have a head support panel, which is a pad that will be sewn into the risers of the parachute. That fix has been tested. It too will be incorporated into lot 10 and it will start being retrofitted in November.

Relative to the helmet weight, we needed to get the helmet down to about 4.6 pounds. We are in process of doing that as we speak. Originally the estimate was that that helmet wouldn't be ready for fielding until November of 2017. I can report now that that helmet will be available in November of 2016.

So when we have the switch, the helmet support pad, and the lighter helmet out there in November, I believe by the end of this year we can remove the requirement of a pilot not being able to fly the airplane less than 136 pounds.

Mr. GALLEGO. And then just the second portion of my question was, can you say with certainty that we have identified all the problems related to this issue in terms of our pilot safety ejection.

General BOGDAN. Sir, we have 14 more sled tests and ejection tests to go between now and September. So I cannot tell you right now definitively that we won't find other things.

What I will tell you is we will completely test it. If there are problems, we have a good track record of fixing them. Because we will not put pilots' lives in danger by putting them in an airplane and an ejection system that is not safe.

Mr. GALLEGO. Thank you. I yield back my time.

Mr. TURNER. Thank you.

General Bogdan, as you are aware, a lot of our discussions between you and the committee are based upon our visit to Eglin Air Force Base, and the questions that we pose are a result of that fact-finding trip. There were 14 of them. And you have continued to both answer those questions and update them. I have your March 17, 2016, letter in response continuing to update us on those

issues. If there is no objection, I am going to enter this into the record of your discussion on these items and the issues that we have been looking for, for oversight.

[The information referred to can be found in the Appendix on page 113.]

General BOGDAN. Thank you, sir.

Mr. TURNER. Ms. McSally.

Ms. MCSALLY. Thank you, Mr. Chairman.

And thank you, gentlemen.

I remain a strong supporter of a fifth-generation fighter, having been an airman myself. Knowing the threats that we have that are emanating, we need that capability. However, I remain concerned about the close air support of FAC(A) [forward air controller-airborne] and combat search and rescue missions that are currently being done by the A–10 Warthog and the F–35's capabilities to replace that without increasing risk to American lives.

General Bogdan, can you confirm that the F–35 requirements document is still that the F–35 would replace the A–10 and the F–16?

General BOGDAN. Ma'am, what I will tell you is the requirements document that I have on the program does not specifically say that it will replace the A–10 and the F–16. My requirements document has to do with what the capabilities of the F–35 is. The decision to replace airplanes with the F–35 is a service decision.

Ms. MCSALLY. Okay. I think, though, on the program page, I mean, the intent of the Department, the intent of certainly the Air Force is that the F–35 will replace the A–10 and the F–16. Is that fair to say?

General BOGDAN. I would believe, from the public statements I have heard from the Chief and the Secretary and the combatant commanders, that is a true statement.

Ms. MCSALLY. Okay. And I think that is also on the JSF Web site, as well, for the program.

On March 3rd, the Air Force Chief of Staff said in a hearing that the mission capability of the A–10 will not be replaced by the F–35. He also talked to me about this after our hearing last week. He went on to say the A–10's current workload would be handled by the F–16 and the F–15E. This was a total surprise to me to hear him say this, to be frank with you. So I am concerned.

And I look at their 5-year plan, that they are going to start mothballing more A–10s, next year, 49; 49 the year after that; 64 the year after that; 98 the year after that, finishing in fiscal year 2022. When do you think, again, we are going to be at FOC [full operational capability] for the F–35?

General BOGDAN. Ma'am, the full capability of the F–35 relative to close air support will be delivered in the late 2017 timeframe. We will have additional capabilities in our block for modernization that would make that mission more viable for the F–35. And I am not sure if the Air Force has declared an FOC date yet.

Ms. MCSALLY. Okay. But from the testimony, I think, for Dr. Gilmore, I mean, we have seen the F–35A, and we have talked about this in previous hearings, capabilities are limited, 20, 30 minutes time on station; two bombs; you know, excuse my language, but we call one pass haul ass; no time to loiter; having to go to tankers;

being Winchester; 182 bullets; limited night capability; inability to get data; targeting information; inability to survive a direct hit in close combat. These are all limitations we know about, we have talked about in previous hearings.

So, Dr. Gilmore, I appreciate that your office has decided to do a comparison test between the F–35 and the A–10 on close air support. And I am concerned also about the combat search and rescue and the forward air control mission. Can you give us an update on that comparison test and when that is going to happen and whether there are any concerns about funding or its continuation in another administration?

Dr. GILMORE. First, with regard to requirements, I reviewed the requirements document before I came here. And there is a clear statement at the beginning of the requirements document, which has been in force for a number of years now, that the F–35 would replace the A–10.

Ms. MCSALLY. That is what I thought. Thanks, Dr. Gilmore.

Dr. GILMORE. I am happy to send you a copy of that.

Ms. MCSALLY. Please do.

Dr. GILMORE. In any event, with regard to——

General BOGDAN. Can I correct the record? When I talk about requirements on the program, I talk about a specification that I put contractors on to deliver a capability. The document you are talking about is a service document known as an operational requirements document,——

Ms. MCSALLY. Okay.

General BOGDAN [continuing]. An ORD, which I do not control.

Ms. MCSALLY. Okay. Thank you.

Dr. GILMORE. And that's the one the Chief of the Air Force, the Chief of Staff of the Air Force signed——

Ms. MCSALLY. Great.

Dr. GILMORE [continuing]. Namely, the operational requirements document. So that is what I was talking about.

With regard to the close air support tests, comparison tests, yes, we are planning that. We are planning all the open air tests as we speak, working with the joint operational test team and the services. We expect to have that effort completed in June or July of this year. And we are happy to share those results with the committee and with you.

With regard to funding, the costs of the close air support tests, including combat search and rescue [CSAR] and Sandy †——

Ms. MCSALLY. Right.

Dr. GILMORE [continuing]. Compared to not doing them——

Ms. MCSALLY. Right.

Dr. GILMORE [continuing]. You know, compared to not having the A–10s fly, you know, conducting the same missions that the F–35s would conduct in those two areas or those three areas, varies between $3.5 million and $5.2 million. The difference is the amount of refly that you have to do. When you are doing—just like when you are doing a test, you can't count on every scenario that you are trying to run actually working.

† "Sandy" refers to a mission in which an aircraft (most often an A–10) is tasked to support and provide protective coverage for a combat search and rescue mission to recover an ejected pilot behind enemy lines.

Ms. MCSALLY. Right.

Dr. GILMORE. So you have to plan in the test for refly, the same way General Bogdan is planning for refly in developmental testing. So that is the reason for the range of $3.5 million to $5.2 million. We are working to, with the joint operational test team, to fit all of these comparison tests within the budget for operational testing, which was established, I think, about 5 years ago in the TEMP [Test and Evaluation Master Plan] that is now rather out of date. But, nonetheless, we take that budget seriously. And we are working to fit all the comparison testing within that budget.

If there is—if we do go over, which, again, we are trying very hard not to do because we do take that budget limit seriously, it wouldn't be by more than 10 or 15 percent. And I would remind the committee that the Block 2B operational utility evaluation, which was supposed to have been done in 2015, was canceled at my recommendation 2 years ago because it was clear to me that the aircraft wouldn't be ready for that kind of rigorous operational test. And the service acquisition executives agreed. And that was a savings of about $100 million.

So we are working to keep within the existing budget and the CAS comparison testing, CSAR, and so forth is, again, a small amount of the overall cost, $3.5 million to $5.2 million.

Ms. MCSALLY. Thanks, Dr. Gilmore. I am over my time. But could you—when would we be able to have those results delivered to Congress of the tests, do you think?

Dr. GILMORE. Well, if we begin the operational testing, according to my estimate, which would be mid-calendar year 2018, the operational test will compose, will comprise, rather, about a year. It will take about a year. And then it would be a few months after that, no more than 6, hopefully fewer, to actually finish the report.

Ms. MCSALLY. So late 2019, early 2020 would be fair?

Dr. GILMORE. Yes.

Ms. MCSALLY. Okay. Thank you. I appreciate it.

Thank you, Mr. Chairman.

Mr. TURNER. Thank you.

Mr. Walz.

Mr. WALZ. Thank you, Chairman. And thank you all for being here again. We really appreciate it. The strategic need for the F–35, I think everyone knows that. We hear it. It is now crunch time, though, on the delivery piece of it.

And, General Bogdan, you are right, there is a perception issue both in what they are going to get and what they expect to get. But there is also this perception that I have held and I have used this as an example.

I have been to no less than 14 hearings dealing with changes to retirement plans, taking away of the housing allowance, transferability of the GI Bill benefit, commissary changes, and TRICARE. And where that relates to this is the perception out there is, is when the Pentagon needs to save money, they go to those programs. And I always use the example that we haven't had as many of these.

So I hear statements like this from one of our partners from the Australian Defence Force, I think it was Keith Joiner said it. He's responsible for evaluating this, and he said some systems like the

radar are fundamentally worse than earlier, which is not a good sign. The next software version Block 4 won't be available. So here we are with bug fixes for the next 7 years. And they are looking, am I correct in this, they are reevaluating their purchases on this.

So I go back home. I talk to soldiers and sailors, say, "So I just lost a GI Bill benefit. What is happening with this?" How do I talk to them about it? Is it a matter of until you deliver it, this is just going to go on? Because I do kind of feel like I am asked to come into the play and do my part and say this, and then it is going to be delivered. How do I go back? How would you answer on this?

General BOGDAN. It is a tough question, Congressman. And I clearly understand the point of view here. I guess the best I would offer, if I were asked that question, is that bringing a new weapon system online to defend our country is never easy. And it always is fraught with mistakes, bad choices, technical challenges. And the history of especially developing airplanes has been murky. We have had lots of problems over the years bringing new airplanes online.

Mr. WALZ. And that is a helpful piece. You have more experience in this. How similar is this to when the F–16 came on? How similar is what we are seeing here today?

General BOGDAN. The F–16 was a very simple airplane when it first came out and over the years got more complicated. And it had setbacks. I am not sure if you are aware, the very first flight of the F–16, sir, was an accident. They were not supposed to take off. Because of the flight control system not being properly rigged, the pilot, in order to save the airplane, had to take off. So airplanes experience this.

Mr. WALZ. No, I think that is true. And I want to be clear on this so that I am not, and I am not teeing this up, because I am one who believes we need these systems. Is it apples to oranges because of the exponential technical differences between that launch and this launch? And I know that is kind of a hard question because we were at our technological limit then and now maybe we are there, so it may be similar to that. But is it the case that there is more things that can go wrong so they probably will?

Secretary STACKLEY. Sir, let me jump in and say that is absolutely the case. And it is not unique to the F–35 program. We are going after a high-end capability on this and other warfare systems that are significantly more complex than the systems that they are replacing. So there is no such thing as replacing legacy, whether it is aircraft, missile systems, ships, tactical vehicles, on a one-for-one basis anywhere near the same cost of those legacy systems because these are so much more capable.

You know, the comments and perceptions from folks that are not well informed on the program, those are tough to defeat because now you are talking about an education process.

The reality is that the F–35 program, albeit it has gone through restructuring, is on a path to deliver all the capability that was promised from day one. It is going to cost more than what was estimated back in the 2002 timeframe. Those costs were rebaselined in 2010. And we have kept those under control to the extent that now we are actually reducing costs with time as the program gets more and more mature.

What you are not hearing, and I think General Bogdan touched on this earlier, is the warfighters that are flying this plane, what their perception is. My comment in the opening statement was the Marines love this aircraft, absolutely love this aircraft. This is what they plan to go to war with, if called upon. I think that you are going to hear that overtake the other rhetoric over time as more and more of our Air Force, Marine Corps, and Navy pilots, and our international partners climb into this cockpit, see what its capability is, train with it, and then deploy with it over time.

Mr. WALZ. Yes, Mr. Sullivan.

Mr. SULLIVAN. Your question is an excellent question. And it is not just the F–35 program. It is about the acquisition process. We do acquisition reform all the time. And actually, it has been improving the last few years. But the bottom-line answer to this is there has got to be a little truth in advertising when these weapon systems start up because they are always started up with optimistic cost estimates and schedules.

This program was originally planned to be completed, everything purchased, by 2026. Now that is 2038. And so that additional 12 years of funding——

Mr. WALZ. And that has as much to do with this side of the table as that side.

Mr. SULLIVAN. Yeah. So, I mean, and that is what you are talking about, is that the Congress is faced with unplanned, you know, funding for 12 years that they weren't planning on when they started. Like I said, it is not the F–35, it is most of the major weapon systems. They just don't have a good business case at the outset.

The F–16 was a really good aircraft when it was delivered, and it was simple. And it is not that simple anymore. It is a very complex aircraft because they planned it properly. They had incremental planning on that and they did block upgrades. That is really what, I think what this is all about. And so other priorities go by the wayside.

Mr. WALZ. I know. Well, thank you. I yield back.

Thank you, Chairman.

Mr. TURNER. Ms. McSally.

Ms. MCSALLY. Thank you, Mr. Chairman. I do just want to follow up on our discussion on requirements, just to make sure. Luckily, I flew airplanes, I never had to procure them. So this process seems a little cumbersome to me.

But just, Dr. Gilmore, an Air Force Chief of Staff has said that the A–10 will not be replaced by the F–35, on the record, within the last few weeks. And then said that to me in a conversation last week, surprising me. Is the Air Force going to be updating their ORD, or whatever you just called it——

Dr. GILMORE. The operational requirements document? I haven't heard that they are.

Ms. MCSALLY [continuing]. To reflect that?

Dr. GILMORE. I haven't heard that they are. And then the F–35s are going to be replacing the F–16s.

Ms. MCSALLY. Right.

Dr. GILMORE. So I am a bit puzzled. But all I know is what the existing operational requirements document said.

Ms. MCSALLY. Okay. So you know of no efforts to update that. And if it is currently——

Dr. GILMORE. I am not aware of any.

Ms. MCSALLY [continuing]. Going to be replacing the A–10 and the F–16, but he is saying the F–16 is going to replace the A–10, but then the F–35 is going to replace the F–16, then we are still in the same situation where we are. In specific circumstances for close air support, we potentially have additional risk or a gap or capabilities that are going to be degraded, which is why it is so important that we have this flyoff. Do you agree, Dr. Gilmore?

Dr. GILMORE. Well, you know, I don't know whether the capabilities will be degraded.

Ms. MCSALLY. Right.

Dr. GILMORE. That is what the comparison testing is supposed to find out.

Ms. MCSALLY. Absolutely.

Dr. GILMORE. And that is why we are planning it to be, you know, absolutely fair. We are going to consider all the conditions under which close air support are done, all the different kinds of threats. And it certainly will be a challenge.

In fact, the A–10 couldn't survive in the highest threat environments. But we are also looking at, you know, less stressing threats like the ones that the A–10 is being used in, the environments it is being used in today: urban, rural situations, buildings, vehicle personnel, different kinds of control for the close air support, different kinds of control interaction, all of the things that you know are done in close air support missions.

We are going to set up the missions. And then the A–10 pilots and the F–35 pilots will use those two aircraft to their best capabilities, using whatever TTPs [tactics, techniques, and procedures] they have. We are certainly not going to specify how the missions are done. We are going to specify what the mission is. And then we will do matched pairs comparisons of how well each set of pilots and aircraft can perform those missions the way they choose to.

Ms. MCSALLY. Great. Thank you. And it seems like there is just some different messages coming out of the Pentagon. I mean, the Secretary of Defense, when he announced his budget, said A–10s will be replaced squadron by squadron, with the F–35 predetermining the outcome of this test. So we are trying to get some consistency out of the Pentagon by just asking these questions. I highlighted this to the Secretary yesterday. We are going to follow up with him and the Chairman. Because it just seems like even between the Air Force and the Secretary of Defense, they have got two different messages going on here.

We believe that any movement forward should be conditional. Let's have the test. Let's get the results of the test. And then let's make a decision afterwards as to whether we are going to be increasing risks to our troops on the ground.

So I appreciate the additional time, Mr. Chairman. Thank you, gentlemen. And I yield back.

Mr. TURNER. Thank you.

Gentlemen, this is one of our most important and certainly largest programs. And I want to thank each of you for your diligence in trying to ensure that this program reaches all of the capabilities

that are obviously going to be necessary. Because of that, before we conclude, knowing your diligence, I want to give each of you an opportunity if you have anything else that you want to put on the record or that you want to raise before the committee as we consider this, knowing that your input is incredibly important.

If not, I know we have your opening statements. And we continue to have your advice and counsel. We appreciate the information you have provided to the committee. Thank you.

[Whereupon, at 12:42 p.m., the subcommittee was adjourned.]

A P P E N D I X

MARCH 23, 2016

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MARCH 23, 2016

Statement of the Honorable Michael Turner
Chairman, Subcommittee on Tactical Air and Land Forces
Hearing on the F-35 Joint Strike Fighter Program
March 23, 2016

The hearing will come to order.

The subcommittee meets today to receive testimony on the current status of the F-35 Joint Strike Fighter (JSF) program.

We welcome our distinguished panel of witnesses:

- **Dr. Michael Gilmore, Director of Operational Test and Evaluation;**
- **Mr. Michael J. Sullivan, Director of Acquisition and Sourcing, Government Accountability Office;**
- **The Honorable Sean Stackley, Assistant Secretary of the Navy for Research, Development and Acquisition; and,**
- **Lieutenant General Christopher C. Bogdan, F-35 Program Executive Officer**

I thank you all for your service and look forward to your testimony today.

The F-35 is a complex program. The program is essentially three major tactical aircraft programs being managed as one program.

It's well known that during its development the F-35 program has experienced significant cost, schedule, and performance problems, and while improvements have been made, more work needs to be done.

Both the Director of Operational Test and Evaluation and the GAO have highlighted concerns about the F-35 program for fiscal year 2017 and beyond, especially with respect to finishing the development program in October 2017 as planned due to software and testing delays.

This hearing today will provide the opportunity to address some of these concerns.

From a committee oversight standpoint we plan to focus on three major efforts for fiscal year 2017: the challenges facing incremental software development and testing, the development of the autonomic logistics information system or ALIS, and the ability of the escape system, or ejection seat, to accommodate all pilot weights.

We look forward to receiving updates on all three of these critical oversight issues from our witnesses today.

Additionally we expect to receive an update on the corrective actions being taken to address the issues and concerns that were raised by pilots and maintainers during the Subcommittee's congressional delegation visit to Eglin Air Force Base last year.

I also have concerns over the impacts of the budget request for the F-35 program in fiscal year 2017.

The F-35 budget request proposes a reduction of five F-35As, and also reduces procurement by 32 F-35s across the Future Year's Defense Program.

According to the Joint Program Office these reductions in planned procurement could result in unit cost increases for the overall program.

Besides the cost increases to the program I have concerns over what message this is sending our international partners in terms of support for the program.

Despite the issues identified for the F-35 program, there is no doubt we need to field a fifth generation strike fighter in order to maintain air dominance.

In the event of a conflict our land forces all assume we will have air dominance and fifth generation strike fighters will provide this capability.

Before we begin, I would like to turn to my good friend and colleague from California, Ms. Loretta Sanchez, for any comments she may want to make.

Opening Statement for Congresswoman Loretta Sanchez
Tactical Air and Land Forces Subcommittee
Hearing on
Update on the F-35 Joint Strike Fighter Program and the Fiscal Year 2017 Budget Request

March 23, 2016

- Today's hearing will focus on the Fiscal Year 2017 budget request for the F-35 Lightning II aircraft program.

- The Fiscal Year 2017 request for this program totals $10.5 billion spread across 24 separate procurement and R&D accounts.

- As always, it is important to keep the size of that request in context.

- This $10.5 billion request exceeds the Army's entire FY17 Research and Development account – by $3 billion.

- And, in the future, the total size of the F-35 program is projected to increase to close to $15 billion a year, which would be close to the size of the Army's entire annual procurement budget.

- Those comparisons are important because it reflects how important the F-35 program is to the entire Department of Defense.

- And, it sets high expectations for the many defense contractors involved in the program.

- If we as a nation are willing to commit billions a year to this program, we better get what we are paying for.

- There are some areas where I'm not sure I can say that is the case, which I'll get into more detail on later.

- Overall, it is fair to say we have seen a lot of progress in both testing and production over the past year.

- Having been on this committee for almost 20 years, I have seen this program from the start.

- So, while the program is roughly on track in terms of overall cost and schedule, it is important to remember just how far off the original plan we are.

- I don't point that out to accuse anyone of anything, but it is important to remember the many years of delays and many billions in cost overruns since the program began.

- It's important because those of us who have been here for the duration of the program have all that in our minds when we are asked to consider things like early "block buys" of hundreds of F-35s before testing is done and potentially letting the F-35 program spend more than $6 billion on "Follow On Development" without it being treated like a normal major defense program.

- The long, and disappointing, history of this program matters. While things might be going better today, we can't just sweep away the many problems the program has had in the past.

- I have several specific concerns I will get into when I do my questions, but I did want to make one other point first.

- That point has to do with testing, and the need to make sure we fully and appropriately conduct realistic operational testing of the F-35 program.

- Testing a complex system is expensive and takes a lot of time, to be sure.

- However, it is vitally important, and it is required by laws passed many years ago in response to a series of scandals where program testing wasn't realistic.

- In addition, the fact that we do realistic testing is actually a huge advantage we have over other countries, not a disadvantage.

- And, for a program as important as the F-35, realistic operational testing is probably even more important than with other programs.

- If we are going to send young men and women into combat in the F-35 in the future they have to know what the plane can do, and what it can't do.

- So, we can't shortchange testing of the F-35. This year's budget shows the testing properly funded, and it needs to stay that way in the future.

NOT FOR PUBLIC RELEASE
UNTIL APPROVED BY THE
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES

STATEMENT

BY

J. MICHAEL GILMORE

DIRECTOR, OPERATIONAL TEST AND EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

TACTICAL AIR AND LAND FORCES SUBCOMMITTEE

NOT FOR PUBLIC RELEASE
UNTIL APPROVED BY THE
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES
HASC – MARCH 23, 2016

J. Michael Gilmore
Director, Operational Test and Evaluation (DOT&E)
Office of the Secretary of Defense

Good afternoon, Mr. Chairman, Ranking Member Sanchez, my testimony today discusses the status of the F-35 program using my Fiscal Year (FY) 2015 Annual Report as the basis. There are a few updates since the report was released in January 2016, which I will highlight today.

Overall, the program is at a critical time. Although the Marine Corps has declared Initial Operational Capability (IOC) and the Air Force plans to do so later this calendar year (CY), the F-35 system remains immature and provides limited combat capability, with the officially planned start of Initial Operational Test and Evaluation (IOT&E) just over one year away. Over the past year, flight test teams continued to accomplish test flights at the planned rate, and a new version of software capability, Block 3i, was fielded. However, there are still many unresolved significant deficiencies, the program continues to fall behind the planned software block development and testing goals, and sustainment of the fielded aircraft is very burdensome. (The latter is not a surprise, since, as the Program Executive Officer has noted, F-35 remains under development notwithstanding the Services' declarations of IOC.) The program is working to resolve the many issues it confronts, but my assessment is that the F-35 program will not be ready for IOT&E until CY18 at the soonest. Because aircraft continue to be produced in substantial quantities (all of which will require some level of modifications and retrofits before being used in combat), IOT&E must be conducted as soon as possible to evaluate F-35 combat effectiveness under the most realistic combat conditions that can be obtained. Over 300 aircraft are planned to be built by the end of FY17 when IOT&E is currently scheduled to begin.

Test teams executed very closely to the planned sortie production rate throughout the year, as has been the case in previous years. It will be important to ensure the government flight test centers and the associated ranges and facilities at Edwards Air Force Base (AFB) and Patuxent River Naval Air Station (NAS) remain sufficiently resourced to overcome the remaining test challenges, which are significant. However, sortie production does not necessarily mean that planned test points were completed successfully, the system under test functioned as designed, the data collected were usable to sign off contract specification compliance, or that the system will actually be effective and suitable in combat.

In fact, the program did not accomplish the amount of test points planned in several flight test venues, and the program continued to add testing via "growth points" while deleting many mission systems test points as no-longer-required. Because of a change by the program in defining growth in test points, the amount of this re-defined growth was less during the last year than in previous years.

