Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-67-V-01	OMS/RCS
PROP-01	GMT:		SPR 67RF04	UA A0016	Manager:
			IPR	PR	
					Engineer:

Title: Vernier Thruster L5D Oxidizer Temperature Erratic (ORB)

Summary: INVESTIGATION/DISCUSSION: At 061:08:54 G.m.t. (00:02:16 MET), the oxidizer- injector temperature (V42T2525C) on vernier reaction control system (RCS) thruster L5D (S/N 461) rapidly decreased below the 130 ?F leak-detection limit which resulted in the automatic deselection of L5D by redundancy management (RM). The indicated oxidizer-injector temperature remained offset low in the range of 50 to 100 ?F throughout the mission. This same behavior occurred on the previous flight of OV-105 (STS-68).

The loss of vernier thruster L5D resulted in the loss of the attitude-control capability using the vernier thrusters. To recover from this condition, a pre- approved general purpose computer (GPC) memory (GMEM) write procedure was implemented to change the oxidizer-injector temperature leak-detection limit of all vernier thrusters from 130 ?F to off-scale-low. Since the software does not allow limits to be set for individual thrusters, all vernier thrusters had their oxidizer-injector temperature leak-detection limits reset. The successful implementation of this GMEM allowed for the reselection of L5D and a recovery of the vernier-thruster attitude-control capability. This recovery option allowed operation of the vernier thrusters with RM fail- leak detection using the fuel-injector temperatures. While the loss of the oxidizer-injector temperatures for leak detection resulted in some degradation of the leak-detection capability, the fuel-injector temperatures provided adequate insight into oxidizer leaks. Thruster L5D performed nominally for the remainder of the mission. Late in the mission, a multiplexer/demultiplexer (MDM) built-in test equipment (BITE) test was performed on channel 7 of card 14 in the flight-aft (FA) 1 MDM to aid in troubleshooting the temperature measurement. The BITE test results indicated that the MDM was functioning properly. Following landing of OV-105 at the Dryden Flight Research Center (DFRC), the oxidizer-injector temperature remained offset low. However, upon arrival of the vehicle at KSC, the oxidizer-injector temperature for L5D was indicating properly and it has continued to do so since that time. The same performance was experienced following STS-68. Troubleshooting following the STS-68 mission included a wiggle test and visual inspection of the thruster connector, and tests of the oxidizer-injector- temperature transducer and the dedicated signal conditioner (DSC). The DSC testing consisted of measuring the excitation voltage from the DSC and sending a full range of the transducer output signal to the DSC. The orbital maneuvering system (OMS) pod was not removed during the troubleshooting, therefore, there was no 'hands-on' testing of the DSC (located inside the OMS pod) or of the wiring/connectors located inside the OMS pod. A final test used a heat gun to apply energy

to the thruster injector through the thruster nozzle to simulate flight conditions. Throughout all of the testing, no anomalies were noted. Since vernier thruster L5D (S/N 102) had been installed prior to the STS-68 mission, and all other hardware that could have caused the anomaly had been undisturbed, the thruster was removed and replaced to eliminate a potential problem source. Troubleshooting following the STS-67 mission included untying, inspecting, and flexing of all accessible wiring harnesses between the OMS pod interface connector and the FA1 MDM. Also, all connectors between the OMS pod interface and the FA1 MDM were demated and inspected and hi-pot tests were performed, and as was done following STS-68, general input and output capabilities of the DSC were verified via OMS-pod external interfaces. Once again, the wiring internal to the OMS pod could not be inspected or flexed because the OMS pod was not removed. As was the case during the post STS-68 troubleshooting, no anomalies were noted. The decision was made to fly the hardware as-is and use, if required, the pre- approved GMEM during the next OV-105 mission (STS-69). Further troubleshooting will be performed when the OMS pod is removed, either for its Orbiter maintenance down period (OMDP) or to repair a more significant problem. CAUSE(s)/PROBABLE Cause(s): The most probable cause of the erratic/offset low oxidizer-injector temperature is an intermittent resistance variation in the instrumentation wiring or connectors located inside the OMS pod. CORRECTIVE_ACTION: Following each of the last two missions of OV-105 (STS-68 and -67), extensive troubleshooting of the hardware that was accessible without removing the OMS pod was performed and the problem was not repeated. Further troubleshooting will be performed when the OMS pod is removed, either for its OMDP or to repair a more significant problem. Results of future troubleshooting/corrective action will be tracked under CAR 67RF04. RATIONALE FOR FLIGHT: Should the problem recur, the vernier-thruster oxidizer- injector temperature leak-detection limit could again be changed via GMEM to off-scale-low. As was the case during the STS-68 and STS-67 missions, this would still enable operation of the vernier thrusters with fail-off, fail-on, and, with the fuel-injector temperature, fail-leak detection using RM. While the loss of the oxidizer-injector temperature for leak detection results in some degradation of the leak-detection capability, the fuel-injector temperature provides adequate insight into oxidizer leaks.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-67-V-02	OMS/RCS
PROP-02	**GMT:**		**SPR** 67RF01	**UA**	**Manager:**
			IPR	**PR** RP01-22-0764	
					Engineer:

Title: R4R Fail Leak (ORB)

Summary: INVESTIGATION/DISCUSSION: At 061:18:56 G.m.t. (00:12:18 MET), reaction control subsystem (RCS) primary thruster R4R (S/N 236) was declared failed-leak by the redundancy management (RM). The oxidizer injector temperature decreased to 13.7 ?F and the fuel injector temperature went to 42.1 ?F. During prelaunch inspection, the ice team noted R4R had a wet paper cover which can be indicative of low-level oxidizer-vapor leakage. The thruster had not been fired during this mission, and no other thrusters were being fired at the time the leak developed. The oxidizer leak rate was estimated at 10,000 cch, liquid. When the R4R fuel injector temperature reached 40 ?F the right manifold 4 isolation valves were closed. The oxidizer manifold pressure dropped to vapor pressure in less than one second indicating the R4R oxidizer did have a significant leak. If the R4R fuel valve leaked, it appeared to have been very small because the fuel manifold pressure followed the temperature. (After the flight, the right fuel manifold 4 isolation valve was found to be leaking - 12,000 scch or 70 - 100 cch, liquid, which could have maintained the manifold pressure and

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-67-V-03	Landing/Decel S
MMACS-01	GMT:		SPR 67RF02	UA	Manager:
			IPR IPR 69V-0008	PR	
					Engineer:

Title: Lefthand MLG Outboard Tire Pressure 1 (V51P0570A) Off-Scale Low (ORB)

Summary: INVESTIGATION/DISCUSSION: During the STS-67 mission, at 062:17:39 G.m.t. (001:11:01 MET), the left-hand outboard main landing gear (MLG) tire pressure 1 (V51P0570A) became erratic for approximately 40 minutes. Half an hour later, the erratic behavior resumed and the measurement then began reading off-scale low, where it remained for 55 hours, at which point it resumed normal operation. No further off-nominal behavior for this measurement was observed for the remainder of the flight. The redundant tire pressure measurement for that particular tire exhibited nominal performance throughout the flight.

