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

STS - 41D, OV - 103, Discovery (1) **Time:04:29:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-41D-V-01	ECLSS
	GMT: Prelaunch		**SPR** AC8418F	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Flash Evaporator System Topping Duct Heater Systems A and B Failed. (ORB)

Summary: DISCUSSION: At 177:09:30 G.m.t., two of four heater zones in FES (flash evaporator system) heater A apparently failed. Heater system B was actuated and one of four system B heater zones apparently failed at 177:10:10 G.m.t. These failures were determined by low temperature transducer readings during prelaunch operations. The crew was informed by the ground operations team to switch to heater A/B (both systems operating) and the temperature stabilized.

A sequential check of the flash evaporator system duct heater systems (C, A, then B) was performed. The check was used to identify the loss of heaters in each duct zone. This was accomplished by operating each heater system for approximately 30 minutes. Actuation of system A heaters revealed zones E and F were failed, while operation of B heater system showed the H zone failed to respond. Operating of C heater system indicated no problem, and the H zone responded with a normal temperature increase. In this mode, zone H is normally heated by B system. Consequently, this indicates that a possible switch or wiring problem exists in heater system B. Loss of heater redundancy in zones F and H of the FES topping duct heaters is not a constraint to launch. Heater redundancy is required at zones D and E to ensure evaporation of carryover water. Under normal operation, steam leaving zone E will be no cooler than 125 deg F with 3 percent carryover water. The steam carries enough energy to warm zones F and H, thereby avoiding freezing. KSC troubleshooting and repair has verified triple redundancy for zones D and E. Zone F and H heaters are only required if all heating is lost from zone D or E, or in the event excessive carryover is generated in the FES core. One active heater string at zones F and H is adequate to meet the system fail safe criteria, considering the low probability of carryover water in excess of three percent. CONCLUSION: Heater zones E and F apparently failed on FES topping duct heater system A while heater zone H system B operated only on system C. Heater zone E system A has been repaired and one active heater string at zones F and H is adequate to meet the system fail safe criteria. CORRECTIVE_ACTION: FES topping duct heater zone E system A has been repaired and verified operational which re-establishes triple redundancy in zones D and E for the STS-41D mission. Subsequent to the STS-41D mission, and as schedule permits, troubleshooting of the FES heater system A zone F and system B zone H will be conducted and the necessary repairs will be made. Failure analysis will be tracked on CAR AC8418F. CAR ANALYSIS: Post-flight troubleshooting revealed a shorted wire splice at 50SP1377 in heater wire 779-A. Further analysis suggests that the shorted splice was the result of poor workmanship and applied force. Workshops have been conducted on splicing techniques and post-installation precautions to prevent future occurrances. [not included

in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET: -067:23:24	Problem	FIAR	IFA STS-41D-V-02	DPS - GPC
	GMT: 177:12:06		SPR AC8304F	UA	Manager:
			IPR	PR	
					Engineer:

Title: GPC (General Purpose Computer) -5 (BFS) Failed. (ORB)

Summary: DISCUSSION: GPC (General Purpose Computer) -5 momentarily indicated internally detected BITE (built in test equipment) errors at the time that the BFS (backup flight system) OPS 0 program was activated at T-32 minutes. The problem indication cleared until BFS OPS 1 transition at T-20 minutes when the GPC hard-failed and set the I-FAIL CAM light. Once OPS 1 was active, a G&N applications routine was stored in an area of memory which consistently generated parity errors. As a result, each time the routine was executed, the bad parity triggered the BITE indication. The BFS operating system does not allow descheduling of the G&N applications routine, and hence, the parity problem was shown as a hard failure. The failed GPC was removed for hardware/software dump and analysis. The dump confirmed staple single-bit errors in an area of memory corresponding to a single memory page in the IOP (input-output processor).

Detailed analysis of the IOP by the computer contractor isolated the problem to a failed memory driver component that was one of 44 such devices on the suspect memory page. A microscopic examination indicated a small (11 mil x 13 mil) area of discoloration on the integrated circuit chip where the aluminum metalization trace used to provide circuit interconnections on the chip was completely corroded and depleted. Chemical examination indicated traces of sodium, phophorus, iron and potassium. These are typical constituents of human spittle or perspiration and are known to be the most common form of such contamination in integrated circuit manufacturing. This precise failure mechanism has not been previously noted in the GPC memory driver; however, two prior memory driver failures were potentially induced by such human-introduced contaminants. Those two failures plus this most recent event were in three widely separate lot date codes. The memory driver manufacturere has procedures in place ot prevent such occurrences. No discoloration was observed inside 14 devices of the same lot and 150 of all lot date codes. More than 3,000 memory drivers are used in the GPC program, and the device has exhibited a failure rate several times better than predicted by classical reliability modeling. CONCLUSION: Contamination during manufacturing of an integrated circuit chip caused a failure in a memory driver component on a single memory page of the GPC-5 IOP. Memory drivers used in the GPC program have exhibited a very low failure rate. This failure is considered to be random in nature. CORRECTIVE_ACTION: The lot date code of the failed chip is not used in the GPC's presently installed on OV-099 or OV-103. The computer contractor found no contamination inside three similar devices with the same lot date code from the same memory page. No additional corrective action is contemplated at this time. CAR ANALYSIS: Since the failure rate of the failed device is very low and the vendor operators are already wearing face masks as they work, no further corrective action is planned. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-41D-V-03	INS
	GMT: Prelaunch		**SPR** AC8354F, AC8374F, AC8348F	**UA**	**Manager:**
				PR	
			IPR		**Engineer:**

Title: Instrumentation Failures. (ORB)

Summary: DISCUSSION: A. Left RCS Fuel Manifold Pressure No. 1 (V42P2312C) measurement became erratic 1 day prior to the scheduled lift-off. Launch Commit Criteria were amended to require only 2 of 4 fuel manifold pressures for launch (was 4 of 4). Measurement repair would be very time consuming and will be done after STS 41-D.

B. ET LH2 Ullage Pressure No. 2 (T41P1701C) measurement read low during propellant loading. The back-up sensor was used during the second propellant loading. Troubleshooting isolated the problem to the sensor which has been replaced. Failure analysis will be tracked on CAR AC8354F. CAR ANALYSIS: Failure analysis at Martin Marietta concluded failure caused by wiper/winding damage (ET hardware). [not included in original problem report] C. SSME NO. 2 H2 Recirculation Pump Speed (V41P1215A) measurement failed to respond when the pump was turned on. Proper pump operation was verified with differential pressure and current measurements, thus propellant loading continued. The RPM measurement is used during pump spin up and run down to determine bearing health. Bearing health is only a minor concern because of the low pump operating time. Measurement replacement will require time consuming pump replacement. The measurement will be repaired after STS 41-D and failure analysis will be tracked on CAR AC8374F. CAR ANALYSIS: Pre-launch anomaly definitely isolated to sensor. Other pump parameters will be used to determine pump health and repair (sensor R/R) is deferred to a convenient time in a future flow. [not included in original problem report] D. APU 3 Lube Oil Outlet Pressure (V46P0353A) measurement read about 6-psi low. The sensor has been replaced and the failure analysis will be racked on CAR AC8348F. CAR ANALYSIS: Pressure sensor low reading was caused by a fractured gold lead in the sensor. The lead was still touching and provided only a high resistance contact. The defect was attributed to a manufacturing technician that omitted a service loop in the gold lead. Manufacturing and inspection personnel have been counselled regarding maintenance of drawing configuration. [not included in original problem report] CONCLUSION: See above. CORRECTIVE_ACTION: See above. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** -066:15:18	Problem	**FIAR**	**IFA** STS-41D-V-04	ECLSS
	GMT: 178:04:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: The Oxygen System 1 Environmental Control System Supply Valve Talkback Failed Closed. (ORB)

Summary: DISCUSSION: Prior to the aborted launch of STS-41D, the crew reported that the oxygen system 1 ECS (environmental control system) supply valve talkback on panel L2 had indicated "closed" when the valve was verified open. Ground indicators also showed the valve to be open. A review of preflight pressure data upstream and downstream of the valve also verified that the valve was open.

