SSVEO IFA List **Date:02/27/2003**

STS - 49, OV - 105, Endeavour (1) **Time:04:14:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Pre-Launch	Problem	**FIAR**	**IFA** STS-49-V-01	RCS
PROP-01	**GMT:** 128:03:50:00.000		**SPR** 49RF01	**UA**	**Manager:**
			IPR	**PR** FRC5-0021	
					Engineer:

Title: Thruster F4R Heater Failed-on (ORB)

Summary: DISCUSSION: During the STS-49 prelaunch activities, it was determined that the heater on forward primary reaction control subsystem (RCS) thruster F4R was failed-on. A data review indicated that the heater had actually failed-on approximately two hours after the flight readiness firing and had gone undetected. At lift-off, the thruster injectory temperatures were holding steady at about 116 ?F, which is approximately 15 ?F above the upper set point of the heater.

Once on-orbit, thruster F4R was placed in last priority to preclude firing the thruster in the event the injector temperatures exceeded 160 ?F. The 160 ?F temperatures sensed at the injector corresponds to a 150 ?F temperature at the valve seat, which is the operational limit of the seat. The non-operational temperature limit of the seat is 175 ?F, which corresponds to 185 ?F sensed at the injector. The thruster temperature was maintained by manually cycling the heater switch "on" during crew sleep and "off" while the crew was awake. This action successfully maintained the thruster temperature in the range of 60 to 160 ?F, following an initial excursion to 169 ?F early in the mission. It should be noted that cyling the F4R thruster heater switch off also removes power from the F4D thruster heater. The F4D injector temperatures never fell below 60 ?F while the heaters were powered off. CONCLUSION: Thruster F4R was removed and the heater was repaired by the vendor on-the-bench at the Kennedy Space Center (KSC). Following checkout of the heater, the thruster was returned to the vehicle. The failure of the heater controller was the cause of the anomaly. The failure analysis of the controller is being tracked on CAR 49RF01. CORRECTIVE_ACTION: The heater controller was removed and replaced. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should the failure recur, the heaters can be manually cycled. Also, primary thrusters have multiple redundancy for all nominal mission phases.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:06:09:59.981	Problem	**FIAR**	**IFA** STS-49-V-02	PRSD
EGIL-01	**GMT:** 129:05:50:00.000		**SPR** 49RF02	**UA**	**Manager:**

IPR 47V-0014 **PR**

Engineer:

Title: O2 Manifold 1 Isolation Valve Failed Open (ORB)

Summary: DISCUSSION: At approximately 129:05:41 G.m.t., the crew attempted to close the O2 manifold 1 isolation valve during the pre-sleep activities. The valve did not close when commanded. A second attempt to close the valve at that time was also unsuccessful. During both of these attempts, the crewmember held the switch to the "CLOSE" position through a count of three. Later in the mission, at 136:23:38 G.m.t., a third attempt to close the valve was also unsuccessful. The second O2 manifold isolation valve performed nominally throughout the mission.

The anomaly could not be repeated during KSC troubleshooting. The valve closed every time it was commanded. A breakout box was inserted into the valve-command circuitry, and wire wiggle tests were performed, but no electrical anomalies were noted. Similar, non-repeatable in-flight anomalies have occurred on OV-104 O2 manifold valve 2 (STS-34 and STS-37) and OV-104 H2 manifold valve 1 (STS-43). The OV-104 O2 manifold valve 2 command circuitry was rewired through a different bulkhead connector after STS-37 and the anomaly has not recurred. Subsequently, however, intermittent electrical continuity problems in other systems, which are initially attributed to bulkhead connector problems, have had their bulkhead connectors cleared through in-flight troubleshooting. CONCLUSION: The cause of the manifold valve failures on this flight and the OV-104 flights is presently unknown. Because of the extensive electrical troubleshooting of the valve command circuitry on OV-105 and OV-104 that did not reveal any problems, possible failures within the valve assemblies will be investigated. CORRECTIVE_ACTION: The OV-104 O2 manifold 2 valve that failed on STS-34 and STS-37 will be removed during the Orbiter maintenance down period following STS-46. The removed valve will undergo extensive analysis to determine if the cause of the failures lies in the valve assemblies. The OV-105 manifold valve will be flown as-is for the short term. Corrective action will be undertaken on the OV-105 valve if the results of the OV-104 valve investigation warrant action. If the anomaly should recur prior to corrective action being taken, a redundant manifold valve is available for leak isolation, if necessary. There is no flight history of PRSD leaks requiring closure of the manifold valves. If, in the worst case, the manifold valve should fail closed, redundancy in the PRSD tanks will allow the continued operation of all three fuel cells. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: Potential recurrence of a manifold valve failing open, until corrective action is determined and implemented.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:08:49:59.981	Problem	**FIAR**	**IFA** STS-49-V-03	ECLSS
EECOM-02	**GMT:** 129:08:30:00.000		**SPR** 49RF03	**UA**	**Manager:**
			IPR 47V-0012	**PR**	
					Engineer:

Title: FES Accumulator/Hi Load Line B Heater #1 (ORB)

Summary: DISCUSSION: Post MECO, the Flash Evaporator System (FES) water feedline 1 heaters were turned on. At this time the high load feedline B temperature

transducer (V63T1896A) had a sharp increase and reached its upper limit of 250 deg. F. The temperature transducer located on the accumulator B inlet line (V63T1894A) near the controller thermostat indicated no heater cycling. This temperature transducer had an erratic temperature rise to 112 deg F which is above the thermostat control point of 85 deg. F. After the first crew sleep period, the feedline B heaters were switched to heater 2. The temperature then dropped within limits and cycled properly. During the mission it was suspected that the thermostat had debonded from FES feedwater line.

The V63T1896A measurement has exceeded its upper limit on past missions, but has always demonstrated thermostat cycling as indicated by the sensor (V63T1894A) located next to the thermostat. At KSC, the thermostat was inspected and found to be securely clamped to the FES water line. The thermostat was removed and replaced with a new thermostat by Hamilton Standard and retested successfully. The removed thermostat will be tested by the vendor to determine the failure mode. CONCLUSION: Control thermostat failed. CORRECTIVE_ACTION: The thermostat was removed and replaced with a new thermostat, which was retested successfully. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:19:50:59.981	Problem	**FIAR**	**IFA** STS-49-V-04	ECLSS
EECOM-03	**GMT:** 129:19:31:00.000		**SPR** 49RF04	**UA**	**Manager:**
			IPR 47V-0013	**PR**	
					Engineer:

Title: PCS O2 system flowmeter failed (ORB)

Summary: DISCUSSION: During the 10.2-cabin depressurization, no oxygen (O2) flow registered on the system 2 O2 flowsensor (V61R2205A). Since secondary indicators (system pressures, dp/dt, and cryo demand) confirmed O2 was flowing, it was determined that the sensor had failed. Secondary indications were used during the rest of the mission to determine when O2 was flowing from system 2. No impact to the mission.

CONCLUSION: Postflight troubleshooting and data analysis confirmed that the O2 flow sensor had failed. CORRECTIVE_ACTION: The sensor will be removed and replaced when the N2O2 control panel is returned to the vendor for mandatory repairs. It is not mandatory that the sensor be replaced. It is acceptable to fly as is using secondary indicators to determine O2 flow. Failure analysis will be tracked by CAR 49RF-04. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: No mission impact.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-49-V-05	EPD&C,DPS

None | **GMT:** Prelaunch | **SPR** 49RF21 | **UA** | **Manager:**

IPR 47V-0005 | **PR**

Engineer:

Title: MEC 2 BITE Failure (ORB)

Summary: DISCUSSION: During the built-in test equipment (BITE) read of master events controller (MEC) 2, serial number (S/N) 11, performed prior to going into the T-20 minute hold, word 10 bit 9 was set to 1 when it should have been 0. This BITE indicates that a Fire 2 command has been received without a corresponding Fire 3 command or vice versa. No Fire 2 or Fire 3 commands are sent to the MEC prior to the T-20 minute hold. Due to this fact, and the fact that two subsequent preflight reads had nominal indications, plus the adequate MEC redundancy, the decision was made to continue with the count. It was assumed to be BITE circuitry problem, which in no way compromises the performance of the MEC.

