
STS-133 MOD FRR

FLIGHT DYNAMICS DIVISION

9/24/10

Agenda Item 6

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- None Issues and Concerns
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Shuttle CoFR Status Summary

MOD Requirements Codes *	DM	USA FDD
NON-CRITICAL PROC/APPL	G	G
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	G	G
CERTIFIED FLIGHT CONTROLLERS	G	G
CERTIFIED INSTRUCTORS	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
 Note: CRIT PROC/APPL responsibility has been transitioned to FDOC

Mission Overview Summary

Launch/Landing Times	Date	GMT	EDT /EST
Launch Window Open	Nov. 1, 2010	20:35:10	16:35:10 EDT (hh:mm:ss)
Launch Window Close		20:45:10	16:45:10 EDT (hh:mm:ss)
Landing Time (KSC)	Nov. 12, 2010	15:40	10:40 EST (hh:mm)

FD3 rendezvous opportunities are anticipated for November 1-7. Mated beta angle will be violated for launch dates from 11/07 through 11/23 for 11+1 day mission.

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	2440 lbs
Projected APM*	669 lbs

* Based on 09/14/10 APM simulation and 9/14/10 Green Book (includes PMM and DragonEye weight updates)

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

Significant Changes Since Design Baseline

- **Launch date changed from 9/16/10 to 11/01/10**
- **Mission duration increased from 8+1+2 to 11+1+2 and EVAs increased from 0/1 to 2/1(scheduled/unscheduled)**
- **Maximum rendezvous altitude decreased from 200 N. Mi. to 190 N. Mi.**
- **Incorporated multi-stage deorbit for contingency payload return cases**
- **MPS budget updated from R0901S to R1005S**
- **Significant mass property changes**
 - Addition of hardware for LWAPA return
 - Addition of Port TSA
 - Increase OMS loading from standard (22,761 lbm.) to near-full (24,860 lbm.)
 - Middeck weight increased
 - PMM weight decreased

Significant Mission Firsts and Unique Items

- **Budgeted propellant to protect for Passive Thermal Control (PTC)**
- **First flight of DOLILU Block Update 2010.02 (S052550PM)**
 - First flight of MPS Budget R1005S (S084799AY)
 - First flight of DOLILU assessment of in-plane launch time
 - Minor updates to discipline scripts
 - Updates approved at SICB OAR (9/14/10)
- **Per program direction, design does not protect for absolute “worst-case forward” scenario where PMM deployed with ELC-4 still in payload bay**
 - Flight Rule ULF5_C2-85 in place documenting rationale that if ELC-4 not deployed, PMM will also not be deployed.

Deviations, Exceedances and Anomalies

Deviation / Exceedances

- **Two contingency return cases exceed NEOM downweight limit**
 - Will evaluate real-time, if required
 - Documented in Flight Rule ULF5_A4-1

Previous Mission Anomalies and Previous Flight of OV-103

- **None**

NCRs and Open Risk Assessments

- **None**

Special Topics

SMS AR 097938 Unconverged Ascent Guidance

- **ADI needles stowed continuously for 38 seconds after MM-103 transition during RTLS case for STS-133 ascent stand-alone crew training**
 - The crew interpreted the longer duration of ADI attitude error needle stowage as continuous PEG unconvergence and responded with attempt to take CSS and engage BFS.
 - Confirmed that an unconverged PEG response to MM103 transition and nominal OMS Assist can cause ADI needle stowage of 10 - 16 seconds (typical).
 - ADI error needle stowage could extend up to 38 sec due to occasional PEG unconvergence spikes (uncommon).
 - During continuous period of ADI needle stowage that results from occasional unconvergence spikes, PEG is predominantly converged with a good guidance solution and allows steering when converged.
 - Audit concluded FSW operating per Level B/C requirements.
 - Corresponding evaluation by A/E Crew Training and GPO offices concluded with plan to adjust Crew / Flight Controller Training and increase situational awareness for cases of suspected non-converged guidance.
 - Final results were presented to the NASA Flight Software Office, A/E Flight Techniques Panel, and SICB Chair.