These data infer that the talkback indicator on panel L2 has failed or an open exists in the circuit wiring to the indicator. Since the valve position telemetry data are good and since other data, such as oxygen pressures and flow are available to check the valve position, the failed talkback on panel L2 can be flown as is until the system is accessible for repair. CONCLUSION: The oxygen supply valve position indicator on panel L2 has failed or an open circuit exists between the telemetry tee-off point and panel L2. CORRECTIVE_ACTION: The anomalous oxygen supply valve position indication on OV-103 panel L2 will be investigated and corrected subsequent to the STS-41D mission or as schedules permit. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** -065:00:01	Problem	**FIAR**	**IFA** STS-41D-V-05		MPS
	GMT: 178:12:43		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Space Shuttle Main Engine 3 Servo Actuator Miscompare On Main Fuel Valve Channel A. (ORB)

Summary: DISCUSSION: A servo actuator miscompare occurred on main fuel valve channel A of SSME (Space Shuttle Main Engine) 3 before the start of SSME 1. This miscompare resulted in an abort shutdown about 4 seconds before SRB (solid rocket booster) ignition and launch. SSME 2 reached about 20 percent thrust before it was automatically cut off while SSME 3 was shut down before the oxidizer valve was opened.

Postflight data review indicated that the automatic abort shutdown operated as designed when redundant control of the SSME 3 main fuel valve was lost prior to SRB ignition. All Orbiter systems operated properly during the launch abort. Postflight inspection determined that the abort shutdown resulted in minimal damage to the Space Shuttle and to the launch pad. See JSC flight problem report STS-41D-6 for an assessment of Orbiter damage and MSFC flight problem reports for SSME 3 failure analysis. CONCLUSION: Loss of redundant control of the SSME 3 main fuel valve prior to SRB ignition resulted in an automatic abort shutdown about 4 seconds before launch. The automatic abort shutdown operated as designed and there was minimal damage to the Shuttle and pad. CORRECTIVE_ACTION: SSME 3 has been removed and replaced. No Orbiter corrective action required. See the MSFC STS-41D flight problem reports for the results of the SSME 3 failure analysis. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** -065:02:18	Problem	**FIAR**	**IFA** STS-41D-V-06	TPS
	GMT: 178:15:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Water And Fire Damage After Prelaunch SSME Abort Shutdown. (ORB)

Summary: DISCUSSION: After the prelaunch abort, a fire was seen on the starboard side of the body flap for about 12 minutes when the aft base heatshield water deluge system was activated. The system was cycled on and off three times spraying water for a total of 9 minutes until fire detectors confirmed a "no fire" condition. The firex deluge system for launch umbilical tower (LUT) protection operated continuously as designed from T-16 seconds until about 1 hour after the abort, subjecting the left side of the vehicle to a misty rain. Structural temperature measurements showed small increases at many locations on the Orbiter, but predominantly on the starboard side. The worst case was the right hand upper wing structure which rose from 73 deg F to 122 deg F at about 8 minutes after abort initiation.

A detailed post-abort inspection revealed that the room temperature vulcanizing (RTV) on the right outboard upper surface and cove of the body flap was severely charred. Felt reusable surface insulation (FRSI) plugs were charred on the base heat shield and the OMS/RCS pod stingers. A ground wire was charred on the LOX T-0 umbilical. Burning RTV resulted in discoloration of the T-0 umbilical ducts and the advanced flexible reusable surface insulation (AFRSI) on the starboard areas of the OMS/RCS stinger, the aft fuselage sidewall, and the upper inboard elevon. Water was found in the flash evaporator system (FES) topping ducts and the water spray boiler (WSB) ducts. The SSME heatshield eyelid insulation blankets were wet. Water was found in several RCS engines and the +X RCS jet insulation was probably wet. The outer fabric of the AFRSI blankets was found to not be waterproof in many locations. It was subsequently concluded that this condition was not related to the fire and that the waterproofing done at the pad had not been effective. Repairs to the thermal protection system (TPS) were made using standard refurbishment procedures. The damaged LOX umbilical ground wire was replaced. The water was removed from the FES and WSB ducts. The SSME insulation blankets were dried out using heat lamps for 24 hours. Water was aspirated from seven RCS engines and all aft RCS engines were vacuum dried. The +X RCS jet insulation was dried using strip heaters for 24 hours. CONCLUSION: Inspection and testing after the prelaunch SSME abort shutdown found that water and fire damage to the Orbiter was minimal. Drying and TPS refurbishment procedures were accomplished with the vehicle at the launch pad. CORRECTIVE_ACTION: All water was removed or aspirated and heater strips or heat lamps were used to dry out wet insulation. Fire damage was repaired using standard TPS refurbishment procedures. The AFRSI blankets on the aft fuselage were re-waterproofed in the Orbiter processing facility (OPF). EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-41D-V-07	HYD
	GMT: Prelaunch		**SPR** AC8341F	**UA**	**Manager:**

IPR **PR**

Engineer:

Title: Hydraulic System 3 Pump Leak. (ORB)

Summary: DISCUSSION: Inspections conducted after the STS 41-D FRF (flight readiness firing) revealed a small leak at the hydraulic system 3 pump outlet rosan fitting. The pump was diapered for the STS 41-D launch. After the STS 41-D launch abort, the pump was removed and sent to the contractor for evaluation. A hydraulic replacement pump was put into the system 3 position, however, the outlet flex hose dynatube face was apparently scratched and this led to a one drop/5-second leak. The hose was replaced and the leak stopped.

The removed hydraulic system 3 pump was evaluated at the contractor and the "O" ring under the pump outlet rosan fitting was found to have a manufacturing imperfection. The pump will undergo re-acceptance testing prior to being returned to the launch site. CONCLUSION: The hydraulic system 3 pump leaked at the outlet rosan fitting. The leakage at the fitting resulted from an O-ring manufacturing imperfection. CORRECTIVE_ACTION: The hydraulic system 3 pump was removed from OV-103 and replaced. The replacement pump has been verified as ready-to-support the STS 41-D mission. Failure analysis will be tracked on CAR AC8341F. CAR ANALYSIS: Vendor failure analysis concluded that the end fitting of the flex hose (ME271-0079-1123) had been overtorqued. Rockwell drawing V070-585303 did not show that the -1123 flex hose has different end fittings and that each requires a different torque. A drawing change has been processed to properly define future installations and other vehicles will be repaired if leakage develops. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:10	Problem	**FIAR**	**IFA** STS-41D-V-08	OMS
	GMT: 243:12:52		**SPR** 14F005	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Left Orbital Maneuvering System Fuel Total Quantity Gaging System Failed. (ORB)

Summary: DISCUSSION: During the OMS (orbital maneuvering system) -1 (orbit insertion) maneuver, the left OMS fuel quantity reading dropped to 45.6 percent and reamined at that reading until the actual quantity reached 45.6 percent during the OMS-6 burn, after which the system operated nominally. This measurement includes the aft tank quantity plus the ungageable quantity. Alternate methods of determining fuel quantities were employed for the remainder of the mission.

