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# **STS-400 MOD FRR**

## **FLIGHT DESIGN AND DYNAMICS**

**September 2, 2008**

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**Agenda Item 5b**

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# Mission Overview Summary

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<b>Launch Time, Date (GMT)</b>	<b>01:36:17, October 16, 2008</b>
<b>Launch Time, Date (EDT)</b>	<b>21:36:17, October 15, 2008</b>
<b>Landing Time, Date(EDT)</b>	<b>20:57, October 22, 2008</b>
<b>Window Duration</b>	<b>66 Minutes</b>
<b>Launch Pad</b>	<b>39B</b>
<b>Flight Duration</b>	<b>7+4+2 Days</b>
<b>Crew</b>	<b>4 up/ 11 down</b>
<b>Insertion Altitude</b>	<b>297 N. Mi.</b>
<b>Max Rendezvous Altitude</b>	<b>304 N. Mi.</b>
<b>Inclination</b>	<b>28.45°</b>
<b>First Stage Design Criteria</b>	<b>DOLILU II / Low Q</b>
<b>OMS Load</b>	<b>25,063 LBM</b>
<b>Forward RCS Load</b>	<b>2,446 LBM</b>
<b>APM (above a 66 minute window)</b>	<b>24000+ lbs</b>

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

# Propellant Summary

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<b>Propellant Summary</b>	<b>FRCS (lbm)</b>	<b>ARCS (lbm)</b>	<b>OMS (lbm)</b>
<b>Loadings</b>	<b>2446</b>	<b>4970</b>	<b>25063</b>
<b>FRR Design Margins **</b>	<b>772</b>	<b>223</b>	<b>1855</b>

\*\* Assumptions: STS-400 ATL, FRR Cycle Trajectory Inputs, 304 nm RNDZ, 0 sec OMS Assist

# Significant Requirements Changes Since Design Baseline

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- **Launch Date changed from August 14, 2008 to October 15, 2008**
  - Interim date included September 4, 2008
- **Non-standard I-Load patch designed and approved**
  - Improved RTLS 3rd peak heating and GRTLS flight control margins
- **Updated AOA priorities to KSC as prime**

# Significant Mission Firsts and Unique Items

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- **First Launch On Need (LON) for non-ISS mission**
  - First planned rendezvous with another Space Shuttle vehicle
  - STS-400 vehicle will approach and grapple the OBSS on the STS-125 vehicle (see backup)
- **Current plan is to conduct all close to launch activities through L-8days**
  - Will be ready to launch within 7days of callup, or sooner if required
- **STS-400 planned to launch from pad B**
  - OV-105 will remain at a Level 1 readiness on launch pad B until after the STS-125 late inspection results are available on flight day 10
- **Abort boundary overlap**
  - Last RTLS overlaps PTA by 82 seconds and overlaps PTM by 25 seconds
  - TAL MRN capability in first stage at 118 sec, will not be executed prior to SRB sep
  - TAL site support not strictly required due to overlap
- **First flight to plan a nominal FD2 rendezvous**
  - FD2 opportunities every day in October, varies from 1min to 42 min
- **Inspection plans**
  - Early inspection and RPM will not be conducted
  - Post-release FD5 late inspection is planned

# Deviations, Exceedances and Anomalies

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## Deviations/Exceedances

- **No Deviations or Exceedances were documented for STS-400**
  - **Contingency Abort Black Zone (CABZ) assessment is not required**
    - **Mass properties do not meet the CABZ assessment criteria of liftoff weight greater than 259,000 lbm and Xcg aft of 1115.0 in.**
    - **FRR cycle liftoff weight = 237,373 lbs. and Xcg = 1120.2 in.**
- **There are no Previous Mission Anomalies or Flight Specific Production Anomalies affecting STS-400 readiness**

# Issues and Concerns

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- None



# Exceptions and Open Work

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

# Significant Mission Firsts And Unique Items

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- **Launch Window**
  - Each launch attempt will be discussed with Ascent Flight Director to determine preferred launch time
    - In general, intend to open on FD2 phasing, even if that occurs at the end of the planar window
    - If FD2 capability on a certain day is very small, will discuss opening at window open
- **Orbiter to Orbiter Rendezvous**
  - Program direction - a certified approach/grappling with dual active Orbiter attitude control
  - Rescuing stranded vehicle without active attitude control will not be certified
- **Orbiter to Orbiter Separation**
  - Stranded vehicle DAPs are based off of CSCS for ISS to simulate free drift for separation but allows active control for disposal
  - Plume loads on released vehicle not analyzed

# Significant Mission Firsts And Unique Items

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- **Flight Day 2 Rendezvous**
  - **Rendezvous profile from NH to MC4 is the same as ISS**
    - STS-125 does maneuver for star tracker, if power available, for optimization
    - STS-125, if power available, will have payload bay flood lights on for radar fail
  - **MC4 to 250 ft, nominal Rbar approach comparable to HST**
    - No RPM due to lack of crew training
  - **250 ft to grapple different than ISS**
    - No corridor approach so crew has more piloting capability
    - LO Z required for both vehicles
  - **TCS reflector could be installed but position could vary**
    - Not an eye hazard to stranded crew

