Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 000:00:03	Problem	**FIAR**	**IFA** STS-51D-V-01	PRSD
	GMT: 102:14:03		**SPR** 23F012	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Cryogenic Oxygen Heaters A and B Tank 1 Controller Automatic Mode Failure. (ORB)

Summary: DISCUSSION: At 102:14:03 G.m.t., about 3 minutes after launch, the oxygen tank pressures fell below 800 psia. The oxygen tank 1 and 2 B heaters were in auto mode and should have come on at 811 psia. Ten minutes after launch, the oxygen tank 1 and 2 pressures fell to 720 psia. Oxygen tank 1 and 2 A heaters were turned to auto with still no heater activation. About 13 minutes and 15 seconds elapsed time, the oxygen tank 3 A and B heaters were positioned to auto. The tank 3 heaters came on and supplied oxygen for the next hour of the mission.

At 102:15:20 G.m.t., troubleshooting was initiated to isolate the problem in the oxygen tank 1 and 2 A and B heaters. Oxygen tank 4 A and B heaters were turned to auto and the tank 4 heaters came on. Oxygen tank 1 A and B heaters were positioned to off. The oxygen tank 2 A and B heaters came on. The oxygen tank 2 A and B heaters were positioned to off and the oxygen tank 1 A and B heaters were positioned to auto. The tank 3 heaters were off while the tank 1 heaters did not come on. Oxygen tank 1 A and B heaters were positioned to on-manual and the tank 1 heaters came on. Oxygen tank 1 A and B heaters were positioned to off and the oxygen tank 2 A and B heaters were positioned to auto. The oxygen tank 2 heaters came on. The oxygen tank 1 heaters were managed manually during the mission without impact.
CONCLUSION: Oxygen tank 1 controller auto mode failed. The oxygen tank 1 heaters were controlled in the manual mode without impact to the mission.
CORRECTIVE_ACTION: The oxygen tank 1 heater controller was removed and replaced. The controller was returned to the vendor for failure analysis and the results will be tracked by CAR 23F012. CAR ANALYSIS: Failure was duplicated at RI-DNY prior to disassembly and was not duplicated thereafter. The failed item was removed from flight status and marked accordingly. No other corrective action is planned. [not included in original problem report]
EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 000:00:19	Problem	**FIAR**	**IFA** STS-51D-V-02	MECH

GMT: 102:14:19 | **SPR** 23F007 | **UA** | **Manager:**

IPR | **PR**

Engineer:

Title: Orbiter Right-Hand External-Tank Door-Latch Indications A and B Were Not Received. (ORB)

Summary: DISCUSSION: At about 102:14:19 G.m.t., subsequent to ET (external tank) separation, the Orbiter right-hand ET door latch indications A and B indicated off. During the initial closing sequence, the ready-to-latch and door-close indications were nominal. The latch motor continued to drive for approximately 48 seconds until the crew positioned the switch to off. Review of the motor-current traces indicated that the motor started to stall with apparent actuation of the torque limiter at about 3 seconds. The normal latch motor closing time is 5.5 to 6 seconds.

