

Space Transportation Vehicle Division



STS-125 MOD FRR
September 2nd, 2008
DS1/Jim Azbell

Agenda Item 4

DS Shuttle CoFR Status Summary

| REQUIREMENT | Training | Analysis | DPS | INCO | MMACS | EGIL | EECOM | GNC | PROP | BOOSTER |
|--|----------|----------|-----|------|-------|------|-------|-----|------|---------|
| Critical Processors /Applications | N/A | N/A | N/A | G | G | G | N/A | G | G | G |
| Non-Crit Processors /Applications | N/A | G | G | G | G | G | G | G | G | G |
| EMCC | N/A | N/A | G | G | G | G | G | G | G | N/A |
| Training - MCC/POCC | G | G | G | G | G | G | G | G | G | G |
| Training - Crew | G | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Training - SMS | G | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| LCC/MEL/MIL | N/A | N/A | G | G | G | G | G | G | G | G |
| FTP - New Ops | N/A | N/A | G | G | G | G | G | G | G | G |
| Flight Anomaly Resolution | G | N/A | G | G | G | G | G | G | G | G |
| Anomaly – Procedures | G | 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 | G |
| CIL/Hazards | G | N/A | G | G | G | G | G | G | G | G |
| No Constraints | G | G | G | G | G | G | G | G | G | G |
| Level II Actions | G | G | G | G | G | G | G | G | G | G |
| Mission Requirements | G | G | G | G | G | G | G | G | G | G |
| Engineering Drawings | N/A | N/A | G | G | G | G | G | G | N/A | G |
| Command Procedures | N/A | 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 | G |
| Contractor Process Insight | N/A | G | G | G | G | G | G | N/A | G | G |
| MOD Work Guidelines | N/A | N/A | G | G | G | G | G | G | G | G |

SSP Electrical Summary

| Reactants | Tanks | Liftoff Load (lbm) | Min L/O (lbm) | Margin (lbm) | Padhold (hrs) |
|-----------|-------|-----------------------|------------------|-----------------|------------------|
| H2 | 5 | 455.5 | 437.4 | 18.1 | 54.7 |
| O2 | 5 | 3906.5 | 3850.2 | 56.3 | 57.4 |

- NOTES:
- 1) Assumes 11+0+2 day mission, 2-2-2 deorbit opportunities
 - 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
+20 lbm O2 above standard 100.7% load
 - 4) Margins protect 51.8 lbm O2 for 6 EVAs, 1 cabin depress/repress
 - 5) HST "Design Mission": 150 attached hrs, 600 kWh (incl. extension days)
TD 10/19:17 (3rd KSC Opportunity: 1 Rev early)
 - 6) ICBC-3D: 16 kWh
 - 7) 100 W crew power savings during Group B powerdowns assumed
 - 8) Nominal Mission: 20.5 lbm H2 (61.7 hrs), 80.3 lbm O2 (81.7 hrs)
5 EVAs, HST 573 kWh, 140 hrs attached, TD 10/20:45 (260.75 hrs)

CSCS:

- 9) Damage identified FD3, CSCS capability with repair attempt allows for 19 days with 4 lbm additional O2 margin and unmanned re-entry on FD20. (CSCS declared FD10)
- 10) Damage identified FD10, CSCS capability w/o repair attempt allows for 16 days with 68 lbm additional O2 margin and unmanned re-entry on FD17. (Nominal mission through FD10, CSCS declared 08/17:00)

SSP Environmental Summary

| Consumable | L/O Load | Min L/O | Margin |
|------------------------|----------------------------|--------------------------|---------------|
| N2 (lb) | 321.8^{1,2} | 268.2³ | 53.5 |
| Supply H2O (lb) | 386⁴ | 353 | 0 |
| LiOH (cans) | 78⁵ | 78 | 0 |

NOTES: 1) Assumes 11+0+2 day mission

2) N2 L/O load protects/reflects KSC 6 lbm prelaunch usage requirement

3) N2 loading protects for 5 scheduled EVAs and 1 unscheduled EVA

4) Supply H2O loading reflects a 150 lbm offload

5) 78 LiOH canisters are required for a 11+0+2 day mission. (46 cans for 11+2 and 32 additional cans for 25 day CSCS mission duration)

Status of Standard Open Work Shuttle (Training – MCC)

- **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.

