MISSION SAFETY EVALUATION REPORT FOR STS-30

Postflight Edition: August 25, 1989

Safety Division

Office of Safety, Reliability, Maintainability, and Quality Assurance

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MISSION SAFETY EVALUATION

REPORT FOR STS-30

Postflight Edition: August 25, 1989

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EXECUTIVE SUMMARY

Space Shuttle *Atlantis* was launched from Kennedy Space Center at 2:46:59.011 p.m. Eastern Daylight Time (EDT) on May 4, 1989. The primary objective of the STS-30 mission, deployment of the Magellan Spacecraft, was successfully accomplished. Magellan is a scientific payload which will be used to gather high-resolution topographic data and altimetry of the planet Venus.

After a successful flight of slightly over 4 days, *Atlantis* landed on concrete runway 22, in a 10-knot crosswind, at Edwards Air Force Base at 3:43:37.89 p.m. EDT on May 8, 1989. The STS-30 mission was relatively clean of major anomalies and problems. Anomalies which relate to prior mission inflight anomalies or resolved significant risk factors from prior flights include:

- Failure of the left-hand forward field joint secondary heater during prelaunch testing.
- Failure of the Reaction Control System Jet R1U during mated coast.
- Failure of the Debris Containment System to properly contain fragments at holddown posts #2, #3, #5, and #7.
- Failure of the Auxiliary Power Unit No. 2 Gas Generator Heater System "A" to respond in the A-Auto position.

These anomalies will be readdressed in the STS-28 Mission Safety Evaluation.

FOREWORD

The Mission Safety Evaluation (MSE) is a National Aeronautics and Space Administration (NASA) Headquarters Safety Division, Code QS produced document that is prepared for use by the NASA Associate Administrator, Office of Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA) and the National Space Transportation System (NSTS) Program Manager prior to each NSTS flight. The intent of the MSE is to document significant safety risk factors that represent a change, or potential change, to the risk baselined by the Program Requirements Control Board (PRCB) in the NSTS Hazard Reports. It also documents unresolved safety risk factors impacting the STS-30 flight.

The MSE is published on a mission-by-mission basis for use in the Flight Readiness Review (FRR) and is updated for the Launch Minus 2 Day (L-2) Review. For tracking and archival purposes, the MSE is issued in final postflight report format after each NSTS flight.

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Section 1

INTRODUCTION

1.1 Purpose

The Mission Safety Evaluation (MSE) provides the Associate Administrator, Office of Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA) and the National Space Transportation System (NSTS) Program Manager with the NASA Headquarters Safety Division position on significant changes, or potential changes, to the Program safety risk baseline approved in the formal Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and Hazard Analysis process. While some changes to the baseline since the previous flight are included to highlight their significance in risk level change, the primary purpose is to ensure that changes which were too late to include in formal changes through the FMEA/CIL and Hazard Analysis process are documented along with the safety position, which includes the acceptance rationale.

1.2 Scope

This report addresses STS-30 safety risk factors that represent a significant change from previous flights, factors from previous flights that have impact on this flight, and factors that are unique to this flight.

Factors listed in the MSE are essentially limited to items that significantly (or have the potential to) affect NSTS safety risk factors and have been elevated to Level I for discussion or approval. These items are derived from a variety of sources such as issues, concerns, problems, and anomalies. It is not the intent to attempt to scour lower level files for items dispositioned and closed at those levels and report them here; it is assumed that their significance is such that Level I discussion or approval is not appropriate for them. Items against which there is clearly no safety impact or potential concern will not be reported here, although items that were evaluated at some length and found not to be a concern will be reported as such. NASA Safety Reporting System (NSRS) issues are considered along with the other factors, but may not be specifically identified as such.

Data gathering is a continuous process. However, collating and focusing of MSE data for a specific mission begins prior to the mission Launch Site Flow Review (LSFR) and continues through the flight and return of the Orbiter to Kennedy Space Center (KSC). For archival purposes, the MSE has been updated subsequent to the mission to add items identified too late for inclusion in the prelaunch report and to document performance of the anomalous systems for possible future use in safety evaluations.

1.3 Organization

The MSE is presented in seven sections as follows:

Section 1 - Provides brief introductory remarks, including purpose, scope, and organization.

Section 2 - Provides a summary description of the STS-30 mission; a brief flight/vehicle description, including launch data, crew size, flight duration, launch and landing sites, and other related information; and a brief payload description.

Section 3 - Contains a summary listing of significant safety risk factors/issues, considered resolved or not a safety concern prior to STS-30 launch, that were impacted or repeated by anomalies reported for the STS-30 flight.

Section 4 - Contains a summary listing of significant safety risk factors that were considered resolved for STS-30.

Section 5 - Contains a summary listing of significant safety-of-flight problems that developed during the STS-29 mission.

Section 6 - Contains a summary listing of significant safety-of-flight problems that developed during the STS-27 mission.

Section 7 - Contains background and historical data on the issues, problems, concerns, and anomalies addressed in Sections 3 through 6. This section is not normally provided as part of the MSE, but is available upon request. It contains (in notebook format) presentation data, white papers, and other documentation. These data were used to support the resolution rationale or retention of open status for each item discussed in the MSE.

Appendix A - Contains the official STS-30 Inflight Anomaly (IFA) Report. This report is included for completeness and reference purposes. Those STS-30 IFAs which are considered to represent significant safety risks will be addressed in the MSE for the next NSTS flight.

Appendix B - Provides a list of acronyms used in this report.

Section 2

STS-30 MISSION SUMMARY

2.1 Summary Description of STS-30 Mission

Space Shuttle *Atlantis* was launched from Kennedy Space Center (KSC) at 2:46:59.011 p.m. Eastern Daylight Time (EDT) on May 4, 1989. The primary objective of the STS-30 mission was deployment of the Magellan Spacecraft/Inertial Upper Stage (IUS) that was successfully accomplished. After a successful flight of slightly over 4 days, *Atlantis* landed at Edwards Air Force Base at 3:43:37.89 p.m. EDT on May 8, 1989.

Magellan is a scientific payload which will be used to gather high-resolution topographic data and altimetry of the planet Venus. The spacecraft will use a 3.7-meter high-gain antenna to gather Synthetic Aperture Radar data revealing terrain features as small as 1 kilometer. The IUS is a two-stage solid propellant, inertially stabilized upper stage which will place Magellan in a transfer orbit from Earth to Venus. The IUS ignites its first stage approximately 60 minutes after deployment. The two IUS stages burn in quick succession intercepting a hyperbolic Earth escape vector and leading to an arrival at Venus approximately 480 days later.

An initial attempt to launch *Atlantis* on April 28, 1989, was scrubbed. During the attempt, the countdown was free of significant problems until the T-9 minute hold. A five-minute unplanned extension of the T-9 minute hold occurred when a range safety computer went off-line, creating a loss of redundancy in the range safety computer network. After computer redundancy was reestablished, the countdown resumed. At the T-31 second point, the launch countdown was automatically put on hold, and the planned launch was subsequently scrubbed because of the failure of the liquid hydrogen recirculation pump for Space Shuttle Main Engine (SSME) #1. Later inspection and analysis revealed that phase B voltage to the pump was shorted to ground in a connector within the pump. Because of the anomaly, the pump was replaced. The launch was rescheduled for May 4 at 1:48 p.m. EDT.

On May 4, the launch countdown was initially held at T-9 minutes (launch minus 16 minutes) for 43 minutes because of unacceptable cloud cover and excessive crosswinds at the Shuttle Landing Facility Return-to-Launch-Site (RTLS) runway. Countdown was resumed at T-9 minutes at 2:15 p.m. EDT. The countdown continued to T-5 minutes, when a hold was again initiated awaiting acceptable cloud cover and crosswinds at the Shuttle Landing Facility. At approximately 2:41:59 p.m. EDT, weather conditions were declared acceptable for launch, and the final countdown was resumed. *Atlantis* was successfully launched at 2:46:59.011 p.m. EDT after an approximate 59-minute delay.

Immediately after External Tank (ET) separation at approximately nine minutes into the flight, low chamber pressure caused the Reaction Control System (RCS) thruster R1U to fail off when initially commanded to fire. Preliminary analysis indicated that the fuel valve opened, but the oxidizer valve did not open upon command after ET separation. It was acceptable to continue the mission since two same-direction-firing pitch thrusters were still available in the right pod of the aft RCS.

About six hours into Flight Day 1, the crew successfully deployed the Magellan IUS from the payload bay. The IUS was fired, at a safe separation distance from the Orbiter, beginning Magellan's 15-month flight to Venus.

At the beginning of Flight Day 4, General Purpose Computer (GPC) #4 failed to synchronize with the other GPCs. The dump data showed that GPC #4 had experienced a "machine check interrupt," followed by GPCs #1 and #2 voting #4 out of the common set. Data analysis revealed a data parity external storage error, which indicated a possible hardware failure. The crew successfully performed an inflight maintenance procedure to replace GPC #4 with the spare. After the initial program load had been performed, the replacement computer was configured into the common set and operated satisfactorily for the remainder of the mission.

A goal of STS-30 was to demonstrate a crosswind landing at Edwards AFB. Development Test Objective 805, the crosswind landing test, has been targeted by the program to expand the orbiter's flight envelope. As *Atlantis* descended through 179,000 feet flying at Mach 12, mission control instructed the *Atlantis* Commander, Capt. David Walker, to change the orbiter navigation target to bring *Atlantis* down on Edwards concrete runway 22, where conditions were best for a crosswind landing. The crosswind landing was performed in winds of 10 knots, with gusts to 16 knots, from 270 degrees. This gave the vehicle an 8-knot crosswind component from the right, close to the parameter sought in the test objective.

The landing was smooth, with *Atlantis* rolling to a stop 10,295 feet down the 15,000-foot runway. Some tile damage was incurred aft of the main landing gear due to tire shredding caused by lateral forces from the crosswind.

The crew reported lateral acceleration following nose gear touchdown. Data recorded confirmed a 1/4-g lateral acceleration and about a 4-second delay from nose gear touchdown to nose wheel steering enable. Investigation found that the rate at which the nose landing gear was lowered during rollout caused the two weight-on-nose-gear transducers to effect an excessive toggling within software limits. This caused the computer to ignore the inputs and required the crew to manually activate the nose wheel steering.

2.2 Flight/Vehicle Data

- Launch Date: May 4, 1989
- Launch Time: 2:46:59.011 p.m. EDT
- Launch Site: KSC Pad 39B
- RTLS: Kennedy Space Center, Runway 33
- TAL Site: Ben Guerir, Morocco
- Landing Date: May 8, 1989
- Landing Time: 3:43:37.89 EDT
- Landing Site: Edwards AFB, CA, Runway 22
- Mission Duration: 4 Days, 56 Minutes
- Crew Size: 5
- Inclination: 28.85 Degrees
- Altitude: 160 Nautical Miles/Standard Insertion
- Orbiter: OV-104 (4) *Atlantis*
- SSMEs: 2027, 2030, 2029
- ET: ET-29
- SRBs: BI-027
- Total Cargo Weight: 45,817 Pounds
- Orbiter Weight, Including Cargo: 260,878 Pounds (at SRB Ignition)
- Total Vehicle Weight at SRB Ignition: 4,526,948 Pounds
- Orbiter Landing Weight: 192,430 Pounds

2.3 Payload Data

Payload Bay:

- Magellan (MGN) Spacecraft/Inertial Upper Stage (IUS)

Middeck:

- Air Force Maui Optical System (AMOS)
- Fluids Experiment Apparatus (FEA)
- Mesoscale Lightning Experiment (MLE)

Section 3

SAFETY RISK FACTORS/ISSUES IMPACTED BY STS-30 ANOMALIES

This section contains a summary listing of the significant safety risk factors/issues, considered resolved or not a safety concern for STS-30 prior to launch (see Sections 4, 5, and 6), that were impacted or repeated by anomalies reported for the STS-30 flight. The list indicates the section of this Mission Safety Evaluation (MSE) in which the item is addressed, the item designation (Element/Number) within that section, a description of the item, and brief comments concerning the anomalous condition that was reported. (Anomalies that arose during the STS-30 flight, that were not preflight safety risk factors/issues, can be found in the complete STS-30 official inflight anomaly report contained in Appendix A.)

ITEM		COMMENT
Section 4: Resolved Significant Safety Risk Factors		
SRM 1	Current spikes and subsequent failure of the primary right-hand (RH) aft field joint heater during STS-29. (STS-29 Inflight Anomaly (IFA))	The left-hand forward field joint secondary heater failed the Dielectric Withstanding Voltage (DWV) test during prelaunch testing. As a precaution, it was decided that the secondary heater would only be used if the primary heater failed. During the countdown, the secondary heater was inadvertently turned on for approximately 4 minutes. This was due to an operator error in correctly reading the position of the cursor on the console cathode ray tube. Note that the cursor position for the right and the left booster forward field joint heaters are adjacent. While this is not necessarily a risk for STS-28, it graphically demonstrates that procedural workarounds should be thoroughly reviewed, down to the position of the cursor on a screen if necessary, to ensure that the fix is not nullified by a potential human error.
Section 5: STS-29 Inflight Anomalies		
Orbiter 6	Reaction Control System (RCS) Jet R1U failed off during mated coast.	On STS-30, immediately after External Tank (ET) separation, the identical RCS Jet R1U thruster failed off when commanded to fire. Indications are that the oxidizer valve failed open. Because this anomaly has been seen on two different Orbiters, this risk factor will be readdressed in the STS-28 MSE.

ITEM		COMMENT
Section 5: STS-29 Inflight Anomalies		
SRB 3	Debris Containment System (DCS) plunger did not properly seat at holddown post #8.	The holddown post DCS did not function properly at locations #2, #3, #5, and #7 on STS-30. Failure of these containment systems could allow holddown post fragments to impact Orbiter critical hardware. A design fix was installed on all holddown posts for the STS-28 evolution. This risk factor will be readdressed in the STS-28 MSE.
Section 6: STS-27 Inflight Anomalies		
Orbiter 1	Auxiliary Power Unit (APU) No. 2 Gas Generator (GG) Heater System "A" failed to respond when switched to A-Auto position. The crew selected Heater System "B", which appeared to fail on. The crew cycled heater system B off and on again, after which the system functioned properly for the remainder of the flight.	On STS-30, APU No. 2 GG Heater System "A" did not respond when the switch was operated. The crew switched to the "B" heater, which operated correctly. Kennedy Space Center (KSC) has been unsuccessful in recreating the problem to date. The investigation continues. Because this anomaly has occurred on sequential flights of the same vehicle (OV-104), this risk factor will be addressed in the STS-34 MSE.

Section 4

RESOLVED STS-30 SAFETY RISK FACTORS

This section contains a summary listing of the significant safety risk factors that were considered resolved for STS-30. These items have been reviewed by the NASA safety community. A description and information regarding problem resolution is provided for each safety risk factor. The safety position with respect to resolution is based on findings resulting from System Safety Review Panel (SSRP), Program Requirements Control Board (PRCB) reviews, or other special investigation findings. It represents the safety assessment arrived at in accordance with actions taken, efforts conducted, and tests/retests and inspections performed to resolve each specific problem.

SECTION 4 INDEX

INTEGRATION

1 Engine Interface Unit single-point failure keeps the Engine Interface Unit in "initialize" state, resulting in total loss of Engine Interface Unit.

ORBITER

1 STS-29 and STS-30 tire inflation valves were overtorqued to 190-210 inch-pounds instead of the correct 70-80 inch-pound specification range. Failure of the valve prior to landing could result in loss of the Orbiter and the crew.
2 OV-104 Tactical Air Command and Navigation System problems.
3 Engine #2 helium fill Check Valve on OV-104 failed in the open position. A second failure in the fill quick disconnect at lift-off would result in the loss of helium overboard.
4 Cold flow problem in Auxiliary Power Unit controller wiring harnesses.
5 OV-102 tile bonding problem.