Postflight testing at KSC (Kennedy Space Center) has not isolated the source of the problem. The totalizer, which is used in both fuel and oxidizer gaging systems, has been removed and replaced to correct a preflight oxidizer gaging problem. CONCLUSION: The left OMS fuel total quantity gaging system failed due to a yet to be determined problem. CORRECTIVE_ACTION: The totalizer has been removed and replaced at KSC. The unit will be returned to the vendor for failure analysis which

will be tracked on CAR 14F005. CAR ANALYSIS: Vendor failure analysis isolated that failure to tolerance build-up on the 1550314-002 circuit card in the totalizer. More stringent acceptance testing is planned. Design changes are not planned. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis. Alternate methods of determining fuel guantities are available.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:00	Problem	**FIAR**	**IFA** STS-41D-V-09	INS
	GMT: 243:12:42		**SPR** 14F001,14F003, 14F011	**UA**	**Manager:**
				PR	
			IPR		**Engineer:**

Title: Instrumentation Failures. (ORB)

Summary: DISCUSSION: A. SSME (Space Shuttle Main Engine) 3 GH2 Outlet Temperatue (V41T1361A) Failed. The measurement failed approximately 30 seconds after lift-off. Similar failures have been experienced on STS-1, -2, -3 and 6 with the SSME 2 GH2 temperature sensor. The sensor will be replaced with a newer design which is more compatible with the high vibration environment during launch. The sensor failure will be tracked on CAR 14F001.

CAR ANALYSIS: Sensor failure was due to high vibration environment. Ruggedized sensor is planned for installation on an attrition basis. Old Sensor P/N: MC449-010-0008 New Sensor P/N: MC449-010-0010 [not included in original problem report] B. SSME 2 and 3 LH2 Inlet Pressures (V41P1200C and V41P1300C). Engine 3 LH2 pressure read between 4 and 12 psi below the engine 2 LH2 inlet pressure and LH2 manifold pressure during ascent. Troubleshooting of both the engine 3 and engine 2 LH2 inlet pressure sensors and electronics showed no problems. An inspection of the Orbiter LH2 engine feedline system was performed and no cause for the pressure differences was found. The pressure difference observed is within the accuracy band of the measurements. They will be flown as is and monitored during the next OV-103 flight. CAR ANALYSIS: A sensor zero point shift had happened, but the new zero point was still within tolerance. This is a non-problem and no further action will be taken. [not included in original problem report] C. SSME 1 LH2 inlet pressure failed (V41P1100C). The measurement failed offscale high approximately 9 seconds after SRB ignition. The failed sensor will be replaced and the failure will be tracked on CAR 14F003. CAR ANALYSIS: Sensor failure was confirmed at the vendor. There have been only two other reports of failure of this sensor since redesign for higher vibration. Based on this history, no corrective action will be taken. [not inclued in original problem report] D. APU 1 exhaust gas temperature 2 (V46T0140A) read erratically during entry. The failed sensor will be replaced and the failure tracked on DR 14F011. This measurement is required for launch commit criteria. CAR ANALYSIS: (Failure transferred from CAR 14F011 to AC7837-010). RI-Downey L&T analysis revealed that the sensor lead wires were twisted and shorted near the transducer exit area. Insulation in the area was also badly frayed. Cause of twisting and insulation damage was attributed to mishandling of the sensor before, during and after installation into the APU exhaust duct. A sensor redesign was submitted by EDCP but was rejected at PMR between Rockwell and NASA. [not included in original problem report] CONCLUSION: See discussion above. CORRECTIVE_ACTION: See above. EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:03:42	Problem	**FIAR**	**IFA** STS-41D-V-10	DPS - GPC
	GMT: 243:16:24		**SPR** 14F004	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Cathode Ray Tube -2 Went Blank. (ORB)

Summary: DISCUSSION: At approximately 243:16:24 G.m.t., the crew reported that CRT (cathode ray tube) -2 went blank. The DU (display unit) and DEU (display electronics unit) BITE flags were on, and the DU filament current error, DU power supply error, and DU deflection error BITE bits were set. No current spikes at the time of the failure are discernible because of the granularity of the instrumentation. A "I/O (input/output) ERROR CRT" fault message was generated as the crew cycled power druing execution of the malfunction procedure. This indicated that GPC (general purpose computer)-DEU I/O interface continued after the time of the failure. The DU BITE flag could not be reset at the time of the failure or when it was tried again the following day.

Engineering analysis indicated that the failure was isolated to the DU, and that there was no mechansim by which a bad DEU could harm a replacement DU. An IFM (inflight maintenance) procedure, which required about 1 hr 15 mins, was then performed to replace DU-2 with DU-4. After clearing the appropriate BITE and POLL FAIL flags, the new DU operated normally. The crew tried powering up the old DU, now in slot 4, and again got DU BITE flags. While executing the IFM procedure, the crew reported positive airflow through the plenum, but described it as just a "little bit." The new DU operated normally for the remainder of the flight, although it was left powered down part of the time as a precautionary measure. DU 2 was removed and returned to the vendor for analysis. Inspection of the four thermal dots showed all had changed color, indicating a temperature over 82 deg C. A failed capacitor in the low voltage power supply was found. CONCLUSION: The DU 2 failure was the result of a failed capacitor in the DU 2 low voltage power supply. CORRECTIVE_ACTION: The vehicle airflow to the DU will be checked and additional thermal evaluation will be conducted. Analysis of the failed capacitor will be covered under CAR 14F004. CAR ANALYSIS: Analysis showed a crack near the base probably caused by mechanical stress. Norden is incorporating an additional inspection into the manufacturing of fillet bonded capacitors to be done prior to the bonding. This was the only failure of this type and no further action is required. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:01:35	Problem	**FIAR**	**IFA** STS-41D-V-11	C&T - S-Band
	GMT: 243:14:17		**SPR** 14F008, 14F021	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: S-Band Antenna Fault Messages Occurred Intermittently Throughout Mission. (ORB)

Summary: DISCUSSION: Several antenna fault messages occurred throughout the mission. Postflight data analysis indicated that the messages were caused by a delayed switching action in the S-Band antenna switch assembly. In each case, the GPC (general purpose computer) management software had selected the upper right antenna while the antenna switch assembly was still connecting the upper left antenna. After 1 or 2 minutes, the antenna switch assembly connected the proper (upper right) antenna. Each delayed switching action occurred when the S1 switch was transferring from B to the A position. Later in the mission, the S1 switch postion monitor contact indicated that the switch was in positions A and B simultaneously.

Starting at about 248:18:50 G.m.t., several antenna beam position fault messages occurred when the GPC selected the upper-left forward beam antenna. Postflight data showed that the beam had switched from aft to forward, but the position was not confirmed by the forward beam position monitor contact. CONCLUSION: The antenna fault messages were caused by delayed switching of the S-Band antenna switch assembly that was most likely the result of a failed S1 switch. The upper-left forward beam antenna position anomaly was most likely caused by a failed position monitor contact. CORRECTIVE_ACTION: The antenna switch will be removed, replaced, and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 14F008. The upper left antenna will be removed, replaced, and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 14F021. CAR ANALYSIS: A new antenna design is now in use. RTV sealed RF switches are incorporated into the new design. No other failures have been noted. The most probable cause of GPC antenna fault messages was an isolated workmanship condition, not likely to reoccur. Corrective action includes conformal coating of any exposed traces on PCB's (on this unit, on any switch assembly returned for disassembly and for any new units). [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:05:53	Problem	**FIAR**	**IFA** STS-41D-V-12	FCP
	GMT: 243:18:35		**SPR** 14F007	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Fuel Cell 1 Performance Monitor Indicator Failed. (ORB)

Summary: DISCUSSION: At approximately 243:18:35 G.m.t., the three fuel cell substack differential voltage measurements (V45V0102A, V45V0103A, V45V0104A) from the performance monitor read zero. These are the only measurements coming from the monitor and the loss of all three is indicative of a loss of power. There was no indication of power problems on any other equipment at that time.

