Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-01	C&T - S-Band
	GMT:		**SPR** 58RF01	**UA**	**Manager:**
			IPR 58V-0116	**PR** COM-A0036	x31458
					Engineer:

Title: S-band Transponder 2 Uplink Failure (ORB)

Summary: DISCUSSION: At approximately 288:11:58 G.m.t., during the second launch attempt, uplink lock was lost on the S-band PM system. Transponder 2 (serial number 301) was being used at that time and would not lock onto the RF signal regardless of mode, frequency, power level, or data rates. Downlink continued to operate properly through transponder 2. Transponder 1 (serial number 304) was selected and RF uplink lock-on was obtained. Subsequent attempts on transponder 2 were also unsuccessful. This was the first observed failure of this type. The launch attempt was scrubbed due to a Launch Commit Criteria (LCC) requirement for 2 of 2 transponders to be operational for launch.

CONCLUSION: Transponder 2 receive-function failed. Failure analysis at the vendor found two failed transistors; one appeared to have failed short circuit, overstressing the second, resulting in an intermittent open circuit which caused the observed loss of function. CORRECTIVE_ACTION: The failed transponder was removed and replaced with serial number 309. Troubleshooting at the vendor has repeated the anomaly and isolated the intermittent failure to two transistors in the second intermediate frequency module. Further troubleshooting and analysis will be tracked by CAR 58RF01. Replacement transistors are available in the logistics spares inventory. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-03	OMS/RCS
PROP-01	**GMT:**		**SPR** 58RF07	**UA**	**Manager:**
			IPR 62V-0003	**PR** LP05-0083, LP05-0084	x39031
					Engineer:

Title: Left OMS Engine Pressure Transducer Failed Offscale Low (ORB)

Summary: DISCUSSION: The left orbital maneuvering system (OMS) engine chamber pressure (Pc) transducer (V43P4649C) failed off-scale low approximately 3 seconds after SSME ignition and remained failed for the rest of the mission. Postflight troubleshooting repeated the problem and determined that the trandsucer was functioning properly, indicating a pod wiring or signal conditioner failure. The OMS pod was removed and further troubleshooting in the orbiter processing facility (OPF) isolated the problem to a failed channel on amplifier buffer attenuator (ABA) card 6 of dedicated signal conditioner (DSC) OL2. A spare was installed in place of the failed card, which was sent to the NASA shuttle logistics depot (NSLD) for repair. Retest of the DSC was successful and the pod was reinstalled.

CONCLUSION: The failure was isolated to a bad channel on ABA card 6 in DSC OL2 in the left OMS pod. Component failure precipitated by vibration occurring at main engine start-up is suspected as the cause. CORRECTIVE_ACTION: The failed card was removed and replaced and the measurement function restored. The card has been sent to NSLD for failure analysis and repair, which will be tracked on CAR 58RF07. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-04	MPS
None	**GMT:**		**SPR** 58RF02	**UA**	**Manager:**
			IPR 62V-0004	**PR** MPS-2-16-0978	x39037
					Engineer:

Title: E1 GH2 Flow Control Valve Sluggish (ORB)

Summary: DISCUSSION: The Main Propulsion System (MPS) Engine 1 GH2 Flow Control Valve (FCV) moved slowly from the low-flow position (18 percent flow) to the high- flow position (100 percent flow) during the first 49 of the 59 total valve cycles that occurred during ascent. The valve's response time was 0.4 to 0.6 second (specified limit is 0.3 second maximum). Valve performance returned to values within specified limits for the last 10 cycles but remained slower than nominal. The problem was identified during data review for in-flight checkout performance verification by correlating the pressure upstream and downstream of the FCVs with FCV commands and the External Tank (ET) LH2 ullage pressure. The engine 2 and engine 3 FCVs performed nominally and overall system performance during ascent was not affected.

The poppet-sleeve assembly was removed from the engine 1 FCV and contamination was found on the external surfaces of the assembly. Minor contamination was found in the valve body and was wiped clean. The poppet-sleeve assemblies were removed from the engine 2 and engine 3 FCVs and minor external contamination was found (less than that observed on engine 1 FCV). A borescope inspection of the inlet and outlet tubes of all 3 FCVs revealed no contamination. The engine 1 FCV poppet-sleeve assembly was sent to Rockwell- Downey and was replaced with a poppet-sleeve assembly that was removed from OV- 104. The engine 2 and 3 FCV poppet-sleeve assemblies external surfaces were wiped clean by KSC and reinstalled. Pull-in/drop-out and current signature tests of all three FCVs showed nominal performance. The