Regarding mission systems test progress over the past year, the program focused on culminating Block 2B development and testing in order to provide a fleet release enabling the Marine Corps F-35B Joint Strike Fighter (JSF) declaration of IOC, while transitioning development and flight test resources to Block 3i and Block 3F.

The program terminated Block 2B development in May 2015, and the Marine Corps declared IOC in July 2015, despite known deficiencies and with, as expected, limited combat capability. Block 3i developmental flight testing restarted for the third time in March 2015, after two earlier attempts in May and September 2014. As mentioned in my annual report, Block 3i began with re-hosting immature Block 2B software and capabilities into new avionics processors. Though the program originally intended that Block 3i would not introduce new

capabilities and would not inherit technical problems from earlier blocks, both of these things occurred. Despite ongoing severe problems with avionics stability, sensor fusion, and other issues, the program terminated Block 3i developmental flight testing in October 2015, and released Block 3i software to the fielded units. This decision was made, despite the unresolved Block 3i deficiencies, in an attempt to meet the unrealistic current official schedule for completing development and flight testing of Block 3F mission systems.

The Air Force insisted on fixes for five of the most severe deficiencies inherited from Block 2B as a prerequisite to use the final Block 3i capability in the Air Force IOC aircraft; Air Force IOC is currently planned for August 2016 (objective) through December 2016 (threshold). However, as the program attempted to concurrently develop and test Block 3i and Block 3F software, the latter of which began flight testing in March 2015, the immaturity and instability of the Block 3i mission systems software continued to manifest problems in flight testing. In February 2016, when the latest version of Block 3F software – version 3FR5 – was delivered to flight test, it was so unstable that productive flight testing could not be accomplished. Consequently, the program elected to reload a previous version of Block 3F software – version 3FR4 – on the mission systems flight test aircraft, to allow limited testing to proceed. The program converted its developmental labs back to the Block 3i configuration in another attempt to address key unresolved software deficiencies, including the avionics instabilities troubling both Block 3i and Block 3F. This decision by the program to return to the Block 3i configuration and address the poor mission systems performance should be commended. It will likely cause some delays, but it is a necessary step to ensure the Air Force has adequate Block 3i software for IOC and that the additional full set of combat capabilities planned in Block 3F can be effectively tested with a stable baseline and eventually fielded to operational units. The extent

to which the significant outstanding deficiencies are being addressed thus far is still to be determined; the program plans to begin flight testing of another version of Block 3i software, version 3iR6.21, in late March 2016.

Realizing the numerous new and advanced capabilities planned to be in Block 3F mission systems, which are specified in the program's Operational Requirements Document (ORD), presents significant challenges for remaining development and flight test. Before the program's decision to pause Block 3F developmental flight testing and rework Block 3i software, test progress was limited as flight testing had only accomplished approximately 17 percent of the Block 3F baseline test points by the end of February 2016. This is because many of the test points, including the more complex weapons delivery accuracy events, could not be flown until stable, functioning Block 3F software was available. After this next version of Block 3iR6.21 software has completed flight testing and the next iteration of the Block 3FR5 software is developed and tested in the lab, the program plans to release 3FR5 to the test centers and resume Block 3F flight testing. Because of the reworking of Block 3i software and the added capability being incorporated in the remaining Block 3F software, it is incorrect to assume that the difficult testing is behind the program. In fact, the most stressing missions systems testing remains to be completed, since the final Block 3F capabilities are both complex and important to the F-35's viability. A recent example is an attempted four-ship Electronic Warfare "Super Scenario" mission with Block 3F software that resulted in only two aircraft arriving at the range because the other two aircraft ground aborted due to avionics stability problems during startup. Also, when the aircraft operated in a dense and realistic electromagnetic environment, the current avionics problems caused poor detection and fusion performance, which is exacerbated in multi-ship F-35 formations. Due to the large amount of difficult flight testing remaining, it is likely

there will be discoveries of additional significant deficiencies that will need to be rectified before IOT&E.

United States Reprogramming Laboratory (USRL). Significant, correctable deficiencies exist in the U.S. Reprogramming Laboratory (USRL) that will preclude development and adequate testing of effective mission data loads for Block 3F. Despite a $45 Million budget provided to the Program Office in FY13, the required equipment was not ordered in time and the USRL is still not configured properly to build and optimize Block 3F Mission Data Files (MDFs). The program still has not designed, contracted for, and ordered all of the required equipment – a process that will take at least two years for some of the complex equipment – after which time for installation and check-out will be required. The estimate of earliest completion is 2019, which is after the planned IOT&E of Block 3F. As I explain in my annual report, the corrections to the USRL are needed to provide F-35s the ability to succeed against the modern threats that are the key rationale for pursuing this $400-Billion program. If the situation with the USRL is not rectified, U.S. F-35 forces will be at substantial risk of failure if used in combat against these threats. Further, I note that the laboratory being built to provide MDFs to the partner nations will be more capable than the USRL is when we are preparing for IOT&E. The full set of required upgrades for the USRL should be pursued immediately, without further delay.

Cybersecurity testing. The limited and incomplete F-35 cybersecurity testing accomplished to date has nonetheless revealed deficiencies that cannot be ignored. Multiple tests are scheduled for spring 2016; however, the JSF Program Office (JPO) and contractor are still reluctant to allow testing of the actual Autonomic Logistics Operating Unit (ALOU) including its many connections, fearing testing might disrupt its operations. Even though the program is

providing alternate systems for ALOU testing in the near term, which is better than foregoing all testing, it must allow full cooperative and adversarial cyber tests on every level and component of the operational Autonomic Logistics Information System (ALIS), as well as the actual aircraft, as soon as possible. Cybersecurity testing on the next increment of ALIS – version 2.0.2 – is planned for this fall, but may need to be delayed because the program may not be able to resolve some key deficiencies and complete content development and fielding as scheduled.

IOT&E readiness and adequacy. IOT&E will be the first rigorous evaluation of the combat capability of the F-35. However, the current schedule to complete development and enter IOT&E by August 2017 is unrealistic. The problem is, and has been, the slow rate at which required combat capabilities are maturing; that is, becoming stable and viable enough to successfully complete testing. Based on the historical performance of the program and the large amount of testing that remains, my estimate for completion of developmental flight test is no earlier than January 2018. For these reasons, the test organizations' capacity should be maintained at current levels, and not reduced in a counter-productive effort to meet unrealistic budget targets. Several other significant obstacles remain to be overcome before IOT&E can begin, including the following:

- **Weapons integration.** A significant amount of weapons integration developmental testing remains in order to integrate and qualify for operational use of the full suite of Block 3F weapons, including the gun. Since my annual report, nothing has changed my estimate that the program must complete weapons employment test events at a pace three times faster than it has previously been able to do. Eliminating some of the planned developmental weapons test events will only result in deferring them to be done later by the operational test squadrons, which will likely delay identification

and correction of significant new discoveries and, therefore, delay IOT&E. The developmental weapons test events are critical in preparing for IOT&E and the Block 3F weapons events are much more complex than previous testing for Block 2B and Block 3i. For example, critical air-to-air and air-to-ground gun accuracy testing still has not occurred because test aircraft have not received the required gun modifications, which are expected in summer 2016. Whether the F-35, the first modern fighter without a heads-up display, can accurately employ the gun in realistic situations with the Generation III Helmet Mounted Display System remains to be seen until this testing can be conducted.

- **Modification of aircraft.** One of numerous penalties associated with highly-concurrent F-35 development and production is that all the early operational aircraft now need many significant, time-consuming, and costly modifications. The 18 U.S. aircraft (6 each of F-35A/B/C) required for IOT&E need to be representative of the configuration of the weapons system that will be bought at full production rates, which is Lot 9 or Lot 10 and later; recall that the operational test aircraft were purchased in early production lots (Lot 3 through 5), when the program planned IOT&E to occur in 2013. The program and the Services need to decide whether to pursue all of the modifications needed to those early-lot aircraft prior to IOT&E, or to equip later production aircraft, requiring few or no modifications, with the necessary instrumentation for IOT&E. Nothing substantive has occurred since my annual report to change my estimate that if the former course is pursued, the aircraft designated for IOT&E will not be ready until April 2019. This is despite ongoing efforts by the program to accelerate the modification schedule. The program is also pursuing other

options, including taking some of the new Block 3i processor sets from the production line to modify some of the IOT&E aircraft. The program and Services are also considering swapping new Block 3i processors from other delivered aircraft with the operational test aircraft that are currently configured with Block 2B hardware. The primary problem with staying on the course of completing modifications of the older aircraft is that the production line and the depots – where earlier lot aircraft are being modified – compete for the same materiel. Of course, this issue affects not only the IOT&E aircraft, but all of the aircraft produced before at least Lot 9 as well. A decision is needed now on the approach to be taken to provide production-representative aircraft for operational testing.

- **Mission data.** I already addressed earlier in my statement the problems with the USRL with respect to the need for upgrades in order to be able to produce mission data loads for Block 3F IOT&E. Again, this is a significant problem for the program and the processes involved in completing the Block 3F laboratory upgrades need to be accelerated, or IOT&E could be delayed well into 2019, with the combat capability of the F-35 remaining deficient. Besides programming the mission data loads, the laboratory is also used as a test venue for optimizing the performance of scan schedules within the data loads. These schedules command the time-sharing of the radar and the electronic support systems to ensure threat signals are detected, geo-located, and correctly identified for battlespace awareness. Such testing takes time in the laboratory and should be completed prior to, and refined after, testing on the open-air ranges.

- **Sustainment.** In my annual report I provided details on operational suitability. I highlight here, with respect to IOT&E readiness, that if the program is only able to achieve and sustain its goal of 60 percent aircraft availability, the length of IOT&E will increase significantly because a combat-ready availability of 80 percent is planned and needed to efficiently accomplish the open-air mission trials with the number of aircraft planned for IOT&E. Improvements in reliability and maintainability, along with significant improvements to the ALIS, are all needed. The program has worked and achieved better performance in these areas over the past two years, but progress is still too slow if the program is to be ready for IOT&E in less than two years. Of course, this is not only an issue for IOT&E execution, but also for the fielded operational units.
- **Operator preparedness.** In addition to having production representative aircraft, effective mission data, and improved sustainment, the units that will execute the operational test trials need viable tactics and enough time to become proficient by training to them. For example, the pilots will need time to adapt to and train with the new Generation III Helmet Mounted Display System that will begin testing later this year. The operational test team has always planned for this training to occur; however, the program continues to believe that this can be done concurrently with development. Concurrent development and training for test has been tried in other programs, and is fraught with difficulty and failure.
- **Test range improvements.** I have been working within the Office of the Secretary of Defense and with the Service staffs for the past five years to improve the test venues for operational testing of F-35 and other platforms, in particular the open-air

test resources. These efforts have resulted in putting improvements on track for F-35 IOT&E to be able to include already fielded advanced threats that previously were not going to be available for testing and training. However, resistance and bureaucratic delays to adequately integrating these assets continue despite the decision having been made by the Secretary of Defense to ensure a full and complete test capability that is no less than that available with older threat systems. I will continue to work to bring the needed level of integration to fruition, and appreciate the support provided so far.

- **IOT&E plans.** IOT&E will include trials in various mission areas, specifically Close Air Support (CAS), Surface Attack, Suppression/Destruction of Enemy Air Defenses (SEAD/DEAD), Air Warfare (both offensive and defensive), and Aerial Reconnaissance. The IOT&E will also include tests that compare the ability of the F-35 to accomplish CAS, Combat Search and Rescue and related missions – such as Forward Air Controller (Airborne) – with the A-10, plus SEAD/DEAD missions with that of the F-16, and Surface Attack missions with that of the F/A-18. These comparison test trials are essential to understanding the new capabilities expected from the F-35 program, relative to the legacy systems it is designed to replace. The trials will be designed to answer the question, "Is the new system as good as or better at accomplishing the mission than the legacy system under the same conditions and in the same environment?" Comparison testing is not new with the JSF. Of note, the F-22 completed comparison testing with the F-15 during its IOT&E. Typically, many variables are present during operational testing that cannot be controlled, especially in force-on-force exercises. Areas where commonality in the variables can be sought

among trials to enable valid comparisons include: the type of mission; the size, organization, and capability of the enemy force; the terrain (or environment) where the test is conducted; the size, organization, and capability of the supporting blue forces; and time available to accomplish the mission. These comparison test trials will be designed as "matched pairs" where the F-35 aircraft will fly the mission trial and then the comparison aircraft will fly the same mission trial, under the same operational conditions, with pilots making best use of the differing capabilities and tactics for employing each aircraft.

Block 2B Capabilities Fielded. As mentioned in my annual report, if used in combat, the Block 2B F-35 will need support from command and control elements to avoid threats, assist in target acquisition, and control weapon employment for the limited weapons carriage available (i.e., two bombs and two air-to-air missiles). Block 2B deficiencies in fusion, Electronic Warfare, and weapons employment result in ambiguous threat displays, limited ability to respond to threats, and a requirement for off-board sources to provide accurate coordinates for precision attack. Since Block 2B F-35 aircraft are limited to two air-to-air missiles, they will require other support if operations are contested by enemy fighter aircraft. The program deferred deficiencies and weapons delivery accuracy test events from Block 2B to Block 3i and Block 3F, a necessary move in order to transition the testing enterprise to support Block 3i flight testing and Block 3F development, both of which began later than planned in the program's integrated master schedule. The program fielded new software for the ALIS during 2015. These versions included new functions, improved interfaces, and fixes for some of the deficiencies in the earlier ALIS versions. The program also fielded a new version of the Standard Operating Unit (SOU) which is more modular and easier to deploy. However, many critical deficiencies remain which require

maintenance personnel to use workarounds to address the unresolved problems. For example, training systems for ALIS are immature and require maintenance personnel to learn ALIS processes in the fielded locations. Also, data within ALIS modules referring to aircraft parts are often inaccurate and need to be manually corrected. In addition, the process for creating and receiving action requests, needed for resolving maintenance issues when technical data are insufficient or not clear, is lengthy and burdensome.

The Marine Corps conducted a deployment demonstration to the USS *WASP* in May 2015, which provided lessons learned and highlighted limitations for conducting ship-borne operations. The Marines also conducted a deployment demonstration to the Strategic Expeditionary Landing Field near Marine Corps Air Station (MCAS) Twentynine Palms, California, in December 2015. Both deployments required extensive time to transfer data to the deployed ALIS and ensure files were formatted correctly to support operations. In addition, low aircraft availability rates resulted in less than planned sortie generation rates.

The Air Force also conducted deployment demonstrations – one as a "cross-ramp" deployment of three F-35A aircraft across the ramp at Edwards AFB, California, in April and May 2015 and another with six F-35A aircraft to Mountain Home AFB, Idaho, in February 2016. Like the Marine Corps demonstrations, the cross-ramp deployment required extensive time to get ALIS set up and data files transferred from the operational unit. ALIS set up and data transfer during the Mountain Home deployment was more efficient than in other demonstration, being completed within four hours for each of the six aircraft. The Air Force attempted two alert launch procedures during the Mountain Home deployment, where multiple F-35A aircraft were preflighted and prepared for a rapid launch, but all failed to accomplish the alert launch successfully due to start-up problems requiring system or aircraft shut-downs and restarts.

There are several issues affecting the F-35's CAS capabilities, as mentioned in my annual report. Both the Air Force, with the F-35A, and the Marine Corps, with the F-35B, have flown simulated CAS missions during training or in support of training exercises, with the aircraft in the Block 2B configuration. These training missions have shown that the Block 2B aircraft will need to make substantial use of voice communications to receive target information and clearance to conduct an attack. This is because of the combined effects of digital communications deficiencies, lack of infrared pointer capability, limited ability to detect infrared pointer indications by a controller (which may be improved in the Generation III Helmet Mounted Display System), and inability to confirm coordinates loaded to GPS-aided weapons. Many pilots consider the Electro-Optical Targeting System (EOTS) on the F-35 to be inferior to those currently on legacy systems, in terms of providing the pilot with an ability to discern target features and identify targets at tactical ranges, along with maintaining target identification and laser designation throughout the attack. Environmental effects, such as high humidity, often forced pilots to fly closer to the target than desired in order to discern target features and then engage for weapon employment, much closer than needed with legacy systems, potentially exposing them to threats around the target area or requiring delays to regain adequate spacing to set up an attack. When F-35 aircraft are employed at night in combat, pilots with the currently-fielded Generation II helmet will have no night vision capability from the helmet, due to the restriction on using the current limited night vision camera (due to poor performance, unless a waiver is granted for combat), which is planned to be subsequently upgraded after aircraft are retrofitted with Block 3i and pilots are equipped with the Generation III helmet, which is still in development and testing. In general, using Block 2B F-35 aircraft, pilots would operate much like early fourth generation aircraft using cockpit panel displays, with the Distributed Aperture

System providing limited situational awareness of the horizon, and heads-up display symbology produced on the helmet.

Fuel and weapons limitations also affect F-35 CAS performance. For example, an F-35B, assuming a 250-nautical mile ingress to a CAS area contact point, would have only approximately 20 – 30 minutes to coordinate with the controller, assess the tactical situation and execute an attack using its two air-to-surface weapons before needing to depart for fuel. By comparison, an Air Force A-10 would have approximately one and one half hours of time in the CAS area under the same conditions, but would be able to autonomously acquire and identify targets, while using datalink to receive and/or pass target and situational awareness information. Also, an A-10 would be able to employ at least four air-to-surface weapons, including a mixed load of ordnance and its internal gun, which provides flexibility in the CAS role. Although F-35 loiter time can be extended by air refueling, operational planners would have to provide sufficient tankers to make this happen. The F-35 fuel burn rate is very high compared to legacy strike fighters, at least 60 percent higher than the F-16C, and 180 percent higher than the A-10. This creates a burden on the air refueling resources if used to increase F-35 time on station. Of course, the F-35 is designed to do more missions than CAS, which is the primary mission for which the A-10 was designed. Also, the F-35 is designed to do these missions in a high-threat area. Furthermore, F-35 development is still not complete. If the capabilities stated in the ORD are realized, Block 3F aircraft will have the ability to carry additional weapons externally, for an increased payload, as well as a gun. For example, a Block 3F F-35A aircraft could carry six Guided Bomb Unit (GBU)-12 laser-guided bombs (vice two in Block 2B) along with four air-to-air missiles (two Air Intercept Missile (AIM)-120C and two AIM-9X). The gun capabilities of the F-35 and A-10 are significantly different. The F-35 has a lightweight, 25-millimeter cannon,

internally mounted on the F-35A with 182 rounds, and in an external pod with 220 rounds for the F-35B and F-35C, while the A-10 has a 30-millimeter cannon with 1,150 rounds. Even though the A-10 gun has a higher rate of fire, the A-10 gun can fire for over 17 seconds versus approximately 4 seconds for the F-35, providing the capability for many more gun attacks. Also, while both guns have a similar muzzle velocity, the rounds fired by the A-10 are twice as heavy, providing twice the impact energy on the target. The F-35's fusion of information from onboard sensors and data from off-board sources (i.e., F-35 aircraft in formation via the Multi-function Advanced Data Link (MADL) and other aircraft via Link 16), along with all-weather ground-moving target and synthetic aperture radar capability, are planned to be more capable in Block 3F and should provide better battlespace awareness than that being fielded with Block 2B and better capability in these aspects than an A-10. The extent that these capabilities improve combat capability over legacy systems will be evaluated during IOT&E.

Mission planning time and the debriefing times for the F-35 with the current version of ALIS – which must account for the long download process for cockpit video – are much longer than those of legacy platforms and will affect operations when the F-35 unit is a member of composite air and surface forces, since planning timelines will have to be adjusted.

Software -- Block 3. As I explained above, Block 3i was intended to be a simple re-hosting of Block 2B mission systems software on new hardware and processors. However, Block 3i content also includes attempted fixes for five significant functional deficiencies related to mission systems identified by the Air Force as necessary for its IOC declaration. Four additional discoveries in Block 3i have since been identified as deficiencies in need of fixes. Unfortunately, as explained earlier in my statement, Block 3i software is still not stable; in fact, it is much less stable than Block 2B. The final version of Block 2B, version 2BS5.2, had 32.5

hours between stability events during flight testing, versus only 4.3 hours for Block 3iR6. Because Block 3i is the basis for the final new and challenging Block 3F capabilities, the program has rightly determined to focus on Block 3i problems in lieu of further Block 3F development. The program is developing another version of Block 3i software – version 3iR6.21 – which it plans to release to flight test in late March 2016. Unfortunately, further development of the software had been on hold, due to the expiration of the Authority to Operate of the software testing labs at the contractor lab facilities, but has now recently re-started. The Block 3i software instabilities, unresolved deficiencies, lab delays, and the potential for additional discoveries are adversely affecting Block 3i tactics development and the IOC Readiness Assessment, currently underway at Nellis AFB, and are likely to affect Air Force IOC. Nevertheless, the program continues to deliver Block 3i aircraft configured with the available software to fielded units and will continue to do so this year and next year.

Success of Block 3F mission systems depends on the program resolving the problems with Block 3i. The stability and functionality problems in the initial versions of Block 3F, inherited from Block 3i, were so significant that the program could not continue flight test. The program recently announced a commitment to shift to capability-based software releases, rather than schedule-driven and overlapping releases. While this may cause further short-term delays to the program, I agree with the program's decision to shift to a serial process of testing and fixing software in the lab before releasing the next software version. If a workable version of 3FR5 is released later this spring or early this summer, mission systems testing and weapons releases can potentially resume in earnest. If this software has better stability and functionality, the test point completion rate may increase, which will be essential given the significant amount of testing that remains.

The program continues to carry a heavy load of technical debt in open and unresolved deficiencies. As of the end of January 2016, the program had 931 open, documented deficiencies, 158 of which were Category 1, defined as deficiencies which may cause death, severe injury, or severe illness; may cause loss of or major damage to a weapon system; critically restricts the combat readiness capabilities of the using organization; or result in a production line stoppage. Of the 158 Category 1 deficiencies, 135 were associated with the air vehicle and the remaining 23 were associated with the ALIS or support equipment. Furthermore, 100 of the 158 open Category 1 deficiencies were categorized as "high severity" by the program or Services. Specific to mission systems, the program was carrying 17 open Category 1 deficiencies for Block 2B capabilities that were characterized as having "high" impact and 35 open Category 1 deficiencies for Block 3F with "high" impact. The Program Office, in cooperation with representatives from the Services, developmental test and operational test organizations, recently led a detailed review of the open deficiencies. This effort, which I applaud, assessed the effect of each deficiency with respect to both combat capability and IOT&E. The resulting list of critical deficiencies should be the top priority fixes for the program prior to finalizing Block 3F and conducting IOT&E.

Mission Data. The problems in the USRL described earlier will not only adversely affect Block 3F combat capability; they are crippling the ability to produce effective mission data loads for today's fielded aircraft. The current tools and software in the lab are very difficult to work with, resulting in a lengthy, inefficient process to produce and test the mission data. Along with the decision to delay moving the lab equipment from the contractor facilities in Fort Worth, Texas, these inefficiencies created sufficient schedule pressure that the program and the Marine Corps directed the lab to truncate the planned testing of the Block 2B mission data so that an

immature version could be fielded in mid-2015 to "support" Marine Corps IOC. The lab provided a Block 2B mission data load, but the risks of operating with these mission data are not understood, and will not be characterized until the full set of planned testing, including operational test flights with the mission data, are conducted later this year. Because the hardware in aircraft equipped with Block 3i cannot operate with the Block 2B mission data, Block 3i mission data must be developed and tested independently of, but concurrently with, the mission data for Block 2B. This creates an additional significant strain on the lab, which is already burdened with inefficient reprogramming tools. Block 3i mission data will likely incur the same fate as Block 2B mission data, as inevitable schedule pressure to field immature mission data will drive product delivery despite incomplete optimization and testing. In any case, the risks in combat associated with operating with these early mission data versions will remain unknown until the planned lab and flight testing are complete.