Postlaunch data retrieval revealed that the bit had been set at T-3 hours, when two previous BITE-reads had been performed. A BITE-read clears the BITE register; however, the problem was still present when the second read was performed. Sometime between T-3 hours and T-20 minutes, the problem was corrected, resulting in the two reads subsequent to the T-20 BITE-read showing the bit cleared. CONCLUSION: Based on the bit involved and the nominal subsequent reads performed prelaunch, it is assumed that an intermittent BITE circuitry failure occurred. CORRECTIVE_ACTION: The MEC was removed, replaced with an EMEC (S/N 73P003), and returned to JSC/SAIL. Testing will continue under CAR 49RF21. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None. There are no indications of a generic MEC problem.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 1	**MET:** 000:22:19:59.981	Problem	**FIAR**	**IFA** STS-49-V-06	RMS
PDRS-01	**GMT:** 129:22:00:00.000		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: RMS False Alarms (RMS)

Summary: This flight problem was transferred to WG (System Integration)

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:21:34:59.981	Problem	**FIAR** B-EMU-300-F003	**IFA** STS-49-V-07	GFE

EVA-05 **GMT:** 131:21:15:00.000 **SPR** **UA** **Manager:**

IPR None. **PR**

Engineer:

Title: EV-2 "Set Power SCU" Message (GFE) (ORB)

Summary: DISCUSSION: During the first INTELSAT extravehicular activity (EVA), at approximately 131:21:15 G.m.t., EV-2 received a "Set Power SCU" message on his display and control module (DCM). The message repeated about 10 to 15 times during the EVA. The message did not repeat during EV-2's subsequent EVA's.

After the flight, a series of short tests were performed on extravehicular mobility unit-2 (EMU-2) to locate any possible short circuits or hardware failures. No short circuits were located and the electronic components that could have caused the problem operated normally. A separate test was performed to determine if the message was generated by electromagnetic interference (EMI) from the EVA power tool. No messages were generated when the power tools were operated near the EMU at distances and locations similar to positions encountered in-flight. EMI from the EMU television camera was considered as a cause, however, the EMU television camera was found to have had a failed transistor and was therefore not able to transmit at all. CONCLUSION: The cause of the repeated "Set Power SCU" messages during the first EVA is presently unknown. The most likely cause is an intermittent short circuit within the power mode switch. CORRECTIVE_ACTION: The DCM was removed and the electronics portion of the module was shipped to the vendor for further troubleshooting. The unit will be x-rayed to locate any possible short circuits within the power mode switch. The results of this failure analysis and subsequent corrective action will be reported under the FIAR listed below. If an EVA should be performed, and the problem repeats on another EMU prior to the implementation of corrective action, continuation of the EVA would still be possible.
EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 000:00:16:59.981	Problem	**FIAR**	**IFA** STS-49-V-08	ECLSS
EECOM-01	**GMT:** 128:23:57:00.000		**SPR**	**UA**	**Manager:**
			IPR 47V-0011	**PR**	
					Engineer:

Title: Avionics bay 3 delta pressures were indicating higher-than-expected pressure at 14.7 and 10.2 psia cabin pressure. (ORB)

Summary: DISCUSSION: Almost immediately after main engine cutoff (MECO), avionics bay 3 differential pressure (V61P2658A) increased by approximately 0.18 inch of water over a two minute period, and continued to increase to 4.4 inches of water. It was suspected that some debris was dislodged at MECO and accumulated in the airloop filters. The A fan was selected to confirm that the problem was not the B fan. A higher delta P was observed on fan "A", so fan "B" was reselected. An in-flight maintenance procedure (IFM) to clean the fan filter was performed. No debris was found on the fan filter or the avionics bay 3 inlet grate. Some lint was found on the general purpose computer (GPC) 3 inlet filter. It was cleaned, but there was no significant change in the delta P. The crew executed an IFM procedure to examine and

clean the modified TACAN cooling duct orifice for debris. The crew discovered blockage at the orifice and it was removed. This procedure was performed during the 10.2 psia depressurization. Extrapolating the fan delta P as seen at 10.2 psia to the 14.7 psia case, indicated an improvement of 0.17 inch of water. Subsequent to the cleaning, the delta P reading was steady at 13.2 inches of water, which is below the upper fault detection and annunciation (FDA) limit (3.3) for 10.2 psia operations.

Toward the end of the mission, the delta P increased to above the FDA limit (3.3), with no associated avionics bay temperature rise. The delta P was steady at 3.3-3.4 inches of water. The MER confirmed that the surge region for the fan begins at 3.4 inches of water. Calculations show that even in the surge region, the fan would satisfy the avionics bay cooling requirements. In the event of fan surge, the only concern would be the service life of the fan. No mission impact. CONCLUSION: Postflight, the TACAN filter in avionics bay 3 was cleaned and the fan delta pressure returned to the preflight level of 4 inches of water. This demonstrated that the delta pressure rise was due to debris collecting on the small orifice filter restricting the flow. CORRECTIVE_ACTION: The orifice of the avionics bay TACAN slot will be moved to the empty central processing unit (CPU) slot as done in avionics bay 2. A larger "hat" filter will be installed in its place which will be able to collect a larger amount of debris without affecting avionics bay delta pressure. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on on Subsequent Missions: No impact.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:01:59.981	Problem	**FIAR**	**IFA** STS-49-V-09	HYD
MMACS--01	**GMT:** 128:23:42:00.000		**SPR** 49RF05	**UA**	**Manager:**
			IPR	**PR** HYD-0066	
					Engineer:

Title: WSB Sys 2 Reg Out Press Sensor (V58P0204A) (ORB)

Summary: DISCUSSION: Water Spray Boiler 2 (WBS) GN2 regulator relief valve cracking was high at 42.5 psig; reseat was nominal. This failed the Operations Maintenance Requirements and Specifications Document in-flight check-out requirement DV58AKO.045, for which the specification is 30.0 to 33.5 psig. Data analysis indicates an intermittent pressure transducer failure, as indicated by an instantaneous pressure drop of 16 psi during the timeframe of cracking. Contamination of the resistive element inside the transducer is suspected to have inhibited brush arm movement during pressure changes. Nominal output was observed throughout the remainder of the mission. This type of failure has been noted on OV-104 system 2 WSB during flights STS-44 and STS-45. These two WSB's were built with pressure transducers manufactured after 1985 by the vendor (Edcliff), as were the spares that Hamilton Standard has acquired. The spares were tested by Hamilton Standard prior to installation on OV-105 to verify performance. No troubleshooting was performed on the pressure transducer at KSC on the vehicle. The transducer was removed and replaced by Hamilton-Standard.

CONCLUSION: Contamination of the resistive element inside the transducer is suspected to have inhibited brush arm movement during pressure changes. The failure analysis has not been completed by the vendor (Edcliff). CORRECTIVE_ACTION: The transducer was removed and returned to Hamilton-Standard for failure analysis. Hamilton-Standard also tested the replacement transducer to verify performance prior to installation into OV-105. Corrective action required will be tracked thru CAR closeout. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:01:59.981	Problem	**FIAR**	**IFA** STS-49-V-10	ECLSS
EECOM-04	**GMT:** 128:23:42:00.000		**SPR** 49RF06	**UA**	**Manager:**
			IPR 47V-0021	**PR**	
					Engineer:

Title: Flash evaporator system (FES) temperature oscillations. (ORB)

Summary: DISCUSSION: The flash evaporator system (FES) exhibited small temperature oscillations in the outlet temperature as it reached the control band for the primary A controller, primary B controller, and the secondary high load controller. The secondary topper controller did not oscillate since it does not use a mid-point sensor. The other modes use the mid-point sensors. These data indicate a mid-point sensor problem. No mission impact.

