

SSVEO IFA List

Date:02/27/2003

STS - 56, OV - 103, Discovery (16)

Time:04:12:PM

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: Prelaunch GMT: 009:06:31:00.000	Problem	FIAR SPR 56RF01 IPR 51V0002	IFA STS-56-V-01 UA PR MPS-3-17-1131 and OEL-3-17-0415
				Manager: Engineer:

Title: MPS LH2 High Point Bleed Valve (PV22) Failed To Indicate Closed. (RMS)

Summary: DISCUSSION: The STS-56 launch countdown was terminated at T-11 seconds (096:06:31 G.m.t.) when Ground Launch Sequencer (GLS) software did not receive the Main Propulsion System (MPS) LH2 High Point Bleed Valve (PV22) closed indication (V41X1469E) ON as required by Launch Commit Criteria (LCC) MPS-12. GLS was programmed to command PV22 closure at approximately T-21 seconds and then to verify PV22 closed at approximately T-12.5 seconds. Data reviewed following the launch countdown termination verified that a nominal command was issued by GLS to close PV22. The MPS pneumatic system and the PV22 open indication showed nominal response, but the PV22 closed indication did not turn ON. The ground support equipment (GSE) LH2 high point bleed line temperature measurement (GLHT4119A) (located in the LH2 Tail Service Mast (TSM) downstream of PV22 and the LH2 High Point Bleed Line Disconnect, PD17) showed that the temperature downstream of PV22 rose at a nominal rate, indicating that flow through the LH2 high point bleed line had been terminated.

During LH2 detanking following the scrub of the launch attempt, five cycles of PV22 were performed under cryogenic conditions and each produced a nominal rise in downstream bleed line temperature, but a PV22 closed indication was not received. After LH2 detanking was completed, a pressure decay test indicated that PV22 was actually closed. The anomaly was then determined to have been caused by either a failure of the PV22 closed-position indication circuitry or a mechanical failure which caused the PV22 ball valve to stop moving in the closed direction after flow was terminated but before the closed-position limit switch was activated. A confidence cycle of PV22 was performed during the fast-fill portion of the LH2 tanking operation for the second launch attempt, and the downstream temperature rose as expected confirming PV22 closure. A software mask was installed in the GLS to prevent the anticipated failure of the PV22 closed verification at T-12.5 seconds from causing launch countdown termination. PV22 failed to indicate closed when the valve was commanded, however at approximately T-3.4 seconds, the PV22 closed indication turned ON (possibly due to vibration induced by space shuttle main engine startup) and remained ON through launch, ascent, and MECO. The indication then showed nominal response when PV22 was cycled for vacuum-inert operations, and remained nominal for the rest of the mission. Postflight troubleshooting included visual inspection and wire "wiggle" checks. Damaged insulation exposing conductors on two of the five PV22 valve body connector wires was found in the area of the connector strain relief