Escape System. The F-35's pilot escape system is immature; it requires modifications and additional testing if the Services are to be reasonably confident the system is safe for their intended pilot populations. The failures during sled tests last summer simulating controlled, low-speed ejections caused the program and Services to restrict pilots below 136 pounds bodyweight from flying the aircraft. Also, the risk to pilots weighing up to 165 pounds, while lower than the risk to lightweight pilots, is still considered "serious" by the program. Last year the program assessed the risk for this 136 to 165 pound weight class, which accounts for approximately 27 percent of the pilot population. The program assessed the probability of death during an ejection in these conditions to be 23 percent and the probability of some level of injury resulting from neck extension to be 100 percent. However, the program and the Services decided to accept that risk and not restrict pilots in this weight category from flying. Subsequently, the program

conducted "proof of concept" tests last fall for modifications to the escape system including a "lightweight pilot" switch on the seat and a fabric head support panel between the parachute risers behind the pilot's head, intended to restrict the severe backward neck extension. The tests apparently showed that the lightweight pilot switch and head support panel prevented a neck load exceedance after parachute deployment and opening shock. However, these changes do not prevent the high loads on the pilot's neck earlier in the ejection sequence due to the rocket firing and wind blast. Full testing of these fixes using the new lightweight Generation III helmet and full range of mannequin weights across different airspeeds is expected to extend through this summer with flight clearance this fall and modification kits in 2017. Additional testing and analyses are also needed to determine the risk of pilots being harmed by pieces of the transparency from the canopy removal system during ejections (the canopy must be explosively shattered during ejection) in other than stable conditions (such as after battle damage or if out-of-control), referred to as "off nominal" conditions.

Structural testing. Major findings are continuing in the durability test articles, particularly in the titanium bulkhead in the F-35C test article. Significant limitations to the life of the fielded F-35C aircraft can only be addressed with intrusive structural modifications prior to the expected full service life, and show again the high cost of concurrent production and development. In the past year, discoveries of unpredicted cracks continued to occur, and in some cases required pauses in testing to determine root causes and fixes. This occurred in all three variants. Currently, only the F-35A structural test article can be tested; it is about to begin the third lifetime test phase, or the third series of 8,000 equivalent flight hours of testing. The F-35B test article is still down for repairs needed to complete the second lifetime. The F-35C test

article restarted testing in mid-February but stopped three days later when strain gauges indicated cracking in a titanium bulkhead; it has not yet restarted.

ALIS. The program has developed a new version of the ALIS hardware, termed Standard Operating Unit version 2 (SOU v2), which possesses all of the functional capabilities included in the original version – SOU v1 – but in a modularized, more deployable form. As I described earlier in my statement, in recent months, both the F-35A and F-35B have conducted deployment demonstrations in an effort to learn how to forward deploy with, and conduct flying operations using, the SOU v2. The Marine Corps and Air Force needed several days to successfully establish a new network in an austere expeditionary environment or to integrate ALIS into an existing network at a non-F-35 military installation before ALIS was able to support flying operations. Although the hardware for the SOU v2 was much more manageable to move and set up, the processes for connecting to the main Autonomic Logistics Operating Unit (ALOU) at Lockheed Martin facilities in Fort Worth took time, as did ensuring the data from home station units was transferred correctly to the deployed unit.

These two Service-led deployment demonstrations showed that ALIS operations will require significant additional time to initiate beyond setting up hardware modules, since the details of a network configuration and data file structure vary among base operating locations. ALIS requires a secure facility to house hardware, including SOU modules, mission planning workstations, and receptacles for transferring data to and from aircraft storage devices, which must be connected to power and external communications and integrated into a network with data exchanges occurring at multiple levels of security. It is difficult to establish and configure a network in the precise manner that ALIS requires, so network personnel and ALIS administrators have needed several days to troubleshoot and implement workarounds to prepare ALIS for

operations. Although Lockheed Martin has provided several techniques for transferring aircraft data from a main operating location SOU to a deployed SOU, data transfers have proven time consuming and have required high levels of support from Lockheed Martin. Also, relatively minor deviations in file structures relative to ALIS' specifications can cause the process to fail.

The program plans to release another increment of ALIS software this year – version 2.0.2, with added capabilities to support Air Force IOC declaration. However, it is struggling to meet the schedule currently required to deliver the planned content. Recent Program Office schedule assessments show delays from six weeks to five months, neither of which align with the planned objective date for Air Force IOC of August 2016. Cybersecurity testing of ALIS 2.0.2 is planned for this fall, but may need to slip if the program cannot deliver the planned increment of additional capability on time, adding associated risk to fielding systems and declaring IOC because adequate cybersecurity testing will not have been completed.

Delays in completing development and fielding of ALIS 2.0.2 will compound the delay already realized for ALIS 3.0, the last planned increment of ALIS, which is needed for IOT&E but is currently not scheduled to be released until April 2018. Although the program is considering deferring content and capabilities to make up schedule, the full set of capabilities for ALIS 3.0 will be needed to comply with the program's requirements and therefore are required for IOT&E.

Aircraft Reliability, Maintainability, and Availability. Although measurements of aircraft reliability, maintainability, and availability have shown some improvement over the last two years, sustainment relies heavily on contractor support, intense supply support to arrange the flow of spare parts, and workarounds by maintenance and operational personnel that will not be acceptable in combat. Measures of reliability and maintainability that have ORD requirement

thresholds have improved since last year, but six of nine measures are still below program target values for the current stage of development; two are within 5 percent of their interim goal, and one – F-35B mean flight hours between maintenance events (unscheduled) – is above its target value. Aircraft availability improved slightly in CY15, reaching a fleet-wide average of 51 percent by the end of the year, but the trend was flat in the last few months and was well short of the program's goal of 60 percent availability that it had established for the end of CY14. It is also important to understand that the program's metric goals are modest, particularly in aircraft availability, and do not represent the demands on the weapons system that will occur in combat. Making spare parts available more quickly than in the past to replace failed parts has been a significant factor in the improvement from 30 to 40 percent availability experienced two years ago. However, F-35 aircraft spent 21 percent more time than intended down for maintenance in the last year, and waited for parts from supply 51 percent longer than the program targeted. At any given time, 10 to 20 percent of the aircraft were in a depot facility or depot status for major re-work or planned upgrades, and of the fleet that remained in the field, on average, only half were able to fly all missions of the limited capabilities provided by Block 2B and Block 3i configuration.

The program showed improvement in 11 of 12 reliability metrics by May 2015; however, as I depicted in my annual report, 8 of the metrics are still below the program interim goals for this point in development, and it is not clear that the program can achieve the necessary growth to reach the reliability requirements for the mature system, at 200,000 total fleet flight hours. Many components have demonstrated reliability much lower than predicted by the contractor, such as fiber channel switches, main and nose-wheel landing gear tires, the display management computer for the helmet, and signal processors. These low-reliability components drive down

the overall system reliability and lead to long wait times for re-supply, which negatively affects aircraft availability.

Maintainability metrics indicate flight line maintenance personnel are working extremely hard to keep up with the demands of unscheduled maintenance (e.g. trouble-shooting and fixing failures) and scheduled maintenance (e.g. inspections). Small improvements in maintainability metrics occurred in the past year, but the measures for all variants are far from the operational requirements. There are a few individual causes for long down times that may be addressed by the program, such as long cure times for low observable repairs, but many must be accepted as facts of life for the time being. Maintenance manuals and technical information must continue to be produced, verified, and validated for use by the military maintenance personnel so that they can learn how to generate combat missions in the most efficient manner. The current process requiring "action requests" to fill gaps in technical information, while improved, will not be acceptable for combat. F-35 maintainers must also dedicate a significant amount of time to scheduled maintenance, in addition to repairs. This accounts for over half of all maintenance time in the last year (from June 2014 through July 2015), a result of fielding an aircraft with an immature structural design that must be inspected for evidence of wear and cracking, such as that which has been found in the structural static test articles.

I also want to point out that the fielded units, and the overall program, have a new challenge with managing multiple software and hardware configurations as aircraft emerge from depot and local modification processes. Modified aircraft include new parts and this should improve reliability metrics. However, managing multiple configurations requires continual, intense focus to ensure correct procedures and parts are used based on aircraft configuration and data elements tracked within ALIS.

Deployment sustainment results. As I outlined earlier in my statement, Service-led deployments over the past year have revealed challenges to adequate suitability performance, and provided useful lessons for future operations. More detail is provided below.

During the Cross Ramp Deployment Demonstration flying period at Edwards AFB during May 4 – 8, 2015, the operational test squadron flew 20 of 22 planned missions. The squadron originally intended to deploy four F-35A aircraft and planned most fly-days with two aircraft flying two sorties apiece, but could only make three aircraft available to participate in the exercise. The ALIS data transfer problems forced the detachment to operate in an ALIS-offline mode until the morning of May 7, which restricted aircraft maintenance to minimal, simple activities. The detachment was able to achieve a relatively high completion rate of planned sorties in spite of this largely because no mission systems were required for the flights, so failures in these components were left un-repaired. By the end of the deployment, one of three aircraft had to be towed back to the test squadron hangar because it was down for a flight system discrepancy that the detachment could not fix in time. The detachment also exposed problems with retaining spare part requisitions against aircraft when they are transferred between SOUs, and issues with keeping maintenance records intact when returning from ALIS-offline operations.

The shipboard flying period of the USS *WASP* deployment demonstration from May 18 – 28, 2015, excluding the return flights from the ship to home base on May 29, was not intended to maximize aircraft utilization rates, but showed difficulties in achieving adequate availability to support planned flight schedules. The six deployed F-35B aircraft were mission capable for flight operations approximately 55 percent of the time, which led to the detachment flying 61 of 78 planned missions. The Marine Corps reports a higher number of sorties than missions, since

each vertical landing constituted a sortie, while each post-flight engine shut down constituted a mission. Several missions were canceled for weather, or other operational reasons, but 13 missions were canceled, apparently due to a lack of available aircraft. In order to consistently generate tactically relevant four-aircraft mission packages day after day, out of the normal complement of six F-35B aircraft onboard an L-class amphibious ship, the F-35B would likely have to achieve availability rates closer to 80 percent; although during the deployment demonstration, the detachment did generate a four-aircraft mission on one day. Fuel system reliability was particularly poor. This is more burdensome in the shipboard environment than at land bases, as fuel system maintenance in the hangar bay can restrict the ability to perform maintenance on other aircraft in the bay. Due to a fuel system problem that would have required an engine to be pulled, one aircraft was transferred on a one-time flight back to shore and swapped with an alternate aircraft, an option that would not exist in forward-deployed combat conditions. Aircraft availability and utilization varied widely among the seven different aircraft used in total on the deployment, with the top performing aircraft flying 20 missions, and the least performing aircraft flying only 2 missions, not including a one-time ferry flight to shore to be swapped. The ALIS data transfers also relied on combat-unacceptable workarounds, including using commercial Wi-Fi access to download aircraft files. Several factors limited the ability to draw more conclusions about shipboard integration of the F-35B from this deployment demonstration. These included the lack of the rest of the Air Combat Element (ACE) aircraft onboard ship except for the required Search and Rescue (SAR) helicopters; the use of developmental Support Equipment (SE), vice the production-representative SE the Marine operational squadron is now equipped with; and no employment of ordnance.

The Marine Corps conducted an assessment of F-35B austere site deployed operations at Twentynine Palms, California, from December 8 – 16, 2015, with eight F-35B aircraft assigned. The Marines intended to fly four aircraft a day from an expeditionary landing field made of aluminum matting and with minimal permanent infrastructure, representing the type of temporary airfield that can be quickly built near the forward line of troops. The demonstration included the use of inert ordnance and production representative support equipment. Aircraft availability for this detachment was again in the 55 to 60 percent range, which led to a significant number of missed flights on the planned flight schedule. The detachment flew 41 out of 79 planned missions; however, 22 of the 38 missions not flown were due to high crosswinds which made landing and taking off from the aluminum matting too risky. Overall, 16 missions were lost due to either lack of aircraft availability, difficulties in transferring and accepting aircraft data into the deployed ALIS, or ground aborts. Propulsion system maintenance was particularly burdensome. Two F-35B aircraft received foreign object damage to their engine fan stages, a result from operating in rugged conditions with jet wash likely blowing small rocks into aircraft intakes. This prevented those aircraft from further participation in flying activities until repairs were completed just prior to the ferry flights home. A contractor technician was called in from the East Coast and was able to repair the engine damage on site, as opposed to having to perform a full engine swap. A further engine system discrepancy required an aircraft swap around mid-way through the detachment. Routine flight operations, such as aircraft start-up and basic troubleshooting, also relied heavily on contractor maintenance.

The Air Force sent a detachment of six F-35A operational test aircraft from Edwards AFB to Mountain Home AFB from February 8 to March 2, 2016, to simulate a combat deployment of this variant in preparation for Air Force IOC later this year. This demonstration

employed both inert and live ordnance in the CAS and Aerial Interdiction roles, in conjunction with legacy platforms. Results from this demonstration are still too preliminary to report on in full, although some early observations were made. The detachment discovered a major discrepancy in the technical data for loading free fall ordnance after a released bomb hit the weapons bay door and then impacted and gouged the horizontal stabilizer. The aircraft returned to base safely and was eventually repaired on station, and the detachment coordinated with Lockheed Martin to correct the appropriate ordnance loading instructions. The deployment also successfully transferred aircraft data files within the autonomic logistics infrastructure (i.e., using ALIS, the Central Point of Entry, and the ALOU); however, there were some difficulties in establishing ALIS on the host Air Force network on Mountain Home AFB. Finally, the relatively frequent requirement to shut-down and restart an aircraft on start-up before flying due to software instabilities in vehicle and mission systems hampered the detachment's ability to conduct alert launches.

Key test range capability improvements are required for IOT&E, on which we have been working with the Office of the Secretary of Defense and Service staff for several years. In particular, these include the Air-to-Air Range Infrastructure-2 (AARI2) system, the instrumentation that allows the many engagements during complex test trials to be accurately assessed and shaped in real time; and the integration of the Electronic Warfare Infrastructure Improvement Program (EWIIP) emitters, that will simulate current, advanced threats on the range. For an adequate IOT&E, the integration of AARI2 with the F-35 should allow the F-35 Embedded Training modes to realistically emulate and display weapons employment data and threat indications to the pilot, and include the shot validation method that is being developed for this purpose. The planned schedule for AARI2 integration, however, does not align with the

current plans for IOT&E and does not include these features. Therefore, the product will either be inadequate or late to need. The new EWIIP emitters, that will simulate current, advanced threats on the range start arriving in fall of this year. However, Air Force integration plans fall short of what is needed for an adequate IOT&E, both in how the emitters are integrated with the range infrastructure and the degree of incorporation with the AARI2 battle-shaping instrumentation. We continue to work with the Air Force in an attempt to correct these problems, and ensure we get the most of the investment made in these emitters. There is no alternative to correcting these problems if IOT&E is to provide a representative threat environment – an environment that has been in existence, and robustly so, in the real world for several years. Not incorporating these assets will result in a test of the F-35 only against decades-old threats, which do not represent the intended operational environment for this fifth generation system. I assess the technical challenges to the integration requirements I mention here as relatively minor; this test concept is not new. Unfortunately, the issues seem to stem primarily from cultural resistance to change and to the adoption of modern technology.

Of all the issues mentioned earlier that threaten IOT&E spin-up and start, the most significant are the modifications needed for operational test aircraft, Block 3F completion (including flight test, weapons deliveries, and envelope release), and completion of ALIS 3.0. The program has an executable plan to pull completion of the modifications back from 2019 to 2018; however, the Services must commit to executing that plan, which has not yet occurred. The Block 3F schedule, even with significant improvements in software stability, deficiency resolution, and flight test rates, still appears to extend into 2018 before the capabilities will be ready and certified for IOT&E. Inadequately tested mission data and failure to provide the Verification Simulation will likely not delay the start of IOT&E, but will affect the results and

adequacy of the test, respectively, and the former will likely limit significantly the ability of the F-35 to be used in combat against existing, modern, stressing threats. Therefore, a mid-2018 start for IOT&E appears to be the earliest viable date based on when the mods, Block 3F and ALIS 3.0 will be ready. Based on the issues above that will not likely be resolved or ready until 2018 or later, I am concerned that the program may not have adequate resources to complete the required System Development and Demonstration activities prior to IOT&E.

Block Buy. In my annual report, I raised several questions regarding the program's proposed "block buy" to combine three production lots comprising as many as 270 U.S. aircraft purchases to gain near-term savings. My understanding is that the program and the Services have decided to delay the consideration of the block buy for at least another year, possibly starting in FY18. Nonetheless, in that case, all of the questions I pose in my annual report remain valid, since IOT&E will not start until FY18, at the earliest, and will not be complete until later that year

Follow-on Modernization. The program's proposed "F-35 Modernization Planning Schedule" is overly optimistic and does not properly align with their current software development schedule, which is also unrealistic. There is a four-year gap between the final planned Block 3F software release in 2016 and fielding of the first proposed modernization increment, labeled 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, likely to be found during IOT&E, prior to adding the proposed new Block 4.1 modernization capabilities. Such a schedule greatly increases risk to development and testing of Block 4. Despite the significant ongoing challenges with F-35 development, 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, before or 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 having a full understanding of the inevitable problems it will reveal. Also, the proposed Block 4 modernization plan and schedule does not clearly depict acquisition milestones, despite the large amount of capabilities and funding required. Finally, the follow-on modernization plan and schedule still do not allocate schedule and resources for operational test and evaluation of each increment consistent with the approach being used for F-22 follow-on development.

J. Michael Gilmore
Director of Operational Test and Evaluation

Dr. J. Michael Gilmore was sworn in as Director of Operational Test and Evaluation on September 23, 2009. A Presidential appointee confirmed by the United States Senate, he serves as the senior advisor to the Secretary of Defense on operational and live fire test and evaluation of Department of Defense weapon systems.

Prior to his current appointment, Dr. Gilmore was the Assistant Director for National Security at the Congressional Budget Office (CBO). In this position, he was responsible for CBO's National Security Division, which performs analyses of major policy and program issues in national defense, international affairs, and veterans' affairs. Specific areas of investigation included the long-term implications of current defense policies and programs, the implications of transformation for equipping and operating U.S. military forces, the effectiveness and costs of alternative approaches to modernizing U.S. military forces, and the resource demands associated with operating and supporting U.S. military forces.

Dr. Gilmore is a former Deputy Director of General Purpose Programs within the Office of the Secretary of Defense, Program Analysis and Evaluation (OSD(PA&E)). As the Deputy Director, he was responsible for developing, formulating, and implementing Secretary of Defense policies on all aspects of Department of Defense general purpose programs, including analyzing the operational effectiveness and costs of U.S. conventional military forces and supporting programs. Before serving as a Deputy Director, Dr. Gilmore served as the Division Director of Operations Analysis and Procurement Planning, within the Office of the Deputy Director, Resource Analysis and prior to that as an Analyst for Strategic Defensive and Space Programs Division, Office of the Deputy Director, Strategic and Space Programs. Dr. Gilmore's service with Program Analysis and Evaluation covered 11 years.

Early in his career, Dr. Gilmore worked at the Lawrence Livermore National Laboratory, Livermore, California performing research in their magnetic fusion energy program. He has also worked as an Analyst with the Falcon Associates, McLean, VA, and the McDonnell Douglas Washington Studies and Analysis Group, where he became Manager, Electronic Systems Company Analysis.

A native of Ohio and resident of Virginia, Dr. Gilmore is a graduate of The Massachusetts Institute of Technology, Cambridge, Massachusetts, where he earned a B.S. in Physics. He subsequently earned a M.S. and Ph.D. in Nuclear Engineering from the University of Wisconsin, Madison, Wisconsin.

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F-35 JOINT STRIKE FIGHTER

Preliminary Observations on Program Progress

Statement of Michael J. Sullivan, Director
Acquisition and Sourcing Management

GAO Highlights

Highlights of GAO-16-489T, a testimony before the Subcommittee on Tactical Air and Land Forces, Committee on Armed Services, House of Representatives

March 23, 2016

F-35 JOINT STRIKE FIGHTER

Preliminary Observations on Program Progress

Why GAO Did This Study

With estimated acquisition costs of nearly $400 billion, the F-35 Joint Strike Fighter—also known as the Lightning II — is DOD's most costly acquisition program. Since 2001, GAO has reported extensively on the F-35 program's cost, schedule, and performance problems. The program plans to begin increasing production rates over the next few years.

The National Defense Authorization Act for Fiscal Year 2015 contains a provision for GAO to annually review the F-35 acquisition program. Today's testimony is based on ongoing work for the first report under this mandate, which GAO expects to issue in April 2016.This testimony focuses on GAO's preliminary observations regarding the F-35 program's (1) future modernization (2) affordability, remaining development, and ongoing manufacturing plans.

GAO analyzed program documentation including management reports, test data and results, and internal DOD program analyses. GAO collected data on F-35 development and test progress, and analyzed total program funding requirements. GAO also collected and analyzed production and supply chain performance data, and interviewed DOD, program, and contractor officials.

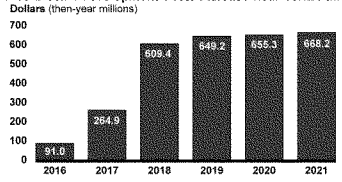
In light of its ongoing work, GAO is not making any recommendations at this time.

View GAO-16-489T. For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

What GAO Found

GAO's ongoing work on the F-35 Joint Strike Fighter (F-35) program shows that the Department of Defense (DOD) has begun planning and funding significant new development work to add to the F-35's capabilities, an effort known as Block 4. The funding needed for this effort is projected to be nearly $3 billion over the next 6 years (see figure below), which would qualify it as a major defense acquisition program in its own right.

F-35 Block 4 Development Costs Increase Near-Term Funding Needs



Source: GAO analysis of Department of Defense data. | GAO-16-489T

DOD does not currently plan to manage Block 4 as a separate program with its own acquisition program baseline but rather as part of the existing baseline. As a result, Block 4 will not be subject to key statutory and regulatory oversight requirements, such as providing Congress with regular, formal reports on program cost and schedule performance. A similar approach was initially followed on the F-22 Raptor modernization program, in which the funding and content were comingled making it difficult to separate the performance and cost of the modernization from the baseline program. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs with their own requirements and acquisition program baselines. The F-22 eventually adopted such an approach. If the Block 4 effort is not established as a separate acquisition program, cost, schedules, and the scope of the baseline and modernization efforts will be comingled. Therefore, it will be difficult for Congress to hold DOD accountable for achieving its cost, schedule, and performance requirements.

GAO's ongoing work indicates that although the F-35 total program acquisition costs have decreased since 2014, the program continues to face significant affordability challenges. DOD plans to begin increasing production and expects to spend more than $14 billion annually for nearly a decade on procurement of F-35 aircraft. Currently, the program has around 20 percent of development testing remaining, including complex mission systems software testing, which will be challenging. Program officials continued to address many of the key technical risks, but the Autonomic Logistics Information System continues to be a challenge. At the same time, the contractors that build the F-35 airframes and engines continue to report improved manufacturing efficiency and supply chain performance.

Chairman Turner, Ranking Member Sanchez, and Members of the Subcommittee:

Thank you for the opportunity to discuss our ongoing work on the F-35 Joint Strike Fighter (F-35), also known as the Lightning II. With estimated acquisition costs approaching $400 billion, the F-35 is the Department of Defense's (DOD) most costly acquisition program. Through this program, DOD is developing and fielding a family of strike fighter aircraft, integrating low observable (stealth) technologies with advanced sensors and computer networking capabilities for the United States Air Force, Navy, and Marine Corps, as well as eight international partners.[1] The F-35 family is comprised of the F-35A conventional takeoff and landing variant, the F-35B short takeoff and vertical landing variant, and the F-35C carrier-suitable variant. Over time, the program has made a number of changes affecting the planned quantities and associated costs.[2] According to current projections, the U.S. portion of the program will require acquisition funding of $12.7 billion a year, on average, from now through 2038 to complete development and procurement of 2,457 aircraft. DOD also estimates that the F-35 fleet will cost around $1 trillion to operate and support over its lifetime, which poses significant long-term affordability challenges for the department.

As we have previously reported, the F-35 program's significant cost, schedule, and performance problems can largely be traced to (1) decisions made at key junctures without adequate product knowledge; and (2) a highly concurrent acquisition strategy with significant overlap among development activities, flight testing, and production. [3] This testimony is based on preliminary observations from our latest annual review of the overall F-35 program. Our work for the ongoing review is being conducted in response to a provision of the National Defense

[1]The international partners are the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. These nations contributed funds for system development and signed agreements to procure aircraft. In addition, Israel and Japan have signed on as foreign military sales customers.