SRB

1 Guidance, Navigation, and Control Authority and Loads may be violated as the result of mismatched Aft Segment.

SRM

1 Current spikes and subsequent failure of the primary right-hand aft field joint heater during STS-29.

SSME

1 G15 nozzle seal bluing due to overheating.
2 Liquid Hydrogen Recirculation Pump failure.
3 Loose screw and excess retainer gap found in green-run tests of High Pressure Oxidizer Turbopump unit 2126.
4 Cracks discovered in High Pressure Fuel Turbopump Bearing #1 and #3 cages at Stennis Space Center.
5 Cupwashers were found rotated on High Pressure Oxidizer Turbopumps from the STS-29 flights.

SECTION 4 INDEX - (Cont.)

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
INTEGRATION		
1	Engine Interface Unit (EIU) single-point failure keeps the EIU in "initialize" state, resulting in total loss of EIU. HR No. INTG-019 INTG-021 INTG-072 ***No anomaly was reported relative to the EIU on STS-30.***	A single-point failure mode was discovered in the EIU through analysis which keeps the EIU in the "initialize" state, resulting in total loss of EIU functions. Loss of EIU functions results in loss of all three command paths and the 60-Kilobit (KB) data path for the associated Main Engine (ME). If loss of the command and data path occurs in the last 30 seconds prior to Main Engine Cut-Off (MECO), the result is a catastrophic ME shutdown. Failure of the General Purpose Computer (GPC) command of the engine requires manual shutdown. Flight rules/crew procedures exist for this condition. Systems management alert and ME status (amber) light on the panel (F-7) will alert the crew. The worst-case failure scenario is EIU failure near MECO. Crew reaction is required to manually shut down MEs prior to prevalve closure. The GPC will close prevalves on the running engine, causing cavitation with potential catastrophic shutdown. The failure mode manifests itself in a short to ground in the +12 Volts Direct Current (VDC) source of the Power-On-Reset (POR) circuit. Single-failure points have been identified which can cause a short failure. Hardware modifications are planned to eliminate this Critical Single-Failure Point (CSFP). No EIU failure history exists for this failure mode. Data search was conducted and did not reveal any failure history for similar devices/components that would result in EIU loss. There is a small exposure time for this Criticality 1 condition. This risk factor is an acceptable risk for STS-30 launch based on the absence of failure history, the last 30 seconds prior to MECO is a very short time window in which the crew cannot react, and flight rules and crew procedures exist for this condition.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
1	STS-29 and STS-30 tire inflation valves were overtorqued to 190-210 inch-pounds instead of the correct 70-80 inch-pound specification range. Failure of the valve prior to landing could result in loss of the Orbiter and the crew. HR No. ORBI-018 ORBI-021 ORBI-185 ***No anomaly was reported on STS-30 relative to the tire inflation valve.***	Prior to STS-27, inflation valves were installed at B.F. Goodrich to the specification requirement torque of 70-80 inch-pounds with locktite on the threads. The Operational Maintenance Requirements and Specifications Document (OMRSD) erroneously called for 190-210 inch-pound torque with locktite on the threads. The inflation valves on two STS-29 tire/wheel assemblies (OV-103) and four STS-30 assemblies (OV-104) were removed and replaced at Kennedy Space Center (KSC), and were torqued to the erroneous Rockwell specification value. In addition, one wheel from STS-30 had the inflation valve overtorqued twice; this wheel was removed and replaced. Tests were conducted at B.F. Goodrich using a specification wheel and inflation valves with locktite on the threads. Yielding occurred at 190-210 inch-pounds, with failure at 250 inch-pounds. Tests conducted at KSC with flight-type wheels, valves with locktite on the threads, and torquing to 210 inch-pounds resulted in no detrimental effects. Also, upon yield, additional strength is picked up due to work hardening. Dye penetration, 30X magnification, and 500X magnification were used in the tests. The Johnson Space Center (JSC) Mechanical and Analysis Branch also indicated that at yield torque the yielding should be quite apparent. The technician who installed the valves at KSC stated that he recalled no feeling of yielding at the 190-210 inch-pound overtorque. However, it is not certain that yield did not occur. A coordinated JSC/Rockwell mechanical stress analysis of the structural integrity of the overtorqued inflation valve revealed that approximately 5000-g loads are required to increase stress loads in the valve critical area. The design shock load for the tire/wheel assembly is approximately 50 g at touchdown; the resulting safety factor is 100.

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
1 (Cont.)		Even if the valve fails, B.F. Goodrich analysis indicated the rate of loss of tire pressure upon landing is too slow to cause tire failure. Tire deflation testing (simulated valve failure at landing) indicated a pressure decrease from 355 to 300 pounds per square inch (psi) in 23 seconds; pressure decrease from 355 to 0 psi in 550 seconds. Time from Main Landing Gear (MLG) wheel touchdown to Nose Landing Gear (NLG) wheel touchdown is less than 20 seconds nominal. Time from MLG wheel touchdown to wheel stop is less than 60 seconds nominal. Rockwell prepared and forwarded certification of the overtorqued valves for STS-29 and STS-30. B.F. Goodrich deferred to Rockwell's judgement on this matter. The torque specification is being changed to the correct 70-80 inch-pounds for STS-28 and subsequent flights. The safety position is that testing and analysis indicate a reasonable margin of safety even at high torque levels. Post landing inspection of STS-29 showed no indication of failures or incipient failure of the tires. This risk factor is resolved for STS-30.
2	OV-104 Tactical Air Command and Navigation System (TACAN) problems. *No TACAN problems were reported on STS 30.*	During retesting of OV-104 TACANs 1, 2 and 3, TACAN 3 failed to meet two OMRSD requirements. The transmitted frequency was offset by 0.0084 %; the limit is 0.0050 %. Also, the transmitted power measured out of the upper antenna was 57.4 decibels referred to 1 milliwatt (dbm), while the OMRSD requires at least 58.2 dbm. KSC, JSC, and Rockwell/Downey system engineers previously agreed to change the OMRSD limit to 57 dbm. The TACAN 3 power would pass with the new requirement. The technical community agreed to waive these two requirements for one flight.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
3	Engine #2 helium fill Check Valve (CV-2) on OV-104 failed in the open position. A second failure in the fill quick disconnect at lift-off would result in the loss of helium overboard. HR No. INTG-019 INTG-068 ***CV-45, Main Propulsion System (MPS)/Space Shuttle Main Engine (SSME) 3 regulator outlet "B" CV had a reverse leak. No other CV leaks or failures were reported on STS-30.***	Several of this type CV are in the engine system. The failure mode is that the poppet cocks and jams in the spring guide. Two other CVs have also failed, but their failure at the time was assessed to occur only if the valve was subjected to high pressure differentials such as seen in the interconnect positions. An OMRSD requirement was implemented to prohibit opening interconnect solenoid valves with differentials greater than 1000 pounds per square inch differential (psid). The OV-104 failure demonstrates that high pressure differential is not the only cause of this failure; modification studies are in progress. The CV is operated for the last time when going to flight pressure in the launch countdown. A leak would not be detected. This risk factor is acceptable for STS-30 based on: - This CV and all CVs in the MPS were inspected and tested for function. - CVs-1, 2, 3, and 4 on OV-104 were removed and replaced. Other OV-104 CVs received a special reverse leak check, and all CVs checked out good. - It requires a second unrelated failure to result in the helium overboard dump. - The second failure would be detectable and allow time for use of abort procedures. This risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
4	Cold flow problem in Auxiliary Power Unit (APU) Controller wiring harnesses. HR No. ORBI-265 ORBI-266 *There were four STS-30 inflight anomalies related to the APU. None of these were related to the APU Controller; however, APU #2 Controller was removed and replaced because of a Gas Generator (GG) heater anomaly.*	Examination of APU in OV-102 indicated a cold flow problem in the 0075 Controller wiring harness. It was sent back to Rockwell for examination and review. However, OV-103 and OV-104 have 0065 APU Controllers, and no problems have been experienced with these harnesses. This risk factor is resolved for STS-30.
5	OV-102 tile bonding problem. HR No. ORBI-085 ORBI-249A *No anomaly was reported on STS-30 relative to loose tiles or debonds.*	Some of the tiles have been bonded on the Orbiters using a "reverse bonding procedure." The nominal procedure is to bond the Strain Isolator Pad (SIP) to the tile and then bond the SIP-tile combination to the structure. In the reverse procedure, the SIP is first bonded to the structure, then the tile is bonded to the SIP. On OV-102, tiles were found with unbonded SIP edges. Further investigation found that the tiles with the unbonded SIP edges were installed using the reverse bonding procedure. The procedure was used on Carrier Panel tiles on the Forward Reaction Control System (FRCS), base heat shield, Orbital Maneuvering Subsystem (OMS) pods, and vertical stabilizer. Wiggle tests were performed on 115 FRCSs, 9 vertical stabilizers, 38 base heat shields, and all engine ring tiles on OV-104. No anomalies were found. This risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
SRB		
1	Guidance, Navigation, and Control (GN&C) Authority and Loads may be violated as the result of mismatched Aft Segment. *No GN&C problems were experienced during ascent on STS-30.*	QM-8 Aft Segment was exchanged with STS-30 right Aft Segment, because the amount of insulation unbonds was greater than previously experienced. There was a concern that the GN&C Authority and Loads due to thrust mismatch at tailoff could be violated as the result of mismatched Aft Segments (right and left). A thrust differential based on unmatched propellant characteristics would be present throughout Solid Rocket Booster (SRB) burn. However, the percentage mismatch would be greatest at the end of tailoff. Because of the Aft Segment exchange, an evaluation was made relative to the GN&C Authority and Loads which identified a slight steady state exceedance of the Volume X specification for thrust differential. The exceedance was examined, and a determination was made that there was ample GN&C Authority (very small SRB/SSME gimbal angle change to trim the vehicle). Loads were determined to be within certification values. An evaluation of the tailoff dynamics was also performed. A 3-sigma SRB specification mismatch for the thrust differential was controllable with the currently certified GN&C models. A 2.5-sigma SRB specification mismatch was also controllable with the preliminary empirical GN&C plume tailoff interaction models. For STS-30, 3-sigma predicted thrust mismatch was controllable by the certified and the empirical GN&C models. This risk factor is an accepted risk for STS-30 based on the results of the analysis using the certified and empirical GN&C models.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SRM</u>		
1	Current spikes and subsequent failure of the primary Right-Hand (RH) aft field joint heater during STS-29. (STS-29 IFA) HR No. AI-01 FI-01 BC-09 ***The left-hand forward field joint secondary heater, which previously failed the Dielectric Withstanding Voltage (DWV) test, was inadvertently turned on for approximately 4 minutes. This was due to an operator error. No apparent damage resulted from this inadvertent action.***	Function of the right aft field joint heater was lost during the STS-29 countdown, and the secondary heater was brought on line. The secondary heater performed flawlessly for the balance of the countdown. Review of available data resulted in suspicion of a short circuit and a potential that the short circuit could be to ground. Testing prior to the launch countdown had indicated that a short circuit to case could cause a pit as deep as 0.032 inch. In a worst-case specification Solid Rocket Motor (SRM) case web thickness, the Factor of Safety (FOS) could be reduced to less than 1.4. It was determined that, using actual case web thicknesses for the affected case, the minimum FOS was 1.43. The launch proceeded with no further anomalies due to the heater problem. Subsequent to SRB retrieval, physical examination determined that the short circuit was not to case, but to the backshell of the supply cable/heater cable connector. All potting in the area and the insulation from all four wires were melted or burned away, and heat effect was noted up to four inches on either side of the connector. Part of the design which could allow this condition was the use of slow clearing 25-ampere circuit breakers which would permit the flow of over 300 amperes for about 3.5 seconds. For STS-30, new inspection and test procedures have been implemented, including a DWV test, and fast-acting 20-ampere Airpax circuit breakers have been installed for all field joints. Clearing time for these breakers is 500 milliseconds and effectively prevents any pitting. Ground Fault Interrupts (GFIs) will be added for all subsequent launches. Software changes have been made in the Launch Processing System (LPS) to shut down the heaters if currents in the system reach 19.5 amperes.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SRM</u>		
1 (Cont.)		Similarly, 4.9-ampere circuit breakers and software control logic are installed and in use for the igniter heaters. For STS-30, the left-hand forward field joint secondary heater failed the DWV test at 800 volts (1500 volts is the level tested). As a precaution, this heater will only be used if the primary heater fails. Design changes and software changes will provide protection if a short circuit occurs. In another activity, Thiokol assumed a worst-case pitting in all potentially affected case joint and igniter areas. The lowest FOS found was 1.43 on the aft joint of segment 4A forward segment. In the forward dome, the minimum FOS is 3.4. Because of the procedural and design changes made for STS-30, this risk factor is resolved.
<u>SSME</u>		
1	G15 nozzle seal bluing due to overheating. (STS-29 IFA) HR No. ME-B5M ME-B5S ***No anomaly relative to the G-15 nozzle seal was experienced on STS-30.***	Disassembly of Engine 2031 Main Combustion Chamber (MCC)-to-nozzle joint (G15) found bluing of the seal. Bluing results from hot gas impingement and overheating of the seal. The shade of blue is indicative of the degree of overheating to which the seal has been subjected. Tests have indicated that a stress rupture will occur at temperatures above 1275 °F. Engine 2031 G15 seal temperature reached about 1075 °F, but the length of exposure is unknown. Previous theories for the geometry of the MCC/nozzle interface, which account for hot gas circulation in the MCC/nozzle gap, involve excessive protrusion of nozzle tubes into the flow stream at the interface. Engine 2031 protrusion was significantly less than the amount thought to cause the circulation flow, which indicates that there is some undetermined mechanism causing the flow.

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
SSME		
1 (Cont.)		A new theory for the hot gas flow into the gap is that a lip of metal at the bottom of the MCC has been machined off since STS-51L. The lip apparently provided a flow shadow for the gap and prevented gas flow into the gap. Two engines on STS-30 were not suspect. Engine 2027 had just been reassembled with a new seal. Engine 2030 still has the pre-51L lip seal configuration. A third, Engine 2029, was suspect. It has basically the same configuration as Engine 2031, which had seal bluing after only one flight. Engine 2029 has seven starts and 2,300 seconds of run time on its seal. The seal cannot be borescoped for bluing while the MCC and nozzle are mated. However, two other engines of the same configuration have been inspected, and the seals were found to be good. There is a strong indication that Engine 2029 experienced a temperature of approximately 1075 °F; stress rupture failure occurs at approximately 1275 °F. Life expectancy is approximately 26,000 seconds before crack initiation. Based on comparison of Engine 2029 with data for 9 other engines, and the run time of 2,300 seconds compared to life expectancy of 26,000 seconds, this risk factor is an accepted risk for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SSME</u>		
2	Liquid Hydrogen (LH_2) Recirculation Pump failure. *No problems were experienced with the recirculation pump on the second launch attempt of STS-30.*	At T-31 seconds, ME-1 LH_2 Recirculation Pump experienced a current spike of 20 amperes on phase "B". The circuit breaker opened, causing pump shutdown and a hold at T-31 seconds. The launch subsequently was scrubbed due to insufficient time remaining in the launch window to attempt to recycle and resume countdown, even if the problem could be cleared up very quickly. The failed pump was removed and was found to have contamination in the pump cavity, some of which was ferrous. In addition, Pin #8 on the connector input was shorted to the case. The pump was replaced. Nominal OMRSD checkout was performed. Failure analysis was done at the Rockwell Service Center (RSC) to confirm the failure mode. Ambient Acceptance Test Procedure (ATP) was performed on the replacement pump at the RSC (last checkout was in 1984). This issue is not a flight safety concern. Prelaunch logic results in hold, and either a switch to the alternate power supply or launch scrub. With replacement of the LH_2 Recirculation Pump, this risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SSME</u>		
3	Loose screw and excess retainer gap found in green-run tests of High Pressure Oxidizer Turbopump (HPOTP) unit 2126. HR No. INTG-042 ME-C1A Rev. A ME-C1C Rev. A ME-C1M ME-C1S ***No anomaly was reported on STS-30.***	During the first green-run test of HPOTP unit 2126, a loose screw was found. The gap check at the loose screw location was 0.003 (<0.0015 required). The screw was replaced, and the gap eliminated. During a second test (regreen run), another screw was found to be loose with a retainer gap of 0.003. This is the first anomaly of this type since new procedures were implemented. Cause of screw loosening is believed to be tolerance stackups and the first hotfire on the new nozzle. STS-30 flight units all passed retainer screw inspection and gap check post green run. No anomalies were found in the other units that have passed initial inspection, been retested, and reinspected. This risk factor is resolved for STS-30.
4	Cracks discovered in High Pressure Fuel Turbopump (HPFTP) Bearing #1 and #3 cages at Stennis Space Center (SSC). ***No anomaly was experienced on STS-30.***	Post test firing inspection of HPFTP 5502 discovered cracks in the #1 and #3 bearing cages. This is the first observation of bearing cage cracks on the pump end of the HPFTP. The bearing ran an undetermined amount of time after cracking. Other bearing cage cracks were discovered after more than 5,000 seconds of firing time. This pump had 7 starts and 3,965 total seconds of run time. The failure mode was a scraping fracture that the SSME Project believes was caused by high cycle fatigue. It was also stated that the cages are undersized and may need to be redesigned for better structural integrity. A change to life limitations of the cages has been approved that will limit run time to 2,000 seconds, about 50% of the run time at which the bearing cages in HPFTP 5502 failed. The OV-104 HPFTPs accumulated time plus one flight is less than 50% of the 5502 time for each pump. This risk factor is resolved for STS-30.

