
STS-126 MOD FRR

FLIGHT DESIGN AND DYNAMICS

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Agenda Item 6

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Shuttle CoFR Status Summary

MOD Requirements Codes *	DM	USA FDD
CRITICAL PROC./APPL	G	G
NON-CRITICAL PROC./APPL	G	Y
FD-TRAJECTORY	N/A	G
FD-CONSUMABLES (PROP)	N/A	G
FD-ANALYST CERT	N/A	G
FD-CTF	N/A	G
FDF	G	G
EMCC	G	G
CREW TRAINING (RNDZ)	G	G
CERTIFIED FLIGHT CONTROLLERS	G	G
CERTIFIED INSTRUCTORS (RNDZ)	G	G
FTP-NEW OPS	G	G
FLIGHT ANOMALY RES	G	G
ANOMALY-PROCEDURE	G	G
EX/AI FROM PRIOR READINESS REVIEW	None	None
NO CONSTRAINTS	None	None
LEVEL II (PROGRAM) ACTIONS	None	None
MISSION REQUIREMENTS	G	G
CMD PROC	G	G
EXCEPTION RESOLUTION	G	None
FPPP REQ MET	G	G
CONTRACTOR PROCESS INSIGHT	G	N/A

G	Ready to support flight or standard open work
Y	Non-standard open work with expected resolution
R	Open work without expected resolution
N/A	Does not apply
None	None identified

* as defined in DA8-020 "MOD Certification of Flight Readiness Process" document

Mission Overview Summary

Launch/Landing Times	Date	GMT	EST	
Launch Window Open	Nov 14, 2008	00:50:16	19:50:16	(hh:mm:ss)
Launch Window Close		01:00:16	20:00:16	(hh:mm:ss)
Landing Time (KSC)	Nov 29, 2008	19:02	14:02	(hh:mm)

FD3 rendezvous opportunities are anticipated for every day in the November launch period

First Stage Design Criteria **DOLILU II / High Q**
Insertion Altitude/Inclination **122 nm / 51.6 deg**

APM (above a 5 minute window centered at in-plane)

I-load Design **1825 lbs**

Projected APM* **1913 lbs**

* Based on 09/30/08 APM simulation and 09/23/08 Green Book

Launch hold capability inside of drainback is dependent upon actual DOL performance.
Abort coverage has sufficient overlap from liftoff to MECO.

Propellant Summary

Propellant Summary	FRCS (lbm)	ARCS (lbm)	OMS (lbm)
Loadings	2175	4970	22761
FRR Design Margins **	673	0	13

** Assumptions: STS-126 ATL, FRR Cycle Trajectory Inputs, 190 nm RNDZ, 103 sec OMS Assist, 2 mated water dump

Significant Requirements Changes Since Design Baseline

- **Launch Date from 9/18 to 11/10 (EST)**
 - Targeting November 14, 2008 (EST) launch
- **FRCS loaded to mid-point**
 - Implemented to increase on-orbit propellant
 - APM reduced by 245 lbs
- **Main Engine #2 swap with STS-125**
 - No impact to Flight Design
- **PSSC deploy/separation plan updated to ensure safe relative motion with the ISS**

Significant Mission Firsts and Unique Items

- **First flight of OI-33 Flight Software**

- LO2 and LH2 Prevalve Timer Modification
 - Ensures that the reference point for the start of the prevalve time delay is measured from the time the engine was first detected to be in shutdown
- MM102 Three Out SERC
 - ASC DAP sets Contingency Single Engine Roll Control flag when MECO cmd flag is set in first stage
- Increase GRTLS Aft RCS Jet Limit
 - Increases Jet Select Logic (JSL) limit on the number of jets per RCS pod available during GRTLS
 - Current limit is hard-coded at 4
 - Creates a new I-Load RCS_JLIM which allows the limit to be increased
- RTLS ET Separation Improvements & Correction to RTLS ET SEP Jet Commanding
 - Addition of new pitch down maneuver during mated coast
 - Changed the maximum time automatic ET sep can be inhibited from hard-coded value to I-Load
 - Flight Control attitude error limits, body rate limits and deadbands modified to support better roll and pitch control during ET sep
 - Moved speedbrake opening from MM602 to MM601 (MECO confirmed)
- Bearing Displays
 - Added new ascent and entry bearing displays for increase situational awareness
 - Assists crew in assessing vehicle performance abort capabilities