At 103:01:22:21 G.m.t., a malfunction procedure was initiated to power the latch motor for 12 seconds. After 1 second, the proper latch indication was received, verifying the door-closed configuration. Power to the latch motor was then terminated. Postflight inspection included visual observations and door-drive and latch-actuation tests. The right ET door was inspected at the landing site (i.e. runway) with the door in the closed position. The only significant observation was the thermal barrier that had rolled inward toward the door for about one foot lengthwise in the vicinity of the door's forward outboard latch. The remainder of the inspection was performed in the orbiter processing facility and consisted of the following functional tests: 1. The first test was limited to the initial opening of the ET door and visual inspection of the door mechanism. On the initial power-on sequence, the door-close latches were released and the door-deploy switch turned-on. The door showed little or no signs of movement through actuator stall. The power was turned off, and a manual opening force was applied at the two centerline latch fittings located on the outboard edge of the door. The door opened approximately nine inches. The door was driven toward closed until the ready-to-latch indication was received and then driven to a 90-degree open position. A visual inspection revealed no apparent damage to the door mechanism, but the thermal barrier at a repaired area located in the vicinity of the forward outboard latch showed signs of having been wedged between the door and door frame. 2. The second test was a continuation of the first . The ET door was cycled closed and latched, and both the functional operation and timings were nominal. During the door-open sequence, there was a recurrence of events noted in the first test. The force to release the door was recorded at 240 pounds (i.e. 120 pounds at each centerline fitting). 3. The third test was conducted with the section of thermal barrier with the damaged area removed. The door and latches were cycled in the operational sequence and a nominal performance was recorded. Most probably, the thermal barrier interferred with the right ET door closure during the STS-51D mission. No apparent damage was incurred to the door mechanism. CONCLUSION: The right ET door uplock latch actuator motors stalled due to the thermal barrier being pulled into the door/door frame cavity, and this in turn caused the door to bind. CORRECTIVE_ACTION: Guidelines for ET door thermal barrier patching has been established and approved for implementation. Reference JSC chit J-1638. EFFECTS_ON_SUBSEQUENT_MISSIONS: 1. Prior to the next flight of OV-103, a stress analysis will be performed to assure the door closure and lock mechanism has not been overstressed. 2. Thermal barrier repair methods will be modified per the corrective action.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51D-V-03	INS
	GMT:		**SPR** AC 7837, 23F010	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Instrumentation Failures. (ORB)

Summary: DISCUSSION: A. APU 1 exhaust gas temperature no. 1 (V46T0142A) failed low just after APU 1 was shut down after ascent. The sensor will be removed and replaced and the failure will be tracked on CAR AC 7837.

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] B. Left RCS thruster L2D chamber pressure (V42P2550A) read low during entry. KSC troubleshooting has isolated the problem to the OMS pod which has been replaced with the OV-104 OMS pod for STS 51-G. Troubleshooting will continue and the measurement will be repaired prior to installation of this OMS pod on another vehicle. CAR ANALYSIS: Problem was determined to be polarized capacitor installed backwards. Board build-up specifically requires polarity check, so no corrective action is planned. [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:** 000:07:55	Problem	**FIAR**	**IFA** STS-51D-V-04	D&C
	GMT: 102:21:55		**SPR** 23F011	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Commander's Attitude Direction Indicator Attitude And Rate Error Needles Behaved Erratically. (ORB)
<u>Summary:</U>DISCUSSION: Upon first entry into MM (major mode) 201, the CDR's ADI (attitude direction indicator) experienced the following anomalies:

1. Roll error needle remained stowed all the time. 2. Pitch and yaw error needles oscillated at approximately 1 Hertz between the "stow" position and zero-error position. 3. Yaw rate pointer intermittently oscillated between the "stow" position and zero-error position. These conditions existed for all ADI modes in both MM201 and MM202. The problem ceased shortly after entry into MM801 for FCS (flight control system) checkout and did not recur upon return to MM201. However, on day 5, the ADI anomaly repeated and the crew powered the DDU (data display unit) off until entry. Throughout entry, the needles again oscillated until the Orbiter was on the ground.

The crew reported that the needles showed no unusual movement while the Orbiter was stationary on the runway. Analysis to the G2 memory dump and variable downlist data obtained both during and subsequent to the OPS 8 checkout showed no problems in the software that could effect the ADI in the manner observed. CONCLUSION: The most probable cause for the erratic behavior of the commander's ADI error needles was a hardware problem in the DDU. CORRECTIVE_ACTION: DDU 1 was removed, replaced and sent to SAIL for test. This will be tracked on CAR 23F011. CAR ANALYSIS: Failure was traced to a DDU CMOS device (parallel in/parallel out shift register) with a latent defect that had escaped all screening including a 160 hour burn-in. No corrective action is planned resulting from this failure. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:19:30	Problem	**FIAR**	**IFA** STS-51D-V-05	C&T - Ku-band
	GMT: 103:09:30		**SPR** 23F008	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: The KU-Band Antenna Experienced Uncommanded And Erratic Motion. (ORB)