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SSME</u>		
5	Cupwashers were found rotated on HPOTPs from the STS-29 flights. *No anomaly was reported on STS-30.*	During disassembly of HPOTP 2222R-1, 3 of 11 cupwashers were found to have rotated (loose). Disassembly of HPOTP 4501R-1 found 2 of 11 cupwashers experienced a similar occurrence. Investigation indicated no cup cracking. This is the first time that detente has been overridden without cracking. There have been no problems of this kind since 1986. Cup cracking problems involve material and material hardness deficiencies, but the material used in these cupwashers meets requirements. Also, the staking processing has been reviewed and was satisfactory. The rotation was never seen on left-hand threaded cup-seal applications, only on the right-hand threaded applications. This indicates the possibility of a force generating enough torque to back out the cupwasher. Although displaced, the cupwasher material did not crack or fracture. There has never been a screw found backed out. This risk factor is not a safety concern for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ET</u>		
1	Leak in 4-inch LH_2 Recirculation Line. *No cryo pumping or visible vapor cloud was seen in the area of the LH_2 Recirculation Line during the second launch attempt of STS-30.*	Following the scrub of STS-30, and approximately 15 minutes after shutdown of the Hydrogen Recirculation Pumps, a gaseous flow was observed in the area of the burst disc on the LH_2 Recirculation Line. The line was removed and replaced while the Orbiter and ET were on the pad. The replacement line functioned normally during the launch. The removed Recirculation Line was flown to the vendor and Marshall Space Flight Center (MSFC) for test and checkout. It was determined that the burst disc was intact and no leaks were found. Spray-on foam insulation and Super Light Ablator (SLA) were intact and undamaged. However, a void in the GX6300 SLA adhesive in the area of the burst disc created cryogenic pumping of liquid air, thus creating the illusion of a burst disc failure. Although inspection identified a possible need for GX6300 application on ablator applied to the bellows shield, this recirculation line could have flown on STS-30 with no detrimental effects. To prevent another occurrence, Room Temperature Vulcanizate (RTV) is being applied to the exposed ablator on the bellows cover to prevent air intrusion and subsequent venting. Modifications to the recirculation line Thermal Protection System (TPS) will preclude cryo pumping on future flights. With the replacement of the failed 4-inch line, this risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ET</u>		
2	Feedline elbow contamination suspected. HR No. P.06 ***No problem was experienced on STS-30.***	During normal (OMRSD) black light inspection of the ET-29 Liquid Oxygen (LO_2) External Tank (ET)/Orbiter disconnect, the flapper valve fluoresced. Aft LO_2 feedline elbow adjacent to the interface with the disconnect also fluoresced. Contamination in both areas was removed with solvents. ET-31 LO_2 elbow was in the same apparent condition as ET-29. One of four Non-Volatile Residue (NVR) tests failed with a value of 3.4 milligrams per square foot. The NVR requirement is 1 milligram per square foot. The elbow contamination has been removed. There is potential of contamination in two other locations in the 17-inch feedline. Testing for impact sensitivity in LO_2 shows ignition is possible. However, the particles are less than 800 microns due to the screen, and the impact level is too low to ignite the maximum contamination amount. The mass is sufficiently small, and the flow of LO_2 is great enough, that combustion cannot be sustained. Contamination levels in ET-31 and transfer tests were below LO_2 impact thresholds. This risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
ET		
3	Disabling of the ET Tumble Valve. HR No. P.09 ***The ET reentered and disintegrated nominally and within the predicted footprint.***	The necessity of the ET Tumble System has come into question. A decision was made to disable the ET Tumble Valve for STS-30. The ET Tumble System has seven Criticality 1 failure modes which would result in loss of crew or vehicle. The ET Tumble System is used to force the separated ET into a "tumbling" motion prior to reentry into the Earth's atmosphere. Its purpose is to ensure that the debris from the falling and reentering ET is controlled to land within a footprint acceptable to Range Safety, i.e., greater than 25 Nautical Miles (NM) from U. S. land masses and 200 NM from foreign land masses. For the inclination and standard orbital insertion used on this flight, the ET Tumble Valve can be deactivated with an extremely low probability of debris landing outside of the calculated footprint. Computer simulations using 24 of the worst-case trajectories for a non-tumbling ET still resulted in a very low probability of debris impact on a land mass. For STS-30, the ET Tumble Valve was disabled, but not removed, by cutting wires leading to the system. By not removing the system, pyros used to initiate the ET Tumble Valve remained in an active state. This risk factor is not a risk to the crew or mission. The probability of risk to property and personnel on the ground is very low and acceptable. This risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>GFE</u>		
1	Six of 13 Extravehicular Maneuvering Unit (EMU) SCYE bearings tested have had anomalies. HR No. EMU-012 ***The EMU was not used on STS-30.***	Failed EMU SCYE bearings have developed leaks and increased bearing torque. Specific cause of failure is unknown. Of the five bearings examined to date, none have shown dimensional discrepancies. For the long term, the bearing will be redesigned and replaced. Each STS-30 SCYE bearing was screened for this failure mode in a manned cycling test that duplicated the test in which both discrepant bearings failed. The screening test was performed on STS-30 EMU flight arms (20 Extravehicular Activity (EVA) equivalent hours) to select four good bearings for flight. Subsequent tests were conducted to verify flight bearing margin for flight usage and to demonstrate failed bearing leak rate. Two flight-configured screened bearings successfully passed simulated Inertial Upper Stage (IUS) jettison and payload bay door closure EVA simulations. Two bearings that had previously failed the screening test were tested to determine worst-case leakage. The first bearing leaked at 1.5 standard cubic feet per minute (scfm) (4.0 scfm is maximum sop makeup capability); the second bearing had no leakage. For STS-30, use was restricted for contingency (Orbiter critical) or unplanned (mission success) EVA only. The crew was briefed on the failure modes and required reactions to be sensitive to signs of binding and/or leakage. If signs of failure occur, the crew can break off operations and return to the cabin. This risk factor is resolved for STS-30.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
KSC		
1	Ground Umbilical Carrier Plate (GUCP) noise during mate. ***No further problems were experienced during the STS-30 prelaunch activities.***	A loud "pop" noise was heard during mating of the External Tank Vent Assembly System (ETVAS) 7-inch vent line to the GUCP. Four of the 12 flange bolts were installed, and force was being exerted on the ETVAS to align the flanges for the installation of the remaining bolts when the noise was heard. The most probable cause of the noise was sideloads applied to the vent line flange and the 7-inch Quick Disconnect (QD) flange to overcome an offset of the line-handling fixture, resulting in movement of the GUCP body relative to the ET. The Ground Support Equipment (GSE) vent line handling fixture had to be modified. Corrective action was taken by demating the vent line from the GUCP, removal of the 7-inch QD ground valve, inspection of the flight seal, and installation of a new 7-inch QD ground valve. A borescope inspection of the bellows and pyro bolt assembly was performed after completion of the corrective action. Nothing abnormal was found. In addition, a leak check of the 7-inch QD and a complete functional check of all GUCP systems were performed with no anomalies. This risk factor is resolved for STS-30 based on the detailed inspections of the critical seal and corrective action performed.
2	Spurious signal locked the Orbiter Access Assembly (OAA) extend locks after OAA retraction. ***Workaround was successfully used for STS-30. An Engineering Support Request (ESR) is in work for the long-term fix.***	A spurious signal was witnessed which sent the lock command to the OAA extend locks after the OAA was retracted. This resulted in inability to fully extend the OAA. Two options were considered to alleviate the possibility of a spurious signal causing problems. The near-term fix for STS-30 countdown is for the console operator to turn the "unlock" command for the extend locks to "ON" after the OAA is retracted. An ESR has been initiated to delete the unlock "OFF" commands from the Ground Launch Sequencer (GLS) as a long-term fix. This risk factor is resolved for STS-30 with imposition of the procedural fix.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>KSC</u>		
3	Potential damage to payload bay doors due to misconfigured TPS waterproofing guns. *No problems were experienced with the payload bay doors on STS-30.*	A NASA Safety Reporting System (NSRS) Report was received which pointed to potential for damage to payload bay doors due to misconfigured TPS waterproofing guns. KSC investigated the report and found that a TPS waterproofing gun had been misconfigured. However, it had been detected and was not used. Corrective actions were implemented to prevent recurrence. Not a safety concern for STS-30.
4	Launch Data Bus (LDB) #2 problem. *No further LDB problems were experienced during the second STS-30 launch attempt.*	On April 27, 1989, KSC experienced several hits (miscommunications) on LDB #2, including one instance of 2 hits within the specified critical time period. Three hits within this time period would have caused a switch to the other LDB. On April 28, 1989, LDB #1 was used in the launch attempt without any problems. LDB #2 was checked, and no problems could be found. Review was made of the effect of losing both LDBs. In the final minutes of prelaunch countdown, there is a concern for geysering in the Liquid Oxygen (LOX) system subsequent to closure of the LOX bleed valves. Review of the system showed that the backup emergency safing panel cannot be used to command the LOX bleed valves if both LDBs are down. A procedure has been worked out by the KSC launch team which would, with assistance from the Orbiter Crew, reconfigure the Orbiter MPS to start drainback and prevent the geysering hazard condition. This risk factor is resolved for STS-30.

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
PAYLOAD		
IUS-1	IUS-1 Aft Frame Tilt Actuator (AFTA) has a single-point failure that can cause a runaway condition. ***The AFTA worked nominally during the Magellan (MGN) launch. No problems were reported on STS-30.***	Preparation of the AFTA Failure Modes and Effects Analysis (FMEA) prior to STS-26 identified a current-limited failure mode that resulted in a runaway condition. Potential damage to the Orbiter was prevented by installation of a crushable stop. Reanalysis of this system prior to STS-29 identified a second, high-current failure mode that resulted in a high-speed runaway condition that was not subject to crew response. This runaway would result in high-speed AFTA collision with the crushable stops. If the backup AFTA also failed in either of these modes, the collision could cause damage to the Orbiter. A numerical risk analysis was submitted in support of Headquarters accepting the risk of AFTA runaway. NASA Headquarters Safety has performed an independent assessment of the analysis and has the following comments: - The approach and analysis is generally good. - A review of the assumptions used in the generation of probability numbers for the AFTA high-current runaway condition has been performed. Agreement has been reached among all parties that the numbers presented in the AFTA Runaway Non-Compliance Report (NCR) have been conservatively derived. Techniques such as derating handbook failure rates, and inflight checkout of the AFTA immediately prior to use, lend additional confidence. - Assuming a significantly higher failure probability, capability of the crushable stops was reviewed. The structural analysis viewed all components as rigid bodies with no damping function. The result is very conservative. If the damping functions were applied, the results may show an ability for the stops to absorb two serial failures. The amount of improvement that would be gained is unknown.

RESOLVED STS-30 SIGNIFICANT SAFETY RISK FACTORS

ELEMENT/ SEQ. NO.	RISK FACTOR	COMMENTS/RISK ACCEPTANCE RATIONALE
PAYLOAD		
IUS-1 (Cont.)		- Because of the rigid body approach, the results of a MGN/IUS runaway would be only insignificantly different than the results of this IUS/Tracking and Data Relay Satellite (TDRS) analysis. Based on the low probability of failure indicated by the results of the analysis, and the capability of the crushable stops, this risk factor is resolved for STS-30.
MGN-1	Battery harness and thermal blanket damaged by fire during spacecraft integration at KSC. *No problems were reported on STS-30. MGN is thus far performing well.*	The battery connector was mismated during preassembly at KSC. The resulting short circuit caused fire which damaged the thermal blanket, connectors, and connector wire harness. Spacecraft electrical mishap investigation was completed. All damaged hardware was replaced. Integration and system integration testing were completed. The payload was certified as safe for flight. Not a safety concern for STS-30.
MGN-2	If an anomaly occurs after batteries are activated requiring a mission abort, the batteries cannot be disconnected. *No IUS anomalies were reported during the STS-30/IUS/MGN evolution.*	Because a single-point failure on the IUS side of the IUS/MGN interface could cause the IUS batteries to disconnect, the MGN batteries are activated after erection in the cargo bay and approximately 20 minutes prior to launch, after which the MGN batteries cannot be disconnected. Review of related payload Hazard Reports (HRs) disclosed that no new HRs were generated and that there was no adverse impact to existing hazard controls. The payload was certified as safe for flight.

Section 5

STS-29 INFLIGHT ANOMALIES

This section contains a supplementary list of significant inflight anomalies arising from the STS-29 mission. Each anomaly is briefly described, and risk acceptance information and rationale are provided.

SECTION 5 INDEX

SRM

1 Left aft center factory joint had several adhesive unbonds of the EPDM vulcanized weather seal.

SSME

1 Main Combustion Chamber aft bond line leak.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
INTEGRATION		
1	Excessive vapor at Liquid Hydrogen (LH_2) External Tank (ET)/Orbiter umbilical area during prelaunch and ascent. HR No. ET-S.06 INTG-015 ***No visible vapor cloud was seen in the vicinity of the 17-inch feedline during the STS-30 launch evolution.***	On STS-29, excessive vapor was observed during prelaunch and ascent. The quantity of vapor was larger than observed on past flights. The vapor cloud formation rate has been estimated to be 1 to 3 ft^3/minute. During the periods of LH_2 fast fill, ET pressurization, and during Space Shuttle Main Engine (SSME) thrust buildup, heavy vapor was seen around the LH_2 ET/Orbiter umbilical. Ice/frost buildup was noted at the disconnect starting with ET fast fill. Numerous drops were also observed falling from the vicinity of the LH_2 umbilical. The drops produced vapor trails which may be indicative of cryogenic fluid vaporization. Ice/frost formed on the LH_2 umbilical, and a portion of the ET 17-inch feedline was reported to be one of the worst cases of buildup ever observed. During the 85% to 98% reduced fast fill procedures, slight melting of accumulated ice was observed in the vicinity of the 2-inch pressure disconnect, but refroze a few minutes later in the same area. During the 98% to 100% fill topping operations, the ET vent valve was opened and the ullage pressure was reduced from approximately 48 pounds per square inch absolute (psia) to 18 psia in a short period of time (approximately 10 minutes). At this time, rapid melting of ice on both the LH_2 umbilical and the ET 17-inch feedline was observed, but all ice previously formed did not melt. The Ice Frost Team was instructed to carefully inspect the LH_2 umbilical. Upon inspection, the Ice Frost Team reported no evidence of an external hydrogen leak. Based on the Ice Frost Team report and other recommendations, the decision was made to fly as is. Review of post-launch films and videos showed that the cloud and cryogenic droplets reappeared when the LH_2 system was brought up to flight pressure at about launch minus 2 minutes. The condition persisted and was exacerbated by engine start. The vapor cloud was in evidence as long as the cameras could see the area.

