
STS-130 MOD FRR

FLIGHT DYNAMICS DIVISION



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Agenda Item 6

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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 | EST | |
|----------------------|-------------------|----------|---------|------------|
| Launch Window Open | February 7, 2010 | 09:34:39 | 4:34:39 | (hh:mm:ss) |
| Launch Window Close | | 09:44:39 | 4:44:39 | (hh:mm:ss) |
| Landing Time (KSC) | February 19, 2010 | | 23:17 | (hh:mm) |
| Landing Time (KSC) | February 20, 2010 | 04:17 | | (hh:mm) |

FD3 rendezvous opportunities are anticipated for ~20 days beginning on 2/4/10

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 **935 lbs**

Projected APM* **893 lbs**

* Based on 12/10 APM sim, 12/22 Green Book (incl. rndz altitude decrease and middeck increase) & O2 offload increase

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

- **Rendezvous altitude decrease from 190 nmi to 188 nmi**
 - Required to increase ascent performance margin
- **Multi-stage deorbit implementation for contingency return cases**
 - Required to increase ascent performance margin
- **Middeck decrease from 8400 lbm to 8060 lbm**
 - Required to increase ascent performance margin
- **Aft fuselage ballast boxes removal**
 - Not required for this mission
- **Removal of GN2 tank**
 - Not required for this mission
- **Node 3 increase in weight**
 - Addition of 3rd resupply rack and additional ~675 lbm upmass

Significant Changes Since Design Baseline - concluded

Recently approved changes

- **Launch date change and mission duration change**
 - Program has approved a 2/7 launch date and an increase in mission duration to 13+1+2 to accommodate PMA3 relocation
 - Will incorporate change in Uplink cycle
- **ISS altitude change to 185 nmi**
 - Program has approved a rendezvous altitude decrease from 188 nmi to 185 nmi
 - Allows for additional manifest
 - Will incorporate change in Uplink cycle
- **Increase in O2 offload**
 - Program has approved an additional 155 lbm O2 offload (645 lbm total)
 - Allows for additional manifest
 - Will incorporate change in Uplink cycle
- **Increase in middeck control weight of 590 lbm**
 - Will incorporate change in Uplink cycle

Significant Mission Firsts and Unique Items

- **First flight of OI-34 on OV-105**
- **Multi-stage deorbit implementation for contingency return cases**
- **DOLILU Block Update 2010.01**
 - Changes have negligible impact, mostly clean-up items, incorporated to establish a final Shuttle baseline and to sync up Boeing and USA Day of Launch databases
 - SSP CR S052189GU- Mated Vehicle Aero Data CMM74- SSME Throttling Factor Coefficients Correction
 - SSP CR S052189GP- Thrust Structure Deformation Model Correction CMM77 Update
 - SSP CR S052189EQ- Revised Mated Vehicle Forebody Force and Moment Coefficient CMM 172 Aero Data Correction
 - SSP CR S052550PJ- Update System Dispersion Load Increments Database due to FMODEL6 Update
 - Flight critical certification of OI-33 FSW for MPSR DOL support
 - Miscellaneous script updates for USA and Boeing
 - Negligible impacts to nominal trajectory and launch probability
 - **All updates have been incorporated for launch (ISVT-12/04, SICB OAR- 12/15)**

Deviations, Exceedances and Anomalies

Deviation / Exceedances

- **No Dock PLS and No Deploy Node 3 cases exceed the nominal EOM downweight limit**
 - No pre-flight analysis is required per AEFTP direction
 - Real-time assessment will be performed, if required
 - Exceedance has been documented in the Flight Rules Annex
- **Entry Commit to Flight (CTF) assessment of SODB Vol. V Angle of Attack Limits**
 - Mission-specific Monte Carlo analysis showed violations of NSTS-08934 SODB Vol. V Entry CTF criteria for TAL and AOA (lower ALPHA limit) and TAL (upper ALPHA limit).
 - Documented in OCRD S164080CP
 - Boeing cleared violations and OCRD was closed at the 11/06/09 JSERP
- **FRR mass properties exceeded the Contingency Abort Black Zone (CABZ) assessment criteria**
 - Liftoff weight greater than 259,000 lbm and Xcg aft of 1115.0 in.
 - FRR cycle liftoff weight = 267,035 lbs. and Xcg = 1115.1 in.
 - Recently approved middeck increases eliminated this exceedence
 - 12/22 Greenbook shows liftoff weight = 267,625 lbs and Xcg 1113.8 in.