engine 1 FCV poppet-sleeve assembly was disassembled at Rockwell-Downey for failure analysis. Small amounts of contamination were noted in the solenoid cavity and between the poppet and sleeve. Analysis of particulate samples taken during valve disassembly determined that the predominant contaminant was 300-series stainless steel along with lesser amounts of 400- series stainless steel and other metallic particulate. The larger particles were 1100 and 800 microns. 300- and 400-series stainless steel particles were found embedded in the armature's gold coating and wear marks were found on the armature which exposed some of the 430 stainless steel base material. 440 stainless steel material was found spalled from the labyrinth seal trailing edges and crack-like surface anomalies were noted in the first two groves of the seal. All other parts exhibited normal wear. Force balance testing performed at Eaton indicated the FCV had substandard force balance. Tests indicated a force balance of 0 to 3 lbs below the spring force (should be 0 to 4 lbs above the spring force) providing less opening force on the poppet than specified. Subsequent destructive analysis of the labyrinth seal revealed the cracks had propagated through the brittle nitride layer, but were arrested at the parent metal interface. It was determined that the cracks did not affect the structural integrity of the seal nor were they the source of any particulate. The cause of the cracks is under evaluation. The anomaly was probably caused by accumulation of particulate in the engine 1 FCV over time between solenoid coil and armature and between the poppet and sleeve which added friction to the valve stroke and slowed the valve response. An additional contributor to the sluggish response of the valve was the substandard force balance which resulted in a decreased opening force on the poppet. Efforts are underway to determine the most likely source of the 300-series stainless steel particulate. The accumulated particulate could have caused abrasive wear in the FCV generating additional 400-series stainless steel particulate. The accumulated particulate could have caused the engine 1 FCV to become sluggish as demonstrated in flight. A sluggish FCV, as seen on STS-58, does not affect system performance. A single FCV stuck in any position can be accomodated by the remaining two FCVs. If two FCVs were to fail in the same position, the GH2 system would not be able to properly control ET pressure during ascent. If two FCVs fail closed, ET pressure is managed by throttling main engines as outlined in flight rules. Two FCVs failed open results in hydrogen venting from the ET during ascent. If an engine fails resulting in an RTLS abort and a FCV fails open on one of the remaining engines, hydrogen venting from the ET would occur. During STS-28 (OV-102 flight 8) the engine 1 FCV movement was slow in both the open and close directions. Contamination was found in all 3 FCVs as well as low poppet-to-sleeve clearances on the engine 1 and engine 3 FCVs. All 3 FCVs were disassembled and cleaned, and the engine 1 and engine 3 FCV parts were machined to specified clearances. Force balance tests were not performed as a part of the rework. All three FCVs were returned to their original positions in OV-102. Another anomaly on STS-46 (OV-104 flight 12) was attributed to transient contamination and a low poppet opening force balance on the engine 3 FCV. No other GH2 FCV anomalies have been noted. CONCLUSION: The problem was caused by a build-up of contaminants in the FCV which slowed the valve response in combination with a marginal flow balance in the valve. CORRECTIVE_ACTION: The engine 1 FCV poppet sleeve assembly was replaced and sent to Rockwell-Downey for refurbishment. The engine 2 and 3 FCV poppet sleeve assemblies were removed, external surfaces wiped clean, and reinstalled. Pull-in/drop-out and current signature tests were performed on all three valves. For the next two flights of each vehicle, pull-in/drop-out and current signature tests will be performed. An OMRSD change is being evaluated to add the pull-in/drop-out and current signature tests every flow and a visual inspection of the valve on a periodic basis (either I-5 or before). Orbiter Project will meet with the SSME and ET Projects to discuss potential contributors of 300/400 series stainless steel contamination. KSC ground systems will also be investigated. Final corrective action, which includes force balance as an ATP requirement, will be documented in CAR 58RF02-010.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-58-V-05	ECLSS
EECOM-01	GMT:		SPR 58RF03	UA	Manager:
			IPR	PR ECL-0936	
					Engineer:

Title: Fluid Found on WCS Odor/Bacteria Filter (ORB)

Summary: DISCUSSION: On flight day (FD) 3 of the STS-58 mission, the crew reported that a small amount of fluid was found on the waste collection system (WCS) odor/bacteria (O/B) filter. The crew reported that they had observed fluid carryover on the filter lid on three occasions prior to reporting it on FD3. The crew also reported that air flow through the urinal hose was nominal. The O/B filter was removed and inspected for free water. Only a small amount of carryover water was observed in the inlet flow path of the filter. The crew switched from fan separator 1 (FAN SEP 1) to FAN SEP 2 for the remainder of the flight and reported that no additional fluid was observed around the O/B filter.