Significant Mission Firsts and Unique Items - Continued

- **First flight of OI-33 Flight Software (cont)**

- Remote Control Orbiter Enhancement
 - Provides automatic capability to arm and deploy landing gear and drag chute if RCO is enabled and TAEM guidance has terminated
 - Resumption of GPS navigation during rollout if RCO capability has been enabled and MLS is no longer available
- ECAL Energy Compensation
 - Compensates the effects of phugoid motion on the orbiters estimated energy state for OPS 6 ECAL cases
- Improved GRTLS TAEM Alpha Trap
 - Modifies Alpha Recovery to Nz Hold Transition logic by employing a hysteresis function for both the arm and trigger alpha criteria
- I-Load Constraints Modification
 - Modifies I-Load constraints to cover newly created I-Loads for OI-33
- No drag for Lambert Guidance Improvements
 - Enables drag from TIG-15 seconds through TIG
 - Clean-up from a previously implemented CR
- Year End Roll Over Reset eases the roll over of FSW into a new year
 - Navigation Category GPT updated to expand the use of I-Load LAUNCH_Year to include 3 Principle Functions
- BFS GPS Auto Update Frequency
 - Allows BFS nav to be updated with the selected GPS state at I-Load specified intervals when in auto mode

Significant Mission Firsts and Unique Items - Concluded

- **First Shuttle operational use of SPOT (Spacecraft Position, Optimal Tracking)**
 - Provides filtered GPS state vectors certified for use in ephemeris updates
- **First flight of Trajectory Server version 12.0.2.1**
- **First flight using Linux MCC workstations**
- **DOLILU Block update 2008.02**
 - System Dispersions for High-Q and Roll Maneuver (CR S052550NV)
 - Alpha/Beta Wind Persistence Increments for Roll Maneuver (CR S052550NV)
 - Large Scale Wind Change Redlines (CR S052550NY)
 - Integrated testing occurred on 08/12/08
 - Operational Acceptance Review approved at the SICB on 08/26/08

Deviations, Exceedances and Anomalies

Deviations/Exceedances

- **Contingency Abort Black Zone (CABZ) assessment required**
 - Mass properties do meet the CABZ assessment criteria of liftoff weight greater than 259,000 lbm and Xcg aft of 1115.0 in.
 - OCF cycle liftoff weight = 266,777 lbm. and Xcg = 1117.9 in.
 - FRR cycle liftoff weight = 266,894 and Xcg = 1115.7 in.
 - Analysis results showed increased black zone exposure, particularly in the 3 engine out and RTLS
 - Results presented at A/E GNC panels, STS-126 Flight Director and Flight Manager, SIRB and SICB
 - Action given by SICB to perform analysis on Uplink TDDP and report back to board

Deviations, Exceedances and Anomalies - Continued

Deviations/Exceedances

- **Thermal/Structural Envelope Program (TSEP) violation identified for a December EOM entry**
 - Violation sent to Boeing for analysis
 - Tracked as Non-Standard Open Work closure date TBD
- **No Dock PLS downweight exceeds the NEOM downweight limit by 2296 lbs.**
 - Preflight thermal analysis is not required
 - Real-time analysis will be performed if required
 - Mission-specific flight rule has been submitted
- **DOL I-load transfer script**
 - During STS-125 TCDT, I-load transfer script failed
 - Failure traced to ftp default format mismatch
 - Manual comparison of GPC dump and I-loads verified good I-load uplink
 - Script to be altered to use correct format
 - Tracked as Non-standard Open Work, expected to be completed by 10/17