Buses A and B were tied together to permit monitoring of fuel cell 1 performance by comparison of its load sharing with fuel cell 2. The buses were untied prior to entry. During postflight testing, a breakout box was installed at the performance monitor connector. It was verified that power existed at the connector, thus confirming the failure in the monitor. CONCLUSION: The fuel cell 1 performance monitor failure was most probably due to a failure within the internal power supply. CORRECTIVE_ACTION: The monitor will be removed and returned to the vendor for analysis under CAR 14F007. CAR ANALYSIS:Failure analysis determined that this monitor indicator failure was due to a random manufacturing defect and not detectable by testing. No further remedial corrective action is deemed necessary. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:15:08	Problem	**FIAR**	**IFA** STS-41D-V-13	RCS
	GMT: 245:03:50		**SPR** 14F009	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Forward-RCS manifold-2 Fuel-Isolation-Valve Close-Indication Failed. (ORB)

Summary: DISCUSSION: At approximately 245:03:50 G.m.t., the forward-RCS manifold-2 fuel-isolation-valve closed-indication (V42X1327X) failed to the high-state (contacts mated) while the valve was open. Since a subsequent limit switch failure could result in continuous power to the valve, the onboard valve control switch was placed in GPC (general purpose computer). This action removed the power source from the valve control circuits.

There was no further impact to system operations for the remainder of the mission and just before landing, the closed indication went to the proper low-state. The problem could not be duplicated during the postflight troubleshooting at KSC. The valve-closed position limit switch is of the type which has previously experienced contamination in the form of conductive and non-conductive particles. A conductive particle in the switch could have caused the noted anomaly. In light of system redundancy and since the limit switches are not easily accessible without removal of the RCS module, OV-103 will be flown as is until the anomalous limit switch is accessible. The onboard valve control switch will be placed in GPC to remove power from the valves should the anomalous condition recur. CONCLUSION: The forward-RCS manifold-2 fuel-isolation-valve closed-indication failure was most probably caused by a contaminated valve-position limit switch. CORRECTIVE_ACTION: Should the noted anomaly recur, the valve control switch will be placed in GPC to remove power from the valve. Replacement of the limit switch and subsequent failure analysis will be delayed until the component is accessible. This action will be tracked via CAR 14F009. EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:20:42	Problem	**FIAR**	**IFA** STS-41D-V-14	Water and Waste
	GMT: 246:09:24		**SPR**	**UA**	Management System
			IPR	**PR**	**Manager:**

Engineer:

Title: Supply/Waste Water Nozzles Iced. (ORB)

Summary: DISCUSSION: During the third supply water dump (80 percent from tank B and 20 percent from tank A), the supply water nozzle temperature decreased from 200 deg F to 38 deg F and recovered to 80 deg F, then peaked at 100 deg F, and returned again to 80 deg F during a 19-minute period of time. Nozzle temperatures below 50 deg F are indicative of ice formation. Based on these data, the RMS (remote manipulator system) was deployed and the RMS CCTV (closed-circuit television) video verified that ice had formed around the supply water nozzle. The ice dimensions were appoximately 12 in. in diameter and tapered out to a point about 27 in. in length from the side of the vehicle. Because of the ice formation, all subsequent supply water dumps were deleted from the STS 41-D mission timeline and the flash evaporator system was used to manage supply water. A waste-water dump was required and attempted on flight day 4 during a live RMS CCTV video coverage period. The waste water dump was terminated after expelling only about 5-7 percent because of rapid ice formation on the waste water nozzle. Adequate waste water tank capacity existed for condensate collection, but the crew was required to use available bags for urine collection.

A procedure was developed and successfully implemented to use the RMS to impact and dislodge the ice from the supply water nozzle. However, because of the proximity of the waste water nozzle to the wong, removal of the waste water ice with the RMS was no attempted. Positioning the vehicle for sun side, followed by repeated heater cycles resulted in the waste water ice being almost completely removed by flight day 7. Analyzing the nozzle temperatures and water tank pressure data has resulted in the following conclusions: a. Based on the supply water nozzle temperature drop below 50 deg F, ice was most probably around the nozzle prior to the start of the third supply water dump. This same phenomena was observed during the STS-11 mission when ice formation also occured. b. During the last 20 percent of the supply water tank B dump, a temperature decrease from 80 deg F to 50 deg F accompanied by a 1 1/2-psi pressure decrease occured in the water-tank nitrogen pressure system. This drop in nitrogen system supply pressure was a result of an increased dump rate caused by a hydrogen gas/water mixture. This is further verified by crew comments that gas was evident in the drinking water both at the start and end of the mission. c. Subsequent to the supply water tank B dump depletion, supply water tank A was also dumped through supply water tank B. This method of supply water dumping resulted in a pressure drop of 7 to 8 psia (5 psi on OV-099) and a corresponding decrease in the supply water dump rater of 110 lb/hr versus 145 lb/hr on OV-099. The lower pressure and corresponding dump rate is more conducive to ice formation and buildup. d. The flash evaporator system (FES) was active during the latter phase of the supply water tank B dump and continued throughout the supply water tank A dump. FES usage was 5 to 10 lb/hr and resulted in about a 2-psi reduction in water dump pressure. The STS 41-D mission was the first flight of a new AFRSI (advanced felt reusable surface insulation) blanket thermal protective system/water nozzle configuration. The configuration included a supply and waste nozzle recess 0.2-inch below the AFRSI blanket. The AFRSI blanket surface was very rough and has rows of stitching around the supply and waste water nozzles that can trap ice particles during normal water dumps. An RTV gap fill exists betwen the nozzles and the AFRSI. The RTV gap fill height is 0.08 in. above the nozzle face which forms an additional lip or edge to trap ice particles. For the STS 41-G mission, the OV-099 vehicle has a tile thermal protective system and stainless steel foil ring/ water nozzle configuration. This nozzle configuration was successfully demonstrated on the STS 41-C mission. Also, the OV-099 vehicle contains two hydrogen/water seperators which restrict hydrogen gas accumulation in supply

water tank 3. The basic dump procedures successfully utilized during the STS 41-C mission will be maintained. CONCLUSION: The formation of ice during the third supply water dump resulted from ice particles being trapped by the AFRSI/nozzle configuration and a large system pressure drop which caused the water dump spray pattern to widen and come in contact with these ice particles. Ice growth eminated from the ice particles back toward the supply water nozzle, covering the nozzle, and also starting the icicle formation. CORRECTIVE ACTION: For the STS 41-G mission: 1. There will be no planned supply water dumps. Supply water management will be through the flash evaporator system. 2. The two or threee planned waste water dumps will be monitored using the RMS CCTV video. 3. The waste water dumps will be limited to 50 percent of the quantity. A dump will be terminated at first indication of ice growth or if the mozzle temperature reaches 50 deg. F. 4. There will be no waste water dumps to a tank quantiy level of less than 5 percent. 5. A supply and waste nozzle preheat to 250 deg F will be utilized prior to initiation of a waste water dump. A bakeout of both nozzles to 250 deg F will also be performed subsequent to the waste water dump. FOR missions subsequent to STS 41-G, the TPS-to-nozzle configuration is under evaluation. The TPS-to-nozzle configuration redesign includes both the supply and waste water nozzles and also the fuel cell water relief nozzle. In addition, the following procedural changes will be incorporated: a. Supply water dumps will be terminated at a nozzle temperature of 70 deg F. b. There will be no supply water dumps of tank A through B. EFFECTS ON SUBSEQUENT MISSIONS: STS 41-G - none Missions subsequent to STS 41-G - evaluation in progress

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Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** 002:20:42	Problem	**FIAR**	**IFA** STS-41D-V-14A		Water and Waste
	GMT: 246:09:24		**SPR**	**UA**		Management System
			IPR	**PR**		**Manager:**
						Engineer:

Title: Supply/Waste Water Nozzles Iced. (Reference STS-41D-14) (ORB)

Summary: DISCUSSION: During the third supply water dump of the STS 41-D mission, the supply water nozzle temperature dropped below 50 deg F indicating ice formation. Video from the RMS (remote manipulator system) television camera (wrist) confirmed that ice had formed around the supply water dump nozzle. All subsequent supply water dumps were deleted from the STS 41-D mission timeline because of the ice formation. A waste water dump was required and attempted using the RMS television camera for observation. The waste water dump was terminated because of rapid ice formation on the waste water nozzle. Subsequent waste dumps were also removed from the STS 41-D mission timeline. The supply water quantity was managed by dumping supply water through the flash evaporator system while the waste water quantity was managed by using bags for urine collection.