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
INTEGRATION		
1 (Cont.)		Extensive investigation and analysis have been conducted to determine the source and cause of the excessive vapor cloud. LH_2 leakage cannot be ruled out, because an LH_2 leak will cause a vapor cloud and will produce liquid air. There is a possibility of a thermal short in the area of insulation removal and rework. A thermal short will contribute to formation of a vapor cloud and production of precipitation. Tests indicated that a cloud formation rate due to a thermal short increases with wind velocity until a velocity sufficient to disperse the cloud is experienced. This phenomenon has been verified by analysis. Launch Commit Criteria (LCC) were developed for determining when vapor clouds and possible leaks in the LH_2/Orbiter umbilical area are of sufficient concern to stop the launch flow. Kennedy Space Center (KSC) installed two quick release Hydrogen (H_2) detector mechanisms to monitor the 17-inch disconnect area for LH_2 leaks during ET fill operations. No vapor cloud was observed in the LH_2/Orbiter umbilical area, and both H_2 detectors read zero throughout the ET fill operations. This anomaly is resolved for STS-30.

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
1	Gaseous Oxygen (GOX) Flow Control Valves (FCVs) can lock up due to contamination. (IFA on STS-26, -27, and -29.) HR No. INTG-017 INTG-150A ET-T.01 ET-S.03 ET-S.05 ***No problems were experienced on STS-30. (STS-30 was the first flight with no GOX FCV inflight anomalies since the return to flight.)***	During checkout of the OV-104 GOX FCVs at KSC, it was found that in the pull-in/drop-out test at low voltage (0-8 volts) the FCV for Main Engine (ME) #2 would not move from the high to low position (i.e., pull in). The valve was then cycled from 0 to 22 volts; still no movement was observed. The valve was then energized with 28 volts, and the armature moved to the low-flow position. Power was then removed, and the valve should have moved to the high-flow (i.e., drop out) position; no movement was observed. As a result of the testing, it was determined that the armature was jammed. All three valve solenoid/poppet assemblies were removed and sent to Rockwell International (RI)/Downey for failure analysis. The following results were observed: (1) all three valves were contaminated, with ME #2 valve the worst of the three; and (2) the particulate is similar to that previously seen in valves, with the size distribution conforming to a class 100 distribution with the exception of two 200+ micron-sized particles. The materials are 21-6-9 and 304 stainless, with the larger particles being the stainless. These valves were cleaned after OV-103 on STS-26 and flew previously on OV-104 on STS-27. This contamination is not different from the contamination observed in every valve that has been examined, and is less severe than the contamination in one of the STS-26 valves. Tolerances were opened up; however, it appears that in-specification contamination can still lock up the valves. The rationale for risk acceptance to permit flight on STS-30 is essentially the same as that arrived at for STS-29. Triple redundancy is represented by the three GOX valves. A positive safety margin exists in all worst-case failure scenarios (the probability of which is considered very small), except Return to Launch Site (RTLS).

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
1 (Cont.)		Sluggish and delayed opening occurred again on STS-29 during the first cycle (valves #1 and #3). This resulted in a low ET/Liquid Oxygen (LO_2) tank ullage pressure (14.5 versus 12.5 pounds per square inch gage (psig) specification limit). Additional delay response could result in tank structural limit violation. The cause of this anomaly is a combination of contamination and thermal transient effects. There was no mission degradation, and the valves cycled well on all cycles subsequent to the first (after the thermal transient period when temperature has stabilized). All three FCVs in OV-104 were inspected, cleaned, and polished since the last flight. The ET Oxygen (O_2) tank prepressurization level is to be lowered 2 pounds per square inch (psi) to ensure that the valves are open at launch and stay open for approximately 60 seconds into flight. Temperature stabilization occurs at approximately T+40 seconds. Once the temperature is stabilized, history of these valves indicates normal cycling occurs. Based on the steps taken to clean and polish the valves, and the lowering of the prepressurization level, this anomaly is resolved for STS-30.
2	Main Propulsion System (MPS) LH_2 feed manifold leak. HR No. ORBI-035 *No anomalies were experienced on STS-30.*	On this flight, the relief valve cycled only once after Main Engine Cut-Off (MECO), indicating a possible manifold leak. Postflight investigation indicated no evidence of a leak. This valve operation is within previous flight experience, although on the low side. This anomaly is resolved for STS-30.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
3	Hydraulic leak in aft compartment. HR No. ORBI-036 INTG-016 *No hydraulic leaks were reported on STS-30.*	Postflight inspection found hydraulic fluid in the aft compartment. Inspection found a loose "B" nut in the leakage collection line from the SSME-1 accumulator. One half to one ounce of hydraulic fluid was found. Hydraulic leaks in the aft compartment are a major concern for loss of hydraulics and the potential for fire and explosion. A fine spraying leak poses the greatest threat for fire and explosion. However, this is a low pressure system, and a spraying leak is not a concern. The quantity was low, because the leak occurred at the accumulator overflow. The B-nuts were not secured, because holes were not drilled for the wiring. However, this is not a high pressure system, and proper torquing should suffice. The B-nuts will be inspected and checked again as part of the Operations and Maintenance Instruction (OMI). This anomaly is resolved for STS-30.
4	Thermal blankets in payload bay found to be loose and damaged. (IFA on STS-26, STS-27, and STS-29.) HR No. ORBI-305A *Some of the blankets that were not modified were found to be loose during the postflight inspection. No damage was incurred.*	Postflight inspection of the STS-29 payload bay found four thermal blankets loose and damaged. The damaged thermal blankets were located at the 1307 bulkhead, where the C-stiffeners were modified. Similar looseness and damage were experienced on STS-26 and STS-27; however, only one thermal blanket on each flight was affected. Damaged blankets could result in debris contamination in the payload bay and potentially adversely interfere with the safe operation of some payload equipment. Probable cause of the damage is air/venting of the payload bay and the acoustical environment during ascent causing the blankets to vibrate and flap.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
4 (Cont.)		A new design was approved for the thermal blankets to cover the aft side with Beta cloth to protect the aluminized Kapton. Thermal blankets in the affected area (1307 bulkhead) have been replaced with new design blankets on OV-104. This anomaly is resolved for STS-30 by installation of the new design blankets.
5	The 17-inch LH_2 disconnect leak. HR No. INTG-009 INTG-010 INTG-035 ET-P.07 ***No anomalies were experienced relative to the 17-inch disconnect on STS-30.***	A blowing leak on the 17-inch LH_2 Orbiter disconnect was discovered during post landing inspection. Inspectors found nicks on the flapper valve seats, and a black streak and small nicks on the inner bore. The cause of the nicks has not been determined; however, investigation has shown that they were present at ET/Orbiter mate. The actual leak rate was measured to be 1080 standard cubic inches per minute (scim) versus the specification allowable of 1000 scim. Subsequent to OV-103 return to KSC, the 17-inch Quick Disconnect (QD) was cleaned, and a following leak test was within specification (209 scims). The most probable cause of the previous out-of-specification leakage is transient contamination. This anomaly is resolved for STS-30.
6	Reaction Control System (RCS) jet R1U failed off during mated coast. HR No. ORBI-203 ***RCS jet R1U failed off after ET separation on STS-30. This failure was almost identical to the failure on STS-29. Analysis is still underway.***	RCS jet R1U failed off during mated coast due to low pressure. Trickle current test was performed and verified that the electrical path was good. It is suspected that the oxygen propellant valve failed closed. The jet was deselected by software, and redundant jets were available. Repair and Replace (R&R) was required. Not a safety concern for STS-30.

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
7	Power Reactant Supply and Distribution (PRSD) cryogenic H_2 tank 3 pressure was high and manifold pressures erratic. HR No. ORBI-089 ***No problems were experienced with the PRSD cryogenic H_2 tank or manifold on STS-30.***	The PRSD cryogenic H_2 tank 3 pressure was erratic. Manifold pressures also indicated several pressure spikes, one of which resulted in exceeding the Maximum Expected Operating Pressure (MEOP) in the PRSD manifold. This condition caused the relief valve to crack until the pressure returned to an acceptable level. The pressure did not exceed the design pressure for the manifold. Further, the relief valve is sized to handle the maximum flow rate from the LH_2 tank with a safety factor of 5. The PRSD tank could also have been isolated, and the fuel cells could have been operated from other tanks. The impact of this would have been to shorten the mission; not a safety impact. The detailed physical mechanism that caused this phenomenon is not completely understood. Similar behavior occurred on STS-26 (same tank), but it did not violate the MEOP redline. Circumstances peculiar to the STS-29 flight included: - Fuel cells were in purge mode when the anomaly occurred; therefore, demand was high. - Tank had higher liquid content since it was earlier in the mission than for the STS-26 usage. - Tank was being used singly instead of in parallel with another tank as was the case on STS-26. Theories on how these factors could contribute to the anomaly and the potential for peculiarities with this tank (none known) were postulated. Safety features designed into the system permitted retesting of the tank in orbit. There was no significant anomaly, and the tank was used additionally without incident. While further investigation is needed to understand the cause of the anomaly, the level of safety risk is small enough to warrant continued flight with these tanks. This anomaly is not a safety concern for STS-30.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
8	Payload bay door B close indication failure. HR No. ORBI-305A *No anomalies were reported on STS-30.*	Payload bay door port aft close limit switch in the ready-to-latch module failed to indicate closed. This is an instrumentation problem and not a safety concern for STS-30.
9	Water Spray Boiler (WSB) #3 low relief valve reseat pressure. HR No. ORBI-170 *WSB #2 experienced a 5 psi drop in the regulator pressure during the first 24 hours of STS-30 flight. There appears to be a leak downstream of the GN_2 supply valve. Investigation continues.*	WSB #3 relief valve appears to have reseated, then developed a slow leak approximately 10 minutes later. It was fully reseated at 26.7 psia. Not a safety concern for STS-30.
10	WSB #1 exceeded specification leak rate. HR No. ORBI-170 *See number 9 above.*	WSB #1 exceeded specification leak rate of 0.04 psi/hour. Subsequently, the leak stopped. Not a safety concern for STS-30.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
11	LH_2 4-inch disconnect slow to close. HR No. ORBI-035 ***No anomaly was reported on STS-30.***	The time from closed power applied to close was approximately 5 seconds. The specification is 1.2 seconds maximum. Ambient tests of OV-104 indicated no problem. Belleville spring inspection on OV-104 also indicated no problem. The valve/actuator was removed and tested to verify the failure mode. This failure is considered unique to OV-103 and may be related to the excessive vapor/ice formation buildup observed at the LH_2 ET/Orbiter umbilical area on STS-29. Not a safety concern for STS-30.
12	Flash Evaporator System (FES) primary controller B outlet oscillation. HR No. ORBI-276B ***No anomaly was reported on STS-30.***	During three different startups on-flight, the FES control temperature oscillated between 38 °F and 41 °F and damped out in approximately 6 cycles. Probable cause lies in the FES primary B control or midpoint temperature sensors. This phenomena contributed to momentary FES shutdown during entry. Not a safety concern for STS-30.
13	Fuel Cell #1 H_2O relief valve temperature overshoot. HR No. ORBI-284 ***No anomaly was reported on STS-30.***	Crew configured Fuel Cell #1 H_2O relief heaters to the B-Auto position per the heater reconfiguration on the morning of Flight Day 3. The B thermostat immediately turned the heater on, because its temperature was 70 °F. The temperature rose to 130 °F before there was a normal cooldown of the H_2O line. STS-26 data on this thermostat showed that the temperature never rose above 105 °F during its cycling when OV-103 was in a cool attitude. The thermostat was removed and replaced at KSC prior to STS-29 flight. Not a safety concern for STS-30.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
14	Orbital Maneuvering Subsystem (OMS) deck delta pressure anomaly. HR No. ORBI-111 ORBI-165 *No anomaly was reported on STS-30. (Pressure instrumentation was not flown on this mission.)*	OMS deck compartment vent pressure shift was experienced during STS-26 and STS-29 ascent. The OMS deck delta pressure versus mach number for these two flights was outside those previously experienced on missions using OV-103. OV-104 venting characteristics are the same as for OV-103, except for structural leakage. The concern for STS-30 is the potential for under predicting the critical OMS deck frame load indicator for the Day of Launch (DOL). The delta pressure transducer was removed from OV-103 for inspection and calibration. During removal, the thrust control system thermal blanket was found blocking the OMS deck transducer port, because there was no cutout in the area of the transducer. Contamination was also found in the transducer port. Recalibration efforts resulted in explaining some of the shift in the delta pressure increase. STS-29 delta pressure dispersion has been removed for STS-30, because the STS-26 and STS-29 delta pressure measurements are now considered unreliable. A configuration check has been initiated for all OMS thrust control system thermal blankets. The thermal blanket configuration is not a concern for STS-30, because there is no instrumentation on OV-104 (i.e., no transducer). This OV-103 anomaly is not a safety concern for STS-30/OV-104.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SRB</u>		
1	Extensive damage to Solid Rocket Booster (SRB) Thrust Vector Control (TVC) components. HR No. A-20-03 Rev. B A-20-18 Rev. C ***Nozzle severance sequence was returned to nominal (20 seconds after low baroswitch operation). No Hydrazine fire or damage to SRB TVC components was reported on STS-30.***	The TVC component damage is considered to be due to Hydrazine reaction/fire. Indications are that a Hydrazine fire was caused during SRB descent following separation of the nozzle extension at apogee. Signs of a Hydrazine fire were seen previously only on STS-1; this was the only other STS flight where the nozzle extension was severed at apogee. On all other flights, the nozzle extension was severed 20 seconds after low baroswitch operation. The change to separation at apogee for STS-29 was decided to alleviate nozzle damage to the main parachutes after separation; this has been seen on many flights. The extensive damage to TVC components caused by the resulting Hydrazine fire could limit reuse of the aft segments of the SRB used on STS-29. For STS-30, nozzle severance will go back to 20 seconds after low baroswitch operation. This anomaly is not a safety of flight issue for ascent (even if nozzle severance is at apogee). Not a safety concern for STS-30 because of return to previous mode of nozzle extension severance at low baroswitch.
2	Structural crack found in the left aft skirt intermediate ring cap. HR No. FC-02 ***No anomaly was reported on STS-30.***	Inspection revealed several areas of missing foam around the intermediate ring. The ring cap crack completely penetrated at the fillet radius runout. The cap has permanent deformation and is dislocated away from the web. All ribs along the entire ring flange showed evidence of soot. Investigation continues. Not a safety concern for STS-30.

STS-29 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SRB</u>		
3	Debris Containment System (DCS) plunger did not properly seat at Holddown Post (HDP) #8. HR No. B-60-12 Rev. B ***HDP DCS did not function properly at locations 2, 3, 5, and 7 on STS-30. A fix has been proposed and was installed to support STS-28.***	Postflight inspection of HDP #8 identified several debris chunks missing; most of the NASA Standard Initiator (NSI) booster cartridge and three large slivers of the frangible nut. Follow-up inspection at the pad found debris in the post #8 sand box matching the aforementioned missing pieces. This evidence supports the position that the plunger failed to completely seat at liftoff. A total of 10 ounces of debris was lost out of a potential 135 ounces. Not a safety concern for STS-30.
<u>SRM</u>		
1	Left aft center factory joint had several adhesive unbonds of the EPDM vulcanized weather seal. HR No. BC-10 Rev. B ***Factory joint weather seal aft edge unbonds were experienced on the left SRB/Solid Rocket Motor (SRM) on STS-30. These unbonds may have been caused by severe water impact.***	Postflight inspection of the left aft center factory joint revealed several adhesive unbonds of the EPDM vulcanized weather seal. All unbonds of the weather seal were adhesive failures (not cohesive). It appears that contamination is the likely mechanism which prevents an acceptable bond of the SRM case to the Chemlok (bonding agent upon which the EPDM weather seal is vulcanized). Inspection of the pin retainer band verified no damage/breakage, but the band was noted as nominally stretched. Radial expansion of the band is expected during pressurization of joints. Not a safety concern for STS-30.