Deviations, Exceedances and Anomalies - Continued

Previous Mission Anomalies

- None

Significant ARs and Disposition

- None

Deviations, Exceedances and Anomalies - Concluded

- **NCR 013693 STS-125 Contingency Abort Anomaly**
 - **During STS-125 simulation, 2 SSME's failed at the Single Engine PTM boundary, ATO targets were not achieved**
 - **Manual Single Engine PTM Gamma Miss procedure approved at Flight Techniques on 8/29**
- **Open Risk Assessments**
 - **None**

Special Topics

- **Launch Opportunity**

- **Beta angle constraint for 11+1 docked days precludes launching on November 26th-December 16th.**

- **MOD assessing November 26th launch opportunity**
- **November 26th launch would exceed beta angle constraint on the contingency docked day**

LAUNCH Date/GMTLO	BETA ANGLE AT UNDOCK	
	11 Docked Days 12/14:41:00 MET	12 Docked Days 13/13:34:00 MET
November 25 20:26:33	-54.8	-59.3
November 26 20:00:49	-59.4	-63.7
November 27 19:38:18	-63.8	-67.8

Exceptions and Standard Open Work

- **Exceptions**
 - **None**
- **Standard**
 - **All open work is scheduled to be completed per standard flight template**
 - **Open work table in backup pages**

Non-Standard Open Work

No concerns identified for completing any of the open work

- **Non-standard**

- **Abort Support Operator Certification** **10/20**
- **DOL Loads QA Operator Certification** **10/29**
- **DOL OPS 2 Operator Certification** **10/29**
- **OCRD S164080CM- TSEP Violation from CTF assessment** **TBD**
- **Report UPL cycle CABZ status to SICB** **TBD**
- **Fix DOL I-LOAD transfer script to output to binary format** **10/17**

Rescue Mission Status

- **STS-119 has been designated as the LON flight for STS-126**
- **STS-119 will be ready to launch on 2/8/09 with the cargo element if required.**
 - **STS-119 production schedule is based on the 2/08/09 STS-126 LON launch date**
 - **Once the STS-126 vehicle is cleared for entry, STS-119 production schedule will be updated to support the STS-119 target launch date of 2/12/09.**
- **All rescue mission-specific analyses will be performed after call-up**

Flight Design and Dynamics Readiness Accountability Statement

☑ **Software** : All software used to create mission products, and MCC software required for mission support including related ISS software and designated critical processors meets generic and mission-specific Program requirements, and is maintained under configuration control in accordance with the FDD Software Management Plan.

☑ **Flight Software** : All flight software Principal Functions (PFs) owned by FDD are ready for flight. All Discrepancy Reports and Program Notes and Waivers related to USA-owned PFs have been reviewed and appropriately dispositioned for this flight.

☑ **Anomaly Resolution** : All anomalies that could impact mission support have been closed, or have accepted and approved work-arounds in place.

☑ **Production** : All flight reconfiguration products and real-time console support products meet generic and mission-specific Program requirements.

☑ **Operations** : All mission support personnel and instructors are or will be trained, certified and current prior to supporting mission related activities. All flight-specific rendezvous crew training will be completed prior to launch.

The FDDOC Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D and E) which defines the processes and products required for a successful flight have been executed and the applicable Program CoFR requirements satisfied.

The undersigned certify that the Flight Design and Dynamics Department, upon satisfactory resolution of any noted exceptions, is ready to support flight STS-126.

