

# Joint Strike Fighter – Lightning II Monthly Assessment Report

Prepared for the Joint Strike Fighter Program Office (JSFPO)

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## 1.0 JSF Executive Summary

Current projection for return to flight of AA-1 has slipped to middle of November; AA-1 still requires resolution of several issues before this can occur – notable items consist of: A final decision to address the F-135 3<sup>rd</sup> Stage Blade liberation anomaly is ongoing. Flight Test Letter (FTL 4109 CTOL-CV Rev G) has been issued defining ground operating limitations and references inspection criteria for the three Initial Flight Release (IFR) engines. Flight Test Engine 1 (FTE-1), currently installed in AA-1 has passed visual borescope inspections, although safety analysis allowing engine flight operation is still pending. FTE-3 has had new 3<sup>rd</sup> Stage Blades installed with a revised assembly procedure, has undergone extensive non-destructive testing, and could potentially be installed into AA-1 to support return to flight activities. An engine change would add additional AA-1 down time. Integrated Power Package (IPP) oil samples have indicated unallowable traces of Ni alloy, similar to Inconel-718. Stator and Rotor clearance issues within the IPP have been identified as the root cause. Design clearance corrections are being implemented, and a rebuilt IPP is forecasted for availability in late October following successful acceptance testing. Additionally, during VSIBIT checks on AA-1, a low reservoir quantity indication occurred on the left hand Horizontal Tail EHA and both Rudder EHA's, preventing IBIT to pass. Other EHA's have experienced leakage issues as well and have been returned to the vendor for analysis.

EAC-6 is underway; with revisions, Budget Change Requests and Cost Performance Report expected in the Spring 2008.

Production Status (As of 7 Oct 07)	
Forward Fuselage	6 – Assembly 3 – Mate
Center Fuselage	11 – Assembly 4 – Mate
AFT Fuselage	5 – Assembly 3 – Mate
Wing	6 – Assembly 2 – Mate
Mate & Delivery (EMAS)	4 (BF-1, BF-2, BG-1 & BF-3 C/F)

**BF-1** – As of 11 Oct 07, critical parts required to support 22 Oct 07 power-on activities have been shipped, although there are delay issues with customs for the EDU and power panels  
 – the development of the remainder of Vehicle System Release Authorization Notices (RANs) in support of power-on is expected to be complete the week of 15 Oct 07. BF-1 Wing build still has of touch labor budget left to earn by its completion date in Dec 07. Current weekly earnings must improve in order to meet this time frame.

Mitigation would entail 3 shift work effort and work-arounds for late parts. As of 7 Oct 07, BF-1's first flight date of 23 May 08 is projected to be -30 Mdays late (~ 1.4 months)

**AF-1** – Center Fuselage has a 40 day slip (was 30 Oct 07, it is now 8 Jan 08).

As of 7 Oct 07, all major build is behind MS5 schedule. Center Fuselage is 84% complete, Forward is 57%, Wing is 17%, and the Aft is 36% complete. Numerous delays such as late to need engineering, tooling, planning, critical jig load parts, late parts, change, re-work, etc pose untenable threats to MS5 first flight date of 5 Jan 09 is -78 Mdays (~ 3.75 months). LM Aero is six (6) weeks behind schedule on their internal Shop Operating Plan – this SOP is a better reflection of reality ( when compared to the Master Schedule). LM is evaluating opportunities to reduce span, however DCMA currently views the majority of proposed Mate and Delivery opportunities as aggressive and overly optimistic.

SPI continues to show improvement – moving from 0.966 to 0.972. The majority of the schedule recovery was due to schedule improvements in Tooling deliveries and Engineering labor. The FET continues to work on identifying delays and working their recovery plans. The FET is projecting the majority of the schedule recovery being completed by CDR (Feb 08).