CONCLUSION: The cause of the problem was excessive liquid being "carried over" in the exhaust air from FAN SEP 1. Normally, any minor carryover is trapped by the O/B filter and the liquid is gradually evaporated. The excess carryover on this mission was great enough to allow some liquid to migrate through the O/B filter before evaporating, thus resulting in the observed leakage. The filter was dissected and inspected postflight and no leak path or anomalous channeling in the filter bed was discovered. On this particular flight, the WCS FAN SEP 1 used a high torque motor with the new separator bowl design and FAN SEP 2 used a low torque motor with the old bowl design. Since the two types of motors operate near the same speed, they were not a factor in this problem. There is, however, a design flaw in the new separator bowl which allows liquid carryover. Also the Urine Monitoring System (UMS), which was part of the payload complement for this flight, requires a 200 milliliter water flush after each use which increases the total liquid volume by approximately 70%. The WCS must process this additional liquid whenever the UMS is used. The UMS also changes the operational pressures of the fan separator which may increase the leakage rate. Also, post flight testing has shown that the new bowl used in FAN SEP 1 has exhibited more carryover than any other new bowl flown to date. These factors, combined with the size of the crew (7 crewmembers) greatly increased the amount of liquid being processed, and subsequently carried over, by the WCS, which in turn led to the observed leakage through the O/B filter lid. CORRECTIVE_ACTION: FAN SEP 1 is a new design fan separator. Until the cause of the excess carryover associated with the new design is determined and corrected, the old design separator bowl will be installed in the WCS. The old design bowls will reduce the amount of liquid carryover entering the filter. Additional testing is being performed to correct the excessive carryover condition as part of CAR 58RF03-010. Once a modified design has been proven and certified, it will be presented for future implementation. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Future flights will use the old design separator bowls. Flight experience has demonstrated that these bowls normally experience minimal carryover.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-08	C&T - S-Band
INCO-03	**GMT:**		**SPR** 58RF04	**UA**	**Manager:**
			IPR 62V-0007	**PR** COM-2-16-0265	x31458
					Engineer:

Title: S-Band FM Sys 1 Power Output Degraded (ORB)

Summary: DISCUSSION: The S-Band FM transmitter 1 power output degraded on flight day 13 from 12.5 W to 6.5 W during the first minute following transmitter power-on at 304:21:05 G.m.t. FM transmitter 2 was selected and used for operations recorder downlink transmissions for the remainder of the flight.

FM transmitter 1 was tested on orbit by comparing the strength of the signal received at ground sites with the signal strength received from FM transmitter 2. Ground measurements confirmed that FM transmitter 1 power output had degraded to about half the output of transmitter 2. A review of data recorded during earlier transmitter 1 operations showed that power output had gradually degraded from a nominal 15.5 W on flight day 1 to 13.5 W on the last transmission prior to the failure. The minimum-specified FM transmitter power output is 10 W. Postflight troubleshooting confirmed the power output problem was isolated to S-Band FM Transmitter 1 and the transmitter was replaced and sent to Teledyne Electronics for troubleshooting and repair. CONCLUSION: The S-Band FM transmitter 1 power output degradation has been isolated to a failure within the transmitter. Further isolation of the failure within the transmitter will be accomplished during vendor troubleshooting. CORRECTIVE_ACTION: S-Band FM transmitter 1 was replaced with a spare transmitter and sent to Teledyne Electronics for troubleshooting and repair. Final corrective action will be documented in CAR 58RF04-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-09	TPS
None	**GMT:**		**SPR** 58RF09, 58RF10	**UA**	**Manager:**
			IPR	**PR** HSS-2-16-0251, HSS-2-16-0252	x38871
					Engineer:

Title: Engine-1 and Engine-2 Dome-Mounted Heat Shield Closeout Blanket Damage (ORB)

Summary: DISCUSSION: During ascent at about 45 seconds mission elapsed time (MET), a piece of white debris was observed exiting the area between Space Shuttle main engine (SSME)-1 and -3. Photo analysis conducted prior to landing determined that the Dome-Mounted Heat Shield (DMHS) blankets were the most probable source of the debris. This was supported by past flight history. On STS-45 material from a DMHS blanket was found on the pad after launch; and on STS-43 a white object observed in launch films was correlated to missing DMHS blanket material after the flight.