Summary: DISCUSSION: At about 103:09:30 G.m.t., the KU-Band system experienced uncommanded motion in both the alpha and beta axis. Subsequent inflight troubleshooting procedures showed that the DA (deployed assembly) was not powered as evidenced by the TWT (traveling wave tube) operate-bit being low. This accounted for the erratic motion because the antenna rate sensor assembly, which receives its power from the DA LVPS (low voltage power supply), was also not powered. Without the required gyro rate data to the servo motor control electronics in the KU-Band electronics assembly no. 1, the servo system is unstable.

Based on the assumption that the DA LVPS had experienced an over-current condition and the fault protection lockout logic had been activated, the KU-Band system power was cycled to off to reset this logic. Upon subsequent power turn on, the system opeated properly and continued to operate normally for the remainder of the mission. Preliminary analysis and data review indicates that a transient over-current conditon existed in the output of the LVPS. However, insufficient data exists to locate or fully understand the nature of the fault condition. Thus the DA will be removed, replaced and returned to the vendor for failure analysis. CONCLUSION: The erratic KU-Band antenna motion was caused by a momentary over-current condition that caused the fault detection circuitry to turn off the LVPS. CORRECTIVE_ACTION: The DA will be removed, replaced, and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 23F008. CAR ANALYSIS: The analysis indicated that a loose washer was the probable cause. Hughes Acft will conduct more stringent visual examinations for loose particles. Better quality control will be implemented. This CAR is closed. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:04:15	Problem	**FIAR**	**IFA** STS-51D-V-06	HYD
	GMT: 103:18:15		**SPR** 23F001	**UA**	**Manager:**

			IPR	**PR**
				Engineer:

Title: Hydraulic System 3 Accumulator Pressure Decay. (ORB)

Summary: DISCUSSION: At about 103:17:00 and 103:19:10 G.m.t., the hydraulic system 3 accumulator pressure decayed at a rate ranging from 7 to 16 psi/min.The hydraulic circulation pump was used to recharge the accumulator for two cycles and then was left on continuously for one crew sleep period. The accumulator pressure stabilized at about 2100 psia during this time. About an hour after the circulation pump was turned off, the accumulator pressure dropped to 1950 psi and the circulation pump was used to recharge the accumulator. The pressure was not maintained when the pump was turned off.

The circulation pump was then run continuously and maintained an accumulator pressure of about 2000 psia until the FCS (flight control system) checkout using hydraulic system 3. After FCS checkout, the accumulator stabilized at about 2300 psia without further circulation pump operation. CONCLUSION: The hydraulic system 3 accumulator pressure decay was most probably the results of unloader valve contamination which subsequently cleared during the flight control system checkout. CORRECTIVE_ACTION: If the anomaly is verified during OPF testing the hydraulic system 3 unloader valve will be removed and replaced with a new configuration valve. The failure analysis of the replaced valve will be tracked by CAR 23F001. CAR ANALYSIS: Analysis indicated that the problem was probably caused by contamination that has since passed thru the valve. Close this CAR. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 000:00:15	Problem	**FIAR**	**IFA** STS-51D-V-07	APU
	GMT: 102:14:15		**SPR** 23F014	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: APU 3 Shutdown Load Abnormal. (ORB)

Summary: DISCUSSION: At 102:14:15:08 G.m.t., during the last 21 seconds of APU (auxiliary power unit) 3 run time at the end of ascent, an abnormally high load of approximately 30 to 35 horsepower was observed. The normal load for this phase of ascent is approximately 10 horsepower. All APU and hydraulic system 3 performance parameters were consistent with an increase of 20 to 25 horsepower corresponding to a 10 to 12 gpm hydraulic pump flow.