CONCLUSION: Mid-point sensors need repacking. CORRECTIVE_ACTION: The mid-point sensor vendor (Hamilton-Standard) has removed, repacked, and replaced the mid-point sensors. They will be retested as part of the normal vehicle turnaround flow. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-11	D&C
EGIL-02, EGIL-03, EGIL-04,	**GMT:** 132:21:12		**SPR** 47RF07, 47RF08, 47RF09, 47RF10	**UA**	**Manager:**
				PR	
			IPR 47V-0027, 47V-0028, 47V-0029, 47V-0030		**Engineer:**

Title: A. Forward Port Floodlight Failure B. Forward Starboard Floodlight Failure C. Aft Starboard Floodlight FailureD. Forward Bulkhead Floodlight Failure (ORB)

Summary: DISCUSSION: A. At 132:21:12 G.m.t., the crew reported that the forward port payload bay floodlight would not illuminate at power up. Approximately 49 minutes later, the crew repowered the floodlight and a 1.5-ampere spike was noted, but no additional electrical signature that would indicate normal payload bay floodlight operation was observed. The light was again turned off and remained off for the rest of the mission.

B. At 133:17:15 G.m.t., the crew reported that the forward starboard payload bay floodlight flickered and then failed to illuminate. The light was off for the rest of the mission. C. At 134:21:20 G.m.t., the crew reported that the aft starboard payload bay floodlight failed to illuminate when turned on. The light was off for the rest of the mission. D. At 134:21:20 G.m.t., the crew reported that the forward bulkhead light failed to illuminate when turned on. The light was off for the rest of the mission. CONCLUSION: A. Analysis of the forward port floodlight data indicates that the lamp failed. The KSC inspection indicated arcing in this light and data shows no current draw. This indicates that the floodlight electronics assembly (FEA) most likely failed due to overstress from the arcing light. B. The crew reported that the forward starboard floodlight flickered and failed. In addition, the data showed that only two of the three floodlights on main bus B turned on. The forward starboard light performed nominally during KSC testing; however, inspection indicated arcing in this light, and this was the most likely cause of the light malfunction. C. Analysis of the data indicates that the associated remote power controller tripped off. The most likely cause of the failure is a short within the FEA which caused the remote power controller to trip. The KSC inspection also indicated arcing in this light. D. Analysis of the forward bulkhead floodlight data indicates that the lamp caused the associated remote power controller to trip. The most likely cause of the failure is a short within the FEA. CORRECTIVE_ACTION: The four floodlights and FEA #1 which drives the forward port, aft starboard, and the forward bulkhead lights were removed and sent to NASA Shuttle Logistics Depot (NSLD) for troubleshooting. The troubleshooting results and any further actions will be tracked under the noted CAR's. The retest on the replacement floodlights is complete and the results were good. Three changes have been identified to improve the reliability of the floodlights. Two of these have been approved and one is currently in review at JSC. The first change eliminates arcing in the floodlights by increasing the spacing between the support ring and the tripod. The second change increases the reliability of the FEA ballast by rerouting the wire, changing the duty-cycle of the power transformer, and performing extra testing to insure adequate output voltage margin. The third change imposes further screen testing on the floodlights to insure adequate starting margin. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: Random floodlight failures may continue to occur until all hardware has been modified to the new configuration. The number of floodlights required is mission dependent. There are six payload bay floodlights and one bulkhead floodlight that are each driven by independent ballasts within the FEA. Generally, there is sufficient redundancy to provide adequate lighting for isolated failures. The four failures on OV-105 were the most ever experienced during a single mission.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 012:21:59:59.981	Problem	**FIAR** BFCE029-F052,	**IFA** STS-49-V-12	GFE, C&T
INCO-04, INCO-07	**GMT:** 141:21:40:00.000		BFCE 029-F053	**UA**	**Manager:**
			SPR	**PR**	
			IPR None		**Engineer:**

Title: A. Camera D FailureB. EV2 EMU Helmet Camera Failure (GFE)

Summary: DISCUSSION: A. The crew reported that closed circuit television (CCTV) Camera D failed at approximately 131:21:40 G.m.t. Attempts to recover the camera function by a ground procedure and by the crew were not successful. Camera D was removed by crewmembers during the first STS-49 extravehicular activity (EVA) and replaced with the cabin camera during the subsequent EVA. B. During checkout for the second EVA, the EV2 helmet-mounted television (TV) camera did not transmit a picture. The camera was not used for the second EVA.

CONCLUSION: A. JSC verified the Camera D failure. B. Troubleshooting the helmet-mounted TV at JSC found the transmitter in the TV to be failed. The TV transmits the radio-frequency (RF) TV signal to the S-band hemi-antennas and the signals are then relayed to the CCTV system for display, recording, or transmission to the ground. CORRECTIVE_ACTION: A. Camera D, serial number 19, has been sent to the vendor for troubleshooting and repair. B. The failed transmitter has been removed from the camera and troubleshooting and failure analysis is in progress at JSC. Further analysis and troubleshooting on these two anomalies will be tracked on FIAR BFCE 029-F052 and BFCE 029-F053. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-13	MPS, INST
None	**GMT:**		**SPR** 49RF11	**UA**	**Manager:**
			IPR 47V-0006	**PR**	
					Engineer:

Title: Engine 1 & 2 H2 Prevalve Pressure Drop Excessive (ORB)

Summary: DISCUSSION: A review of main propulsion system (MPS) LH2 feed system pressure data from ascent revealed anomalous pressure signatures for main engine (ME)-1 and ME-2. The ME-1 inlet pressure (V41P1100C) shifted down 3.5 psia between T+160 seconds and T+220 seconds. This occurred after the expected transients due to the throttle bucket and solid rocket booster (SRB) separation, when the measurement should have read steady. After this shift, its bias was 8.3 psia low based on a comparison to the External Tank (ET) ullage pressure transducers. The ME-2 inlet pressure (V41P1200C) was biased 8.0 psia low throughout the engine run time based on a comparison to the ET ullage pressure transducers.

Although these biases are the highest that have been seen since return-to-flight, it should be noted that the accuracy requirement for these measurements is 10 psi (5 percent of the 0 to 200 psia range). The main area of concern was not the magnitude of the bias but the ME-1 pressure shift. If this shift was real, it would equate to a significant feed-system blockage. However, the SSME Project's review of engine data found no evidence to support an actual pressure drop. Candidate explanations of the ME-1 pressure shift are prevalve screen blockage or an instrumentation problem. Prevalve screen blockage is considered unlikely since producing the smooth ramping observed during the pressure shift would have required depositing debris on the screen in a gradual manner over a one-minute period. Also, all three engines exhibited the same inlet pressure recover with flow reduction during 3-g throttling, which would not have occurred if the ME-1 prevalve screen was blocked. Troubleshooting of the vehicle instrumentation has been performed and no problems have been found. This included verifying signal conditioner performance and performing wire wiggles. The pressure transducers have been removed and sent to Rockwell/Downey for calibration verification and failure analysis. CONCLUSION: The most probable cause of the anomalous pressure responses are problems with the pressure tranducers. Prevalve screen blockage is considered highly unlikely, and no additional vehicle work is required. CORRECTIVE_ACTION: The pressure transducers have been removed and replaced. The removed transducers have been sent to Rockwell/Downey for test and evaluation. The transducers should not be returned to service even if no anomalies are found. The failure analysis for these transducers is being tracked on CAR 49RF11. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 2	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-14	
RNDZ-01	**GMT:** 134:18:30		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Orbit Targeting Ti Computation Failure ()

Summary: This problem was transferred to WG (System Integration)

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:17:19:59.981	Problem	**FIAR**	**IFA** STS-49-V-15	C&T
INCO-08	**GMT:** 135:17:00:00.000		**SPR** 49RF12	**UA**	**Manager:**
			IPR 47V-0031	**PR**	
					Engineer:

Title: Ku-band Antenna Problem (ORB)

Summary: DISCUSSION: At approximately 135:13:00 G.m.t., the Ku-band system lost the ability to move the antenna in the beta axis. In addition, after many steering mode changes, an oscillation of the antenna occurred. It appeared that there may have been interference that was preventing the antenna from moving in the beta axis. The antenna was free to move in the alpha axis but could not move from approximately +65 degrees in beta to +75 degrees (the positive beta stop). As a result, the antenna was stowed at 136:00:09 G.m.t. using an in-flight maintenance (IFM) procedure, during which an extravehicular crewperson manually positioned the antenna to the lock position, and the middeck crew bypassed the electronics assembly 1 and powered the lock motors to lock the gimbals. While manually positioning the antenna, the EV-3 crewperson reported a 3-inch to 4-inch pin popped out of the area near the Ku-band deployed assembly (DA) gimbals. This pin moved down into the payload bay and bounced away from the vehicle. The pin was not retrieved. (At this time, it has not been determined that the pin contributed to the problem.) There are no parts of the Ku-band DA or the antenna deployment assembly that fit this description. The DA remained stowed for the remainder of the mission.