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:

MEL-13: MOD has coordinated the Flight Specific Minimum Equipment List with the LCCWG. The LCN has been approved by all of the LCCWG members and awaiting PRCB scheduling for final approval and publication. ECD 9/10

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

- **New Ops Work Status:** All significant differences from previous flights have been reviewed by FTP, POWG, or other appropriate operations forum and where required documented in either new procedures or new flight rules, except as follows:

DAP configurations and constraints - (Awaiting C. S. Draper Laboratory Memo) The current versions of the 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.
ECD 9/15

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

- **New Ops Work Status:** All significant differences from previous flights have been reviewed by FTP, POWG, or other appropriate operations forum and where required documented in either new procedures or new flight rules, except as follows:

Reboost planning - PROP, FDO, and GNC are awaiting the final reboost efficiencies and load information from Draper and ATK, to finish planning reboost. ATK and Draper have deemed reboost Config 4 unacceptable due to loads and the amount of analysis and reconfiguration that would be required to make it acceptable. Draper has delivered a preliminary set of prop efficiency numbers, to help with reboost planning. The final numbers will be delivered in the Draper memo. Config 3 reboost (VRCS for translation and attitude control) is the primary reboost method to extend HST orbital lifetime. Additionally, a PRCS reboost mode will be available for a loss of vernier scenario. This reboost mode uses +X for translation and ALT DAP for attitude control. This backup reboost mode is primarily for collision avoidance reboost maneuvers while HST is in the payload bay; however, this PRCS reboost mode can be utilized for the FD09 reboost session, if propellant margins support. ECD 9/15

CSCS procedures - EGIL, GNC, and Rendezvous are working to complete the powerdown and powerup procedures that will be available in the event that STS-125 requires STS-400. These procedures allow the vehicle to remain in active attitude control while using as little power as possible. Additionally, the vehicle is powered up for the STS-400 rendezvous, and in the proper configuration for separation and disposal. ECD 9/15

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

Unacceptable Underspeed Due to Automated Single Engine

Completion - In a standalone STS-125 SMS simulation, the crew was unable to successfully complete an ATO OMS-1 burn for a Single Engine Press to Mecro (SEPTM) case, even though the SSME failures occurred after the SEPTM boundary. An investigation attributed the underspeed to the timing of the OI-32 automated single engine throttleback (too early). For STS-125, the automated throttleback occurs prior to the guidance altitude/planar release constraint, resulting in a vehicle pitch down and large (1066 fps) underspeed. DS and DM met with DA8/N. Knight and agreed on a proposal to use previous OI-32 manual throttles solution/workaround for STS-125/HST. Stand-alone and integrated training will provide both the crew and MCC the necessary opportunities to exercise this scenario.

SSME Controller Power Cycle for Hubble Rendezvous - Flight Rule CR 9794 has been submitted into Workflow. This CR extends the permission to power cycle a Space Shuttle Main Engine (SSME) Controller to clear a performance case and regain rendezvous capability with the Hubble Space Telescope to the STS-125 mission. Current flight rules permit the power cycle of an SSME controller in order to regain rendezvous with the ISS.

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

- CRITICAL PROCESSORS/APPLICATIONS - All MCC critical processors/applications have followed the defined change control process, and have completed verification, validation, and certification testing. Additionally, the Critical Processor Certification Form has been fully executed and signed at the Division level. All critical processor changes are made in accordance with the MCC Critical Processor Certification Policy JSC-23474. The appropriate Quality Assurance Plan has been executed and all records are complete. Exceptions are noted below:

GNC LOC Button - GNC is working with the MSOC and ROCC to ensure the reported 3 sec delay in signal from console activation to ROCC reception is not an issue. There are other delays in this overall function related to vehicle controllability. The MCC has a telemetry delay of a few seconds. Once the GNC officer has the data, at least 5 seconds of data is required per flight rules prior to making a decision, plus a few seconds to finalize the decision and push the buttons. So, at a minimum there is at least a 10 second delay prior to the signal even being initiated at the GNC console. A test with the ROCC will be performed on 8/29 to confirm and baseline the delay and then a meeting with DA8 and DM will discuss if this delay time is acceptable (GNC believes it is) ECD 9/5

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

- 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:

DCDisplay – locks up when “Locate” or “unbound” functions are used during real time monitoring of data. Software developers are expecting to release a fix for testing on 9/3. ECD 9/10

Orphan Code – Linux recompile with newer uncertified code was identified (IMU Eigen comp and 7 potential other CI). IMU Eigen comp has been compiled with the proper version and will complete testing prior to L-30

Incorrect Test Environment – Linux testing inadvertently performed with comp running on DEC Alpha workstation server. 1 program identified and 3 other potentials. All will be retested in the proper environment.