The RMS was used to dislodge a major portion of the ice formation from the supply water dump nozzle. Side sun attitude plus repeated heater cycles removed the remaining residual ice from the waste water nozzle prior to the entry phase of the mission. Analyses of the nozzle temperatures and system pressures established that seed ice particles existed adjacent to the nozzle prior to the third supply water dump. Reduced supply water system pressure caused the spray pattern at the nozzle orifice to widen and contact the seed ice particles, thus growing ice over the supply water nozzle. The STS 41-D mission (OV-103) incorporated a new AFRSI (advanced felt

reusable surface insulation) blanket thermal protective system/water nozzle configuration. Ice particles adhered to the surface of the AFRSI and the gap filler between the AFRSI and nozzle. The accumulation of these ice particles during normal dumps provided the seed ice from which the icicle was formed. The STS 41-G mission (OV-099) incorporated a tile-to-nozzle configuration which had previously demonstrated the performance of successful water dumps. As a result of flash evaporator system problems, supply water dumps were added to the STS 41-G timeline during the mission. The supply and waste water dumps were successfully performed using established constraints. CONCLUSION: The formation of ice during the third supply water dump of the STS 41-D mission resulted from ice particles being trapped by the AFRSI/nozzle configuration and a large system pressure drop which caused the water dump spray pattern to widen and come in contact with these ice particles. Ice growth eminated from the ice particles back toward the supply water nozzle, covering the nozzle and also starting the icicle formation. CORRECTIVE_ACTION: For STS 51-A and subsequent missions: a. Retain option of managing supply water either by performing supply water dumps or use of the flash evaporator system. b. Maintain the supply and waste water dump procedures and constraints successfully demonstrated during the STS 41-G mission. c. OV-103 AFRSI adjacent to the supply and waste water dump nozzles has been changed to black tile. Advantages of black tile include faster heat absorption during side-sun attitudes, lower water absorption rate than AFRSI, smoother surface that does not trap ice, and less adhesive for ice attachment. d. Investigate a redesign of the supply and waste water nozzles and associated heaters. The potential exists for future program changes to incorporate an advanced nozzle/heater configuration to guarantee ice-free operations.
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:10:28	Problem	**FIAR**	**IFA** STS-41D-V-15A	C&T - Ku-band
	GMT: 244:23:10		**SPR** 7112-010	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: KU-Band Radar Experienced Undamped Oscillations. (ORB)

Summary: DISCUSSION: Recent KU-Band radar system high-speed-scan tests at beta angles greater than 41 degrees, using S/N 101, have revealed an incompatibility between the software-generated gimbal-motor drive commands and the analog-servo-loop implementation of the alpha-gimbal drive rates.

The alpha-gimbal drive rates are a function of the beta-gimbal drive rates and the software generates the alpha-motor dirve commands as a function of time. If the high-speed scan starts at beta angles greater than 41 degrees (assuming no Orbiter motion), the alpha gimbal rate exceeds 140 deg/sec. At this gimbal rate, the servo loop tachometer trip function turns off the gimbal motor and when the gimbal slows to a rate that is less than 120 deg/sec the trip function is reset. The software, however, cannot sense that the gimbal drive has been turned off and continues to generate torque commands to the gimbal motor, thus repeating the process. This results in undamped oscillations that can only be stopped by turning the KU-Band system off. A proposed software change will automatically alleviate this phenomena by the judicious selection of scan parameters for a given beta location at the start of high-speed scans. CONCLUSION: An incompatibility exists in software-generated gimbal motor drive commands and KU-Band servo loop implementation in that the software algorithm does not account for the gimbal-motor excessive rate cut off.
CORRECTIVE_ACTION: A software change will be proposed to alleviate the undamped oscillation condition by the judicious selection of scan parameters for a given

beta location at the start of high-speed scans. The results of this activity will be tracked via CAR 7112-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None [the following was included in the computer database but not the paper files:] [DISCUSSION: At about 244:23:00 G.M.T., the Ku-band antenna experienced undamped oscillations and hit the drive stops in both the alpha and beta axes. At that time, the Ku-Band system was in the radar mode for DTO (detailed test objective) 726. The oscillations occurred after the cable positioning procedure when the mode switch (S7) on panel AIU was placed in GPC accordihng to the procedure.k Since the system was in the radar mode, the antenna properly entered a 60degree highspeed spiral scan. This was initiated at a roll angle of -96.2 degrees and a pitch angle of 57.9 degrees which is near the alpha and beta mechanical stops. This resulted in simultaneous contact of both the alpha and beta stops which can cause undamped oscillations. This condition will not occur in the radar mode, if panel A1U is configured to GPC DESIG or to MAN SLEW after the cable wrap procedure. The crew stopped the oscillations by turning the KU-band system off There was no further problem with the Ku-band for the remainder of the mission. The cable positioning procedure will be changed, starting with STS 51-A, to place the mode switch (S7) on panel A1U in the manual slew position. A flight note will be used to properly configure panel A1U for STS 41-G. This change should prevent future undamped oscillations of the antenna as experienced on STS 41-D. A special post-flight test procedure was conducted at KSC (Kennedy Space Center) that indicated the antenna stops were not damaged andsystem performance was normal. CONCLUSION: The antenna oscillations wer caused by and off-nominal system configuration DTO 726), in conflict with antenna cable positioning procedures. CORRECTIVE_ACTION: The crew cable positioning procedure will be changed to configure panel A1U to the manual slew position. CAR ANALYSIS: CAR remains open at this date (10-28-86). Closure anticipated in early 1987. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE]

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:09:27	Problem	**FIAR**	**IFA** STS-41D-V-16	HYD
	GMT: 245:22:09		**SPR** 14F016	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Hydraulic System 1 Unloader Valve Malfunctioned. (ORB)

Summary: DISCUSSION: AT 245:22:09 G.m.t., during the circulation pump 1 thermal conditioning cycle, 1 the hydraulic system 1 accumulator pressure increased to 2978 psi, which exceeded the maximum relief setting (2560 psi) of the three-way valve.

