Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-01	EPD&C - Hardwar
EGIL-01	**GMT:**		**SPR** 64RF04	**UA**	**Manager:**
			IPR 63V-0002	**PR**	x38393
					Engineer:

Title: Aft MCA 1 Status 4 Went To 0 (ORB)

Summary: INVESTIGATION/DISCUSSION: At approximately 254:11:55 G.m.t. (01:13:32 MET), aft motor control assembly (AMCA) 1 operational status (op stat) bit 4 transitioned from a 1 to a 0. Just over three hours later, the status bit returned to 1. Evaluation of the anomaly found that no drive currents were detected on the supplying ac bus and there were no position changes of the associated controlled motors. The AMCA 1 op stat bit 4 measurement (V76X2254E) is downlinked at 1 sample per second through MDM OA 1, card 7, channel 00. No other measurements on that channel changed state during the specified period. The AMCA 1 op stat 4 was the only measurement affected. There are 21 motors controlled by 17 relays within this op stat. The motors are External Tank (ET) Umbilical doors (Left-hand (LH) drive motor 1, LH latch motor 1, centerline (CL) latch 1 motor 1, CL latch 2 motor 1), aft reaction control subsystem (RCS) isolation valves, right-hand (RH) RCS crossfeed manifold 3,4,5, LH RCS crossfeed manifold 3,4,5, LH orbital maneuvering subsystem (OMS) crossfeed, and OMS isolation valves. Of the 17 AMCA 1 relays, 8 are wired directly to a motor function, while the remaining 9 are wired in series with other relays. The 8 directly wired relays could not be related to the failure since there were no AC current changes nor were related functions activated during the three hour time period. The remaining 9 relays were verified operational during the mission and/or the subsequent Orbiter Processing Facility (OPF) flow. Postflight troubleshooting at KSC could not duplicate the anomaly.

CAUSE(s)/PROBABLE Cause(s): This anomaly has not been isolated to a particular line replaceable unit (LRU). The most probable cause is within the op stat measurement V76X2254E circuitry (criticality 3). Circuit components include AMCA 1, MDM OA 1, and interconnecting wiring. CORRECTIVE_ACTION: Vehicle troubleshooting could not duplicate the problem. Both the KSC problem report and the CAR will be closed as an unexplained anomaly, to be revisited in the event of a recurrence of this condition. RATIONALE FOR FLIGHT: A failed op stat circuit is detectable on the ground and during the mission and does not affect the functionality of any subsystem. Subsystem functionality or redundancy would only be affected if the incorrect op stat is a result of an inadvertent hybrid relay transfer. Eight of the 17 related relays were exonerated in flight. All 17 AMCA 1 relays are the -0002 configuration. There has never been a -0002 hybrid relay failure with a signature like the one experienced in flight. This is based on more than ten years of successful use of over 2000 relays. All relays were verified operational in flight and/or during the OPF flow for the next OV-103 flight (STS-63).

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-02	Active Thermal
EECOM-01	**GMT:**		**SPR** 64RF01	**UA**	**Manager:**
			IPR	**PR** ECL-3-20-1006	x39045
					Engineer:

Title: FES Supply Water Accumulator Temperature Cycling Low (ORB)

Summary: INVESTIGATION/DISCUSSION: On-orbit, the flash evaporator system (FES) supply water system A accumulator temperature (V63T1750A) cycled between 48?F and 55? F. The normal control range is 55?F to 75?F. The temperature cycle signature indicated that the heater was operating properly. When reconfigured to the B system, the temperature cycled regularly as in the A heater configuration, but in a lower band, indicating that the problem was with the temperature sensor rather than the system A thermostat. The condition did not affect FES operation since the sensor is used for system health and performance monitoring and not for control.

