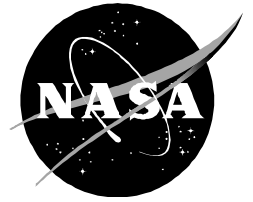


National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
2101 NASA Parkway  
Houston, Texas 77058-3696



Reply to Attn of: DF-06-011

August 21, 2006

TO: Distribution

FROM: DF/Chief, Systems Division

SUBJECT: STS-115 "Delta" MOD Systems Division Flight Readiness Review  
(FRR) Data Pack/Prelaunch Systems Issues

The enclosed data pack is provided to aid in the preparation for STS-115. The inputs are provided from Systems Division Flight Control Team disciplines for STS elements (Orbiter, SSME, SRB, and ET) and reflect new or recently closed issues since publication and distribution of the original STS-115 FRR Data Package. The focus of the data pack is in-flight operations and the list of items in each section is not necessarily comprehensive. This memo replaces the original data pack.

Changes or issues that require updates after the final publication will be provided to the Flight Control Team at the L-1 briefing on console.

If you wish to remain on distribution for future data packs, please reply to DF Shuttle Technical Assistant/Michael Interbartolo.

*Original signed by:*  
Stanley J. Schaefer

Enclosure  
Distribution: See list

SYSTEMS DIVISION FLIGHT READINESS REVIEW  
DELTA FRR DATA PACK  
STS-115 (OV-104)  
August 21, 2006

**A. Open Flight Anomalies**

**NONE. ALL Previously reported Flight Anomalies have been closed or are not a constraint to STS-115 Launch.**

**B. New Operations**

**ET Photo Pitch Maneuver**

The planned pitch maneuver for the crew handheld photos of the ET has been delayed until 30 seconds after the MPS dump starts. This delayed pitch-up maneuver cuts the APM impact in half as compared with STS-114/STS-121.

**GPS Ramp-Up Flight Rule:**

Per AEFTP decision, STS-115 will be the first incorporation of GPS to PASS NAV during entry. This will be accomplished post high-speed tracking acquisition. Associated flight specific rule updates submitted.

**C. Operational Workarounds**

**Tin Whisker Ops Control**

Because of the ongoing concern in regards to tin whiskers, RJDF 2 was removed and replaced on OV-104 for flight. In conjunction with this hardware change out the primary jets will be reprioritized prior to rendezvous to put the jets with least impact in highest priority to help alleviate the concern of a tin whisker leading to an inadvertent jet firing. The primary RJD powerup prior to undock has been moved to the Free Drift period just prior to separation.

## **C. Operational Workarounds(cont.)**

### **Shelf Pulsing/FORP Control**

With the engineering concern of short duty cycle thruster firings leading to the generation of FORP (Fuel/Oxidizer Reaction Products) which may build up in the Pc sense tubes of the vernier jets, during the orbiter controlled maneuver to the initial mated attitude Free Drift will be selected on the DAP at approximate 10 minute intervals to recenter the phase plane. This will help to mitigate shelf-pulsing which is believed to lead to FORP buildup which is theorized to be a candidate for causing burn through of the Pc sense tube.

### **Main Landing Gear Tire Pressures**

The new tire pressure transducers for the main landing gear tires are supposed to measure pressure between 260 psi and 460 psi on a 0 to 5 volt scale. It has been learned that the transducers actually measure the pressure based on a 0 to 5.1 volt scale which produces a slight bias. The bias is essentially 0 psi at 260 (0 volts), and 4 psi at 460 (5.1 volts). MMACS will have to make the MCC calibration (cal) curve corrections with Telemetry Services. Boeing engineering will provide the new slope coefficient in the standard MCC ODRC memo at L-7 days. The tire bias information that MMACS receives from KSC will also need to be adjusted to account for the incorrect cal curve. The MCC and onboard software will not be correct until STS-117.