The hydraulic system 1 pressure was relieved by the priority valve at 3000 psi. This higher system pressure during circulation pump operations did not impact the mission or affect system operations. Subsequent pump 1 cycles exhibited a similar high pressure profile. The circulation pump 1 currents and temperature have been reviewed and were nominal. Higher than normal system pressures were attributed to a malfunction in the three-way valve. This indicates probable contamination in the valve. The three-way valve will be removed and replaced with a spare currently available at the launch site. CONCLUSION: The hydraulic system 1 three-way valve malfunction was most probably due to contamination. CORRECTIVE_ACTION: The hydraulic system 1 three-way valve will be removed and replaced. Failure analysis will be tracked by CAR 14F016. CAR ANALYSIS: The anomaly was not verified, however, all valves in service are being reworked when cycled back to Arkwin (vendor) for refurbishment. This involves a rework of the adjusting screw to provide a flat surface on the end of the screw. No further action be taken. [not included in original problem

report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:19:59	Problem	**FIAR**	**IFA** STS-41D-V-17	HYD
	GMT: 247:08:41		**SPR** 14F017	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Hydraulic System 3 Bootstrap Pressure Drop. (ORB)

Summary: DISCUSSION: At 247:08:41 G.m.t., the hydraulic system 3 circulation pump was commanded on by a cold temperature in the rudder/speed brake area. After circulation pump 3 shut down, the system pressure dropped from 2380 psi to 1860 psi in approximately 4 minutes. This drop triggered the FDA (fault detection annunciator) alarm. System pressure should remain above 2050 psi. The circulation pump was commanded on again and the accumulator pressure increased to 2550 psi. After the pump was shut down, the pressure again decayed at approximately the same rate as previous observed. The pump was turned back on and operated until the end of mission to maintain accumulator pressure.

The pressure decay was most probably due to contamination in the three-way valve which precluded proper ball-valve seating. This is similar to bootstrap pressure losses experienced on previous missions. The three-way valve will be removed and replaced with a spare currently available at the launch site. CONCLUSION: The hydraulic system 3 pressure decay was most probably caused by contamination in the three-way valve. CORRECTIVE_ACTION: The hydraulic system 3 three-way valve will be removed and replaced. Failure analysis will be tracked by CAR 14F017. CAR ANALYSIS: The anomaly was not verified, however, all valves in service are being reworked then cycled back to Arkwin (vendor) for refurbishment. This involves a rework of the adjusting screw to provide a flat surface on the end of the screw. No further action contemplated. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:19:59	Problem	**FIAR**	**IFA** STS-41D-V-18	RCS
	GMT: 248:08:41		**SPR** 14F010	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Aft right Reaction Control System Fuel Crossfeed Valve 3/4/5 Did Not Indicate Open. (ORB)

Summary: DISCUSSION: During OMS (orbital maneuvering system)-to-RCS (reaction control system) interconnect initiation, the aft right RCS fuel crossfeed valve 3/4/5 telemetry (V42X3338X) did not indicate that the valve had opened. The AMCA (aft motor control assembly) 1 status 2 light indicated that power was being applied to the

valve. The valve control switch was cycled to CLOSE and back to OPEN with no change in the light status. The crew reported that the onboard position indication was OPEN. The valve control switch was then placed in GPC to remove power from the valve.

There was no further impact to system operations for the remainder of the mission. The problem was duplicated at KSC (Kennedy Space Center) resulting in the removal and replacement of the valve actuator which also contains the valve position limit switches. These limit switches are of the type which have previously experienced contamination in the form of conductive and non-conductive particles. A non-conductive particle in the limit switch which provides the downlink valve open indication, can cause the noted anomaly. CONCLUSION: The aft right RCS fuel crossfeed valve 3/4/5 open indication failure was most probably caused by a contaminated limit switch. CORRECTIVE_ACTION: The valve actuator with the suspect position limit switch will be returned to the vendor for failure analysis. The results of the activity will be tracked via CAR 14F010. CAR ANALYSIS: This and many other switch problems is attributed to conductive and non-conductive particles floating within the switch containers in zero g. Problem switches are being replaced as replacement switches (without contaminants) become available. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** 003:08:32	Problem	**FIAR**	**IFA** STS-41D-V-19		EPD
	GMT: 246:21:14		**SPR**	**UA**		**Manager:**
			IPR	**PR**		
						Engineer:

Title: Photo Floodlight Failed. (GFE)

Summary: DISCUSSION: During middeck filming using the IMAX camera and two photo floodlights, one photo floodlight failed. The crew was given instructions on continuing IMAX filming using only one floodlight, which is less than optimum lighting, and the IMAX filming was completed in this mode.

Troubleshooting of the floodlight at JSC indicated a blown fuse internal to the floodlight, which is a JSC-modified version of a standard movie floodlight. Attempts to duplicate the failure at JSC were unsuccessful. No correlating voltage spikes were recorded that could have contributed to the failure. The film quality was reported to be grainier on those rolls of film where only one floodlight was used, but the film was considered acceptable. CONCLUSION: The cause of the blown fuse in the photo floodlight is unknown, but the most probable cause was a weak or under-rated fuse. Since filming can be accomplished with one floodlight, two identical floodlights will be flown on STS 41-G. CORRECTIVE_ACTION: NONE EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** 004:23:00	Problem	**FIAR**	**IFA** STS-41D-V-20		HYD

GMT: 248:11:42	**SPR**	**UA**	**Manager:**
	IPR	**PR**	
			Engineer:

Title: Landing Gear Isolation Valve 2 Indicated Open During Flight Control System Checkout. (ORB)

Summary: DISCUSSION: At 248:11:42 G.m.t., which was during FCS (flight control system) checkout and approximately 25 seconds after APU no. 2 start, the landing gear isolation valve no. 2 went from closed to open.

After APU no. 2 shut down, the crew commanded isolation valve no. 2 open per the checklist, not knowing that telemetry already showed the valve to be open. The crew confirmed that the switch was not actuated while the APU was running. Review of thermal instrumentation data from downstream of the isolation valve shows a thermal response that indicates the valve was open. A slow start of circulation pump 2 during FCS checkout preparations, possibly resulting from high voltage from tieing bus A to bus B, caused a low differential pressure across the isolation valve. This resulted in a slow valve response which caused the valve to not latch in the close position. The valve subsequently moved from a non-latched closed position to the open position during APU no. 2 operation for FCS checkout. The change in valve position did not impact the operation of the system during the entry phase. CONCLUSION: The landing gear isolation valve 2 changed from closed to open was most probably the result of a non-latched condition attributed to a slow valve response. This response was due to low hydraulic pressure during the first 10 seconds after the circulation pump was started. CORRECTIVE_ACTION: The operation of landing gear isolation valve 2 and circulation pump 2 will be verified through tests to be conducted during turnaround ground operations. A procedure has been established to assure the landing gear isolation valve properly latches. The procedure which has been given to mission operations is time dependent and allows 10 seconds for the circulation pump to reach full pressure plus 3 seconds to hold the switch in the energized position for a total of 13 seconds. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 005:08:10	Problem	**FIAR**	**IFA** STS-41D-V-21	OMS
	GMT: 248:20:52		**SPR** 14F013	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right Orbital Maneuvering System Oxidizer Low-Point Drain Line Heater System B Thermostat Failed. (ORB)

Summary: DISCUSSION: The right OMS (orbital meaneuvering system) oxidizer low-point drain line heater, system B, dropped to 48 deg F as measured on V43T6237A, at approximately 248:20:52 G.m.t. When the temperature went below the FDA (fault detection annunciator) limit of 50 deg F, a propellant thermal OMS alert was generated and the crew reconfigured from the system B to the system A heaters. Temperatures returned to normal in approximately 10 minutes. Heater system A was used

for the remainder of the mission.