stub after Teflon tape abrasion protection had been removed. One wire led to pin 2 supplying Main A voltage to the closed-position indication switch, and the other led to pin 3 returning voltage from the open-position indication switch to MDM OA1. A continuous short would have had to exist for two days between the pin 2 wire and the connector strain relief stub to cause the PV22 closed indication to fail as observed. Inspectors reported that it would have been very difficult to force contact between the exposed conductor and the stub. No other wiring discrepancies were noted, and wiggle checks did not reproduce the failure. Additional troubleshooting produced nominal results without reproducing the anomaly. All valve cycle times recorded during troubleshooting were within allowable limits, which demonstrated nominal operation of MPS pneumatics. PV22 and the valve body connector assembly were removed shipped to Rockwell-Downey for failure analysis. Replacement retests were nominal. ATP procedure DTP5221-801B was performed on the removed valve which included testing with LH2, and all ATP results were satisfactory. Failure analysis of the valve assembly will include mechanical testing at ambient and LN2 chilled temperatures to determine ball valve positions for position switch activation and full valve closure. A test will then be performed to establish a profile of flow rates vs. ball valve position in one-degree increments. After all mechanical testing has been completed, the valve will be disassembled and inspected. Failure analysis of the connector assembly will include a visual inspection and a test of the assembly's insulation, dielectric strength, and wiring resistance. Final corrective action and failure analysis will be documented in CAR 56RF01-010. Problem Report MPS-3-17-1131 will remain open at KSC pending failure analysis results. **CONCLUSION:** The problem was caused by either a fault in the PV22 closed-position indication circuitry or a mechanical failure which caused the ball valve to stop moving in the closed direction after flow was terminated but before the closed-position limit switch was activated. The valve's ability to close and terminate LH2 flow was confirmed by leak testing and the response of a downstream temperature measurement. **CORRECTIVE_ACTION:** PV22 and the attaching connector assembly were removed and shipped to Rockwell-Downey for failure analysis. LCC MPS-12 was changed to require verifying either the PV22 closed indication ON or the GSE high point bleed line temperature above -409.5 degrees F (1 of 2) between T-14 and T-10 seconds. GLS software was changed to command PV22 closure at T-26 seconds to provide sufficient time for high point bleed line warm-up. Final corrective action will be documented in CAR 56RF01-010. **EFFECTS_ON_SUBSEQUENT_MISSIONS:** None. For STS-55, a confidence cycle of PV22 was successfully performed during LH2 tanking and a GLS mask was installed to prevent launch countdown termination caused by a failure to receive the PV22 closed indication. For subsequent missions, the LCC and GLS software changes that were made will improve launch probability by eliminating a potential launch countdown termination caused by a failure to receive the PV22 closed indication.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: 001:17:23:00.014	Problem	FIAR	IFA STS-56-V-02 FCP
EGIL-01	GMT: 098:46:52:00.000		SPR 48RF03	UA UA3-A0023 Manager:
			IPR UA3-A0023	PR
				Engineer:

Title: Fuel Cell 1 O2 Reactant Valve False Close Indication. (ORB)

Summary: DISCUSSION: The fuel cell 1 O2 reactant valve changed status from an open indication to a closed indication at 098:46:52 G.m.t. (1 hour 17 minutes MET). Responding to the accompanying caution and warning indications, the crew attempted to open the fuel cell 1 reactant valves and performed a bus tie of fuel cell 1 to fuel cell 2. Continued satisfactory operation of the fuel cell confirmed that the closed indication was false because the fuel cell would have shut down in a maximum of 6

minutes had the reactant valve actually been closed. Fuel cell 1 was eventually tied to fuel cell 3 to meet payload power sharing constraints. This bus tie configuration remained for the duration of the flight. The false close indication did not affect performance of the fuel cell.

Following landing, the proper indication returned when the reactant valve was cycled following fuel cell 1 shutdown/inerting. Troubleshooting performed during KSC turnaround operations was unable to recreate the problem. The same anomaly occurred on STS-48, flight 13 of OV-103 (IFA STS-48-V-03). The close indication cleared when the adjacent O2 manifold 1 isolation valve, mounted on the same structural panel, was cycled closed during the nominal tank reconfiguration. Troubleshooting following STS-48 could not determine the cause of the anomaly and no changes were made. The anomaly did not repeat during the next two flights of OV-103. Since the STS-56 event was the second occurrence of this anomaly, and since this fuel cell is to be intentionally shut down as part of a DTO during the next flight of OV-103, the entire panel containing the reactant valve and manifold valve was removed and replaced. Failure analysis will be performed on the removed unit. **CONCLUSION:** The false fuel cell 1 O2 reactant valve close indication was most probably caused by a temporary open condition in the valve status indicator circuit.

CORRECTIVE_ACTION: The entire panel, which is the line replaceable unit, containing the reactant valve and manifold was removed and replaced.

EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should the problem recur, the presence of a false reactant valve closed indication does not affect fuel cell operations. The launch commit criteria protects against launching with a similar condition.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	MET: 000:04:47:00.014	Problem	FIAR	IFA STS-56-V-03	C&T
INCO-01, INCO-05	GMT: 098:10:16:00.000		SPR 56RF04	UA	Manager:
			IPR 51V-0005	PR	Engineer:

Title: Low Frequency Uplink Command Difficulty (ORB)

Summary: DISCUSSION: Two extended periods of intermittent uplink command difficulty were experienced during the first flight day of STS-56. The S-Band phase modulation (PM) system was operating in the low-frequency mode with transponder string 2 selected. Both of these periods of intermittent uplink command difficulty were noted to occur while high noise levels were observed on transponder 2 automatic gain control (AGC) signal strength, and while intermittent losses of transponder phase lock, network signal processor (NSP) bit synchronization lock, and NSP frame synchronization lock occurred. The noise signature observed was similar during both anomaly periods, and was not affected by Orbiter antenna switching or Tracking and Data Relay Satellite System (TDRS) handovers.