During the FCS (flight control system) checkout, APU/hydraulic system 3 performance did not exhibit the higher load, but returned to the normal 10 horse power during quiescent flow. The additional APU 3 load of 20 to 25 horsepower is consistent with the bypass valve in the SSME (space shuttle main engine) 3 TVC (thrust vector control) isolation valve remaining open after TVC isolation valve closure. Based on acceptance test data, the bypass valve should close at system pressures above 650 psi, but it would flow 11.1 gpm if transient contamination held it open at 3000 psi. CONCLUSION: The 20 to 25 horsepower increased load on APU 3 during the final stages of ascent was possibly due to transient contamination which caused the TVC bypas valve to remain open after SSME 3 TVC isolation valve closure. The contamination cleared resulting in normal APU operation during FCS checkout. CORRECTIVE_ACTION: During the OV-103 vehicle turnaround flow, hydraulic system 3 was pressurized and bypass valve performance was verified on the SSME 3 TVC isolation valve. Fly as is. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 003:22:50	Problem	**FIAR**	**IFA** STS-51D-V-08	GFE
	GMT: 106:12:50		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Biomedical Data Inoperative On Second Extravehicular Crewman During Extravehicular Activity. (GFE)

Summary: DISCUSSION: During EVA (extravehicular activity) the biomedical channel on the second extravehicular crewman (EV-2) was flat, reading about 1.5 volt offset. The inactive channel switched when the EVA crewman swapped modes. This indicated that the signal path from the EMU biomedical signal conditioner through the EVC and the Orbiter transiever was operating normally. Postflight troubleshooting confirmed that biomedical communications in the EV-2 crewman's suit operated normally.

Postflight crew debriefing found that EV-2 crewman was unable to make the biomedical sensor adhesive stick to his unshaved chest. CONCLUSION: The biomedical data was inoperative on EV-2 during EVA because the biomedical sensor adhesive did not stick to the crewman's unshaved chest. CORRECTIVE_ACTION: Crew procedures will insure that the extravehicular crewman will shave as required for the biomedial sensor adhesive to stick properly when applied. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:00:00	Problem	**FIAR** EE-0607F	**IFA** STS-51D-V-09	C&T
	GMT: 106:14:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Extravehicular-2 Crewman Reported Uplink Voice Breaking Up 25 Percent Of Time. (GFE)

Summary: DISCUSSION: At about 106:14:00 G.m.t., the EV-2 crewman reported that the uplink voice was breaking up approximately 25 percent of the time. A review of the mission voice tapes and crew responses at the subsystem debriefing indicated that both EVA (extravehicular activity) crewmen experienced the problem, and that the Orbiter crewmen observed a significant imbalance between the onboard EVA voice and the S-band forward link levels. This imbalance indicates that the forward link voice level was low and that the breakup was probably caused by inadequate signal levels at the UHF (ultra high frequency) transceiver. The breakup problem was apprent only during TDRSS (tracking data relay satellite system) coverage; however, the STDN (Spaceflight Tracking and Data Network) coverage was limited. The imbalance was noted only during the EVA operations, since during non-EVA periods, the low level from the ground could be accommodated by independently increasing earphone volume on the air-to-ground 1 and UHF channels.