**STOVL –**

BF-4: NGC Delivery of Center Fuselage has a 21 day slip (was 14 Nov, it is now 7 Dec07). As of 11 Oct 07, ~83% of the work in J320 has been completed (624 hrs remain open) and ~4.6% of J300 has been complete. Approximately 375 hrs of work remains open in J345. BF-4 lost 3.8 days of Master Schedule margin; down to 13.9 days ahead of schedule; however, BF-4's critical path position improved by 0.8 days to 10.1 days behind assembly schedule. The completion percentage improved slightly by 0.3% to 9.1% behind planned completion (99.1% planned / 90.0% actual). Late TFE remains 30 items (~197 hrs of work) which are currently planned to defer back to LMA.

BF-5 – Not loaded; initially scheduled to load 24 Aug 07; however with CV units delaying entry into the duct cost centers and schedule adjustments anticipated in MS6, this start will be delayed until sometime in October.

**CTOL –**

AF-1: As of 11 Oct 07, as ~ 3,465 hrs open to complete prior to delivery. waiting for the engineering buy-off for DITMCO electrical testing on the wire harnesses ATP, and is still planning to transition to Hydraulic installation/testing as soon as possible given part availability; there are still approx +/-70 parts holding up assembly

Approx. 20 parts remaining have delivery ECDs on or prior to 17 Oct; 6 NGC parts have unknown ECDs  
Installation planning continues to stress schedule.

AF-2 – Currently in J330a for lower keel assembly mate with upper duct assembly; delivery of the gun trough assembly remains problematic: the trough assembly ECD remains unknown due to a non-conformance condition; the current ECD for the AF-2 Forward Gun Access Panel remains unknown. Composite skins needed for J330 have ECDs at the end of October: this will stress efforts to contract the span-time in J330 or will increase down-stream work if internally traveled to the next cost center.

AF-3 – Currently in J345c working fuel systems (fuel tubes) and other initial upper systems and skin installation, as well as lower keel weapons bay web assemblies. Gun Trough Blast Port Assembly delivery has slipped 1 month. The current ECD for the AF-3 Forward Gun Access Panel remains unknown; however other critical gun trough assembly pieces should be delivered in time to support AF-3's delivery date.

**CV –**

CF-1: As of 11 Oct 07, currently in J351 as implements their mitigation/recovery plan caused by the scrapped J355 Keel section. Mitigation consists of using the scrapped LH Keel section in the lower tank assembly (J355) as a surrogate with the intent of locating and preparing as many parts as possible prior to receiving the re-made Keel section – currently estimated for an 11/13 delivery. At this time, the ducts have been mated to the Forward 270 Bulkhead and the drag brace and other pieces of the lower tank assembly are being located/temp installed. If the new Keel section delivery date holds, assembly spans in later cost centers will be further compressed.

Considering the behind schedule position at LMA, the current delivery Need Date for the Center Fuselage in Ft. Worth appears ahead of the actual need for the Center Fuselage, and is apprising LMA of costs and schedule risks to continue to hold the CF-1 delivery date. LMA is assessing risks to schedule vs. cost of compression/schedule recovery and will decide on a course of action in the next 2 weeks.

CF-1 is currently 30.9% behind planned completion; 39.5-days behind critical path schedule/19.5-days behind Master Schedule.







### **Effective Acceptance Processes / Safety of Flight –**

Aircraft AA-1 Return to flight effort – performed the following product evaluations:

- Ejection Seat Rail installation
- Cockpit prior to Seat installation
- Seat inspection (prior to install)
- Fuel Cells AF5 L&R close-out – Completed End Item Inspection (CEII)
- L&R Flaperon EHA Installation
- Panels 4170 L&R CEII (Flaperon EHA areas)--Close-out
- Panels L&R (Fwd Eng Bay Area)--Close-out
- Panels L&R (XX)--Close-out
- Landing Gear Normal Extension/Retraction SCOP

Reassessments of two Panels on AA-1 were required due to identified loose harness clamps – both discrepancies were corrected.

### **Safety of Flight Implementation –**

LM effort to implement DCMA SOF requirements into progressing slowly – DCMA attending weekly LM planning meetings in an effort to expedite implementation of SoF requirements. DCMA is currently updating the SOF list to include STOVL requirements as well as known requirements for CV. The updated format and list will be submitted to LM by mid October 2007 – this will ensure STOVL specific SOF inspections are conducted on BF-1 as well as and-on aircraft.