The DA was returned to Hughes Aircraft for test, teardown, and evaluation. An interference between the armature and stator magnet ring of the beta axis motor was observed during the DA gimbal test. Removal of the motor magnet showed evidence of overheating. The overheating of the motor caused extrusion of the winding encapsulation epoxy from the slots between the armature segments, and this extrusion resulted in the interference. CONCLUSION: It is postulated that the overheating of the motor occurred when the antenna was being driven into the positive beta stop for approximately 54 minutes. This occurred when the Ku-band system was in the auto steering mode and the antenna was being commanded to remain inertially stabilized. CORRECTIVE_ACTION: A change to the Shuttle Operational Data Book (SODB)

will be generated to document this occurrence and how to preclude it for future flights. Further analysis of the motor will be tracked on CAR 49RF12. EFFECTS_ON_SUBSEQUENT_MISSIONS: The flight controllers will select the GPC Designate mode when entering the obscuration zone. This should safe the system during periods of vehicle blockage when it is not as obvious that stops have been reached i.e., loss of Ku-band communications.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:03:13:59.981	Problem	**FIAR**	**IFA** STS-49-V-16	INST,ECLSS
EECOM-05	**GMT:** 135:02:54:00.000		**SPR** 49RF14	**UA**	**Manager:**
			IPR 45V-0022	**PR** ECL5-02-0227	
					Engineer:

Title: Cabin dp/dt sensor slow response. (ORB)

Summary: DISCUSSION: The cabin dp/dt sensor exhibited a slower response than expected during the cabin 2 psid load check and cabin repressurization from 10.2-psia operations. No performance specification on response rate exists but the data show a rate that was three to four times slower than experienced on previous flights. Operational redundancy for this sensor is obtained by monitoring the cabin pressure decay rate as exhibited by the cabin pressure sensor. No impact to the mission.

CONCLUSION: Postflight troubleshooting and data analysis confirmed that the dp/dt sensor had failed. CORRECTIVE_ACTION: Sensor has been removed and replaced. Failed sensor sent to vendor for failure analysis. Failure analysis will be tracked by CAR 49RF14-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:22:35:59.981	Problem	**FIAR**	**IFA** STS-49-V-17	MECH
MMACS--05	**GMT:** 134:22:16:00.000		**SPR** 49RF23	**UA**	**Manager:**
			IPR 47V-0017	**PR**	
					Engineer:

Title: PRLA 4 Latch/Unlatch Indicator B Failed (ORB)

Summary: DISCUSSION: While installing the Assembly of Space Station by Extravehicular Activity (EVA) Methods (ASEM) bottom plane during the third Intelsat EVA, the payload retention latch assembly (PRLA) system B microswitches began to operate intermittently. This PRLA (payload select 2, latch 4) was installed on the starboard sill longeron at Xo1069 (bay 9). At various times, the release, latch, and ready-to-latch indications were intermittent in their operation. The release indication was lost momentarily when the latch was open prior to trunnion installation. When the PRLA was closed with the trunnion installed, the latch and ready-to-latch indications were lost. During a subsequent PRLA cycle test, both motors operated nominally. However, with the system B microswitches lost, the B motor continued to drive until the latch switch was taken to off. The latch and ready-to-latch indications returned after the cycle test but operated intermittently for the remainder of the flight.

CONCLUSION: The anomaly seen was an intermittent condition in the system B microswitch circuit. Both motors in the PRLA operated nominally. CORRECTIVE_ACTION: When initially attempted, troubleshooting was able to repeat the anomaly one time. However, all subsequent attempts to repeat the anomaly were unsuccessful. PRLA's are installed as required by payloads on a flight-by-flight basis. The PRLA installed at position 4 has been removed and will be returned to Rockwell/Downey for inspection. The vehicle wiring and connectors in the indicator circuit were inspected and no problems were found. Further investigation of this anomaly will be tracked on CAR 49RF23. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 007:18:42:59.981	Problem	**FIAR**	**IFA** STS-49-V-18	RCS
PROP-03	**GMT:** 136:18:23:00.000		**SPR** 49RF15	**UA**	**Manager:**
			IPR 47V-0015	**PR** LP04-12-0361	
					Engineer:

Title: Thruster L4L Leak (ORB)

Summary: DISCUSSION: Approximately 30 seconds after being fired during the reaction control subsystem (RCS) hot-fire (136:18:23 G.m.t.), left aft RCS primary thruster L4L was declared failed-leak and was deselected by the RCS redundancy management (RM) when the oxidizer injector temperature dropped below 30 ?F. The oxidizer injector temperature dropped to 17 ?F while the fuel injector temperature, which was influenced by the oxidizer leak, reached a minimum temperature of 48 ?F.

The magnitude of the leak was small, estimated to be less than 100 cc/hr. Flight and ground experience has shown that maintaining pressure on valves with leakage of low magnitude is effective in sealing leaks; therefore, the manifold isolation valves were not closed. It should be noted that the thermal environment of this thruster was nominal with temperatures between 75 and 95 ?F prior to the leak failure. The leak stopped after approximately 1 hour and 45 minutes and the thruster was reselected and placed in last priority. The thruster was fired 3 times during entry and the leak did not recur. Currently, the thruster is being monitored in the Orbiter Processing Facility (OPF). Although slight leakage has been detected, it is not sufficient to require removal of the thruster. CONCLUSION: Based on previous flight experience, the most probable cause of the leak is iron nitrate or particulate contamination at the main or pilot poppet valve seats. CORRECTIVE_ACTION: Thruster L4L is being monitored in the OPF. The current plan is to fly the thruster as-is. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Primary thrusters have multiple redundancy for all nominal mission phases.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:16:42:59.981	Problem	**FIAR**	**IFA** STS-49-V-19	DPS

DPS-01 **GMT:** 130:16:23:00.000 **SPR** 49RF16 **UA** **Manager:**

IPR **PR** DIG 0024

Engineer:

Title: CRT 1 BITE (ORB)

Summary: DISCUSSION: General purpose computer (GPCs) 1 and 2 annunciated a cathode ray tube (CRT) 1 built in test equipment (BITE) message. Display electronics unit (DEU) 1 hardware status word 2 indicated a keyboard adapter channel B failure, which may be caused by the keyboard adapter (part of the DEU) detecting a keystroke but not servicing it. The message could not be accounted for by any user note. The Operational Test Program (OTP) display BITE register clear command recovered the CRT per crew procedures.

CONCLUSION: No cause is currently known. The DEU is assumed to have had a transient failure. CORRECTIVE_ACTION: The DEU has been removed and replaced. Vendor analysis is in work. EFFECTS_ON_SUBSEQUENT_MISSIONS: Effects on Subsequent Missions: None. There is no indication of a generic DEU problem.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-20	ECLSS
None	**GMT:**		**SPR** 49RF17	**UA**	**Manager:**
			IPR 47V-0024	**PR**	
					Engineer:

Title: Cabin Humidity Sensor Failed. (ORB)

Summary: DISCUSSION: The cabin humidity sensor reading appeared to become stagnant at about 30 percent during the mission. The sensor should have been reading between 40 and 50 percent. No mission impact.