The first period of uplink command difficulties began at approximately 098:10:16 G.m.t. with NSP 2 selected and persisted for over three hours until shortly after a switch from NSP 2 to NSP 1 was performed at 098:13:24 G.m.t. Nominal ground equipment configuration and operations were verified during this time period. After switching to NSP 1, nominal S-Band PM low-frequency operation and uplink command performance was maintained for the next nine hours. The second period began at

approximately 098:22:47 G.m.t. with NSP 1 still selected, this time persisting for approximately two hours until the S-Band PM system was switched to high-frequency operation during the TDRS-West to TDRS-East handover at approximately 099:00:47 G.m.t. Nominal S-Band PM system performance was maintained for the remainder of the mission. NSP 2 was reselected at 099:08:15 G.m.t., and the S-Band PM system was returned to low-frequency operation at 104:05:33 G.m.t. In-flight troubleshooting was planned, but the troubleshooting was not performed since the anomaly did not recur. Postflight troubleshooting included testing of the coaxial cable assemblies in the low-frequency path and a verification of the low-frequency path performance. Cable assembly temperatures and data integrity were monitored during high-power operation of the S-Band PM system in the low-frequency operating mode. All components that were monitored performed nominally, no abnormal connector temperatures were noted, and no abnormal data conditions (e.g. loss of phase lock, bit or frame synchronization, etc.) were identified. Possible causes for the anomaly appear to be between the transponder and the antenna switch assembly internal coaxial cable switch 52. One suspected cause is an intermittent failure of the low-frequency coaxial cable assembly W545 (because of symptom similarity to an STS-52 in-flight anomaly caused by a failure of this assembly). A second suspected cause is intermittent noise associated with the hybrid parametric amplification circuitry or with internal coaxial cable switch units within the preamplifier assembly. A third suspected cause is an intermittent noise associated with a frequency source module or an intermediate frequency module within transponder assembly. No hardware replacement or repair has been performed. The anomaly did not result in a loss of the S-Band PM system. If the anomaly recurs on a subsequent mission, loss of the S-Band PM system is not considered likely. Final corrective action will be documented in CAR 56RF04-010. CONCLUSION: Two extended periods of high noise in the S-Band PM system low-frequency communication path caused uplink command difficulties. Possible causes of the noise appear to be either intermittent noise sources within the transponder, intermittent noise sources within the preamplifier assembly, or an intermittent failure of one of the semi-rigid coaxial cable assemblies. Ground testing was unable to reproduce the anomaly. CORRECTIVE_ACTION: No component replacement or repair was performed. Final corrective action will be documented in CAR 56RF04-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: The anomaly may recur while using the S-Band PM system in the low-frequency operating mode on subsequent missions. If the anomaly does recur, a total loss of the S-Band PM system is not likely. Multiple transmission path redundancy for the S-Band PM system is provided through dual strings with cross-strapping capability. Existing flight rules provide for recovery of communications in the event of loss of the S-Band PM system.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 1	MET: 000:07:01:00.014	Problem	FIAR	IFA STS-56-V-04
INCO-02, 04	GMT: 098:12:30:00.000		SPR	UA
			IPR 51V-0003	PR
				Manager:
				Engineer:

Title: High Data Rate Downlink Problems (ORB)

Summary: This IFA was transferred to WA (Systems Integration)

Downlink data quality degraded on both Ku-Band Channels 2 and 3 when 32 MBPS or 48MBPS data was put on the Ku-Band Channel 3 in Payload Max (PL MAX) mode (PM mode). When 2 MBPS data was put on Cheannel 3 in PL MAX mode, data quality was intermittent. B45 chit approved to delay removal of ATLAS.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: 003:11:49:00.014	Problem	FIAR	IFA STS-56-V-05
eecom-01	GMT: 101:17:18:00.000		SPR 56RF02	UA
			IPR	PR TCS-3-17-1673
				Manager:
				Engineer:

Title: Aft Bulkhead Thermal Blanket Loose (ORB)

Summary: DISCUSSION: During video views of the payload bay at 003:11:50 MET, a thermal blanket on the 1307 bulkhead was observed to be partially detached. The equipment located behind the detached blanket included part of auxiliary power unit (APU) 2, hydraulic system 2 circulation pump and reservoir, and several hydraulic lines. The mid high-point fuel bleed line is located near the detached blanket but it was still covered. A review of the available APU, hydraulics, and high point bleed line temperature data indicated nothing unusual. The thermal impact on these components in the aft compartment was minimal. Further inspection at KSC revealed 2 blankets detached and 8 blankets partially detached (V070-363645-023, V070-363645-024, V070-363719-018, V070-363723-013, V070-363724-032, V070-363729-024, V070-363729-025, V070-363730-018, V070-363730-019, V070-363731-029) from the bulkhead.

Detached insulation blankets on the 1307 bulkhead, as well as damaged blankets, have occurred on many missions. Review of insulation blanket damage and detachment history indicated that after the redesign of 18 blankets (addition of Beta cloth on the backface), blanket damage has been eliminated; however, blanket detachment has not been eliminated. When blanket detachment occurs, the same blankets are involved, but differ slightly for each vehicle. **CONCLUSION:** The cause of the detached blankets has not been corrected or positively identified. The most probable cause is air intrusion during the first 90 seconds of ascent due to the inability of the payload bay door (PLBD) environmental seals to maintain pressure integrity. Until the cause of the detached blankets has been properly identified and corrected, detached blankets will continue to occur on some flights. **CORRECTIVE_ACTION:** The blankets on the 1307 bulkhead were inspected for detachment and a map was made of the area. The 10 blankets were reinstalled. Chit J4129A has been approved by the Space Shuttle Program to obtain a consistent set of PLBD seal deflection measurements which may help identify the cause. Failure analysis will be tracked under CAR 56RF02-010. **EFFECTS_ON_SUBSEQUENT_MISSIONS:** Detached blankets may continue to occur on some flights with possible thermal concerns, depending on the severity of the situation and planned Orbiter thermal orientations.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 2	MET: 001:08:01:00.014	Problem	FIAR	IFA STS-56-V-06
GNC-01	GMT: 099:13:30:00.000		SPR	UA
			IPR	PR
				Manager:
				Engineer:

Title: Universal Pointing Total DAP Error Buildup (ORB)

Summary: IFA was transferred to WA (System Integration)

During execution of the SUSIM Alignment Procedure Part B, there was an unexpected change in roll attitude while DAP was in INRTL Mode. While holding this attitude, roll total errors indicated a change in roll attitude of approximately -0.03 deg/min; however' DAP errors remained within the 0.033 attitude dead band. The problem was repeated and a workaround of using DAP auto mode was proven successful.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 3	MET:	Explained Condition	FIAR	IFA STS-56V-07
	GMT:		SPR	UA
			IPR	PR
				Manager:
				Engineer:

Title: IFA was deleted from list ()

Summary: IFA was deleted from list

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: 000:22:25:00.014	Problem	FIAR	IFA STS-56-V-08
EEDCOM-03	GMT: 099:03:54:00.000		SPR None	UA
			IPR None	PR
				Manager:
				Engineer:

Title: Water Bypass Valve Controller Slow (ORB)

Summary: DISCUSSION: During the STS-56 mission while operating the water loop 2 bypass valve in the auto mode, data indicated that the valve responded slower than expected. Further review of the data showed that when the controller moved the bypass valve from closed (0-percent bypassed) to some bypass position (> 0 percent bypassed), the valve position changed at approximately 10.8 percent/minute. The required change rate for this valve is between 80 and 133 percent/minute as specified in the Shuttle Operational Data Book (SODB). When the valve was moved in-flight from some bypassed position to the closed position, the rate of movement was approximately 95.6 percent/minute which was within SODB limits. During the flight, the crew changed the water bypass valve control from auto to manual to achieve a more efficient flow and thereby provide more cabin cooling. The crew manually opened the water loop 2 bypass valve decreasing the flow rate from approximately 1150

lb/hr to 950 lb/hr. The rate of change was within the specified value of 80 to 133 percent/minute. This verified that the slow response was due to the controller and not some type of mechanical hardware failure in the actuator or the valve.