Special ADFD Assessment

- **Significant mass property and propellant quantity changes occurred after I-Load design necessitating a special assessment to identify impacts.**
- **Determined that all necessary changes can be incorporated in Uplink cycle and standard close-to-launch product deliveries**

Special Topics - continued

Projected Ascent Performance (APM) Margin below guidelines

- Flight Manager reserve is 400 lbs APM at open of launch window (not including 700 lbs DOL reserve)
- APM based on FRR TDDP is 203 lbs at open of a 5 minute window
- Current projection is approximately -30 lbs (IPT projection)
- Additional threats exist
- SSP/MOD evaluating what get wells are available to mitigate issue

Dryden Radar (FDRC) Tracking Test

- Currently down for maintenance, expected to resume service on 9/20/10
- Testing and evaluation planned prior to STS-133 mission.

Special Topics - concluded

Radar Support

- **Antigua scheduled to be closed on October 1st.**
- **Kwajalein (KWAJ) C-band and White Sands Missile Range (WSMR) data scheduled to be unavailable due to Information Assurance (IA) policy issues.**
- **DM has requested a waiver extension for KWAJ.**
 - If waiver not in place data would be received with significant time delay.
 - No significant impact to potential loss of KWAJ data.
- **WSMR work-around allows receipt of data from WSMR sites regardless of IA.**
 - Validation test of WSMR Software Version 10.3 supported by JSC Navigation on June 24, 2010 which verified GMT day rollover fix and IA procedural work-around. Test validated the software for SSP tracking support
 - No issues with WSMR landing

FDOC Software Transition

- **Final part of FDD discipline software transferred to FDOC control on 9/03/10.**
 - **During STS-133 design, FDD retained responsibility for some discipline software maintenance**
 - **Continue to support FDOC capture and release of DOL script updates for DOLILU Block Update**
-

Exceptions and Standard Open Work

Exceptions

- None

Standard Open Work (complete listing in backup charts)

- All open work is scheduled to be completed per standard flight template
- No issues have been identified

Non-Standard Open Work

- Dynamics certification 10/15/10
- FDR Tracking Test TBD
- Support FDOC Capture and Release of DOL Script Updates (DOLILU BU 2010.02) 9/30/10

Rescue Mission Status

STS-134 has been designated as the launch on need (LON) flight for STS-133

STS-134 nominal mission planning is on schedule, and will be launched as a rescue mission on 02/26/11, if required, with the planned cargo elements installed

- Expedite the Processing of Experiments to Space Station (ExPRESS) Logistics Carrier 3 (ELC3)
- Alpha Magnetic Spectrometer-02 (AMS-02)

All rescue mission-specific analyses will be performed after call-up

Flight Design and Dynamics Readiness Accountability Statement

☑Software : FDD discipline software used to create mission products meets generic and mission-specific Program requirements and is maintained under configuration control in accordance with the appropriate 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 crew training will be completed prior to launch.

The FDD Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D) which define 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-133.

Flight Design and Dynamics	S. A. Anderson Director	<i>Originally Signed by S. A. Anderson</i> <small>Signature</small>	<i>9/17/2010</i> <small>date</small>
Ascent/Descent Flight Design	D. J. Brockway Manager	<i>Originally Signed by D. J. Brockway</i> <small>Signature</small>	<i>9/17/2010</i> <small>date</small>
Orbit Flight Design	R. M. Hill Manager	<i>Originally Signed by R. M. Hill</i> <small>Signature</small>	<i>9/17/2010</i> <small>date</small>
Navigation & Flight Design Integration	G. E. Schrage Manager	<i>Originally Signed by G. E. Schrage</i> <small>signature</small>	<i>9/17/2010</i> <small>date</small>

Flight Design and Dynamics Declaration of Compliance with CoFR Endorsement Requirements for STS-133 Flight Readiness

Software : FDD discipline software used to create mission products meets generic and mission-specific Program requirements and is maintained under configuration control in accordance with the appropriate 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 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-MJ	9/01/10
Flight Implementation Data Pack (FIDP) - Flight Specific	133-BASE-X	9/13/10

Waivers & Exceptions:

None

The FDD Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D) which define 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 is ready to support STS-133.