CONCLUSION: Postflight troubleshooting showed that the sensor was working properly. Decided to leave sensor in for STS-47 and evaluate.
CORRECTIVE_ACTION: None. Sensor will be flown again and the performance evaluated. Failure will be tracked by CAR 49RF17.
EFFECTS_ON_SUBSEQUENT_MISSIONS: No mission impact.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:16:44:59.981	Problem	**FIAR**	**IFA** STS-49-V-21	ECLSS

EECOM-07 **GMT:** 137:16:25:00.000 **SPR** 49RF18 **UA** **Manager:**

IPR 47V-0025 **PR**

Engineer:

Title: Waste Collection System (WCS) Fan Separator 1 Failed. (ORB)

Summary: DISCUSSION: During entry preparation, the AC 1 bus current trace indicated several unsuccessful attempts were made to start Waste Collection System (WCS) fan separator 1. The crew switched to fan separator 2 which operated normally. In addition, the crew was asked to allow the fan separator to run an additional 30 seconds after urinal operations to preclude any potential flooding. Fan separator 1 was removed from the WCS prior to the WCS removal from the Orbiter to preserve data. The fan separator 1 was sent to JSC for troubleshooting.

CONCLUSION: Failure analysis of the WCS showed that a hair had gotten past all of the WCS screen filters and lodged in the dual check valve going towards the waste tank. This resulted in a slow dripping leak of about one drop a minute from the waste tank back into the WCS resulting in the flooding of fan separator 1. With the slow leak rate, a decrease in the waste tank quantity was not evident with the humidity separators and WCS continuing to put new liquid into the tank. CORRECTIVE_ACTION: An evaluation of the Extended Duration Orbiter (EDO) WCS prefilters on the current WCS is being proposed for STS-47. The EDO WCS prefilter is designed similar to a windsock which has a large surface area to limit pressure drop, while providing a fine filter which will prevent hairs from reaching the fan separator. The filter material is similar to that of a hair net which is used in most clean rooms or cafeterias. This filter will fit in the urinal hose block in the same location as the present prefilter without modification to the WCS. A sticker is being made to remind crew members to allow the fan separator to continue to run for 30 seconds after each use to preclude potential flooding. Future modifications of the fan separator to prevent flooding will include a timer to automatically allow the fan separator to continue to run for 30 seconds after each use. The failure mode of this new system is such that if it fails, the operations prior to the modification will be used. This will be implemented early next year. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. There is not any crew action which could have prevented this type of failure. Should this exact failure recur, the crew would switch to fan separator 2. If the leak would have occurred earlier in the mission and flooded both fan separators, the WCS fan separator clearing in-flight maintenance would have been implemented to allow recovery of the system. To preclude any potential flooding of the fan separators, crews are now trained to allow the fan separators to run an additional 30 seconds after urinal operations.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 008:17:56:59.981	Problem	**FIAR**	**IFA** STS-49-V-22	MECH
MMACS--08	**GMT:** 137:17:37:00.000		**SPR** 49RF13	**UA**	**Manager:**
			IPR 47V-0026	**PR**	
					Engineer:

Title: Port Aft Bulkhead PLBD Latch Indications Missing (ORB)

Summary: DISCUSSION: During payload bay door (PLBD) closing, the port aft bulkhead latch gang failed to reach the fully latched position. After the initial latch attempt, the latches were driven to the released position. The latches were then driven to the latched position, and a current increase was noted 21 seconds into the operation that indicated the existence of some type of obstruction. Although the port aft bulkhead latch "latched" indication was never achieved, the remaining seven PLBD latch gangs latched and the indications were nominal. Flight Rules permit entry with one latch gang unlatched and no entry/landing problems occurred as a result of the PLBD configuration.

A detailed inspection of the bulkhead latch mechanism and the PLBD/bulkhead interface was performed prior to opening the port PLBD in the Orbiter Processing Facility (OPF). Latches 1, 2 and 3 were found to be latched although latch 3 was displaced slightly inboard. At latch 4, the fore/aft door alignment roller was displaced inboard of the guide hook with the tip of the latch hook contacting the side of the roller. Upon completion of this inspection, the port PLBD was unlatched and a force was applied which sprung the door into its nominal position. The door was then opened, closed, latched, and unlatched nominally. Following the above activities, the decision was made to inspect the shear pins in the expansion joint between door panels 4 and 5 (joint 4). Performing this inspection required the deservicing of freon loop 1 and the removal of port radiator panel 4. This inspection revealed binding at shear pin 5 caused by a slight misalignment of its forward and aft bearings. The function of the expansion joints is to accommodate longitudinal motion of the door during closure. This motion is necessary due to dimensional changes between the aluminum structure of the Orbiter midfuselage and the composite structure of the PLBD's caused by the on-orbit thermal environment. The binding of shear pin 5 prevented the expansion joint from allowing the door to adjust to this dimensional change. As a result, the closing/latch loads deflected the door and forced the roller inboard of the hook, thus holding the door in the mislocated position and preventing a full cycle of the latch. Troubleshooting also included the inspection of the shear pins and expansion joint between door panels 3 and 4 (joint 3). This inspection required the removal of the port radiator panel 3. These shear pins showed no signs of binding. CONCLUSION: The most likely cause of the problem was the result of binding of shear pin 5 in expansion joint 4 between PLBD panels 4 and 5. This binding prevented the expansion joint from allowing the door to adjust to a thermally induced dimensional change between the Orbiter midfuselage and the PLBD. As a result, the closing/latch loads deflected the door and forced the fore/aft alignment roller inboard of its guide hook, thus holding the door in the mislocated position and preventing a full cycle of the latch. An inspection revealed that the binding at shear pin 5 was caused by a slight misalignment of the pin and its forward and aft bearings. CORRECTIVE_ACTION: To eliminate binding, the misalignment of the forward and aft bearings at shear pin 5 in expansion joint 4 was corrected. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-23	DPS
None	**GMT:**		**SPR** AD9261, AD9262	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: GPC AP101S Microcode Error (FSW)

Summary: DISCUSSION: During troubleshooting of an orbit targeting error in the OI-21 software, an unrelated problem was found in the AP101S general purpose computer (GPC) microcode (firmware). Two microcode instructions, compare extended data (CED) and compare extended data register (CEDR), can return a condition code of "equal" when the operands are actually different.

Subsequent testing uncovered another microcode instructon which could return an incorrect result. This instruction, divide extended data register (DEDR), returned an incorrect response in eight of the 10,000,000 cases tested. The result of the problem is that accuracy is lost from bit 30 on. Single precision provides accuracy to 24 bits. Double precision provides accuracy to 56 bits. With this problem, DEDR, a double precision divide, only provides a result accurate to 29 bits. The impacts to STS-50 flight software are insignificant. In the case of the compare instruction, two unequal numbers are incorrectly determined equal. However, they are sufficiently equal for the flight software to perform correctly. With the divide instruction, the precision lost is not used by the software. The flight software only requires a rough estimate of the correct answer. CONCLUSION: The microcode problems discovered will not impact the STS-50 primary avionics software system (PASS) or backup flight system (BFS). The problems may affect subsequent missions utilizing OI-21, if patches are applied, and subsequent OI's. The problem was not caught in the preliminary microcode verification due to the method used. The standard method of running data through an AP101B and an AP101S and comparing the results could not be used because these instructions did not work correctly on the AP101B machines. The instructions were only verified on the AP101S. The review of the results did not identify the incorrect data. CORRECTIVE_ACTION: Flight software discrepancy reports 106644, 108519, 106660, and 108522 have resulted in software audits being added to the configuration management data base (CMDB) for PASS and patch checklist for BFS. These audits will be done on each patch to the software and on each OI. EFFECTS_ON_SUBSEQUENT_MISSIONS: The software for subsequent missions will be reviewed for impacts per CMDB and the patch checklist. A potential exists to uncover a significant impact, in which case a fix would be developed.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-24	ECLSS
None	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR 47V-0023	**PR**	
					Engineer:

Title: PCS System 1 N2 Flowmeter Signature Off-nominal. (ORB)

Summary: DISCUSSION: The pressure control system (PCS) 1 N2 flowmeter signature appeared off-nominal during the cabin repressurization from 10.2-psia operations. The anticipated signature for this sensor was to drive to an off-scale high indication and then wrap around to an in-range value. During the repressurization, this signature was not exhibited.

