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

STS - 60, OV - 103, Discovery (18) **Time:04:10:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-01	undefined
EECOM-01	**GMT:**		**SPR** 60RF01	**UA** 117	**Manager:**
			IPR None	**PR** MVO-519A-2-0004	x30268
					Engineer:

Title: Unable to Place Diffuser Cap Into Tunnel Adapter Floor Fitting (ORB)

Summary: DISCUSSION: During Spacelab activation, the nominal procedure is to remove the diffuser cap from the middeck floor air duct fitting and connect it to the tunnel adapter air duct. The tunnel-adapter duct precludes dead air spaces in the tunnel adapter with the aft tunnel adapter hatch closed. Due to insufficient clearance between the tunnel-adapter duct fitting and the tunnel- adapter floor, the crew was unable to properly install the diffuser cap. The crew used gray tape to hold the diffuser cap in place.

The tunnel-adapter air duct is attached to the tunnel-adapter floor with two clamps. During installation, the duct fitting is positioned to provide enough clearance to allow the diffuser cap to be installed. It is possible that the duct fitting could be inadvertently rotated down after installation such that there is insufficient clearance to install the diffuser cap. This can happen if it is bumped or stepped on during vehicle processing or a crew member inadvertently uses the duct fitting to push-off while moving through the tunnel. CONCLUSION: The most likely cause of the insufficient clearance for the diffuser cap installation was that the tunnel-adapter air-duct fitting received sufficient force to rotate it towards the floor through some inadvertent action during the vehicle processing or Spacehab activation. CORRECTIVE_ACTION: To prevent a similar occurrence on a future flight, the manufacturer is proposing the procurement of additional diffuser caps to allow one to be installed on the tunnel-adapter air-duct fitting during the prelaunch processing. This would eliminate the need for the crew to install a diffuser cap during Spacelab/Spacehab activation. The diffuser cap removed from the middeck floor fitting would be stowed until Spacelab/Spacehab deactivation. This IFA will continue to be tracked on CAR 60RF01. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should this condition arise on a future flight, the crew will be able to hold the diffuser cap in place using gray tape.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-02	Water and Waste

EECOM-02 **GMT:** **SPR** 60RF05 **UA** **Manager:**

IPR None. **PR** 123

Engineer:

Title: Supply Water Dump Valve (ORB)

Summary: DISCUSSION: Over a period of approximately two hours following the termination of the first supply water dump at 035:10:56 G.m.t., three addidional slugs or "burps" of water were detected to have been released from the supply dump line. After termination of the second suppy water dump at 036:09:44 G.m.t., 10 more burps were noted over a 16-1/2 hour span. None of the burps were massive enough to measurably affect supply water quantities. Further supply water dumps during this flight were followed by a cabin air purge of the dump system to minimize the chances of further burps, thereby minimizing the chances of payload contamination.

The burping phenomenon has been noted on a number of OV-103 flights dating back to STS-29 (OV-103 flight 8). The phenomenon has also occurred sporadically on the OV-104 supply water dump system. No occurrences of burping have been noted on OV-102 or OV-105. Following STS-48 (OV-103 flight 13), in-flight anomaly STS-48-V-04 was written against this phenomenon. A pressure test of the dump valve indicated no leakage. The dump line, valve, and nozzle were then removed and replaced. The removed equipment was placed in a vacuum chamber to simulate on-orbit operation in an attempt to duplicate the burning phenomenon. Several water dumps were performed, but no burping was detected. However, it was noted that at the termination of a dump, the add-on temperature measurements in the line from the valve outlet to the dump nozzle decreased, and ice formation was detected. This condition may have indicated that the capacity of the line heater was inadequate. The valve was then returned to the vendor for failure analyis; however, no cause for the burping phenomenon was found. The supply water dump system burped again on STS-53 (OV-103 flight 15) and in- flight anomaly STS-53-V-05 was written. Troubleshooting at KSC revealed that the heater system was one wrap short of that specified for the dump valve. The heater was rewrapped per print. Additional testing at Rockwell-Downey on a spare dump valve bellows assembly showed that the burping phenomenon could be induced by spraying water droplets on the bellows in a vacuum chamber. As the water droplets fell on the bellows, they filled the convolutes. As the water froze, it caused the bellows to expand. The bellows expanded enough to unseat the poppet of the valve. To investigate why this phenomenon does not occur in the waste dump system, a test was conducted using a 1-percent salt solution (typical waste- water concentration). No bellows expansion was observed. Analysis was performed to determine if modifications to the supply dump line heater system would preclude freezing in the valve bellows. The results showed that the existing heater power at the valve could not prevent ice formation in the bellows. Heaters sized to maintain the bellows above freezing were found to exceed the valve housing certification temperature limit or required such high power and power density that additional analysis would be required to determine the effect on line temperatures. CONCLUSION: Extensive troubleshooting has not explicitly revealed the mechanism that produces the burping phenomenon. The most likely cause is trapped water in the dump valve bellows is freezing, which expands the bellows to the point of opening the valve; the open valve allows a burp of warm water to flow out of the valve, which then melts the ice and allows the valve to reseat. Fly as-is for the next four Shuttle missions (STS-62, STS-59, STS-65, STS- 68). All four of these flights are now on OV-102 and OV-105 which have no history of the burping phenomena. In-flight maintenance equipment and procedures are in-place to perform cabin air purges of the supply dump line should burping occur and present a contamination concern. For STS-64 and STS-66 (next flights of OV-103 and OV-104, respectively), a new piece of equipment will be provided to allow automatic air purges following supply water dumps. This will be a dual-series check valve assembly that the crew can plug into