Flight Design and Dynamics	A. F. Najarian Director	<i>Original signed by G.E. Schrage for</i> <small>signature</small>	<i>9/26/08</i> <small>date</small>
Flight Design and Dynamics Software	F. M. Hamilton Software Project Manager	<i>Original signed by F.M. Hamilton</i> <small>signature</small>	<i>9/29/08</i> <small>date</small>
Ascent/Descent Flight Design	D. J. Brockway Manager	<i>Original signed by D.J. Brockway</i> <small>signature</small>	<i>9/26/08</i> <small>date</small>
Orbit Flight Design	R. M. Hill Manager	<i>Original signed by R.M. Hill</i> <small>Signature</small>	<i>9/26/08</i> <small>date</small>
Navigation & Flight Design Integration	G. E. Schrage Manager	<i>Original signed by G.E. Schrage</i> <small>signature</small>	<i>9/26/08</i> <small>date</small>
Trajectory Operations & Software Development	F. M. Hamilton Manager	<i>Original signed by F.M. Hamilton</i> <small>signature</small>	<i>9/29/08</i> <small>date</small>
Management & Engineering Services	A. T. McDowell Manager	<i>Original signed by A.T. McDowell</i> <small>signature</small>	<i>9/29/08</i> <small>date</small>

Flight Design and Dynamics Declaration of Compliance with CoFR Endorsement Requirements for STS-126 Flight Readiness

- ☑ **Software** : All software used to create mission products, and MCC software required for mission support including related ISS software and designated critical processors meets generic and mission-specific Program requirements, and is maintained under configuration control in accordance with the FDD Software Management Plan.
- ☑ **Flight Software** : All flight software Principal Functions (PFs) owned by FDD are ready for flight. All Discrepancy Reports and Program Notes and Waivers related to USA-owned PFs have been reviewed and appropriately dispositioned for this flight.
- ☑ **Anomaly Resolution** : All anomalies that could impact mission support have been closed, or have accepted and approved work-arounds in place.
- ☑ **Production** : All flight reconfiguration products and real-time console support products meet generic and mission-specific Program requirements.
- ☑ **Operations** : All mission support personnel and instructors are or will be trained, certified and current prior to supporting mission related activities. All flight-specific rendezvous crew training will be completed prior to launch.

Requirements Compliance: All requirements defined by the documents below (as required by the FIDP Compliance Matrix) have been or will be satisfied prior to flight.

DOCUMENT	VERSION	DATE
Flight Implementation Data Pack (FIDP) - Generic	GEN-KF	9/24/08
Flight Implementation Data Pack (FIDP) - Flight Specific	126-BASE U	9/26/08

Waivers & Exceptions:

None

The FDDOC Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D and E) which defines the processes and products required for a successful flight have been executed and the applicable Program CoFR requirements satisfied.

Pending completion of open work and closure of noted exceptions, if applicable, Flight Design & Dynamics Operations Center is ready to support STS-126.

Director	Date
Flight Design & Dynamics Operations Center	

DM Flight Design and Dynamics (Trajectory Operations)

Significant Mission Firsts and Unique Items

- **ISS Phasing Strategy**

- ISS reboosts on 10/02/08 and 10/30/08 of about 0.8 m/s each.
- Oct 30th burn allows for Shuttle phasing closer to the launch date which can account for slips and atmosphere perturbations.
- Provides 13 consecutive launch days with Flight Day 3 rendezvous capability. (Dot Chart provided in Backup Charts)

- **Reboost/Deboost Capability**

- ATV undocked September 5, 2008
- SM engines is our current capability for STS-126 Joint Underspeed Recovery
- Propellant available for one full burn and a second half burn
 - Takes 4 days to refill SM fuel tanks after a full burn
 - 2 days will provide enough fuel for half a burn
- Full burn provides 29.5 fps delta velocity

Significant Mission Firsts and Unique Items

- **Pico-Satellite Solar Cell (PSSC) Deploy**

- Deploy at more than 5 km below ISS is required to maintain safe long term relative motion between the PSSC and ISS. Protects start of secondary mission phase which involves PSSC thruster firings with altitude changes of 30 km.
- A minimum retrograde component of 3 fps at deploy is required to ensure a sufficient separation rate from the Shuttle after deploy.
- PSSC / Orbiter relative motion will be closely monitored in the event a retrograde orbit adjust is required prior to EOM.