### **Water Loop 1 LCN change**

Due to bias of Water Loop 1 Pump Out Pressure transducer, an LCN was created to adjust LCC limits for this measurement

## **C. Operational Workarounds(cont.)**

### **Radiator Retract Hoses**

The OV-103 radiator retract hoses were flown on STS-114 under the first of a two flight certification waiver (covers first two lights following RTF for OV-103 and OV-104). Post STS-114 inspection of the hoses showed possible damage to the hose braids not seen preflight. This damage was thought to invalidate the waiver and necessitate a test plan to certify the hoses prior to STS-121 and 115. Due to issues with the hardware during the testing, this data will not be available prior to STS-121 but may be available in part prior to STS-115. EECOM supports the current waiver rationale for STS-115. Because the possibility of initiating a radiator leak during PLBD opening increases due to increased flexure placed on the hose, the activation threshold of the auto isolation software will be raised from the nominal 12% accumulator quantity limit to approximately Liftoff quantity minus 10%. This value will be changed in the software via TMBU once in OPS 2 and then reset to the nominal 12% after PLBD opening is complete + ~30 minutes. These 30 minutes will give the flight control team time to evaluate any potential leakage from the Freon Loops before restoring the software limit to the 12% nominal value. This threshold limit change was also performed for STS-114 and STS-121 PLBD opening.

### **Vent door procedure updates**

The philosophy for vent door operations changed prior to STS-121 and there was not enough time to complete all procedure changes prior to the STS-121 482 cut-off date. The highest priority procedures were changed for STS-121. The remainder of the procedures has been changed for STS-115, but will not be published. Per flight director direction the changes are in workflow and will be uplinked realtime if needed.

## **C. Operational Workarounds(cont.)**

### **Limit Shutdown Control and Manual Throttling for Low LH2 NPSP**

Flight rule annex updates were required due to recent analysis that shows that the Block-II SSME redlines may not protect for low Liquid Hydrogen (LH2) Net Positive Suction Pressure as utilized in the current Flight Rules for LH2 Ullage Leaks. The Phase-II SSME redlines did protect for this. An annex update was submitted for STS-115.

### **OMS/RCS Procedures During Entry**

Current OMS/RCS leak procedures in the Entry Pocket Checklist and Ascent/Entry Systems Procedures FDF call for orbiter vent doors (Left 1&2 and Left 8&9) to be opened in order to prevent an overpress of the forward module or OMS pod. New thermal analysis for the vent doors indicates a potential burn through if a vent door remains open during the entry timeframe. Because Probabilistic Risk Assessments resulted in an OMS/RCS oxidizer or helium leak being seven orders of magnitude less likely than a failure that prevents a vent door from being closed, flight rules and FDF procedures are being modified to ensure the vent doors are closed during entry. A 482 was processed to either remove steps or limit the timeframe when the vent doors can be opened for an OMS/RCS oxidizer or helium leak.

## **C. Operational Workarounds(cont.)**

### **Cabin Leak Procedures**

EECOM recently identified that the Cabin Leak procedures in all the pocket checklists as well as the Malfunctions Procedures do not adequately address a leak through the EMU waste drain line. The EMU waste drain is a 1/4 inch (O.D.)/0.216 in (I.D.) line which runs from the External A/L into the cabin WCS where it meets the urine line that goes to the waste water tank. It is used during shuttle-based post-EVA activities to create ullage in the EMU waste tanks by flowing into the Orbiter waste water tank in prep for subsequent EVAs. A portion of the line runs outside the cabin between the Ext A/L and 576 bulkhead. Because the WCS urine line is open to the cabin through the urinal funnel as well as the odor bacterial filter behind the WCS, a leak in the external portion of the EMU drain line would induce approximately a 33 lbm/hr (AOA sized on ascent) cabin leak. As a workaround for STS-115, procedural deltas were submitted via a Safety-of-Flight 482 and will be incorporated via errata pack into the 115 FDF. The crew is aware of this situation and will discuss it further during their upcoming WCS refresher. A more permanent solution, which may include either a H/W mod or a configuration mod, will be pursued for subsequent flights.

## D. Anomaly Resolution

- **INCO:**

**Experienced loss of decom lock on MADS PCM data stream during playback of the 'E1' channel on SSR-1:**

Low Pass Filter installed between MADS PCM and SSR 1 E1 input. Documented operational workaround within the Console Handbook Procedure must be followed to record MADS PCM on SSR1.

**DAM UNIT POWER LIGHT WENT OUT DURING STEP 70-29 OF V1248 MADS TIME AND CYCLE FOR MADS UNIT:**

Inspection of Digital Amplification Module (DAM) indicated unseated cards. Cards were reseated and fuses replaced. System checkout was successful.

**MADS PCM signal as measured at the input to the MCM during TPS INS-231 does not indicate proper 2.5 VDC:**

The Engineering Drawing was incorrect and had two pins "swapped". After pin correction, retest completed successfully.