the supply water quick disconnect on the contingency cross- tie panel. The crew will terminate supply dumps using the dump isolation valve, causing the check valve assembly to open and pull cabin air through the dump line and valve. After a suitable length of time, the purge will be terminated by closing the dump valve. This is a similar configuration and methodology as used in the Apollo Program for supply water dumps. The new hardware and procedures for the supply water dumps will be evaluated during STS-64 and STS-66. If the results are favorable, this new method of performing supply water dumps will be applied to all vehicles. CORRECTIVE ACTION: Fly as-is for the next four Shuttle missions (STS-62, STS- 59, STS-65, STS-68). All four of these flights are now on OV-102 and OV-105 which have no history of the burping phenomena. In-flight maintenance equipment and procedures are in-place to perform cabin air purges of the supply dump line should burping occur and present a contamination concern. For STS-64 and STS-66 (next flights of OV-103 and OV-104, respectively), a new piece of equipment will be provided to allow automatic air purges following supply water dumps. This will be a dual-series check valve assembly that the crew can plug into the supply water quick disconnect on the contingency cross- tie panel. The crew will terminate supply dumps using the dump isolation valve, causing the check valve assembly to open and pull cabin air through the dump line and valve. After a suitable length of time, the purge will be terminated by closing the dump valve. This is a similar configuration and methodology as used in the Apollo Program for supply water dumps. The new hardware and procedures for the supply water dumps will be evaluated during STS-64 and STS-66. If the results are favorable, this new method of performing supply water dumps will be applied to all vehicles. EFFECTS ON SUBSEQUENT MISSIONS: For STS-64 and STS-66, minor modifications to supply water dump procedures will be required.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-03	C&T - Audio
INCO-01	**GMT:**		**SPR** 60RF02	**UA**	**Manager:**
			IPR	**PR** MVO627A-3-0038	x30150
					Engineer:

Title: PLT HIU Failure (ORB)

Summary: DISCUSSION: When the crew transitioned to the on-orbit communications configuration (very lightweight headsets), the crew reported that the pilot's headset interface unit (HIU) was failed. The faulty unit was replaced with a spare unit, and no other problems were noted. The crew taped/tagged the unit for postflight analysis. KSC sent the hardware to NASA Shuttle Logistics Depot (NSLD) for troubleshooting and analysis.

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 60FR02. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Prior to cabin close-out, the astronaut support personnel (ASP) are able to switch a failed HIU; in addition, a spare HIU is always stowed on-board.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-04	FC/PRSD

EGIL-01	**GMT:**	**SPR** 60RF03	**UA**	**Manager:**
		IPR 64-V-0003	**PR** FCP-3-19-0310	x39034
				Engineer:

Title: 02 Tank 2 Quantity Sensor Erratic (ORB)

Summary: DISCUSSION: During flight, the Oxygen (02) tank 2 quantity sensor (V45Q1205A) showed random fluctuations of about 4 percent (not more than 2 percent allowed). A review of past flight data revealed that similar, shorter duration, behavior has occurred during the last six flights of OV-103. The condition has not affected the use of the tank and has not occurred during cryogenics loading, launch, or landing operations. Postflight troubleshooting at KSC could not repeat the problem. Wiring inspection revealed no anomalies and wire wiggle and tapping the signal conditioner did not cause the quantity to fluctuate or the self-test to fail.

The Power Reactant Storage and Distribution (PRSD) subsystem tank quantity gaging system uses a capacitance probe, and a signal conditioner which is mounted directly on the tank. One possible cause for an anomaly with this signature involves a loose probe, that would result in capacitance fluctuations. Verification of a loose probe would, however, require removal of the tank. Another more probable cause is lifting of the wiper on the

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Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-05	MECH
MMACS-05	**GMT:**		**SPR** 60RF04	**UA**	**Manager:**
			IPR 64V-0005	**PR**	x38946
					Engineer:

Title: WSF Latch 2 Switch Indicates Release (ORB)

Summary: DISCUSSION: During STS-60 on-orbit operations at 040:16:07 G.m.t. (006:03:57 MET), the payload rentention latch 2 switch (switch 42 on panel A6U) position indication began showing release. This indication normally shows release when the switch has been placed in the release position, which sends a command to the latch to drive to the release direction. The command was inhibited, and no command moved the latch. The switch was not being operated at the time, and the crew verified that the switch was in the off position; thus, the indication should have been off rather than release.