Postflight, the communication systems on both the EMU (extravehicular mobility units) were found to be operating normally. Low signal levels at the UHF transceiver were found after communications problems on the first Shuttle EVA. The Orbiter UHF transceiver VOX (voice-operated transmission) actuation level was adjusted to maximize sensitivity and tests were performed to develop a new procedure for optimization of STDN voice processing and delta modulator input level setup. These tests were all performed using normal STDN support configuration i.e. HDR (high data rate). For the TDRSS operation, the drive level to the MCC (Mission Control Center) delta modulation equipment was the same as that developed for the STDN sites, although normal operations through TDRS use LDR (lower data rate). A 3dB (half power) difference exists in the delta modulation system output between HDR and LDR. These factors coupled with the LDR used for the forward link through TDRSS may have accounted for the poor forward link to the EVA crewmen. A test will be performed using the building 30 audio processing and delta modulation equipment with the Orbiter NSP (network signal processor) and the audio distribution system in the ESTL (electronics systems test laboratory). This test should determine if an alternate procedure for premodulation level setup in Building 30 can be developed that will result in the reliable relay of forward link UHF voice and reduce the volume imbalance for the onboard audio during TDRSS LDR operations. CONCLUSION: Insufficient signal levels to voice-operate the UHF transceiver resulted in intermittent uplink voice to EVA crewmen. CORRECTIVE_ACTION: A. Tests will be performed to determine the following: 1. NSP output level difference between HDR and LDR. 2. Optimum building 30 delta modulator drive level. 3. Use of HDR forward link through TDRSS. B. Procedures will be developed for use by ground control and flight crew to improve voice communications should the condition recur. EFFECTS_ON_SUBSEQUENT_MISSIONS: Unknown pending the results of communications link testing. FIAR ANALYSIS: The problem was concluded to be a ground station problem which created a volume imbalance problem. The reported anomaly was confirmed through voice tapes and the recommended solution is documented in the NASA failure reporting system under FIAR EE-0607F. [not included in original problem report]

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:03:04	Problem	**FIAR**	**IFA** STS-51D-V-10	DPS - GPC
	GMT: 103:17:04		**SPR**	**UA**	**Manager:**
			IPR Software DRs 51776 and 62180	**PR**	
					Engineer:

Title: Primary Avionics Software System General Purpose Computers Logged Six Cycle Wraps In The Mid-Frequency Executive Program. (ORB)

Summary: DISCUSSION: Six cycle wraps were logged during GPC (general purpose computer) operation from 103:17:04:00 G.m.t. to 103:22:25:18 G.m.t. At the time of each of the six errors, the CPU (central processor unit) usage was normal (around 65 percent) and no maneuver or unusual activities were in progress. It is known that the

MFE (mid-frequency executive) program has one pass every 1.92 seconds that is significantly longer than other passes. The MFE cycle wraps occurred when both star trackers were in the star-of-opportunity mode. SPF (Software Production Facility) simulations of this star tracker mode have shown that star tracker processing can take from 2 to 23 milliseconds. The 23-millisecond cycle will occur when a star tracker is performing star confirmation and sighting table calculations following the collection of 21 data samples. If this star tracker processing cycle occurs on a normally heavily loaded MFE cycle, then an MFE cycle wrap may occur. All of the observed MFE cycle wraps were confirmed via the GPC error log to have occurred during a heavily loaded cycle.

This scenario, with the resulting MFE cycle wraps, has been successfully duplicated in the SPF and documented in DR 51776. CONCLUSION: The MFE cycle wraps are the result of the GPC processing star tracker data during a heavily loaded MFE cycle. CORRECTIVE_ACTION: None for STS 51-B. An operations note/waiver is to be proposed beginning with STS 51-G under DR 51776. A software change is being evaluated for the OI-7 PASS release and will be tracked on software DR 51776. A user note under DR 62180 is in place to cover a possible cycle wrap, if both star trackers execute the star-confirm logic on the same cycle. Future software requirements changes are being investigated for the double star tracker star-confirm case. EFFECTS_ON_SUBSEQUENT_MISSIONS: Very occasional errors may be noted, but they will not impact operations.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:23:20	Problem	**FIAR**	**IFA** STS-51D-V-11	C&T
	GMT: 109:13:20		**SPR** 23F006	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Tacan 3 Range And Bearing Failed. (ORB)

Summary: DISCUSSION: At about 109:13:20 G.m.t., the TACAN in position 3 did not search in range. Later, at about 109:42:45 G.m.t., the same TACAN (3) did not lock in bearing. The TACAN units in positions 1 and 2 were used for landing operations. Postflight, TACAN (3) failed the self test and would not lock on the TACAN ground station. Thus, the TACAN in position 3 has been removed, replaced, and returned to the vendor for failure analysis.