CAUSE(s)/PROBABLE Cause(s): Postflight investigation by the FES vendor, Hamilton Standard, confirmed that the anomaly was caused by a debonded temperature sensor on the supply water system A accumulator. This sensor is bonded in place on the accumulator using a two part epoxy adhesive. A review of prior flight history has revealed a similar debonded sensor on OV-104's supply water system B accumulator during STS-38. The most probable cause for the infrequent debonding of these sensors is that an occasional poor bond coupled with subsequent age & cycle conditions will eventually lead to detachment of the sensor. CORRECTIVE_ACTION: The sensor was replaced without removing the FES from the vehicle. Reference CAR 64RF01. RATIONALE FOR FLIGHT: Sensor debonding does not affect system performance. Thermister-type temperature probes are used for FES control rather than this type of surface-bonded sensor. Output biases caused by this condition are readily recognizable by comparison to prior flight data for the specific measurement involved, and by comparison to redundant measurements. Should a complete loss of redundant measurements occur, the result is loss of insight into heater operation.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-03	RCS
PROP-01	**GMT:**		**SPR** 64RF02	**UA**	**Manager:**
			IPR	**PR** LP01-23-0636	x36845
					Engineer:

Title: Primary Thruster L1A Failed Off/Deselected on Low Chamber Pressure (ORB)

Summary: INVESTIGATION/DISCUSSION: Reaction control subsystem (RCS) primary thruster L1A was declared failed-off during the RCS hot-fire test. This was the first attempted firing of thruster L1A during the mission. At 261:14:56 G.m.t. (008:16:33 MET), L1A was declared failed off by redundancy management (RM). A good command was observed out of the RJD (V79X2617X), but a chamber pressure (Pc) of 16 psia was observed (V42P2541A). RM declares a thruster failed-off after receiving three consecutive Pc discretes indicating a chamber pressure of less than 36 psia. The nominal Pc for a primary thruster is approximately 152 psia.

The oxidizer flow was most probably pilot-valve-only (or limited) flow, which would account for the low chamber pressure. The oxidizer valve main stage probably failed to open fully due to iron nitrate contamination of the pilot stage. The RCS oxidizer valve has a pressure-operated main stage and a failure to operate due to iron nitrate contamination is the most common failure mode. Thirty seconds after the fail off, RM annunciated fail leak on the thruster because the oxidizer injector temperature (42T2501C) fell below the RM limit of 30 ?F. The fuel injector temperature remained above 60 ?F indicating no fuel leakage. The leak was small enough that the manifold 1 was left open. The thruster was left deselected for the remainder of the mission. Thruster L1A (S/N 215) has flown 14 missions, all with the same oxidizer valve. The oxidizer valve is a -505 configuration and the thruster will be removed and sent to the White Sands Test Facility (WSTF) for valve flushing. If flushing is successful in clearing the contamination, the thruster will be returned to service. If the flushing fails, the thruster will be returned to the vendor for refurbishment. CAUSE(s)/PROBABLE Cause(s): The most probable cause of the thruster fail-off was iron nitrate contamination in the oxidizer-valve pilot-stage that prevented its proper operation. CORRECTIVE_ACTION: KSC will replace thruster L1A and it will be transferred to the WSTF for the thruster-flush program. The primary thruster oxidizer and fuel valves have pressure-operated main stages and are susceptible to failure due to iron nitrate contamination. Iron nitrate formation is assisted by the presence of water (moisture) in the oxidizer valve. Therefore, the primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system. Also, a program to develop a direct-acting valve, which would be less susceptible to failure from iron nitrate contamination, is being considered. Results of the thruster flush at the WSTF and any necessary failure analysis will be documented in CAR 64RF02. RATIONALE FOR FLIGHT: Thruster failure to fire is detectable by the Pc transducers which are monitored by RM software. The RCS system can tolerate two failures in the same axis for a nominal mission. The RM software will automatically deselect a thruster that has failed to fire and a redundant thruster in the same axis will be reprioritized. Failure of two or more thrusters in the same functional axis may affect RTLS or critical abort/ET separation due to insufficient thrust capability in the required axis.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-04	APU
MMACS-04	**GMT:**		**SPR** 64RF03	**UA**	**Manager:**
			IPR 63V-0009	**PR**	x30663
					Engineer:

Title: APU 3 EGT 2 Failed (ORB)

Summary: INVESTIGATION/DISCUSSION: Beginning at 263:20:54 G.m.t. (10:22:32 MET) during entry, auxiliary power unit (APU) 3 exhaust gas temperature (EGT) 2 measurement (V46T0340A) became increasingly erratic until APU shutdown. The temperature measurement read about 100 ?F at APU shutdown, and then the temperature rose slowly to a value near the APU 3 EGT 2 temperature. During troubleshooting on the vehicle, KSC was unable to duplicate the temperature signature observed during entry. The troubleshooting included wiggle testing of the wiring up to the sensor. The temperature sensor was removed and replaced. The sensor was sent to KSC Materials and Analysis Branch Failure Analysis Laboratory for functional testing. Visual and radiographic examination did not reveal any noticeable anomalies that could have caused the in-flight behavior. An Omega microprocessor thermometer was used to measure the thermocouple temperature at ambient conditions and the thermocouple was operating as designed. Light flexing of the cable did not cause any significant fluctuations in output at ambient laboratory conditions.