Review of temperature instrumentation on the left outboard wheel rim revealed that the anomaly occurred while the tire temperature was between approximately 40 ?F and 20 ?F. When wheel/tire temperatures cooled to below 20 ?F, the measurement returned to normal. Wheel/tire temperatures remained below 20 ?F for the remainder of the mission, during which time the measurement performed normally. This temperature range is typical for the wheel well area and is within the tire pressure data monitoring system (TPDMS) operating limits of - 30 ?F to +120 ?F. The breakaway harness was sufficiently intact after landing to allow some electrical testing. No problems were found. The sensor excitation voltage was measured and simulated input voltages were injected back towards the signal conditioner. All indications were nominal. Accessible permanent wiring routed through the wheel/tire assembly was inspected and flexed with no anomalous indications. The most likely cause is a poor connection in the breakaway harness, which, under certain thermal conditions, becomes intermittent. Because the harness is designed to breakaway at touchdown, this suspected intermittent connection is not verifiable. The problem could also be due to an intermittent open/short internal to the transducer or in the permanent vehicle harness. Regardless of the specific failure location, it is believed that temperature- induced expansion/contraction caused the intermittent loss of continuity (open) or contact to electrical ground (short). There have been 11 previous failures of the tire pressure sensors during flight or ground operations. None of these previous failures involved intermittent operation. Of these, 10 were typical failures, i.e., operating outside of the specification allowed error band. The remaining previous failure was related to a clearance problem between the sensor wiring and surrounding hardware. There was no failure of the TPDMS as a result of the clearance problem, only minor damage to the sensor wiring. CAUSE(s)/PROBABLE Cause(s): The most likely cause is an intermittent connection in the harness resulting from temperature-induced loss of continuity or contact to electrical ground. CORRECTIVE_ACTION: None required. RATIONALE FOR FLIGHT: Postflight testing indicates no anomalies with the permanent Orbiter wiring associated with the tire pressure measurement. A new breakaway harness is installed and verified prior to each flight, and a redundant

pressure measurement exists, with a secondary sensor and separate signal conditioner channel and wiring, should the failure recur. This failure is not considered generic because there has been no previous failure of this type.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-67-V-04	C&T - Audio
INC0-01	GMT:		SPR	UA	Manager:
			IPR IPR 69V-0009	PR	
					Engineer:

Title: Loss of Middeck Audio, ICOM, A/G (ORB)

Summary: INVESTIGATION/DISCUSSION: Shortly after ascent, during post-insertion reconfiguration activities, the crew found that the middeck audio terminal unit (ATU) intercom and air-to-ground (A/G) communications functions had failed, and that the middeck speaker unit (SU) was not functioning. Although the condition was first noticed during post-insertion reconfiguration procedures, it was not reported until 061:21:54 G.m.t. (000:15:16 MET). During debriefing, crew members seated on the middeck reported that the communication system functioned nominally during preflight A/G checks and ascent. As they were getting out of their launch escape suits (LES's) and re- configuring middeck communications, they heard a second or so of very loud flight-deck voice transmission over the middeck speaker unit (SU). This occurred immediately upon switching on the SU at approximately 061:06:54 G.m.t. (000:00:16 MET) after which there was no further successful use of the middeck ATU or SU. Per normal procedures, a hand-held microphone (HHM) was connected prior to turning on the SU. Although this same HHM also failed to function when a crew member was reconfiguring middeck communications using the airlock ATU, upon later reflection that crew member believed that this failure was probably due to an incorrect configuration. As a precaution, this HHM was tagged and not used for the remainder of the flight. During subsequent in- flight investigation of the anomaly, the circuit breaker for this system on panel R15 (CB5, 3 amps) was found open. Analysis of fuel-cell current data from the post-insertion time frame revealed a 15-amp spike with a 1-second duration at 061:06:54:08 G.m.t. (000:00:15:55 MET). The spike was characteristic of what happens when a 3-amp breaker trips due to a low resistance short (around 2 ohms) or component failure. Although this current spike roughly corresponded to the time at which the crew was performing the middeck communication configuration for orbit, it could not be directly correlated to either a crew action or the opening of the breaker. Because of these indications of a possible short circuit or overload, the crew was directed to configure for middeck communications using the airlock ATU rather than re-engaging the breaker. In-flight troubleshooting of the anomaly did not reveal the cause of the condition. As a result, flight rule 9-534 prohibited re-engagement of the circuit breaker for the remainder of the flight because of the potential existence of a shorted condition. During entry, middeck audio was provided through the use of an extension cable routed to the payload specialist ATU.