**PDI Decom 2 Bit Rate and Bit Sync showed 'Locked' but with no data:**

No impact to STS-115 primary configurations.

**KU-Band Protect Box:**

A new POINTING/INCO FCOH procedure will document coordination of Ku-Band Protect Boxes. Draft procedure is in review and will be complete prior to STS-115.

## D. Anomaly Resolution (cont.)

- INCO(cont.):

**Return Loss measurements for S-Band Xpndr 2 PM Lower Left and Lower Right antennas did not meet OMRS minimum requirement.**

The losses were measured at 9.5 to 10.3 dB. OMRSD V74AH0.030 requires the measured value to be 10.5 dB: A waiver was approved to accept the lower signal strength and with the understanding that the engineering values should have no operational impact.

**S-Band PM power 2 in STDN HI mode through the LLA antenna was 53.62dBm; S/B NMT 53.5 dBm:**

The antenna was realigned and recalibrated. It passed and the IPR was closed

**Primary and Secondary ET/TPS GFE firewire Cables failed bit error rate testing.:**

JSC test results indicated the Bit Error Rate were within specifications. IPR was closed.



## **D. Anomaly Resolution (cont.)**

- **DPS:**

### **GPC 3 Mode Talkback**

During the STS-112 mission the GPC 3 mode talkback remained in 'RUN' when the mode switch was taken to standby during a G2 set contraction. Initially problem was thought to be a sticky/failed talkback. After further review the STS-112 crew concluded the Mode switch was toggled past the STBY position into HALT and then placed into STBY. This explained why the talkback appeared to stay in 'RUN' and GPC was operating per design.

### **IDP 4 MSU Failure Indication**

DP reported a Mass Storage Unit (MSU) Fail Built-In-Test (BIT) error during orbiter powerup. The error occurred during MSU Power On Self Test (POST), and resulted from a failure of the Read/Write Head Retract Test. In this occurrence the automatic retry was successful and a normal MSU operational state was achieved. During subsequent power cycles of the IDP no errors against the MSU and anomaly was closed as a transient condition.

### **General Purpose Computer Backup Battery Units (BBUs)**

GPC 1 BBU was replaced after BITE indications were present when the GPC was powered. GPC 4 was also R&R due to BITE indications against the BBU. KSC installed a refurbished (new battery cells) BBU into GPC 5 (BBU S/N #43).

### **IDP2 MSU failure during powerup**

IDP2 indicated an MSU failure at power up. Signature was consistent with MEDS hardware note #4. Closed and an explained condition.

## **D. Anomaly Resolution (cont.)**

- **DPS(cont.):**

### **Indication of FF1 IOM3 (card 3) failure**

KSC was performing a BITE 3 test of FF1, which forces one of the two MDM core power supplies to reduce its power output in order to test the ability of the other core supply's ability to power the MDM. During this test, card 3 dropped offline. This is consistent with a known EMDM condition whereby the current limiter on the IOM3 card 'trips' due the inrush of current. KSC cycled the MDM power, and the card was recovered. The MDM was power cycled 15 times, with a BITE 3 read after each cycle, all with nominal results. The MDM PRT decided to fly as-is with this unit.

### **MDU PLT2 R&R'd**

During a MEDS MDU evaluation performed on 5/25/04, MDU PLT2 (P/N MC409-0185-0021 S/N 514) exhibited white corner degradation in both the upper left and right corners of the MDU. The unit was R&R'd.

### **GPC 4 Main Power Feed C Indicated Off**

Testing isolated the problem to a wire break behind ECL duct in the aft flight deck area. A splice repair was performed and the box was retested with no anomalies observed.