Additionally, DCMA LMFW has recently approved DCMA Palmdale NGC SoF Plan for center section production operations. DCMA Palmdale is presently incorporating their SoF requirements into our master surveillance plan. Completion is TBD.

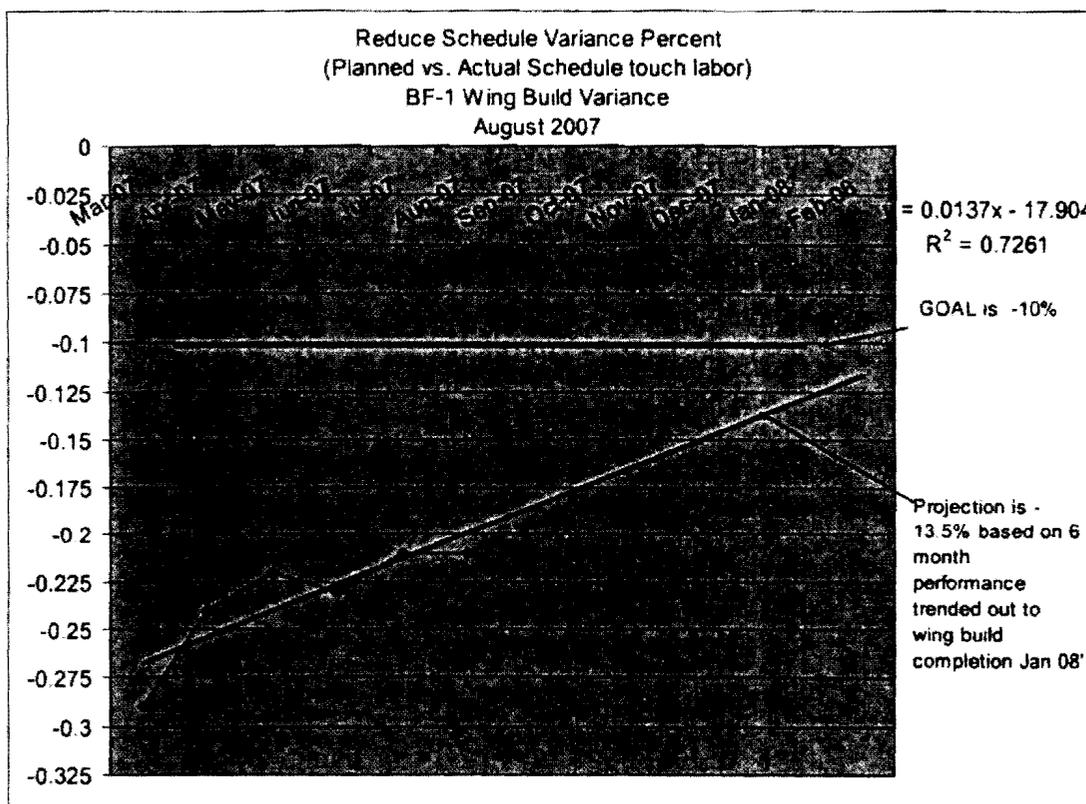
### **Effective Manufacturing Processes / Successful Component Build –**

WBS 3100 performance to date has been degrading over the last six months with WBS 3140 Wing build remaining on the critical path. With the exception of BF-1, we have no Wing builds (BF-2, BG-1, BF-3, AF-1, etc.) with assembly touch labor cost efficiencies

Due to shortages, complex work, engineering change traffic, QARs, late planning, and a host of other factors continue to impact the mechanics ability to earn budget in an efficient manner.

Some program improvements LM is working on include: Standing up advanced workable set-up teams to review job packages prior to major assembly start, design and tooling changes to reduce metrology work, tiger teams to improve part deliveries, process improvement initiatives and increasing manpower and outsourcing to reduce planning backlogs.

BF-1 Wing schedule variance percent (Planned vs. Actual Schedule) has improved over the last six months. Projecting this performance out to build completion yields a -13.5% variance. This is still below our DCMA internal goal of -10%, however, it would be a considerable improvement over AA-1 Wing build variance of ~-50%.



Based on the current state of Wing Production, DCMA Fort Worth feels that addressing the part shortage should be our next process review area. Next month we will contact LM Production, Planning and Control to initiate our next review.