Upon re-engagement of the breaker during postflight troubleshooting, system function was nominal. Troubleshooting, which included functional testing of all nominal audio configurations, verification of system parameters during operation using a break-out box, system load checks using an external power source, and insulation resistance checks of the power wiring, was unable to re- create the problem or identify any possible causes. All HHM's were checked out as well, connectors were examined for signs of damage, and circuit breaker open and closing function was verified. Disassembly and inspection of the HHM in use at the time of the failure revealed no internal damage. In addition, to help preclude the possibility that the anomaly was time or temperature related, the system was operated for extended periods of time during normal turnaround processing activities. Since ground troubleshooting efforts were unable to reproduce the anomaly or identify suspect hardware, the Interim Problem Report (IPR) will be upgraded to a Problem Report (PR) and closed as an unexplained anomaly (UA). CAUSE(s)/PROBABLE Cause(s): Post flight troubleshooting could not determine a cause for the condition. One possible cause is that the circuit breaker opened through inadvertent contact. This is considered to be remote because it would be physically difficult to do, and because the crew was not aware of any such contact. In addition, the fuel-cell current spike, which was observed in the time frame in which the anomaly is suspected to have occurred, was characteristic of a trip of this type of breaker rather than simply opening the switch. Other possible causes are transient conductive contamination in an LRU or a short in a cable. This is considered unlikely for the ATU or SU since both are internally conformally coated and both have performed nominally on previous flights of OV-105 (7 flights for the ATU, 5 for the SU). Also, damage resulting from this type of short circuit should be obvious. Close inspection of the HHM involved, and testing and inspection of the cables, revealed no evidence of an internal short. CORRECTIVE_ACTION: Since the failure could not be repeated, and troubleshooting could not find evidence of failed hardware, no corrective action has been identified. The IPR will be upgraded to a PR and closed as an unexplained anomaly. Upon upgrade to a PR, a CAR will be opened against the Orbiter and then also closed as an unexplained anomaly. The hardware will be flown again as is. RATIONALE FOR FLIGHT: Failure of this communication system hardware is criticality 1R3. Should a loss of middeck communication capability occur on future flights, the workarounds used during STS-67 are available. Middeck communications can be provided by way of the airlock ATU, or via extension cable from the flight deck. Circuit design mitigates the effects of a short circuit or overload through the selection of circuit breakers which are sized to provide proper wire protection. Flight Rules augment this fail safe design by not permitting the in-flight re-engagement of a breaker unless the cause of the trip is determined and corrected or the lost function is critical to the safe operation of the Orbiter. Recurrence of the anomaly will not impact mission success or flight safety, except in the case of an abort/bailout situation during ascent. At present, there is no backup to the middeck communication system for informing the middeck crew of an ascent contingency situation.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-67-V-05	OMS/RCS
PROP-03	GMT:		SPR 67RF03	UA	Manager:
			IPR	PR RP01-22-0765	
					Engineer:

Title: R1A Fail Off (ORB)

Summary: INVESTIGATION/DISCUSSION: Reaction control subsystem (RCS) primary thruster R1A (S/N 318) was declared failed-off when used during the RCS hotfire. This was the first attempted firing of thruster R1A during the mission. When the fire command was initiated, the thruster chamber pressure (Pc) indication increased to only 8 psia prior to deselection by redundancy management (RM) at 320 msec. RM declares a thruster failed-off after receiving three consecutive chamber pressure discretes indicating a chamber pressure of less than 36 psia. The nominal chamber pressure for a primary thruster is approximately 152 psia. Injector tube temperature data indicate both oxidizer and fuel flow occurred. The injector temperature data also indicate that the thruster failed to fire as evidenced by the lack of a post-firing temperature rise due to soakback heating.