[2]An overview of changes in program cost and quantity from 2001 through 2015 can be found in appendix I.

[3]GAO, *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks*, GAO-12-437 (Washington, D.C.: June 14, 2012); *Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability is a Major Concern,* GAO-13-309 (Washington, DC.: Mar. 11, 2013)

Authorization Act for Fiscal Year 2015, for GAO to review the F-35 acquisition program annually until the program reaches full-rate production. This statement, similar to our ongoing work, assesses: (1) future modernization; (2) program cost and affordability; (3) remaining development and testing; and (4) ongoing manufacturing including supply chain performance. We plan to issue our final report in April 2016.

For our ongoing work, we reviewed budget documents to identify costs associated with the future modernization effort and collected and analyzed information regarding capability and oversight plans. We reviewed and analyzed best practices identified by GAO and reviewed relevant DOD policies and statutes. To assess cost and affordability, we reviewed and analyzed program funding requirements through 2038 and compared cost information as of March 2016 to prior years. To assess ongoing development and testing we reviewed and analyzed test data and results, program briefings, and internal program analyses. To assess ongoing manufacturing and supply chain performance, we collected and analyzed manufacturing and supply chain performance data from Lockheed Martin, Pratt & Whitney, and DOD. We assessed the reliability of the cost, schedule, and performance data by reviewing supporting documentation and interviewing knowledgeable officials. Based on these steps, we determined that all of the data we used were sufficiently reliable for the purposes of this report. We discussed the information in this statement with DOD officials and incorporated their comments as appropriate. The ongoing work on which this statement is based is being conducted in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In brief, our preliminary results indicate that DOD plans to manage F-35 modernization as part of the existing program baseline, which has oversight implications. DOD has begun planning and funding significant new development work to add to the F-35's capabilities, known as Block 4. The funding needed for this effort is projected to be nearly $3 billion over the next 6 years, which would qualify it as a major defense acquisition program in its own right. DOD does not currently plan to manage Block 4 as a separate program with its own acquisition program baseline but rather as part of the existing baseline. As a result, Block 4 will not be subject to key statutory and regulatory oversight requirements, such as providing Congress with regular, formal reports on program cost

and schedule performance. A similar approach was initially followed on the F-22 Raptor modernization program, making it difficult to separate the performance and cost of the modernization from the baseline program. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs with their own requirements and acquisition program baselines. The F-22 eventually adopted this approach. If the Block 4 effort is not established as a separate acquisition program, transparency will be limited. Therefore, it will be difficult for Congress to hold DOD accountable for achieving its cost, schedule, and performance requirements.

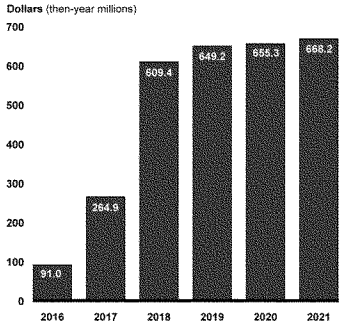
In addition, our ongoing work indicates that although the estimated F-35 program acquisition costs have decreased since 2014 the program continues to face significant affordability challenges. DOD plans to increase annual spending on F-35 aircraft procurements over the next 5 years and expects to need more than $14 billion annually for most of the following decade. Moreover, the program's total operating and sustainment costs are estimated to be around $1 trillion which some within the Office of the Secretary of Defense have stated is unaffordable. Currently, the program has around 20 percent of development testing remaining, including complex mission systems software testing, which will be challenging. The program continues to address technical risks but challenges with the Autonomic Logistics Information System (ALIS) remain. At the same time, the contractors that build the F-35 airframes and engines continue to report improved manufacturing efficiency and supply chain performance.

DOD's Approach to Managing Follow-on Modernization May Hinder Transparency and Oversight

The F-35 program has begun planning and funding the development of new capabilities, known as follow-on modernization, but our ongoing work indicates that DOD's current plan for managing the development of these new capabilities may limit transparency and oversight. The current F-35 development program is projected to end in 2017, when Block 3F developmental flight testing is complete, with a total development cost of $55 billion. The first increment of follow-on modernization, known as Block 4, is expected to add new capabilities and correct deficiencies of 9 capabilities carried over from the current development program such as the prognostics health management system down-link and communication capabilities. Although the requirements are not yet final and no official cost estimate has been developed for Block 4, DOD's fiscal year 2017 budget request indicates that the department expects to spend

nearly $3 billion on these development efforts over the next 6 years (see figure 1).

Figure 1: F-35 Joint Strike Fighter Block 4 Development Costs Increase Near-term Funding Needs



Source: GAO analysis of Department of Defense data. | GAO-16-489T

Our preliminary analysis indicates that F-35 Block 4 development costs of this magnitude would exceed the statutory and regulatory thresholds for what constitutes a major defense acquisition program (MDAP), and it would be larger than many of the MDAPs in DOD's current portfolio. However, in August 2015, the Under Secretary of Defense for Acquisition, Technology, and Logistics issued an Acquisition Decision Memorandum directing the F-35 program office to manage Block 4 development under the existing F-35 acquisition program baseline and not as a separate incremental acquisition program. As a result, DOD will not hold a Milestone B review—the decision point in which program officials would present a business case in order to initiate system development. A Milestone B review would also set in motion oversight mechanisms including an acquisition program baseline; Nunn-McCurdy unit cost

growth thresholds[4]; and periodic reporting of the program's cost, schedule, and performance progress. These mechanisms form the basic business case and oversight framework to ensure that a program is executable and that Congress and DOD decision makers are informed about the program's progress. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs and that a business case should match requirements with resources—proven technologies, sufficient engineering capabilities, time, and funding—before undertaking a new product development.[5] Because DOD does not yet have approved requirements and is not planning to hold a Milestone B review, its approach for Block 4 modernization will not require the program to have such important cost, schedule, and performance reporting and oversight mechanisms in place.

Based on our ongoing work, we have concerns about DOD's approach to Block 4 that are partly rooted in our assessment of a similar case with the F-22 modernization program. In March 2005 we found that the Air Force was managing its multi-billion dollar F-22 modernization efforts as part of the program's existing acquisition baseline and had not established a separate knowledge-based business case.[6] As a result, the F-22 baseline and schedule were adjusted to reflect the new timeframes and additional costs, comingling the funding and some content for the baseline development and modernization efforts—some content that had not been achieved under the baseline program were deferred into the modernization program. When the content, scope, and phasing of

[4]Section 2433 of title 10 of the United States Code, commonly referred to as Nunn-McCurdy, requires DOD to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. This is commonly referred to as a Nunn-McCurdy breach. Significant breaches occur when the program acquisition unit cost or procurement unit cost increases by at least 15 percent over the current baseline estimate or at least 30 percent over the original estimate. For critical breaches, when these unit costs increase at least 25 percent over the current baseline estimate or at least 50 percent over the original, DOD is required to take additional steps, including conducting an in-depth reassessment of the program. Programs with critical breaches must be terminated unless the Secretary of Defense certifies to certain facts related to the program and takes other actions, including restructuring the program. 10 U.S.C. § 2433a.

[5]GAO, *Tactical Aircraft: Air Force Still Needs Business Case to Support F/A-22 Quantities and Increased Capabilities*, GAO-05-304 (Washington, D.C.: March 15, 2005) and GAO, *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, GAO-01-288 (Washington, D.C.: March 8, 2001).

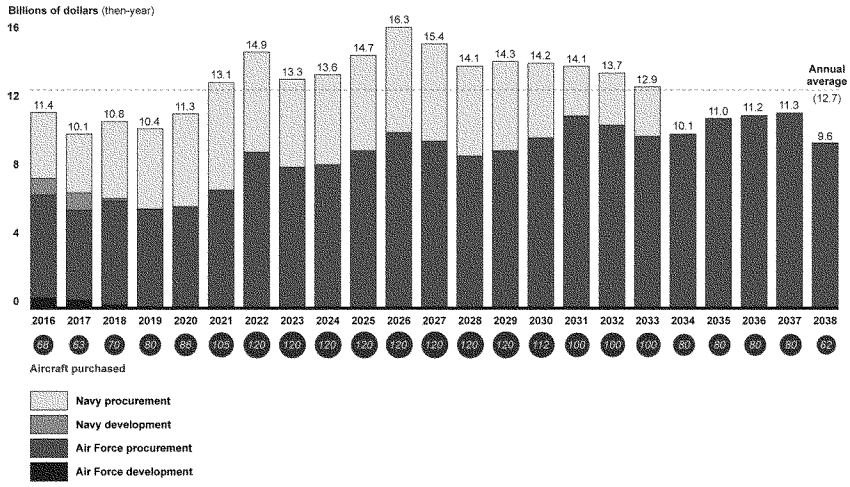
[6]GAO-05-304.

modernization capabilities changed over time, it appeared that the F-22 program was fraught with new schedule delays and further cost overruns. The comingling of modernization efforts with the existing baseline reduced transparency and Congress could not distinguish the new costs associated with modernization funding from cost growth in the original baseline. We recommended that the Air Force structure and manage F-22 modernization as a separate acquisition program with its own business case—matching requirements with resources—and acquisition program baseline. Eventually, the department separated the F-22 modernization program from the baseline program with a Milestone B review, in line with our recommendation, which increased transparency and better facilitated oversight. The department has the opportunity to apply similar lessons learned to the F-35 Block 4 program.

Program Continues to Face Affordability Challenges

Although the estimated F-35 program's total acquisition costs have decreased since 2014, the program continues to face affordability challenges. As of March 2016, DOD's estimated total acquisition cost for the F-35 program is $379 billion, or $12.1 billion less than it reported in 2014. The program will require an average of $12.7 billion per year to complete the procurement of aircraft through 2038 (see figure 2).

Figure 2: F-35 Joint Strike Fighter Budgeted Development and Procurement Costs Reported By Service as of December 2015



Source: GAO analysis of Department of Defense data. | GAO-16-489T

Note: Program office data from December 2015 was used to determine yearly funding requirements reflected in this figure, because updated funding data was not available at the time of this testimony.

The program expects to reach peak production rates for U.S. aircraft in 2022, at which point DOD expects to spend more than $14 billion a year on average for a decade. At the same time, DOD will be operating and sustaining an increasing number of fielded F-35 aircraft. DOD officials we spoke with for our September 2014 report, stated that the current F-35 sustainment strategy with cost estimates around $1 trillion is not affordable.[7] When acquisition and sustainment funds are combined,

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

annual funding requirements could easily approach $30 billion in some years.

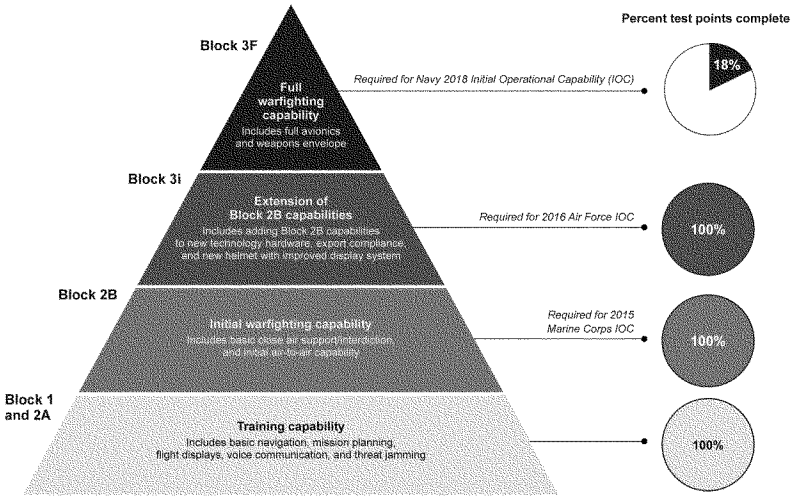
Our preliminary results indicate that affordability challenges will compound as the program competes with other large acquisition programs including the long range strike bomber, KC-46A Tanker, Ohio Class Submarine Replacement and the DDG-51 Class Destroyer. In recent years, affordability challenges, in part, have forced the Air Force to defer F-35 aircraft procurements to later years. Since 2014, the Air Force has deferred 45 aircraft between 2017 and 2021 to later years. This will likely require the military service to make unplanned investments in extending the service life of their current fighter aircraft. The cost of extending the lives of current fighter aircraft and acquiring other major weapon systems, while continuing to produce and field new F-35 aircraft, poses significant affordability risks in a period of austere defense budgets.

Developmental Flight Testing Is Nearing Completion with Challenging Mission Systems Software Testing Remaining

The F-35 program is nearing the completion of the initial developmental test program with about 20 percent of its flight sciences and mission systems testing remaining; however our ongoing work indicates that the remaining testing is likely to be challenging as it will require complex missions and stressing environments. Developmental flight testing is separated into two key areas referred to as flight sciences and mission systems. Developmental flight science testing is done to verify the aircraft's basic flying capabilities, while mission systems testing is done to verify that the software and systems that provide warfighting capabilities function properly and meet requirements. The F-35 program is nearing the completion of developmental flight testing with only 20 percent of its total planned test points remaining. Before completing the remaining high speed and high altitude flight science testing, Lockheed Martin officials noted that they will incorporate a pressure relief valve into the aircraft's fuel system to allow the aircraft to fly at altitudes and speeds that are currently restricted due to fuel pressure concerns.

As we have reported in the past, DOD is developing, testing, and fielding mission systems capabilities in software blocks (see figure 3).

Figure 3: Subsequent Development and Flight Test Status of F-35 Joint Strike Fighter Mission Systems Software Blocks as of December 2015



Source: GAO analysis of Department of Defense data. | GAO-16-489T

The full warfighting capability for the F-35 is to be attained with the completion of Block 3F, the final software block in the current development program. As indicated by the percent of test points completed, all of the blocks leading up to 3F have been completed, although they experienced delays in getting to this point. Block 3F has completed 18 percent of its test points. Our preliminary findings show that the program completed all of the mission systems software testing planned in 2015, but completion of Block 3F testing could be challenging given the complexity of the missions and the stressing environments that remain to be tested. Program officials believe that the completion of 3F developmental testing could be delayed by about 2-3 months. As of December 2015, our preliminary analysis of program data indicated that Block 3F testing could be delayed by as much as 6 months if the program

performs at the same rate it has in the past and is executed according to the current plan with no additional test point growth.[8] Delays could be exacerbated by the current mission system software stability issues and large number of remaining weapon delivery accuracy events that must take place.

Our preliminary work indicates that in 2015 program officials continued to address many of the key technical risks that we have highlighted in the past—including an engine seal and the helmet mounted display—and they identified some new risks. Problems with the engine seal were addressed through a design change that was incorporated into production, and as of September 2015, 69 of 180 engines had undergone retrofits. A new helmet—known as the Gen III helmet—that is intended to address shortfalls in night vision capability, among others, was developed and delivered to the program in 2015. Developmental testing of the new helmet is mostly complete, with final verification testing planned in 2016. The program also identified new risks with the ejection seat and cracking in the F-35C wing structure. Program officials discovered that pilots less than 136 pounds could possibly suffer neck injuries during ejection. Officials noted that although the problem was discovered during testing of the new helmet, the helmet's weight was not the root cause. The program is exploring a number of possible solutions to ensure pilot safety. In addition, program officials discovered cracking in the wing structure of the F-35C structural test aircraft during durability testing. Structural testing was halted for about 3 months, and Lockheed Martin officials we spoke with stated that a long-term fix had not been identified.

Although improvements have been made, ALIS continues to pose technical risks. Recognizing that a fully functional ALIS is critical to the program's overall success, in October 2015, the F-35 executive program officer testified before Congress that ALIS is one of the most significant technical and schedule risks to the program. ALIS is a complex system of systems that supports operations, mission planning, supply-chain management, maintenance, and other processes. In the past, we have reported that ALIS software has not been delivered on time and has not

[8] Test point growth is defined as test points that are unplanned and are required to be conducted, often as a result of issues found during testing. The program plans for test point growth, but has historically experienced higher growth than anticipated.

functioned as expected when it is delivered.[9] In addition to continuing software problems, our ongoing work indicates that the F-35 program faces other key challenges related to ALIS. For example, some equipment management data is inaccurate or incomplete and engine health information is not included in the current version of ALIS. In addition, the system may not be deployable and does not have a backup in case the hardware system was to fail.[10]

Ongoing Manufacturing and Reliability Progress Continue

Our ongoing work has shown that the F-35 airframe and engine contractors continue to report improved efficiency and supply chain performance, and program data indicates that reliability and maintainability are also improving. Since 2011, a total of 154 aircraft have been delivered to DOD and international partners, 45 of which were delivered in 2015.[11] As Lockheed Martin continues to deliver more aircraft, the number of hours needed to manufacture each aircraft continues to decline. Although prior to 2015 Lockheed Martin had only delivered one aircraft on or ahead of its contracted delivery date, the contractor has been making progress and in 2015 the contractor was able to deliver 15 of the 45 aircraft on time or early. Other manufacturing data are also trending in a positive direction. For example, scrap, rework, and repair hours, and time spent on work conducted out of sequence continue to decrease. Although it has improved, Lockheed Martin's supply chain continues to deliver parts late to production, resulting in inefficiencies and requiring workarounds.

Engine manufacturing deliveries remain steady and 218 engines have been delivered to date. The labor hours required for assembling engines has remained steady and very little additional efficiency is expected. As a result, Pratt & Whitney is looking for additional ways to save cost. Scrap,

[9]GAO, *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks*, GAO-12-437 (Washington, D.C.: June 14, 2012); GAO- F-35 *Joint Strike Fighter: Program Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities*, GAO-14-322 (Washington, D.C.: March 24, 2014). GAO- F-35 *Sustainment: Need for Affordable Strategy, Great Attention to Risks, and Improved Cost Estimates*, GAO-14-778 (Washington, D.C.: September 23, 2014).

[10]GAO is currently conducting an in-depth review of ALIS. The final report is expected to be issued in April 2016.

[11]Lockheed Martin has delivered 10 international: 2 to Australia, 1 to Italy, 3 to Great Britain, 2 to the Netherlands, and 2 to Norway.

rework, and repair costs have remained steady over the last year and engineering design changes is relatively low and continues to decrease. Pratt & Whitney is conducting production reviews of its supply chain and is managing supplier quality initiatives to address shortfalls, according to officials.

Our ongoing work shows that although the program has made progress in improving some reliability and maintainability measures, the program continues to fall short in some measures as shown in figure 4.

Figure 4: F-35 Joint Strike Fighter System-level Reliability and Maintainability Status as of August 2015

Metric	F-35A Program office assessment	F-35A Trend of values	F-35B Program office assessment	F-35B Trend of values	F-35C Program office assessment	F-35C Trend of values
Mean flight hours between failure (design controlled) – measures time between failures that are directly attributable to the design of the aircraft and are considered fixable with design changes	●	+	●	+	●	+
Mean flight hours between critical failure – measures time between failures that result in the loss of a capability to perform a mission-essential function	⊙	+	⊙	−	N/A	N/A
Mean time to repair – measures the amount of time it takes a maintainer to repaire a failed component or device	⊙	+	⊙	+	◉	+
Mean corrective maintenance time for critical failures – measures the amount of time it takes to correct critical failure events	⊙	−	⊙	+	N/A	N/A
Maintenance man hours per flight hour – measures the average amount of time spent on maintenance per flight hour	●	+	●	+	◉	−
Mean flight hours between maintenance event – measures all failures that lead to maintenance, unscheduled inspections, and servicing actions	⊙	+	●	+	⊙	+
Mean flight hours between removal – measures time between part removals from the aircraft for replacement from the supply chain	●	+	●	+	⊙	+

● At or above the plan line
◉ At or above the threshold line
⊙ Below the threshold line
\+ Positive trend
− Negative trend

Source: GAO analysis of Department of Defense data. | GAO-16-489T

While the metrics in most areas were trending in the right direction, the F-35 program office's own assessment indicated that as of August 2015 the F-35 fleet was falling short of reliability and maintainability expectations in 9 of 19 areas. The program has time to improve. As of August 2015, the F-35 fleet had only flown a cumulative total of 35,940 hours of the 200,000 cumulative flight hours required for system maturity.

Similarly, although engine reliability improved significantly in 2015, the engine was still not performing at expected levels. In 2014, Pratt and Whitney data indicated that engine reliability—measured as mean flight hours between failure (design controllable)[12]—was very poor and we reported in April 2015 that the engine would likely require additional design changes and retrofits.[13] While Pratt & Whitney has implemented a number of design changes that have resulted in significant reliability improvements, the F-35A and F-35B engines are still at about 55 percent and 63 percent, respectively, of where the program expected them to be at this point.[14] Program and contractor officials continue to identify ways to further improve engine reliability.

In conclusion, our preliminary results indicate that, although the F-35 development program is nearing completion, the program is not without risks. The remaining significant and complex 3F mission systems software developmental testing, continuing issues with ALIS, and new issues with the ejection seat and F-35C wing structures pose ongoing risks. Going forward, the program will likely continue to experience affordability and oversight challenges. DOD expects that beginning in 2022 it will need more than $14 billion a year on average for a decade to procure aircraft. It is unlikely that the program will be able to receive and sustain such a high level of funding over this extended period, especially given DOD's competing resources such as the long range strike bomber and KC-46A tanker. DOD's plan to manage Block 4 under the current acquisition program baseline presents oversight challenges because key reporting requirements and oversight mechanisms will not be initiated; therefore, the two efforts will be comingled. Without setting up the

[12] This specific metric tracks failures that are directly attributed to design and are considered fixable with design changes.

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

[14] The F-35C variant will use the same engine as the F-35A variant.

modernization as a separate program with its own baseline and regular reporting as best practices recommend, it will be difficult for Congress to hold DOD accountable for achieving F-35 Block 4 cost, schedule, and performance goals. It also makes it easier to re-categorize work planned for the baseline program as modernization. In light of our ongoing work, we are not making any recommendations to DOD at this time. We plan to issue our final report in April 2016.

Chairman Turner, Ranking Member Sanchez, and members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions you may have. We look forward to continuing to work with the Congress as we to continue to monitor and report on the progress of the F-35 program.

GAO Contact and Staff Acknowledgments

For further information on this statement, please contact Michael Sullivan at (202) 512-4841 or sullivanm@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this statement. Individuals making key contributions to this statement are Travis Masters, Peter Anderson, Jillena Roberts, and Megan Setser.

Appendix I: Changes in Reported F-35 Joint Strike Fighter Cost, Quantity, and Deliveries, 2001-2015

	October 2001 initial baseline	March 2012 latest baseline	December 2015 estimates	Change from 2001 to 2012	Change from 2012 to 2015
Expected quantities (number of aircraft)					
Developmental quantities	14	14	14	0%	0%
Procurement quantities	2,852	2,443	2,443	-14	0
Total quantities	**2,866**	**2,457**	**2,457**	**-14**	**0**
Cost estimates (then-year dollars in billions)[a]					
Development	$34.4	$55.2	$55.1	60%	-.18%
Procurement	196.6	335.7	319.1	71	-4.94
Military construction	2.0	4.8	4.8	140	0
Total program acquisition	**233.0**	**395.7**	**379**	**70**	**-4.22**
Unit cost estimates (then-year dollars in millions)a					
Program acquisition	$81	$161	$154	99	-4.35
Average procurement	69	137	130.6	99	-4.67
Estimated delivery and production dates					
Initial operational capability	2010-2012	Undetermined	2015-2018	undetermined	5-6 years
Full-rate production	2012	2019	2019	7 years	0 years

Source: GAO analysis of DOD data| GAO-16-489T

[a]Annual projected cost estimates expressed in then-year dollars reflect inflation assumptions made by a program.