# Significant Mission Firsts And Unique Items

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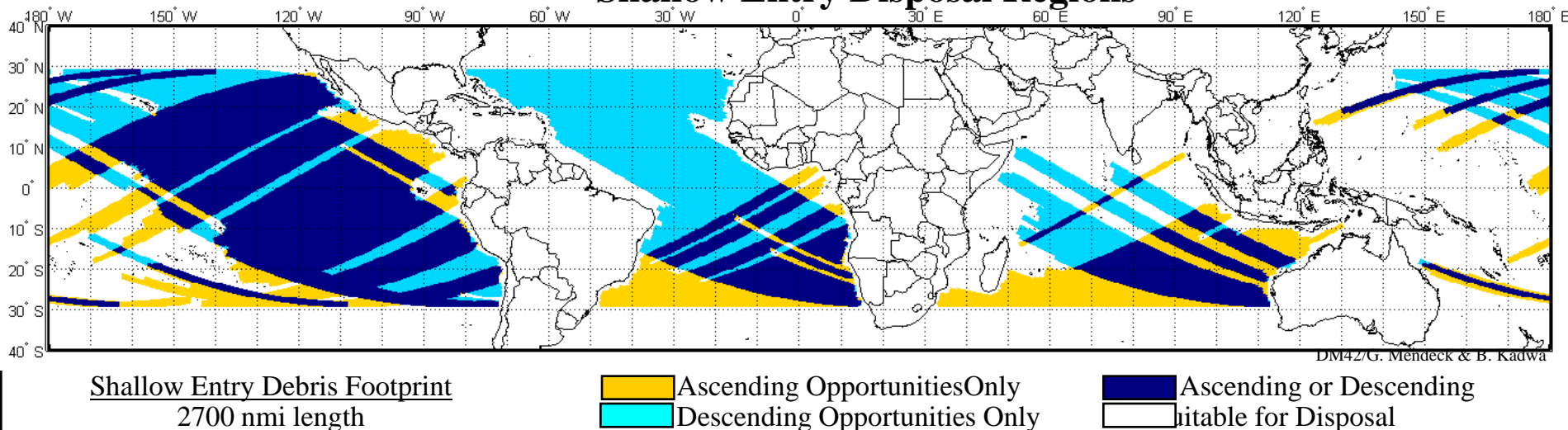
- **Orbit Adjust for MMOD**
  - **No official program direction to implement for 400**
  - **Was not included in FRR Flight Design cycle**
  - **DA8 direction is to plan to execute it**
    - Risk reduction is the same as for STS-125
  - **Will include on CTL FDOWeb**

# Significant Mission Firsts And Unique Items

## • Orbiter Disposal

- For un-repairable entry critical damage discovered on the STS-125 vehicle, it is desired to safely dispose of the Orbiter after crew egress to the STS-400 vehicle.
- Disposal sites for 28.5 degrees inclination is unique to STS-125. Near Hawaii appears to be the best location identified by DM42. FDO will work with DM42 in real time for the exact TIG and delta V required to ensure safe breakup and disposal.

### Shallow Entry Disposal Regions



# Significant Mission Firsts And Unique Items

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- **Picosatellite Solar Cell Experiment (PSSC) Deployment**
  - PSSC will be in the payload bay if STS-400 launches
  - Deploy not in pre-flight plan
  - Ready to support if deploy opportunity occurs and we are asked to

# Deviations, Exceedances and Anomalies

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- None

# Issues and Concerns

---

- None



# Exceptions and Open Work

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- **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**
  - **RGPO tasked with coordinating the ungrapple/sep/disposal timeline**
    - **Going to 125/HST Flight Techniques 8/28/08**

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**Pending Completion of all Standard and Non-Standard  
Open Work The Flight Design and Dynamics Division  
will be prepared to support STS-400**

# Back-Up

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- **Flight Readiness Open Work**
- **Items listed below in separate file**
  - **Launch Window**
  - **Abort Regions**
  - **Nominal ET Impact Area**
  - **Approach/Grapple/Separation plans**

