Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:05:19:37.003	Problem	**FIAR**	**IFA** STS-50-V-01	RCS
PROP-01	**GMT:** 177:21:32:00.000		**SPR** 50RF01	**UA**	**Manager:**
			IPR	**PR** LP05-0056	
					Engineer:

Title: Thruster L1U Heater Failed On (ORB)

Summary: DISCUSSION: Temperature traces of thruster L1U fuel and oxidizer injectors indicated that the thruster heater was failed on. The failure was identified approximately five hours after liftoff. Subsequently, temperatures were maintained within operational limits (60-160 ?F sensed at the injector) by manual operation of the switch which enables heaters for all thrusters on manifold 1 in both the right and left pods. This technique was utilized for approximately three days when it was noted that L1U injector temperatures stabilized at between 135 and 145 ?F, indicating that, although still failed on, heater performance had degraded such that manual cycling was unnecessary.

Each thruster utilizes an integral heater controller which consists of a bridge sensing circuit, an amplifier, and a transistorized heater switching circuit. The lower and upper setpoints are 72 ?F and 102 ?F respectively. This thruster (S/N 625) was a new component which had not flown previously. The thruster (and controller) were removed, replaced, and sent to the vendor for failure analysis. Similar anomalies involving heaters failed off or on have occurred on six previous flights. All failures have been attributed to the solid state controller. CONCLUSION: The initial "fail on" condition was most likely caused by a component failure in the heater controller. The subsequent degradation in heater performance was most likely caused by a failed transistor in the controller switching circuit. Failure analysis results will be documented on the CAR. CORRECTIVE_ACTION: Thruster L1U and associated heater controller have been removed and replaced. Final corrective action will be documented on the CAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: Should the failure recur, thruster temperatures may be maintained within operational limits by manual control of heater circuits via cockpit switches.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:04:13:37.003	Problem	**FIAR**	**IFA** STS-50-V-02	ECLSS
EECOM-02	**GMT:** 178:20:26:00.000		**SPR** 50RF02	**UA**	**Manager:**

			IPR None. **PR** ECL-2-13-0824	
				Engineer:

Title: RCRS Failure. (ORB)

Summary: DISCUSSION: Shortly before the STS-50 mission began, a failure mode in the regenerable CO2 removal system (RCRS) was found. In this failure mode, the actuator output bearing was able to slide down the actuator shaft until it contacted pins on the valve position indicator (VPI) and shorted the pins to ground. The controller is designed to automatically terminate all RCRS operations with the loss of any of the VPI signals. This possible failure mode was presented at the STS-50 L-2 day review and deemed not a constraint to flight due to the amount of LiOH being flown.

During the flight, at about 178:13:14 G.m.t., the RCRS experienced the first in a series of shutdowns. The shutdowns occurred on both controllers. After multiple shutdowns within a one-hour period, RCRS operations were terminated and LiOH canisters were installed to remove CO2. Analysis of the failure data indicates that the shutdowns could be attributed to the loss of the controller 1 actuator counter-clockwise (CCW) VPI and the controller 2 actuator clockwise (CW) VPI. The data show that the B actuator was the cause of the RCRS shutdowns. The failure mode was identical to the failure mode discovered prior to flight. An in-flight maintenance (IFM) procedure was performed on flight day 6 that bypassed the CW VPI on both the actuators for controller 2. Controller 2 was chosen for the IFM because the CW VPI could be corrected without any impacts to design integrity, safety, or reliability. CO2 removal by the RCRS must be verified independently using the onboard PPCO2 sensors, since these indications would not be available to shutdown the RCRS when vacuum cycle valves only open partially or not at all. Controller 1 was not modified because the CCW VPI is used to detect a leak to space, and bypassing it is considered a safety-of-flight issue. Once repowered after the IFM procedure the RCRS functioned nominally on controller 2 for the remainder of the mission. CONCLUSION: The RCRS shutdowns were caused by the actuator output bearing shorting-to-ground pins on both of the valve position indicator switches. The short eliminated the signals for the counter-clockwise indicator on controller 1 and the clockwise indicator on controller 2. CORRECTIVE_ACTION: All RCRS actuators will be modified to include a non-metallic spacer installed between the actuator output bearing and the valve position indicator switches. Shrink-wrap insulation will be installed to cover the pins on the valve position indicator switches. In addition, the CW VPI will be permanently bypassed in the actuator. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation	Subsystem
MER - 0	**MET:** 000:11:50:37.003	Problem	**FIAR** B-FCE-029-F058 **IFA** STS-50-V-03	GFE
INCO-04	**GMT:** 178:04:03:00.000		**SPR** **UA**	**Manager:**
			IPR None **PR**	
				Engineer:

Title: Camera A Erratic (GFE)

Summary: DISCUSSION: At 178:04:03 G.m.t., the downlink video from the closed circuit television (CCTV) camera A (S/N 17) had white horizontal lines accross the picture. Power to the camera was cycled without effect on the anomaly. Later in the mission, camera A was observed to be operating nominally.

The camera has been returned to the vendor for trouble-shooting and repair.   CONCLUSION: The cause of the anomaly is unknown. Troubleshooting will be performed by the vendor. The troubleshooting and repair of the camera will be tracked on FIAR B-FCE-029-F058.   CORRECTIVE_ACTION: The camera will be repaired and tested by the vendor before re-entering the flight camera pool.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:05:31:37.003	Problem	**FIAR** JSC EE-0669F	**IFA** STS-50-V-04	GFE
INCO-05	**GMT:** 179:21:44:00.000		**SPR**	**UA**	**Manager:**
			IPR PV6-223943	**PR**	
					Engineer:

Title: TAGS Failure (GFE)

Summary: DISCUSSION: During an uplink at approximately 2:05:32 MET, the Text and Graphics System (TAGS) telemetry indicated a JAM condition. While performing the JAM-clear malfunction procedure, the crew discovered several sheets of paper in the lower paper path and the upper booster rollers not turning. This latter condition indicated a failed developer motor. As this is a non-recoverable condition, the TAGS was declared unusable for the remainder of the STS-50 mission.

CONCLUSION: Postflight analysis of the developer assembly revealed a workmanship problem with the faceplate. An excessive amount of insulating foam in the faceplate caused the plate and attached paper guides to warp when installed in the TAGS. The warped paper guides then came into contact with the developer drum resulting in a significant increase in the torque required to turn the drum. This excessive load on the developer motor caused premature aging and early motor failure. CORRECTIVE_ACTION: The developer faceplate was repaired and now functions properly when installed. The developer motor was replaced. The motor failure was caused by the developer, which in turn was the victim of a workmanship problem. For this reason, this is not considered a generic problem. The faceplate problem seen in this unit is screenable, and all units from now on will be checked for this condition.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-50-V-05	PRSD
EGIL-02	**GMT:** 178:05:42		**SPR** 50RF18	**UA**	**Manager:**
			IPR 52V-0005	**PR**	
					Engineer:

Title: Cryo O2 Tank 2 Heater A2 Erratic (ORB)

Summary: DISCUSSION: The cryogenic oxygen (O2) tank 2 heater A2 element "ON" discrete (V45X1211E) behaved erratically during a period early in the mission from 177:17:15 G.m.t. to 178:03:30 G.m.t. Although the A1 discrete correctly indicated "ON" when the A heater system was commanded on, the A2 discrete failed to indicate "ON". However, two cycles occurred at approximately 178:01 G.m.t. during which the A2 discrete indicated "ON". During the erratic operation, both the A and B heater systems were enabled and both B element discretes displayed "ON". Analysis of the pressure, quantity, and electrical current data during these events were powered. Because of the inability to know the actual status of the A2 heater, the A heater system was powered off for the remainder of the mission. The B heater System functioned normally for the flight's duration.