## D. Anomaly Resolution (cont.)

- **Booster:**

- **STS-121 LH2 Liquid Level Sensor :**

During liquid level sensor checks at T-2 hours, 30 minutes on the first launch attempt, the Liquid Hydrogen (LH2) 5% sensor indicated it was failed wet (open circuit). This sensor is from the "suspect 1996 lot" of sensors. Recall that the four LH2 engine cutoff sensors in the tank were changed out to a newer lot of sensors, but not the 5% or other liquid level sensors. The 5% sensor is not required for loading or flight, but is used to aid post flight performance reconstruction. During the first drain, the 5% sensor stayed wet for approximately 2 hours, then spontaneously indicated dry. During the second drain, the 5% sensor exhibited erratic behavior for a few minutes then indicated dry. These signatures were similar to previous signatures on failed LH2 engine cutoff sensors. The 5% sensor behaved normally during initial tanking on the second and third attempts, but was found failed wet during the same T-2 hour, 30 minute check both times. The 5% sensor remained indicating wet up until ET separation during the successful launch on 7/4/2006. Failure signature is indicative of an open circuit anywhere in the system circuitry including the orbiter point sensor box, orbiter wiring/connectors, ET wiring/connectors and LH2 ET tank sensor. In addition to the 5% sensor situation, evaluation of prelaunch tanking data suggest that there was significantly more wet/dry activity on the 100% liquid level sensors than observed during replenish for the previous 5 super light weight external tank flights. The data suggests significantly more activity in the top layer of the propellant and indicates a consistent out of family condition.

- **STS-121 Left SSME On Orbit Micro-Meteorite Strike:**

Postflight examination of the engines from STS-121 showed that SSME 2051 had sustained a micro-meteorite strike on the cold wall side of the Left SSME nozzle. The strike left a 0.010 inch diameter pinhole into a single coolant tube of the nozzle wall, 4 inches above the aft manifold. Damage of this sort, occurred some time after powered flight, poses no hazards to safety of flight. This nozzle will be repaired using standard tube overlay braze.

## D. Anomaly Resolution (cont.)

- **Booster(cont.):**

- **STS-121 Fuel Preburner Purge Pressure Anomaly:**

Approximately 9.6 seconds after MECO, the right SSME (ME2056) experienced an anomaly affecting three purge pressures in the engine's Pneumatic Controller Assembly (PCA). Fuel Preburner Purge pressure rose by 40 psi, Oxidizer Preburner Purge pressure rose by 10 psi, and HPOTP Intermediate Seal Pressure rose by 4 psi.

Additionally, the orbiter helium regulator outlet pressure, supplying that engine, rose by 8 psia. Analysis on the pressure trace and relative magnitudes indicate a flow restriction in the Fuel Preburner (FPB) purge in the vicinity of the Fuel Preburner Oxidizer Valve (FPOV). Inspections of the purge lines, filter, and FPB Dome Checkvalve indicated that no contamination remained in these components. The PCA and FPOV have been removed, disassembled, and inspected for contamination. The check valves have been X-rayed. The FPOV and check valves have been flow tested. No anomalies have been observed. FPOV Wave Spring Bottoming triggered by transient contamination is the most likely scenario causing this anomaly. FPOV Wave Spring Bottoming occurs when purge helium separates the FPOV shaft from its retainer, compressing (bottoming) the wave springs and closing one of the purge paths through the FPOV. The transient contamination could be water ice originating from prelaunch GN2 purge, prelaunch and in flight helium purge, and/or combustion gas backflow during shutdown. Flight rationale may be developed based on findings that support a hypothesis of transient contamination originating not within the PCA, but rather downstream where impacts can be shown to be limited to Crit 3 functions or a pad abort. GN2 purge moisture content is continuously monitored real time. A chit has been taken to sample the OV-103 helium supply and analyze it for moisture content. Final discussion will be at the L-2 briefing.

## D. Anomaly Resolution (cont.)

- **MMACS:**

**Emergency Egress Net Daisy Wheel Knob Breakage:**

During the removal of the emergency egress net (the trampoline), the port side daisy wheel knob broke. The crew reported that the knob was extremely tight and that it would not turn in either direction. The knob shaft broke due to excessive force. The knob was previously designed to turn right to loosen in contrast to the standard left hand turn to loosen. The knob has been redesigned and labeled to aid the crew in its correct use.

**APU 1 Erratic Exhaust Gas Temperature (EGT) Transducer:**

During entry, APU 1 EGT became erratic, eventually dropping to 200 deg F. Normal temperature is over 1000 deg F. The APU EGT transducers have historically had this type of behavior. The APU has been replaced.

**APU 2 Oil Out Pressure Alarm on Entry:**

During Entry, APU 2 gearbox GN2 pressure decreased 6 psi and approached the repressurization limit. The oil out pressure decreased as well and began to experience larger pressure fluctuations until it finally annunciated the alarm. The pressure subsequently recovered and no further occurrences were noted. This behavior has been noted on several past flights. The APU has been replaced.