A Lindberg tube furnace was used to perform elevated temperature testing on the thermocouple. During testing, the thermocouple cable was periodically flexed along its entire length to simulate the physical stresses it experienced during landing. At lower temperatures (below 500 ?F), there were no significant fluctuations in the thermocouple output. At approximately 1100 ?F while flexing the cable near the thermocouple's bulkhead connector, the output voltage dropped from 1.1 Vdc (1100 ?F) to less than 70 mVdc (70 ?F). Several waveforms were captured showing the thermocouple's output voltage varying between these two limits with slight movement of the cable near the bulkhead connector. While the thermocouple was cooling down, at approximately 250 ?F, the cable was again flexed near the bulkhead connector. At this temperature, the thermocouple operated as designed and no significant fluctuations in the output were noted. The erratic temperatures output measured during elevated temperature testing indicates that the thermocouple was the cause of the in-flight signature. The thermocouple will be sent to the manufacturer for a detailed failure analysis. This is the fourth field failure of the redesign EGT sensor; and this failure occurred on the fifth flight of this particular EGT sensor. CAUSE(s)/PROBABLE Cause(s): The exact cause of the in-flight signature is unknown but testing has isolated the problem to high temperature operation of the thermocouple and the flexing of the cable near the thermocouple's bulkhead connector. Failure analysis will be performed at the manufacturer to pinpoint the cause of the erratic performance at elevated temperatures. CORRECTIVE_ACTION: The EGT sensor was replaced and the verification was successfully completed. Testing performed at the KSC Materials and Analysis Branch Failure Analysis Laboratory duplicated the in-flight signature at elevated temperature with flexing the cable near the thermocouple's bulkhead connector. The sensor will be sent to the manufacturer for failure analysis which will be documented in CAR 64RF03-010. RATIONALE FOR FLIGHT: Each APU has two EGT sensors for redundancy. If both the APU's EGT sensors were to fail, there are other temperature and pressure measurements that indicate the health of the APU.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-05	C&T - Ku-band
INCO-01	**GMT:**		**SPR** 64RF07	**UA**	**Manager:**
			IPR 63V-0012	**PR**	x31450
					Engineer:

Title: Ku-band Radar Failed to Acquire at Low Range (ORB)

Summary: INVESTIGATION/DISCUSSION: The Ku-Band radar failed to lock-on to the SPARTAN payload following deployment. The Ku-Band passed several self tests during the first hour after deployment with nominal results. The radar acquired the SPARTAN about one hour later after a manuever, when the target was at a range of 2700 feet. The radar continued to track the SPARTAN to a range of 9100 feet when the Ku-Band system was switched back to comm mode. For the rendezvous phase, the radar acquired the SPARTAN at an estimated range of 128,000 feet. The radar immediately acquired, and locked until the nominal break-track at 80 feet. All Ku-Band operations during the rendezvous were nominal. Review of navigation data determined that the release location from the arm was correct and that the satellite was not out of the line-of-sight of the antenna during the initial radar scans. Postflight testing of the Ku-Band system at KSC indicates that electronics assembly (EA) 2 (serial number 104) may not be processing the received signal properly. EA-2 is used for radar operations. It provides control signals to the Ku-Band system for radar operations.

CAUSE(s)/PROBABLE Cause(s): The anomaly has been isolated to the EA-2 (serial number 104). CORRECTIVE_ACTION: EA-2 has been removed for further troubleshooting. Further troubleshooting, failure analysis, and corrective action will be documented on CAR 64RF07. RATIONALE FOR FLIGHT: The loss of the Ku-band radar may result in increased propellant usage during a rendezvous. The functional integrity of the Ku-band is verified during ground turnaround testing. The loss of the Ku-band radar on-orbit will not affect crew safety or vehicle performance.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-06	BFS
DPS-01	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: BFS DR 109628 Big X on BFS Display on Transition From Halt During Deorbit Preparation Block 4 (ORB)