DCMA Fort Worth continues working with the 6S Continuous Improvement Team: Tool Storage and Retrieval and have several open actions being worked related to our audit findings last month.

Some highlights of DCMA participation include:

- Worked Closely With Material Handlers and Mechanics
- Sorted Tools by SWBS



**Effective Quality Processes / Reduction in MRB Discrepancies –**

Based on the review of customer metrics, audits were conducted by DCMA with our focus in the hole drilling process. We have created Process audit checklists and are continually updating them to meet our goal. Areas observed during audits consisted of the following- LM Employee Training, EWI/Blueprint/AEI/AEA data currency, engineering change implementation, FOD/tool control, housekeeping and controlled materials usage. As data is collected we can better determine a plan of attack for recommendations that will reduce the amount of MRB.

Contractor corrective measures are being reviewed and our focus on the multiple drilling issues continues to show as an area of concern. DCMA will continue audits focusing on the drilling processes as well as the other high drivers in MRB.

Forward Fuselage Assembly (Risk -Moderate): No change of risk as Manual Hole Drill / Prep continues to be the top defect driver.

Wing Assembly (Risk – Moderate): No change of risk as Manual Hole Drill /Prep continues to be the top driver for defects in this area as well. Tool control is a very unstable process in the Wing area

Mate (Risk – Moderate) No change of risk as defects for hole issues and fastener installs continue to be an area needing attention.

Flight Ops / Delivery (Risk – Moderate): 2AA1, Customer Concern (ICA # 69008) Follow-up surveillance has revealed no additional areas of concern. DCMA has performed several follow-up audits to assess the adherence to written work instruction in the flight operations area (Run station 4). Having found no further incidence of the concern referenced in ICA # 69008. We have given authorization to close this concern but have informed LM that we will continue surveillance to insure that this process remains in control and progresses with added requirement.

Engineering, EWI, and workmanship discipline issues continue to be the high drivers.

DCMA will continue to audit to ensure engineering changes are carefully controlled during implementation. Continued monitoring of contractor corrective measures are being undertaken to focusing on the multiple drilling issues. We are continuing audits focusing on the drilling processes being used. Contractor data is reviewed weekly and process audits are being scheduled in each area in attempt to influence MRB and to establish a DCMA observed trend as well as establishing documented surveillance strategy.

## 5.0 Vehicle Systems

Electro-Hydrostatic Actuation System (EHAS) – SOF testing will start with the -8 Electronic Units (EU's) and end with the -10 configuration. The -8 EU configurations will be used for BF-1 power-on activities. Ultimately, the -10 EU configurations will be used for STOVL B-1 first flight.

is working to a new specification to update functional SOF test procedures (120). LM has approved 59 functional SOF test procedures and 61 remain to be completed before the start of STOVL System SOF. Approval for a remaining quantity of SOF test procedures will be required to complete STOVL System SOF testing. Testing is in progress utilizing previously approved procedures.

The current EHAS system specification (Rev F) has 23 supplements. A Rev G is to be issued to consolidate Rev F and all current supplements.

The program plan is under pressure to meet LM remaining needs for:

- Software FQT completion by **Dec 07** (slipped from Sept 07)
- B-1 system (wing and empennage) SOF completion by ~~Dec-07~~ **Feb 08**
- System SOF completion by ~~Dec-07~~ **Feb 08**
- SOF completion by ~~Dec-07~~ **Mar 08**

The above aggressive schedule is dependent on a timely solution of CTOL system Problem Reports (PRs) that have been pushed to STOVL. The number of EHA and EU CTOL PRs will not have a great impact/risk on the STOVL schedule.

LM Aero comment: LM has reacted strongly to the emerging situation at by putting an experienced, multidisciplinary RTG team in place at

This 15-person team is led by a proven Sr. Manager who is acting essentially as a co-Program Manager to the PM. Lockheed JSF executive management has also actively encouraged to assume more responsibilities as a partner to and has put a manager in place at as well.

has established a Risk Board. The team is working to identify all known risks that are being reported in all IPT areas. Efforts include the development of a comprehensive Risk Management strategy. Risk Management Tool selection is among the current discussion items.