CONCLUSION: The rate at which the water-loop 2 bypass valve controller was opening the water-loop bypass valve was outside specification requirements. The failure was related to the controller and was not a mechanical failure. The manual mode of operation was still operating per specification and was available if needed. CORRECTIVE_ACTION: None. When in AUTO mode, the controller has shown that it can still control the valve at a rate that meets mission requirements. The manual mode is also available should the valve-opening rate become unacceptable. EFFECTS_ON_SUBSEQUENT_MISSIONS: Should the bypass valve not support future mission requirements, the crew may be required to operate the valve in the manual mode. Prior to STS-44, the manual mode was the standard mode of operation for the water bypass valve.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	MET: 006:01:38:00.014	Problem	FIAR	IFA STS-56-V-09	GN&C
GNC-02	GMT: 104:07:07:00.000		SPR 56RF03	UA	Manager:
			IPR 51V-0004	PR	Engineer:

Title: ATVC 4 Power Loss Indication (ORB)

Summary: DISCUSSION: During OPS 8 flight control system (FCS) on-orbit checkout, a power problem was noted with the ascent thrust vector control (ATVC) 4 (P/N MC621-0043-6541, S/N 0023) electronics. During the flight control channel switch test, the flight control channel 4 switch was moved from override back to auto. The break-before-make switch causes a momentary power dropout for the aerosurface servo amplifier (ASA) and the ATVC unless the switch is moved rapidly. This momentary dropout was seen and expected. However, when the switch was moved back to the auto position, the Space Shuttle main engine (SSME) thrust vector control (TVC) pitch and yaw channel 4 fail indicators remained on and the channel 4 servo drivers dropped to near null. The fail indications and the driver currents were indicative of ATVC 4 power loss. The power loss could have been a wiring problem or a bad connection between the power control assembly (PCA) and the ATVC; however, the problem was expected to be in the ATVC power supply regulator circuits. The ATVC power supply regulator circuits were suspect because of the good power signatures from the PCA and because the ATVC cycle cleared the problem.

Ground troubleshooting included cycling the FCS channel 4 switch 25 times and cycling ATVC 4 power 11 times after landing while the vehicle was still on fuel cell power. Wires were wiggled to verify power connections and continuity between the PCA and ATVC. The troubleshooting was unable to reproduce the anomaly that occurred during FCS checkout. CONCLUSION: The ATVC power supply regulator circuits are suspected of causing the anomaly during FCS checkout. CORRECTIVE_ACTION: Ground testing of the FCS channel 4 switch, ATVC 4, and wiring did not reproduce the flight signatures. The ATVC has been removed and

replaced with a spare ATVC S/N 0029. A frequency response test (FRT) was performed after the ATVC replacement and the results were satisfactory. Failure analysis will be performed under CAR 56RF03-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: 006:02:27:00.014	Problem	FIAR	IFA STS-56-V-10
INCO-08	GMT: 104:07:56:00.000		SPR 56RF03	UA
			IPR None	PR
				Manager:
				Engineer:

Title: CDR HIU Failure. (GFE)

Summary: DISCUSSION: During STS-56 on-orbit operations, the commander reported that his headset interface unit (HIU), S/N 4, failed to operate. The unit was replaced with a spare unit carried on-board and no other problems were noted.