Conclusion Shuttle

All identified open work will be
completed in time to support
STS-125

Space Transportation Vehicle Division



STS-400 LON MOD FRR

September 2nd, 2008

DS1/Jim Azbell

DS Shuttle CoFR Status Summary

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

SSP Electrical Summary

| Reactants | Tanks | Liftoff Load (lbm) | Min L/O (lbm) | Margin (lbm) | Padhold (hrs) |
|------------------|--------------|-------------------------------|--------------------------|-------------------------|--------------------------|
| H2 | 5 | 455.5 | 378.4 | 77.1 | 210.8 |
| O2 | 5 | 3886.4 | 3441.1 | 445.3 | 429.6 |

- NOTES:
- 1) Reflects 7+4+2 day mission, 2-2-2 deorbit opportunities
 - 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) Mission average power is 13.623 kW
 - 5) SSPL 5510/PSSC payload energy of 10.1 kWh during orbit ops
 - 6) 2 days of STS-400/STS-125 joined ops; metabolic budgeted for STS-125 crew
 - 7) 57 lbm O2 budgeted for 3 crew transfer EVAs and 1 unscheduled EVA, with 2 Cabin 10.2 depress/14.7 repress cycles
 - 8) Assumes 4 additional days as follows:
 - Pre-rndz off-duty day: avg pwr 12.65 kW, 24.9 lbm H2, 206.4 lbm O2
 - Post-sep off-duty day: avg pwr 12.81 kW, 26.3 lbm H2, 240.3 lbm O2
 - Post-sep unscheduled EVA day: avg pwr 13.98 kW, 28.8 lbm H2, 262.9 lbm O2
 - Post-sep Late Inspection day: avg pwr 14.37 kW, 29.7 lbm H2, 257.3 lbm O2

SSP Environmental Summary

| Consumable | L/O Load | Min L/O | Margin |
|------------------------|----------------------------|--------------------------|---------------|
| N2 (lb) | 387.3^{1,2} | 283.4³ | 103.9 |
| Supply H2O (lb) | 353⁴ | 353 | 0 |
| LiOH (cans) | 59⁵ | 59 | 0 |

NOTES: 1) Assumes 7+4+2 day mission

2) N2 L/O load protects/reflects KSC 6 lbm prelaunch usage requirement

3) N2 loading protects for 3 crew transfer EVAs and 1 unscheduled EVA

4) Supply H2O loading reflects a 180 lbm offload

5) 59 LiOH canisters are required for a 7+4+2 day mission. This supports 4 crew for 3 days and 11 crew for 10 days.

Status of Standard Open Work Shuttle (Training – MCC)

- **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:

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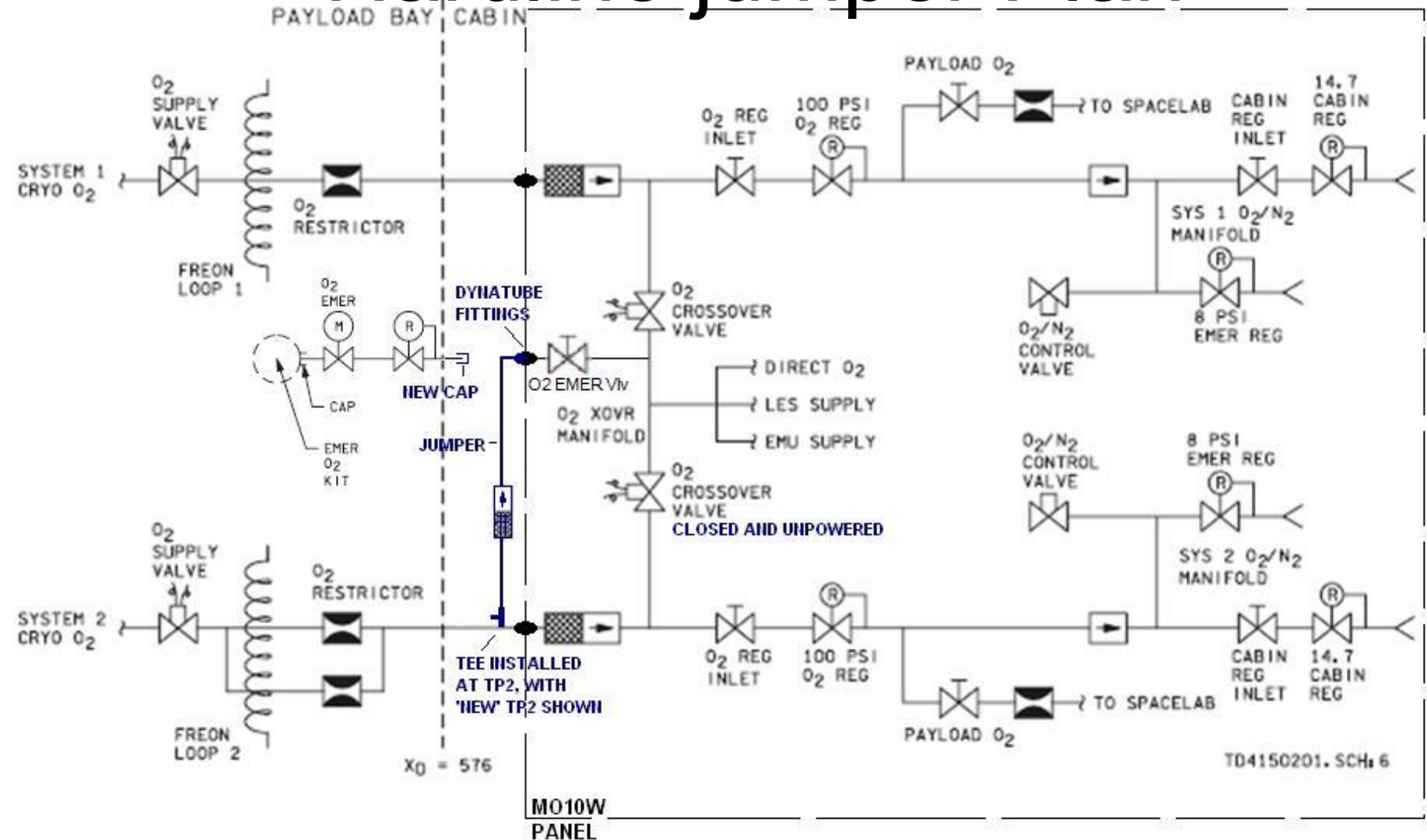
DAP configurations and constraints - (Awaiting C. S. Draper Laboratory Memo) The current versions of the flight rules contain the preliminary data from C. S. Draper Laboratory. Upon receipt of the official memo, GNC will review the document, and update any DAP constraints in the FDF and Flight Rules as required.
ECD 9/15

Status of Non-Standard Open Work Shuttle (Flight Anomaly)

- FLIGHT ANOMALY RESOLUTION - All previous in-flight anomalies have been resolved and all operational or procedural changes required have been implemented and verified. Exceptions are noted below:

OV-105 O2 System 2 Crossover Valve Anomaly - During a nominal ground processing O2 System Decay Test on OV-105, an off-nominal pressure signature was noted indicating the O2 System 2 Crossover Valve was intermittently closing. This is a solenoid valve and fails closed when it loses power. Retesting confirmed the O2 Crossover Valve is receiving good power from the vehicle therefore the problem is within the LRU which is contained within the MO10W panel. It was decided at the OPO on Monday August 18 that it is not safe to fly as-is. Failure of the O2 Crossover Valve in the closed position will leave only one O2 system to supply O2 to the crew in the case of an emergency. Flight data has indicated one system may not be enough. Each system supplies ~25 lb/hr of flow. PRCB has decided to braze an O2 hardline jumper to plumb around the failed O2 System 2 Crossover Valve. With the hardline jumper installed, there are several FDF procedure, flight rule, and MEL deltas required for STS-400.

Hardline jumper Plan



Oxygen system

Conclusion Shuttle

All identified open work will be
completed in time to support
STS-400