The A2 heater discrete functioned normally during prelaunch operations. No anomalies were observed during postflight troubleshooting which included continuity checks, wire-wiggle tests, and connector inspections. CONCLUSION: The erratic operation of the O2 tank 2 heater A2 discrete was most probably caused by a loose connection in the heater or "ON" discrete electrical circuitry. The actual status of the A2 heater element during the mission was unable to be determined. CORRECTIVE_ACTION: None. The heater system will be flown as is. Final corrective action results will be documented in CAR 50RF18-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: Erratic behavior of the O2 tank 2 heater A2 "ON" discrete could recur.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:07:37.003	Problem	**FIAR**	**IFA** STS-50-V-06	OMS
GNC-01	**GMT:** 177:16:20:00.000		**SPR** 50RF03	**UA**	**Manager:**
			IPR	**PR** RP05-2-02-0047	
					Engineer:

Title: The Right OMS Yaw Actuator Drifted during Ascent. (ORB)

Summary: DISCUSSION: Flight data indicated that the right OMS yaw actuator moved from -6.06 degrees to -5.82 degrees during the time period from lift-off until shortly after max-Q. This indicates slippage of the actuator no-back device by an amount greater than the OMRS File IX limit of 0.20 degree. The purpose of the no-back brake device is to prevent movement of the actuator during times when it is not actively powered. The OMRS limit is based in part on previous flight history, and is intended to identify units which are out-of-family or which may be approaching end-of-life. After repeated flights some increase in slippage may be expected due to wear. Typical movement is 0.1 degree or less.

This actuator (S/N 134) is a new unit with no previous flights. All acceptance test data were well within allowable limits, however, acceptance test procedures do not include vibration testing. The actuator was sent to the vendor for failure analysis. A tear-down inspection revealed no out-of-tolerance components or manufacturing anomalies. CONCLUSION: The slippage observed on this device was not due to degradation or failure of any component, nor to a manufacturing amonaly. The slippage is most likely within the limits which may be expected from allowable manufacturing tolerances.   CORRECTIVE_ACTION: The right OMS yaw actuator has been removed and replaced with S/N 109. An OMRSD change to increase the allowable slippage is being considered. Final corrective action will be documented on the CAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: The primary concern is that the nozzle damage due to airstream effects could occur if drift reaches approximately 1.5 degrees. During ascent, flight software will enable the actuator and reposition the gimbal if drift reaches 0.70 degree. Existing flight rules prohibit gimbal-off OMS burns if the OMRSD limit is exceeded during ascent.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:19:28:37.003	Problem	**FIAR**	**IFA** STS-50-V-07	FCP
EGIL-03	**GMT:** 181:11:41:00.000		**SPR** 50RF04	**UA**	**Manager:**
			IPR	**PR** FCP-2-13-0248	
					Engineer:

Title: Fuel Cell 3 O2 Purge Valve Leakage (ORB)

Summary: DISCUSSION: At the end of an automatic purge of fuel cell 3 (FC3) at 181:11:41 G.m.t. (03/19:29 MET), the FC3 oxygen (O2) purge valve failed to fully close when commanded. The O2 flow rate remained at 70 percent of the total purge flow rate. Ten minutes later, the valve was manually opened to full purge flow rate for 10 seconds; the valve then reseated and closed completely when it was commanded to close. Rather than risk a failed-open purge valve, a decision was made to forego purging FC3 for the remainder of the mission unless its performance degraded to near the Shuttle Operational Data Book end-of-life curve. FC3 degraded only 0.4 volt for the remaining 240 hours of the mission. An additional 0.74 volt decay at 200 amps would have been allowed before purging would have been attempted.

The transient nature of the purge valve leakage suggests that it was caused by contamination under the valve seat. Some contamination, caused by corrosion within the fuel cell, is normal and is the result of the potassium hydroxide electrolyte attacking the fiberglass epoxy cell frame, producing potassium carbonate (K2CO3). Although K2CO3 has a consistency of fine powder, the wet environment causes it to produce clumps. During postlanding purge operations, the purge valve operated nominally as it did during prelaunch purging. The fuel cell was removed postflight and returned to the vendor. The purge valve will be removed from the fuel cell and undergo failure analysis.   CONCLUSION: The fuel cell 3 purge valve leakage was most probably caused by the presence of fuel cell corrosion products under the valve seat. This corrosion cleared during the manual purge.   CORRECTIVE_ACTION: The fuel cell was removed and replaced.   Failure analysis results will be documented in CAR 50RF04-010.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:07:49:37.003	Problem	**FIAR**	**IFA** STS-50-V-08	PRSD
EGIL-01	**GMT:** 178:00:02:00.000		**SPR** 50RF08, 50RF17	**UA**	**Manager:**
			IPR	**PR** FCP-2-13-0249	

Engineer:

Title: O2 Tank 2 Leak (ORB)

Summary: DISCUSSION: Cryogenic oxygen (O2) tank 2 experienced a leak of approximately 0.9 lb/hr (5000 sccm) throughout the duration of the mission. The pressure in the tank decayed from 830 to 740 psia before the tank heaters were turned on at 0/0830 MET. When O2 tank 2 was not being used, the heat leaking into the tank should have kept the pressure from decaying. However, the pressure and tank quantity continued to decay during this time, thus providing evidence that the tank was leaking overboard. During the first few days of the mission, it was thought that the tank behavior could have been a result of severe stratification within the tank. Evaluation of additional data led to the conclusion that an actual tank leak existed. The leak had no impact on the mission.