**A7L Switch Guard Broken:**

One of the Russian-built U-shaped switch guards on the docking panel (A7L) was broken at one attach point. The crew reported that the switch guards were frequently used as translation aids while on orbit. The switch guards for the docking panel have been redesigned to be more robust and have been incorporated on this vehicle (OV-104).

## **D. Anomaly Resolution (cont.)**

- **MMACS(cont.):**

### **APU 1 Fuel Tank Pressure Decay:**

Testing is being performed to determine the source of the APU 1 GN2 leak. This is vehicle specific and not believed to be a generic hardware issue. Not a constraint for OV-104/STS-115.

### **APU 3 Gas Generator/Fuel Pump Heaters :**

Both the A and B primary thermostats failed to control in their control bands. Dual Thermostat failure has been determined to be the cause but it is not believed to be a generic hardware issue. Not a constraint for OV-104/STS-115.

### **Drag Chute Pushbutton Failure:**

The drag chute Pushbutton Indicator (PBI) Deploy 2 indication was not received at either the panel F2 or F3 PBIs. Testing isolated this failure to an open circuit just prior to Annunciator Control Assembly 2. Visual inspection of the connector showed no anomalies. The failure is a redundant indication only, and has no effect on Drag Chute system functionality. Both DCCA (Drag Chute Control Assembly) 1 & 2 Arm, Deploy, and Jettison circuits have been verified to be fully functional. This lack of indication does not increase the chance of inadvertent deploy, nor does it decrease the chance of a nominal deploy post landing. The open wire segment has been capped and stowed at both ends. There is an OMRSD waiver for this indication through at least STS-117 with the likelihood that this will not be fixed until OMDP.

## D. Anomaly Resolution (cont.)

- **MMACS(cont.):**

### **KU Bolt Antenna: Suspect Thread Engagement:**

Recently discovered short bolts on MPM hardware prompted investigation of other critical bolts. Evaluation of KU Bolt drawings identified 2 out of 4 installation bolts with suspect thread engagement. The suspect bolts are the rear installation bolt that mount the KU Band to the longeron.. The last installation of the Ku Band actuator on OV104 was 1984 with 195 in-lbs of torque. Currently access to the Ku Band on OV-104 is problematic and inspections of OV-103 & 105 are complete and the bolts have been changed for those vehicles. The thread engagement is a maximum 2.4 threads, but would still not be enough to engage the locking feature. The Program decided to R&R the OV-104 bolts at the PAD to preclude backout during ascent.

### **WSB #3 PGME Spill:**

Following the landing of STS-121, there were indications of a spill of the water/PGME coolant around WSB vent #3. There were dark colored stains and a strong odor of PGME reported around the vent. Early indications are that there was some undetermined failure that caused the WSB to continue spraying even after the liquid level sensors should have stopped the spraying. The WSB filled to the point that liquid apparently flowed out of the vent. The concern is that the water/PGME mixture is flammable and as it spilled, it flowed downhill toward the APU 3 exhaust vent; a potential ignition source. There is a special PRT effort to determine the real risk and whether or not OV-104 WSB 3 should be drained of its water/PGME prior to the next flight. The orbiter project did not recommend a PGME changeout since there is not a concern for ignition. The August 4<sup>th</sup> PRCB agreed that the risk of ignition was remote and decided to leave PGME in WSB #3 for STS-115.

## **D. Anomaly Resolution (cont.)**

- **EECOM:**

### **Flash Evaporator Primary B Controller (STS-121 AR 1631):**

FES PRI B had transient temperature excursions that led to a shutdown on FD01. A FES Core Flush was performed with no ice detected. FES PRI A was selected for the remaining FES activities. On FD13, a FES test was performed on all three FES controllers. FES PRI B exhibited similar temperature excursions as were seen on FD01, but did not shut down. FES PRI A was successfully used during D/O Prep and Entry. Evaluation of FES PRI B will be performed in the coming weeks. Not an issue for STS-115. The ATCS PRT and OPO have concluded it is highly unlikely that whatever caused the OV-103 FES problems will manifest itself on the OV-104 FES.

### **External Airlock / Vestibule Delta Pressure Transducer(STS-121 AR 1698):**

This sensor had a bias that trended downward. This sensor is required for post-docking and pre-undocking leak check procedures. This transducer requires R&R prior to the next flight of the vehicle. Not an issue for STS-115.