Post-flight testing revealed that the system B heater thermostat had failed. The thermostat (S2151) was removed and replaced, and the failed thermostat was returned to the contractor for failure analysis. Of the only two previous flight failures of this type thermal switch, both were related to contact contamination. CONCLUSION: The cause of right OMS oxidizer low-point drain line heater system B thermostat failure is unknown pending the results of the failure analysis. CORRECTIVE_ACTION: The right OMS oxidizer low-point drain line heater system B thermostat was removed and replaced. Failure analysis for the thermostat will be tracked on CAR 14F013. CAR ANALYSIS: Contact resistance of thermal switch (S015B) was high and erratic. The high/erratic resistance is believed to be caused by contamination found on the switch contacts following disassembly of the switch. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification		Documentation		Subsystem
MER - 0	**MET:** 005:09:30	Problem	**FIAR**	**IFA** STS-41D-V-22		Atmospheric
	GMT: 248:22:12		**SPR**	**UA**		Revitalization Subsytem
			IPR	**PR**		**Manager:**
						Engineer:

Title: Oxygen Leak Downstream of Environmental Control System (ECS) Supply Isolation Valve 2. (ORB)

Summary: DISCUSSION: On flight day 6, an oxygen leak of about 30 lb/hr was identified in the secondary flow path to the ECLSS (environmental control and life support system) from the PRSD (power reactant storage and distribution system). The leak was isolated and stopped by closing ECS supply isolation valve 2 after losing about 150 lb of oxygen. The crew reported that they did observe some white particles leaving the payload bay at the time of cabin repressurization from 10.2 to 14.7 psia and data review verified that the leak began at that time.

A postflight visual inspection showed no obvious damage, nor was any leakage evident from system 2 during postflight testing with helium. However, the secondary cryogenic oxygen restrictor/heat exchanger assembly was found installed backwards. The most probable leak source is a mechanical flange fitting in the flow restrictor/heat exchanger assembly. The leak was reproduced during testing at Rockwell with a qualification flow restrictor assembly and using reverse flow to simulate the Orbiter with the restrictor assembly reversed. A significant leak was observed at a flange body temperature of about -100 deg F. The leak stopped when the temperature was raised to -22 deg F. CONCLUSION: The cryogenic oxygen leak downstream of the ECLSS supply isolation valve 2 was probably caused by the reverse installation of the oxygen supply loop 2 restrictor/heat exchanger assembly permitting low cyrogenic temperatures to open the flange seal during the high flow interval of cabin repressurization. CORRECTIVE_ACTION: Photos confirmed correct installation of the flow restrictor/heat exchanger assembly on OV-099. The STS 41-G vehicle was also leak checked and no leaks were identified during 5 previous flights including 4 cabin repressurizations from 10.2 to 14.7 psia. The oxygen supply loop 2

lines will be reworked on OV-103 to reverse the oxygen flow through the restrictor. The system will be leak checked with helium. Oxygen flow will occur as a part of the schedule EMU oxygen flow tests. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:20:53	Problem	**FIAR**	**IFA** STS-41D-V-23	MECH
	GMT: 249:09:35		**SPR** 14F012	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Aft Starboard Payload Door Open Indication Remained On And The Closed Indication Was Delayed. (ORB)

Summary: DISCUSSION: During the pre-entry payload bay door closing operations the starboard door aft open position indication remained on. After landing, the open indication went off.

In addition, the starboard door aft closed indication was delayed until 13 seconds into the aft starboard bulkhead latch cycle. This caused uninhibited power to the right door drive unit motor 2 for about one half of the latch cycle. All latches were engaged and there was no impact to payload bay door closure. The payload bay door position limit switches are of the type which have experienced contamination in the form of conductive and non-conductive particles internal to the switch. A conductive particle or sticking contacts in the limit switch could have caused the anomalous open indication. The problem could not be repeated during postflight troubleshooting. The actuator which contains the open limit switch has been removed and replaced. The suspect unit will be returned to the vendor for failure analysis. The anomalous closed indication could have been caused by a faulty limit switch or by misalignment in the switch rigging. The troubleshooting will be completed on this unit when the payload door checkout operations are conducted prior to the next OV-103 rollout. Any failed components will be removed, replaced, and verified at that time, and failed components will be returned to the vendor for failure analysis. CONCLUSION: The anomalous open indication was most probably caused by contamination in the open limit switch. The anomalous closed indication was most probably caused by either a faulty limit switch or by misalignment in the switch rigging. CORRECTIVE_ACTION: The actuator containing the open limit switch has been removed, replaced, and will be returned to the vendor for failure analysis. Troubleshooting to determine the cause of the anomalous closed indication will be completed during payload bay door verification prior to the next OV-103 rollout. The results of this activity will be tracked via CAR 14F012 and KSC vehicle discrepancy documentation. CAR ANALYSIS: Unable to duplicate flight failure. Since anomaly cleared at touchdown, suspect failure is vibration related. Most probable cause was determined to be minor bending of the actuator mechanism which cleared at touchdown. PIND tested limit switches will be installed when they are available. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:23:42	Problem	**FIAR**	**IFA** STS-41D-V-24	OMS
	GMT: 249:12:14		**SPR** 14F014	**UA**	**Manager:**

IPR **PR**

Engineer:

Title: Right Orbital Maneuvering System Crossfeed B Fuel and Oxidizer Valves Closed Indications Failed. (ORB)

Summary: DISCUSSION: At about 249:12:14 G.m.t., the right OMS (orbital maneuvering system) crossfeed B fuel and oxidizer downlink closed discretes went to zero. The onboard valve position indication was proper (closed). The onboard valve control switch was placed in GPC to prevent continuous power from being applied to the valves. The deorbit operations followed with no impact.

Postflight troubleshooting revealed hard failures on both the fuel and oxidizer closed discretes. Since the onboard indication was normal and uses the same power source as the closed discretes, the failure was most likely caused by faulty limit switches. In light of system redundancy and since the limit switches are not easily accessible without removal of the OMS pod, OV-103 will be flown as is until the switches are accessible. Loss of these limit switches causes continuous power to be applied to the valve motor if a close command is manually initiated. To prevent this, the onboard valve control switch will be placed in GPC which limits the time that power is applied to the valve motor. CONCLUSION: The right OMS crossfeed B fuel and oxidizer valves closed indications failure was most probably caused by faulty valve position limit switches. CORRECTIVE_ACTION: When the suspect limit switches become accessible, they will be removed, replaced and returned to the vendor for failure analysis. This activity will be tracked via CAR 14F014. This and many other switch problems is attributed to conductive and non-conductive particles floating within the switch containers in zero G. Problem switches are being replaced as replacement switches (without contaminants) become available. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:00:25	Problem	**FIAR**	**IFA** STS-41D-V-25	OMS
	GMT: 249:13:07		**SPR** 14F015	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right Orbital Maneuvering System Fuel Tank Isolation Valve A Open Indication Failed. (ORB)

Summary: DISCUSSION: At about 249:13:07 G.m.t., shortly after the deorbit maneuver, the AMCA (aft motor control assembly) status 1 telemetry indicated that a motor was driving. Ground data showed no activity for any motor in the status daisy chain.