Following the mission the failed unit was shipped to NSLD for troubleshooting and repair. CONCLUSION: Failure analysis has not been completed, therefore the cause of the HIU failure is unknown at this time. CORRECTIVE_ACTION: The failed unit has been sent to NSLD for repair and corrective action will be documented on CAR 56RF03-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Prior to cabin close-out, the astronaut support personnel (ASP) is able to switch a failed HIU with their own unit. A spare HIU is always stowed on-board.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET: 006:11:48:00.014	Problem	FIAR EE-0684F	IFA STS-56-V-11
INCO-07	GMT: 104:17:17:00.000		SPR	UA
			IPR JSC DR 3U330004	PR VJCS-3-17-0366
				Manager:
				Engineer:

Title: TAGS Jam. (GFE)

Summary: DISCUSSION: The Text and Graphics System (TAGS) hardcopier was idle after receiving the last page of an uplinked message. Telemetry then indicated that the TAGS internal microprocessor had spontaneously transitioned to an illegal state (possibly caused by a single-event upset), which caused the TAGS unit to incorrectly indicate that it was in developing (DVLP) status without having received a page-advance command from the ground. At 104:17:17 G.m.t., the crew also reported the observed indications. One page-advance command was transmitted, but the TAGS continued to show DVLP status and the crew reported that no paper could be seen in the developer.

TAGS power was then cycled which re-initialized its internal microprocessor, and although the DVLP status indication was restored to normal ready (RDY) status, the TAGS indicated a JAM after the power cycle. Ground operators had expected these indications because TAGS had been powered down in the Full Image Ready state, and TAGS internal software assumes that the unit was powered down in the Partial Image Ready state when it re-initializes the internal microprocessor. Before ground operators could communicate this information to the crew, the crew had already responded to the JAM indication and had initiated performance of MAL procedure 2.8. The crew was asked to stop the procedure leaving TAGS in an unknown state, and the ground then transmitted another page-advance command which did not clear the problem. Further action was deferred until crew time was available for troubleshooting. When time permitted, the crew was asked to perform MAL 2.8 from the beginning. The crew opened the paper transport door and removed paper which had become folded up at the cutting bar, possibly due to the last page-advance command sent by the ground. The crew then threaded paper into the lower paper path with the TAGS powered up. The lower booster rollers "grabbed" the paper and fed it into the developer, causing the paper to jam in the developer. Further attempts to clear the jam and feed additional paper were unsuccessful, and the TAGS hardcopier was powered down for the remainder of the mission because alternate means were available to provide text and graphics hardcopies to the crew. **CONCLUSION:** The original problem was the telemetry indication of an improper transition of the TAGS internal microprocessor to an illegal state. While this problem would normally have been recoverable, troubleshooting interruptions forced by more pressing mission operations and the troubleshooting of other problems resulted in a series of miscommunications and procedural errors that rendered the TAGS inoperable. **CORRECTIVE_ACTION:** The discrepant TAGS unit was removed from OV-103 and shipped to JSC for a repair that will likely consist of clearing the jammed paper. Repair, cleaning, and retest of the unit will be performed. Final corrective action will be documented in FIAR No. JSC EE-0684F. **EFFECTS_ON_SUBSEQUENT_MISSIONS:** None. A different TAGS unit is installed in OV-105 for STS-57. A Program Change Request (S052882, "Add Thermal Impulse Printers To Orbiter") has been submitted to permanently remove TAGS and replace it with the Thermal Impulse Printer System (TIPS) for all flights subsequent to STS-57. If this Program Change Request is approved, the discrepant TAGS unit will not fly on another Orbiter mission.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET:	Problem	FIAR	IFA STS-56-V-12
EGIL-03	GMT:		SPR 56RF05	UA
			IPR	PR FCP-3-17-0298
				Engineer:

Title: Fuel Cell 1 Substack 3 Delta Volt Increase During Purge. ()

Summary: DISCUSSION: The Cell Performance Monitor (CPM) substack delta voltage readings for fuel cell 1 substack 3 displayed a trend during the mission whereby the readings increased during reactant purges and gradually decreased between purges. The increase during purges was larger with each succeeding purge. Typically, changes in CPM readings are gradual and small.