### **Right Flight Deck Smoke Detector Anomaly (STS-121 AR 1630):**

During the FD01 Smoke Detection Circuit Test B Part 1, the Right Flight Deck Smoke Detector did not illuminate the panel L1 light nor did MCC receive the telemetry. The remaining 3 B side detectors did illuminate the panel L1 lights and MCC did receive the telemetry, however there was a delay between receiving each of those. Upon completion of the test, the crew repeated Test B Part 1 and all lights and telemetry were received simultaneously. No further action was taken and the Right Flight Deck Smoke Detector was deemed to be working for the remainder of the mission. Engineering has already reported that this signature is common for this type of switch. This circuit is tested each flow as a standard, but no additional troubleshooting will be performed based on this flights occurrence. Not an issue for STS-115.



## **D. Anomaly Resolution (cont.)**

- **EECOM(cont.):**

### **Crew assessment of CO2 levels during period of no LiOH changeouts on STS-121:**

STS-115 commander has disapproved the original plan of no LiOH changeouts while docked, due to discussions with STS-121 crew. During STS-121, approximately three days without LiOH changeouts occurred, resulting in favorable CO2 levels throughout the stack. However input from the STS-121 crew to this CO2 management scheme was unfavorable. The new plan is to press with LiOH changeouts nightly which will require carrying a full shuttle load of LiOH cans (31) as well as a possible supplement of 3 cans from stockpile. The additional cans will be taken from the LiOH stockpile per agreement with both programs, but only if needed for additional days or if shuttle booster fan remains off for bypass config. New Cue Cards are in place as well as the coordination of which cans will be transferred from the ISS stockpile. In the event ISS CDRA remains in "single-bed" mode due to a recent check valve failure, further options are being explored, including further stockpile use and/or booster fan activation.

## **D. Anomaly Resolution (cont.)**

- **EECOM(cont.):**

### **FD13 CWC and PWR Overboard Dump Temperatures (STS-121 AR 1699):**

During a simultaneous dump of condensate CWC's and EVA PWR's on FD13, abnormal nozzle temperatures were observed. Two condensate CWC's were dumped serially thru the waste dump line. Slower than normal heat up rates were observed on the waste nozzle during bakeouts. Multiple bakeouts of the waste nozzles were performed post dump. All of these subsequent bakeouts showed nominal heat up rates. Two PWR's were dumped serially thru the supply dump line. During the PWR dumps, the temperatures did not plateau above the termination temperature as had been seen during the FD08 PWR dumps. Instead, the nozzle temperatures dropped thru the termination temperature and multiple bakeouts were performed to complete the dumps. Additionally, the team on console increased the bakeout temperature from 250 to 300 degrees F to allow for greater dump time in between bakeouts. The leading theory has to do with the dump cones being larger/wider when dumping a bag that is unpressurized. Because the nozzles are relatively close together (7 in. apart) the Life Support PRT believes there is more interaction between the plumes and essentially a lot more particulate impingement (bounce back) on the nozzle. No dual-PWR/CWC dumps are planned for 115. If PWR dumps are requested in real-time, they will be scheduled so as to avoid dumping at the same time as CWCs. Procedure mods can be easily accommodated via flight note as EXEC PKG input. A Flight Rule update post STS-115 will reflect this philosophy.

## D. Anomaly Resolution (cont.)

- **GNC:**

- **Right Air Data probe:**

- Initially failed to fully deploy on STS-121. It was returned to stow and then fully deployed. The crew reported that the switch felt loose, but all indications, switch contacts, motor currents, and ADTA data indicated that the switch worked properly; the probe initially moved to a position less than fully deployed, returned to fully stowed, and then deployed completely. Post landing photos show scuffs and scratches on tiles around the probe. Further investigation has found a metal part of the deploy mechanism to be damaged resulting in physical interference. The investigation is continuing, but this is not considered a generic problem. Not a constraint for STS-115.

- **PROP:**

- **Use of Primary RCS jets during mated operations:**

- Rationale for acceptance of NCR-ISS-063, "Orbiter zero-fault-tolerant to inadvertent primary jet firing", notes an exception is allowed for a failure contingency case requiring use of the Primary jets. Loss of the vernier control mode for mated attitude operations during STS-121 raised questions as to the meaning of the exception. ISS Safety recommended against any use of Primary RCS jets during mated operations. For the loss of vernier attitude control during STS-115, the operations that can be accomplished using the Primary jets are documented in the flight rules.