CONCLUSION: The cause of the TACAN failure awaits failure analysis. CORRECTIVE_ACTION: The TACAN in position 3 has been removed, replaced and returned to the vendor for failure analysis. The results of this activity will be tracked via CAR 23F006. CAR ANALYSIS: Flight failure was duplicated and problem was isolated to Frequency Synthesizer card P/N 8020000455. Two transistors were defective and showed evidence of arc or burn marks. Replacement of the transistors was accomplished and operation was restored. Five similar transistors were delidded and examined for arc or burn marks and none were found. This demonstrated sufficient confidence that no further corrective action was necessary. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: None pending failure analysis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:23:55	Problem	**FIAR**	**IFA** STS-51D-V-12	MECH
	GMT: 109:13:55		**SPR** 08F011	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right Main Landing Gear Inboard Tire Burst. (ORB)

Summary: DISCUSSION: The inboard tire on the right main landing gear burst after the right inboard brake locked up at 20.6 knots ground speed 113 feet before the orbiter stopped. The tire skidded for 33 feet wearing through 11 of the 16 cord layers before the tire burst. Spin up wear went through 2 cord layers at a nearby location along the tire centerline and the left rib wore through 2 cord layers all around the tire. The spin up and left rib wear was similar to the wear experienced on the other main landing gear tires.

The outboard tire on the right main landing gear wore through 4 of the 16 cord layers when the right outboard brake locked and the tire skidded for the last 5 feet to orbiter stop. CONCLUSION: The inboard tire on the right main landing gear burst after the right inboard brake locked, causing the tire to skid for 33 feet and wear through 11 of the 16 cord layers. CORRECTIVE_ACTION: All 4 main landing gear tires have been removed and replaced. See problem 51D-13 for a report on the brake damage. CAR ANALYSIS: Tire blowout is attributed to the very rough runway at KSC and the brake locking up that caused a 33 foot skid. The skid wore through all 16 cord layers of the tire. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:23:55	Problem	**FIAR**	**IFA** STS-51D-V-13	MECH
	GMT: 109:13:55		**SPR** 08F011	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right Main Landing Gear Brakes Locked Near End Of Rollout. (ORB)

Summary: DISCUSSION: The number 3 stator on both the inboard and outboard right MLG (main landing gear) brakes broke into several pieces, causing both brakes to lock. The inboard right brake locked at 20.6 knots 113 feet before the Orbiter stopped and the outboard right brake locked for the last 5 feet of rollout. Brake-on velocity was 156 knots with a 5 to 6 ft/sec2 average deceleration rate during braking. A crosswind of about 8 knots, gusting up to 12, resulted in extra brake energy on the right brake while returning to and holding the runway centerline during rollout. Right brake energy was 41 million foot pounds for 48 seconds on each brake, while left brake energy was about 20.5 million foot pounds for 45 seconds on each brake. Hydraulic actuator package temperatures reached 290 and 150 deg F on the right and left brakes, respectively.