A leak in the airborne half of the fill quick disconnect (QD) poppet on O2 tank 2 (IPR 50V-0428) was noted when the tank was filled during prelaunch Extended Duration Orbiter pallet cryogenic load test. The leak was approximately 3500 sccm when the delta pressure across the poppet (tank to ambient) was 400-450 psia. Increasing the delta pressure across he poppet by increasing the tank pressure to flight pressure (800-875 psia) decreased the leak to 390 sccm. Requirements specify leakage to be no more than 900 sccm at flight pressure, so the configuration was approved for flight. Additionally, a flight cap was installed on the QD to eliminate the leakage and maintain the pressure integrity of the tank. A subsequent bubble leak test showed no leakage. The initial postflight bubble check of the cap showed no leakage. However, a check using the O2 sniffer meter revealed a leak. A change in the bubble soap test then produced bubbles. The change consisted of agitating the leak test solution and applying bubbles to the flight cap rather than just liquid solution. Although the cap found to be loose--it moved 1/4 turn when torqued--the leak continued when the cap was properly torqued. Inspection of the cap revealed a damaged seal. Replacement of this seal stopped the leak. Improper torqueing of the cap causes damage to the O-ring seal by allowing a pressure build-up behind the seal to blow the seal out of its groove in the cap. The on-orbit leak rate of 0.9 lb/hr (5000 sccm) at flight pressure can appear to contradict the prelaunch leak profile of the poppet which showed that a large delta pressure across the poppet decreased the leak rate. This issue is resolved by including the leaking flight cap. The resistamce across the cap seal leak was sufficient to cause the pressure upstream of the cap leak/downstream of the poppet leak to be intermediate to the flight-pressure-to-vacuum range. This produced a sufficiently low delta across the poppet to cause the leak rate observed. CONCLUSION: The small on-orbit leak from O2 tank 2 was most probably caused by a damaged seal in the fill QD flight cap that was caused by improper torqueing of the flight cap after installation. The flight cap leakage prevented the within-specification QD poppet leakage from being sealed by the flight cap. CORRECTIVE_ACTION: The QD was replaced. Leak check and cap installation procedures are being revised. The flight caps will be torqued as each one is installed instead of installing all flight caps and then torqueing them. The technicians will also be retrained on the proper techniques for performing bubble leak checks. Failure analysis results will be documented in CARs 50RF08-010 and 50RF17-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 000:21:44:37.003	Problem	**FIAR**	**IFA** STS-50-V-09	APU,TCS
MMACS--01	**GMT:** 178:13:57:00.000		**SPR** 50RF05	**UA**	**Manager:**

IPR 52V-0003 **PR**

Engineer:

Title: APU 3 Test Temperature Out-Of-Tolerance (ORB)

Summary: DISCUSSION: After activation of the auxiliary power unit (APU) tank/fuel system B heaters following ascent, the APU 3 test line heater was cycling low with the test line temperature 1 sensor (V46T0383A) nearing the lower fault detection and annunciation (FDA) limit of 48 ?F. The test line temperature 2 sensor (V46T0384A) was cycling in a typical range of 60 to 80 ?F. When the system A heaters were selected approximately two hours later per normal opertions, the test line heater initially cycled higher than normal range as indicated by the temperature 2 sensor; however, the temperature 1 sensor was nominal in the 60 to 80 ?F. The temperature 2 sensor surpassed the FDA limit of 95 ?F and approached temperatures in the 96 ?F range. A Table Maintenance Block Update (TMBU) was sent to raise the FDA limit to 110 ?F. Shortly after the TMBU, the temperature 2 sensor exceeded 110 ?F and reached 112 ?F. A TMBU was again sent to raise the FDA limit to 120 ?F. As the mission progressed, the heater continued to cycle high as indicated by the temperature 2 sensor, but was only in the 80 - 100 ?F range. The temperature 1 sensor continued to read in the 60 to 80 ?F range throughout the mission. The system B heaters were selected again after FCS checkout per normal operations and again the temperature 1 sensor cucles low nearing the FDA limit of 48 ?F. The temperature 2 sensor was in the 60 to 80 ?F range.

CONCLUSION: During the mission, both abnormalities were thought to be associated with the heater wrap, temperature sensor, and/or the insulation installation. Upon ?nspection of the system, it was found that the insulation thickness around the thermostats was out-of-specification. The insulation thickness around the A thermostat was 2.02 inches and around the B thermostat was 1.86 inches, and both should have been a minimum of 2.12 inches. KSC removed the line ?nsulation and evaluated the heater wraps, temperature sensors, and thermostats locations. The temperature 1 sensor and both the A and B thermostats were installed per print; however, the temperature 2 sensor was found to be located 0.70 inch away from the B thermostat, and it should have been within 0.26 inch. To correct this condition, the B thermostat was moved closer to the temperature 2 sensor. This was done because the thermostat has a larger location tolerance, and it could be moved closer to the temperature sensor and still remain within its location tolerance from the line clamp. This also helped prevent destruction of the temperature sensor.Channelization of both temperature sensors was verified to be correct and resistance measurements of the temperature sensors were within specification. The original heater wrap and/or insulation associated with the A and B heater systems are the most probable cause of the high cycling on temperature sensor 2 and low-cycling on temperature sensor 1, respectively.
CORRECTIVE_ACTION: The thermostat B has been moved closer to the temperature sensor 2 (still leaving it within specification), the temperature sensors have been respliced, the heater rewrapped, and the insulation replaced. The system has been returned to drawing configuration and the retest is complete.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** 002:05:46:37.003	Problem	**FIAR**		**IFA** STS-50-V-10	HYD

MMACS--02	**GMT:** 179:21:59:00.000		**SPR** 50RF09	**UA**	**Manager:**
			IPR 52V-0015	**PR**	
					Engineer:

Title: Circ Pump 2 Pressure Sensor Dropout (ORB)

Summary: DISCUSSION: During hydraulic circulation pump operations, the pressure transducer (V58P0237A) for system 2 was erratic and fluctuated between 0 and 235 psia. The first instance of the circulation pump pressure transducer indicating 0 psia occurred during a period of loss of signal (LOS). During the LOS, the crew received a fault detection and annunciation (FDA) alarm, after which the pump was turned off. The pressure transducer returned to a normal reading of 50 psia. However, the pressure transducer became erratic again during other circulaton pump operations.

CONCLUSION: When the transducer was indicating 0 psia, the main pump filter module transducer continued to read approximately 200 psia indicating normal circulation pump performance. During the flight, the engineering community suspected either the transducer or wiring causing the false readings. During troubleshooting, KSC wiggled cable T210A26 which is mated to the suspect pressure transducer with no change in output. A wiggle test was performed while the circulation pump was running and no erratic readings were observed. Connector 50V77W119P63 to the pressure transducer was disconnected and inspected with no anomalies found. CORRECTIVE_ACTION: The pressure transducer was removed and replaced with a retest to follow. The suspect sensor will be sent to Rockwell Int. for calibration testng. If the transducer passes claibration, then the unit will be returned to spares. Failure analysis is being performed under CAR 50RF09-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. If the anomalous condition recurs, then the FDA can be TMBU'd and main pump filter module transducer can be monitored.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:21:47:37.003	Problem	**FIAR** B-FCE-029-F059	**IFA** STS-50-V-11	GFE
INCO-06	**GMT:** 181:14:00:00.000		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Camera D Heater Failed Off ()

Summary: DISCUSSION: At 181:14:00 G.m.t., closed circuit television (CCTV) camera D (S/N 33) showed a temperature of -9 ?C. During subsequent operations, the temperature of the camera dropped to -13 ?C. Heaters in the camera are supposed to maintain a temperature between 0 ?C and 8 ?C. Should the temperature drop below -29 ?C, there is a risk that the high voltage power supply will not start.