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Mr. Sullivan currently serves as Director, Acquisition and Sourcing Management, at the U.S. Government Accountability Office. This group has responsibility for examining the effectiveness of DOD's acquisition and procurement practices in meeting its mission performance objectives and requirements. In addition to directing reviews of major weapon system acquisitions such as the Joint Strike Fighter, F-22, Global Hawk, and various other major weapon acquisition programs, Mr. Sullivan has developed and directs a body of work examining how the Department of Defense can apply best practices to the nation's largest and most technically advanced weapon systems acquisition system. This work has spanned a broad range of issues critical to the successful delivery of systems, including technology development; product development; transition to production; software development; program management; requirement-setting; cost estimating; and strategic portfolio management. The findings and recommendations from this work have played a major role in the department's recent acquisition policy revisions. Most recently, he has directed the GAO's annual assessment of major weapon systems programs for the Congress and GAO's work with Congress in establishing acquisition policy reforms. His team also provides the Congress with early warning on technical and management challenges facing these investments.

Mr. Sullivan has been with GAO for 29 years. He received a bachelor's degree in Political Science from Indiana University and a Masters Degree in Public Administration from the School of Public and Environmental Affairs, Indiana University.

NOT FOR PUBLICATION UNTIL RELEASED BY
THE HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES

STATEMENT OF

THE HONORABLE SEAN J. STACKLEY
ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)

AND

LT GENERAL CHRISTOPHER C. BOGDAN
PROGRAM EXECUTIVE OFFICER, F-35

BEFORE THE

TACTICAL AIR AND LAND FORCES SUBCOMMITTEE

OF THE

HOUSE ARMED SERVICES COMMITTEE

ON

F-35 PROGRAM REVIEW

MARCH 23, 2016

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THE HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON TACTICAL AIR AND LAND FORCES

I Introduction

Chairman Turner, Ranking Member Sanchez and distinguished Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the F-35 Lightning II.

The F-35 Lightning II is the Department of Defense`s largest acquisition program, matched by its importance to our Nation's security. The F-35 will form the backbone of United States (U.S.) air combat superiority for decades to come, replacing or complementing the legacy tactical fighter fleets of the Air Force, Navy, and Marine Corps with a dominant, multirole, fifth-generation aircraft, capable of projecting U.S. power and deterring potential adversaries. For our International Partners and Foreign Military Sales (FMS) customers, who are participating in the program, the F-35 will become a linchpin for future coalition operations and will help to close a crucial capability gap that will enhance the strength of our security alliances. Accordingly, delivering this transformational capability to front-line forces as soon as possible remains a top priority.

II Accomplishments

The F-35 program is executing well across the entire spectrum of acquisition, to include development and design, flight test, production, fielding and base stand-up, sustainment of fielded aircraft, and building a global sustainment enterprise. In February 2016, the F-35 reached 50,000 flight hours, including approximately 26,000 for the F-35A, 18,000 for the F-35B and almost 6,000 hours for the F-35C. We are pleased to report many accomplishments by the F-35 team during the past year, since we last addressed this committee. Of note, we have seen declaration of Initial Operating Capability (IOC) for the F-35B by the U.S. Marine Corps

(USMC) last summer, providing our Combatant Commanders with a 5th generation strike fighter capable of operations from expeditionary airstrips or sea-based carriers, the delivery of first seven F-35A aircraft to Hill Air Force Base (AFB) in preparation for the U.S. Air Force's (USAF) declaration of IOC later this year, and delivery of Block 3F software to flight test in support of Navy F-35C IOC in 2018. The F-35 team remains committed to sustaining and expanding these fielded capabilities.

Accomplishments in flight testing in recent months include completion of F-35B Block 2B Operational Test aboard the USS WASP and successful completion of the second round of sea trials with the F-35C aboard the USS DWIGHT D. EISENHOWER (CVN 69). We have now completed a total of five sea trials with the F-35B and F-35C. The developmental test program is progressing steadily with a focus on wrapping up testing of the Block 3i software this spring. This last iteration of Block 3i software will give the F-35A the combat capability required for USAF IOC. The team also completed F-35A high angle of attack and performance testing and continued flight envelope expansion for all aircraft variants. High angle of attack flight testing will complete this spring for F-35C and fall for F-35B. For the F-35A, we have performed a series of successful AIM-9X air-to-air missile launches and airborne test firings of its GAU-22 internally-mounted 25-millimeter cannon. Air-to-ground accuracy testing of the GAU-22 is now underway and expected to complete in summer 2016. Additionally, we successfully conducted the first operational fleet weapons drops for the USMC and USAF, and completed all Block 3i weapons delivery accuracy events.

Our overall assessment is that the program is making solid progress across the board and shows improvement each day while continuing to manage emerging issues and mitigate

programmatic risks. We are confident the F-35 team can overcome these challenges and deliver on our commitments. In this testimony, we present a detailed update on the progress that has been made over the past year, providing a balanced assessment of the current status of the program, highlighting both the accomplishments and the setbacks, as well as articulating where we believe risks remain.

III Development

Steady progress continues toward completion of the F-35 System Development and Demonstration (SDD) phase in fall of 2017. Last year, we testified before this subcommittee and said the program was nearing completion of Block 2 software development and was closing in on completing all flight testing necessary to field our initial warfighting capability, also known as Block 2B. We are now in the same position for our next increment, Block 3i. We should complete all 3i testing this spring and convert all the fielded aircraft with earlier versions of Block 3i to the latest version starting this summer.

The final block of F-35 development program capability, known as Block 3F, provides a fully capable F-35 aircraft and marks the end of the SDD program. Block 3F Mission Systems software is currently undergoing Developmental Test (DT), and many of the deficiencies discovered in Blocks 2B and 3i software will be corrected in Block 3F. However, since both 2B and 3i testing took longer than originally planned, the program estimates there is a risk to completing Block 3F on time – it is now projected to be about four months late and will be delivered in late fall of 2017. This delay is an improvement over our projection from one year ago, and it is not expected to impact U.S. Navy (USN) IOC for the F-35C in 2018 or the other U.S. and coalition partner's capabilities. There are still some stability issues with both the 3i and

3F software that we are currently working through.

Looking beyond the SDD program, the Follow-on Development or Modernization effort, also known as Follow-on Modernization, will be the means to deliver improved capabilities to the weapon system to ensure its relevance against advanced and emerging threats. The program anticipates the Joint Requirements Oversight Council will approve the Follow-on Modernization / Block 4 Capabilities Development Document this summer. Work continues with the U.S. services and International Partners to ensure the Modernization Program will be "right-sized" for affordability and sustainability. In addition, the Department will ensure that separate cost, schedule, performance and earned-value data will be available to provide detailed insight into program execution. To this end, we awarded the initial Planning and Systems Engineering contract in June 2015, and execution remains on track to conduct a comprehensive System Requirements Review this fall. Two additional contract actions are planned. The first will allow for the decomposition of system level requirements through a rigorous systems engineering effort, and the second will continue that work through Preliminary Design Review planned in spring 2018 and will support a Defense Acquisition Executive decision point to move forward with the Block 4 development program in mid-2018.

F-35A Dual Capable Aircraft (DCA) continues to be aligned with and included in the Block 4 Follow-on Modernization effort. This past summer a series of test flights were conducted to assess the vibration, acoustic, and thermal environments of the F-35A weapons bay with the B61-12 weapon. Nuclear Certification planning efforts have been initiated as part of the Block 4 contracting activity in anticipation of beginning B61-12 integration on the F-35A in 2018.

Commensurately, we have begun to "right size" the Development Test fleet of aircraft in preparation for Follow-on Modernization. As part of this process, the services and program office are working together to determine the correct mix of capacity and capabilities to allow us to operate a flight test fleet that is representative of the warfighter's fleet. This will provide the needed capability at a lower cost, allowing the services to put more resources toward capability enhancements.

Although solid progress is being made -- we are now 80 percent complete with all of SDD -- F-35 development is not without technical discoveries and deficiencies, which are common for a system that is still in development.

On August 27, 2015, the U.S. Services and International Partners restricted F-35 pilots weighing less than 136 pounds from operating the F-35 after safe escape tests indicated the potential for increased risk of injury to this pilot population. Currently, no F-35 pilots are impacted by this restriction. The restriction is focused on this population, as lighter pilots are assessed to have lower neck strength and are therefore more prone to injury as a result of neck loading observed during testing.

There are three technical solutions that when in place will reduce the risk of neck injury to all pilots and will eliminate the restriction to any pilot population. Two of the solutions pertaining to the ejection seat, have been verified through testing, and will be ready to incorporate into production aircraft and retrofit to delivered aircraft by the end of 2016. These solutions are a head support panel between the parachute risers that prevents neck over-extension and a pilot-selectable weight switch, which adds a very slight delay in the opening of the main parachute, thus reducing opening shock loads. The third solution applies to the helmet and

involves reducing its weight. This lighter helmet is expected to field by the end of 2017, but the program intends to accelerate this timeline.

Another deficiency the Program is solving involves the Ground Data Security Assembly Receptacle (GDR), which is part of the Off-board Mission Planning system and is used to encrypt and decrypt the mission and maintenance data carried on the Portable Memory Device to and from the airplane by the pilot. In 2015, the program faced significant challenges with the pilot debrief timeline, because the GDR required approximately 1.5 hours to download a 1.5 hour flight -- far too long. We have now developed an improved GDR that will decrease the timeline to download mission data by a factor of 8, meaning a 1.5 hour flight will be downloaded in about 15 minutes. The new program successfully completed a CDR for the redesign in September 2015. Test units are now being built for qualification and integration testing. We will deliver the new GDR in summer 2016 with the first ten units delivered to Hill AFB in Utah in support of USAF IOC. Further GDR deliveries to back-fill other units will begin in fall 2016.

As previously reported, in September 2013, during F-35B full-scale durability testing, we experienced a significant bulkhead crack at 9,056 equivalent flight hours (EFH). The root causes have been established and redesign effort for the bulkheads is well underway. A laser shock peening process is being developed to address specific locations requiring additional material improvement to meet full life. The qualification of this process is progressing satisfactorily and is expected to be available for both production and retrofit of fielded aircraft by the end of 2017. The F-35B durability test restarted in February 2015 and progressed to 11,915 EFH by August 2015. At that time, cracking had developed at a previously identified short life location and

required repair. That repair work is nearing completion now. The F-35B durability test is expected to complete its second life of durability testing during summer 2016.

In October 2015, the F-35C test article experienced cracking in the wing front spars at 13,731 EFH. The root cause has been established and redesign efforts for the spars has begun. Standard redesign techniques, such as local material thickening and cold-working are expected to be used to achieve full intended life. This finding does not affect the F-35A or B variant spars because the F-35C spars are designed differently to account for the aircraft's larger wings. In addition, at 13,931 EFH additional cracking was found in the left side of a main fuselage bulkhead. Once an investigation got underway, a similar, though smaller crack was also found on the right side. This new cracking is under investigation and analysis in on-going. There is no near-term airworthiness concern for fielded or test aircraft due to either case of cracking because these aircraft can fly for approximately 10 years or more before these structural issues require a fix. The F-35C is expected to complete its second life of durability testing in late 2016.

The F-35 Program Office is making progress in resolving two technical issues involving the fuel system: fuel tank overpressure at elevated g-loading and fuel tank inerting for lightning protection. The technical solution for the fuel overpressure has been designed, tested and is in the process of being fielded. This will allow all F-35 variants to reach their full structural capability. Additionally, the F-35 team recently qualified the improved fuel tank inerting system, and the operational restriction to avoid lightning in-flight was lifted for the F-35A in late 2015. The fuel systems differences among the three aircraft variants require additional measures to qualify the new inerting system for F-35B and F-35C. The F-35B requires the next software release, which is expected this spring, and the F-35C will be corrected with a hardware change

beginning summer 2016. Implementation of both overpressure and lightning corrective actions will provide full g-envelope and full lightning protection for all three variants prior to SDD closure and is expected to meet all IOC requirements.

IV Cost, Schedule, and Performance Metrics and Production Status:

Affordability remains a top priority. We continue to make it clear to the program management team and the F-35 industrial base that the development phase must complete within the time and funding allocated, continue to drive cost out of aircraft production, and reduce life-cycle costs. To that end, the program has engaged in a multi-pronged approach to reduce costs across production, operations, and support. The government/industry team is reducing aircraft production costs through "blueprint for affordability" initiatives and reducing F135 engine costs via ongoing engine "war on cost" strategies. These efforts include up-front contractor investment on cost reduction initiatives, mutually agreed upon by the government and contractor team. This arrangement motivates the contractors to accrue savings as quickly as possible in order to recoup their investment, and it benefits the government by realizing cost savings at the time of contract award. The goal is to reduce the flyaway cost of the USAF F-35A to between $80 and $85 million dollars by 2019, which is anticipated to commensurately decrease the cost to the Marine Corps F-35B and Navy F-35C variants. The program has also set a goal of decreasing overall operating and support life-cycle cost by 30 percent.

The price of F-35s continues to decline steadily Lot after Lot. For example, the price (including airframe, engine, and contractor fee) of a Low Rate Initial Production (LRIP) Lot 8 aircraft was approximately 3.6 percent less than an LRIP Lot 7 aircraft, and an LRIP Lot 7 aircraft was 4.2 percent lower than an LRIP Lot 6 aircraft. LRIP Lots 9 and 10 contract

negotiations are nearing completion, and LRIP 9 contract award is anticipated no later than May of this year. LRIP 10 will award when the Secretary of the Air Force certifies that F-35As delivered during FY18 will be full Block 3F capable.

The program met its 2015 production goal of delivering 45 aircraft and is on track to meet the goal of delivering 53 aircraft in calendar year 2016, with 48 of those aircraft produced in Fort Worth, Texas and another five produced in the Italian Final Assembly and Check Out facility at Cameri, Italy. As of March, 2016, a total of 171 aircraft have been delivered to our test, operational and training sites. The delivery schedule for aircraft also continues to improve. LRIP Lot 6 aircraft averaged 68 manufacturing days behind contracted delivery dates, and LRIP Lot 7 aircraft have improved to an average of 30 manufacturing days behind contract dates. We expect that gap to continue to reduce as we approach the first LRIP Lot 8 deliveries in the March-April 2016 timeframe. We continue to work with both Lockheed Martin and Pratt & Whitney to prepare the program for the production ramp increase over the next few years.

The F-35 enterprise is exploring the possibility of entering into a Block Buy Contract (BBC) for LRIP Lots 12-14 (FY18-20). A BBC would enable significant program cost avoidance by allowing the contractors to utilize Economic Order Quantity purchases, increase cost reduction initiatives enabling suppliers to maximize production economies of scale through batch orders. To substantiate the potential savings of a BBC concept, the F-35 Program Office contracted with RAND Project Air Force (a Federally Funded Research and Development Center) to provide an independent assessment, which is expected in March 2016. Due to budget timing and uncertainty, the Department of Defense intends to begin the Block Buy in Lot 13 rather than Lot 12. However, we are considering an option to allow the F-35 Partners and FMS

customers to begin a BBC in Lot 12, followed by U.S. participation in LRIP Lots 13 and 14. This option will still result in significant cost savings.

Overall, we believe the risk of entering into a BBC in LRIP Lot 12 (FY18) to the F-35 International Partners and FMS customers is low. By the time it is necessary to commit to a Block Buy many aspects of the program will be stable including completion of durability testing for all three variants, near completion of all hardware qualification, completion of the majority of 3F software and weapons delivery testing, and stable production processes and ramp.

Earlier this year, the program reached agreement with Pratt & Whitney on the next two lots of F135 propulsion systems. The F-35A/F-35C propulsion system reduced 3.4 percent from the previously negotiated LRIP Lot 8 price to the negotiated LRIP Lot 10 price. The F-35B propulsion system (including lift systems) reduced 6.4 percent from the previously negotiated LRIP Lot 8 price to the LRIP Lot 10 price. For calendar year 2015, all F135 production deliveries met contract requirements. However, recurring manufacturing quality issues have created issues with delivered engines. Recent quality escapes on turbine blades and electronic control systems resulted in maintenance activity to remove suspect hardware from the operational fleet prior to delivery, but Pratt & Whitney still met their timeline for the Lockheed production line. Pratt & Whitney has taken action to improve quality surveillance within their manufacturing processes and is executing a rigorous quality program with their supplier. Additionally, the program office manufacturing quality experts have engaged both Lockheed and Pratt & Whitney to ensure quality improvement processes are in place to meet production ramp requirements. We are also continuing to conduct stringent Production Readiness Reviews with hundreds of suppliers to ensure the production ramp will be achievable and smooth.

V Sustainment

As of the beginning of March 2016, there are 151 operational (fleet and operational test) and 20 DT F-35s in the inventory operating at eight sites. Together, the entire fleet has logged more than 50,000 flight hours since our first flight in 2006. F-35A deliveries to Eglin AFB in Florida are complete, and the program continues deliveries to Luke AFB, which is the main training base for the USAF and Partners, including Australia's and Norway's first two F-35As. During 2015, the program began delivering F-35As to Hill AFB in support of the USAF's first operational F-35 wing. The program has also started F-35B pilot training at Marine Corps Air Station Beaufort in South Carolina. In the next four years, we will add another seventeen operating bases to the F-35 enterprise across all three regions: North America, the Pacific and Europe.

As additional aircraft come off the production line, the program is working to ensure sites across the globe are ready to accept the F-35. Since January 2015, the program has sent out fifty-one site activation teams supporting detailed planning at twenty-five different locations around the globe. These sites include stand up of F-35 capability for six of the Partner Nations, all three of the foreign military sales customers, as well as additional sites for USAF, USMC and USN. Planning commenced in 2015 for base standups in Norway, the Netherlands, Turkey, United Kingdom, Israel, Japan and Korea. The site activation highlight for 2015 was the successful preparation and arrival of the F-35 at Hill AFB, forming the foundation for a projected 2016 USAF IOC.

Aircraft availability rates continue to be a focus area for the program and various program initiatives are now showing a positive trend in this area. A disciplined Reliability &

Maintainability program, improved maintenance procedures and manuals, continued improvement in Autonomic Logistics Information System (ALIS), better forecasting of spares requirements, improved repair turn around times from supplier, and incorporation of aircraft design improvements have resulted in excellent gains in mission capability rates and aircraft availability rates. Today, across the fleet, we are seeing 55 to 60 percent availability rates with units performing at 63 percent mission capability.

Last year the program provided information regarding its efforts toward the establishment of the Global Sustainment posture across Europe, Asia-Pacific, and North America. In 2015, the program made progress in standing up regional Maintenance, Repair, Overhaul, and Upgrade (MRO&U) capabilities for airframes and engines in the European and Pacific regions. These initial MRO&U capabilities will support overseas F-35 airframe and engine heavy-level maintenance for all customers, including the U.S. Services, and will continue to provide the best-value to the enterprise. Italy will provide initial airframe MRO&U capability in the European region in 2018. Turkey will provide engine heavy maintenance in the European region in 2018 with The Netherlands and Norway providing additional capability a few years later. F-35 airframe MRO&U capability in the Pacific region will be provided first by Australia in 2018 and then by and Japan. Australia will also be providing initial engine heavy maintenance, followed by Japan about five years later.

In 2015 the program also kicked-off initial planning efforts for expansion of component repair into the European and Pacific regions. Efforts began to identify 'best value' repair sources in each region for approximately 18 key depot-level repairable items. International Partners and their respective industries will be requested to propose component groupings which leverage

their strongest industrial competencies to deliver optimum repair capability at best cost to the global sustainment solution.

The program will continue this process in 2016 and 2017 with the Department of Defense assigning to our Partners and FMS customers repair capabilities such as wheels and brakes, electrical and hydraulic systems, maintenance of support equipment, and warehousing for the global supply chain. These same capabilities either currently exist or are being developed at the U.S. Services' CONUS depots in accordance with current U.S. law.

VI Risk & Challenges

Although improving, the Program is not without risks and challenges. Currently, our most significant technical concern is the development and integration of mission systems software.

The aircraft has approximately eight million lines of code, with another 16 million lines of code on the off-board systems. This is an order of magnitude greater than any other aircraft in the world and represents a complex, sometimes tricky, and often frustrating element in the program. Several years ago the program instilled discipline in the way software is developed, lab tested, flight tested, measured and controlled by the program office. This has produced much better and more predictable results over the past two years. However, both the fielded Block 3i software and the 3F software in flight test are not as stable as they need to be to support our warfighters. We are experiencing instability in the sensors -- particularly the radar – leading it to shut off and "reboot" in flight. Currently, this problem occurs about once every four hours of flying, and we expect to improve this to once every eight to ten hours of flying. We believe we have identified the root cause of these stability problems to be the timing of software messages

from the sensors to the main F-35 fusion computer, and we have tested solutions in the lab environment. We will be flight testing these fixes in the March-April timeframe. If the fixes are successful, we will add them to a new version of 3i software and field that in time for USAF IOC. We will also incorporate the fixes in the 3F software we are developing and flight testing. To ensure we completely understand these issues the program office has launched an in-depth look at this issue in the form of a software stability "Red Team." This team, made up of a group of experts from the Navy and Air Force, will conduct its study beginning in March and report back to the Program Office.

The final software version, Block 3F, has the most software risk facing the program for a number of reasons. First, 3F testing started later than planned because we had to spend more time fixing Block 2B and 3i software. Second, 3F has the same stability issues as Block 3i as described above. Third, the Block 3F software must take information from other sources, such as other non-F-35 aircraft, satellites, and ground stations and fuse this information with F-35 information, giving the pilot a complete and accurate picture of the battlespace. Additionally, the remaining flight loads, buffet, and weapons delivery accuracy flight testing needs to be accomplished. We estimate there is about four months of risk to this schedule, placing full 3F capability to the warfighters in the late fall of 2017.

The next version of ALIS, version 2.0.2, which includes new capabilities to support USAF IOC, also has some schedule risk. This version of ALIS combines the management of F135 engine maintenance within ALIS and tracks all the life-limited parts on each and every F-35 aircraft. The development of these capabilities is proving to be difficult because they

require integration with Lockheed Martin's and Pratt & Whitney's Enterprise Resource Planning systems, or the "back end" of ALIS.

We are also working closely with the Joint Operational Test Team to finalize its F-35 FY16 Cyber Test Plan. This testing is scheduled to begin in April 2016 and will perform end-to-end Vulnerability and Adversarial Testing on ALIS and the F-35 Air Vehicle. Hundreds of penetration and cyber security test have already been accomplished on the system, enabling us to connect the F-35 systems to the DoD Global Information Grid (DoD and Services networks).

We have also instituted an ALIS initiative aimed at fixing prior deficiencies and rapidly fielding them to the warfighter. As we continue to develop new capabilities, the Program has set up a parallel effort -- known as "Service Packs" -- to fix many of the deficiencies the maintainers in the field have brought to our attention. These deficiencies usually result in workarounds and add workload to our maintainers' already busy jobs. Service Packs are developed, tested and fielded on a much quicker timeline than our larger increments of ALIS. We fielded the first Service Pack in January, and feedback from the field has been encouraging. We will continue to rapidly field Service Packs to improve the usability of ALIS for our maintainers, the next of which will be fielded this spring.

One final comment concerning risks and issues on the program deals with the recent report issued by the Director of Operational Test and Evaluation (DOT&E). This report is factually accurate and was written entirely based on information that came from the F-35 Program Office – there is no information in the report that was not already known by the Program Office, the U.S. Services, and our Partners. While not highlighted by the DOT&E report, for each issue cited the F-35 Program has a dedicated effort underway to resolve or

otherwise mitigate the issue. We are prepared to provide further details on any of these issues and our actions to address them.

VII Delivering Combat Capability

Following the declaration of IOC in June of 2015, the USMC has continued to train and exercise its combat capable F-35B aircraft. At the beginning of December 2015, Marine Fighter Attack Squadron 121 deployed eight F-35Bs to Twentynine Palms in California for Exercise Steel Knight. The team executed 32 sorties in support of the combined arms live-fire exercise, taking an important step toward integrating the F-35B into the Marine Corps Ground Combat Element and demonstrating their capability to execute close air support and strike missions from an austere operating site.

The USAF also showed their increasing capabilities with the F-35A, executing a deployment of six Operational Test aircraft from the 31st Test and Evaluation Squadron at Edwards AFB, California to Mountain Home AFB, Idaho. The squadron executed 54 sorties over twelve days of flying as part of a joint training exercise with U.S. Navy Seals, F-15Es, A-10s, and Apache and Blackhawk helicopters, delivering 10 GBU-31 and 20 GBU-12 precision guided inert munitions. This is the first time the F-35A has deployed to and operated from a base with no organic F-35 support or presence.