CONCLUSION: Postflight data analysis has shown that this type of signature has been exhibited on other missions and is no longer considered to be anomalous for this out-of-range operation. CORRECTIVE_ACTION: None required. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-49-V-25	APU
None	GMT: 137:20:50		SPR 49RF20	UA	Manager:
			IPR 47V-0019	PR	
					Engineer:

Title: APU 3 GN2 Press Low (ORB)

Summary: DISCUSSION: During ascent and entry, the improved auxiliary power unit (APU) 3 gearbox GN2 pressure (V46P0351A) showed erratic pressure traces. This condition has been attributed to the relocation of the GN2 pressure transducer on the improved APU. During entry, both the GN2 and lube oil out pressure (V46P0353A) were erratic and low. A few minutes after the APU was started, the GN2 pressure began to drop to approximately 7.2 psi and climbed back up to 9.0 psi. The climb peaked at 9 psi and started a variable rate descent down to a low of approximately 6.5 psi. The pressure stayed erratic for approximately 18.5 minutes until nose gear touchdown. At nose gear touchdown the pressure began a steady smooth rise to approximately 9.7 psi, at which time the APU was shutdown.

CONCLUSION: Postflight gearbox ullage verification indicated that the lube oil quantity was 56 cc low as compared to the quantity recorded preflight. This was within the OMRSD maximum lube oil leakage postflight specification of 150 cc. Troubleshooting was performed with no problem found with the lube oil load or its documentation. No lube oil was found in the lube oil seal cavity. The most probable cause of the loss of gearbox lube oil is dynamic leakage across the turbine seal allowing lube oil and GN2 to escape. The gearbox GN2 pressure traces observed on this flight are all similar to other IAPU's flown on this and other previous flights. The nominal pressure trace for an IAPU begins with an initial drop due to the pump startup scavenging characteristics followed by a slow increase corresponding to increasing lube oil temperatures. Once lube oil cooling is initiated and the oil temperatures remain constant, the pressure tends to level off or start a slow decrease. This decrease in pressure is normally the result of small amounts of GN2/lube oil leakage during operation; which is a normal characteristic of all APU's, both baseline and improved. The difference between the improved and baseline APU GN2 pressure traces is that the improved units are more erratic. This is attributed to the relocation of the pressure transducer from the back side of the accumulator to the suction side of the lube oil pump. With this new location, the transducer is more responsive to the transient conditions associated with the pump. Another result of moving the pressure transducer is monitoring a lower pressure while the APU is operational. The lower pressures being monitored coupled with the erratic conditions cause the GN2 pressure values to approach or drop below the repressurization limits of the APU controller. Gearbox repressurizations are considered acceptable due to the known GN2/lube oil leakage during operation. An analysis is in work to establish the acceptable limit for GN2/lube oil leakage. The traces seen on this flight are all characteristic of a nominal IAPU and should be expected on future flights. CORRECTIVE_ACTION: The lube oil has been reserviced for the next flight with all quantities within specifications. A gearbox pressure decay test was performed postservicing with no leakage detected. Further investigation and analysis on the relocated IAPU GN2 gearbox pressure transducer is ongoing and will be tracked under CAR 49RF20.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:21:49:59.981	Problem	**FIAR**	**IFA** STS-49-V-26	APU,INST
MMACS--07	**GMT:** 137:21:30:00.000		**SPR** None	**UA**	**Manager:**
			IPR 47V-0016	**PR**	
					Engineer:

Title: APU 1 Injector Temperature Measurement Erratic (ORB)

Summary: DISCUSSION: At 137:21:08 G.m.t., about 3 minutes prior to APU deactivation, the APU 1 injector tube temperature (V46T0174A) measurement became erratic. Following APU shutdown, the temperature suddenly dropped from 1350 deg. F to 750 deg F. The temperature slowly decreased for approximately 85 minutes corresponding with the APU cooldown process, and then suddenly increased from 250 deg. F to 550 deg. F. The temperature measurement reacted normally from that time on. It is suspected that either the sensor became detached from the injector well wall or that a lead wire became loose due to vibration of the APU. The instrumentation has been repinned to the backup injector temperature sensor for the next flight. The IAPU was designed and built with two injector tube temperature sensors along the injector well wall. This measurement is the backup measurement to the Gas Generator Bed Temp (V46T0122A) and is not a constraint to flight.

CONCLUSION: The exact cause of the erratic behavior associated with the injector tube temperature measurement was not determined due to its internal location within the APU. The most probable cause of the failure is that the sensor became temporarily debonded from the injector well wall due to the vibration associated with the operation of the APU. CORRECTIVE_ACTION: During post flight turnaround operations, the instrumentation was repinned to the backup injector tube temperature sensor. Verification of this measurement was performed successfully. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:21:30:59.981	Problem	**FIAR** B-EMU-300-F004	**IFA** STS-49-V-27	GFE
EVA-12	**GMT:** 135:21:11:00.000		**SPR**	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: EV-3 "Power Restart" Message Frozen on DCM (GFE) (EVA)

Summary: DISCUSSION: At approximately 135:21:11 G.m.t., when the EV-3 crewperson transferred to battery power, the expected "Power Restart" caution and warning system (CWS) message was received, but could not be cleared off of the display. The EV-3 crewperson reported that the message appeared to be "burnt" into the display, and this prevented subsequent messages from being read. However, CWS tones for subsequent messages could be heard. The EVA was continued since EV-3 could hear when CWS messages were annunciated, EV-3 had a suit pressure reading available through a mechanical gauge, and since EMU parameters were monitored on the ground.

A contingency response plan was developed real-time should EV-3 encounter CWS tones; however, the CWS annunicated no further messages.

After the flight, extravehicular mobility unit (EMU) -3 was tested with its flight battery in the vacuum chamber. The DCM power mode switch was cycled 20 times, triggering the "Power Restart" message, which cleared after each annunication. The EMU was then checked on the bench for any voltage ripples in the DCM power supply lines. No ripples were noted. The CWS was then subjected to a number of performance tests which indicated no problem with the CWS. The problem was duplicated on a breadboard test unit at the vendor. The cause of the breadboard test unit problem was isolated to the reset circuit of the microprocessor on the display/logic board of the DCM. CONCLUSION: The flight problem was most likely caused by a microprocessor problem within the DCM. CORRECTIVE_ACTION: The breadboard test rig will be upgraded to more closely resemble the flight configuration. Further tests will be performed on the upgraded configuration to better characterize the failure cause, and determine appropriate corrective action. The results of these tests will be reported under the listed FIAR. If this problem should recur on another DCM prior to the implementation of corrective action, EVA operations can still continue. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:02:29:59.981	Problem	**FIAR** B-EMU-300-F002	**IFA** STS-49-V-28	GFE
EVA-09	**GMT:** 135:02:10:00.000		**SPR**	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: EV-2 Loss of DCM Display (GFE) (EVA)

Summary: DISCUSSION: At approximately 135:02:10 G.m.t., while performing an extravehicular mobility unit (EMU) status check during the third INTELSAT EVA, the EV-2 crewperson reported that he was unable to read his suit display and control module (DCM) display. This did not affect the completion of the EVA since the EMU parameters were available on the ground and suit pressure was available to the crewperson through a mechanical gauge. This phenomenon was reported again during airlock ingress.

