

# Space Transportation Vehicle Division

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STS-120/10A MOD FRR

September 17<sup>th</sup>, 2007

DS1/Michael Interbartolo

# DS Shuttle CoFR Status Summary

REQUIREMENT	Training	GNC	DPS	PROP	INCO	MMACS	EGIL	EECOM	BOOSTER
Critical Processors/Applications	N/A	N/A	G	N/A	G	G	G	G	G
Non-Crit Processors/Applications	N/A	G	G	G	G	G	G	G	G
EMCC	N/A	G	G	G	G	G	G	G	N/A
Certified Flight Controllers	G	G	G	G	G	G	G	G	G
Crew Training	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Certified Instructors	G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LCC/MEL/MIL	N/A	G	G	G	G	G	G	G	G
FTP - New Ops	N/A	G	G	G	G	G	G	G	G
Flight Anomaly Resolution	G	G	G	G	G	G	G	G	G
Anomaly – Procedures	N/A	G	G	G	G	G	G	G	G
Exceptions/Action Items from prior reviews	G	G	G	G	G	G	G	G	G
CIL/Hazards	G	G	G	G	G	G	G	G	G
No Constraints	G	G	G	G	G	G	G	G	G
Level II Actions	G	G	G	G	G	G	G	G	G
Mission Requirements	G	G	G	G	G	G	G	G	G
Engineering Drawings	N/A	G	G	N/A	G	G	G	G	G
Command Procedures	N/A	G	G	G	G	G	G	G	G
Flt Prep Process Plan Requirements Met	G	G	G	G	G	G	G	G	G
Contractor Process Insight	N/A	N/A	N/A	G	G	G	G	G	G
MOD Work Guidelines	N/A	G	G	G	G	G	G	G	G

# CAF SSP Electrical Summary

Reactants	Tanks	Liftoff Load (lbm)	Min L/O (lbm)	Margin (lbm)	Padhold (hrs)
H2	5	455.5	409.9	45.6	131.7
O2	5	3886.4	3671.5	214.8	214.1

- NOTES:**
- 1) Assumes 13+1+2 day mission
  - 2) Assumes H2 target load obtained and loading completed at L- 45 Hrs
  - 3) Assumes O2 target load obtained and loading completed at L- 47.5 Hrs
  - 4) 25 lbm O2 transfer to ISS protected

## **SSPTS NOTES:**

- 1) Planned SSPTS output is 2 converters at full power from post-docking to EVA4, except during 2 water dumps and P6 install activities. SSPTS output energy required is 602.26 kWh, which is an average of 4.33 kW output for the 139.25 hrs that SSPTS is activated.
- 2) Average 120 Vdc input required from ISS at the APAS is 4.8 kW.
- 3) Mission duration without SSPTS is 13+0+2 days with 2.7 hrs launch hold, O2 Limited.

## **CSCS NOTES:**

- 1) CSCS capability with the planned SSPTS average power transfer until unmanned undock allows for 27 docked days with an additional 38.4 lbm O2 margin and unmanned undock on FD30. ISS crew metabolic has been accounted for during the docked duration.

# CAF SSP Environmental Summary

<b>Consumable</b>	<b>L/O Load</b>	<b>Min L/O</b>	<b>Margin</b>
<b>N2 (lb)</b>	<b>387.3<sup>1,2</sup></b>	<b>340.9<sup>3</sup></b>	<b>46.4</b>
<b>Supply H2O (lb)</b>	<b>356<sup>4</sup></b>	<b>356</b>	<b>0</b>
<b>LiOH (cans)</b>	<b>31<sup>1,5</sup></b>	<b>31</b>	<b>0</b>

**NOTES:1) Assumes 13+1+2 for N2 and 13+1+3 for LiOH day mission with 7 crew.**

**2) N2 L/O Load reflects 6 Full N2 Tanks along with KSC 6 lbm prelaunch usage requirement.**

**3) N2 loading protects for 5 ISS EVA's.**

**4) Supply H2O loading reflects a nominal 180 lbm offload.**

**5) LiOH L/O load reflects planned stowage. Loading reflects equivalent of 29 cans provided by ISS CDRA and Vozduhk operation and ISS pre-position LiOH.**

# CAF SSP Prop Loading/Budget Overview

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OMRSD Propellant Loading Quantities to be delivered on September 25, 2007.