Deviations, Exceedances and Anomalies (concluded)

Previous Mission Anomalies

- None

Significant ARs and Disposition

- None

Previous Flight Ops FRR Open Action Status

- None

Exceptions and 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

- ONAV2 target certification 1/15/10
- Landing Analyst / Winds (LAW) (Landing) certification 1/21/10
- Winds Analyst (Launch) certification 1/21/10

Rescue Mission Status

- **STS-131 has been designated as the LON flight for STS-130**
- **STS-131 will be ready to launch on 03/18/10, if required, with the cargo element installed**
- **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 rendezvous 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-130.

| | | | |
|---|------------------------------------|--|-------------------------|
| Flight Design and Dynamics | S. A. Anderson Director | <i>Original signed by S.A. Anderson</i> signature | <i>12/11/09</i> Date |
| Ascent/Descent Flight Design | D. J. Brockway Manager | <i>Original signed by D.J. Brockway</i> signature | <i>12/11/09</i> date |
| Orbit Flight Design | R. M. Hill Manager | <i>Original signed by R.M. Hill</i> signature | <i>12/11/09</i> date |
| Navigation & Flight Design Integration | G. E. Schrage Manager | <i>Original signed by G.E. Schrage</i> signature | <i>12/11/09</i> date |

Flight Design and Dynamics Declaration of Compliance with CoFR Endorsement Requirements for STS-130 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 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.

| <u>DOCUMENT</u> | <u>VERSION</u> | <u>DATE</u> |
|--|----------------|-------------|
| Flight Implementation Data Pack (FIDP) - Generic | GEN-LR | 11/20/09 |
| Flight Implementation Data Pack (FIDP) - Flight Specific | 130-BASE-X | 12/15/09 |

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-130.

Original signed by S.A. Anderson
Director
Flight Design & Dynamics

12/21/09
Date

Significant Mission Firsts And Unique Items

ISS Phasing Strategy

- ISS Reboosts planned 1/22 (test burn) and 1/24 – sets up FD3 rendezvous and ISS visiting vehicle constraints
- Rendezvous altitude will be approximately 185 nm.
- FD3 rendezvous from 2/4 – 2/24
- Beta cutout 4/15 – 4/30
- Window open on small phase angle days limited by minimum of about 37 deg.

Joint Underspeed Recovery Capability

- Thruster: 8 R&D Progress engines (assumes launch after 36P docking on 2/5)
- Delta-Velocity capability: ~5 mps (~16 fps) per burn
- Propellant available: 8350 lbs total (limited to four 2000 sec. burns)
- Burn sequence: FD3 daily orbit 1&3, FD4 daily orbit 1&3
With 4 burns, rendezvous is on FD5.

Significant Mission Firsts And Unique Items

Second Flight Taking Ku Radar to Standby Prior to RPM.

- Change initiated by INCO to avoid radiating the crew during the GPC/AUTO TRK switch.
- Performed with no issues on STS-129.
- Small risk of not detecting and locking onto ISS after the RPM.
 - If TCS is working, no impact.
 - If TCS is not working, HHL is the backup so radar is not required.

No Planned Hardware Jettisons

No Deployable Payloads

Payloads of Opportunity

- MAUI, SEITE, SIMPLEX
- First Flight of RAMBO 2

Special Topics

RPM with Loss of One Forward Downfiring Jet

- Previously loss of 1 FxD jet was no-go condition for RPM
- PRCB approved the change to be go for RPM with 1 FxD down if prop budget will support re-rendezvous
- Real-time assessment will include re-rendezvous cost to evaluate RPM go/no-go