Postlanding, the crew reported that the right OMS (orbital maneuvering system) fuel tank isolation valve A onboard talkback was indicating barberpole (miscompare). The right OMS tank isolation valve control was then placed in GPC to remove power from the fuel valve motor. Later, when the right OMS fuel tank isolation valve A was placed in the closed position for ferry operations, the onboard talkback indication was normal. The anomalous indication could not be duplicated during postflight

troubleshooting. The valve talkback limit switch, which provides inputs to the onboard position indication, is of the type that has previously experienced contamination in the form of conductive and non-conductive particles internal to the switch. A non-conductive particle, preventing the close of the limit switch open contacts, will cause the noted anomaly. In light of system redundancy and since the valve talkback limit switches are not easily accessible without the removal of the OMS pod, OV-103 will be flow as is until the right OMS pod is removed for other reasons. The right OMS tank isolation valve A will be flown in the open position. If a miscompare occurs during the missin, then the valve control switch will be placed in GPC. CONCLUSION: The anomalous AMCA status 1 telemetry indication was probably caused by right OMS fuel tank isolation valve A position limit switch contamination. CORRECTIVE_ACTION: The right OMS fuel tank isolation valve will be flown in the open position and the valve control will be placed in GPC to remove power from the valve should a miscompare occur. When the failed limit switch becomes accessible it will be removed, replaced, and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 14F015. CAR ANALYSIS: This and many other switch problems is attributed to conductive and non-conductive particles floating within the switch containers in zero g. Problem switches are being replaced as replacement switches (without contaminants) become available. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:00:55	Problem	**FIAR**	**IFA** STS-41D-V-26	MECH
	GMT: 249:13:37		**SPR** 14F018	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Vehicle Pulled To Right After Nose Gear Touchdown. (ORB)

Summary: DISCUSSION: Postlanding, the crew reported that the vehicle pulled to the right after nose gear touchdown. During the technical debriefing, the commander said he applied about 25 degrees rudder for correction as the vehicle was turning to the right. The Orbiter responded properly to the rudder, and there was no tendency to overshoot. Differential braking was started at about 120 knots and the tendency to pull right diminished as the ground speed was reduced. Nose wheel steering was not used.

The postflight inspection showed that the right main landing gear shock strut was compressed to within 0.5 in. of the fully compressed position; whereas, the left shock strut was normal, compressed to within 3.5 in. A bubble check located gaseous nitrogen leakage from the right shock strut Schrader valve. The loss of pneumatic pressure caused the partial deflation of the right shock strut and resulted in the vehicle pulling to the right during rollout. CONCLUSION: The vehicle pulled to the right after nose gear touchdown because loss of pneumatic pressure partially deflated the right shock strut. The loss of pneumatic pressure in the right shock strut was traced to a gaseous nitrogen leak in the Schrader valve. CORRECTIVE_ACTION: The OV-099 shock struts were visually checked for hydraulic fluid leaks and all gas seals were bubble checked for gaseous nitrogen leaks. Minimum installation torque was verified in each swivel nut, the strut stroke was visually checked and the servicing procedural records were verified. The Schrader valve on OV-103 has been removed and replaced. The piston top was inspected and no bottoming damage was evident. The OMRSD will be revised to add a bubble leak check and specify torque values for the valve and valve cap. Failure analysis of the leaking Schrader valve will be tracked on CAR 14F018.

CAR ANALYSIS: Valve was replaced. Failure analysis indicated that the swivel nut was overtorqued. No further action required. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of the failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:00:55	Problem	**FIAR**	**IFA** STS-41D-V-27	MECH
	GMT: 249:13:37		**SPR** 14F019, 14F020	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Oscillating Linear Acceleration During Light Braking. (ORB)

Summary: DISCUSSION: After landing, the crew reported that an oscillating linear acceleration had occurred during light braking on the rollout. The crew decelerated only to 6 ft/sec instead of the planned 8 ft/sec due to the increased oscillation. The commander said it felt like a very slow antiskid operation, as if the wheels were sliding over patches of ice.

Evaluation of the ground track and brake hydraulic pressures both indicate that there was no antiskid operation. Evaluation of the limit braking data revealed no cause for the oscillation. The probable cause for the oscillating linear acceleration was the low right main gear shock strut. See problem STS-41D-26. CONCLUSION: The oscillating linear acceleration during light braking probably resulted from the low right main gear shock strut. CORRECTIVE_ACTION: Forty nine channels of brake instrumentation have been installed on OV-099 for STS 41-G to better understand brake/hydraulic dynamic interaction. CAR ANALYSIS: Some degree of brake damage occurs with nearly every mission. Several approaches have been put forward to redesign the brakes but only minor changes to the existing design have been approved. Damage to brakes does not represent a flight failure. Until proven corrective action is taken, the brakes will be new or refurbished to like new condition, incorporating all design changes approved to date and utilizing all new inspection criteria. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of flight data evaluation.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-41D-V-28	HYD
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right Inboard Elevon Secondary Differential Pressure (Delta P) Channel 4 High. (ORB)

Summary: DISCUSSION: During the STS 41-D prelaunch operations, the right inboard elevon secondary channel 4 differential pressure was high for approximately a 23-second period started about 10 seconds after the first APU (auxiliary power unit) was started.

After the APU's reach full pressure (3000 psi), but prior to the aerosurface profile test, a force fight was observed in the right inboard elevon actuator. This condition lasted for 23 seconds during which time channel 4 was opposing the other 3 channels. Data evaluation shows that the ASA (aerosurface servo amplifier) was operating properly in that the equalization network issued commands to correct the offset created by the force fight. The data also indicated that the actuator was healthy during circulation pump operation as well as during the low-pressure operation of the APU's. Most probably a transient contamination condition existed during the 23 seconds, and subsequently cleared prior to the aerosurface profile test. No evidence of the condition could be found during the on-orbit flight control surface checkout. CONCLUSION: The high differential pressure of the right inboard elevon secondary channel 4 was most probably due to transient contamination, which subsequently cleared. CORRECTIVE_ACTION: No further testing of the right inboard elevon secondary channel 4 is planned; however, it will be observed during subsequent ground turnaround testing. Hydraulic samples will be taken and evaluated for contamination in accordance with the OMRSD. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:01:18	Problem	**FIAR**	**IFA** STS-41D-V-29	D&C
	GMT: 246:14:00		**SPR** 14F024	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Forward Orbiter DAP (Digital Auto Pilot) Panel C3 Rotational Pulse Pitch Push Button Indicator Light Intermittent. (ORB)

Summary: DISCUSSION: The crew reported that the PBI (push button indicator) light on panel C3 did not come on when the DAP mode associated with this light was selected. This occurred several times during the mission and in each case the proper DAP mode selection was achieved. Light test operations were tried several times and during at least one of these, the light did illuminate.

Post-flight troubleshooting isolated the failure to the switch/light assembly. CONCLUSION: The failure of the PBI light was due to a switch/light assembly problem. DAP mode selections were proper. CORRECTIVE_ACTION: The switch/light assembly was replaced and the light operation verified. The problem will be tracked on CAR 14F024. CAR ANALYSIS: Flight data analysis indicates that the lamp was responding to valid data inputs. Failure analysis of lamp and switch failed to reveal an anomaly which might have caused the problem. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR JSC-EE-0589	IFA STS-41D-V-30	CCTV
	GMT:		SPR	UA	Manager:
			IPR	PR	
					Engineer:

Title: CCTV Video From The Remote Manipulator System Elbow Camera Contained Flashing, Horizontal Lines During Low-Light-Level Conditions. (GFE)

Summary: DISCUSSION: During orbit 36, the OAST-1 solar array experiment was extended and retracted while the RMS (remote manipulator system) elbow camera viewed its operation. Near the end of the retraction sequence, the camera was subjected to a direct view of the sun for a period of approximately 1 1/2 minutes. Following this, the camera exhibited flashing, horizontal lines in the video, especially when viewing low-light-level scenes. This condition continued throughout the remainder of the mission; however, the video from the camera was usable.

CONCLUSION: The cause of the flashing horizontal lines in the video awaits failure analysis at the camera vendor. CORRECTIVE_ACTION: The camera and lens assembly will be returned to RCA for analysis and corrective action. Corrective action will be tracked on FIAR JSC-EE-0589. FIAR ANALYSIS: Erratic television is GFE to the Orbiter. Failure analysis is being tracked in the NASA failure reporting system under FIAR EE-0589F (transferred to RCATVB0146). [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None, pending results of failure analysis.