FRCS= 1912 lbm      ARCS= 4970 lbm      OMS= 22761 lbm

FRR Design Propellant Margins:                      ARCS/OMS = 61/32 lbm  
FRCS = 356 lbm

FRR Design Assumptions: STS-120 ATL, FRR Cycle Trajectory Inputs, OMS Assist Timer 106 sec, TPS inspection, Two mated water dumps, 2-2-2 Deorbit opportunity, 10-hour period of PTC attitude control, Early and late inspections.

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PROP Real-time Propellant Margins:

ARCS/OMS = 740/1300 lbm  
FRCS = 360 lbm

PROP Real-time Assumptions: OCFR1 Cycle Trajectory Inputs, OMS Assist Timer of 165 seconds, successful payload deploy (i.e., no propellant protected for contingency payload return), 2-2-2 deorbit opportunities, 2 mated water dumps and associated maneuvers, maneuver to TEA attitude post-dock, maneuver to attitude pre-undock.

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Nominal Propellant Dump Configuration

No Dock PLS case exceeds the EOM down weight limit by 4048 lbm, and WCAFT case exceeds the EOM down weight limit 576 lbm

# Status of Standard Open Work Shuttle (Training – Crew & Flight Controllers)

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- **Crew Training Status:**

The flight specific Crew Training Plan has been developed from the Crew Training Catalog and is being executed. All standalone lessons and crew flight specific training objective are either completed or scheduled to be completed prior to launch, with no waivers.

- **MCC Training Status:**

The FOIG approved flight specific integrated simulation training plan has been developed and is being executed. All flight specific integrated training has been completed or is schedule to be completed prior to launch, with no waivers.

# Status of Standard Open Work Shuttle (Training – MCC)

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- **MCC Team Certification Status:**

- All SMS training instructors have completed required training according to their Certification Guides. All operators have been certified and all certification records are complete.
- All Flight Controller certification requirements are complete except as follows:

**Various Physicals, Proficiency and Final Certifications to be completed prior to flight with backup personnel available if required for all positions.**

- **MOD Work Guidelines:**

- All flight controllers meet the MOD work guidelines with the following exceptions:
  - INCO O2 Team exceeds 12 day mission guideline by one day, if the mission extends beyond 14 days Team 4 will offload O2 INCO team
  - All other DS teams do not violate guidelines due to 4 team rotation

# Status of Standard Open Work Shuttle (Non-Critical Processors/Applications)

- NON-CRITICAL PROCESSORS/APPLICATIONS - Non-critical processing (e.g., applications, utilities, and scripts) have followed defined development and change control constraints (Software Management Plan for Mission Control Center Applications - JSC 27029) and have been tested and certified for operational use, except as noted:

Discipline	Application Name	Open Item
GNC	MSKView & ELOG	Cert paperwork for matrix align changes. ECD 9/20/07
INCO	WAMS 4.5	Display the Post P6 Install and SA Deploy model. ECD 9/15
EECOM	MSKView EECOM ORBIT DISPLAY	Update display to use the latest ECLSS PUI for MCA Sampling location for ISS PP02 and PPCO2. The X2R6 software load changed the PUI that EECOM had been using for the MCA Sampling location parameter. ECD 9/20/07
Booster	DDD Panel - ME pushbutton status logic	Certification in work. ECD 9/20/07