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SSME</u>		
1	Main Combustion Chamber (MCC) aft bond line leak. HR No. ME-B5A ME-B5C ME-B5M ME-B5S *No anomaly was reported on STS-30.*	Postflight leak check and borescope inspection indicated a small leak in the MCC/nozzle bond line which was internal to the nozzle. Two visible leaks, approximately 0.020 and 0.060 inch, were confirmed by ultrasonic inspection; each is coincident with a nozzle protrusion of 0.028 inch. Engine flight data showed no evidence of a leak. The Failure Modes and Effects Analysis/Critical Item List (FMEA/CIL) lists the aft region internal fuel leak as Criticality 1. If the leak occurred rapidly and was large enough, the High Pressure Fuel Turbopump (HPFTP) would cavitate, and the pump and engine would operate oxidizer rich. This could result in a catastrophic failure of the engine and result in loss of the Orbiter and crew. There is no fabrication or assembly history indicative of a problem on this unit. It has a history of 10 starts and 2580 seconds. Liner aft corner is trimmed for additional nozzle clearance (bond line is not machined). There has been no liner-to-nozzle tube contact on any prior assembly. OV-104 units passed leak test and have no proof test disbond indicative of marginal bonding. Proof test should detect any gross bond deficiency. Disbond propagation rate is slow based on previous testing. The 3 OV-104 engines have been ultrasonically inspected on the pad, and no anomalies were found. The 13 remaining engines in the field were also inspected; no anomalies were found. Based on the review of flight data, inspections performed, and test results, this anomaly is resolved for STS-30.

Section 6

STS-27 INFLIGHT ANOMALIES

This section contains a summary listing of the STS-27 inflight anomalies. Each anomaly is briefly described, and the resolution is addressed. STS-27/OV-104 anomalies are assessed for STS-30/OV-104 applicability.

SECTION 6 INDEX

INTEGRATION

1 Launch Systems Evaluation Advisory Team program error could have given incorrect data upon which to base Day of Launch "Go/No-Go" decisions.

ORBITER

1 Auxiliary Power Unit No. 2 Gas Generator Heater System "A" failed to respond when switched to A-Auto position. The crew selected Heater System "B," which appeared to fail on. The crew cycled Heater System "B" off and on again, after which the system functioned properly for the remainder of the mission.

2 Right Reaction Control System oxidizer "B" Helium Regulator response slow.

3 Humidity Separator B flooded. The crew reported that about two gallons of free water was discovered in and around the Environmental Control and Life Support Subsystem bay.

4 During ascent and descent, Hydraulic System No. 2 accumulator pressure read low.

5 A carrier panel on the right Orbital Maneuvering System pod was discovered missing during postlanding tile inspection.

6 Cabin Temperature Controller 2 was nonresponsive. The crew reported that it was frozen and would not move when the cabin temperature selector position was changed.

7 Liquid Hydrogen topping valve (PV13) showed simultaneous open/closed indications during dump and vacuum inert.

8 Tactical Air Command and Navigation System No. 1 (prelaunch) did not lock onto Kennedy Space Center ground station; Tactical Air Command and Navigation System cycled and then locked on with normal data.

9 Certain Eaton/Dill pneumatic valve caps may cause loss of pressure.

10 During STS-27, the OV-104 Liquid Hydrogen outboard 8-inch Main Propulsion System Fill and Drain Valve closed slower than OMRSD requirements.

11 During closure of External Tank doors, no Ready-to-Latch No. 2 indicator was received. No. 1 & 3 received properly. No. 2 RTL limit switch signals on the left External Tank door failed to go high.

SECTION 6 INDEX (Cont.)

SRB

1	Shoe shims missing. STS-27 postflight inspection results showed that the Epon shoe shims were partially missing.
2	Rate Gyro Assembly shock exceedance.

SRM

1	Igniter Heater discoloration.
2	Cork missing from right-hand center field joint on STS-27. Breakup and debris could cause damage to the adjacent STS.

SSME

1	Liquid Oxygen pump bearing anomaly. Cracked inner race found on #3 bearing of High Pressure Oxidizer Turbopump 9109R1.
2	Hot gas temperature sensor failed on STS-27 flight.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>INTEGRATION</u>		
1	Launch Systems Evaluation Advisory Team (LSEAT) program error could have given incorrect data upon which to base Day of Launch (DOL) "Go/No-Go" decisions. HR No. INTG-165 *No anomaly reported on STS-30.*	Structural load indicators were incorrectly computed and displayed. The error was traced to an interpolation routine. The problem has existed since STS-8, but required the unique conditions of STS-27 to reveal itself. The error has been corrected by computer software modifications. Not a safety concern for STS-30.
<u>ORBITER</u>		
1	Auxiliary Power Unit (APU) No. 2 Gas Generator (GG) Heater System "A" failed to respond when switched to A-Auto position. The crew selected Heater System "B," which appeared to fail on. The crew cycled Heater System "B" off and on again, after which the system functioned properly for the remainder of the mission. HR No. ORBI-104 ***APU #2 GG Heater System "A" did not respond when switch was operated on STS-30. Crew switched to "B" heater, which operated correctly. Kennedy Space Center (KSC) has been unsuccessful in recreating the problem.***	During post-mission troubleshooting, cockpit switch 2A failed intermittently. The switch was replaced and sent to the vendor for failure analysis. Failure analysis showed the switch to be normal. However, the switch can be placed in a false detente position if the toggle is not positioned completely to hardstop. This anomaly is the result of a known characteristic of the switch. Crews have been briefed on proper switch operation. Not a safety concern for STS-30.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>ORBITER</u>		
2	Right Reaction Control System (RCS) oxidizer "B" Helium Regulator response slow. HR No. ORBI-129A *No Helium Regulator anomalies reported on STS-30. The Oxygen/Helium Isolation Valve did fail open on the right RCS (unrelated).*	Flow data taken during postflight deservicing indicated the B leg regulator was defective. The vendor is conducting a failure analysis. The regulator was removed and replaced. Not a safety concern for STS-30.
3	Humidity Separator B flooded. The crew reported that about two gallons of free water was discovered in and around the Environmental Control and Life Support Subsystem (ECLSS) bay. HR No. ORBI-321A *No anomaly was reported on STS-30.*	OV-104 Humidity Separator B was found to be nonfunctional due to a clogged pilot tube which prevented liquid water from being pumped out of the unit. The Humidity Separators were removed and sent to the vendor for testing. Humidity Separator A functioned within specification and Humidity Separator B was found to be nonfunctional due to a clogged pilot tube which prevented liquid water from being pumped out of the unit. Spare Humidity Separators were placed onboard OV-104 for subsequent flights. Their humidity removal capability was successfully verified under the Operational Maintenance Requirements and Specifications Document (OMRSD) inflight maintenance workaround. Not a safety concern for STS-30.
4	During ascent and descent, Hydraulic System No. 2 accumulator pressure read low. *No anomaly was reported on STS-30.*	This failure was repeated in post-mission troubleshooting. The priority valve was removed and replaced. Failure analysis on the priority valve is in work. Not a safety concern for STS-30.

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
5	A carrier panel on the right Orbital Maneuvering System (OMS) pod was discovered missing during postlanding tile inspection. HR No. ORBI-152 ***No anomaly was reported on STS-30.***	Investigation revealed that this carrier panel did not have the correct hardware configuration. Washers were not installed, and the wrong length fasteners were used. This problem was corrected. Job card documentation changes were made. This anomaly is resolved for STS-30.
6	Cabin Temperature Controller 2 was nonresponsive. The crew reported that it was frozen and would not move when the cabin temperature selector position was changed. HR No. ORBI-321A ***No anomaly was reported on STS-30.***	The crew switched to Controller 1 which operated properly. Four to 10 minutes are required for the actuator to go from full heat to full cool. The controller was probably at the low end of its operating range and may have appeared not to move, but was actually moving at a very slow rate. A crew procedure change is planned to alert the crew to the time required for the temperature controller to reach its normal operating position. The controller was verified as working properly in postflight retest. Not a safety concern for STS-30.
7	Liquid Hydrogen (LH_2) topping valve (PV13) showed simultaneous open/closed indications during dump and vacuum inert. HR No. ORBI-035 ***No anomaly was reported on STS-30.***	KSC could not duplicate the problem during post-mission troubleshooting. However, the component was removed and replaced. The failed valve was sent to the vendor for analysis. Not a safety concern for STS-30.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
8	Tactical Air Command and Navigation System (TACAN) No. 1 (prelaunch) did not lock onto KSC ground station; TACAN cycled and then locked on with normal data. HR No. ORBI-211 ***No TACAN anomalies were reported on STS-30.***	Postflight troubleshooting failed to reproduce the anomaly. Two related problems have occurred on other TACAN units. A possible common link is that the TACAN channel select became latched up in a mode such that an improper or invalid channel was selected. The possibility of recurrence of such a latch-up is considered extremely rare and can easily be cleared by a simple procedure. Not a safety concern for STS-30.
9	Certain Eaton/Dill pneumatic valve caps may cause loss of pressure. HR No. ORBI-179 ***Some Dill caps are still in the system. However, no related anomalies were experienced on STS-30.***	The Eaton Corporation advised that valve caps with Part Number MS20813-1 and the trademark "Dill" stamped into them may cause loss of pressure. All wheels and gear struts on all Orbiters were inspected for valve cap configuration. Critical areas of all flight Elements had their valve cap configuration verified, and corrective action implemented, as required. Approved Dill, Schraeder, and Hydrofitting caps are available for use. Shuttle Processing Contractor (SPC) logistics has purged their stock of the suspect valve caps. Not a safety concern for STS-30.
10	During STS-27, the OV-104 LH_2 outboard 8-inch Main Propulsion System (MPS) Fill and Drain Valve closed slower than OMRSD requirements. HR No. ORBI-035 ***No anomalies were reported on STS-30.***	This valve provides for External Tank (ET) LH_2 operations in the MPS and provides redundancy to the inboard Fill and Drain and/or the LH_2 Topping Valve to prevent leakage from the T-0 umbilical. The valve is commanded closed at T-48 seconds. Post Main Engine Cut-Off (MECO), the valves are opened to dump LH_2 and to vent LH_2 residuals. Failure to close prelaunch would result in a launch scrub (hold at T-31 seconds). Failure after launch could result in loss of aft compartment purge, a catastrophic hazard, for Return to Launch Site (RTLS) and Transatlantic Abort Landing (TAL) abort modes.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
ORBITER		
10 (Cont.)		An STS-27 postlaunch data review indicated slow closure times for both post-MECO operations, 13.27 and 12.77 seconds. The safety concern is that slow valve operation could be indicative of incipient valve failure. The actuator was removed and sent to the vendor, and failure analysis is in work. Ambient and Liquid Nitrogen (LN_2) tests have been completed, and the actuator was verified to be slower than nominal (6 runs at 7.59 to 9.3 seconds). The slowness is temperature driven. For a valve on the high side of the Acceptance Test Procedure (ATP), it is expected that response would be correspondingly slower in LH_2. The valve actuator on OV-104 has been replaced with a faster unit. The Launch Commit Criteria (LCC) has been revised to allow 14 seconds closure time. This anomaly is resolved for STS-30.
11	During closure of ET doors, no Ready-to-Latch (RTL) No. 2 indicator was received. No. 1 & 3 received properly. No. 2 RTL limit switch signals on the left ET door failed to go high. HR No. ORBI-302A ***No anomaly was reported on STS-30.***	Found open fuses, bare wires, and broken connector backshell. The switch has been repaired. Door closed talkback requires a 2 of 3 vote from the RTL signal. The only function of the RTL signal in question is to provide 1 of 3 votes. If 2 of 3 RTL signals are lost and the ET doors can be verified to be closed, the ET doors can still be latched. Not a safety concern for STS-30.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
<u>SRB</u>		
1	Shoe shims missing. STS-27 postflight inspection results showed that the Epon shoe shims were partially missing. ***Water impact damage occurred on left SRB of STS-30. However, it resulted in other damage.***	Postflight inspection showed no scorching of the shoes, and the substrate was clean. This is indicative of loss at water impact rather then during early ascent. Therefore, the missing shims are not considered a debris problem. This anomaly is resolved for STS-30.
2	Rate Gyro Assembly (RGA) shock exceedence. HR No. B-50-10 Rev. C ***No anomaly was reported on STS-30.***	The pyro shock level of the RGA is exceeded at Right-Hand (RH) frustrum separation. This exceedence is comparable to a similar pattern recorded on STS-51F. Level II Program Requirements Control Board Document (PRCBD) S40443A limits use of RGAs to one flight. SRB RGAs function only during ascent. The observed exceedence occurs during decent at frustrum separation. Not a safety concern for STS-30.
<u>SRM</u>		
1	Igniter Heater discoloration. HR No. BC-03 Rev. B BI-02 Rev. B ***Igniter Heaters on STS-30 worked correctly and were deemed in excellent condition during postflight inspection.***	Some heat damage and charring were evidenced by discoloration at two locations on both igniter heaters. The cause of this anomaly was improper routing of instrumentation wiring between the igniter heater and the igniter. This resulted in loss of the igniter wiring heat sink. The wire routing and closeout instructions have been changed to reestablish the heat sink. STS-29 wire routing on igniter flanges was removed, heaters were installed, and wiring was properly reinstalled over the heaters. This anomaly is resolved for STS-30.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
SRM		
2	Cork was missing from RH center field joint on STS-27. Breakup and debris could cause damage to the adjacent STS. HR No. INTG-037A ***On STS-30, the cork was generally in excellent condition, with no mission cork or K5NA in the "Orbiter Debris" zone.***	Engineering changes were written to perform fixes on STS-29 and STS-30. They included drilling vent holes through the extruded cork, drilling of vent holes in the Solid Rocket Motor (SRM) joint cork bonding locations of Kevlar band buckles and pin retainer band trunions. The same cork should be inspected for internal low-density inclusion and repaired, where detected. Tap tests and drilling were completed before flight. Not a safety concern for STS-30.
SSME		
1	Liquid Oxygen (LOX) pump bearing anomaly. Cracked inner race found on #3 bearing of High Pressure Oxidizer Turbopump (HPOTP) 9109R1. HR No. ME-C2A ME-C2C ME-C2M ME-C2S ***No anomalies were reported on STS-30.***	The HPOTP was removed from the engine and shipped to the vendor for failure analysis. Some contamination was found within the crack. Other small cracks were found in the bearing #4 inner race. Analysis determined that the crack in the bearing race occurred due to stress corrosion. Stress corrosion is a product of stress due to an interference fit, chlorine contamination (despite cleaning measures), and moisture trapped in the cavity between the bearing race, spacer, and pump shaft. Presence of moisture is attributed to inadequate drying during pump assembly. A decision was made by the National Space Transportation System (NSTS) Program Manager to remove and replace all three STS-29 and STS-30 HPOTPs on the pad. New processing requirements were implemented to improve drying procedures during pump assembly. The contact surfaces between the bearing races and spacers were also roughened to prevent a metal-to-metal seal from occurring.

