

Space Transportation Vehicle Division



STS-126 MOD FRR

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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
Fit 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	407.0	48.5	139.3
O2	5	3886.4	3660.6	225.7	224.5

- NOTES:
- 1) Assumes 15+1+2 day mission with 4+1 ISS-based EVAs
 - 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) 26 lbm O2 protected for PMA/ODS Repress, MPLM Vestibule Repress, and 5 ISS-based EVAs. No O2 transfer budgeted.
 - 5) SSPTS output energy provided is 1375.3 kWh based on:
 - 3 converters at full power for 166.4 hrs
 - 2 converters at full power for 78.4 hrs (including Additional Day)
 - SSPTS deactivated during 5 EVAs for 6.5 hrs each
 - 6) Powering the Main Landing Gear heaters for 120 hours will cost 61.3 kWh, which equates to 5.3 lbm H2 and 42.1 lbm O2. Launch hold will be reduced to 125.2 hrs, H2 limited (183.6 hrs O2 launch hold).
 - 7) CSCS capability with 3 SSPTS converters allows for 26 days docked with 66.8 lbm additional O2 margin and unmanned undock on FD29. O2 margin includes ISS crew metabolic for the docked duration.

SSP Environmental Summary

Consumable	L/O Load	Min L/O	Margin
N2 (lb)	387.3^{1,2}	355.0³	32.3
Supply H2O (lb)	353⁴	353	0
LiOH (cans)	42⁵	42	0

NOTES: 1) Assumes 15+1+2 day mission

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

3) N2 loading protects for 4 scheduled ISS based EVAs and 1 unscheduled ISS based EVA

4) Supply H2O loading reflects a 180 lbm offload

5) 42 LiOH canisters are required for a 15+1+3 day mission.

The equivalent of 25 canisters will be provided by ISS CDRA (dual bed) and Vozduhk and ISS pre-positioned LiOH to support Shuttle docked operations.

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 (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 10/16

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

Undock Rate Requirement - During STS-124 it was discovered that ISS plume loads analysis assumptions regarding the Shuttle DAP were incorrect. The analysis assumes mated stack body rates lower than is possible with our current Shuttle DAPs (both VRCS and ALT PRCS). The concern is the potential attitude errors after physical undock at the 100 second timer has expired and ISS performs a snap-and-hold of its current attitude. Historically rates at free drift 3 minutes prior to undock have been much lower than the analysis assumed. However, the DAP rate limits allow for rates higher than what was assumed.

ISS GN&C has developed a rate limit requirement at free drift prior to undock that will maintain the validity of their assumptions. Draper Labs is currently working on certification of a VRCS DAP specific to undocking that will meet these requirements. Presently, it is not believed that an ALT PRCS DAP can be certified for STS-126 that will have a rate limit meeting the requirement. The plan to meet these requirements for undocking on ALT PRCS will be to manually monitor the body rates, both the crew and MCC, prior to moding to free drift. Updates to the undocking rate block will go into the RNDZ book once the final Draper memo is released. ECD
10/16

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

JEMRMS Constraints on PRCS Usage - There is currently no position designed for the JEMRMS that will allow PRCS usage during mated operations. Previous JAXA analysis showed JEMRMS joint slippage during a 9 hour period of ALT PRCS attitude hold. JAXA is working on analysis of certain JEMRMS positions that would allow ALT PRCS control. Action to JAXA from the JOP to get ACO updates for the Docked loads matrix. ECD 10/20

Mated Shuttle Reboost CMG Constraints - As part of standard ISS operations, the CMG can be pre-positioned in anticipation of resuming attitude control while the mated stack is being controlled on VRCS. This results in a disturbance torque that the Shuttle VRCS would have to react to while in control. While there are not flight control stability concerns associated with this, it would change and increase the amount of jet firings needed for attitude control during reboost. This could result in loads exceedances or changing the expected delta-velocity from the reboost. To avoid this, the flight specific reboost flight rule will be updated to reflect this CMG constraint. ECD 10/16

OBSS DAPs During Undock - Robotics Engineering has only evaluated certain DAPs for use while the OBSS is unberthed. As part of the nominal undock timeframe, the DAP is changed to a config that ER has not evaluated. GNC is working with ER to address their concerns. Changes to the Flight Plan are likely, but modifications to the RNDZ book may also be required. ER will update the flight rule if required if not GNC will update the flight plan to reflect the constraints. ECD 10/20