# Flight Readiness Open Work

Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work:</b>				
FSW Verification Test Results Review	ADFD	08/29/08		
PROP37 SODB Volume II Amendment	PROP	08/29/08		
DATA43 FDD FRR Data Pack	FDM	09/02/08		
PROP06 OMRSD OMS/RCS	PROP	09/12/08		
PROP07 Abort Propellant Dump Tagup	PROP	09/14/08		
FSW Verification Test Results Review	Orbit	09/15/08		
RNDZ/FDO Phasing Plan Meeting	Orbit	09/15/08		
CM FOE L-30 day audit	Bedford	09/15/08		
DATA45 FDD FSW PF Sign-off	FDM	09/16/08		
ONOR29B RNDZ Launch Target Data	Orbit	09/17/08		
ASCTU43 MPS Minimum Sigma Level	ADFD	09/17/08		
L-4 week LDO Database Freeze	ADFD	09/17/08		
PROP02 Mass Properties	PROP	09/19/08		
RNDZ08 RNDZ Phasing Limits	Orbit	09/22/08		
Prop Analyst & Flt Controller Tag-up	PROP	09/22/08		
ONOR37B Daily Planar/Phase Windows	Orbit	09/24/08		
ASCT04 Uplink APM	ADFD	09/24/08		

## Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work - Continued:</b>				
NAVO16B GPO COTM Data Pack	Navigation	09/24/08		
NAVO18B GPO/ONAV Ops Memo	Navigation	09/24/08		
LDO: L-3 week LDO Checkout/TCDT Sim	ADFD	09/24/08		
ONOR27 Launch and Landing Data	Orbit	09/26/08		
ASCT44 DOL Uplink I-loads	ADFD	09/29/08		
PROP00A PROP/Ascent Abort Dump Tag-up	PROP	10/06/08		
PROP02A DOL Mass Properties Updates	PROP	10/07/08		
Pre-Launch Mass Properties Request	PROP	10/07/08		
ONOR29C RNDZ Launch Target Data	Orbit	10/07/08		
DSCT17 Landing Site Tables	ADFD	(L-7d)*		
RNDZ02 Target Drag Characteristics	Orbit	10/08/08		
C-Band tracking Scheduling Message	Navigation	10/08/08		
ASCT99 OMS Assist - ATO Update	ADFD	(L-6d)*		
ONOR37C Daily Planar/Phase Windows	Orbit	10/09/08		
RNDZ09 Rendezvous COLA Plans	Orbit	10/10/08		

\* Will be performed after callup

## Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work - Continued:</b>				
PROP33 Ferry Data Package	PROP	10/06/08		
PROP34 MCC Data	PROP	10/06/08		
PROP31 ARD Data	PROP	10/07/08		
Flight Annex	Navigation	10/12/08		
SRB & ET RTLS Impact Point Update Memo	ADFD	(L-3d)*		
ASCT42 Collision Avoidance Data	ADFD	(L-3d)*		
ASCT47 Final MCC Trajectory Inputs	ADFD	(L-3d)*		
DSCT66 Real-Time Support Files	ADFD	(L-3d)*		
Range Safety Launch Window Cutout	ADFD	(L-3d)*		
ASAB32B AME MCC Support Tables	ADFD	(L-2d)*		
L-2 day DOLILU System Checkout	ADFD	(L-2d)*		
DSCT05 Maximum Crossrange Capability	ADFD	(L-2d)*		
ASAB25 ARD Bias Tables	ADFD	(L-1d)*		

\* Will be performed after callup



## Flight Readiness Open Work - Continued

Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>Trajectory Operations Standard Open Work</b>				
L-30 HA Server Audit	TOCSS	09/07/08		
Close to Launch Trajectory Data	OFDO	09/12/08		
Flight Load Checklist Complete	Nav	09/26/08		
Flight Load Checklist Complete	DOLILU	09/26/08		
Flight Load Checklist Complete	Entry Support	09/26/08		
Flight Load Checklist Complete	Orbit-RNDZ	09/26/08		
PERA Pre-Flight Product	DM42 PERA Lead	(L-7d)*		
Close to Launch Mass Properties	OFDO	(L-3d)*		
Flight Load Checklist Complete	RGPO	09/26/08		
Flight Load Checklist Complete	AE FDO	09/26/08		
Flight Load Checklist Complete	AE GPO	09/26/08		
Flight Load Checklist Complete	OFDO	09/26/08		
Flight Load Checklist Complete	LSO	09/26/08		

\* Will be performed after callup



# Flight Readiness Open Work - Continued

Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>Trajectory Operations Standard Open Work</b>				
FS Orbit FDO CHB Annex	OFDO	10/01/08		
Present new ops notes at Trench tagup	TOCSS	Trench Tag-Up		
<b>Trajectory Operations Non-Standard Work:</b>				
Orbiter ungrapple/sep/disposal timeline	RGPO	08/28/08		

\* Will be performed after callup

# Flight Readiness Open Work - Concluded

Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>DM Standard Open Work:</b>				
Orbiter Readiness Statement	FDRIB	09/25/08		
Range Safety Readiness Statement	FDRIB	09/29/08		

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\_\_\_\_\_

\_\_\_\_\_  
 Chief, Flight Design Requirements and Integration Branch  
 Date\_\_\_\_\_

\_\_\_\_\_  
 Director, Flight Design and Dynamics Department  
 Date\_\_\_\_\_

\_\_\_\_\_  
 Chief, Flight Design and Dynamics Division  
 Date\_\_\_\_\_