STS-27 INFLIGHT ANOMALIES

ELEMENT/ SEQ. NO.	ANOMALY	COMMENTS/RISK ACCEPTANCE RATIONALE
SSME		
1 (Cont.)		Replacement pumps were assembled using a new drying procedure to preclude or minimize trapped moisture. New assembly procedures were utilized to minimize the potential of stress corrosion. With the new processing procedures and changeout of all three HPOTPs, this anomaly is resolved for STS-30.
2	Hot gas temperature sensor failed on STS-27 flight. HR No. ME-D3A ME-D3C ME-D3D ME-D3M ME-D3S ***No anomaly was reported on STS-30.***	High Pressure Fuel Turbopump (HPFTP) channel A temperature disqualified at approximately start plus 277 seconds. The sensor was retrieved and shipped to the supplier for analysis. Analysis/investigation results revealed a discontinuity in the element. The failure mode resulted in disqualification by the controller. Sensors are redundant. Current sensors have a very low failure rate. Redesign of sensors and thermocouples is being evaluated. Initial pull testing was inconclusive; additional testing is planned. More rigorous sensor inspection has been implemented. No anomalies of this type were reported against STS-29. This anomaly is resolved for STS-30.

Section 7

BACKGROUND INFORMATION

This section contains pertinent background information on the safety risk factors and anomalies addressed in Sections 3 through 6. It is intended as a supplement to provide more detailed data if required.

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
KSC	01A	1833E . 4/27/89 . .	IPR 30RV-0252 IV-6-015363	EPD	B	Problem Report required.
	01B	0639E . 4/28/89 . .	IPR 30RV-0254 IV-6-015356	CPWR	S	Activation of LO2 aft strut heaters was performed 2-3 min. later than allowable window.
					B	Waiver generated, IPR is closed. Status: Closed; Presented at a special Corrective Action Briefing to Mr. Crippen on 5/2/89. No further PRCB action required. No Flight Problem Report required.
	01C	0830E . 4/28/89 . .	IPR 30RV-0255 IV-6-015358	CPWR	S	Aft ET LO2 hardware heaters were turned off for 3 min 9 sec approx 34 minutes after initiation.
					B	Explained condition. IPR is closed. Status: Closed; Presented at a special Corrective Action Briefing to Mr. Crippen on 5/2/89. No further PRCB action required. No Flight Problem Report required.
	01D	2139E . 4/28/89 . .	IPR 30RV-0257 IV-6-015374	CPWR	S	ET Bipod heaters were deactivated too soon after the LH2 98% sensors were dry. Was less than 9 mins, S/B between 9 and 10 minutes.
					B	Waiver - WK1118 approved. IPR closed. Status: Closed; Presented at a special Corrective Action Briefing to

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

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ELEMENT	NO.	DETECTED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
KSC	01D	2139E . 4/28/89 . .	IPR 30RV-0257 IV-6-015374	CPWR	B	Mr. Crippen on 5/2/89. No further PRCB action required. No Flight Problem Report required.
	01E	1623E . 4/28/89 . .	IPR 30RV-0261 IV-6-015367	CPWR	S	LOX aft strut heaters deactivated 10 min after ECO sensors dry. S/B 4 to 5 min after sensors dry.
					B	Waiver - Wk1119 approved. IPR closed
						Status: Closed; Presented at a special Corrective Action Briefing to Mr. Crippen on 5/2/89. No further PRCB action required. No Flight Problem Report required.
	01F	2147E . 4/28/89 . .	IPR 30RV-0266 IV-6-015373	CPWR	S	ET LH2 aft heaters were turned off 2 mins after low level sensor dry. S/B 4-5 mins.
					B	Waiver - WK1120 approved. IPR closed.
						Status: Closed; Presented at a special Corrective Action Briefing to Mr. Crippen on 5/2/89. No further PRCB action required. No Flight Problem Report required.
MSFC/ET	01	. . POST-SCUB . .	PR-ET-29-FP-0056 IPR 30RV-0260	.	S	Visible leak detected on 4" LH2 Recirculation line during launch scrub activities.

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
MSFC/ET	01	POST-SCUB	PR-ET-29-FP-0056 IPR 30RV-0260		B	Four inch LH2 Recirculation line was R&R'd on 4/30/89. Post removal inspection found no leak in the line. KSC LSOC Tracking Numbers: IV-6-015365; PV-6-128169 Status: Closed; significantly briefed at the second launch attempt L-2 day review. No further PRCB action required. No Flight Problem Report required.
MSFC/ME	01	ASCENT L. GRANT/EE21	STS-30-E-1 IPR 34V-0021	UCRA020052	S	The ME-3 (S/N 2029) AFV D/S skin temperature sensor #1 failed off scale high at engine start plus 420 seconds.
					B	The AFV skin temperature measurement is a Launch Commit Criteria (LCC) parameter, monitored from purge sequence number 3 to T-31 seconds. The requirement is that one of two channels must be operational for launch "GO". After engine start, this measurement is not used for engine control or perfomance monitoring. Post landing resistance checks revealed an open circuit in the channel 1 sensor. The open circuit was most likely caused by vibration of the sensing assembly during engine operation. Due to the close proximity of the channel 2 sensor, both sensing elements will be replaced per SSME Problem Report PV-6-130735. Flight and ground test experience has

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
MSFC/ME	01	. . ASCENT L. GRANT/EE21 .	STS-30-E-1 IPR 34V-0021	UCRA020052	B	shown that the sensors are adequately protected from damage during LCC monitoring. Since there is no history of an open circuit failure of this measurement during LCC monitoring, redesign is not warranted at this time. The failure is considered benign due to its occurrence subsequent to its designed function. Closed in the MSFC PRACA for STS-28R and subs. . KSC LSOC Tracking Numbers: IV-6-015494 and PV-6-130735. PR# ME2029-4-05-0097 Flight Problem Report approved at Level II Noon PRCB on 7/21/89. (PRCBD #S62041) Status: Closed
	02	. . J. MOORHEAD/EE21 .	STS-30-E-2 .	UCRA015214	S	The ME-1 (S/N 2027) HPOTP radial FASCOS accelerometer exceeded the vibration redline limit at approximately engine start plus 135 sec until MECO.
					B	The 135-3 accelerometer is used as a maintenance parameter only and does not affect engine performance. The two other accelerometers showed normal vibration levels, indicating this was an instrumentation anomaly only. During the fault investigation at KSC, a time domain reflectometer test, capacitance check, FASCOS pin retention test, and visual inspection of the accelerometer and cable were performed and no indication of a problem cause for the poor signal was found. Similar

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
MSFC/ME	02	J. MOORHEAD/EE21	STS-30-E-2	UCRA015214	B	conditions have been observed in ground tests and are typical of a break or intermittent of the shield in the cable which connects to the accelerometer. Until the problem is better understood, the possiblitiy exists that another accelerometer/cable may experience a similar problem. This condition will not affect flight since the redline is not active and is used for information only. The accelerometer measurement is triple redundant, thus an engine cut command would not have been issued due to this condition. Deferred for STS-28R only in the MSFC PRACA.
						Flight Problem Report approved at Level II Noon PRCB on 7/21/89. (PRCBD #S62042)
						Status: Deferred
	03	J. MOORHEAD/EE21	STS-30-E-3	UCRA020331	S	ME-2 (S/N 2030) HPOTP exhibited leakage at the primary LOX drain line at the tee fitting near joint D3 during postflight inspections.
					B	The leak (5.0 X 10-5 SCIM) is in the parent metal (321 Cres material) of the fitting in the heat affected zone of weld 59. The failure cause is attributed to an inclusion stringer within the parent metal of the tee fitting. This condition is "aggravated" by the etchant attack from etch fumes/splattering during the housing rework cycle. A material change for the tee fitting to preclude chemical attack is presently being considered. Due to the low leakage rate expected

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
MSFC/ME	03	. . J. MOORHEAD/EE21 .	STS-30-E-3 .	UCRA020331	B	from this condition and the knowledge that such a flaw will not grow during flight, the failure is considered benign. In addition, a special leak check was performed on the turbopumps of Columbia for STS-28R which verifies this condition does not exist. A similar leak check will be performed on the Atlantis engines for STS-34. . Open in MSFC PRACA System. Flight Problem Report approved at Level II Noon PRCB on 7/21/89. (PRCBD #S62043) Status: Open
MSFC/SRB	01	. . R. RUNKLE/EE11 .	STS-30-B-1 PV-6-128949	.	S	The number two left SRB main parachute (S/N 8045) collapsed shortly after inflation. As a result of higher loading during reentry, chute #3 had a couple of broken suspension lines.
					B	The failure to chute #2 occurred in gore number 93 from the skirt band through the vent band and across the vent cap. The most probable cause appears to be associated with the parachute canting at an angle greater than twenty degrees. Consequently, the parachute was forced against the MPSS (Isogrid) during deployment from the parachute bag (at a velocity of greater than or equal to 300 ft/sec) resulting in distressed ribbons. This was a failure. For STS-33 and the following five flights, ripstop will be implemented on one main parachute per

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
MSFC/SRB	01	. . R. RUNKLE/EE11 .	STS-30-B-1 . PV-6-128949	B	SRB. Ripstop is currently scheduled for implementation on all main parachutes for STS-38 and subsequent flights. . Flight Problem Report approved by Lv II Noon PRCB on 6/22/89. (PRCBD #S62051) Closed in the MSFC PRACA system on 7/20/89. Status: Closed
	02	. . W. MANN/EE11 .	STS-30-B-2 . .	S	The HDP DCS did not fuction properly at locations #2, #3, #5, and #7, resulting in the loss of some debris.
				B	Varing amounts of debris were lost from each of the subject HDPs. The only debris found at the MLP was at HDP 5, totaling 4.4oz. A phased enhancement of the present design is being evaluated. Changes include the addition of a rubber shock absorber between the stud attach and plug tip and material/configuration changes on the stud attach. The present DCS is an acceptable risk for STS-28 for the following reasons: 19 of 24 HDPs have functioned since the assembly process change; most of the debris has been lost subsequent to liftoff; and the weight of the largest "piece" of potential debris is 2 to 3 oz. . Flight Problem Report approved by Lv II Noon PRCB on 6/22/89. (PRCBD #S62052) Closed in the MSFC PRACA system on 7/20/89.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
MSFC/SRB	02	W. MANN/EE11	STS-30-B-2	B	KSC LSOC Tracking Numbers: PV-6-129210 and PV-6-129212 Status: Closed
	03	W. MANN/EE11	STS-30-B-3 PV-6-128951	S	Four of the ETA Ring cover fasteners were sheared off near the in-harbor tow bracket of the left SRB.
				B	Physical evidence on the fasteners and cover holes support the conclusion that the fasteners failed during buckling of the ring segment (see IFA no STS-30-B-4). All four fasteners exhibited a similar shear failure mode. The ring segment is not reusable. There is no corrective action required. This is not a contraint to STS-28 or subsequent flights due to occurrence following initial water impact. Flight Problem Report approved by Level II Noon PRCB on 6/22/89. (PRCBD #S62053) Closed in the MSFC PRACA system on 7/18/89. Status: Closed
	04	W. MANN/EE11	STS-30-B-4 PV-6-129209	S	The left SRB ETA Ring cap and web separation continues approx 100

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
MSFC/SRB	04	W. MANN/EE11	STS-30-B-4 PV-6-129209	S	inches circumferentially on ring segment 283.
				B	The damage is attributed to a combination of cavity collapse loads and negative internal pressure within the motor case. Furthermore, this anomaly is directly associated with the higher than normal water impact loads resulting from the left SRB main parachute failure (see IFA no. STS-30-B-1). This is a random occurrence which has been experienced on previous flights. There is no corrective action required.
					Flight Problem Report approved by Level II Noon PRCB on 6/22/89. (PRCBD #S62054)
					Closed in the MSFC PRACA system on 7/18/89.
					Status: Closed
MSFC/SRM	01	J. TRENKLE/EE51	STS-30-M-1 DR4-5/151	S	Postflight inspection of the left SRM identified several aft edge unbonds of the factory joint weatherseals.
				B	The aft segment stiffener-to-stiffener factory joint weatherseal exhibited intermittent aft edge unbonds around the circumference. Also exhibiting a single, localized debond along the weatherseal aft edge were the stiffener-to-stiffener and forward-center factory joints. All unbonds are adhesive failures between the Chemlok 205 primer and the

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
MSFC/SRM	01	J. TRENKLE/EE51	STS-30-M-1 DR4-5/151	B	motor case. Bonding surface contamination was determined not to be the cause of the unbonds. However, case surface smoothness has been found to reduce the weatherseal bond strength. A change allowing the entire bond surface to be gritblasted is in signoff. Planning requirement being imposed for a 70 Ra minimum surface finish. Minimum conscan requirements for these surfaces are currently in place. Flight Problem Report approved by Level II Noon PRCB on 6/27/89. (PRCBD #S62055) Deferred in the MSFC PRACA for STS-28R, STS-34, and STS-33R. KSC LSOC Traking Numbers: PV-6-128773 and PV-6-128775 Status: Deferred
	02	J. TRENKLE/EE51	STS-30-M-2 PV-6-129207 DR4-5/153	S	Postflight inspection of the left SRM igniter revealed a cut at 285 degrees on the secondary seal of the outer gasket.
				B	The nick exists on approximately 50 percent of the crown and extends radially (at a diagonal) inboard. Dimensions are approximately 0.010" long by 0.010" wide by 0.030" deep. The cut is on the gasket forward face and was not visable in the void area. The exact cause of the o-ring damage is unclear. Prior to igniter installation the gasket was visually inspected, and the igniter joint passed both the high and

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
MSFC/SRM	02	J. TRENKLE/EE51	STS-30-M-2 PV-6-129207	DR4-5/153	B	low pressure leak tests. During assembly two separate gouges in the metal retainer of the gasket at 230 and 248 degrees were written on a DR and dispositioned "use as is." Corrective action consists of updating shipping, handling, storage, and inspection operations for new and refurbished gaskets and is in place. Flight Problem Report approved by Level II Noon PRCB on 6/27/89. (PRCBD #S62056) Deferred in the MSFC PRACA for STS-28R and STS-34. Status: Deferred
	03	B. POWERS/EE51	STS-30-M-3 PV-6-128972	DR4-5/152	S	The left SRM Nozzle snubber ring was displaced slightly forward and wedged into the aft end ring. Nozzle is wedged out of null position.
					B	All bolts connecting the snubber support ring to the forward exit cone are sheared. The support ring is displaced ten inches forward at 248 degrees and is in its normal position at 68 degrees. Snubber support ring and snubber segments are wedged between the forward exit cone and the bearing end rings causing the flex bearing to be stretched forward approximately 3/4 inch. The nozzle hardware damage and "snubbed" condition is attributed to high splahdown loads which are associated with the left SRB parachute anomaly (see IFA No. STS-30-B-1). No SRM

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
MSFC/SRM	03	. . B. POWERS/EE51 .	STS-30-M-3 PV-6-128972	DR4-5/152	B	corrective action is being considered. MTI and SPC desnub tooling and procedures called out in the KSC disassembly manual are to be omitted. All future nozzle desnubbing operations will be accomplished at MTI/ Clearfield. The nozzle damage incurred on STS-30R may limit/prevent reuse of this hardware on future flights. . Flight Problem Report approved by Level II Noon PRCBD on 6/27/89. (PRCBD #S62057) Deferred in the MSFC PRACA for STS-28R, STS-34, and STS-33R. . Status: Deferred
ORB	01	118:16:39. PRLNCH 1ST ATT D. DILLMAN .	PR-ECL-4-04-0337 IPR 30RV-0256	EECOM-01 IM/30RF04	S	Cabin Pressure Transducer Failed.
					B	Cabin pressure transducer failed to register cabin pressurization properly. During turnaround found dust cap on transducer port. KSC procedures revised. Deviations have been written to OMI S0007. . Flight Problem Report approved at Level II Noon Board on 6/14/89. (PRCBD #S62001) KSC LSOC Tracking Numbers: IV-6-015362; PV-6-128152 .