The crew cycled the circuit breaker five times in an attempt to regain the heater function. The camera temperature was controlled by the ground by cycling power to the camera. When the camera was not in use, the iris was closed to prevent burning-in an image. Postflight troubleshooting revealed that the heater thermostat had failed. The camera has been shipped to the vendor for repair. CONCLUSION: The failure of the heater thermostat was the cause of CCTV camera D heater anomaly. The final troubleshooting and repair of the camera will be tracked on FIAR B-FCE-029-F059. CORRECTIVE_ACTION: The camera will be repaired and tested by the vendor before re-entering the flight camera pool. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:09:47:37.003	Problem	**FIAR**	**IFA** STS-50-V-12	PRSD
EGIL-05	**GMT:** 186:02:00:00.000		**SPR** 50RF06	**UA**	**Manager:**
			IPR	**PR** EDO-1-2-0003	
					Engineer:

Title: O2 Tank 7 Check Valve Stuck Open (ORB)

Summary: DISCUSSION: After several days of normal operation, the cryogenic oxygen (O2) tank 7 heater control pressure (V45P3210A), equivalent to the tank pressure, began tracking the pressures of the O2 manifold and O2 tanks 8 and 9 at approximately 186:02:00 G.m.t. This occurred even though the O2 tank 7 heater was off. A check valve downstream of the tank should have kept the tank pressure nearly steady when its heater was not operating by preventing reverse flow of cryo from the manifold back into the tank. The pressure signature of tank 7 implied that the check valve was stuck in the open position. In addition, the heater duty cycles of O2 tanks 8 and 9 were less frequent. This further verified that less quantity of O2 was being removed from tanks 8 and 9--consistent with some O2 being fed from tank 7. The check valve remained open for several days, then unexpectedly reseated and began functioning normally at 190:14:10 G.m.t. It again stuck open on entry day.

No abnormalities were observed during postlanding deservicing or during prelaunch testing of the Extended Duration Orbiter pallet. The check valve will be removed and undergo failure analysis. CONCLUSION: The O2 tank 7 pressure began tracking the manifold and tanks 8 and 9 pressure while its heater was inactive because the tank 7 check valve failed open and no longer isolated the tank. CORRECTIVE_ACTION: The check valve was removed and replaced. Failure analysis results will be documented in CAR 50RF06-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 010:05:47:37.003	Problem	**FIAR** JSC EE-0671F	**IFA** STS-50-V-13	GFE
INCO-11	**GMT:** 187:22:00:00.000		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Mark II Camcorder Fail (ORB)

Summary: DISCUSSION: At approximately 10:05:48 MET, the STS-50 crew reported that one of the Mark II camcorders onboard had failed. The camcorder would not display an image on its monitor screen. It did, however, continue to function as a video recorder.

CONCLUSION: The camcorder was inspected postflight for contamination and/or damage and functional testing was performed. The inspection revealed no anomalies and the in-flight problem could not be repeated during the testing. CORRECTIVE_ACTION: This camcorder has been downgraded from a flight unit to a training unit and will not be flown again. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. This is not considered to be a generic camcorder problem. The failed camera will not be flown again.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:07:32:37.003	Problem	**FIAR**	**IFA** STS-50-V-14	OMS
PROP-02	**GMT:** 177:23:45:00.000		**SPR** 50RF07	**UA**	**Manager:**
			IPR 52V-0009	**PR**	
					Engineer:

Title: OMS Bulkhead Fuel Hi-point Bleedline Temperature High on A Heater (ORB)

Summary: DISCUSSION: When the OMS crossfeed line A heater system control was initiated by the crew at approximately 178:00:00 G.m.t., the OMS bulkhead fuel hi-point bleedline temperature (V43T6234A) began cycling between 72 and 94 ?F. This range is indicative of temperature regulation by the overtemp thermostat instead of the lower range expected under control thermostat regulation. Six days later, the crew switched to B heater control and V43T6234A began cycling between 65 and 85 ?F, the control thermostat range. Nominal operation on the B heater continued for the remainder of the mission.

Heater A control of V43T6234A was in the control thermostat range on the previous flight OV-102. No changes to configuration were made during the intervening vehicle Orbiter Maintenance Down Period. CONCLUSION: The high operating range of the OMS bulkhead fuel hi-point bleedline temperature on the A heater system was most probably due to a failed-on condition in the control thermostat which caused the overtemp thermostat to assume control. CORRECTIVE_ACTION: Postflight troubleshooting of the heater wrap and thermostat will be performed. If the control thermostat is found to be failed, it will be replaced. Failure analysis results will be documented in CAR 50RF07-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 010:23:31:37.003	Problem	**FIAR**	**IFA** STS-50-V-15	HYD
MMACS--05	**GMT:** 188:15:44:00.000		**SPR** 50RF10	**UA**	**Manager:**

			IPR 52V-0012	**PR** HYD-2-13-0543	
					Engineer:

Title: Hydraulic System 2 Accumulator N2 Leak (ORB)

Summary: DISCUSSION: The first four accumulator recharges of the mission showed nominal responses by achieving a GN2 pressure of approximately 2500 psia. However, during flight day 11, the fifth recharge only achieved a GN2 pressure of 2348 psia, while the reservoir pressure reached 76 psia. The sixth recharge achieved a GN2 pressure of 2127 psia, while the reservoir fluid pressure again reached 76 psia. The reservoir fluid pressure is normally 1/40th of the accumulator GN2 pressure as long as the accumulator piston is not "topped out" toward the GN2 side of the accumulator. This knowledge, coupled with the successively lower recharge pressures, indicated loss of GN2 from the accumulator. The GN2 accumulator pressure observed at each subsequent recharge was an indication of the pressure (and mass) remaining in the volume between the accumulator piston and the end of the accumulator. Loss of GN2 pressure would result in loss of bootstrap pressure and loss of inlet pressure to the main and circulation pumps (i.e., potential loss of system). Extended circulation pump operation was required to manage the bootstrap pressure and maintain system readiness for entry.

CONCLUSION: During turnaround activities the dump valve was opened which relieved the hydraulic pressure and allowed the remaining GN2 to expand into the preflight GN2 volume. The GN2 pressure in the accumulator was 640 psi, which is much lower than the precharge of 1700 +/- 50 psig, confirming an accumulator GN2 leak. CORRECTIVE_ACTION: The accumulator has been removed and replaced with a spare. The failure analysis of the accumulator will be conducted under CAR 50RF10-010. A bellows-type accumulator design is being investigated as part of the Long Duration Orbiter program. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 012:01:47:37.003	Problem	**FIAR**	**IFA** STS-50-V-16	ECLSS
EECOM-04	**GMT:** 189:18:00:00.000		**SPR** KB2348	**UA**	**Manager:**
			IPR	**PR** ECL-2-13-0825	
					Engineer:

Title: Waste Water Dump Degraded (ORB)

Summary: DISCUSSION: At 189:17:51 G.m.t. (12:01:21 MET), the third waste water dump of the STS-50 mission was initiated. During the dump, the flow rate decreased from 2.1 percent/minute to 0.7 percent/minute, at which time the crew was told to terminate the dump. The duration of the dump was eight minutes with a final dump rate of 0.42 percent/minute. Waste water liquid pressure readings after the dump valve was closed suggested that a blockage existed and that it was located in the urine solids filter. Since this filter is upstream of the contingency water cross-tie, the in-flight maintenance (IFM) procedure that purges the line with air or water would not clear the blockage and was not attempted.