The F-35 Lightning II Joint Program Office's top priority is now meeting USAF IOC at Hill AFB, Utah with Block 3i capabilities between August and December 2016. Hill's active-duty 388th Fighter Wing and Reserve 419th Fighter Wing will be the first USAF combat-coded units to fly and maintain the Lightning II. In support of meeting the USAF's IOC date, Hill AFB

has already received its initial F-35As and is now training with them, including the first weapons employment from an operational F-35A.

The USN has set August 2018 as its IOC objective date with the F-35C. In support of meeting the USN IOC, sea trials will continue this year and culminate in the third and final DT period afloat. This test is expected to last approximately 21 days and will test and certify the remaining embarked launch and recovery environmental envelopes, including those with various ordnance and fuel load combinations expected in fleet use. The test will also complete all initial shipboard flight deck and hangar deck supportability procedures and processes, paving the way Operational Test and Fleet use.

VIII International Partner and FMS Participants

International participation on the program with eight Partners and three FMS customers remains solid. The program has now delivered the first Royal Norwegian Air Force F-35 to Luke AFB expanding the International Partner pilot training currently ongoing there. The first Italian Air Force F-35A was also delivered from the production facility in Cameri, Italy, and then subsequently completed the first F-35 trans-Atlantic flight in February, landing at Naval Air Station, Patuxent River in Maryland. After completion of some program testing, this aircraft will also join the pilot training effort at Luke AFB. F-35A has also conducted aerial refueling flight testing with a Royal Australian Air Force KC-30A tanker and completed aerial refueling flight testing and certification with an Italian Air Force KC-767 tanker.

In 2015, as part of initial site planning, we commenced standup of maintenance capabilities in Norway, Netherlands, Turkey, United Kingdom, Israel, Japan and Korea. Also, the Japanese Final Assembly and Check Out assembly facility is now complete with both

Electronic Mate Assembly Stations tools installed and accepted. Construction and installation activities remain on schedule, and the major components are now being shipped. The first Japanese F-35A is scheduled to rollout of the facility in November 2016.

We anticipate that Denmark will make its final decision on its fighter replacement late spring 2016. Additionally, although Canada has indicated that it will conduct a new fighter replacement competition, it still remains a full partner in the F-35 program. We continue to provide the Canadian government with the most up-to-date and accurate information to aid them in their future selection process.

IX Conclusion

In summary, the F-35 program is making solid progress across all areas including development, flight test, production, maintenance, and stand-up of the global sustainment enterprise. As with any big and complex program, new discoveries, challenges and obstacles will occur. The F-35 is still in development, and it is the time when technical challenges are expected. However, we believe the combined government / industry team has the ability to resolve current issues and future discoveries. The team's commitment to overcoming these challenges is unwavering and we will maximize the F-35's full capability for the Warfighter.

We will continue executing with integrity, discipline, transparency and accountability, holding ourselves accountable for the outcomes on this program. The team recognizes the responsibility the program has been given to provide the pillar of the U.S. and allied fighter capability with the F-35 for generations to come, and that your sons and daughters, grandsons and granddaughters may someday take this aircraft into harm's way to defend our freedom and way of life. It is a responsibility we take very seriously.

Thank you again for this opportunity to discuss the F-35 program. We look forward to answering any questions you have.

The Honorable Sean J. Stackley
Assistant Secretary of the Navy
(Research, Development and Acquisition)
7/28/2008 - Present

Sean J. Stackley assumed the duties of assistant secretary of the Navy (ASN) (Research, Development & Acquisition (RDA)) following his confirmation by the Senate in July 2008. As the Navy's acquisition executive, Mr. Stackley is responsible for the research, development and acquisition of Navy and Marine Corps platforms and warfare systems which includes oversight of more than 100,000 people and an annual budget in excess of $50 billion.

Prior to his appointment to ASN (RDA), Mr. Stackley served as a professional staff member of the Senate Armed Services Committee. During his tenure with the Committee, he was responsible for overseeing Navy and Marine Corps programs, U.S. Transportation Command matters and related policy for the Seapower Subcommittee. He also advised on Navy and Marine Corps operations & maintenance, science & technology and acquisition policy.

Mr. Stackley began his career as a Navy surface warfare officer, serving in engineering and combat systems assignments aboard USS John Young (DD 973). Upon completing his warfare qualifications, he was designated as an engineering duty officer and served in a series of industrial, fleet, program office and headquarters assignments in ship design and construction, maintenance, logistics and acquisition policy.

From 2001 to 2005, Mr. Stackley served as the Navy's LPD 17 program manager, with responsibility for all aspects of procurement for this major ship program. Having served earlier in his career as production officer for the USS Arleigh Burke (DDG 51) and project Naval architect overseeing structural design for the Canadian Patrol Frigate, HMCS Halifax (FFH 330), he had the unique experience of having performed a principal role in the design, construction, test and delivery of three first-of-class warships.

Mr. Stackley was commissioned and graduated with distinction from the United States Naval Academy in 1979, with a Bachelor of Science in Mechanical Engineering. He holds the degrees of Ocean Engineer and Master of Science, Mechanical Engineering from the Massachusetts Institute of Technology. Mr. Stackley earned certification as professional engineer, Commonwealth of Virginia, in 1994.

Updated: 14 January 2011

Lieutenant General Christopher C. Bogdan

Lt. Gen. Christopher C. Bogdan is the Program Executive Officer for the F-35 Lightning II Joint Program Office in Arlington, Va. The F-35 Lightning II Joint Program Office is the Department of Defense's agency responsible for developing and acquiring the F-35A/B/C, the next-generation strike aircraft weapon system for the Navy, Air Force, Marines, and many allied nations.

General Bogdan was commissioned in 1983 from the U.S. Air Force Academy. He has served as an operational pilot, test pilot, staff officer, executive officer, acquisition program manager, and program director. He is a command pilot and experimental test pilot with more than 3,200 flying hours in more than 35 aircraft types, including the KC-135, FB-111A, B-2 and F-16. He has commanded at the squadron and group levels, and served as the executive officer to the Commander, Electronic Systems Center, and to the Commander, Air Force Materiel Command.

General Bogdan also served as the Program Executive Officer for the KC-46 Tanker Modernization Directorate, Wright-Patterson AFB, Ohio.

Prior to his current assignment, General Bogdan was Deputy Program Executive Officer for the F-35 Lightning II Joint Program Office in Arlington, Va.

EDUCATION

1983 Distinguished graduate, Bachelor of Science degree in aeronautical engineering, U.S. Air Force Academy, Colorado Springs, Colo.
1989 Distinguished graduate, Squadron Officer School, Maxwell AFB, Ala.
1990 Distinguished graduate, USAF Test Pilot School, Edwards AFB, Calif.
1994 Master of Science degree in engineering management, with distinction, California State University, Northridge
1995 Distinguished graduate, Air Command and Staff College, Maxwell AFB, Ala.
1998 Air War College, by correspondence
2000 Distinguished graduate, Master of Science degree in national resource strategy, Industrial College of the Armed Forces, Fort Lesley J. McNair,Washington, D.C.
2005 Advanced Program Managers Course, Defense Systems Management College, Fort Belvoir, Va.
2006 U.S. Air Force Senior Leadership Course, Center for Creative Leadership, Greensboro, N.C.
2007 National Security Management Course, Maxwell School of Citizenship, Syracuse University, N.Y.
2013 Cyber Operations Executive Course, Air University, Maxwell AFB, Ala.

ASSIGNMENTS

1. July 1983 - June 1984, student, undergraduate pilot training, Reese AFB, Texas
2. June 1984 - November 1984, pilot, KC-135 crew training, Castle AFB, Calif.
3. November 1984 - March 1987, pilot, KC-135A and T-37A, 509th Air Refueling Squadron, Pease AFB, N.H.
4. March 1987 - April 1988, pilot, FB-111A Crew Training, Plattsburgh AFB, NY
5. April 1988 - June 1990, FB-111A instructor pilot, 393rd Bomb Squadron, Pease AFB, N.H.
6. June1990 - June 1991, student, Class 90B, U.S. Air Force Test Pilot School, Edwards AFB, Calif.
7. June 1991 - December 1991, experimental test pilot, 6512th Test Operations Squadron, Edwards AFB, Calif.
8. December 1991 - June 1995, B-2 experimental test pilot, B-2 Chief of Training, B-2 Test Program Manager and Assistant Deputy for Operations, 420th Flight Test Squadron, Edwards AFB, Calif.
9. June 1995 - June 1996, student, Air Command and Staff College, Maxwell AFB, Ala.
10. June 1996 - May1997, Program Manager, Theater Missile Defense Systems, Special Projects Program Office, Electronic Systems Center, Hanscom AFB, Mass.
11. May 1997 - June 1999, executive officer to the Commander, Electronic Systems Center, Hanscom AFB, Mass.
12. June 1999 - June 2000, student, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.
13. June 2000 - May 2001, Deputy Commander, 412th Operations Group, Edwards AFB, Calif.
14. May 2001 - July 2002, Commander, 645th Materiel Squadron, Wright-Patterson AFB, Ohio
15. July 2002 - September 2003, executive officer to the Commander, Air Force Materiel Command, Wright- Patterson AFB, Ohio
16. September 2003 - June 2005, Commander, Special Operations Forces Systems Group, Wright-Patterson AFB, Ohio

17. June 2005 - May 2006, Deputy Director, Directorate of Global Power, Office of the Assistant Secretary of the Air Force for Acquisition, Headquarters U.S. Air Force, Washington, D.C.
18. May 2006 - May 2008, Senior Military Assistant to the Deputy Under Secretary of Defense for Acquisition and Technology, Office of the Secretary of Defense, Washington, D.C.
19. May 2008 - May 2009, Senior Military Assistant to the Under Secretary of Defense for Acquisition, Technology and Logistics, Office of the Secretary of Defense, Washington, D.C.
20. June 2009 – July 2012, KC-46 Program Executive Officer and Program Director, KC-46 Tanker Modernization Directorate, Aeronautical Systems Center, Wright-Patterson AFB, Ohio
21. July 2012 – December 2012, Deputy Program Executive Officer for the F-35 Lightning II Joint Program Office, Arlington, Va.
22. December 2012 – present, Program Executive Officer for the F-35 Lightning II Joint Program Office, Arlington, Va.

SUMMARY OF JOINT ASSIGNMENTS
May 2006 - May 2009, Senior Military Assistant to Deputy Under Secretary of Defense for Acquisition and Technology, and Senior Military Assistant to the Under Secretary of Defense for Acquisition, Technology and Logistics, Office of the Secretary of Defense, Washington, D.C.

FLIGHT INFORMATION
Rating: Command pilot, parachutist
Flight hours: More than 3,200
Aircraft flown: KC-135A/E, FB-111A, F-16A/B, B-2A, T-37A, T-38, B707, RC-135, T-39A and 25 other aircraft types

MAJOR AWARDS AND DECORATIONS
Defense Superior Service Medal
Legion of Merit
Meritorious Service Medal with six oak leaf clusters
Air Force Commendation Medal
Air Force Aerial Achievement Medal
Air Force Achievement Medal

OTHER ACHIEVEMENTS
Outstanding Cadet in Aeronautical Engineering, U.S. Air Force Academy
British Marshall Scholarship National Finalist
Rhodes Scholar Candidate, U.S. Air Force Academy
Distinguished graduate, KC-135 Training
Outstanding graduate, FB-111A Flight Instructor Course
Company Grade Officer of the Year, Air Force Flight Test Center

PROFESSIONAL CERTIFICATIONS
Program Management, Level III, Acquisition Professional Development Program
Test and Evaluation, Level III, APDP

EFFECTIVE DATES OF PROMOTION
Second Lieutenant June 1, 1983
First Lieutenant June 1, 1985
Captain June 1, 1987
Major March 1, 1995
Lieutenant Colonel Sept. 1, 1998
Colonel Aug. 1, 2002
Brigadier General Dec. 9, 2008
Major General Nov. 18, 2011
Lieutenant General Dec. 6, 2012

(Current as of December 2013)

DOCUMENTS SUBMITTED FOR THE RECORD

MARCH 23, 2016

F-35 LIGHTNING II JOINT PROGRAM OFFICE
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Lieutenant General Christopher C. Bogdan
Program Executive Officer
200 12th St. South, Suite 600
Arlington, VA 22202

The Honorable Michael Turner
Chairman, Tactical Air and Land Forces Subcommittee
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman,

Thank you for your continued support of the F-35 Program. Please find attached updated information to the original responses we provided on 20 Apr 15 and updated on 9 Sep 15. If you desire further discussion, we are happy to provide additional information or set up a time for an in-person meeting.

Once again, thank you for your interests, oversight, and continued support of the F-35 Program.

Sincerely,

CHRISTOPHER C. BOGDAN
Lieutenant General, USAF
Program Executive Officer

Attach: Updated responses to discussions at Eglin AFB, FL

DEPARTMENT OF DEFENSE
INFORMATION PAPER

SERVICE/AGENCY: U. S. NAVY
SUBJECT: HASC PSM requesting update to questions from Congressman Turner following 27 Mar 15 CODEL visit and pilot discussion at Eglin AFB, FL
DATE: 10 March 2016

Notes from F-35 Pilot Discussion at Eglin AFB, March 27, 2015

1. **Comment:** Pilots were uncomfortable with L-M's scale of control over the maintenance program due to ALIS and other policies in place that limit their ability to work on the aircraft. In particular, the inability to maintain an on-hand parts inventory and a prohibition on making parts on-site were noted.

   Original Response: The JPO does not disagree with the pilots' concerns. However, at this early stage of the program (only 66% of Development and Flight Test completed) we are still developing the capabilities of ALIS and learning about how best to maintain the weapon system. The services and JPO intend to transfer to organic personnel many things that LM now does today – such as ALIS administration and disposition of non-standard engineering. Unfortunately, because the design of ALIS and the weapon system are not fully mature and stable, we use LM to a greater extent due to their knowledge of the systems.

   As we learn more about the weapon system, the services and JPO will relax the maintenance policies to allow the units to be more self-sufficient. As for making parts on-site – until the final design and qualification of the airplane is complete (late 2017), not only is it risky to allow local units to manufacture parts on-site, but we have yet to provide the units all the tooling and manuals/instructions to do so. We will eventually stand up capability to do these low-tech tasks (known as the "O-plus" level maintenance) at the operational units in the 2017 to 2019 timeframe.

   September 2015 Update: The JPO continues working hard with the services to identify those processes that can be transferred to organic maintenance, and in the future intends to transfer to organic maintenance many of the things LM currently does. For ALIS administration, the USMC intends to use organic personnel, while the USAF plans for Contractor Logistics Support (CLS). The USN has not finalized its plans as of yet.

   Updated Response: Response still current.

2. **Comment:** ALIS information, and L-M info, on parts status is still not always accurate. The 'just-in-time' parts system leads to significant wasted time and effort, and lower availability for training.

   Original Response: We agree that the units require accurate information about parts status – we call this "total asset visibility" – and we clearly do not have that in the F-35 supply chain now.

This is not an ALIS problem, although ALIS can be used to solve part of the issue. Last year, LM was tasked by the JPO to develop tools that would link parts supply chain information from the end-user (warfighter) all the way back to the vendors so parts orders could be tracked from beginning to end and provide units accurate delivery dates and parts status. LM has yet to deliver this solution and the JPO is pressing hard for a realistic plan to do so.

September 2015 Update: JPO continues to develop strategy to ensure global Total Asset Visibility (TAV) through contractor-based System Application Products (SAP) systems, ALIS, US Gov't Accountable Property System of Record (APSR), and other supporting inventory managements system to achieve total asset visibility. As part of the F-35 asset management strategy, LM was tasked by the JPO to develop tools that would link parts supply chain information from the end-user (warfighter) all the way back to the vendors so parts orders could be tracked from beginning to end and provide accurate unit counts, delivery dates, and parts status. JPO continues to engage with LM in pursuit of asset management solution that will leverage LM data management systems.

Note: ALIS is one component of the TAV solution and is in the process of a system upgrade to augment ALIS interface capability with interim Product Support Integrators' SAP systems used for messaging.

Updated Response: The JPO continues to pursue global Total Asset Visibility (TAV) through contractor-based System Application Products (SAP) systems. In addition, we push real-time information to F-35 sites twice daily by sending Mission Impaired Capability Awaiting Parts (MICAP) reports. Also, there are daily telephone calls with the Lockheed Martin Field Support Representatives, who provide snap shots of their inventories and provide requisition data information.

3. **Comment:** Concerns about the international supply chain and the length of time it takes to get parts.

Original Response: We fully agree that there are many shortfalls and gaps in the "on-hand" inventory of parts (spares) at the units. This is the result of poor forecasting of what parts we need, a lack of funding in the early years to buy the spares, and late contracting actions by the JPO and LM. We are addressing this problem aggressively with a new forecasting tool, additional funding, and improved, more timely purchasing of spares. However, it will take 6-12 months for us to dig out of the "hole" we have put ourselves in.

September 2015 Update: The JPO continues to address issues that have resulted in shortfalls of inventory at the sites. We have addressed this problem aggressively by pursuing additional Service funding and the use of a new forecasting tool which predicts material availability several years in advance and continually adjusts data with revised engineering estimates and flight line usage numbers, thereby improving safety stock. We are also improving the timing for purchasing spares: all LRIP 9 spares contracts will have been awarded by the end of FY15, within the first year of budget execution; LRIP 10 spares contracts actions are scheduled as soon as FY16 funding is available; and the LRIP 11 spares listing has been completed for further contracts actions. In 2015, there has been a steady upward trend for repairable stockage effectiveness.

Updated Response: To increase readiness and improve the "Not Mission Capable Supply" rate, we have focused on reducing Depot Repair Cycle Time (DRCT). With a shorter DRCT, asset availability will increase, resulting in fewer operations interrupted while awaiting repairs. Retrograde processing improvements include:

- More expedient removal of the part from the aircraft to delivery to the repair location; procedures have improved in providing more timely Source of Repair (SOR) documentation to the sites.
- Targeting the top readiness degraders in reducing the repair backlog. 39 Master Repair Agreements (MRAs) are in place with performance incentives/penalties for suppliers, and additional MRAs are being pursued. MRAs have resulted in significant reductions in repair time.
- We are in process of maximizing government repair capability and capacity and are exploring options to increase commercial capacity.

Timely depot repair is essential to operational readiness and sustainability to support customer requirements. These cumulative actions will materially increase the flexibility and responsiveness of the depot repair process and increase asset availability.

4. **Comment**: Concerns about "false positives" with ALIS. Maintenance personnel said that the rate of false positives was around 80%.

   Original Response: Yes, we agree this is a valid concern/problem.

   The F-35 air system is experiencing some "false" Health Reporting Codes (HRCs) generated by the aircraft, then downloaded and filtered in ALIS. This is manifested in the early software versions (Block 1B and Block 2A) of the F-35 software. Many of the aircraft-generated HRCs do not require maintenance action (false codes) but do generate work orders that cause unnecessary administrative burden for maintainers and pilots to close out the action. The release of Block 2B software has resulted in a significant improvement of these false codes over earlier Block 1B/2A versions.

   The "80% false positive" figure is related to the work-orders that ALIS automatically generates after each flight. As an example, a given aircraft may generate 20 HRCs after a flight. Of those 20, any number of them (50%, or 10, in this example) may be automatically flagged as not valid and removed by systems within ALIS – this function is called the Nuisance Filter List (NFL). The remaining 10 HRCs would result in work-orders requiring maintenance personnel action. This is where the reports of "80% false positives" comes into play – eight of these work-orders are potentially false positives and require a maintainer to take administrative steps to close. The final two would be "legitimate" work-orders that warrant maintenance actions.

   Both the aircraft (false HRCs) and ALIS (proper filtering) contribute to this issue. Valid HRC software fixes are being addressed in the aircraft software via Software Product Anomaly Reports. With these software updates, "false" work orders for the maintenance personnel will continue to be reduced with each aircraft software release. The JPO is also updating the ALIS

software to improve correlation of HRCs and consolidation of work orders. The ultimate goal with the improvements of both the aircraft off-board prognostics health monitoring system and ALIS software is negligible false positives by the end of 3rd Quarter of 2017.

September 2015 Update: Response still current.

Updated Response: Automated correlation of HRCs in ALIS will not be added during SDD. As an interim workaround, a manual correlation guide is provided as part of the F-35 electronic technical manuals. The JPO is assessing alternatives for potential future automation.

5. **Comment**: Debrief downloads take 2 hours, which significantly disrupts the normal debriefing cycle, resulting in a huge loss of training value. Needs to be 1 hour or less.

   Original Response: We agree that downloading the debrief materials takes far too long for effective training. This is a "must fix" deficiency for the USAF. Consequently, we are redesigning the equipment (known as the Ground Data Receptacle or "GDR") that takes information off the jet and puts it in the correct format for the pilots to use during debriefing. Preliminary testing has demonstrated the newly designed GDR can download a standard 1.5 hour mission in "tens of minutes" vice the nearly three hours it now takes. This new capability is under development now and will be fielded next year. We will also retrofit all the current units with the new download capability.

   September 2015 Update: The Ground Data Receptacle (GDR) upgrade is on track, with a Critical Design Review (CDR) planned for mid-Sep. A production contract has been awarded with an option to deliver ten updated GDRs to the Air Force to support its Initial Operational Capability (IOC) by August 2016. Future GDR deliveries and retrofit planning is underway and will be implemented after CDR is complete.

   Updated Response: The Ground Data Receptacle (GDR) upgrade continues to be on track. The GDR development is currently conducting qualification testing, integration with the Off-board Mission Support (OMS) system and security certification activities. Lab testing will be performed in late spring 2016 to measure the new debrief time. Updated GDRs will initially be delivered beginning with LRIP 8 in July 2016 to AF Initial Operational Capability (IOC) aircraft at Hill AFB.

6. **Comment**: Flight gear is not comfortable or practical. Too constraining. Does not allow pilots to relieve themselves without unstrapping from the entire restraint system. Overall lack of comfort and suitability.
   Original Response: Virtually all fighter aircraft require the pilot to unstrap to relieve him/herself. The F-35 is just a bit harder because the harness is integrated into the seat instead of having to be donned outside of the aircraft. The pilot flight equipment (PFE) is integrated with the ejection seat arm restraint system, which further limits mobility.

   The JPO is pursuing the implementation of a commercial off-the-shelf system (AMXD-MAX) to provide capability for in-flight relief without male/female pilots having to unbuckle the seat restraint harness. This system automatically activates when required to draw liquid waste into a

collection bag. Approval for the use of the AMXD-MAX is scheduled for late summer 2015 after the completion of a Safe-to-Fly assessment currently in progress.

September 2015 Update: Response still current.

Updated Response: The JPO is in discussion with the OEM to determine if a commercial off-the-shelf system (AMXD-MAX) can be deemed technically ready and Safe-to Fly to provide capability for in-flight relief without male/female pilots having to unbuckle the seat restraint harness. This system automatically activates when required to draw liquid waste into a collection bag. Approval for the use of the AMXD-MAX has been delayed due to communications from the OEM regarding COTS item obsolescence. In the meantime, the JPO is pursuing interim clearance of legacy relief devices until the necessary technical and sustainment assessments regarding the AMXD-Max solution are available.

7. **Comment**: Rear visibility very limited compared to F-15 and F-16. Made worse by the ejection seat configuration that is intended to protect against injuries.

   Original Response: F-35 ejection seat upper head rest is designed to provide adequate neck/head support to full range of US and partner nation pilots (103 lbs -245 lbs). Additionally, the canopy and shape of the aircraft behind the pilot's head were necessary to give the best stealth/low observable capability possible.

   21st century air warfare depends much less on dogfighting (where rear visibility is important) than seeing your enemy using long-range sensors without him seeing you. The design of the F-35 is optimized for 21st century warfare long-range see, shoot, kill tactics rather than close-in dogfighting. No change to the rear visibility of the jet will be possible without reducing the one thing that makes the F-35 so survivable – stealth. The pilot community is currently developing tactics and CONOPS to deal with this visibility limitation and should not detract from its survivability or mission accomplishment.

   September 2015 Update: Response still current.

   Updated Response: Response still current.

8. **Comment**: IOC capability using 3i software will be very limited, and will only allow the use of "old" weapons, not the latest and greatest available. They are worried that the IOC won't be "for real" if they have to deploy and fight with 3i.