The switch positions are release, off, and latch. The erroneous indication is routed through multiplexer-demultiplexer (MDM) OF2, serial number (s/n) 116, card 4, channel 0, bit 15. The other bits on this channel and card remained nominal. Earlier in the flight, the switch had been used to latch and release the Wake Shield Facility WSF several times with no anomalous indications. The failure occurred several hours after the final berthing of the WSF, and the switch was not to be used again during the flight. A redundant inhibit to prevent actuation of the latch was activated by the crew as a further safety measure. When vehicle power was cycled after landing, the unexplained indication cleared. Troubleshooting did not recreate the problem. MDM OF2 s/n 116 has only one failure on record, a power supply built-in test equipment

(BITE) failure in 1982. The problem was transient and did not repeat; however, as a result, the three parts identified as the most probable causes of the failure were removed and replaced. The parts were the power supply master hybrid, the power supply control hybrid, and a transformer. This BITE failure is unrelated to the erroneous indication observed during STS- 60. Three failures involving a single bit failed-high have occurred in a flight MDM in the history of the program. They occurred in 1985, 1987, and 1992. Two of the three were traced to hardware failures in the MDM: a miswired diode in the 1985 failure, and a faulty capacitor in the 1992 failure. The 1987 failure was an unexplained anomaly. The three units were removed and replaced. However, the signatures on all three of the MDMs differed from that seen in the s/n 116 failure during this flight. The three previous failures were repeatable in testing and did not clear with a power cycle, unlike the failure during STS-60. The switch is also a candidate for having caused the failure. Three failures have occurred on similar switches that resulted in one contact being made. In 1988, gold flakes from the contact-shoe gold plating in a switch bridged the gap between the center- and inhibit-position contacts. This switch had an estimated 50,000 cycles on it. The retention latch switch on STS-60 has an esitmated 900 cycles on it. The switches are rated for 5,000 cycles. During STS-41, a switch contact was made due to a solder ball. The continuity lasted 27 seconds, at which time another switch on the same panel was cycled, clearing the problem. During STS-57, copper shavings made continuity across one pole of a four-pole switch until the switch was cycled. The problem did not repeat. The STS-57 failure was on a 105-build switch, and the copper-shavings problem has not been observed on the older switches flown on OV-103. All three of these previous switch failures were caused by contamination, and none of them would respond to power being cycled, which the failure on STS-60 did. The contamination would also dislodge when subjected to the entry dynamics, which the failure on STS-60 did not do. This leads to the conclusion that it is not likely that contamination in the switch caused indication seen on STS-60. However, because the failure of this switch during a subsequent flight could cause loss of mission objectives, the switch was removed and replaced. It will be subjected to acceptance test procedures (ATP). After ATP, it will be determined whether to perform destructive failure analysis or return the switch to flight spares. Failure analysis will be tracked under CAR 60RF04. The most likely failure scenario is the bit in the MDM channel failed high. The impact to future flights, should the failure recur, is loss of insight into the switch position. The MDM would most likely be recovered with a power cycle. Because the failure was a one-time transient and because this bit failing high does not affect safety or mission success, the MDM will remain on the vehicle. It will, however, be monitored and removed if any further anomalies are observed. CONCLUSION: The MDM is believed to be the cause of the erroneous indication. This is based on the observed signature being sustained through entry and only clearing when vehicle power was cycled. CORRECTIVE_ACTION: The switch was removed and replaced. It will undergo ATP and possibly destructive failure analysis. The MDM will be monitored and if any further anomalies are observed, the MDM will be removed and replaced. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. This is not believed to be a generic failure. If the problem does recur in-flight, the result will be loss of insight into the swtich position if the MDM fails, or loss of commands to the latch if the switch fails.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-60-V-06	Hydraulics
None	**GMT:**		**SPR** 60RF06	**UA**	**Manager:**
			IPR HYD-0687	**PR** HYD-3-19-0687	
					Engineer:

Title: Internal Leakage Through WSB GN2 Regulator (ORB)

Summary: DISCUSSION: At approximately 035:08:03 G.m.t. (00:19:53 MET), data showed that water spray boiler (WSB) 3 gaseous nitrogen (GN2) regulator (S/N 014) had an internal leak of 26 sccm for a period of approximately 30 minutes. The specification internal leakage for this regulator is no more than 0.5 sccm (acceptance test procedure specification). Following this 30-minute period, when the downstream pressure increased from 26.4 to 27.3 psia, the leak stopped without any action being taken. Analysis indicates that at the time the leak stopped, the pressure upstream of the regulator was still greater than the pressure downstream. Any additional leakage that might have subsequently occurred may have been masked by the in-specification leakage of the relief valve.

Prior to STS-60, the WSB 3 GN2 regulator had failed a