The data seen during flight are the classic signature for a fail-off due to metallic-nitrate contamination of the thruster oxidizer valve. The oxidizer flow seen in the injector tube temperature data was most probably pilot-valve- only (or limited) flow, which accounted for the low chamber pressure. The oxidizer-valve main-stage probably failed to open fully due to metallic- nitrate contamination of the pilot stage. The RCS primary-thruster oxidizer valve has a solenoid-operated pilot stage and a pressure-operated main stage, and a failure to operate due to metallic-nitrate contamination in the pilot stage is the most common failure mode. The thruster was left deselected for the remainder of the mission. The S/N 318 thruster had been flown on 15 missions prior to STS-67. During its thirteenth mission (STS-47), installed in the L3A position on OMS pod LP03, it failed-off due to low Pc when fired following External Tank separation. Following the mission, the thruster was removed from the vehicle and sent to the White Sands Test Facility (WSTF) for deionized water flushing. The thruster failed the post-flush leak test (forward leakage during the high-pressure leak test was 462 scch, should be no-more-than 350 scch) at the WSTF and it was then sent to the vendor for further testing. At the vendor, the valve passed the leak test and additional functional testing. However, the vendor found metallic chips, most likely remnants of the build process, in the Pc tube and at the pressure transducer. As a result, the vendor replaced the transducer. It is uncertain if the contamination in the Pc tube resulted in the STS-47 fail-off; however, based on past failure history, metallic nitrate-contamination in the oxidizer valve is the most probable cause. The vendor returned the thruster to KSC where it was installed on OMS pod RP01 and flew on STS-59, STS-68 and STS-67. The R1A thruster exhibited increased leakage throughout the STS-67 flow. The R1A desiccants were changed out four times in the Orbiter Processing Facility (OPF). The desiccant changeout rate increased to about one per day following the thruster R3A oxidizer leak, which, coupled with the cold temperatures experienced during the OPF-to-vehicle assembly building (VAB) rollout, allowed the manifold pressure to decrease to vapor pressure. In the last several weeks prior to launch, the desiccant changeout rate had increased to about one per shift. It is believed that oxidizer-valve leakage can lead to moisture (water) intrusion, and it is known that the formation of metallic-nitrate contamination is aggravated by the presence of water in the oxidizer valve. The thruster was removed and replaced at KSC and will be shipped to the WSTF. It is believed that the thruster failed-off as a result of metallic-nitrate contamination. However, because of the previous failure history of this thruster, the decision was made to remove and replace the oxidizer valve instead of performing the deionized water flush. The thruster will re- acceptance tested, which includes a hot-fire, prior to being returned to spares at KSC. The oxidizer valve removed from the thruster will be returned to the vendor and rebuilt. A failure analysis will not be performed. CAUSE(s)/PROBABLE Cause(s): The cause of the thruster fail-off was most probably metallic-nitrate contamination in the oxidizer-valve pilot-stage that prevented its proper operation. CORRECTIVE_ACTION: KSC removed and replaced thruster R1A, and the thruster will be shipped to the WSTF. The oxidizer valve will be removed and replaced and the thruster will be re-acceptance tested prior to being returned to KSC. The removed oxidizer valve will be shipped to the vendor where it will be rebuilt. A failure analysis will not be performed. Due to the frequency of primary thruster failures, a team was formed to evaluate the causes of the failures and consider solutions. These solutions include possible hardware changes for the future and processing changes for the near term. Among the recommended processing procedures, many are already in place. Metallic-nitrate contamination, the cause of the fail-off, is aggravated by the presence of water (moisture) in the oxidizer system. Therefore, the primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion into the propellant system. Also, RCS break-ins are minimized to preclude the introduction of contamination and the propellant manifolds are maintained, whenever possible, at an elevated pad pressure to maintain sealing integrity. Periodic water flushing of the valves, hard-filled-manifold pod processing, and improved thermal conditioning for all flow phases, are among several proposed processing changes that are being considered. A program to develop a direct- acting valve, which would be less susceptible to failure from metallic-nitrate contamination, is currently in progress. Additionally, an evaluation of modifications to improve the existing valve will be pursued. RATIONALE FOR FLIGHT: System redundancy is adequate to support the failure rate of the primary RCS thrusters. There have been no changes to the thruster design or to the RCS turnaround processing procedures that would adversely affect this failure rate.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-67-V-06	Atmospheric Rev
EECOM-04	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR 69V-0015	**PR** RCL-0418	
					Engineer:

Title: PCS System 2 N2 High Flow Transcients After Switches from O2 to N2 (ORB)

Summary: INVESTIGATION/DISCUSSION: After the mid-mission change from pressure control system (PCS) -1 to PCS-2, several occurrences of transient-high nitrogen (N2) flow were observed. The transients occurred at the beginning of the N2 flow cycle upon switch-over from oxygen (O2)-to-N2 flow. The initial higher-than- normal N2 flow was observed during six of the 11 O2-to-N2 switch-over cycles, with flow rates ranging from 2.75 to 5.0 lbm/hr and lasting up to several minutes. Normal N2 flow profiles sustain an initial peak of 1.5 lbm/hr for just a few seconds. During one event, the flow went off-scale high (over 5.0 lbm/hr) for about 1.5 minutes, tripping the caution and warning alarm for exceeding the N2 flow-rate fault detection and annunciation (FDA) limit of 4.9 lbm/hr. None of the high-flow transients can be explained by events known to produce high N2 flow, such as waste collection system (WCS) usage near the time of switch-over, low cabin pressure, or decreasing cabin temperature. Data from previous flights of OV-105 reveal similar transient-high PCS-2 N2 flow behavior; however, this behavior typically only occurred on the first two or three switch-over cycles. The cabin 14.7-psia regulator is the PCS component that controls the amount of oxygen/nitrogen flow that enters the cabin. The regulator design includes low- and high-flow sections which provide flow rates based upon the total cabin pressure. In the low-flow section, a poppet opens based on the differential pressure across an aneroid and the total flow is limited to less than 1.0 lbm/hr by an internal orifice. The flow rate through the high-flow section occurs after a pressure-balanced poppet is opened and is based upon the pressure drop across the internal orifice that feeds the low-flow section of the regulator. As the flow rate to the low-flow section increases, the pressure drop across the internal orifice increases and this results in an unbalanced pressure condition across the high-flow poppet that lifts it off of its seat. After the poppet has lifted, very minor pressure fluctuations can cause the high-flow alarms that were experienced in flight. Several possibilities have been identified that could result in aggravated unbalancing of the high-flow poppet beyond its lift-off differential pressure. These include contamination, excessive wear and tear, and/or a change in the poppet spring rate. Postflight testing revealed that the PCS-2 cabin-pressure-regulator control pressure was within specification, but the control pressure had shifted to where it is out-of-family when compared to the rest of the fleet. It is thought that this shift may be another symptom of the cause of the high N2 flow. This condition may have also caused transient-high O2 flow rates; however, the O2 flow meter is currently not functioning. A

KSC Request Form (Chit) will be processed to remove the N2/O2 control panel during Orbiter Maintenance Down Period (OMDP) and return it to the vendor for failure analysis.

A workaround has been developed to prevent a predicted activation of the N2- flow FDA alarm during on-orbit operations as a result of an O2/N2 switch- over. Ground controllers will perform a table maintenance block update (TMBU) to change the alarm limits shortly before a switch-over is to occur. Also, the PCS-2 regulator will continue to be operated on-orbit for a minimum of one complete switch-over cycle from O2-to-N2 and N2-to-O2 to allow for the incremental evaluation of the regulator condition. CAUSE(s)/PROBABLE Cause(s): The component causing the transient-high N2 flow rates has been isolated to the PCS-2 14.7-psia cabin regulator. The exact failure has not been identified, but ground testing of the regulator has determined it to be acceptable for flight until an opportunity to replace the regulator occurs during the upcoming OMDP. CORRECTIVE_ACTION: Workaround procedures have been developed to enable the ground controllers to prevent the ringing of an FDA alarm as a result of this transient condition. During the OMDP following flight 11, the N2/O2 control panel will be removed and shipped to the vendor where test, teardown and evaluation (TT&E) plus failure analysis will be performed to identify the exact cause of the high flow and control point shift. If the control-point continues to shift downward, this plan will be re-evaluated to determine if an earlier removal and replacement is required. RATIONALE FOR FLIGHT: The condition itself does not affect the ability of the regulator panel to control the amount of oxygen and nitrogen introduced into the cabin. Procedures have been developed to prevent the ringing of FDA alarms. As such, there is currently no need to remove the panel prior to the scheduled OMDP.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-67-V-07	Active Thermal
EECOM-01	GMT:		SPR	UA	Manager:
			IPR IPR 69V-0004	PR	
					Engineer:

Title: FES Supply B Accumulator/Hi-Load Line System 2 Heater Performance During Prelaunch (ORB)

Summary: INVESTIGATION/DISCUSSION: The flash evaporator system (FES) supply B accumulator/hi-load line system 2 heaters are used to control the accumulator/hi-load line temperatures during the prelaunch time frame. When the External Tank (ET) cryogenic loading began, the accumulator line temperature (V63T1894A) began decreasing from its pre-tanking value of approximately 80 ?F. The temperature reached 56.6 ?F before the heater was reconfigured to system 1. The Launch Commit Criteria (LCC) limit is 56 ?F. Normal system 2 heater performance was observed prior to the start of ET cryogenic loading.

Approximately four minutes and 20 seconds after the heater reconfiguration to system 1, the accumulator line temperature began to increase. The high-load line heater is controlled by the same thermostat, and its temperature remained above 100 ?F while being controlled by both systems. The heater thermostat is located on the accumulator line and remained closed (heater on) throughout the prelaunch period following the start of ET cryogenic loading. During the mission, the FES feedline heaters were reconfigured from system 1 to system 2 at 069:05:22 G.m.t. (07:22:44 MET) for normal system redundancy checkout. Normal heater cycles were observed on the FES supply B accumulator/hi-load line system 2 heater. Postlanding, a detailed inspection of the FES feedline insulation revealed a small gap between the feedline insulation wrap and an insulation box that covers the thermostat. The accumulator-line temperature sensor (V63T1894A) is located under the edge of the thermostat insulation box at the location where the gap was found. The gap was covered by tape. When ET cryogenic loading began, convective cooling from the cold temperatures in the aft compartment caused a gradual decrease in the accumulator-line temperature even though the heater remained on. After the prelaunch heater switching change occurred, the system 1 accumulator body heater came on immediately, but no increase in the accumulator line temperature occurred for over four minutes. At that time, the accumulator temperature increased at a rate similar to that of the accumulator body, indicating conductive heating or water movement from the accumulator body. Convective cooling does not occur on orbit, and therefore, the performance of heater string 2 during the flight was nominal. Two potential causes of the problem have been identified. The vendor replaced a thermostat on the System A feedline in the affected area during the STS-67 flow, and it is possible that the insulation could have been disturbed during that work. Normal heater checkout during turnaround sometimes requires removal of the insulation from a thermostat location to activate the thermostat, and could have occurred during the STS-67 flow. Both the vendor and KSC technicians have been made aware of the importance of installing the insulation properly. Additionally, an LCC revision has been prepared to clarify the requirements for reconfiguring heater strings and will protect against a launch impact should similar conditions occur. CAUSE(s)/PROBABLE Cause(s): The most probable cause of the FES supply B accumulator/hi-load line system 2 heater performance during the prelaunch time frame was a workmanship error that left a gap in the insulation on the accumulator line. CORRECTIVE_ACTION: The vendor and KSC technician have been informed of the importance of assuring that all FES insulation is installed properly. An LCC revision has been prepared that clarifies the heater switching process. RATIONALE FOR FLIGHT: The incomplete installation of insulation is only a concern during the prelaunch time frame as convective cooling can and will affect thermostats and temperature sensors. The on-orbit environment is such that the cooling effects due to a small gap in the insulation are not a concern. This anomaly does not result in loss of heater function or FES capability. The LCC currently allows launch with a loss of one heater string. The LCC change will protect against a launch delay due to a similar problem.