The urine solids filter was removed for postflight analysis. This was a new filter making its first flight. With a new urine solids filter installed, the waste water system was thoroughly flushed. After the flush, this urine solids filter was replaced. The waste dump line, valves, and nozzle were then flushed end-to-end using iodized water from the waste tank. An analysis of the flight filter revealed a blockage formed by calcium-phosphate granules. Calcium phosphate may be discharged by humans in their urine. Concentrations of calcium phosphate will naturally form granules in slow-moving liquids. The generally stagnant water in the waste water tank provides a good environment for the formation of the calcium-phosphate granules. The granules attach to the sides of the tank and lines. The more granules there are, the greater the chance that some granules will detach and flow through the lines to become trapped in the urine-solids filter. As such, it can be expected that the more the tank is used, the greater the chance of encountering large numbers of calcium-phosphate granules. Calcium-phosphate granules were observed for the first time in the STS-42 urine solids filter (STS-42-V-08). It has been determined that the urine solids filter blockage on STS-42 (OV-103) was also caused by calcium-phosphate granules. The OV-103 waste tank was the fleet leader in terms of the number of flights it has been used. CONCLUSION: The urine solids filter became blocked with calcium-phosphate granules that formed in the waste water tank. Additional information pertaining to the filter blockage will be documented in CAR KB2348-010. CORRECTIVE_ACTION: The waste tank and waste dump lines have been flushed during the STS-52 flow as a part of the failure analysis for this problem. Two gallons of water were flushed through both the contingency water cross-tie quick disconnect (QD) and the urine dump QD. Ten gallons of water were flushed through the waste tank. A new urine solids filter has been installed for STS-52. A requirements change notice (RCN) is being processed that will have the urine solids filter replaced after every mission than the current three-flight interval. IFM procedures are under developmet to allow a spare urine-solids filter to be used to bypass a blocked primary filter. The spare filter will be connected between the urine dump QD and the cross-tie QD to provide a path that liquid from the waste tank can be dumped overboard. The spare filter is planned to be manifested on STS-52. Development and certification of a smaller filter to be used as a spare are under way with an expected first flight of either STS-53 or STS-54. Acceptable methods of dissolving the calcium-phosphate granules in the waste tank without damaging the soft goods in the waste dump system is also under investigation. EFFECTS_ON_SUBSEQUENT_MISSIONS: A calcium-phosphate blockage of the urine solids filter on STS-47 is not anticipated since the waste tank and filter have been used for only one flight. Since the amount of calcium phosphate in the waste tank is dependent on the amount of use the tank has had, this type of filter blockage is possible on future flights of vehicles with older tanks. With the waste system flushes that were performed during this turnaround along with the spare filter, calcium-phosphate blockage is not expected to be a problem during the STS-52 mission. Should the urine solids filter become blocked, four to five days worth of waste water can be stored using the two contingency water containers (CWC) carried on board.

Tracking No	Time	Classification	Documentation				Subsystem
MER - 0	**MET:** 012:06:24:37.003	Problem	**FIAR**	B-FCE-029-F060	**IFA**	STS-50-V-17	GFE
INCO-13	**GMT:** 189:22:37:00.000		**SPR**		**UA**		**Manager:**
			IPR	None	**PR**		

Engineer:

Title: Camera C Failed (GFE)

Summary: DISCUSSION: During an attempt to use closed circuit television (CCTV) camera C (S/N 36) at 189:22:37 G.m.t., no video was received. Data suggested that a stuck iris was the most probable cause of the problem. The camera was not used for the remainder of the mission.

The camera has been returned to the vendor for troubleshooting and repair. CONCLUSION: The most probable cause of the camera failure is a stuck iris. Troubleshooting at the vendor will reveal the actual cause of the failure. The troubleshooting and repair of the camera will be tracked on FIAR B-FCE-029-F060. CORRECTIVE_ACTION: The camera will be repaired and tested by the vendor before re-entering the flight camera pool. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 012:15:37:37.003	Problem	**FIAR**	**IFA** STS-50-V-18	RCS
PROP-03	**GMT:** 190:07:50:00.000		**SPR** 50RF11	**UA**	**Manager:**
			IPR	**PR** FRC2-13-0326	
					Engineer:

Title: Thruster F2F Fail Off (ORB)

Summary: DISCUSSION: Reaction control subsystem (RCS) primary thruster F2F was declared failed off by redundancy management (RM) at 190:07:50:40 G.m.t., when it attempted to fire for the first time of the mission during the RCS hot-fire test. Upon receiving the fire command, the chamber pressure (Pc) increased to a maximum of 5.5 psia (nominal is 150 psia). RM declared the thruster failed-off after three consecutive Pc discretes of less than 36 psia. Injector temperature profiles were nominal indicating that both oxidizer and fuel entered the injector tubes. No attempt to refire the thruster was made during the remainder of the mission.

Data analysis of the F2F failure indicates that full fuel flow and only partial oxidizer flow most probably occurred. This is similar to thruster failures on prior missions that were attributed to an acccumulation of iron nitrates which impedes flow through the pilot stage, preventing the main stage from opening. Iron nitrate formation is accelerated by the reaction of N_2O_4 with moisture. Nitrate accumulation at the thruster valve can result in degraded performance and component failure. Although faiure of the thruster due to a plugged chamber pressure tube is possible, the rapid Pc rise and decay rate do not support this scenario. CONCLUSION: The most probable cause of the low chamber pressure reading is a failure of the oxidizer valve main stage to open due to iron nitrate-induced flow impedance in the pilot stage. CORRECTIVE_ACTION: KSC removed and replaced the thruster and transferred it to White Sands Test Facility for the thruster flush program. The primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system. Failure analysis results will be documented in CAR 50RF11-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 012:22:56:37.003	Problem	**FIAR**	**IFA** STS-50-V-19	OMS
50RF21	**GMT:** 190:15:09:00.000		**SPR**	**UA**	**Manager:**
			IPR	**PR** RP05-02-0048	
					Engineer:

Title: R OMS Fuel Total Quantity Gage Biased High (ORB)

Summary: DISCUSSION: The right orbital maneuvering system (OMS) fuel total quantity gage (V43Q5331C) behaved erratically during each OMS burn, exhibiting a reading that was higher than the actual fuel quantity. The gage value was approximately 2.5 percent high after the OMS-2 burn. After counting down properly for the first 14 seconds of the OMS-3 burn, the gage suddenly jumped from reading 42.8 percent to 50.8 percent. The gage value was 17-18 percent high after the deorbit burn.