System Check-Out Procedures (SCOPs) Completion Progress – A total of 107 SCOPs remain to be completed prior to BF-1 first flight (May 08). Current completion rate is approximately 46% behind MS5 schedule as of Sep 07.

Leading Edge Flap Actuation System (LEFAS) – , has proposed design changes to LEFAS performance based specification (PBS) 2ZRZ00010 Revision C to revise the temperature requirement to -77 °F to 248 °F. This change will require Safety of Flight regression testing and retrofitting of 2AF and 2BF aircraft hardware.

Electrical Power System (EPS) – has completed AA-1 return to flight (RTF) activity with re-certification of the Inverter Converter Controller (ICC) and sub-system on 22 Aug 07. This included multiple interim software releases, extensive fault testing in System Integration Lab (SIL) at and the Vehicle System Integration Facility (VSIF) at LM, failure and safety analyses, a thorough review of high voltage design rules, and support to other suppliers. Per LM direction, this effort was made priority #1, and the impact to the remainder of the program is being assessed.

Following the PMR, held a detailed schedule review on 18 Sept 07 to mitigate RTF impact to the CF-1 alternate configuration of hardware. Key sequencing and hardware allocation initiatives were taken to pull back certification dates for the ICC, ESG and sub-system to support the vehicle manufacturing plans and provide hardware as early as possible to VSIF for EHAS integration risk reduction testing. Several actions remain open in order to meet this plan, and an impact assessment of the schedule acceleration is under way.

HS finalized an enhancement to the ground fault logic that provides a more robust solution to short circuit conditions encountered on Flight 19. The solution is incorporated into Block 6 software which has been delivered to LM. This should eliminate the possibility of one ICC tripping because of fault return current from the other ICC. This solution also increases sampling time for critical fault parameters which prevents the possibility of nuisance tripping. Verification tests have been successfully completed in both the VSIF and SIL.

A humidity test failure is under investigation for the 5.4 kVA Nonlinear Inverter (NLI). This has caused a delay in the SOF certification and hardware shipments to BF-1. A workaround plan is underway to provide a qualification unit to the aircraft for power-on pending completion of the failure resolution plan.

Power Thermal Management System – On 21 Aug 07, the Integrated Test Stand (ITS) experienced a shut down while the PTMS was operating in cooling bleed mode. The ITS is currently in refurbishment due to damage sustained during testing. Due to the ITS system shut down, the developmental testing is now 40 days behind schedule. will re-scope their development activities, but will maintain the BF-1 SOF start date of 26 Oct 07.

is confident that the rotor was the root cause of the PTMS failure. They believe that the rotor contacted the stator and gradually wore the stator, the rotor's sleeve and the enclosing magnet " is redesigning the or by introducing additional clearance between the rotor and stator.

Supplier Schedule – A total of 10 components remain to be delivered which are required for BF-1 initial power-on schedule for 22 Oct 07. See attached document below for detailed list.

## **6.0 Mission Systems**

The following SW Productivity table provides the required and an estimate of the actual block 0.1 and 0.5 software productivity for each of the major software teams. This table shows results of SW Productivity calculation that uses cumulative hours since the over target baseline (OTB).





## 8.0 Earned Value

DCMA JSF – August 07 Data

Lockheed is now reporting to an Over Target Baseline of \_\_\_\_\_ reported in the Cost Performance Report (CPR). The August 2007 cost summary is as follows:

	BAC	LMEAC CPR	DCMA IEAC
Performance Measurement Baseline (PMB)			
Management Reserve (MR)			
Total:			

Table 1 – Budget Baseline and EAC Summaries

Primary Trip Wires				Secondary Trip Wires				
System Indicator	Baseline Indicator	Cum BEI	SPI	Cum CPLI	CPI	CPI/TCPI 10%	Contract Mods 10%	Baseline Revs 5%
(a) Yellow		0.90				5.3%		N/A

### Primary Trip Wires –

(a) System Indicator: See EV Report (System Surveillance Section)

(b) Baseline Indicators: A baseline assessment shows the contractors BAC and EAC to be optimistic. To complete the contract within the CBB, the contractor needs to be about 5.3 percent more efficient. The BAC has increased by 36% since the start up in Cot of 2001. The cost growth is likely to increase due to inherent engineering risks in the first versions of STOVL and CV

aircraft

**Secondary Trip Wires –**

The Baseline Execution Index (BEI) metric is an Integrated Master Schedule (IMS) based metric that calculates the efficiency with which actual work has been accomplished when measured against the baseline. The BEI provides insight into the realism of program cost, resource, and schedule estimates. An index of 1.0 indicates the program is being completed as planned.