- **Last mission to use Edwards Temporary Runway**

- Edwards permanent runway construction almost complete
- Transition scheduled post STS-126

Significant Mission Firsts and Unique Items

- **Visiting Vehicle Traffic during STS-126 mated operations**
 - 30P undock Nov 25. Program working on undocking 30P prior to STS-126
 - 31P launch on Nov 26, dock on Nov 30. Program working on delaying the 31P launch until after STS-126

Deviations, Exceedances and Anomalies

- **Information Sharing Protocol (ISP) Server Issue**
 - **Sluggish Lightweight Directory Access Protocol (LDAP) controller causing ISP data loss while looking for ISP servers that are not yet started.**
 - **Cause: In specific case, LDAP server had not been rebooted in over 150 days.**
 - **Workaround: LDAP controller will be part of MCC global reboots**

Exceptions and Standard Open Work

- **Exceptions**

- None

- **Standard Open Work:**

- Remaining Integrated Sims
- CTL Trajectory Data (L-35 & L-7)
- TCDT Checkout in Ops Cert Mode (L-16)
- DOD Support Readiness (L-15)

- Remaining Crew Rendezvous Standalone Lessons (L-14)
- FS Orbit FDO Console Handbook Annex (L-14)
- PERA Pre-Flight Product (DM42 PERA Lead) (L-7)
- Flight Load Checkouts
 - Orbit , Ascent, A/E GPO, Entry, LSO (L-6)

Non-Standard Open Work

- None

STS-126 Flight Design & Dynamics Division Readiness Statement

The Flight Design and Dynamics Division has performed the reviews necessary to assess the flight readiness relating to flight design requirements definition, crew and flight controller rendezvous training, and trajectory operations. We have determined all applicable responsibilities acceptable for flight pending closure of the identified open work and issues.