   Original Response: The capabilities delivered in Blocks 2B/3i are indeed limited – that was how the program was designed. The decision as to whether these limited capabilities are good enough for declaration of IOC is purely a U.S. Air Force senior leader decision. The JPO believes the 2B/3i capabilities provide the warfighter with ample combat capability and survivability in some – but not all – combat situations. The final Block 3F in late 2017 will deliver many more weapons and capabilities. The JPO is prepared to brief the committee (classified or unclassified) on the Block 2B/3i capabilities.

September 2015 Update: Response still current.

Updated Response: Response still current.

9. **Comment**: The cycle time on software fixes is too long. Things get fixed, but it takes months after the problem is identified.

   Original Response: Fixing software deficiencies is a complicated and sometimes time-consuming task. Anytime software in the aircraft is changed, many things must happen before the new software and capability can be delivered to the warfighter. First and foremost, the software must be tested in the lab and in flight test to ensure the fixes actually work. Then the software must undergo certification to ensure it is airworthy and safe. Then the documentation to the pilots and maintainers must be upgraded to include the new software fixes and capability descriptions – because the JPO cannot field changes to the aircraft systems without making sure the warfighters and maintainers know what they are getting. Finally, all the aircraft in the field must be retrofitted and uploaded with the new software. Having said that, the JPO and LM have re-engineered our software processing to significantly reduce the time it takes to design, test and field limited software fixes. In the past this cycle took three months; today the JPO and LM have reduced this cycle time (from fix, to lab test, to flight test) to about one month.

   September 2015 Update: Response still current.

   Updated Response: Correcting software defects is an often time-consuming task depending on the level of complexity of the change. When weapon systems software is changed, many things must happen before the change can be delivered to the warfighter. First, the end-state functionality and performance requirements of the change must be developed and documented for the coders. Next, the change has to be coded and integrated with the remainder of the software and hardware, which could take significant time depending on what in the rest of the system is affected by the change. Then, the software must be tested in the lab and in flight test to validate correct functionality and performance. The software must also undergo a certification process to ensure it is airworthy and safe, and finally, a software build created for release to operational units. Documentation to the pilots and maintainers must be updated to include information on the corrections because the JPO cannot field changes to the aircraft systems without making sure the warfighters and maintainers know what they are getting. Finally, all the aircraft in the field must be retrofitted and uploaded with the new software. It is most efficient and cost effective for the F-35 Enterprise as a whole to bundle changes with a pre-planned software update, rather than send new software to the field each time there is a single change made. This is standard practice in software intensive systems. This issue is exacerbated in F-35 because we are still in a period of development, testing, production, and fielding concurrency. JPO software development processes are continuously evaluated to determine where they can be streamlined and made quicker. Having said that, the JPO and LM have re-engineered software processing to significantly reduce the time it takes to design, test and field limited software fixes. In the past this cycle took three months; today the JPO and LM have reduced this cycle time (from fix, to lab test, to flight test) to about one month.

10. **Comment**: Concerns about quality of the gun aiming system. When combined with very small ammo load they think it might be a step backwards from legacy aircraft.

    Original Response: Aircraft gun system testing is scheduled to begin summer 2015 with air-to-ground accuracy testing occurring first part of CY2016. Gun aim point accuracy is currently forecast to be comparable to that of legacy aircraft. It is true the current gun (GAU-22) has only 180 rounds (F-35A) and 220 rounds (F-35B & C) which is less than legacy aircraft. However, the F-35 was designed to accomplish a broad spectrum of missions where the use of the gun is not necessary or tactically important. The limited gun capability was a design constraint that was necessary to improve other aspects of the weapon system such as stealth, range, and speed.

    September 2015 Update: The three F-35 variants are in various phases of testing the internal gun (F-35A) and external gun pod (F-35B/C). The F-35A gun system ground testing is complete with test firings of 10, 15, 30, 60, 90, 120, and 181 rounds. Gun accuracy, measured during the ground testing, is performing better than the required specification. Effectiveness testing of the combat ammunition is ongoing, and when combined with the measured accuracy, should show favorable comparisons to most legacy aircraft. Airborne gun functionality testing is scheduled to begin September 2015 while F-35A air-to-ground accuracy testing is tentatively scheduled for August 2016.

    Updated Response: The GAU-22 25-millimeter gun accuracy, measured during the ground testing, is better than the required specification. Effectiveness testing of the combat ammunition is ongoing, and when combined with the measured accuracy, should show favorable comparisons to most legacy aircraft. Airborne gun functionality testing was started in September 2015 and scheduled to resume in April 2016 while F-35A air-to-ground accuracy testing is tentatively scheduled for September 2016. Ground testing of the Missionized Gun Pod is scheduled to start in June 2016.

11. **Comment**: EOTS limitations compared to external targeting pods, especially for CAS.

    Original Response: The F-35's EOTS performance requirements were established as part of the development baseline in the mid-2000s. Meanwhile, development in external targeting pod capabilities has continued to progress, while F-35 has worked to integrate EOTS based on its unique requirement set. The F-35 will deliver an initial baseline warfighting capability that meets the warfighter's needs; however, it will not initially execute every mission with the same capability that exists in currently fielded / upgraded platforms that have benefitted from technology investment. The F-35 has significant growth potential and at the end of Development (end of CY2017) the Program will begin its Follow-on Development work which will include upgrades and technology insertion of its sensors. Improving EOTS to leverage the significant investment in targeting pod capabilities over the last 10 years is a high priority in Follow-on Development (Block 4).

    September 2015 Update: Response still current.

Updated Response: Response still current. Note: Follow-on Development renamed Follow-on Modernization (FoM) to reflect transition from system development and demonstration (SDD) to recurring incremental modernization updates and improvements.

12. **Comment**: "Old weapons on 5th gen aircraft". Newer, better weapons won't be usable at IOC. Will come much later.

    Original Response: The weapons planned for release with Block 2B in 2015 and Block 3F in 2017 are expected to meet Service requirements. The program must first complete development with the basic weapons in the Services current inventories before embarking on newer weapons. Newer weapons such as GBU-38/54 (500 LJDAM/JDAM) and SDB-II (GBU-53) are planned for integration on the F-35 beginning with Follow on Development in the 2019-2021 timeframe.

    September 2015 Update: Response still current.

    Updated Response: Response still current; however to reflect current program schedules, newer weapons F-35 integration are now planned in the 2020-2022 timeframe. Note: Follow-on Development renamed Follow-on Modernization (FoM) to reflect transition from system development and demonstration (SDD) to recurring incremental modernization updates and improvements.

13. **Comment**: IOC with only two air-to-air weapons max load, not four. Significant concern about going to combat with that limited load.

    Original Response: It is true that in Block 2B/3i the aircraft will be capable of only two AMRAAMs carried internally--but again this is a limited capability that will be improved with the full Block 3F capability in late 2017. With Block 3F the internal AMRAAM capability will double to four. Post SDD, the authorized AMRAAM Loadouts can be increased to the maximum aircraft capability of 12 missiles, carried both internally and externally.

    September 2015 Update: Response still current.

    Updated Response: Response still current.

14. **Comment**: MADL is not currently compatible with IFDL (F-22) data link.

    Original Response: The U.S. Air Force has not identified a requirement for MADL – IFDL compatibility--current information sharing between the F-35 and F-22 is accomplished via Link-16. While improved F-35 - F-22 datalink compatibility approaches are being investigated by numerous companies under Independent Research and Development, there is no formal Program of Record effort to integrate MADL - IFDL compatibility on either aircraft yet. The JPO believes such capability, if it were to become a requirement, could be developed in Block 4 Follow-on Development.

    September 2015: Response still current.

Updated Response: Response still current. Note: Follow-on Development renamed Follow-on Modernization (FoM) to reflect transition from system development and demonstration (SDD) to recurring incremental modernization updates and improvements.

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

MARCH 23, 2016

QUESTIONS SUBMITTED BY MR. TURNER

Mr. TURNER. What do you think are the biggest hurdles for the program to overcome to be ready for IOT&E?

Dr. GILMORE. The current plan to complete development and enter IOT&E by August 2017 is unrealistic. Several obstacles must be overcome before IOT&E can begin. These include:

- Completion of Block 3F development. The completion of Block 3F development will provide full combat capability to the F–35, including the ability to employ the full suite of weapons planned for the F–35. However, the program has completed less than 20 percent of the baseline Block 3F test points as of the end of April 2016. Completing the remaining nearly 4,200 baseline points will likely not occur until the end of January 2018, based on historical test point burn rates.
- Weapons integration. Much of the weapons testing remains, particularly to support the additional weapons being brought on with Block 3F (SDB, JSOW, AIM–9X, and the gun)
- Mission data. The programming lab that provides mission data needs to be upgraded to provide adequate, optimized, and tested mission data files for IOT&E. Despite being provided a $45 Million budget in FY13, the program has still not designed, contracted for, and ordered the required equipment—a process that will take at least two years, not counting installation and check-out. As a result, the signal generators needed to adequately test the mission data loads against advanced threat waveforms will probably not arrive until 2019 at the soonest, causing risk to F–35 avionics performance during IOT&E and in combat.
- Sustainment. The program set a target of 60 percent aircraft availability for the fleet as an objective at the end of CY14, but has yet to reach that goal. To efficiently complete the mission trials during IOT&E, most of which will require 4-ship formations of a single variant (out of 6-aircraft fleets of each US variant), the program will need to have an availability of approximately 80 percent, which is also the availability that will be required to succeed in actual combat. Improvements in reliability and maintainability, along with significant improvements to ALIS, are all needed.
- Modifications to operational test aircraft. The operational test aircraft must be production-representative and have the required instrumentation called for in the Test and Evaluation Master Plan (TEMP). Modifying the currently designated fleet of operational test aircraft to the Block 3F configuration would extend beyond August 2017. Although the requirement to modify these aircraft has been known for years by the program and Lockheed-Martin, adequate plans were not made to accommodate these modifications. For example, all of the operational test aircraft need the Tech Refresh 2 (TR2) processors, which have been included in the production aircraft since Lot 6 aircraft were delivered in late 2014, but TR2 processors for retrofitting the OT aircraft were not ordered in time to support completing modifications prior to August 2017.

There is very little which can be done to mitigate these timelines to meet an August 2017 IOT&E start date. Although the program office is considering options with the Services provide operational test aircraft earlier, either by getting parts from the production line or from later-lot aircraft, or by substituting in newer aircraft, decisions must be made soon to have the TEMP-required number of production-representative aircraft in time for IOT&E.

Mr. TURNER. Do the F–35 development and production schedules have more or less risk than last year and what is that level of risk?

Dr. GILMORE. My assessment is that the progress in development over the past year has been less than planned, and hence—given the shorter timeline remaining to the completion of System Development and Demonstration (SDD)—the risk to the development schedule is greater than it was last year. The program's decision to pause the Block 3F mission systems development in order to address the Block 3i stability and other deficiencies was a good decision, but the needed fixes came at a cost to schedule. For several reasons, SDD will likely not be complete before March 2018, at the earliest. This assessment is based on the following assumptions:

- Block 3i mission systems testing is complete and will not need to restart
- Block 3i stability fixes have been successfully transferred to the Block 3F software
- Block 3F mission systems has restarted in earnest with all SDD aircraft
- The balance of approximately 4,200 Block 3F mission systems baseline test points (the number as of the beginning of May) will be completed by the test teams, without significant deletions by the program
- No additional discoveries which cause significant delays or unplanned software releases (beyond those currently planned) occur in Block 3F flight testing
- All planned weapon delivery accuracy (WDA) events—which include 25 events with air-to-air missiles or bombs and two sets 19 WDA events supporting of gun tests, one with the embedded gun in the F–35A and one with the podded gun for the F–35B and F–35C—are completed before the end of SDD. As of the end of April, none of these WDA events had been completed and will likely not begin before August 2016, after a version of software is released to flight test that will support the start the of the WDA events. The latest Program Office schedule shows that the missile and bomb events are planned to start in June and be complete by the end of November 2016, a schedule that I consider to be unrealistic. The program has prioritized 16 of the 25 bomb and missile events to be completed to support flight certification of weapons releases for Block 3F; however, all events, including the WDAs with the gun, must be completed to support end-to-end fire control characterization for all required weapons prior to the start of IOT&E. Although possible, the program's ability to complete these events before March 2018 will depend on efficiencies in completing WDA events and data analyses that have not been seen in the past (i.e., during the Block 2B and Block 3i WDA events) and the maturity of mission systems software to support the find-fix-track-target-engage-assess kill chain for each of these events.

Concerning production risk, the program continues to have discoveries from testing that require modifications to be cut into production and retrofits to fielded aircraft. These discoveries are reflective of a design that is still not mature. Recent examples include cracking in the titanium bulkhead of the F–35C durability test article (CJ–1) where significant limitations to the life of the fielded F–35C aircraft can only be addressed with intrusive structural modifications prior to the expected full service life, and show again the high cost of concurrent production and development. Another example is the observed structural exceedances in both the F–35A and F–35C at the external carriage points for the AIM–9X missile—a weapon being integrated in Block 3F. Both aircraft have shown structural exceedances during in-flight maneuvering, and the F–35C during simulated carrier landings. The program is currently investigating a way forward to address these structural exceedances.

Mr. TURNER. Your report mentioned some concerns in your annual report about the U.S. Reprograming Lab not having the equipment necessary to produce the software necessary for F–35 combat operations. What are the implications of the USRL not having the required equipment?

Dr. GILMORE. Significant, correctable deficiencies exist in the U.S. Reprogramming Laboratory (USRL) that will preclude development and adequate testing of effective mission data loads for Block 3F. Despite a $45 Million budget provided to the Program Office in FY13, the required equipment was not ordered in time and the USRL is still not configured properly to build and optimize Block 3F Mission Data Files (MDFs). The program still has not designed, contracted for, and ordered all of the required equipment—a process that will take at least two years for some of the complex equipment—after which significant time for installation and checkout will be required. The estimate of earliest completion, with the required signal generators and other upgrades to properly test Block 3F mission data loads, is late 2019, which is after the planned IOT&E of Block 3F. As I explain in my annual report, the corrections to the USRL are needed to provide the F–35 with the ability to succeed against the modern threats that are the key rationale for pursuing this $400-Billion program. If the situation with the USRL is not rectified, U.S. F–35 forces will be at substantial risk of failure if used in combat against these threats. Further, I note that the laboratory being built to provide MDFs to the partner nations will be more capable than the USRL is when we are preparing for IOT&E. The program must take immediate action to complete required modifications and upgrades to the lab before the USRL is required to provide the Block 3F mission data load for tactics development and preparations for IOT&E.

Mr. TURNER. Are you concerned that the program paused its software development schedule to try and fix the avionics stability problems and other critical deficiencies in Block 3i and 3F?

Dr. GILMORE. No, I am not concerned. In fact, I applaud the program's effort to change from the schedule-driven, concurrent development process that the program was previously using to develop, test, and field versions of missions systems software to pursue a serial approach of addressing deficiencies before moving on to the next iteration of software. The decision by the program in February to return to the Block 3i configuration and address the poor mission systems performance has caused some near-term delays, but it is a necessary step to ensure the Air Force has adequate Block 3i software for IOC and that the additional full set of combat capabilities planned in Block 3F can be effectively tested with a stable baseline of software and eventually fielded to operational units. The success of Block 3F mission systems depends on the program resolving the problems with Block 3i. The stability and functionality problems in the initial versions of Block 3F, including those inherited from Block 3i and problems caused by new Block 3F capabilities, were so significant that the program could not continue flight test. I agree with the program's decision to shift to a serial process of testing and fixing software in the lab before releasing the next software version, and the recent improvements observed in Block 3i stability validate this serial approach. The program recently released an updated version of Block 3FR5 software to flight test in April and then plans to release Block 3FR6 later this summer. If the fixes to stability programmed into the latest Block 3i software continue to suppress the need for avionics resets in flight, mission systems testing and weapons releases can potentially resume in earnest and the test point completion rate will increase, which is essential given the significant amount of testing that remains.

Mr. TURNER. What more can be done or focused on to improve operational suitability?

Dr. GILMORE. The operational suitability of all variants continues to be less than desired by the Services and relies heavily on contractor support and workarounds that would be difficult to employ in a combat environment. Almost all measures of performance have improved over the past year, but most continue to be below their interim goals to achieve acceptable suitability by the time the fleet accrues 200,000 flight hours, the benchmark set by the program and defined in the Operational Requirements Document (ORD) for the aircraft to meet reliability and maintainability requirements. To improve operational suitability, the program should:

1. Improve the reliability of components with higher-than-planned failure rates. While the program focuses on contract specification requirements, particularly Mean Flight Hours Between Failure for Design-Controllable components, I noted in my annual report that, among the measures of reliability that have ORD requirement thresholds, eight of nine measures are still below program target values for the current stage of development, although two are within 5 percent of their interim goal.

2. Improve aircraft availability. Aircraft availability improved slightly in CY15, reaching a fleet-wide average of 51 percent by the end of the year, but the trend was flat in the last few months and was well short of the program's goal of 60 percent availability that it had established for the end of CY14. It is also important to understand that the program's metric goals are modest, particularly in aircraft availability, and do not represent the demands on the weapons system that will occur in combat. With respect to IOT&E readiness, if the program is only able to achieve and sustain its goal of 60 percent aircraft availability, the length of IOT&E will increase significantly because a combat-ready availability of 80 percent is planned and needed to efficiently accomplish the open-air mission trials with the number of aircraft planned for IOT&E.

3. Improve maintainability by improving the quality and number of validated and verified Joint Technical Data, which are the reference documents used by uniformed personnel to conduct maintenance. Doing so would reduce the dependence on Action Requests currently experienced by fielded units to complete actions not clearly addressed in JTD, or to fix faults which are not yet addressed or covered by JTD.

4. Deliver the planned capabilities of ALIS through ALIS 3.0 by the end of SDD. Functions such as propulsion data and life-limited parts management are expected to improve the overall utility of ALIS and streamline post-mission maintenance processes.

5. Improve the accuracy of the Prognostic Health Management (PHM) system by reducing the number of false alarms reported after each flight. PHM is designed to automatically detect faults in the aircraft and alert maintenance personnel to take corrective actions. Unit maintenance personnel spend a sizable amount of maintenance time confirming there is no fault when one is reported, including time clearing known "nuisance" faults in the maintenance logs within ALIS.

Mr. TURNER. Your latest report indicates that it is premature to commit to a block buy for the F–35 program. However, the Department does have the potential to benefit in cost savings from such an approach. a. Please discuss the risks that you see

in such a commitment. b. Given that a block buy was not requested in fiscal year 2017, do you believe the Department would be in a better position to commit to a block buy in fiscal year 2018? Please discuss why or why not and at what point you feel a commitment would be warranted.

Dr. GILMORE. a. As stated in my annual report, committing to a block buy prior to completing the Initial Operational Test and Evaluation (IOT&E) may cause the Department and the partners participating in the block buy to:

1. Commit to aircraft that may require corrections to significant deficiencies discovered during IOT&E before they can be used in combat, particularly with the expected capabilities from Block 3F.

2. Commit to large numbers of aircraft in a configuration that may need modifications to reach full combat capability and full service life.

3. Lose the needed incentives to the contractor and the Program Office to correct an already substantial list of deficiencies in performance, a list that will only lengthen as Block 3F testing continues and IOT&E is conducted.

4. Commit to an acquisition strategy that is not consistent with the "fly before you buy" approach to defense acquisition that many in the Administration have supported and is not consistent with the intent of Title 10 U.S. Code, which stipulates that IOT&E must be completed and a report on its results provided to Congress before committing to Full-Rate Production—a commitment that some could argue would be made by executing the "block buy.

b. My understanding is that the program and the Services have decided to delay the consideration of the block buy for at least another year, possibly starting in FY18. Nonetheless, even if the proposed block buy is delayed to FY18, all of the risks I identified previously remain valid, since IOT&E will not start until FY18, at the earliest, and will likely not be complete until FY19. The Department should not commit to a block buy until after IOT&E is complete and the decision to do so can be informed by the results of the planned, dedicated, operational testing.

Mr. TURNER. In your statement, you highlight similarities of the F–22 modernization program and the current F–35 modernization program. Can you discuss some of these similarities and the risks involved with the Department's current approach to managing the F–35 modernization program?

Mr. SULLIVAN. Our experience with the F–22 highlighted that managing modernization programs of this magnitude under an existing baseline hinders transparency. In March 2005, we found that the Air Force was managing its multi-billion dollar F–22 modernization efforts as part of the program's baseline and had not established a separate knowledge-based business case.[1] As a result, the F–22 baseline and schedule were adjusted to reflect the new timeframes and additional costs, comingling the funding and some content for the baseline development and modernization efforts—some content that had not been achieved under the baseline program were deferred into the modernization program. When the content, scope, and phasing of modernization capabilities changed over time, it appeared that the F–22 program was fraught with new schedule delays and further cost overruns. The comingling of modernization efforts with the existing baseline reduced transparency and Congress could not readily distinguish the new costs associated with modernization funding from cost growth in the original baseline. We recommended that the Air Force structure and manage F–22 modernization as a separate acquisition program with its own business case—matching requirements with resources—and acquisition program baseline. Eventually, the department separated the F–22 modernization program from the baseline program with a Milestone B review, in line with our recommendation, which increased transparency and better facilitated oversight.

The F–35 Block 4 modernization effort is much larger than the F–22 modernization effort. DOD expects Block 4 modernization to develop and deliver 80 new capabilities and 17 weapons that were not part of the program's original acquisition baseline, compared to 8 new capabilities and 3 weapons for the F–22 modernization effort. In its fiscal year 2017 budget request, DOD has identified the need for nearly $3 billion over the next 6 years for development of the new capabilities. If Block 4 is managed as a distinct program with a separate baseline, it would be easier for Congress and DOD decision makers to track program-specific cost and schedule progress. A hypothetical $1 billion cost increase in Block 4 illustrates the difference in cost reporting and oversight. While a $1 billion cost increase is significant, it would represent growth of less than 1 percent if tracked against the current F–35 program baseline—currently about $400 billion. That same cost increase, if tracked against the $3 billion funding estimate reflected in DOD's budget request for Block

[1] GAO, Tactical Aircraft: Air Force Still Needs Business Case to Support F/A–22 Quantities and Increased Capabilities, GAO–05–304 (Washington, D.C.: March 15, 2005).

4, would be more visible, representing a 33 percent cost increase. The department has the opportunity to apply lessons learned from the F–22 modernization effort to the F–35 Block 4 program.

Mr. TURNER. In this testimony as well as in the past, you have consistently raised long-term affordability as a key area of risk. Please explain why you continue to believe that affordability is a risk. In your opinion, has the program addressed this risk?

Mr. SULLIVAN. Affordability continues to be a concern because of the sheer magnitude of the funding needs for this one program. For example, the F–35 program will require more than $14 billion a year on average for a decade. Affordability challenges will compound as the F–35 program competes with other large acquisition programs including the long range strike bomber and KC–46A Tanker. At the same time, the number of operational F–35 aircraft that DOD will have to support will be increasing. The total cost to operate and support the F–35 fleet is still estimated to be more than $1 trillion. In recent years, affordability challenges, in part, have forced the Air Force to defer F–35 aircraft procurements to later years. Since 2014, the Air Force deferred 45 aircraft between 2017 and 2021 to later years. This will likely require the military service to make unplanned investments in extending the service life of their current fighter aircraft. The cost of extending the lives of current fighter aircraft and acquiring other major weapon systems, while continuing to produce and field new F–35 aircraft, poses significant affordability risks in a period of austere defense budgets.

Mr. TURNER. Your statement mentioned that the program is making progress in testing, but that the most complex testing still remains. What do you see as the major risks in completing the remaining developmental test program?

Mr. SULLIVAN. Although early software blocks (Block 2A through 3i) have completed testing, risks remain with the completion of Block 3F mission systems software testing. These risks center on the complexity of Block 3F, software issues, and the completion of a number of weapons accuracy events that have proven to be difficult in the past. Block 3F is the F–35's full warfighting capability and consists of challenging testing given the complexity of the missions and the stressing environments that are required. The program continues to experience problems with some mission system software functions shutting down and restarting during flight testing. Officials believed they had identified a fix at the end of 2015 and program officials plan to continue addressing the issue during 2016 in order to meet the Air Force initial operational capability in August 2016. There are also concerns about the tight timeframes to conduct the 55 weapons accuracy events that remain—30 of which are related to a gun. As of December 2015, the program had completed 17 weapons events many of which were delayed by months due to software deficiencies and fleet groundings. Program officials are analyzing the remaining test schedule to identify potential efficiencies in their weapons test plan. Any delays in developmental testing could pose risk to the timely start of initial operational test and evaluation, currently planned for December 2017.