Postflight troubleshooting confirmed a bias in the forward fuel probe. Propellant leakage into the probe assembly is the suspected cause. This was the first of the OMS pod RP05 which utilized a new fuel probe. CONCLUSION: The most probable cause of the erroneous fuel gage output was propellant leakage into the forward probe assembly. CORRECTIVE_ACTION: Replacement of the probe will be deferred until a non-interference replacement opportunity is available. During flight, the fuel quantity can be accurately determined by use of burn-time computations. Failure analysis results will be documented in CAR 50RF21-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 012:01:22:37.003	Problem	**FIAR**	**IFA** STS-50-V-20	PRSD
EGIL-08	**GMT:** 189:17:35:00.000		**SPR** 50RF19	**UA**	**Manager:**
			IPR 52V-0023	**PR**	
					Engineer:

Title: O2 Tank 3 Quantity Reading Erratic. (ORB)

Summary: DISCUSSION: Erratic operation of the cryogenic oxygen (O2) tank 3 quantity measurement (V45Q1305A) was observed beginning at approximately 189:17:34 G.m.t. The measurement periodically jumped from a value of 80 percent to an off-scale high (106 percent) reading and then returned to 80 percent. The duration of the abormal readings varied up to a maximum of 12 minutes. This abnormal behavior occurred over a period of approximately 10 hours.

An open circuit in the cryogenic quantity circuit results in an off-scale high reading. The erroneous reading was most probably the result of transient open-circuit conditions. Postflight continuity checks and wire wiggle checks did not reveal any anomalies. CONCLUSION: The erratic quantity readings were most probably caused by transient open-circuit conditions in the quantity circuitry. CORRECTIVE_ACTION: None. The problem was not repeatable during postflight troubleshooting.

Failure analysis results will be documented in CAR 50RF19-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: Erratic tank 3 quantity readings have no mission effect. If the readings were to become constant off-scale high, the quantity in tank 4 could be used as a substitute for tank 3 since the two tank quantities are approximately equal.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 013:15:39:37.003	Problem	**FIAR**	**IFA** STS-50-V-21	D&C
EGIL-11	**GMT:** 191:07:52:00.000		**SPR** 50RF12	**UA**	**Manager:**
			IPR 52V-0036	**PR** DDC-004	
					Engineer:

Title: The forward starboard payload bay floodlight failed. (ORB)

Summary: DISCUSSION: At payload bay door closing, the crew reported the forward starboard payload bay floodlight flickered, but did not come on. The failure was confirmed at KSC. The floodlight was removed and sent to the NASA Shuttle Logistics Depot (NSLD) fo failure investigation. Inspection at NSLD revealed arcing due to loss of backfill. The loss of backfill was caused by a combination of incorrect shimming around the housing window and teflon o-ring, and inproper torqueing of the backfill port seal-off nut. These processes had been performed by the vendor.

CONCLUSION: The failure was caused by arcing around the support ring due to loss of backfill, which was the result of incorrect assembly procedures at the vendor. CORRECTIVE_ACTION: Corrective action has previously been initiated to minimize the possibility of arcing. A design change is being implemented to increase the spacing between the support ring and the tripod. (Reference closed CAR 36RF27). The failed floodlight was replaced with a redesigned unit. Vendor procedures will be reviewed to assure adherence to correct shimming and torqueing specifications. Final corrective action will be documented on CAR 50RF12. EFFECTS_ON_SUBSEQUENT_MISSIONS: Redesigned floodlight assemblies will be placed in the flight inventory as they become available. Floodlight redundancy is considered adequate to accomplish mission objectives.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 013:19:16:37.003	Problem	**FIAR**	**IFA** STS-50-V-22	APU
MMACS--08	**GMT:** 191:11:29:00.000		**SPR** 50RF13	**UA**	**Manager:**
			IPR 52V-0013	**PR**	
					Engineer:

Title: APU 1 Gearbox N2 Pressure Low During Entry (ORB)

Summary: DISCUSSION: Approximately 22 minutes after auxiliary power unit (APU) 1 was started for entry, the gearbox pressure measurement began failing off-scale low (zero psia) intermittently, which caused the APU controller to activate the gearbox repressurization circuit. The measurement failed to zero several times and this resulted in a complete dumping of the GN2 from the repressurization bottle into the gearbox. During repressurizations, the gearbox pressure increased from approximately 8 psia to 28 psia. This gearbox pressure increase was within the APU operational range and did not endanger the APU operation.

CONCLUSION: The APU gearbox GN2 pressure measurement (V46P0151A) is routed to the APU controller gearbox repressurization circuit before being downlinked through instrumentation. The anomalous condition could be associated with the transducer, the wiring harness on the APU, the wiring harness from the APU to the controller, or with the signal conditioning circuits within the controller. KSC troubleshooting of the APU hardware has included continuity checks of the wire harnessses up to the avionics bay (during wiggle testing), resistance checks of the transducer bridge circuit, and controller checks of the repressurization circuit. The controller was returned to the vendor, where an acceptance test procedure (ATP) was conducted along with thermal and vibration testing. The controller passed the ATP and associated testing and will be sent back to KSC for use as a spare. CORRECTIVE_ACTION: The cause of the anomalous condition has not been determined; however, the gearbox pressure transducer, the associated APU wire harness, the wire harness form the APU to the controller, and the controller all have been removed and replaced. The pressure transducer was sent to Statham and the APU wire harness and controller were sent to Sundstrand for failure analysis. Following the installation of the new transducer and wire harness on te APU, a decision was made to remove the APU due to another problem. All failure analyses will be conducted under CAR 50RF13-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 013:18:28:37.003	Problem	**FIAR**	**IFA** STS-50-V-23	INST
None	**GMT:** 191:10:41:00.000		**SPR** 50RF14	**UA**	**Manager:**
			IPR 52V-0027	**PR**	
					Engineer:

Title: MADS FDM MUX 4 Momentary BITE Indication (ORB)

Summary: DISCUSSION: A momentary BITE indication was observed on the Modular Auxiliary Data System (MADS) Frequency Division Multiplexer (FDM) 1 MUX 4. Review of data indicated that no data were lost during the time of the intermittent BITE. Postflight troubleshooting at KSC failed to reproduce the anomaly.

CONCLUSION: The anomaly was most likely caused by an intermittent problem within the BITE circuitry in MUX 4. CORRECTIVE_ACTION: None. Fly-as-is. EFFECTS_ON_SUBSEQUENT_MISSIONS: BITE failures have no effect on the data being processed. Should MUX 4 be lost, the only impact would be loss of recording of non-critical vibration measurements from FASCOS 2.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 008:18:52:37.003	Problem	**FIAR**	**IFA** STS-50-V-24	GFE
INCO-10	**GMT:** 186:11:05:00.000		**SPR** None	**UA**	**Manager:**
			IPR N/A	**PR**	
					Engineer:

Title: OEX System Control Module Anomaly ()

Summary: DISCUSSION: At 186:11:05 G.m.t. during the STS-50 mission, the Orbiter Experiments (OEX) data recorder was manually commanded, via the OEX system control module (SCM), to a "mark" on the data tape. It skipped the mark and continued to the end of the tape. When commanded back to the mark, the tape stopped at the mark. A "label" command had been sent to the SCM immediately after the initial mark command, however, the SCM did not respond to this label command. After sending an "all stop" commad and another label command, the label was accepted by the SCM. No further anomalies were noted.