After five purges of all fuel cells had been performed, the fuel cell 1 substack 3 delta voltage had increased from 25 mV post-launch to a high of 90 mV, well below the 150 mV threshold of concern. Fuel 1 was not included in the sixth and final purge since the performance of fuel cell 1 was otherwise normal and was not predicted to degrade significantly if not purged prior to entry. Performance of fuel cell 1 remained normal for the remainder of the flight. Analysis of the data suggests a plugging of the reactant

ports in one or more of the cells in substack 3. A possible cause is that some of the cells in one half (16 cells) of the substack were experiencing significant blockage due to cell materials corrosion. The effects of the resulting inert accumulation were amplified during the purge, when all or most of the cells in one substack group were effectively purged of inerts while some of the cells in the other 16-cell group received little or no benefit from the purge. **CONCLUSION:** The most probable cause of the fuel cell 1 increased CPM readings during purges was fuel-cell corrosion contaminants blocking one or more reactant ports within the cells in substack 3. **CORRECTIVE_ACTION:** Since the number one fuel cell is to be intentionally shut down as part of a development test objective during the next flight of OV-103, the decision was made to remove and replace this fuel cell after flight and perform failure analysis to verify the cause of the observed behavior. Failure analysis will be reported under the listed CAR. **EFFECTS_ON_SUBSEQUENT_MISSIONS:** None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	MET:	Problem	FIAR	IFA STS-56-V-13
None	GMT:		SPR 56RF07	UA
			IPR 51V-0011	PR
				Manager:
				Engineer:

Title: L5D Heater Failed On (ORB)

Summary: DISCUSSION: During deorbit preparation, the vernier thruster heater for L5D (s/n 402) exhibited behavior that could be interpreted as a failed-on heater. The thruster L5D temperature was 30 to 40° F higher than the other verniers and was exhibiting a slower cool-down rate. The cool-down rate converged with the other vernier thrusters when the vernier heaters were turned off for deorbit. Data review revealed that the L5D injector temperatures were off-scale high for the majority of the mission. The thruster's oxidizer and fuel injector temperatures never decreased below 220° F until the heaters were turned off for entry. The off-scale high temperatures (250° F) are not unusual, especially with high duty-cycle operation; however, this coupled with the slow cool-down rate seemed to indicate a failed-on thruster heater. The temperatures experienced by L5D during the course of the mission could not be explained on the basis of attitude and/or duty cycle. The thruster functioned normally at the higher temperatures. All the other vernier thrusters exhibited normal temperature traces.

Postflight troubleshooting started with the removal of the thruster from the vehicle. Testing of the thruster heater system verified the heater was failed on. The vendor replaced the heater controller and the temperature sensor on the thruster. The thruster was retested with good results, and the thruster was reinstalled on the vehicle. **CONCLUSION:** The failed-on heater on vernier thruster L5D was caused by either the heater controller or the temperature sensor. **CORRECTIVE_ACTION:** Vernier thruster L5D was removed from the vehicle. Testing duplicated the in-flight problem. The vendor replaced the heater controller and temperature sensor. The thruster was retested with good results and reinstalled on the vehicle. The failure analysis of the heater controller and temperature sensor is being conducted under CAR 56RF07-010. **EFFECTS_ON_SUBSEQUENT_MISSIONS:** None

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	MET: 009:03:34:00.014	Problem	FIAR	IFA STS-56-V-14	INST
None	GMT: 107:09:03:00.000		SPR 56RF09	UA	Manager:
			IPR	PR INS-3-16-0634	
					Engineer:
<u>Title:</u> MADS Didn't Record When Commanded Prior To Entry (ORB)					
<u>Summary:</u> DISCUSSION: During the entry phase of STS-56, the Modular Auxiliary Data System (MADS) recorder (s/n/ 1001) failed to begin recording after the Instrumentation and Communication Officer (INCO) sent the "PCM ON" and "WB/ACIP" commands. The commands were sent at approximately 107:09:03 G.m.t. The Recorder-Recording BITE (V78X9604) and the Recorder-Tape Motion BITE (V78X9605E) did not indicate good until 107:09:09 G.m.t., which was a delay of over 6 minutes. The MADS recorder experienced similar delays in recording prior to the mission. These delays are believed to be the signature of a sticky tape.					
The MADS recorder was removed and replaced with a recorder which has a new tape that is less susceptible to stickiness. CONCLUSION: A sticky tape is suspected to have caused the 6-minute delay of the MADS recorder tape motion. CORRECTIVE_ACTION: The MADS recorder was removed and replaced with s/n 1004. The MADS recorder was returned to the vendor, where the recorder will be cleaned and refurbished as required along with the installation of a new tape. Failure analysis will be conducted under CAR 56RF09-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.					