SSOR Reduced Output Power

- Expect lock-on at ~16 kft instead of 30 kft
- No procedural Changes

PMA-3 Relocation Plan

- Due to PMA-3 location (Node 2 zenith for dock, Node 3 port for undock), reflector 5 for TCS will not be visible
- FDF diagrams updated

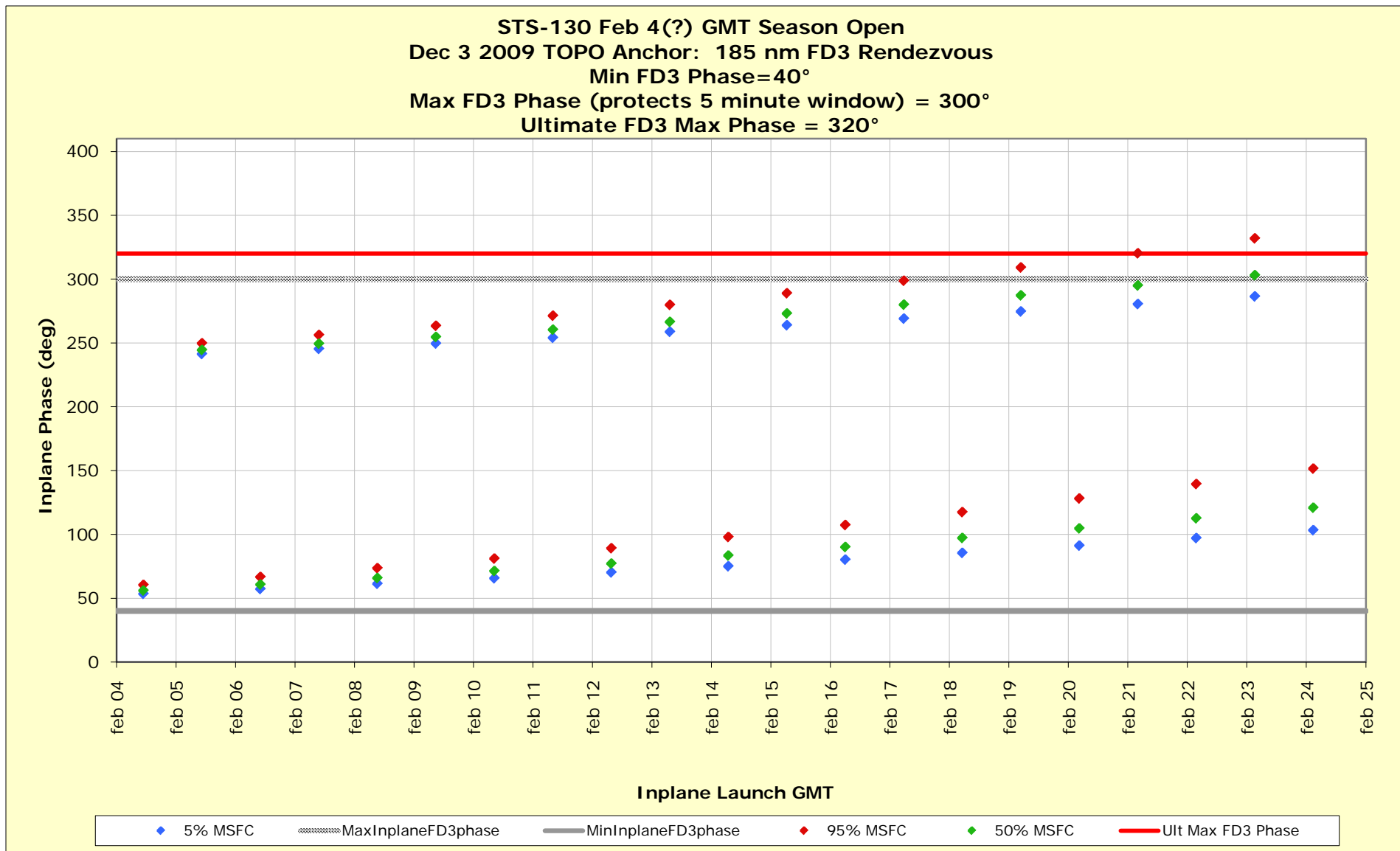
RPM Lighting for ET Umbilical Door Photography

- In some beta regions, window for good ET umbilical door photos is much smaller than window for overall RPM
- No Shuttle changes - if necessary, ISS crew will adjust photo sequence to ensure umbilical door photos at optimum lighting

Centerline Camera Activation for Undock

- No callouts in FDF to power on vestibule lights during activation.
- Results in dark picture, 129 crew reported possible camera malfunction.
- Will be handled via training and possibly a reminder for STS-130. Procedure update for STS131.