This anomaly was reproduced during postflight troubleshooting. All of the display characters were partially lit. Varying the intensity control changed the backlighting, but did not improve the readability of the characters. Further DCM display testing isolated the anomaly to the DCM and verified that the EMU caution and warning system was not at fault. CONCLUSION: The unreadable DCM display was unique to this particular DCM and did not affect successful completion of the EVA. CORRECTIVE_ACTION: This DCM unit has been returned to the vendor for complete failure analysis and correction action. The results of these activities will be reported under the listed FIAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 007:18:22:59.981	Problem	**FIAR** None	**IFA** STS-49-V-29	GFE
EVA-15	**GMT:** 136:18:03:00.000		**SPR** None	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: EMU Battery S/N 1181 Bad (GFE) (EVA)

Summary: DISCUSSION: After the fourth extravehicular activity (EVA), at approximately 136:18:03 G.m.t., while performing extravehicular mobility unit (EMU) battery recharge procedures, battery S/N 1181 could not be recharged on battery charger S/N 1002. This charger had performed satisfactorily after the two previous EVA's. The battery was moved to the spare charger with the same result. This was no impact to the flight since enough charged batteries were available to support a payload bay door closure EVA if required.

After the mission, the battery and charger were returned to JSC. The battery successfully passed its receiving inspection and the battery and charger were subjected to the full range of performance testing, with no repeat of the failure-to-charge. This testing eliminated all plausible hardware failure modes from consideration as the cause of the problem. CONCLUSION: No hardware-related cause of the failure-to-charge has been determined. Procedural causes believed to be unlikely since the crew successfully used the charger twice earlier in the flight. A detailed review of the middeck battery charger design requirements was conducted. The battery specifications used in the charger design did not reflect the full range of battery performance seen during operational use. The most likely cause of the failure is that battery S/N 1181 was outside the range of battery performance that the middeck charger could handle when the in-flight charging was attempted. CORRECTIVE_ACTION: A middeck battery charger redesign is being considered to allow charging across the full range of battery performance. The middeck charger is not currently manifested for another flight. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:18:14:59.981	Problem	**FIAR**	**IFA** STS-49-V-30	C&T
GNC-01	**GMT:** 137:17:55:00.000		**SPR** 49RF19	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: TACAN 3 Self-test Failure. (ORB)

Summary: DISCUSSION: Tactical Air Navigation (TACAN) unit 3 (serial number 003), manufactured by Collins, indicated intermittent self-test failures beginning about three hours prior to touchdown. It also experienced delayed range acquisition. Since range acquisition was expected to be later than the Gould TACAN unit (located in

slot 1), this occurrence was not initially considered discrepant. Once acquired, range and bearing data were as expected. The TACAN was sent back to Collins, where it was confirmed that a self-test failure had occurred. The cause of the self-test failure and the delayed range acquisition was low power output.

Further inspection revealed that a screw holding down the transistor Q5 mount had backed out, causing the mount to come loose. The mount holds down Q5 and causes it to make contact with a ground plane. Q5 was not making good ground contact. Q5 is the driver for the final three RF power-output transistors. Inspection of TACAN serial number 002 (flown in slot 2), also manufactured by Collins, revealed that all screws inside the box were tight, but some were not torqued to the 32 inch-ounce specification. CONCLUSION: The self-test failure and the delayed range acquisition resulted from transistor Q5 not making good ground contact. The cause of this condition was a loose transistor mount screw. CORRECTIVE_ACTION: Collins has inspected the remaining two TACANs (serial numbers 004 and 005) for any loose screws and found none. Rockwell will develop a plan to ensure proper torquing of the screws inside the TACANs with the possible addition of a screw retention device or locktite. Also, a mandatory Defense Contract Administration Services (DCAS) inspection of the screws will be added to the Acceptance Test Procedure for future TACANs and/or TACAN repairs. EFFECTS_ON_SUBSEQUENT_MISSIONS: Currently, OV-105 is the only Orbiter with Collins TACANs. The Collins TACANs will have the screws properly torqued and inspected, and the units will be returned to KSC before they are required for the STS-47 (OV-105, flight 2) flow. Therefore, this problem will cause no schedule impact.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 007:18:22:59.981	Problem	**FIAR**	**IFA** STS-49-V-31	GFE
EVA-14	**GMT:** 136:18:03:00.000		**SPR** None	**UA**	**Manager:**
			IPR	**PR** FCS-05-02-0144	
					Engineer:

Title: EMU 2 Difficult to Mount on Airlock Wall (EVA)

Summary: DISCUSSION: At approximately 136:18:03 G.m.t., the crew reported that the pip pin could not be installed in the airlock adaptor plate (AAP) in the lower forward mounting V-bracket on the extravehicular mobility unit (EMU) 2 mount during reinstallation to the airlock wall. The AAP had been removed on-orbit during reconfiguration of the airlock for the three-person extravehicular activity (EVA). No problem was encountered during removal from the wall. During reinstallation, an attempt was made to fit each of the AAP's into the troubled spot with no success. To finally secure an AAP into the wall mount, four bolts were loosened on the AAP joint, the AAP was fitted into the mount, and the bolts were retightened.

Prior to the flight, KSC wrote a problem report stating that proper adjustment could not be made on the AAP lower mount actuating pin to allow installation of the AAP to the airlock wall. The holes in the forward and aft airlock mounting dovetail fitting and plate were elongated to allow proper pin operation. The AAP was then installed into the wall mount, with some difficulty. CONCLUSION: Because of the preflight problems at KSC, and the fact that none of the AAP's could be installed in this slot in-

flight, the problem is most likely caused by the bolt holes in the airlock being out of position. CORRECTIVE_ACTION: Measurements of the bolt-hole relative position will be taken to determine how much the specification is exceeded. Corrective action will be determined and implemented once the measurements have been analyzed. Future removal of the AAP's in-flight is unlikely. Even if the AAP must be removed, and the problem recurs, the AAP can be reinstalled with workarounds by the crew. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:23:04:59.981	Problem	**FIAR** BFCE-026-F002,	**IFA** STS-49-V-32	GFE
EVA-07, EVA-10, EVA-11,EVA-13, EVA-17, EVA-16	**GMT:** 134:22:45:00.000		BFCE-026-F003, BFCE-026-F004	**UA**	**Manager:**
				PR	
				SPR	**Engineer:**
				IPR None	

Title: EVA Equipment Failure (GFE)

Summary: DISCUSSION: A) During the final INTELSAT extravehicular activity (EVA), at approximately 134:22:45 G.m.t., the crew reported that one of the retractable tether reels had failed to retract. B) During the final INTELSAT EVA, at approximately 135:03:59 G.m.t, the crew reported that the retractable tether on one of the EVA power tools had broken. The crew used gray tape and tie wraps to create a tether point and the tool was retethered. C) During the final INTELSAT EVA, at approximately 135:04:07 G.m.t., the crew reported that one adjustable joint on one of the portable foot restraints lost its capability for adjustment. Redundant portable foot restraints were available and were used for subsequent EVA operations. D) During the Assembly of Station by EVA Methods (ASEM) EVA, at approximately 136:04:20 G.m.t., the port-side safety-tether reel being used by EV4 would not lock. The lock lever would not move to the lock position. E) During the final INTELSAT EVA, at approximately 135:03:33 G.m.t., the crew noted that a very loud "blender-type" noise was heard on the EMU headsets when the EVA power tool was being used. This noise was only noticeable in the backup communications mode (not communications mode A or B) and noticeable only toward the aft of the payload bay, near the INTELSAT perigee kick motor. F) During the first INTELSAT EVA, at approximately 132:00:10 G.m.t., the crew noted two minor problems with both the mini-workstations. The lock knob of the end effector tether for the first unit stiffened up to an unacceptably high actuation torque. On the second unit, the lock knob of the end effector jaws spun too freely to a position opposite from the desired setting.