Postflight inspection confirmed damage to the engine 2 and engine 3 DMHS blankets on OV-102. The engine 3 blanket had significant damage and loss of material at the 9 o'clock position. Engine 2 had a blanket at the 3 o'clock position which was detached on 3 sides. There was no damage to the engine dome flexseal or the aluminum honeycomb dome structure. The inspection also revealed that this ship set of blankets had undergone an extensive amount of repair during previous flows. It is believed that the cumulative effect of these repairs contributed to the STS-58 failures. The blankets were removed and replaced with spares and will be repaired as required per standard repair procedures. The DMHS blankets are designed to protect the inner flexseal, pressure seal, and support structures against ascent-heating effects. Partial blanket failure, as experienced through STS-58, does not present a concern for damage to these components. Complete loss of a blanket, which has never occurred, could potentially result in failure of the flexseal, leading to loss of purge capability for RTLS. It could also lead to degradation of the aluminum honeycomb dome structure. Modification of the blanket design has been implemented on OV-103 and -105, resulting in an increase in durability and a reduction in turnaround rework. The present design uses S-glass covering material and is tack-stitched on 3- inch centers. The modified design is through-stitched on 1-inch centers and uses a thicker AB312 Nextel covering which has a higher temperature resistance. CONCLUSION: This failure of the DMHS blankets is within the experience base for such occurrences. While the current design is adequate to protect the vehicle, the availability of new materials has enabled modifications to the design which increase blanket life, reduce turnaround rework effort, and improve reliability. CORRECTIVE_ACTION: The damaged blankets were removed and replaced. Repairs will be made as needed per standard procedures and the blankets will be returned to spares. Modifications to the DMHS blanket design have been successfully implemented on OV-103 and OV-105, resulting in a considerable reduction of turnaround rework. Engineering is evaluating implementation of these modifications on OV-102 and -104.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-58-V-10	MPS
None	**GMT:**		**SPR** 58RF08	**UA**	**Manager:**
			IPR None	**PR**	x39037
					Engineer:

Title: LO2 Umbilical Lightning Strip Detached. (ORB)

Summary: DISCUSSION: A review of the ET umbilical well camera film following the STS-58 mission revealed that the lightning contact protection strip became detached from the LO2 umbilical and portions of the sheet were seen floating away after ETseparation. The sheet was bonded to the ET half of the 17-inch disconnect and should have stayed with the ET at separation.

Following the ET separation on STS-37, the LH2 lightning contact strip debonded and became trapped in the umbilical well. This was the first time that a piece of the lightning contact strip was recovered, and this condition allowed a postflight analysis to be performed on the adhesive material on the strip. The tests performed indicated that the adhesive was inadequately cured. The cause of the improper curing of the adhesive on STS-37 was determined to be a failure of the Rockwell-Downey Manufacturing to follow the approved bonding procedures. The manufacturing procedure used to bond the lightning contact strip was corrected following STS-37 to match the approved written procedures. No additional debondings were observed until STS-54 when a partially debonded lightning contact strip was observed.

Additionally, the lightning contact strip was observed to be completely debonded on STS-57. Since no portion of the strip was recovered from the STS-54 and STS-57 flights, no way existed to determine if an improper cure of the adhesive continues to be the cause of the debondings. It should be noted that the ET umbilical well cameras are installed only in OV-102 and OV-105. Thus, no information is available on any possible debondings for OV-103 and OV-104 flights. The lightning contact strip debris is not a safety-of-flight issue for the following reasons: a. The Orbiter umbilical door and latching power drive units (PDUs) are housed to prevent entry of foreign objects. b. The PDU drive linkages are not exposed, and there are no exposed gears to jam. The only exposed parts are the torque tubes, bell-cranks and push-rods. c. The PDUs have sufficient torque, 9500 in-lb minimum for the door closure, to overcome any resistance the strip might create. d. The uplock hooks are protected by housings. e. It is possible that the lightning contact strip could become captured in the ET umbilical door edge. However, analysis shows that the plasma flow path created by a 0.48-inch step at the ET umbilical door edge is survivable. The 0.005-inch thickness of the lightning contact strip is unable to produce a step anywhere near 0.48 inch, and therefore, the thermal barrier would mold around the strip, eliminating any plasma flow path. CONCLUSION: Given the history of lightning contact strip debondings along with the analysis of the bonding adhesive from STS-37, the most probable cause of the lightning contact strip detaching on this flight is an improper bonding of the lightning contact strip to the ET umbilical. CORRECTIVE_ACTION: Rockwell Downey is in the process of evaluating several modifications to the ET/Orbiter umbilical, one of which is an improved attachment method for the lightning contact strip. Only if a cost effective method of preventing the debonding of the strip is found will the change be included in the change package for the ET/Orbiter umbilical. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The lightning contact strip is too small to prevent the umbilical door from closing and its 0.005-inch thickness is too small to provide a plasma flow path through the thermal barrier. Therefore, the debonding of the lightning contact strip is not a safety-of- flight issue.