- Baseline Execution Index (BEI): Cumulative Tasks from October 2001 thru September 2007: Cum BEI = 113,851 Completed Tasks/126,446 Planned Tasks = 0.90  
Monthly (September 2007) BEI = 1197 Completed Tasks/1959 Planned Task = 0.61
- SPI= BCWP/BCWS= .985

The Critical Path Length Index (CPLI) indicates whether or not the program schedule can be completed on time. This is an Integrated Master Schedule (IMS) based metric that calculates the longest, continuous sequence of tasks through the network schedule from contract start to contract completion. An index of 1.0 indicates the program will finish on-time.  $CPLI = (Critical\ Path_{Baseline}\ Duration + Float\ Duration) / Critical\ Path_{Baseline}\ Duration$

- CPLI= (2990 + (377))/2990 = .87
- CPI= BCWP/ACWP= -0.982
- CPI/TCPI= 0.982/1.034=.947
- Contracts Mods – (BAC now)/original BAC 10/01= .359

The DCMA Risk Rating for EVMS at the total program level is rated yellow - using the agreed to parameter of VAC (-6.04%). Compare this to the Lockheed's EAC and one can see a difference of over 5%. Similarly, the  $TCPI_{EAC}$  is different when using the DCMA IEAC versus the contractor's EAC:

$TCPI_{DCMA\ IEAC}$	= 0.873
$TCPI_{LM\ EAC}$	= 1.034

Cumulative to date SPI and CPI are at .985 and .982 compared to .987 and .982 in the previous month. Cumulative SV% and CV% are -1.54% and -1.80%, compared to -1.33% and -1.79% in previous month and are also rated green.

The complete EV Report is attached:

## **9.0 Process Reviews**

A process review of System Engineering Memorandum (SEM) -103 was conducted by DCMA Fort Worth. This SEM is a temporary modification to System Engineering Instruction, SEI-1074 – JSF Aerospace Equipment Instruction, and replaces the first three paragraphs of that Instruction in its entirety. The Instruction establishes uniform requirements for defining, preparing, implementing, and using JSF Aerospace Equipment Instructions (AEIs). They and are generated when Build-To-Packages (BTP) data is insufficient or too complex to provide the user the needed instructions and details to accomplish an engineering requirement.

AEI's are formally released engineering documentation. As such they are used to provide system test requirements and procedures for maintaining, rigging and troubleshooting aircraft issues. They are also used as the source material for Planning and System Check-Out Procedure (SCOP) development. Once the aircraft has been delivered (DD-250), the Joint-Services technical Document (JTD) must be utilized.

All AEIs are required to be reviewed and approved by the AEI Review Group (ARG) prior to formal release. ARG membership consists of Subject Matter Experts (SMEs) of the various disciplines listed with in Para. 3.J.4 of SEM-103.

which is maintained by the ARG Chairperson. No published list of current membership was available. The document review process and subsequent approval signatures of the ARG membership are managed virtually through Product Data Management (PDM) System to provide traceability. If conflicts occur, the ARG board is convened with the responsible Engineering IPT (AEI's owner) in attendance.

Current strategy is to revisit SEM-103 process to verify its formal incorporation into SEI-1074 has occurred within 6 months.

## 10.0 Appendix A

**EV Assessment Criteria** Rating Criteria is based on the DCMA VAC% and when possible should include MR in the DCMA IEAC

- - VAC% > -5%
- Yellow -  $-10\% < \text{VAC}\% < -5\%$
- - VAC% < -10%
- N/R - Not Rated or Not Reported