Mr. TURNER. The committee is concerned about meeting the U.S. Air Force's IOC requirements later this year. The Chief of Staff of the United States Air Force, General Mark Welsh, recently summarized two risks related to reaching Air Force F–35A IOC later this year (Aug-Dec time frame), the Autonomic Logistics Information System (ALIS), and aircraft software stability. a. Do you agree with General Welsh's assessment? b. Please tell us where you are with the ALIS development, its challenges, and what lies ahead to meet the Air Force initial operational capability? c. Characterize for us the software challenges, the approach you are taking to address them, as well as the timing to get this resolved for the warfighters? d. Finally, please share with us the progress you are making to get the Air Force combat ready with its F–35s later this year.

General BOGDAN. a) At the time United States Air Force Chief of Staff General Welsh made this remark, his assessment was spot on. These were the two biggest risks my team was working. Fortunately since that time, the software issue has been resolved.

b) The ALIS software development to support AF IOC is complete and this version of the ALIS system is currently in the Integration and Test Phase. We are finding defects that are taking longer than planned to fix which is delaying our test events. In this version, we are integrating the F–135 Pratt & Whitney (P&W) engine management capabilities into ALIS for the first time. The ALIS system will be connected to the P&W enterprise supply and maintenance systems. This is a complex effort and we will take the time necessary to ensure we get it right. We are working through these issues and expect its resolution before the AF IOC threshold date of 31 December 2016.

c) The F–35 had been experiencing some timing communications issues between the sensors and the aircraft main operating computer causing the system to reset. However, after much lab and flight testing to get to root causes, the F–35 Joint Program Office (JPO) has completed development of the Block 3i software the AF will use to declare IOC this year. The Block 3i software provides F–35s with initial warfighting capability on upgraded computer hardware. As of 1 May, the F–35 program has flown more than 100 flight hours with the 3i software and it has shown approximately twice the level of stability as the previously fielded Block 2B software and three times better stability than the original 3i software. The JPO began upgrading the F–35 fleet (Low Rate Initial Production (LRIP) Lots 6–8 aircraft) with 3i software the week of 9 May. The same stability and mission effectiveness enhancements have also been incorporated into a new version of Block 2B software, for the benefit of earlier fleet aircraft. The new version of 2B software will be used to start upgrading LRIP Lots 2–5 aircraft by the end of May. The entire fleet of fielded F–35 aircraft will eventually be upgraded to these two new software versions by the end of calendar year 2016.

d) In addition to resolving the software stability, the newest software also includes fixes to deficiencies that the USAF deemed "must-fix" prior to IOC and also includes the Generation III helmet which has improved night sensor video processing and optics above the Generation II helmet. Other IOC needs are Mission Data Files (MDFs), training simulators, spares and support equipment, aircraft and training. Three developmental versions of MDFs to support USAF IOC have been delivered to Hill Air Force Base (AFB) in Utah to aid in its IOC preparations. Currently, we project two of the operational MDFs to deliver in early August 2016 and the remaining two to deliver in September 2016. We are working to pull all four MDFs further left in the schedule. All required training simulators have been delivered to Hill AFB. Sufficient support equipment and spares are forecasted to be in place to support IOC declaration. Twelve jets have already been delivered to Hill AFB and by July have 12 jets completed with all required modifications. For ALIS, we've already delivered (March 2016) the necessary hardware to Hill AFB that will support USAF IOC. Additionally, we've developed a training plan with USAF that provides multiple opportunities to review the new capabilities, train on those capabilities and ultimately receive "hands-on" experience with the new software prior to delivery at Hill AFB to support the AF IOC decision.

Mr. TURNER. The President's Budget request includes provisions to leverage economies of scale for a block buy contract. a. Please share with the committee what the benefits are of a block procurement strategy. b. Do these benefits also include the engine? c. Could you implement this sooner if we advance the President's proposal to FY17? And in your response, please let us know where the F–35 International Partners are with this and their view of the timing. d. If the International Partners elect to proceed with Block Buy economies of scale investments in FY17, and the United States waits until FY18, could this result in the U.S. Services paying a higher procurement price for the same F–35? e. If granted block buy authority, what would be your strategy to mitigate risks to the United States if the U.S. Services reduced or deferred their procurement quantities, similar to the five-aircraft reduction included in the current budget request for the U.S. Air Force?

General BOGDAN. a) The F–35 Joint Program Office (JPO) believes a Block Buy Contract (BBC) approach has the potential to save real money on this program. A BBC would achieve significant program cost savings by allowing the contractors to utilize Economic Order Quantity (EOQ) purchases, enabling suppliers to maximize production economies of scale through batch orders. To substantiate the potential savings of a BBC concept, the F–35 Joint Program Office contracted with RAND Project Air Force, a Federally Funded Research and Development Center (FFRDC), to conduct an independent assessment. RAND's assessment, delivered in March 2016, indicated that savings on the order of $2.5 to $3.0 billion can be achieved by providing a total of 4 percent EOQ funding to selected suppliers. b) Yes, overall BBC savings includes the propulsion system. EOQ will be provided to engine suppliers that offer the best return on EOQ funding. c) The JPO is ready to implement a BBC sooner if Congress includes the language and EOQ funding in FY17. Almost all F–35 International Partners expressed they would follow the U.S. in such a BBC, while most may elect to begin in FY17 even if the U.S. starts in FY18. d) At this time, RAND is evaluating this hybrid option for the JPO; however if the F–35 International Partners follow this strategy and begin a year earlier than the U.S., the cost of an International Partner F–35 could be lower than one sold to the US Services. e) It is important to guard against year-to-year adjustments to the budget; therefore, the F–35 JPO will structure the contract using a variable-quantity matrix as a tool to accommodate year-to-year adjustments should they occur, regardless if they are due to a downward budget adjustment or to address an increase to the

quantities coming from the International Partners, Congressional adds, or through Foreign Military Sales.

Mr. TURNER. The President's Budget request includes $290 million in FY17 for F–35 Follow-on Modernization Block 4. What is your strategy to structure the F–35 Follow-on Modernization so it provides the most efficient use of tax payers' dollars while at the same time providing the maximum amount of transparency to the Congress to support our oversight responsibilities?

General BOGDAN. The F–35 Lightning II Joint Program is committed 100% to ensuring the Follow-on Modernization (FoM) effort is as lean as possible so that the output—capability to our warfighters—is maximized. This will not be System Development and Demonstration (SDD) all over again but a smaller effort with a smaller footprint. We believe the F–35 FoM program should not be designated a separate Major Defense Acquisition Program (MDAP) but should be sub-program to the existing F–35 program. The JPO estimates the documentation and approvals necessary to establish and start a new program will cost between $10 million and $13 million and delay execution of FoM six to twelve months.

The JPO will place FoM on a separate contract, establish a separate program baseline and require cost, schedule, and performance metrics—to include Earned Value Management metrics and Nunn-McCurdy criteria—on this separate FoM baseline. This contract structure will allow the JPO, Defense Contract Audit Agency and you the Congress and your staffs to have full insight into its costs, performance, and earned value—all the tools necessary for you to perform your oversight function. We are completely receptive to adding your specific reporting requirements that you believe are necessary. The JPO has no intent to "bury" the FoM program within the larger F–35 program to avoid performance monitoring and oversight—we just want to avoid unnecessary and costly effort. We can assure this openness and believe it is achievable without characterizing it as a new program, as some have recommended.

Mr. TURNER. When you appeared before this committee last fall we heard a lot about the pilot escape system. You testified that there are three things you are pursuing to address the light-weight pilot restriction. Briefly summarize the problem and the fixes that you're developing. More importantly, let us know the status of the fixes and when can we expect to see them so the pilot restriction can be lifted?

General BOGDAN. The F–35 pilot escape system is designed to be superior to legacy systems. The system provides reduced ejection stresses on the pilot and accommodates the widest range pilot sizes and weights (103 to 245 lbs).

Lightweight Pilot Restriction: In August 2015, the U.S. Services and International Partners restricted F–35 lightweight pilots (weighing less than 136 lbs) from operating the F–35 after tests to qualify safe escape with an F–35 Generation (Gen) III helmet at low speed ejections indicated the potential for increased risk of neck injury for lightweight pilots due to forces experienced on the pilot's head.

Solutions: There are three technical solutions that when in place will reduce the risk of neck injury to all pilots and will eliminate the restriction. All three are planned to be ready by the end of 2016, clearing the way for the U.S. Services and International Partners to lift the F–35 lightweight pilot restriction. These solutions include: 1. A head support panel between the parachute risers. This eliminates the possibility of the head/helmet going between the parachute risers in low speed ejections. 2. A pilot-selectable switch to delay parachute deployment for lighter weight pilots. This ~0.5 second delay will reduce parachute opening shock and neck loads during the parachute deployment phase of the ejection. 3. A lighter Gen III pilot helmet. This will reduce neck loads during all phases of ejection (catapult, windblast, drogue, and parachute deployment).

Mr. TURNER. As the F–35 program continues to field aircraft and the number of F–35 sites increase, there is a concern that the ALIS global network will become more vulnerable. What efforts are you pursuing to protect the ALIS global network from nefarious activities and other network disruptions such as those caused by natural disasters?

General BOGDAN. We are continuing to implement the necessary Information Assurance controls and testing required by the Department and the individual Services to allow Autonomic Logistics Information System (ALIS) to be connected to the US Air Force, US Marine Corps, and US Navy networks. Second, the Joint Operational Test Team (JOTT) is now performing Cyber Testing on the ALIS system and will continue this over the next year and a half. This testing will inform us of any deficiencies that may require mitigation. And finally, we have contracted for backup hardware for key elements of the ALIS system that we will be installing later this year in different geographic areas. This effort will eliminate single points of failure and mitigate risks from natural disasters.

Mr. TURNER. Last year, the Fiscal Year 2016 NDAA included a provision that asked for assurances that Block 3F software is on the right course and will be in F–35A aircraft delivered during fiscal year 2018.

a. Can you elaborate on this and share with us what capabilities are in the Block 3F software? b. What is the status of Block 3F development and what risks and mitigations are you managing to deliver this capability?

General BOGDAN. a) The Senate included this provision to prevent the significant ramp up in annual F–35A procurement rate unless the F–35A aircraft hardware and software were mature enough to minimize costs for retrofits should aircraft continue to be delivered without the full capability. In this regard, the Low Rate Initial Production (LRIP) Lots 9 and 10 aircraft delivered after 1 October 2017 (start of FY18) have an extremely low risk of retrofit costs because the full Block 3F mission software will be inherent with all LRIP 9 aircraft by May 2017. Block 3F includes the Tech Refresh 2 suite of hardware, coupled with software functionality that enables or enhances several F 35A mission areas. Block 3F incorporates advanced tactical avionics and opens the full flight envelope for the F–35. Block 3F weapons for the F 35A will include the GAU–22 internal 25-millimeter gun system, internally-carried AIM–120C Advanced Medium-Range Air-to-Air Missiles, GBU 31 Joint Direct Attack Munitions, GBU–39/B Small Diameter Bombs, GBU–12 Paveway II laser guided bombs, and externally-carried AIM–9X Sidewinder missiles.

b) The program plans to deliver the first F–35A (LRIP 9 procured with FY15 funds) with Block 3F hardware and software in August 2017 with the full Block 3F capability minus the ability to use the AIM–9X weapon until the airworthiness and engineering communities clear the capability for use. We expect this AIM–9X capability to be released in September 2017. It will provide the full Block 3F combat capability of the F–35A, in advance of the first F–35A delivery in FY18. However, there is some schedule risk to meeting this full Block 3F capability as a result of delays in improving Block 3i and Block 3F software stability, which delayed the start of Block 3F flight testing. The program is taking concrete steps to mitigate this schedule risk including: committing all software development activities to Block 3F, condensing software release cycles, increasing software maturity prior to release from the lab, surging manpower and material resources, and deploying to high-capacity flight test ranges. We are confident we will be able to mitigate this schedule risk.

Mr. TURNER. As more and more F–35 aircraft are produced and enter operational use, there is a concern if we have everything in place to provide for their continued support. Are we providing adequate levels of spare parts across all the F–35 variants, or is there an imbalance between aircraft quantities and spare parts procurement along with other aspects of support. What are the impacts?

General BOGDAN. Sustaining the fleet especially our operational units is a top priority for the F–35 team and we will continue to ensure it remains as such. Spares are essential to keeping sortie rates up and we will do everything we can to keep our operational units flush with spares. There are three things that have impacted spares: 1) a prior year underfunding, 2) a downward congressional mark (e.g., $380M reduction to aircraft support per 2016 Consolidated Appropriations Act) and, 3) upward congressional aircraft procurement quantities (e.g., +11 aircraft per 2016 Consolidated Appropriations Act). The combination of these requires us to rebalance our spares pools to support scheduled 2017 deployments but adds risks to home base F–35 operations resulting in higher supply downtime, decreased aircraft readiness levels and poor contingency availability.

Mr. TURNER. GAO and others continue to raise concerns about the long term affordability of the F–35 acquisition program, noting that as procurement ramps up over the next 5 years, annual funding requests are projected to increase significantly. By 2022 it is projected to reach between $14 and $15 billion and stay at that level for a decade. At the same time other high profile DOD programs will be competing for funds, including the KC–46A Tanker, new bomber, and the *Ohio* class submarine replacement. a. What are the key factors driving the current F–35 procurement plans–production rate levels and funding levels? b. Given Federal budget constraints and the competition for funding within DOD, do you believe that sustained annual funding of that magnitude is going to be achievable? Has the Department considered different procurement options, and if so, what has been considered? Are there any viable alternatives if the current plan is not affordable?

Secretary STACKLEY. The key factors driving the Department's procurement plans-production rate levels and fiscal decisions include the F–35 Program's progress and fiscal constraints as the Navy considers competing priorities for annual resources. Since the program was re-baselined in 2012, following the Nunn-McCurdy unit cost critical breach in 2010, the development costs have remained stable. The costs required to complete the System Development and Demonstration (SDD) phase are

tracking to what was budgeted for in 2011. Production costs continue to decrease with each production lot. Unit cost reductions are in line with projections and allowing for procurement quantity changes. The F–35 Program is tracking to meet the unit costs targets that were established when Milestone B was re-certified in 2012.

The sustained funding requirements are certainly a priority for the Department. The F–35B and F–35C are much needed replacements for legacy platforms that have well outlived their expected service life. The AV–8B and F/A–18A–D fleet of aircraft were originally designed as 6,000-hour airframes. The Department has successfully enabled flight beyond the designed services lives, but continued modernization and sustainment is a fiscal challenge. Moreover, warfighting requirements demand a fifth generation aircraft to counter the expanding threat environment. Consequently, the Department considers the F–35 Program a critical node in Naval Aviation warfighting requirements and prioritizes funding accordingly.

The Department is also considering a number of options in resourcing competing priorities. Given the fiscal and strategic implications for the Department of Defense as a whole, the Under Secretary of Defense for Acquisition, Technology & Logistics is examining the long-term health and viability of the TACAIR industrial base in depth. This study includes affordability as a primary objective in evaluating the TACAIR procurement plans.

Mr. TURNER. A year ago, the Navy deferred nearly 20 aircraft to the out-years. The latest Presidential Budget request shows that the Navy appears to be moving some of those same aircraft into the near-term and at the same time buying more F–18s. a. What is the rationale for these constant changes? b. How will this address the current fighter shortfall?

Secretary STACKLEY The 2017 President's Budget submission represents a comprehensive approach to close growing gaps in Naval Aviation warfighting capacity and capability. The Department has committed to a balanced objective of sustainment, modernization and procurement across the strike fighter force. If resourced as requested, the plan will integrate fifth generation capabilities to meet the expanding adversary threat, continue modernization of the current fleet to maintain warfighting relevance and sustain strike fighter capacity to meet anticipated operational commitments into the future.

The 2017 President's Budget request addresses all facets of Strike Fighter Inventory Management. In the near-term, sustainment investments are targeted at maximizing F/A–18A–D availability. The Navy has harmonized critical readiness accounts to target repair requirements which will ultimately continue to increase depot throughput to meet operational demand. In the mid-term, investments are targeted at decreasing F/A–18E/F service life extension risk to sustain inventory capacity into the 2030's. Targeted investments accelerate the F/A–18E/F Service Life Assessment Program and procure additional aircraft to ensure inventory capacity and pipeline aircraft availability during the process. In the far-term, the Department has focused on overmatching the expanding adversary threat with the integration of fifth generation capabilities. An additional ten F–35C aircraft over the Future Years Defense Program, relative to the 2016 President's Budget request, will assure capacity to meet warfighting requirements.

Mr. TURNER. Regarding the prospect of a block buy, do you believe the program is in a position to capitalize on economies of scale beginning in FY17 if the Congress provided the authority?

Secretary STACKLEY The Department supports a future Block Buy Contract (BBC) to capitalize on economies of scale. A BBC would achieve significant savings by allowing the contractors to utilize Economic Order Quantities (EOQ) purchases, enabling suppliers to maximize production economies of scale through batch orders. An independent assessment by RAND Project Air Force, a Federally Funded Research and Development Center (FFRDC), indicates potential BBC savings between $2.5B and $3.0B over three Low Rate Initial Production (LRIP) lots starting in Lot 12. The cost savings from a BBC have been factored into the procurement cost savings in the F–35 Fiscal Year 2015 Selected Acquisition Report (SAR 2015).

As the Department is exploring the possibility of a block buy, the F–35 International Partners and FMS customers are already considering a three-year BBC beginning with production Lot 12 (FY18), which requires EOQ funding in FY17. The risk of entering into a BBC in Lot 12 is low. By the time it is necessary to commit to a BBC in Lot 12, many aspects of the Program will be stable, including completion of durability testing, 98 percent completion of all hardware qualification, completion of majority of 3F software and weapons delivery testing, stable production processes and ramp-up.

QUESTIONS SUBMITTED BY MS. DUCKWORTH

Ms. DUCKWORTH. Why is the program office including follow-on modernization efforts (Block 4 upgrades) within the base F–35 acquisition program? Is there a quantifiable benefit to not treat the Block 4 upgrades as a separate major development and acquisition program?

General BOGDAN. We estimate the documentation and approvals necessary to establish and start a new program Major Defense Acquisition Program (MDAP) will cost between $10 million and $13 million and delay execution of Follow-on Modernization (FoM) six to twelve months. The F–35 Lightning II Joint Program is committed 100% to ensuring the FoM effort is as lean as possible so that the output—capability to our warfighters—is maximized.

The JPO will place FoM on a separate contract, establish a separate program baseline and require cost, schedule, and performance metrics—to include Earned Value Management metrics and Nunn-McCurdy criteria—on this separate FoM baseline. This contract structure will allow the JPO, Defense Contract Audit Agency and you the Congress and your staffs to have full insight into its costs, performance, and earned value—all the tools necessary for you to perform your oversight function. We are completely receptive to adding your specific reporting requirements that you believe are necessary. The JPO has no intent to "bury" the FoM program within the larger F–35 program to avoid performance monitoring and oversight—we just want to avoid unnecessary and costly effort. We can assure this openness and believe it is achievable without characterizing it as a new program.

QUESTIONS SUBMITTED BY MR. JONES

Mr. JONES. What is the total cost of the F–35 program from its inception through FY 2016?

Dr. GILMORE. Program costs are officially reported in the Selected Acquisition Reports (SAR), formally submitted by the Department. According to the December 2015 SAR for the F–35 (as of the FY 2017 President's Budget), released in March, 2016, the "Appropriation Summary" table on page 28 shows that the total cost of the F–35 program from inception through FY 2016 is $111,219.4M or $111.2B.

Mr. JONES. What is the total cost of the F–35 program from its inception through the President's Budget request for FY2017?

Dr. GILMORE. Program costs are officially reported in the Selected Acquisition Reports, formally submitted by the Department. The following answer is from the December 2015 SAR for the F–35 (as of the FY 2017 President's Budget), released in March, 2016. Per the "Appropriation Summary" table on page 28, the total cost of the F–35 program from inception through FY 2017 is $121,931M or $121.9B.

Mr. JONES. What is the total cost of the F–35 program from its inception through FY 2016?

Mr. SULLIVAN. By the end of fiscal year 2016, DOD will have invested a total of $59.02 billion in F–35 development and procurement. When the F–35 development program began in 2001 DOD estimated the total acquisition cost to be $233 billion (then-year). As of December 2015, the total program acquisition cost estimate had increased to $379 billion (then-year), an increase of 62 percent.

Mr. JONES. What is the total cost of the F–35 program from its inception through the President's budget request for FY2017?

Mr. SULLIVAN. The total investment in F–35 development and procurement from program inception through the end of fiscal year 2017 will be $69.14 billion, based on DOD's fiscal year 2017 budget request.

Mr. JONES. What is the total cost of the F–35 program from its inception through FY 2016?

General BOGDAN and Secretary STACKLEY. $127.5B

Appropriated through Fiscal Year (FY) 2016: Below reflects the total cost of the F–35 program from inception through FY16 to include United States Air Force (USAF), United States Marine Corps (USMC), United States Navy (USN) and the International Partners. System Development and Demonstration (SDD) includes Pre-SDD and International Partner contributions. Military Construction funds are not executed out of the Joint Program Office but are shown for completeness.

The USMC declared Initial Operational Capability (IOC) with its F–35Bs in July 2015 and USAF IOC is scheduled between 1 August and 31 December 2016. The F–35 program completed Block 2B and Block 3i software. Block 3F software is now in Developmental Flight Test. The program completed Italian, Australian, and Dutch tanker aerial refueling flight test. Overall, the F–35 Fleet has over 51,000 flight hours and we recently completed the second trans-Atlantic flight in an F–35. The Fleet consist of 184 operational and test aircraft, and the program has procured

a total of 203 US and International aircraft through Low Rate Initial Production (LRIP) Lot 8 and will contract for an additional 52 and 91 in LRIP Lots 9 and 10, respectively, by end of 3rd quarter FY16.

Program / Appropriation	FY94–FY16 US $M	FY94–FY16 International $M	Total $M
System Development and Demonstration	48,182	5,205	53,387
Defense Wide (1994–1998)	118	0	118
Deployability and Suitability	287	57	344
Follow-on Modernization	167	51	218
Procurement	55,879	14,303	70,182
Other Procurement Navy	33	0	33
Operations and Maintenance	1,482	0	1,482
Military Construction	1,782	0	1,782
Total	**107,930**	**19,616**	**127,546**

Mr. JONES. What is the total cost of the F–35 program from its inception through the President's budget request for FY2017?

General BOGDAN and Secretary STACKLEY. $144.7B

Appropriated through Fiscal Year (FY) 2017: Below reflects the total cost of the F–35 program from inception through FY17 to include United States Air Force (USAF), United States Marine Corps (USMC), United States Navy (USN) and the International Partners. System Development and Demonstration (SDD) includes Pre-SDD and International Partner contributions. Military Construction funds are not executed out of the Joint Program Office but are shown for completeness.

During FY17, the program will complete Block 3F Verification and Mission Effectiveness Testing and begin Block 3F introduction to F–35A. Also, the program will transition to leaner Follow-on Modernization for developing and delivering enhanced capability. The program will procure 63 aircraft for the US Services as part of Low Rate Initial Production (LRIP) Lot 11 and we will continue to build the Global Sustainment Posture in order to best deliver the required cost and performance outcomes.

Program / Appropriation	FY94–FY17 US $M	FY94–FY17 International $M	Total $M
System Development and Demonstration	49,596	5,227	54,823
Defense Wide (1994–1998)	118	0	118
Deployability and Suitability	383	67	450
Follow-on Modernization	458	178	636
Procurement	64,582	19,712	84,294
Other Procurement Navy	36	0	36
Operations and Maintenance	2,155	0	2,155
Military Construction	2,354	0	2,354
Total	**119,682**	**25,184**	**144,866**

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