CONCLUSION: A) A screw that normally holds the tether reel brake shoe mechanism was found to be only partially tightened. The brake pad was then allowed to drag on the reel causing the failure of the reel to retract. B) The Kevlar cable that broke was inspected and found to have been abraded at several spots including the point of breakage. This weakened the cable to the point that it failed under nominal loads. C) The initial design of the pivot machanism utilized a lubricated helicoil to prevent galling between similar materials. A recent modification changed the pivot-bolt material and eliminated the galling potential; however, the helicoil was left in place in a tapered-end cavity. On this unit, the helicoil extruded through the cavity, bound up the bolt, and this caused the knob shaft to seize. D) The tether reel locking lever was found to have seized. The locking lever and its shoulder bolt were made of the same material and this allowed galling to take place, eventually causing the lever to seize.

E) Further research has shown that the EVA power tool is a payload-supplied item and is not standard Oribter/GFE hardware. F) The unit with the reported high-actuation torque on the end-effector tether lock lever was found to have no different actuation torque than before the flight. During preflight training, a problem with high actuation torque on the tether lock lever was noted by the crew. The spring force in the lock lever detention pin was decreased at that time, and a crewperson inspected and accepted the flight units with the reduced spring force. The second unit, with the reported end-effector jaws lock knob spinning too freely was also found to have no different characteristics than preflight. This unit had flown previously with the same lock knob characteristics with no adverse crew comments. CORRECTIVE_ACTION: A) This tether reel will be repaired. Preflight inspection requirements have been changed so that this mechanism is inspected after each flight that a tether reel is used. B) This tether material will be changed to stainless steel with a Teflon coating. The new material will be less susceptible to weakening due to abrasion than the original Kevlar material. C) For the short term, a new bushing will be used, eliminating the need for the helicoil. A dry film lubricant will be applied to further prevent galling. In the long term, a complete redesign of the portable foot restraint adjustment mechanism is under consideration. D) The shoulder-bolt diameter will be decreased, and a non-metallic bushing will be installed to prevent galling. E) Electromagnetic interference (EMI) testing of the EVA power tool will be performed in an attempt to recreate the problem. Appropriate corrective action will be determined after the testing, and will be tracked by payloads personnel. F) The end effector tether lock lever assemblies will be reworked to further reduce the actuation torque. The end effector jaws lock knobs will be flown as-is. Since this was the first crew comment against how freely the lock knobs spun, and there is no minimum requirement for the torque, this problem was believed to be a subjective crewperson preference. A design effort will be initiated to develop a more "user-friendly" device. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-49-V-33	APU
None	**GMT:** Prelaunch		**SPR** None	**UA**	**Manager:**
			IPR	**PR** APU-5-0047	
					Engineer:

Title: APU 3 Fuel Test Line Temp (ORB)

Summary: DISCUSSION: The APU system A heaters are activated prior to cyrogenic loading through ground commands. Upon initiation of the cryo loading, the aft temperature decreases below the thermostat lower set point of 55 ? 5 deg F requiring the heaters to cycle. Once the system 3 fuel test line heaters began to cycle, a temperature miscompare was noticed between temp 1 (V46T0383A) and temp 2 (V46T0384A) at the low end of the heater cycle. The maximum delta was 7 degrees F. (Temp 1 was 54 deg F and temp 2 was 47 deg F.) This condition violated the LCC lower limit of 48 deg F. The LCC limit is derived from the thermostat set point, uncertainty, instrumentation error, and location delta.

An LCC waiver/deviation was processed to allow the measurement to cycle to 42 deg F with the following rationale: The temp 1 measurement (V46T0383A) which is located 4.8 inches from V46T0384A was cycling nominally with a low value of approximately 54 deg F; the new lower limit still allowed for adequate protection against freezing of the Hydrazine (N2H4) (35 deg. F); the primary function of the system had been verified; the low temperature cycle was previously observed during Flight Readiness Firing; and, if the instrumentation was considered to have been failed, the LCC allows for continuance with the remaining instrumentation. As the heater

continued to cycle over the next several hours it was noticed that the two temperatures traced each other on the high end of the cycle (approximately 70 deg F), but the miscompare remained on the low end and was consistent. Prior to launch two possible explanations were offered: The heater wrap may have been concentrating more heat in the area of temp 1 versus temp 2, or some insulation may be missing or loose around the area of temp 2. During OPF processing inspection of the fuel test line at KSC, it was found that the thermostat area insulation thicknesses were all nominal. When the insulation was removed at the thermostat and temperature sensors, the heater wrap was nominal for the A system. However, it was noted that the A system controlling thermostat (50V46S36A) was 2.87 inches from the hard-line clamp and should have been 1.62 inches maximum. This thermostat location condition was accepted per an Engineering Order (E.O.) due to a bend in the hard-line between the clamp and the thermostat preventing a closer attachment. Following the visual inspection, splices were cut and the temperature sensors were tested for resistance measurement. Sensor V46T0384A was found to have an anomalous resistance reading. CONCLUSION: The anomalous temperature reading was most likely caused by a combination of thermostat/sensor/heater location uncertainties, the anomalous resistance reading on the temp 2 sensor, and unknown insulation characteristics. CORRECTIVE_ACTION: Both temperature sensors (1&2) were removed, replaced, and verified to be functioning properly. The temp 1 sensor was relocated closer to the controlling thermostat. The heater was rewrapped per print and reinsulated. The test line temperature LCC (SSID APU-14) is in engineering review to determine if the minimum redline may be lowered. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 3	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-34	
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: This problem was deleted. ()

Summary:

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-35	D&C
None	**GMT:**		**SPR** 49RF22	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Panel F9 DC Amps Signal Strength Meter Sticky. (ORB)

Summary: DISCUSSION: In the crew debriefing, the crew reported that the panel F9 "DC Amp/Sig Str" meter stuck at a value of 400 several times during flight. The crew would free the stuck value by tapping on the meter.

CONCLUSION: The cause of the "sticky" meter cannot be determined until the unit undergoes testing and disassembly at the NASA Shuttle Logistics Depot (NSLD). CORRECTIVE_ACTION: The meter was removed from the Orbiter and sent to NLSD for troubleshooting. The troubleshooting results and any future actions, if necessary, will be tracked by CAR 49RF22. A spare meter was installed on the Orbiter and good retest results were obtained. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The meter failure is considered to be an isolated instance. Other means exist during a mission to obtain the same data. The data are available both on the crew's cathode ray tube (CRT) displays and in the downlinked data list.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-49-V-36	STR
MMACS--08	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR	**PR** TES-5-2-001	
					Engineer:

Title: Window Number 1 Chipped On-Orbit (ORB)

Summary: DISCUSSION: During the postflight inspection at Edwards Air Force Base, an impact crater (pit) with "spider-webbing" type cracks emanating from the impact point was discovered at the upper right hand corner of the left-hand outer window thermal pane (Orbiter window 1). Per the STS-49 crew debrief, Commander Daniel C. Brandenstein did not observe the pit in the window prior to launch and ascent however, he did observe the pit midway through the mission prior to entry. When the vehicle was returned to the KSC, the pit was measured using a mold impression and a microscope. The pit dimensions were a maximum diameter of 0.0449 inch and a maximum depth of 0.0039 inch. All of these dimensions exceeded the allowable specifications. An anlaysis evaluated the window's residual strength and life and indicated that the window should be replaced. The window was removed and replaced and the pitted window was sent to storage warehouse 338.

Window damage is a natural occurrence during atmospheric and orbital operations. Pits similar to the one discussed in this report have been observed after previous flights (reference CAR 07F015-010 and IM's 08F022-000, 09F033-000, 19F008-000, 30RF24-000 and AD1897-000). Since this is a recurring problem, the Orbiter windows are inspected for damage after each flight of each vehicle and thermal panes are replaced as required. Limited spares are available. A test program to further the understanding of this damage is under way at JSC. CONCLUSION: The window damage is typical of that noted on previous flights. CORRECTIVE_ACTION: Remove and replace the window. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.