Summary: INVESTIGATION/DISCUSSION: During deorbit preparation for the nominal end-of- mission landing opportunity for STS-64, the crew reported that the backup flight system (BFS) would not drive a cathode ray tube (CRT). A big X was present on any CRT to which BFS was assigned, but no poll fail message was present. This signature is consistent with the situation described in BFS discrepancy report (DR) 109628. Earlier in the flight, the ground had previously configured the BFS variable parameter downlist to include a memory location that would indicate whether the DR condition had occurred. This condition was confirmed, and the precoordinated recovery steps of reloading the BFS software into general purpose computer (GPC) 5 were executed. The DR condition was succesfully cleared and the BFS performed without further problems for the remainder of the mission, including a deorbit backout and subsequent landing a day later.

The DR condition was discovered and documented during a simulation at the Shuttle Mission Simulator (SMS). This condition occurs when BFS is transitioned to halt or operational sequence 000 (OPS 0) while the software task multifunction CRT display subsystem (MCDS) update module (MUM) is running or suspended. When this occurs, the MUM is not completed, and thus does not set the flag MUMDONE in the software. The MUM task is then inactive and BFS is unable to drive a CRT and a big X is displayed. During the flight, the BFS was configured to include the MUMDONE flag in variable downlist so that ground personnel could verify that the situation described in DR 109628 had occurred. This condition was introduced into the OI-23 software with a fix to a previous DR. The BFS software development process is being assessed to determine if steps can be added to prevent a problem such as this from recurring in future OIs. This work will be tracked as a Shuttle Avionics Software Control Board (SASCB) action. Analysis indicates that the likelihood of this condition occurring is less than one in 20 times that the BFS is transitioned to halt or OPS 0. The remaining OI-23 flights and all of the OI-24 flights will have the MUMDONE flag in the BFS variable downlist so that a confirmation of the DR condition can be readily made, should the BFS be unable to drive a CRT when brought out of halt or when taken to OPS 0. Either a patch or a source fix will be implemented on OI-25 and subsequent OIs. An audit of the software revealed that no other tasks have a similar problem. CAUSE(s)/PROBABLE Cause(s): The MUM does not get properly deactivated in some instances of moding the BFS to halt and some instances of taking BFS to OPS 0. This problem was introduced into the software with an OI-23 fix to DR 108658. CORRECTIVE_ACTION: Flights using OI-23 and OI-24 software are still subject to this problem and the MUMDONE flag will be added to the BFS variable downlist for easy identification of the DR condition. The software will be patched or fixed for OI-25 and all subsequent OIs. The BFS software development process will be modified if that is deemed appropriate. RATIONALE FOR FLIGHT: The problem is understood, and a safe and acceptable workaround is in place.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-07	undefined
INCO-07	**GMT:**		**SPR** 64RF09	**UA**	**Manager:**
			IPR 63V-0010	**PR** INS-3-20-0698	x30663
					Engineer:

Title: PDI/LITE Decom 4 BITE Discrepancy (ISS)

Summary: INVESTIGATION/DISCUSSION: At approximately 256:13:53 G.m.t. (03:15:30 MET), a warm start occurred on the LITE Smart-Flex Multiplexer/Demultiplexer (SFMDM). As expected, Payload Data Interleaver (PDI) decommutator (Decom) 4 locked up using the Quiescent data format load (DFL) at a data rate of 3.125 Kbps. The built in test equipment (BITE) bits for Decom 4 went high and those for Decom 1 went low, also as expected. About two minutes later, the crew selected the regular DFL, which uses Decom 1 and a 20.833 Kbps data rate. Decom 1 correctly locked onto the regular format and began writing LITE data into the toggle buffer. However, the Decom 4 BITE bits maintained an indication of bit, word, and frame lock on the regular format data, when it was expected that Decom 4 would lose lock on the higher bit-rate data. Only the bit rate accuracy BITE indication for Decom 4 went back to low. The Decom 4 lock indications remained until about 22 minutes later, when the PDI input source was zeroed out and the LITE data source was reselected. The anomaly did not affect LITE payload data. A review of the downlinked Orbiter data showed that the Decom 4 window was filled with 1's, indicating that Decom 4 was not processing regular format data even though lock indications were present. This condition only occurred once out of 17

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-64-V-08	TPS
None	GMT:		SPR	UA	Manager:
			IPR	PR LRWING-3-20-5466, RWING-3-20-4896	Engineer:

Title: Right and Left Main Landing Gear Door Thermal Barrier Assemblies Fell Out During Door Opening (ORB)

Summary: INVESTIGATION/DISCUSSION: During main landing gear door (MLGD) opening, two symmetrically opposite thermal barrier assemblies became separated from their respective baseplates on the aft edge of each main gear compartment. After landing, the barrier assemblies were found approximately 100 yards from the perimeter fence. The barriers were inspected and one assembly was found to be frayed. No damage to the carrier plate was noted. Minor tile damage was located adjacent to the righthand side missing barrier. No other impact damage was discovered. Each of the missing barrier assemblies were clipped back into place for the ferry flight back to KSC.

The assemblies were installed at KSC during the STS-64 processing flow. A barrier assembly consists of a thermal barrier (1-inch diameter) bonded to an aluminum carrier plate (0.08-inch high by 1.3-inch wide by 20-inches long). The barrier assembly clips into a baseplate that is attached to the main-gear wheel-well perimeter. Inspection of the barrier assemblies revealed no damage or evidence of failure of the spring-clip locking hardware. Enlargement of closeout photos taken prior to the STS-64 show that the spring clip locking mechanism was not engaged on the righthand side thermal barrier. The lefthand side photo was inconclusive. A review of the installation procedure indicates that the barriers were installed with the vehicle on the MLGD jack stands, which limits access to the area. The barriers were also installed with the adjacent barriers in place. Since the barriers have an interference fit with each other, the final barrier is difficult to install and slide over to engage the locking mechanism. Investigation into the installation procedures also revealed that if the barrier assembly is rotated slightly during installation, the assembly can be installed and the spring clip locked in place even though the carrier-plate tabs are not inserted into the baseplate slots. The results is that the visible locking feature is intact, while the hidden locking feature is not intact. Inspection of OV-104 found two barrier assemblies to be incorrectly installed in this manner. All barriers on OV-102 were found to be properly installed. Based on these findings, an inspection technique was developed to insure that incorrect installations are identified and corrected. The associated training and processing specifications are being updated to preclude improper installation of barrier assemblies. CAUSE(s)/PROBABLE Cause(s): Improper installation of the thermal-barrier assemblies was the cause of the assemblies separating from their baseplates and falling out of the MLGD wells at gear deploy. CORRECTIVE_ACTION: The barrier assemblies were refurbished and installed correctly. The training and installation procedures are being updated to prevent the incorrect installation of the barrier assemblies. Also, an inspection technique was developed during the failure analysis to insure that incorrect installations are identified and corrected. RATIONALE FOR FLIGHT: The barrier assembly is completely captive. If the hidden locking tabs are not inserted in the baseplates slots or if the spring

clip locking mechanism is not properly engaged, the barrier assembly will remain in place until the main landing gear is extended. The barrier assembly may shift slightly if installed incorrectly. Potential for filler bar char exists, but no aluminum damage will result.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-64-V-09	OMS/RCS
None	**GMT:**		**SPR** 64RF06	**UA**	**Manager:**
			IPR None	**PR**	x36845
					Engineer:

Title: Slow Pc Rise On Primary Thruster F4D (ORB)

Summary: INVESTIGATION/DISCUSSION: Primary reaction control system (RCS) thruster F4D (serial number 457) exhibited random slow chamber pressure (Pc) ramp-up of 0.080-second pulses. This occured on 16 of the 122 total pulses. Some longer pulses on F4D also appeared to indicate slow Pc rise. A detailed review of the data from the deorbit preparation period for 10 of 13 flights since return- to-flight indicates a steadily increasing number of slow Pc rise indications.

Thruster serial number 457 was shipped for failure analysis to White Sands Test Facility (WSTF). Trouble-shooting revealed contamination in the Pc tube as the cause of the sluggish response. The source is most likely left over contamination from the drilling of the upper end of the Pc tube following welding into the injector. A new transducer will be placed on the thruster, and the thruster will be sent to NASA Shuttle Logistics Depot (NSLD) as a spare. Initial troubleshooting was designed to rule out problems with the pressure sensing system before proceeding into hot-fire testing. During trouble- shooting, it was discovered that rapid pressurization cycles produced chamber pressure signatures that mirrored those observed in flight. Upon removal of the transducer, a small piece of contamination was found. This contamination was free to move about the Pc tube. It is postulated that this contamination acted as a

---