Original signed by Scott Anderson 09/17/2010

Director	Date
Flight Design & Dynamics	

DM Flight Design and Dynamics (Trajectory Operations) Significant Mission Firsts and Unique Items

ISS Phasing Strategy

- Two ISS Reboosts prior to STS-133 set up phasing for STS-133, 22S landing, and 24S launch
 - 9/15: Completed 4.1 ft/s (1.25 m/s)
 - 10/16: Planned 3.8 ft/s (1.15 m/s)
- Rendezvous altitude will be approximately 190 nm.
- FD3 rendezvous from 11/1 – 11/7
 - For a launch on 11/7, beta constraint would be violated if extension day added to mission
- Beta cutout 11/8 – 11/23 and 1/5 – 1/22
- Window open on small phase angle days limited by minimum of about 37 deg.

Mated Reboost

- Mated reboost is not scheduled, however, if propellant is available, reboost could be used to optimize future vehicle phasing without using Russian propellant.

Significant Mission Firsts and Unique Items

Joint Underspeed Recovery Capability

- Thrusters: 8 R&D Progress engines
- Delta-Velocity capability: ~4 mps (~13 fps) per burn
- Propellant available: **TBD** lbs total (expecting to be limited to two 2000 sec and one 1000 sec JURE burns)
- Burn sequence: FD3 daily orbit 1 & 3, FD4 daily orbit 1
With 3 burns, rendezvous is on FD5.

Development Test Objectives

- DTO 701B DragonEye Flash LIDAR
 - Also flew on STS-126
- Boundary Layer Transition (BLT) Flight Experiment
 - 0.5 in. protuberance

Significant Mission Firsts and Unique Items

No Planned Hardware Jettisons

No Deployable Payloads

Payloads of Opportunity

- MAUI, SEITE, SIMPLEX, RAMBO 2

Exceptions and 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)
- PERA Pre-Flight Product (PERA Lead) (L-7)
- EMCC Checkout (L-7)
- Flight Load Checkouts (L-6)
 - Orbit , Ascent, A/E GPO, Entry, LSO

Non-Standard Open Work

None

STS-133 Flight Dynamics Division Readiness Statement

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

Originally signed by Barbara A. Conte Reichart

Barbara A. Conte
Chief, Ascent & Descent Dynamics Branch

Originally signed by Christine M.

Christine M. Reichart
Chief, Orbit Dynamics Branch

Originally signed by Robert D. Banfield

Robert D. Banfield
Chief, Flight Dynamics Division

by:

As compiled

Renshaw
STS-133 MOD FRR – 09/24/10
FLIGHT DESIGN AND DYNAMICS
DM3/JR/DG:
Mayhew

Back-Up

Flight Readiness Open Work

Propellant Summary

Separate Back-up File

- **Launch Window**
- **Abort Regions Chart**
- **Nominal ET Impact Area**

Flight Readiness Open Work

Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Standard Open Work:				
PROP37 SODB Volume II Amendment	PROP	9/22/2010		
DATA43 FDD FRR Data Pack	FDM	9/24/2010		
FSW Verification Test Results Review	ADFD	9/27/2010		
FSW Verification Test Results Review	Orbit	9/27/2010	8/06/10	Completed
RNDZ/FDO Phasing Plan Meeting	Orbit	9/28/2010	9/07/10	Completed
DATA45 FDD FSW PF Sign-off	FDM	10/1/2010		
ONOR29B RNDZ Launch Target Data	Orbit	10/4/2010		
L-4 week LDO Database Freeze	ADFD	10/4/2010		
PROP06 OMRSD OMS/RCS	PROP	10/4/2010		
PROP07 Abort Propellant Dump Tagup	PROP	10/4/2010		
PROP02 Mass Properties	PROP	10/6/2010		
RNDZ08 RNDZ Phasing Limits	Orbit	10/7/2010		
Prop Analyst & Flt Controller Tag-up	PROP	10/7/2010		
ONOR37B Daily Planar/Phase Windows	Orbit	10/11/2010		
ASCT04 Uplink APM	ADFD	10/11/2010		