SYSTEMS DIVISION FLIGHT READINESS REVIEW  
DELTA FRR DATA PACK  
STS-115 (OV-104)  
August 21, 2006

## E. Information Only – Miscellaneous

### SSME Hardware<sup>1</sup>:

Position Number	1(C)	2(L)	3(R)
Engine Number	2044	2048	2047
Engine Type	Block II	Block II	Block II
Last Hotfire (# Flights)	STS-113 (9)	STS-112 (6)	STS-112 (9)
Powerhead	6010	6021	6016
MCC	6007	6012	6011
Nozzle	2035	(4025)	4027
Controller	(F43)	(F58)	(F38)
AHMS Phase 1 mod (Y / N)	N	N	N
RTVMS monitor / active	N/A	N/A	N/A
LPFTP	2133	6102R1	2225
HPFTP	8021R1	8019	8118
HPFTP R/L Deg. R	1860	1860	1860
LPOTP	(4207)	(2231)	(2336)
HPOTP	(8118)	(8114)	(8222)
HPOTP R/L Deg. R	1660	1660	1660

NOTES:

<sup>1</sup> Items in parentheses have been changed out since the last hot-fire of the SSME.

## **E. Information Only – Miscellaneous (cont.)**

### **ET 118 (STS-115) Liquid Level sensors and Engine Cutoff (ECO) Sensors**

A small resistance shift on the 100+ liquid level sensor used for loading and replenish control demonstrated a small resistance shift prior to being shipped to KSC. This shift is small and still within the allowable limits for sensor operation. This sensor is one of three that used for replenish control, and the LCC requirement is that only one sensor be operable for launch and the 100+ sensor is only used if the other two sensors have failed. The current plan is maintain current ground operations and rely on the loading procedures in place at KSC.

It was previously reported that there was an issue with the pedigree of the ECO sensors for ET-118 since they came from the same lot that failed during STS-114. Since the L-3 FRR, these sensors have been changed out and are not expected to be an issue. Prelaunch checkout procedures are in place to verify sensor functionality prior to T-9.

### **STS-121 LO2 Inlet temperature conditions pre-engine start.**

Near launch on the third launch attempt, KSC raised concerns the Main Propulsion System (MPS) Launch Commit Criteria (LCC) MPS-25 on the Liquid Oxygen (LO2) inlet temperature between T-75 seconds and T-31 seconds would likely be very near the maximum allowed value. This maximum value was a new LCC limit not present on previous flights. The LCC requires that 2 of 3 inlet temperature sensors be within limits, however only one temperature exceeded the limit, and the launch proceeded normally. The KSC team was prepared to implement the preplanned contingency procedure to implement a short hold at T-31 seconds to allow further LO2 drainback and cooling of the LO2. The higher LO2 inlet temperature were caused by the warmer LO2 in the storage tank with multiple loading during high ambient temperatures.

## **E. Information Only – Miscellaneous (cont.)**

### **Ground Umbilical Carrier Panel vapor trail**

The LH2 Ground Umbilical Carrier Panel (GUCP) vapor trail seen on STS-114 was seen again on STS-121. This is now thought to be a common occurrence and only noticing it now due to better observation capability. LH2 pressurization performance was nominal.

### **Helium Check valves**

Two of the helium check valves in OV-104 have been examined and has shown that they are not completely seated in the spring guides. The valves in question are CV5 and CV29 which are the regulator outlet check valves for the A and B helium regulators, respectively, on the center engine. The concern with this is that they could either fail open or closed, but the conditions required to create this failure mode would be on the order of 86 g's instantaneous acceleration. Even in the worst case conditions, the instantaneous acceleration at those valves doesn't exceed 46 g's. The current decision is to fly as-is and remove and replace CV29 after flight and MR accept CV5.

### **GO2 Pressurant Spike During STS-121 Engine Start Transient.**

A spike was observed in GO2 repress pressure between engine start and SRB ignition due to SSME start transient behavior. The pressure spike is normally seen and due to power-up of the High Pressure Oxidizer Turbopump (HPOTP) and the thermal transient on the GO2 Heat Exchanger. The STS-121 data showed a spike close to the 3-sigma experience base for Block II and Block IIA engines, but is encompassed by the pressure of steady state operation. The peak of the pressure spike is a function of flow characteristics of the particular HPOTP. LO2 Ullage pressure is maintained by this flow and shows a corresponding spike in pressure. Even though this is a 3-sigma event, SSME project has no concerns with the start.