# Status of Standard Open Work Shuttle (LCC/MEL/MIL)

- LCC/MEL/MIL - The Launch Commit Criteria Minimum Equipment List and Mandatory Instrumentation Lists have been reviewed and verified as complete and accurate. Any flight unique requirements have been specified, exceptions as noted:
  - STS-120 MEL-13**: Shuttle TA has worked with the LCCWG to review the MEL-13 (STS-120 Flight Specific Minimum Equipment List). It went to the LCCWG on 9/12 and is awaiting their voting approval (ECD 9/19) and will be scheduled for the Noon Board the week of the 24th.
  - OI-32 OMS Crossfeed B Mask Control (CR 92861)**: To allow a Go condition for launch with a failed OMS Crossfeed B open microswitch, this software update allows the Abort Interconnect Sequence to use the functioning B valve. In the event of a failed OMS Crossfeed B open microswitch, the valve will be confirmed to be open prior to launch via crew talkback and the switch will be left in the GPC position. Additionally, a KSC ground command will be performed to mask the failed microswitch prior to launch. LCC update is in work, but not considered mandatory. Is scheduled for the LCCWG on 9/18, ECD to the PRCB NLT 10/1/07
- **LCN 01215R01 Cabin Pressure Requirements Update** –
  - ECL-04 was changed to clarify the requirement (1 of 2) is for confirmed instrumentation failure only, and to define the use of Cabin Press if the Cabin Press Rate of Change IND measurement is lost. The minimum and maximum limits were changed for the dp/dt to align with the minimum/maximum values in engineering units (psi/minute) and not voltage output.
  - ECL-05 was changed to better clarify the pre-planned contingency procedures with regard to the relationship between cabin pressure and the airlock differential pressure. A better definition of a nominal cabin pressure was added to the preplanned contingency procedure as a result of a S0044 post-test action. Additionally, changes to Cabin Press maximum redlines and Airlock Diff Press No.1 maximum redlines were incorporated to reflect the latest relief valve cracking pressure.
- It went to the LCCWG on 9/12 and is awaiting their voting approval (ECD 9/19) and will be scheduled for the Noon Board the week of the 24th.

# Status of Standard Open Work Shuttle (FTP- New Ops)

- **New Ops Work Status:**

**Final DAP Configuration/Constraints** (Awaiting C. S. Draper Laboratory Memo):

The current versions of the FDF and Flight Rules contain the preliminary data from C. S. Draper Laboratory. Upon receipt of the official memo, GNC will review the document and update any DAP constraints in the FDF and Flight Rules as required. This will include specific DAP parameters (attitude & rate deadbands, maneuver rate, ALT config, etc.), RCS jet group selection/deselection for mated control, orbiter external airlock pressurized/depressurized constraints, robotics operations DAP constraints, and any other required system constraints. For STS-120, the majority of the flight specific DAP parameters have been I-loaded. This was done due to the need to use an ALT rate limit (0.035 deg/s) that is below the allowable keyboard entry limit (0.05 deg/s). Since this parameter needed to be I-loaded, all other flight specific DAP parameters were included. This results in eliminating the need for the typical FD1 flight specific DAP edits performed in previous flights. ECD 9/20/07

**OI-32 ADI Rate Scale MCC Cal Curve** – Due to changes in the scaling of the OI-32 Orbit ADI Rate switch (OPS 2 & 8), GNC will be required to implement real-time MCC Calibration Curve updates for orbit operations. This is to ensure proper scaling of downlisted ADI rate information used in the MCC. Once the orbiter is in OPS 3, the calibrations will be changed back to the standard curves. This operation has been practiced during flight specific integrated sims utilizing a documented FCOH procedure.

# Status of Standard Open Work Shuttle (FTP- New Ops)

- **New Ops Work Status:**

**OI-32 IMU/IMU Matrix Alignment** – OI-32 FSW updates provide a new matrix alignment capability to use an IMU as a reference. An IMU can be matrix aligned to itself and align an IMU to another IMU. This has resulted in changes to on-board displays, FDF, MCC displays, and G&C documentation. All FDF changes have been submitted. MCC display changes have been made and tested and are in the certification paperwork process. ECD 9/20/07. Numerous G&C console procedure (SCP) changes/updates have been made, and are in final review to be published in PCN-13. ECD 10/1/07

**–Post P6 Install ALT DAP** - Currently, the Shuttle ALT DAP has violated structural loads limits in the post P6 installation configuration, with the exception of the 1-jet attitude hold option. The flight control community and Draper are investigating if any methods of regaining ALT maneuver capability exist. It has long been expected that a situation like this could arise as the ISS assembly continues, due to the increased mass and lack of data to refine loads models. One of the two potential fixes is to change the ALT Delay Time. The other option would involve a real-time GMEM; if pursued, this would be ready pre-launch. ECD 9/20/07