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	10/11/2010		
NAVO18B GPO/ONAV Ops Memo	Navigation	10/11/2010		
LDO: L-3 week LDO Checkout/TCDT Sim	ADFD	10/11/2010		
ONOR27 Launch and Landing Data	Orbit	10/13/2010		
ASCT44 DOL Uplink I-loads	ADFD	10/17/2010		
ONOR29C RNDZ Launch Target Data	Orbit	10/21/2010		
Dial Down Decision FIDP	FDM	10/22/2010		
PROP00A PROP/Ascent Aborts Tagup	PROP	10/22/2010		
PERA Pre-Flight Product	ADFD	10/25/2010		
DSCT17 Landing Site Tables	ADFD	10/25/2010		
RNDZ02 Target Drag Characteristics	Orbit	10/25/2010		
ONOR37C Daily Planar/Phase Windows	Orbit	10/26/2010		
RNDZ09 Rendezvous COLA Plans	Orbit	10/27/2010		
Flight Annex	Navigation	10/25/2010		
ASCT99 OMS Assist - ATO Update	ADFD	10/26/2010		
C-Band Tracking Message	NAV	10/27/2010		

Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Standard Open Work - Continued:				
PROP02A DOL Mass Properties Updates	PROP	10/27/10		
Pre-Launch Mass Properties Request	PROP	10/27/10		
PROP31 ARD Data	PROP	10/27/10		
PROP33 Ferry Data Package	PROP	10/24/10		
PROP34 MCC Data	PROP	10/24/10		
SRB & ET RTLS Impact Point Update Memo	ADFD	10/29/10		
ASCT42 Collision Avoidance Data	ADFD	10/29/10		
ASCT47 Final MCC Trajectory Inputs	ADFD	10/29/10		
DSCT66 Real-Time Support Files	ADFD	10/29/10		
Range Safety Launch Window Cutout	ADFD	10/29/10		
ASAB32B AME MCC Support Tables	ADFD	10/30/10		
L-2 day DOLILU System Checkout	ADFD	10/30/10		
DSCT05 Maximum Crossrange Capability	ADFD	10/30/10		
ASAB25 ARD Bias Tables	ADFD	10/31/10		

Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
USA Flight Design Non-Standard Open Work:				
Dynamics Certification	NAV	10/15/2010		
FDRC Tracking Test	NAV	TBD		
Support FDOC Capture and Release of DOL Script Updates (DOLILU BU 2010.02)	ADFD	09/30/2010		

Flight Readiness Open Work - Continued

Item	Responsible	Due Date	Closed	Closure Rationale/Status
Trajectory Operations Standard Open Work				
Close to Launch Trajectory Data	OFDO	10/25/10		
TCDT Checkout in Ops Cert Mode	AE GPO	10/15/10		
DOD Support Readiness	LSO	10/18/10		
Flight Load Checklist Complete	NAV	10/18/10		
Flight Load Checklist Complete	DOLILU	10/17/10		
Flight Load Checklist Complete	Entry Support	10/17/10		
Flight Load Checklist Complete	Orbit-RNDZ	10/18/10		
Successful Completion of RNDZ Training	RNDZ Instructor	10/18/10		
EMCC checkout	OFDO	10/25/10		
Flight Load Checklist Complete	RGPO	10/26/10		
Flight Load Checklist Complete	AE FDO	10/26/10		
Flight Load Checklist Complete	AE GPO	10/26/10		
Flight Load Checklist Complete	LSO	10/26/10		
Flight Load Checklist Complete	OFDO	10/26/10		
Trajectory Operations Non-Standard Work:				
None				

Flight Readiness Open Work - Concluded

Item	Responsible	Due Date	Closed	Closure Rationale/Status
DM Standard Open Work:				
Orbiter Readiness Statement	DM	10/12/2010		
Range Safety Readiness Statement	DM	10/16/2010		

Propellant Summary

Propellant Summary	FRCS (lbm)	ARCS (lbm)	OMS (lbm)
Loadings	1912	4970	24,860
FRR Design Margins**	4	0	5

** Assumptions: STS-133 ATL, FRR Cycle Trajectory Inputs, 190 nm RNDZ, 134 sec OMS Assist, 1 mated water dump