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE		PROBLEM NUMBERS		TC	TEXT LINE
ORB	01	118:16:39. D. DILLMAN	PRLNCH 1ST ATT .	PR-ECL-4-04-0337 IPR 30RV-0256	EECOM-01 IM/30RF04	B	Status: Closed
	02A	118:18:30. D. CORCORAN	PRLNCH 1ST ATT 4/28/89	PR-APU-4-04-0136 PR-APU-A-0007	MMACS-01 CAR 30RF05	S	Instrumentation: APU-3 EGT-2 (V46T0340A) failed.
						B	During APU startup APU-3 EGT 2 failed. . R&R of transducer is complete. KSC LSOC Tracking Number: PV-6-128137 Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002) Status: Closed
	02B	118:18:30. D. CORCORAN	PRLNCH 1ST ATT 4/28/89	PR-APU-4-04-0136 PR-APU-A-0007	MMACS-01 CAR 30RF06	S	Instrumentation: APU-1 EGT-1 (V46T0142A) failed.
						B	During APU startup, APU-1 EGT 1 failed. . R&R of transducer is complete. KSC LSOC Tracking Number: PV-6-128137 Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002) Status: Closed

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE		PROBLEM NUMBERS		T C	TEXT LINE
ORB	02C	118:18:30. D. CORCORAN	PRLNCH 1ST ATT 4/28/89	PR-APU-4-04-0136 PR-APU-A-0007	MMACS-01 CAR 30RF07	S	Instrumentation: APU-2 EGT-1 (V46T0242A) failed.
						B	During APU startup, APU 2 EGT 1 failed.
							.
							R&R of transducer complete.
							KSC LSOC Tracking Numbers: PV-6-128137
							Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002)
							Status: Closed
	02D	124:18:49. D. CORCORAN	ASCENT .	PR-MPS-4-05-0497 IPR 34V-0024	BSTR-02 CAR 30RF08	S	Instrumentation: SSME #3 GH2 press sys temp (V41T1361A) failed high
						B	SSME #3 GH2 press sys temp failed high prelaunch.
							.
							T/S'ing work at KSC has traced the problem to a bad transducer.
							.
							R&R of Transducer is complete. Awaiting retest.
							.
							KSC LSOC Tracking Number: PV-6-130566
							Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002)
							Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
ORB	02E	124:18:54. ASCENT D. CORCORAN	PR-MPS-4-05-0498 IPR 34V-0023	BSTR-03 CAR 30RF09	S	Instrumentation: Center Engine LH2 inlet pressure transducer failed (V41P1100C)
					B	The center engine LH2 inlet pressure transducer failed to about 1-2 psi during ascent. . T/S'ing work at KSC has traced the problem to a bad transducer. . R&R of transducer is complete. Awaiting retest. . KSC LSOC Tracking Number: PV-6-130565 Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002) Status: Closed
	02F	126:11:36. D. CORCORAN	PR-FCP-4-05-0107 PV-6-129544	EECOM-03 IM/30RF10	S	Instrumentation: Fuel Cell #2 H2 flow meter failed.
					B	At about 126:10:00 the FC2 H2 flow transducer (V45R0270A) shifted high by .2-.3#/hr. Started working properly toward end of mission. . KSC action to transfer this PR to next flow. Deferred per PR-FCP-4-A0009. Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002)

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	02F	126:11:36. D. CORCORAN .	PR-FCP-4-05-0107 PV-6-129544	EECOM-03 IM/30RF10	B	Status: Closed
	02G	. . D. CORCORAN .	PR-APU-A-0007 .	MMACS-06 CAR 30RF11	S	Instrumentation: APU 1 EGT 2 failed (V46T0140A)
					B	APU 1 EGT 2 failed on entry . R&R of transducer is complete. Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002) Status: Closed
	02H	128:19:34. D. CORCORAN .	. .	BSTR-06 IM/30RF12	S	Instrumentation: Left engine LH2 inlet pressure transducer biased low (V41P1200C)
					B	The left engine LH2 inlet pressure transducer was reading about 10 psi lower than actual pressure from VREL = 4500 FPS to touchdown. . KSC evaluation shows eng #2 typically 10 psi lower than other two engines. JSC/KSC/DWNY review showed that this is a nominal behavior. . No further action required. Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62002)

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE		PROBLEM NUMBERS		T C	TEXT LINE
ORB	02H	128:19:34. D. CORCORAN	.	. .	BSTR-06 IM/30RF12	B	Status: Closed
	03	118:18:28. S. MCMILLAN	PRLNCH 1ST ATT .	PR-MPS-4-04-0487 IPR 30RV-0259	BSTR-01 CAR 30RF01	S	SSME-1 LH2 Recirculation pump failed
						B	SSME #1 LH2 recirculation pump failed. Intermittent short popped phase B circuit breaker. Pump R/R and retested okay. . MCR 14890 Approved for OV-104 7/15 EOD pumps LCC change being submitted by JSC for STS-28 and subs. LCC will state that if problem can be determined to be a ground problem, then GO, else NO-GO. KSC LSOC Tracking Numbers: IV-6-015363; PV-6-128164 . Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62003) Status: Closed
	04A	4/28/89 . D. DILLMAN	PRLNCH 1ST ATT .	PR-FCS-4-04-0194 PR-LAF-4-04-0086	. CAR KB0821	S	CFE - MS-1 RH shoulder belt adjuster "c" clip missing
						B	After the launch attempt the MS-1 RH shoulder belt adjuster was found missing during seat ingress. .

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE		PROBLEM NUMBERS		TC	TEXT LINE
ORB	04A	4/28/89 . D. DILLMAN	PRLNCH 1ST ATT .	PR-FCS-4-04-0194 PR-LAF-4-04-0086	. CAR KB0821	B	MS-1 seat R&R'd during launch turnaround.
							.
							Flight Problem Report approved by Level II Noon PRCB on 6/28/89. (PRCBD #S62004A)
							KSC LSOC Tracking Number: PV-6-128141
							Status: Closed
	04B	125:23:48. D. DILLMAN	.	FIAR BFCE-210-F003 .	MMACS-04	S	GFE - Arriflex 16mm camera operate lever failed.
						B	During crew operations the Arriflex 16mm camera lever failed to function. The crew performed a routine malfunction procedure and regained the camera function. However, in this mode the camera will run continuously unless the battery pack is unplugged.
							.
							Flight Problem Report approved by Level II Noon PRCB on 6/21/89. (PRCBD #S62004)
							Status: Closed
	04C	126:13:37. D. DILLMAN	.	. .	EECOM-04 J3003A	S	GFE - Galley Failures
						B	1. Galley H2O dispenser not selectable.
							2. Chilled water QD failed to disconnect. JSC Chit approved to check QD's, then R/R galley.

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	04C	126:13:37. D. DILLMAN .	. .	EECOM-04 J3003A	B	3. Package-in-place lever was stuck for about 80 percent of mission. .
						KSC is performing galley work, per OMI V5114 and the approved CHIT. .
						Galley has been removed and shipped to JSC. .
						T/S'ing at JSC has found a possible bad solder connection on one switch. No anomalies have been found with the QD's. T/S'ing to complete week of 6/5. Galley to be returned to KSC prior to need date.
						FIAR's: BFCE-023-F002; BFCE-023-F003; BFCE-023-F004; .
						Flight Problem Report approved at Level II Noon PRCB on 8/4/89. (PRCBD #S62004C)
						Status: Closed
	04D	126:12:52. D. DILLMAN .	FIAR-BFCE-210-F002 .	MMACS-05	S	GFE - Hasselblad 70mm camera failed
					B	Hasselblad 70mm camera shutter jammed.
						Remove and send to JSC.
						Flight Problem Report approved by Level II Noon PRCB on 6/28/89. (PRCBD #S62004D)
						Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

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ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	04E	126:18:45. D. DILLMAN .	DR BH930060 FIAR BFCE-029-F011	INCO-03	S	GFE - CCTV Camera A - Spots on image
					B	Two translucent white spots, above midscreen, overlapping and each about 1/8" in diameter, were noted on D/L video from P/L bay camera A. 5 black spots, less than 1/32" in diameter and scattered across the screen, were also noted. The spots stayed stationary after zoom performed. R&R complete; Camera is at JSC. Bad Silica Intensifier Target (SIT) Tube. . Flight Problem Report approved at Level II Noon PRCB on 7/19/89. (PRCBD #S62004E) Status: Closed
	04F	125:04:54. D. DILLMAN .	FIAR-BFCE-029-F010 .	INCO-02	S	GFE - Teleprinter messages illegible
					B	Top half of teleprinter characters did not print. . R&R complete; Teleprinter is at JSC. Paper not installed correctly. Key hammer had buildup of ink. . Flight Problem Report approved at Level II Noon PRCB on 7/14/89. (PRCBD #S62004F) Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	04G	. . D. DILLMAN .	. .	.	S	GFE - Gas Bubbles in Drinking Water
					B	Crew reported gas bubbles in drinking water during debrief. Post flight analysis inconclusive as to source of gas. Fly-as-is. Ground test apparatus being assembled to attempt resolution of gas source.
	05	124:18:56. ET SEP T. WELCH .	IPR 34V-0026 IV-6-015550	PROP-01 CAR 30RF14	S	RCS jet R1U failed off post ET SEP
					B	Reaction control system jet R1U failed off post ET SEP due to low chamber pressure. KSC requested to expedite T/S and remove thruster on OV-103 and ship to vendor for failure analysis. KSC will schedule T/S on KSC-PR. KSC will expedite schedule. Trickle current test inflight and on ground showed good electrical path. . Chit J3001R1 signed out of board on 5/30/89. . Valve signature on OV-103 indicated a sluggish poppet. Showed 23 msec, S/B 12 msec, high current. Valve removed on 5/23 and shipped to the vendor. OV-104 pod (RP01) sent to ORPA for repairs. Use OV-103 pod (RP03) on OV-104 for STS-34. . Flight Problem Report approved by Level II Noon PRCB on 6/28/89. (PRCBD #S62005)

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	05	124:18:56. ET SEP T. WELCH .	IPR 34V-0026 IV-6-015550	PROP-01 CAR 30RF14	B	Status: Closed
	06	125:00:15. ON-ORBIT S. MCMILLAN .	PR-EPD-4-04-0551 IPR 34V-0025	MMACS-02 IM/30RF15	S	APU 2 GG Fuel Pump "A" Heaters inoperative
					B	APU 2 GG fuel pump "A" heaters did not respond when switch operated. Switched to "B" heaters. Operating properly. T/S to include LCA and controller C/O postflight. KSC C/O per OMRSD and in accordance with Downey identified additional EPDC test procedures. . For Ferry Flight, use "B" heaters, KSC deviation and exception in work. Exception (EK 1130) approved at noon PRCB on 5/12/89. . T/S'ing at KSC has been unsuccessful in recreating the problem. . Rational, from RI/DNY, for why the Load Control Assemblies (LCAs) are not considered the problem source has been received at JSC and KSC. . KSC has demated all connectors, starting forward and moving aft, and performed wiggle test and pin pull test. No discrepancies were found. Panel A12 removed on 6/14. Sent to RCS for analysis and c/o. Panel returned and reinstalled on 6/22. ALCA #2 R&R completed on 6/30/89. . STS-27 Tracking Numbers: IFA-STS-27-04 and IPR 30RV-0030

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	06	125:00:15. ON-ORBIT S. MCMILLAN .	PR-EPD-4-04-0551 IPR 34V-0025	MMACS-02 IM/30RF15	B	. KSC LSOC Tracking Numbers: IV-1-000042 . Panel A12 PR# APU-4-05-0139 (PV-6-132002). APU #2 LCA PR# APU-4-05-014 (PV-6-132128). . Flight Problem Report draft in-work
	07	124:22:52. D. SUITER .	PR-COM-4-05-0071 FIAR JSC-EE-0655	INCO-01 CHIT J2999	S	TAGS JAM
					B	The onboard hardcopier (OHC) was being configured for receipt of data. This configuration requires that 20 pages of paper be advanced. Eighteen pages had been advanced and the OHC jammed on the 19th page. In flight maintenance procedure performed. No Go for mission. Chit approved for JSC TAGS personnel to T/S postflight at KSC. . Capstan screw found loose. T/S'ing at KSC could not remove the jammed paper. No cause for malfunction found at KSC. . TAGS has been shipped to JSC. Cause is possible crew procedure error in trying to clear jam. Change to crew procedures and training will be made. . KSC Tracking Numbers: IPR 34V-0029 (PV-6-015560)

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	07	124:22:52. D. SUITER	PR-COM-4-05-0071 FIAR JSC-EE-0655	INCO-01 CHIT J2999	B	. Flight Problem Report approved at Level II Noon PRCB on 7/14/89. (PRCBD #S62007) Status: Closed
	08	124:19:31. T. WELCH	IPR 34V-0027 IV-6-015551	PROP-02 IM/ 30RF16	S	ROMS FU total QTY gauge failed (V43Q5331C)
					B	During the OMS-2 burn, the R OMS fuel total quantity gauge stopped decreasing at 49.8%. Expected to decrease to 31.4%. Normal T/S to be performed postflight, per OMRSD requirements. . T/S'ing will be performed in the ORPA. Status: Closed; Problem Report in Level III Signature cycle.
	09	126:13:45. T. WELCH	PR-RP01-11-0355 IPR 34V-0001	PROP-03 IM/30RF17	S	Right RCS A-leg OX He isolation valve (LV304) failed open
					B	The right RCS A-leg oxidizer helium isolation valve failed open when commanded to close. Deviation required. Valve verified open postflight. Tank blown down to ferry pressure through regulators and fill/drain valve. . Exception (EK1132) approved at noon PRCB on 5/12/89 to ferry with

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	09	126:13:45. T. WELCH	PR-RP01-11-0355 IPR 34V-0001	PROP-03 IM/30RF17	B	valve open.
						Normal T/S'ing to be performed at KSC per OMRSD requirements. .
						KSC T/S'ing showed signal okay to pod connector. .
						Replacement valve to KSC on 5/26. .
						Valve worked properly when pod was removed from the vehicle. OV-104 pod (RP01) sent to ORPA for repairs. Metal chips found in P29 connector. During vacuming of connector some pins were bent. .
						Flight Problem Report disapproved at Level II Noon PRCB on 7/19/89. (PRBCD #S62009)
	10	125:19:00. S. MCMILLAN	IPR 34V-0028 IV-1-000043	MMACS-03 CAR 30RF18	S	Water spray boiler #2 nitrogen pressure decay (V58P0204A)
					B	There appears to be a leak downstream of the GN2 supply valve in WSB#2 as evidenced by a 5 psi drop in the WSB regulator pressure during the first 24 hrs of flight. .
						Normal c/o by KSC per OMRSD requirements. .
						RCN in work by RI/DNY to raise the leak rate limit. RCN ready by 7/1 per RI/DNY.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	10	125:19:00. S. MCMILLAN .	IPR 34V-0028 IV-1-000043	MMACS-03 CAR 30RF18	B	Flight Problem Report approved at Level II Noon PRCB on 8/4/89. (PRCBD #S62010) Status: Closed
	11	127:19:46. M. SUFFREDINI .	PR DIG-4-05-0134 IPR 34V-0030	DPS-02 CHIT J3035	S	GPC 4 failed to sync
					B	The system management GPC (4) experienced a 'failed to sync'. GPC's 1 and 2 voted against GPC 4. GPC 4 replaced with spare. KSC to remove lockers MF710 and MF21M. Ship CPU and IOP to OWEGO. . Interconnect cables will not be sent from KSC to OWEGO. Cables to be reinstalled in vehicle. . CHIT approved at Level II Noon Board on 6/15/89. Chit authorizes a wiggle test to be performed on the three CPU/IOP interface cables, while in SM2. Wiggle test of I/F cables was negative. . Test Complete, could not duplicate. Close as Unexplained Anomaly. KSC LSOC Tracking Numbers: IV-6-015559 CAR Numbers: 30RF02 and 30RF03 Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62011) Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
ORB	12	. . DEORBIT S. MCMILLAN .	PR-MPS-4-05-0503 IPR 34V-0031	BSTR-05 CAR 30RF19	S	MPS SSME 3 reg outlet "B" C/V leak
					B	The MPS SSME 3 regulator outlet "B" check valve (CV45) had a reverse leak when the MPS He system was configured for entry at TIG-25 minutes . KSC to T/S per OMRSD. Leak checks showed zero leakage on check valve. Valve will still be R&R'd due to past history of this part. . R&R scheduled for mid-July. KSC LSOC Tracking Number: PV-6-131752 Flight Problem Report approved at Level II Noon PRCB on 7/20/89. (PRCBD #S62012) Status: Closed
	13	. . ENTRY D. SUITER .	FIAR-JSC-EC-0393 .	.	S	MS-3 COMM Cap Headset failed.
					B	Mission specialist on middeck reported failure of comm cap's headset during entry. R&R'd and sent to JSC. JSC T/S'ing has found numerous broken wires at the connector. . Flight Problem Report approved at Level II Noon PRCB on 7/14/89. (PRCBD #S62013) Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
ORB	14	. . OMS BURNS T. WELCH .	IPR 34V-0003 . . IM/30RF20	S	Right OMS GN2 Pressure regulator regulated low
				B	Right OMS GN2 pressure regulator regulated 5 psia below specifications during post OMS burn purges, and during postlanding GN2 tank venting. . Standard c/o by OMI at the ORPA. . Flight Problem Report disapproved at Level II Noon PRCB on 7/19/89. (PRCBD #S62014)
	15A	. . POST-LANDING S. MCMILLAN .	PR MEQ-4-05-0234 . . IM/30RF21	S	RH Main Landing Gear Fluid Leak
				B	About 4 to 8 ounces of fluid was found in the right main landing gear wheel well postlanding. KSC to T/S per OMRSD requirements I/W. . Sample Analysis in-work. Possible MEQ fluid coming from the struts. . Lab analysis has been unable to determine type of fluid. Struts have been diapered to attempt to catch any additional leakage. . Leakage at .9 drops/hr vs 1 drop/hr spec. Flight Problem Report approved at Level II Noon PRCB on 8/2/89. (PRCBD #S62015) Status: Closed