CONCLUSION: Postflight laboratory tests revealed an SCM commanding characteristic that was not accounted for in the OEX Command Plan for STS-50. Specifically, the SCM cannot be asked to execute a label while he OEX tape recorder is in the process of advancing the tape to a "mark". To do so causes the SCM to miss the mark and permit the recorder to advance all the way to the end of the tape. It then refuses to accept any subsequent label commands until an "all stop" command is issued. CORRECTIVE_ACTION: The OEX commanding procedures will be updated by OEX project personnel, which should ensure no further occurrences of this problem. These procedural updates will be incorporated into the INCO Console Handbook and the OEX Systems Brief via OPS notes, ensuring that all subsequent OEX command plans are correct. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 012:00:17:37.003	Problem	**FIAR**	**IFA** STS-50-V-25	HYD
None	**GMT:** 189:16:30:00.000		**SPR** 50RF15	**UA**	**Manager:**
			IPR N/A	**PR**	
					Engineer:

Title: Excessive Temperature in System 2 and Hydraulic Intersystem Leakage (ORB)

Summary: DISCUSSION: Late in the flight, extensive circulation pump 2 operation was required to manage GN2 leakage from the system 2 accumulator (IFA STS-50-V-15). Extended hydraulic circulation pump 2 operation resulted in an excessive heating of the hydraulic fluid without typical stabilization as well as unusually high intersystem leakage. The maximum system temperature limit is 230 ?F because of circulation pump electronic components. Also, temperatures above 210 ?F at start-up for entry could result in freeze-up of the associated water spray boiler requiring late start of the APU.

The associated intersystem leakage was primarily into the hydraulic system 3 and increased after FCS checkout on system 3. While intersystem leakage from an active system is a normal occurrence during single-pump operation, the rate of leakage was unusually high. As a result, a concern existed that reservoir 3 volume would reach 100 percent. In that condition, any system demand during entry could cause the reservoir relief valve to cycle and dump fluid into a volume behind reservoir pistons which is designed to contain the vented fluid. This would not be a problem unless the relief valve did not reseat, the hydraulic fluid would fill the volume behind the piston and the system would be considered lost. Relief valve crack and reseat is not tested routinely during ground operations. When the reservoir 3 volume reached approximately 85 percent (from the original volume of 72 percent), circulation pump 3 was activated in a attempt to force hydraulic fluid back into the system 2 and/or prevent additional leakage into system 3. Immediately after system 3 pump activation, reservoir 3 volume climbed to about 93 percent due to the thermal effects. Thrust Vector Control (TVC) isolation valve 3 was opened to increase system 3. When the intersystem leak rate did not noticeably decrease, system 2 circulation pump was deactivated. Upon circulation pump 2 deactivation, reservoir 2 temperature began to decrease from a maximu of 194 ?F and reservoir quantity 3 stabilized. During the next 12 hours of system 3 circulation pump activation, the reservoir quantity decreased, which indicated a reversal of the intersystem leakage. Subsequent circulation pump operations were performed to manage reservoir quantites, limit system temperatures, and maintain reservoir 2 pressure above 28 psia. (15 psia minimum required for main pump and circulation pump startups plus 13 psia error). Review of past flight data indicated that during STS-41D, circulation pump 3 operated continuously for over two days with reservoir fluid temperature stabilizing at less than 100 ?F; also similar performance was seen during STS-51D. Also, past flight data indicated that intersystem leakage was not the magnitude experienced on STS-50. CONCLUSION: A theory has been proposed to explain the high circulation pump/system temperatures based upon Freon loop temperature. Freon loop temperatures during most flights, including those in which extended circulation pump operation was required, was below 100 ?F. The hydraulic fluid is thermally conditioned during prelaunch and on-orbit by the hydraulic/Freon heat exchanger. Hydraulic fluid flow through the heat exchanger is controlled by the thermal bypass valve. At hydraulic temperatures above 100 ?F, the valve begins to reduce flow through the heat exchanger and completely bypasses the heat exchanger at temperatures above 115 ?F. Freon loop temperatures at the time of extended circulation pump operation were approximately 100 ?F, which caused the bypass valve to begin to close. This limited the amount of hydraulic fluid heat rejection to the Freon and ultimately the temperature increased above the bypass valve closing point. Hydraulic fluid temperature continued increasing after losing heat transfer to the Freon. This would not have occurred had the Freon been below 100 ?F. Extra heat loads imposed by Spacelab caused the Freon temperature to be warmer than normal during STS-50. The source of intersystem leakage is through switching valves which are inside aerosurface actuators. Summation of the acceptance test procedure (ATP) allowable switching valve leakage for all actuators is greater than the leakage observed this mission. The differnce in leakage rate before and after the flight control system (FCS) checkout is believed due to two factors. First, increased system temperature reduced fluid viscosity, which increases leakage. Second, the switching valves cycled during FCS checkout due to increased pressure in system 3, This cycling caused a small change in the available leakage path as the valve did not return to exactly the same position it had been in initially. This changed the leakage rate. It is also possible that the switching valves could have been in some intermediate position not detectable by telemetry and this condition resulted in a larger flow path.
CORRECTIVE_ACTION: The analysis of intersystem leakage and the high temperature is being performed under CAR 50RF15-010. Once the analysis is completed, several actions may be taken to prevent this problem from recurring. Changing the setting for the Freon heat exchanger bypass valve may not be viable due to environmental control and life support system (ECLSS) temperature limitations. Since continuous circulation pump operation is only required for loss of bootstrap pressures, an emergency pump start system may need to be investigated. Also, since accumulator pressure does not correlate directly to reservoir pressure when a GN2 leak is present, a vehicle software change is being proposed to allow automatic circulation pump starts based on reservoir pressure in addition to accumulator pressure. This change would allow less extensive circulation pump runs. Finally, a bellows type accumulator which is less prone to GN2 leakage is being considered under the LDO

program.   EFFECTS_ON_SUBSEQUENT_MISSIONS: Manual control of the circulation pump may be required if a GN2 leak occurs with a heavy heat load on the Freon system or high intersystem leakage. If GN2 leak occurs and management of the bootstrap pressure, circulation pump temperature, or intersystem leakage is unsuccessful, then early termination of the misssion is possible due to loss of associated hydraulic system.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-50-V-26	MECH, HYD
MMACS--09	**GMT:** Postlanding		**SPR** 50RF20	**UA**	**Manager:**
			IPR 52V-0011	**PR**	
					Engineer:

Title: Right Outboard Brake Pressure Lag (ORB)

Summary: DISCUSSION: The right outboard brake pressure 4 measurement (V51P0744A) remained static for approximately 9 seconds following initial application of brakes. It then followed the general profile of the other three right-hand brake pressures, but indicated approximately 400 psi lower. It peaked at 558 psia, while the others peaked at 936 to 1008 psia.