Original Signed by B. A. Conte

Barbara A. Conte

Chief, Flight Design Requirements and Integration Branch

Original Signed by G. T. Oliver

Gregory T. Oliver

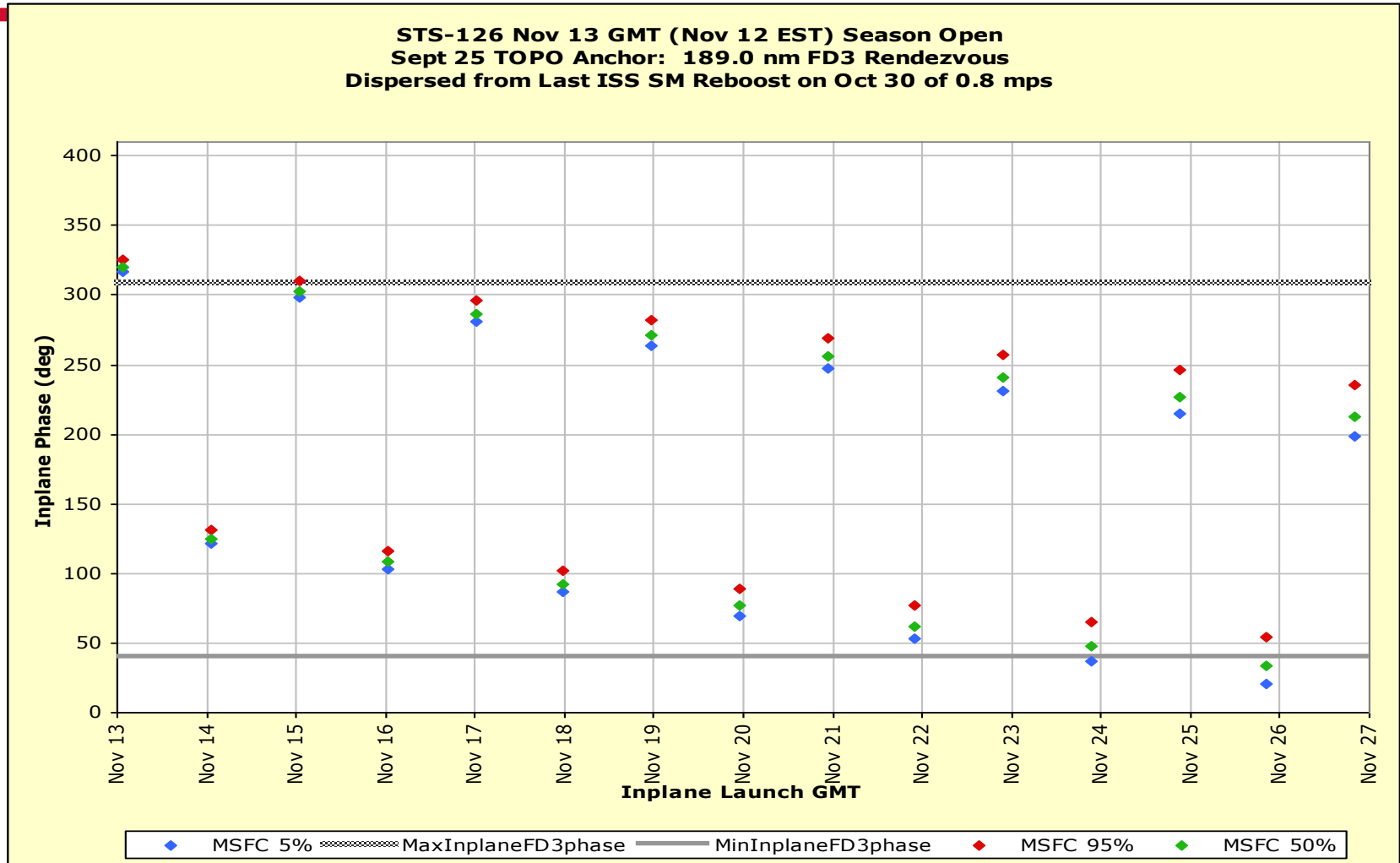
Chief, Flight Design and Dynamics Division

**As compiled by: FDM/ David Tee
FDO/ Roger Rojas**

Back-Up

- Launch Window “Dot” Chart
- Flight Readiness Open Work
- Launch Window (separate file)

Backup: Launch Window "Dot" Chart



Flight Readiness Open Work

Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Standard Open Work:				
PROP37 SODB Volume II Amendment	PROP	10/1/2008		
DATA43 FDD FRR Data Pack	FDM	10/7/2008		
PROP06 OMRSD OMS/RCS	PROP	10/13/08	9/29/08	delivered
FSW Verification Test Results Review	ADFD	10/14/08		
FSW Verification Test Results Review	Orbit	10/14/08		
RNDZ/FDO Phasing Plan Meeting	Orbit	10/14/08		
L-4 week LDO Database Freeze	ADFD	10/14/08		
CM FOE L-30 day audit	Bedford	10/14/08		
ONOR29B RNDZ Launch Target Data	Orbit	10/15/08		
DATA45 FDD FSW PF Sign-off	FDM	10/16/08		
PROP07 Abort Propellant Dump Tagup	PROP	10/17/08		
PROP02 Mass Properties	PROP	10/22/08		
RNDZ08 RNDZ Phasing Limits	Orbit	10/20/08		
Prop Analyst & Flt Controller Tag-up	PROP	10/23/08		
ONOR37B Daily Planar/Phase Windows	Orbit	10/22/08		
ASCT04 Uplink APM	ADFD	10/24/08		

Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Standard Open Work - Continued:				
NAVO16B GPO COTM Data Pack	Navigation	10/24/08		
NAVO18B GPO/ONAV Ops Memo	Navigation	10/24/08		
ONOR27 Launch and Landing Data	Orbit	10/24/08		
LDO: L-3 week LDO Checkout/TCDT Sim	ADFD	10/29/08		
ASCT44 DOL Uplink I-loads	ADFD	10/30/08		
ONOR29C RNDZ Launch Target Data	Orbit	11/4/08		
Dial Down Decision FIDP	FDM	11/6/08		
ONOR37C Daily Planar/Phase Windows	Orbit	11/6/08		
DSCT17 Landing Site Tables	ADFD	11/7/08		
RNDZ02 Target Drag Characteristics	Orbit	11/7/08		
PROP00A PROP/Ascent Aborts Tagup	PROP	11/7/08		
C-Band tracking Scheduling Message	Navigation	11/7/08		
RNDZ09 Rendezvous COLA Plans	Orbit	11/7/08		
PERA Pre-Flight Product	ADFD	11/7/08		
ASCT99 OMS Assist - ATO Update	ADFD	11/8/08		
PROP02A DOL Mass Properties Updates	PROP	11/9/08		

Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Standard Open Work - Continued:				
Pre-Launch Mass Properties Request	PROP	11/9/08		
PROP31 ARD Data	PROP	11/9/08		
PROP33 Ferry Data Package	PROP	11/9/08		
PROP34 MCC Data	PROP	11/9/08		
SRB & ET RTLS Impact Point Update Memo	ADFD	11/11/08		
ASCT42 Collision Avoidance Data	ADFD	11/11/08		
ASCT47 Final MCC Trajectory Inputs	ADFD	11/11/08		
DSCT66 Real-Time Support Files	ADFD	11/11/08		
Range Safety Launch Window Cutout	ADFD	11/11/08		
Flight Annex	Navigation	11/11/08		
ASAB32B AME MCC Support Tables	ADFD	11/12/08		
L-2 day DOLILU System Checkout	ADFD	11/12/08		
DSCT05 Maximum Crossrange Capability	ADFD	11/12/08		
ASAB25 ARD Bias Tables	ADFD	11/13/08		

Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Non-Standard Open Work:				
Abort Support Operator Certification	ADFD	10/20		
DOL Loads QA Operator Certification	ADFD	10/29		
DOL OPS 2 Operator Certification	ADFD	10/29		
TSEP Violation from Commit-to-Flight assessment (OCRD S164080CM)	ADFD	TBD		
Report UPL CABZ assessment to SICB	ADFD	TBD		
Fix DOL I-LOAD transfer script to output to binary format	ADFD	10/17		

Flight Readiness Open Work - Continued

Item	Responsible	Due Date	Closed	Closure Rationale/Status
Trajectory Operations Standard Open Work:				
L-30 HA Server Audit	TOCSS	10/15		
Close to Launch Trajectory Data	OFDO	10/10		
TCDT Checkout in Ops Cert Mode	AE GPO	10/30		
DOD Support Readiness	LSO	10/31		
Flight Load Checklist Complete	Nav	10/30		
Flight Load Checklist Complete	DOLILU	10/30		
Flight Load Checklist Complete	Entry Support	10/30		
Flight Load Checklist Complete	Orbit-RNDZ	10/30		
FS Orbit FDO CHB Annex	OFDO	11/01		
Close to Launch Mass Properties	OFDO	11/07		
L-5 HA Server Audit	TOCSS	11/09		
Flight Load Checklist Complete	RGPO	11/08		
Flight Load Checklist Complete	AE FDO	11/08		
Flight Load Checklist Complete	AE GPO	11/08		
Flight Load Checklist Complete	LSO	11/08		

Flight Readiness Open Work - Concluded

Item	Responsible	Due Date	Closed	Closure Rationale/Status
Trajectory Operations Standard Open Work				
Flight Load Checklist Complete	OFDO	11/08		
Present new ops notes at Trench tagup	TOCSS	Trench Tag-Up		
Real-time Data Transfer Schedule	OFDO	TBD		
Trajectory Operations Non-Standard Work:				
None				