Special Topics



Exceptions and 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

- None

STS-130 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 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 Ed Gonzalez for

Scott D. Dunham
Chief, Orbit Dynamics Branch

Original signed by Barbara Conte

Barbara A. Conte
**Chief, Ascent & Descent
Dynamics Branch**

Original signed by Rick Gavin for

Robert Banfield
Chief, Flight Dynamics Division

As compiled by: **Lead FDO/Jason T. Smith**
 Lead FDM/Ray Moreno

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: | | | | |
| DATA43 FDD FRR Data Pack | FDM | 12/22/09 | 12/18/09 | Delivered |
| PROP37 SODB Volume II Amendment | PROP | 12/23/09 | | |
| FSW Verification Test Results Review | Orbit | 01/04/10 | | |
| RNDZ/FDO Phasing Plan Meeting | Orbit | 01/04/10 | | |
| FSW Verification Test Results Review | ADFD | 01/05/10 | | |
| DATA45 FDD FSW PF Sign-off | FDM | 01/06/10 | 12/18/09 | Delivered |
| ONOR29B RNDZ Launch Target Data | Orbit | 01/06/10 | | |
| PROP06 OMRSD OMS/RCS | PROP | 01/07/10 | | |
| PROP07 Abort Propellant Dump Tagup | PROP | 01/07/10 | | |
| L-4 week LDO Database Freeze | ADFD | 01/07/10 | | |
| RNDZ08 RNDZ Phasing Limits | Orbit | 01/11/10 | | |
| PROP02 Mass Properties | PROP | 01/12/10 | | |
| Prop Analyst & Flt Controller Tag-up | PROP | 01/13/10 | | |
| ONOR37B Daily Planar/Phase Windows | Orbit | 01/13/10 | | |
| ASCT04 Uplink APM | ADFD | 01/14/10 | | |

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 | 01/14/10 | | |
| NAVO18B GPO/ONAV Ops Memo | Navigation | 01/14/10 | | |
| ONOR27 Launch and Landing Data | Orbit | 01/15/10 | | |
| LDO: L-3 week LDO Checkout/TCDT Sim | ADFD | 01/16/10 | | |
| ASCT44 DOL Uplink I-loads | ADFD | 01/20/10 | | |
| Dial Down Decision FIDP | FDM | 01/21/10 | | |
| ONOR29C RNDZ Launch Target Data | Orbit | 01/26/10 | | |
| DSCT17 Landing Site Tables | ADFD | 01/28/10 | | |
| ONOR37C Daily Planar/Phase Windows | Orbit | 01/28/10 | | |
| RNDZ02 Target Drag Characteristics | Orbit | 01/28/10 | | |
| PROP00A PROP/Ascent Aborts Tagup | PROP | 01/28/10 | | |
| PERA Pre-Flight Product | ADFD | 01/28/10 | | |
| C-Band tracking Scheduling Message | Navigation | 01/29/10 | | |
| ASCT99 OMS Assist - ATO Update | ADFD | 01/29/10 | | |
| RNDZ09 Rendezvous COLA Plans | Orbit | 01/29/10 | | |
| Flight Annex | Navigation | 01/29/10 | | |