Similar brake damage and lockup on STS-5 (OV-102) was attributed to thermal soak back when the left inboard brake number 3 stator broke after dissipating 42.6 million foot pounds of energy over 54 seconds with a 166.5-knot brake-on velocity. Work has been initiated to identify and implement improvements to the Orbiter landing/rollout systems and techniques in the areas of crew procedures/techniques, automatic elevon load relief, active nose wheel steering, and brake system improvements. Earlier brake hardware improvements underway include brake instrumentation for OV-099 and OV-103, studies to determine hydraulic system modification to dampen/soften hydraulic response characteristics, stiffer Orbiter axles, and hardware to provide improved brake pedal feel/response. For the longer term, implementation of identified hydraulic changes, retrofitting the fleet with stiffer axles and significantly upgrading the Wright Patterson Brake Test Facility are being considered. CONCLUSION: The right MLG brakes failed and locked due to thermal soak back when the number 3 stators broke after dissipating 41 million foot pounds of energy over 48 seconds with a 156-knot brake-on velocity. CORRECTIVE_ACTION: Standard procedures to prevent heat soak back are as follows: A. Brake-on velocity between 140 to 120 knots. B. Deceleration rate between 8 to 10 ft/sec2. C. Deceleration rate reduced to 6 ft/sec2 at 40 knots. If brake-on velocity exceeds 140 knots, continue 8 to 10 ft/sec2 deceleration. The forward action plan includes crosswind placards, automatic elevon load relief, active nose wheel steering, brake system improvements and a new brake design study. EFFECTS_ON_SUBSEQUENT_MISSIONS: None, except for the current crosswind limits when landing at KSC which are 8 knots at night, 10 knots in daylight and 15 knots for RTLS (return to launch site) aborts. 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]

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51D-V-14	TPS
	GMT:		**SPR** 23F009	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Left Outboard Elevon Thermal Protection System Damage Near Hinge Line. (ORB)

Summary: DISCUSSION: The postflight inspection showed that the outboard end of the left-hand lower outboard elevon had received significant heat damage. Specifically, the outboard forward corner of the elevon lower-honeycomb outer-face-sheet was buckled and delaminated and had two small burn-through holes. The outboard elevon lower-leading-edge tile-carrier panel was completely melted under the outboard tile and a hole was melted in the elevon-cove primary-seal support plate. This permitted the lower-outboard carrier-panel outermost tile to fall onto the runway when the elevon was deflected upward after landing.

All inspection evidence indicates that the entry plasma flow entered the inboard gap of the outboard tile, then progressed under the tile flowing outboard where it eventually burned the tile-attachment strain isolation pad, thus allowing the tile to become loose. This then allowed more plasma flow under the tile, which resulted in the melting of the aluminum carrier panel, primary seal panel structure, and elevon honeycomb outer face sheet, as well as melting two tiles aft of the plasma entry point and two elevon sidewall tiles. It is believed that this flow path may have existed for the two previous flights, with progressive deterioration of the bond, but was not evident from outside inspection of this area during postflight inspections. CONCLUSION: The elevon tile damage was casued by entry plasma flow erosion. The plasma entered a tile gap and proceeded under the tile and outboard resulting in melting of tiles and structure. Inspection procedures will be expanded to include periodic internal inspections. CORRECTIVE_ACTION: The elevon structure was thoroughly inspected to identify all structure that was damaged or weakened by the high temperature plasma flow. The affected structural components have been replaced with new or modified structure of comparable strength. The OV-099 elevon structure was inspected at the pad and tested to assure all the bonds were acceptable for the STS 51-B flight. Several locations required repair or replacement of gap fillers. A requirement has been established to remove the outboard leading-edge carrier-panel on each side of all Orbiters for detailed inspection after the next several flights. In addition, a more comprehensive detailed inspection of each outboard elevon/wing area will be accomplished during the normal thermal protection system postflight inspections. CAR ANALYSIS: Cause of the TPS and structural damage that occurred during descent has not been positively identified. Most probable cause was an out-of-spec step/gap of the lower wing surface forward of the elevon leading edge. This would disturb the boundary layer and allow hot gasses to impinge on the elevon leading edge. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51D-V-15	RCS
	GMT:		**SPR** 23F003	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Reaction Control System Thruster R2U Oxidizer Leak. (ORB)

Summary: DISCUSSION: The oxidizer temperature dropped to about 57 deg F when RCS (reaction control system) thruster R2U was fired during the RCS hot-fire test at 108:09:48 G.m.t. The fuel injector temperature warmed back up to approximately 85 deg F while the oxidizer injector temperature remained at 57 deg F. This signature is indicative of a small oxidizer leak. During the remainder of the orbital portion of the mission, the oxidizer injector temperature slowly converged on the fuel injector temperature, but never got above 70 deg F. No action was taken since the oxidizer temperature did not trip the RM (redundancy management) trip limit (injector temperature less than 30 deg F). During entry, the RCS R2U thruster was a third priority thruster and never fired.