# Status of Standard Open Work Shuttle (FTP- New Ops)

- **New Ops Work Status:**

–**P6 Installation Reboost Capability** - The P6 installation process takes over 50 hours of loaded RMS activities to accomplish. In the past, Draper flight control analyses did not provide any reboost capability during loaded RMS activities, largely because the window of exposure has been around 20 hours on previous flights. Draper has been requested to evaluate any options for reboost, to provide some measure of COLA maneuver capability during this time frame. The option with the most potential looks to be a passive reboost capability while P6 is at the handoff position (~40 hours) using long-duration VRCS attitude hold. During analysis from previous flights, Draper has indicated that VRCS hold provides some measure of reboost delta-velocity. Note that no ISS reboost capability is certified for mated operations for STS-120/10A. ECD 9/20/07

–**Sensor Package 2, Thermal Clock Engineering Information** - Due to the design of Node 2 Heaters and the physical location of EVA Members during EVA 1, INCO will need to cycle APCU #2 several times during EVA #1. INCO is currently working with Engineering Personnel (M. Flahaut (ES)) to determine the maximum off/on times to allow greater flexibility for the EVA members in the Payload Bay. ES will deliver thermal data 7 Sept 2007. Data will be review and assessed with FD and EGIL for potential Flight Rule update. ECD 9/14/07

# Conclusion Shuttle

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All identified open work will be  
completed in time to support  
STS-120/10A

# OI-32 Highlights

- **BFS Reaction to GPC HALT Transient (New to OI32)**: Prior to OI32, Backup Flight Software (BFS) reacted to a transient General Purpose Computer (GPC) halt by transitioning to OPS 0. With modifications to the OI32 release of BFS, the system will now react to a transient halt by picking back up where it left off prior to the halt. As a result, the BFS GPC FAIL procedure must be changed in the Ascent Pocket, Entry Pocket and Ascent/Entry Systems Procedures books. A 482 is in workflow and pending review/approval. ECD 10/8/2007.
- **OI-32 GPS Compensation For MTU Failure** – OI-32 creates a flight software capability to compensate for GPC clock drift in the event of an MTU failure. This upgrade replaces lengthy ground procedures that were required if an MTU failure occurred to maintain a useable GPS navigation state. This is a mandatory item for the first OI-32 3-string GPS flight on OV-105, currently scheduled for STS-123. GPS on STS-120 is single string and is not mandatory for entry; however the plan per flight techniques is to utilize this capability if required for a timing system failure. An STS-120 flight specific flight rule has been submitted to document the use of this capability. A minor G&C console procedure update and all associated MCC display changes have been completed.

# OI-32 Highlights

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- **OI-32 BFS GPS Aiding** – Adds a new function in BFS to maintain GPS aiding state. This upgrade protects for a GPS state vector walk-off in the BFS. No change to rules or procedures.
- **OI-32 DAP Notch Filter Upgrade** – The operational impacts from this notch filter improvement are: docked DAPs no longer need separate control accels for ALT or VERN attitude control; potentially lower propellant consumption; reduced number of I-loads; improved DAP performance during mated control.
- **BFS HUD** – With OI-32 post engage on the BFS there is the capability for the HUD

# OI-32 Highlights

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- **OI-32 DAP Shelf Pulsing Upgrade** – This DAP update changes how flight control executes vernier jet maneuvers. In previous FSW versions, the number of firings to complete mated maneuvers came close to the SODB limit (in firings per hour); this CR created logic to recognize when shelf pulsing is occurring and modify the DAP to stop the phenomenon. This will allow the Shuttle to continue performing large mated maneuvers as ISS assembly continues, and removes the requirement to periodically select FREE during mated maneuvers (as has been done on recent flights during the post docking maneuver).
- **Remote Control Orbiter (RCO) Inhibit/Enable Command Feedback** – A command has been added to OI32 that enables PASS SM management of antennas during the Entry timeframe as well as early OMS burn enable for the purpose of remotely configuring the vehicle for entry. For STS-120, DPS will monitor the flag that indicates whether or not this capability is enabled via the Universal Data Display (UDD) utility. As a long term solution, DPS will have the DPS Real Time Expert (DTEX) display modified to include this flag.