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 | 01/30/10 | | |
| Pre-Launch Mass Properties Request | PROP | 01/30/10 | | |
| PROP31 ARD Data | PROP | 01/30/10 | | |
| PROP33 Ferry Data Package | PROP | 01/30/10 | | |
| PROP34 MCC Data | PROP | 01/30/10 | | |
| SRB & ET RTLS Impact Point Update Memo | ADFD | 02/01/10 | | |
| ASCT42 Collision Avoidance Data | ADFD | 02/01/10 | | |
| ASCT47 Final MCC Trajectory Inputs | ADFD | 02/01/10 | | |
| DSCT66 Real-Time Support Files | ADFD | 02/01/10 | | |
| Range Safety Launch Window Cutout | ADFD | 02/01/10 | | |
| ASAB32B AME MCC Support Tables | ADFD | 02/02/10 | | |
| L-2 day DOLILU System Checkout | ADFD | 02/02/10 | | |
| DSCT05 Maximum Crossrange Capability | ADFD | 02/02/10 | | |
| ASAB25 ARD Bias Tables | ADFD | 02/03/10 | | |

Flight Readiness Open Work - Continued

| Work Item | Responsible | Due Date | Closed | Closure Rationale |
|--|-------------|----------|----------|-------------------|
| USA Flight Design Non-Standard Open Work: | | | | |
| CABZ assessment | ADFD | 1/5/10 | 12/22/10 | Not required |
| ONAV2 Certification | Navigation | 1/15/10 | | |
| LAW Flight Controller Certification (Landing) | ADFD | 1/21/10 | | |
| Winds Flight Controller Certification (Launch) | ADFD | 1/21/10 | | |

Flight Readiness Open Work - Continued

| Item | Responsible | Due Date | Closed | Closure Rationale/Status |
|---|-----------------|----------|----------|--------------------------|
| Trajectory Operations Standard Open Work | | | | |
| Close to Launch Trajectory Data | OFDO | 12/31/09 | 12/18/09 | Posted on FDOweb |
| Successful Completion of RNDZ Training | RNDZ Instructor | 01/11/10 | | |
| TCDT Checkout in Ops Cert Mode | AE GPO | 01/19/10 | | |
| Flight Load Checklist Complete | Orbit-RNDZ | 01/19/10 | | |
| DOD Support Readiness | LSO | 01/20/10 | | |
| Flight Load Checklist Complete | Nav | 01/20/10 | | |
| Flight Load Checklist Complete | DOLILU | 01/20/10 | | |
| Flight Load Checklist Complete | Entry Support | 01/20/10 | | |
| Flight Load Checklist Complete | RGPO | 01/29/10 | | |
| Flight Load Checklist Complete | AE FDO | 01/29/10 | | |
| Flight Load Checklist Complete | AE GPO | 01/29/10 | | |
| Flight Load Checklist Complete | LSO | 01/29/10 | | |
| Flight Load Checklist Complete | OFDO | 01/29/10 | | |
| | | | | |
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| | | | | |

Flight Readiness Open Work - Continued

| Item | Responsible | Due Date | Closed | Closure Rationale/Status |
|---|-------------|----------|--------|--------------------------|
| Trajectory Operations Non-Standard Work: | | | | |
| ARD Support Certification | OFDO | 01/07/10 | | |
| Ascent GSO Certification | OFDO | 01/07/10 | | |

Flight Readiness Open Work - Concluded

| Item | Responsible | Due Date | Closed | Closure Rationale/Status |
|----------------------------------|-------------|----------|--------|--------------------------|
| DM Standard Open Work: | | | | |
| Orbiter Readiness Statement | DM | 01/15/10 | | |
| Range Safety Readiness Statement | DM | 01/19/10 | | |

The Flight Design and Dynamics Division has performed a final review and determined all Division and USA FDD open work and/or actions for this mission are closed or acceptable rationale is provided for proceeding with the flight.

 Flight Design Manager
 Date_____

 STS Integration Manager
 Date_____

 Director, Flight Design and Dynamics Operations Center
 Date_____

 Chief, Flight Dynamics Division
 Date_____

Propellant Summary

OMRSD Propellant Loading Quantities will be delivered on January 7th, 2010.

FRCS = 1912 lbm

ARCS = 4970 lbm

OMS = 22761 lbm

FRR Design Propellant Margins

ARCS/OMS = 30 lbm

FRCS = 2 lbm

FRR Design Assumptions: STS-130 ATL, FRR Cycle Trajectory Inputs - 188 nm RNDZ, 124 sec OMS Assist, 1 mated water dumps