Initial troubleshooting at KSC confirmed the anomaly, however, subsequent testing with break-through-boxes installed failed to repeat the condition. Intermittent contamination was suspected in the control valve module (LV22). The module (S/N 103) was sent to the vendor for inspection and failure investigation. All components were found to be in tolerance and only minor fluid contamination was observed. Similar anomalies occurred on OV-104 during STS-37 and STS-43. (Reference IFA's STS-37-V-17 and STS-43-V-14). Following STS-43, the OV-104 module (S/N 106) underwent failure analysis which also revealed minor fluid contamination. (Reference CAR 43RF-15-010 which has been closed). During the STS-47 turnaround flow, the OV-105 valve module (S/N 101) experienced an uncommanded brake pressure anomaly of approximately 750 psia. Teardown inspection of this valve revealed a large metallic burr in the pressure dropping orifice. The burr had been inside the module since fabrication.   CONCLUSION: This OV-102 anomaly was most likely caused by intermittent fluid contamination in the valve module.   CORRECTIVE_ACTION: The servo valve module has been removed and replaced. Final failure analysis results and corrective action will be documented on CAR 50RF20. EFFECTS_ON_SUBSEQUENT_MISSIONS: None anticipated. Sufficient braking energy is available with the loss of one set of pucks on a wheel.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-50-V-27	TPS, MECH
None	**GMT:** Postlanding		**SPR** 50RF16	**UA**	**Manager:**
			IPR	**PR** STR-2-13-3652	
					Engineer:

Title: Protuding PLBD Dogbone Seal (ORB)

Summary: DISCUSSION: Following landing, a 24-inch in length section of environmental seal protruded from the expansion joint between the front two panels of the left payload bay door (PLBD) approximately 5 inches from the PLBD centerline. This seal had not been observed prior to pre-deorbit PLBD closing and was apparently dislodged during entry.

Inspections revealed the debonded environmental seal to be a section of the dogbone assembly. The OV-102 environmental seal is a 0.24-inch inside diameter (I.D.), non-reinforced Teflon tubing attached to a floating metal platform called the dogbone. Two seals are mounted on each dogbone, located forward and aft of the panel joint. This arrangement provides an evironmental thermal barrier between PLBD sections during expansion and contraction of the transverse door joints. This dislodged seal on this flight was located aft of the door joints. The debonded end of the seal segment was clean-cut, suggesting that the seal became debonded at a Material Review (MR) splice. A debonded environmental seal occurrence on STS-35 (OV-102 flight 10; Flight Problem STS-35-16) invloved a section of seal located forward of the joint. The OV-102 dogbone seals are known to be inferior to those on other Orbiters. The seals have a smaller diameter (0.24 vs. 0.38 inch I.D.), are not wire-mesh reinforced, and were applied using less effective adhesive and bonding processes. During a modification to the monkey fur in 1989, unbonded seals were noted at random locations and were repaired. Analysis has determined that a breach in the thermal barrier and environmental seal results in, at most, localized heating damage to the door structure. Gas flow into the payload volume might impinge on a payload, but has insignificant effect on differential pressure across the doors. CONCLUSION: The debonded dogbone environmental seal was most probably caused by the unbonding of the seal due to normal expansion/contraction of the PLBD segments. The OV-102 seal installation is known to be less secure than that of other Orbiters. CORRECTIVE_ACTION: The debonded section of environmental seal was removed and replaced. A modification to the OV-102 dogbone assembly to match that of the other Orbiters is being proposed. Failure analysis results will be documented in CAR 50RF16-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 013:19:17:37.003	Problem	**FIAR**	**IFA** STS-50-V-28	GN&C
GNC-03	**GMT:** 191:11:30:00.000		**SPR** None	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Excessive Aileron Trim During Entry (ORB)

Summary: DISCUSSION: During the entry of STS-50, the aileron trim began to rise from a start point of 0.5-degree deflection at Mach 16 to a steady-state peak if 1.7-degree deflection at Mach 9. This occurred during the performance of DTO 0251, an aerodynamic flight test designed to provide data for forward c.g. envelope expansion. A series of programmed test inputs (PTI's) were performed using a fixed forward elevon schedule to provide the required flight data. When the trim on STS-50 reached the Flight Rule (2-100) limit of 1.5 degrees, the DTO was terminated and the AUTO elevon schedule was selected at Mach 8. Because the trim change (0.5 to 1.7 degrees) was significant and the aileron trim integrator in the Flight Control System (FCS) is fairly slow, a large amount of RCS fuel (approximately 350 pounds) was used to trim the vehicle.

Flight analysis of the PTI data showed some defference between the aerodynamic derivatives listed in the data book and those derived from the actual flight data. Most of the differences were, however, within the data book uncertainties, with the exception of the roll due to sideslip derivative, which was 2 - 3 uncertainty levels below the data book value. This error alone did not account for the aileron trim anomaly. An aerodynamic model was developed which provided the moments required to match the flight data. This model was used to develop the RCS fuel budgets for flights STS-47 and STS-52. Initial review of the thermocouple, axial-force coefficient, and TPS surface condition data provided no conclusive evidence of asymmetric boundary layer transition. This prompted a review of other areas including the elevon surface calibration, aeroelastic effect due to up-elevon, and effects of atmosphere. No answers were identified. A review of all past flight data identified similar occurrences on flights STS-41G (OV-099), STS-28 (OV-102), and STS-48 (OV-103). The STS-28 thermocouple data was analyzed postflight, and it was conclusively determined that asymmetric boundary layer transition caused the difference in-flight to predicted aileron trim. The other two flights showed a similar trend in aileron trim to STS-50 and STS-28. The most plausible conclusion, based on these analyses, is that the excessive aileron trim was due to the Orbiter FCS responding to asymmetric boundary layer transition. DTO 0251 has been performed successfully on four subsequent flights (STS-47/OV-105, STS-52/OV-102, STS-56/OV-103, and STS-55/OV-102). High aileron trim was also experienced on STS-56 (1.8 degrees), along with high structural temperatures on one side of the vehicle (indicative of asymmetric boundary layer transition). CONCLUSION: Because of the similarity seen between the motion on the four flights mentioned earlier (STS-41G, STS-28, STS-48 and STS-50), it has been determined that the anomaly seen on STS-50 was probably caused by asymmetric boundary layer transition. Asymmetric boundary layer transition occurs whenever the boundary layer is disturbed (e.g., by rough thermal protection system surfaces or by protruding gap filler) on only one side of the vehicle. The phenomenon was not caused by the up-elevon schedule required by the DTO. CORRECTIVE_ACTION: Near Term - Since the potential for asymmetric flow transition exists for every flight, additional RCS propellant will be budgeted for all flights to account for such an occurrence. This propellant will come from OMS contingency propellant normally maintained in the OMS tanks. It will now be maintained in the RCS tanks instead. As a result, the current RCS/OMS total propellant redlines have not been changed. Crew procedures have also been updated to include more frequent propellant checks. In addition, whenever DTO 0251 is scheduled for a flight, an extra 350 pounds plus projected programmed test input (PTI) usage will be redlined to protect for as recurrence of the STS-50 case. Mid Term - An aerodynamic model which covers the worst case effects of asymmetric transition will be included in a Monte Carlo simulation to develop new RCS redlines for entry. Results should be complete by October or November 1993. Long Term - FCS upgrades that will reduce fuel usage in this situation have been proposed and can be incorporated into entry software if the result of the Monte Carlo analysis deem this appropriate. The corrective action for this problem closeout is being tracked ia a Mission Operations Directorate (MOD) Flight Techniques Panel action item. EFFECTS_ON_SUBSEQUENT_MISSIONS: Additional RCS fuel must be budgeted to account for this phenomenon.