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	15B	. . POST-LANDING S. MCMILLAN .	PR MEQ-4-05-0235 .	. IM/30RF22	S	LH Main Landing Gear Fluid Leak
					B	Fluid was also found in the left main landing gear wheel well postlanding. KSC to T/S per OMRSD requirements I/W. .
						Sample analysis in-work. Possible MEQ fluid coming from the struts. .
						Lab analysis has been unable to determine type of fluid. Struts have been diapered to attempt to catch any additional leakage. .
						Leakage at .9 drops/hr vs 1 drop/hr spec. Flight Problem Report approved at Level II Noon PRCB on 8/2/89. (PRCBD #S62015)
						Status: Closed
	16	128:19:43. B. LEVERICH .	PR-MED-4-05-0238 .	IM/30RF23 CHITJ3033A	S	Nose Wheel Steering Enable Late
					B	Crew reported lateral acceleration following nose gear touchdown. Data confirmed 1/4g lateral acceleration, and about 4 second delay from nose gear touchdown to nose wheel steering enable. .
						Chit J3020 approved for OV-102 only.
						Chit J3033A approved on 6/9 to check-out WOW switches on OV-104. .

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		TC	TEXT LINE
ORB	16	128:19:43. B. LEVERICH	PR-MED-4-05-0238	IM/30RF23 CHITJ3033A	B	KSC T/S'ing found RH NLG sensor out of adjustment. Switch re-rigging completed. Retest completed. Flight Problem Report approved at Level II Noon PRCB on 8/2/89. (PRCBD #S62016) Status: Closed
	17	POST-LANDING	PR-STR-4-05-1575 PV-6-128814	IM/30RF24	S	Ding on Forward Window #6
					B	Ding is larger than allowable specifications. KSC to R/R week of 5/29. Pit 11 1/2 mills deep. Window R&R complete. Flight Problem Report approved at Level II Noon PRCB on 7/26/89. (PRCBD #S62017) Status: Closed
	18	POST-LANDING J. GUTHERY	PR PYR-4-05-0073 PR PYR-4-05-0075	CAR 30RF25	S	ET LO2 Umbilical Yoke and Detonators
					B	A pyro retainer clip, RH outboard, fell out of the umbilical cavity when the ET Umbilical doors were opened. Two LO2 umbilical detonators, one from RH AFT and one from RH Inboard, were missing and were not found on the runway. Concern is that debris could prevent ET umbilical doors from closing while on orbit. Rockwell and JSC are investigating.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	18	. . POST-LANDING J. GUTHERY .	PR PYR-4-05-0073 PR PYR-4-05-0075	. CAR 30RF25	B	MCR 11960 to CCB week on 7/21/89. RI Logic states safe to fly. OV-104 fly as is. KSC LSOC Tracking Numbers: PV-6-128858 and PV-6-129131 . Flight Problem Report approved at Level II Noon PRCB on 8/2/89. (PRCBD #S62018) Status: Closed
	19	. . ON-ORBIT B. LEVERICH .	. .	. IM/30RF26	S	Commander's AVVI reading high during FCS checkout.
					B	The commander's AVVI read 20,600 ft/sec during FCS checkout, should have read 20,000 ft/sec. . Downey review in work to determine tolerance. . Acceptable range to be added to Flight Data File. KSC to run standard OMI V1028 test. . Flight Problem Report approved at Level II Noon PRCB on 7/26/89. (PRCBD #S62019) Status: Closed
	20	. . POSTLANDING J. GUTHERY .	PR-TCS-4-05-0515 PV-6-130244	. CAR 30RF27	S	1307 Bulkhead Blanket Damage

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS		T C	TEXT LINE
ORB	20	J. GUTHERY POSTLANDING	PR-TCS-4-05-0515 PV-6-130244	CAR 30RF27	B	Some 1307 bulkhead blankets, adjacent to those recently modified, sustained cover damage. In addition, nine snaps were found unsnapped. Downey to submit MCR to modify blankets. Engineer to be complete on 7/31. Problem report in-work.
	21	S. MCMILLAN PRELAUNCH		IM/30RF28	S	AFT FUS Temps Low Prelaunch
					B	WSB vent/nozzle temps 10 deg F warmer on first launch attempt than on launch day. Due to local weather. Clear/sun on first attempt; cloudy/showers on launch day. Status: Closed
	22	S. MCMILLAN ENTRY	IPR 34RV-0035		S	During MPS LO2 Manifold Repress/GO2 Press Lagged
					B	When the MPS LO2 Manifold Repress was initiated during Rentry, the GO2 disconnect press rise lagged by approx 1 min 30 secs. Press should rise concurrently. GO2 filter suspect. KSC Troubleshooting on 7/22/89 indicated the GOX manifold orifice was two small or restricted. Orifice replacement complete and X-rays of brazes are good.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
ORB	23	D. DILLMAN ON-ORBIT		S	High Iodine concentration in drinking water
				B	The crew measured drinking water iodine concentration several times during the mission and found that the concentrations increased throughout the flight, reaching a maximum value of 13ppm. Microbial check valve is designed to inject 2 ppm iodine into 70 deg F. water, however the galley input water temperature is higher, causing increased iodine concentration. Further data will be taken on STS-28, 34, and 33 to determine how to redesign the microbial check valve.
PLYD	01	1704E 4/28/89	IPR 30RV-0262 IV-6-015369	S	Magellan RF receiver unexpectedly locked-up on orbiter S-band (High Power Mode).
				B	T/S shows that if the orbiter is on its primary frequency and MILA is at high power (10KW) then Magellan will always lock up on us. If we use our secondary frequency then no Magellan lock-up, but JSC doesn't like that. So our Magellan folks would like us to stay at low power (2 KW) until the T-9 min hold. For the second launch attempt the MILA station stayed at low power until T-11 min at which time it went to high power for the remainder of the count. Also the Payload went to secondary frequency (2041.9 mhz) until the first stateside pass.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

STS-30 (OV-104 FLT 4) OFFICIAL INFLIGHT ANOMALY REPORT

ELEMENT	NO.	DETECED/PHASE RESP.MANAGER/DATE	PROBLEM NUMBERS	T C	TEXT LINE
PLYD	01	1704E . 4/28/89	IPR 30RV-0262 IV-6-015369 .	B	Flight Problem Report in-work.
	02	. .	. .	S	PI Channel Selector showed 906 onboard and on ground, but there was no indication of CIU lock onboard.
				B	Ground does not have insite into the CIU status. Crew reported during debrief that they "fiddled" with control and immediately got a CIU lock indication.
					Belief is that with the FM and PI both on, interference is causing the CIU not to acquire a lock. For deploy activity the FM was turned off prior to turning on the PI. This procedure change worked sucessfully. A crew procedure change, Form 482, is in work to incorporate this change into future procedures.

TC: S-SUBJECT, B-BACKGROUND, C-CLOSURE

Appendix B

LIST OF ACRONYMS

AFB	Air Force Base
AFTA	Aft Frame Tilt Actuator
AFV	Anti-Flood Valve
AMOS	Air Force Maui Optical System
APU	Auxiliary Power Unit
ATP	Acceptance Test Procedure
AVVI	Altimeter Vertical Velocity Indicator
C/O	Checkout
CA	California
CCB	Change Control Board
CCC	Central Computer Complex
CIL	Critical Items List
CIU	Controller Interface Unit
COMM	Communications
CPU	Central Processing Unit
CSFP	Critical Single-Failure Point
CV	Check Valve
dbm	Decibels Referred to 1 Milliwatt
DCS	Debris Containment System
DNY	Downey
DOL	Day of Launch
DR	Discrepancy Report
DWV	Dielectric Withstanding Voltage
ECLSS	Environmental Control and Life Support Subsystem
EDT	Eastern Daylight Time
EGT	Exhaust Gas Temperature
EIU	Engine Interface Unit
EMU	Extravehicular Maneuvering Unit
ESM	Extended Semiconductor Memory
ESR	Engineering Support Request
ET	External Tank
ETA	External Tank Attachment
ETVAS	External Tank Vent Assembly System
EVA	Extravehicular Activity

Appendix B

LIST OF ACRONYMS (Cont.)

F	Fahrenheit
FASCOS	Flight Acceleration Safety Cutoff System
FCS	Flight Control System
FCV	Flow Control Valve
FEA	Fluids Experiment Apparatus
FES	Flash Evaporator System
FMEA/CIL	Failure Modes and Effects Analysis/Critical Items List
FOS	Factor of Safety
FRCS	Forward Reaction Control System
FRR	Flight Readiness Review
ft/sec	Feet Per Second
ft^3	Cubic Feet
FUS	Fuselage
FWD	Forward
g	gravitational acceleration
GFE	Government Furnished Equipment
GFI	Ground Fault Interrupt
GG	Gas Generator
GH_2	Gaseous Hydrogen
GLS	Ground Launch Sequencer
GN_2	Gaseous Nitrogen
GN&C	Guidance, Navigation, and Control
GO_2	Gaseous Oxygen
GOX	Gaseous Oxygen
GPC	General Purpose Computer
GSE	Ground Support Equipment
GUCP	Ground Umbilical Carrier Plate
H_2	Hydrogen
H_2O	Water
HDP	Holddown Post
He	Helium
HPFTP	High Pressure Fuel Turbopump
HPOTP	High Pressure Oxidizer Turbopump
HR	Hazard Report
I/F	Interface
IFA	Inflight Anomaly
INTG	Integration
IOP	Input/Output Processor
IPR	Interim Problem Report
IUS	Inertial Upper Stage

Appendix B

LIST OF ACRONYMS (Cont.)

JSC	Johnson Space Center
KB	Kilobit
KSC	Kennedy Space Center
KW	Kilowatts
L-2	Launch Minus 2 Day Review
LCA	Load Control Assemblies
LCC	Launch Commit Criteria
LDB	Launch Data Base
LH	Left Hand
LH_2	Liquid Hydrogen
LN_2	Liquid Nitrogen
LO_2	Liquid Oxygen
LOX	Liquid Oxygen
LPS	Launch Processing System
LSEAT	Launch Systems Evaluation Advisory Team
LSFR	Launch Site Flow Review
MCC	Main Combustion Chamber
MCR	Master Change Record
ME	Main Engine
MECO	Main Engine Cut-Off
MEOP	Maximum Expected Operating Pressure
MGN	Magellan
mHz	Megahertz
MILA	Merritt Island Launch Area
MLG	Main Landing Gear
MLE	Mesoscale Lightning Experiment
MLP	Mobile Launch Platform
MPS	Main Propulsion System
MPSS	Main Parachute Support Structure
MS	Mission Specialist
MSE	Mission Safety Evaluation
msec	Milliseconds
MSFC	Marshall Space Flight Center

Appendix B

LIST OF ACRONYMS (Cont.)

NASA	National Aeronautics and Space Administration
NCR	Non-Compliance Report
NLG	Nose Landing Gear
NOS	Network Operating System
NM	Nautical Mile
NSRS	NASA Safety Reporting System
NSTS	National Space Transportation System
NVR	Non-Volatile Residue
O_2	Oxygen
OAA	Orbiter Access Assembly
OHC	Onboard Hardcopier
OMI	Operations and Maintenance Instruction
OMRSD	Operational Maintenance Requirements and Specifications Document
OMS	Orbital Maneuvering Subsystem
ORBI	Orbiter
OV	Orbiter Vehicle
OX	Oxidizer
PCASS	Program Compliance Assurance and Status System
PI	Payload Interrogator
PL (P/L)	Payload
p.m.	Afternoon (Post Meridiem)
POR	Power-On-Reset
PP	Peripheral Processor
ppm	Parts Per Million
PR	Problem Report
PRACA	Problem Reporting and Corrective Action
PRCB	Program Requirements Control Board
PRCBD	Program Requirements Control Board Document
PRSD	Power Reactant Supply and Distribution
psi	Pounds Per Square Inch
psia	Pounds Per Square Inch Absolute
psid	Pounds Per Square Inch Differential
psig	Pounds Per Square Inch Gage
QD	Quick Disconnect

Appendix B

LIST OF ACRONYMS (Cont.)

RCN	Requirements Change Notice
RCS	Reaction Control System
RF	Radio Frequency
RGA	Rate Gyro Assembly
RH	Right-Hand
RI	Rockwell International
RIO	Realtime Disk Driver
R&R	Repair and Replace
RSC	Rockwell Service Center
RSO	Range Safety Officer
RTL	Ready-to-Latch
RTLS	Return to Launch Site
RTV	Room Temperature Vulcanizate
S/N	Serial Number
SAIL	Shuttle Avionics Integration Laboratory
scim	Standard Cubic Inches Per Minute
scfm	Standard Cubic Feet Per Minute
SCYE	(* Anthropometric Measurement Unit)
SEP	Separation
SIP	Strain Isolator Pad
SIT	Silica Intensifier Target
SLA	Super Light Ablative
SPC	Shuttle Processing Contractor
SRB	Solid Rocket Booster
SRM	Solid Rocket Motor
SRM&QA	Safety, Reliability, Maintainability, and Quality Assurance
SSME	Space Shuttle Main Engine
SSRP	System Safety Review Panel
STS	Space Transportation System
T/S	Troubleshoot
TACAN	Tactical Air Command and Navigation System
TAGS	Text and Graphic System
TAIL	Trident Acquisition Impact Location
TAL	Transatlantic Abort Landing
TDRS	Tracking and Data Relay Satellite
TPS	Thermal Protection System
TVC	Thrust Vector Control
UEM	User Extended Memory

Appendix B

LIST OF ACRONYMS (Cont.)

VDC	Volts Direct Current
VREL	Relative Velocity
WOW	Weight On Wheels
WSB	Water Spray Boiler