## **E. Information Only – Miscellaneous (cont.)**

### **Water Spray Boiler (WSB) non-standard coolant loading**

WSB #1 and #2 water tanks are loaded with 118# of water each while WSB #3 water tank is loaded with 139# of water/PGME. The vehicle was previously serviced to perform detailed test objective (DTO) 850, WSB Cooling Verification but because of the back-to-back flights of OV-103, DTO 850 will not be performed on this flight.

### **Fuel Cell Heater Relay Failure:**

Description: During the performance of Pre-ATP pulse purges at UTC on Fuel Cell S/N 124 the startup heater prematurely energized. This event occurred before the coolant pump is normally activated resulting in an overheating of the coolant loop and possible internal damage to the fuel cell. Failure of the relay was due to internal rotation of a bus bar resulting in shorting of contacts; possibly due to over torque on a connector lug terminal. OMSRD procedure changes are in work to modified to screen for the failure of the Hartman Start Relay during fuel cell startup. Flight Rules changes are in work to address the failure of this relay.

Ops Product Impact: Flight Rules updates in Annex to address failed ON startup heater (will eventually become a generic rule).

Status: Closed

## E. Information Only – Miscellaneous (cont.)

### **Potential Generic Problem With MDM Power Supplies:**

There have been three failures since 1981 of the integrated circuits critical to the operation of MDM power supplies. The failures involved chips with the same lot code (manufactured at the same time). The concern is that if all of the same chips in that lot code have a common cause defect, it would implicate multiple MDM cards and/or MDM core power supplies. The chips that have failed are undergoing failure analysis to determine if we indeed have a common cause failure mode. The issue is considered closed for five flights per vehicle and if the cards failed it would not cause loss of crew/vehicle.

- FA1 Card 0
- FA4 Secondary core power supply
- FA4 Card 14
- PL1 Primary core power supply
- OA2 Secondary core power supply
- OA2 Card 0
- OA2 Card 11
- OA2 Card 9
- OA2 Card 15

### **BFS Downlist of False Uplink First Word/Last Word Error Indication DR# 110665:**

During STS-121, downlist measurement V98X4270X (first/last word error) indications were seen when no other error conditions were flagged by the Backup Flight Software (BFS). There were no other BFS-detected error indications, and no other BFS-directed uplink problems were reported. This false first/last word error indication is visible in downlist only, is not used by BFS, and does not otherwise impact BFS uplink processing.



## **E. Information Only – Miscellaneous (cont.)**

### **MDM INTERNAL MODULES NOT RE-TORQUED PER SPEC:**

During repairs at the NSLD of Orbiter Flight Critical, Payload, and Orbiter Instrumentation MDMs Honeywell process specification were not followed. Honeywell requires the re-torque of all 16 module screws whenever a module is exposed to temperatures exceeding 165 Deg F as seen during the de-moisturization process. Only the screws on the re-worked side of the modules were re-torqued (8 of 16). Analysis has shown sufficient breakaway torque on the 8 screws not re-torqued in the re-work process. In addition physical limitations within the LRU preclude many of the screws from working themselves out. The issue is closed for 5 flights per vehicle and if any work is done on the boxes prior to that PR's are in place to ensure proper torque.

- FA2 (card 7)
- PL2 (card 15)
- OF2
- OF3

### **ALT DAP**

The STS-115 ISS loads issue with 3 jet ALT DAP maneuvers after P3/P4 installation has been resolved. By slightly reducing margins, CSDL has updated the forcing function they provide to the ISS structure analysts. The ISS structural analysts have also slightly reduced their margins, allowing the two programs to meet in the middle except for a prohibition during EVA. As the ISS structure grows this problem is likely to return.

### **IMU Slip Ring:**

A flaw exists in the design of the IMU tape cables used to transmit data to and from its inertial components (gyros, accelerometers, etc.) and the clamp used to hold the wires in place. The current design can create a small amount of flexure in some of the wires. This condition can, and has, led to breakage of slip ring wires during ground calibrations and flight operations. A modification to the IMU hardware has been designed and successfully implemented on S/N 210; this IMU has been installed in OV-104 in slot 1. The two remaining IMUs on OV-104 have not had the modification performed and are susceptible to this failure mode. The modified IMU eliminates the susceptibility of all three IMUs to the generic failure mode, and thus the need for early mission termination under the generic failure mode section of the flight rules.

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