The RCS thruster R2U was leak checked during subsequent ground safing operations and was found to be leaking oxidizer. The RCS thruster R2U will be removed and replaced during turnaround operations. CONCLUSION: The RCS thruster R2U oxidizer leak was most probably caused by contamination. CORRECTIVE_ACTION: The RCS thruster R2U will be removed and replaced. It will be returned to the vendor for failure analysis and tracked on CAR 23F003. CAR ANALYSIS: Fiberglass particles appear to be the most probable cause of thruster valve leakage. Fiberglass is commonly found on returned thrusters, but this is the first time they have been in evidence at the downstream side of the pilot seal. Since this is the first instance of fiberglass migration, no corrective action is planned. [not included in original problem report] EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51D-V-16	MISC
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Crew Interface Equipment Problems. (RMS)

Summary: DISCUSSION: A. A retainer fastener on avionics access panel R17 came off and several of these internal hex-head fasteners cracked during IFM (inflight maintenance) activities. A change will provide avionics filter access, without requiring fastener/panel removal, via use of cutouts in the panel and soft Armalon covers attached with snaps/velcro.

B. Crews systems locker MA16N did not close properly. The crew reported that only one latch could be engaged during preparation for deorbit. Hinge modification and/or improved door latch fasteners are in design and flight evaluation to compensate for locker deformation. C. The cover on the airlock depressurization valve was difficult to remove. The cover had been difficult to remove on STS 51-A because the lanyard ring caught on the panel lip. The lanyard ring is being redesigned to eliminate interference with the panel lip. D. A screw/washer fell out of the IMU access panel and the panel was secured for entry with only one of the two fasteners. The structural area will be modified to improve structural deflection concerns, and Milson-type captive fasteners with misalignment capability will replace the screws. E. The personal hygiene door was very difficult to close on-orbit prior to entry. The crew had to push off of the CFES (continuous flow electrophoresis system) to close the door. A strap tie down will be added to the personal hygiene door for positive retention. CONCLUSION: See above. CORRECTIVE_ACTION: See above. EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-51D-V-17	MPS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Main Propulsion System Liquid Hydrogen Manifold Pressure Decay. (ORB)

Summary: DISCUSSION: The MPS (main propulsion system) manifold dump was performed without using the liquid hydrogen manifold helium repressurization system; instead, the four fill/drain valves were opened for 180 seconds. The vehicle MPS was then returned to a post-vacuum inert configuration. The liquid hydrogen manifold pressure rose 27 psia over the next 25 minutes. At OMS-2 ignition, apparently the fuel settled against the warmer SSME interface and the heating rate increased. The liquid hydrogen manifold pressure increased 23 psia over the next 5 minutes and finally reached about 50 psia at a mission elapsed time of 48 minutes. The hydrogen manifold pressure started to decay at a rate of about 0.4 psia/min, reaching 33 psia, at which time the second vacuum inerting was initiated. The second inerting dropped the hydrogen manifold pressure to zero. There was no mission impact or further action required.

Prior to the vacuum dump, the hydrogen manifold pressure increased until the hydrogen manifold relief valve functioned, which resulted in a drop in the manifold pressure. The hydrogen manifold relief valve crack and reseat signatures were nominal. Postflight functional tests of the hydrogen manifold relief valve verified nominal relief valve operation. Hydrogen manifold leak tests were nominal.   CONCLUSION: The MPS liquid hydrogen manifold pressure decay is unexplained. Flight data and postflight functional tests have verified the nominal operation of the hydrogen manifold relief valve. The hydrogen manifold pressure decay was no impact to the mission. CORRECTIVE_ACTION: NONE   EFFECTS_ON_SUBSEQUENT_MISSIONS: NONE