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

Undock Sep 3 Burn Duration - The Sep 3 burn during undocking was changed to target 5 ft/s to support payload deployment later in the flight. As the burn is performed manually, the procedures direct the crew to deflect the THC for a specified amount of time to achieve the targeted delta-velocity. However, these burn times are calculated using an estimated mass of the Orbiter. The SRMS/OBSS engineering community has only approved burns of up to 5 ft/s. A decision has to be made as to any impacts from exceeding this approved burn limit. DM and ER are working to address this and will make any changes to the flight rules, if required. ECD 10/20

GNC I/O RESET Diamond - This update was brought forth as a precaution step for Non-universal scenarios (e.g. STS-124 set split seen on the pad). The ground has additional insight to failures and could preclude the crew from attempting to upmode an MDM which has commfaulted with indications of a non-universal I/O ERROR. Per crew request, a 482 will be put in place to add the diamond. In addition, training plans to incorporate this practice into overall training philosophy as well. The 482 will be a MULTI 482, affecting 9 books, 28 pages, and 3 procedures. If the 482 is not in for STS-126, the crew has been trained to check with MCC (time-permitting) prior to performing I/O RESETs for these scenarios.

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

- 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:

ADI Rate Errors - On STS-124 the crew reported erratic output from the ADI Rate Error needles in the LOW switch position during burns. Post-flight investigation determined this behavior was normal: a change to the flight software in OI-32 changed the scaling of the ADI switches. In the LOW position, the scale was small enough to reflect the normal IMU data noise. A change to the FDF has been submitted to position that switch in the MED position for burns; this issue will also be addressed during flight specific crew training. The change to the generic ORB OPS has been submitted for STS-126. STS-125's RNDZ book was updated; GNC will work with DM to ensure the changes are made for STS-126 as well.

CO2 Symptoms - The CO2 issues that were noted on several previous flights seemed to have been solved by the ducting configuration used on STS-124. There is a proposal by ISS program and engineering to change this ducting config by eliminating the Node 2 duct in an effort to reduce the crew workload and access issues caused by the duct. MOD is opposed to this proposal because both analysis and data show this portion of the ducting changes to be the most efficacious of the deltas made to the config. There is a JOP splinter on Oct 6th to discuss the engineering proposal. This issue may have to be presented to the ISS program as well so the ECD is mid October.

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

- ANOMALY-PROCEDURE - Any special procedures or flight rules required because of uncorrected anomalies have been written, reviewed, and verified. This applies to vehicle problems the program elected not to fix but fly "as is" as well as ground problems which were not corrected but procedurally worked around for this flight. Exceptions are noted below:

O2 SYS 2 XOVR Failure - The O2 SYS 2 XOVR valve has been unpowered due to unstable operations during ground processing. The valve has been bypassed and the O2 EMER valve on MO10W now functions as the O2 SYS 2 XOVR valve. Procedures that are either performed nominally or one failure deep have been modified in the flight data file to replace the L2 switch with the MO10W switch for this function. Procedures that are not performed nominally or that are greater than one failure deep will be modified and ready for uplink if required. ECD is 10/31/08

FCS C/O Imagery – During the FCS C/O aerosurface drive and secondary actuator check, the vehicle undergoes perturbations that may cause trapped FOD to release from the payload bay. To better characterize any observed FOD, the OPO is requesting a crew member be staged to capture video/still imagery. Photo/TV is developing crew procedures for video and still imagery. ECD 10/03/08

Conclusion

All identified open work will be
completed in time to support
STS-126

Backup

Info Only: OI-33 changes

- OMS Gimbal ZAP Command - OI-33 software corrects the software timing issue where the OMS TVC ZAP command gets commanded prior to the enabling of the associated TVC mechanism. Prior to OI-33, the crew has been req'd to select secondary TVC twice when moding to that system in failure situations. FDF has been updated for OI-33 to remove the "(twice)" callout in these procedures.
- Improved RTLS ET Sep - Logic was added to the RCS jet selection software for improved capability. Additionally, the Speedbrake opens at MECO confirmed to provide additional control authority.
- Rate Pointers - ADI Rate Pointers will move in the direction of the established vehicle rate, e.g. the pitch rate pointer will move down if the vehicle is pitching down. (Previously the rate needles were "fly-to" indicators.)
- Updated OI-33 RTLS shutdown cue - The OI-33 MECO target for RTLS has changed from $\alpha=-2$ to $\alpha=0$. The current shut down cue for RTLS at $\alpha=-1$. Since OI-33 will never reach that angle of attack, the cue for shutdown is being changed to $\alpha=+2$ to ensure that the engine(s) are shutdown prior to the commanded MECO. The change was approved by the A/E FTP OSB, and FDF and Flight Rule changes have been incorporated.