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STS 61-C National Space Transportation System Mission Report

August 1987

NASA
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Space Administration

Lyndon B. Johnson Space Center
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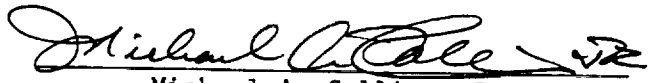
NSTS-22301

STS 61-C

NATIONAL SPACE TRANSPORTATION SYSTEM

MISSION REPORT



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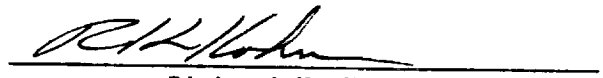

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INTRODUCTION AND MISSION OBJECTIVES

The STS 61-C National Space Transportation System (STS) Mission Report contains a summary of the major activities and accomplishments of the twenty-fourth Space Shuttle mission and the seventh flight of the OV-102 vehicle, Columbia. The sequence of events for this flight is shown in table I. The Orbiter problem tracking list is presented in table II.

The major objectives of this flight were to successfully deploy the SATCOM KU-2/Payload Assist Module-Delta Class (PAM-D II) and SYNCOM IV-5/UNQ satellites and to perform the planned operations of the Material Science Laboratory-2 (MSL-2). An option was maintained to fly the Getaway Special (GAS) Bridge Assembly (GBA) and the Hitchhiker G-1 (HG-1) to replace the SYNCOM, if it was not ready for flight. This option was exercised since the SYNCOM-IV-5/UNQ did not fly during STS 61-C.

The crew for this twenty-fourth Space Shuttle mission were Robert L. Gibson, Commander, U. S. Navy, Commander; Charles F. Bolden, Lt. Col., U. S. Air Force, Pilot; Franklin R. Chang-Dias, Ph. D., Steven A. Hawley, Ph. D., and George D. Nelson, Ph. D., Mission Specialists; Robert J. Cenker and William Nelson, Payload Specialists. Mr. Robert J. Cenker is a representative of the Radio Corporation of American (RCA). Mr. William Nelson is a member of the U. S. House of Representatives.

MISSION SUMMARY

The 5-day STS 61-C mission was planned for launch on December 18, 1985. The launch was scrubbed and rescheduled on six different occasions because of hardware problems or unacceptable weather. The mission was launched on January 12, 1986, at 6:55 a. m. e.s.t., and was scheduled for landing 5 days later on January 17, 1986. The final countdown was normal. The ascent phase was normal in all aspects with main engine cutoff (MECO) occurring at the planned time. Both solid rocket boosters were recovered and the external tank impacted within the predicted footprint. After the first two planned orbital maneuvering system (OMS) maneuvers were completed, the vehicle was in the planned 175 nmi. circular orbit.

During the first day, the RCA SATCOM-KU satellite predeployment checks were completed and the satellite was deployed at the planned time. The MSL-2 carrier systems were activated and operating properly, and the infrared imaging experiment (IRIE) camera was used on revolutions 3, 4, and 5. Also, of the 12 GAS experiments, five were activated. The Hitchhiker-G payload was activated about 3.5 hours after launch, and a minor data problem was corrected. The capillary pump loop operations appeared nominal, and the particles analysis cameras were operated satisfactorily.

Flight day 2 operations were conducted in general accordance with the flight plan and consisted mostly of experiment operations. All Orbiter systems operated well and no restrictions were imposed on on-orbit operations. The MSL-2 carrier subsystems continued to operate properly and activities with the Three-Axis Acoustic Levitator experiment were completed. Some problems developed with the other two experiments on the MSL-2 carrier and future operations were evaluated. Three more GAS experiments were activated. Also, attempts were made to monitor the Comet Halley.

Flight day 3 proceeded smoothly with no vehicle anomalies affecting payload operations. Mission Specialist Chang-Diaz presented the first Spanish broadcast which consisted of a systems/vehicle tour. Operations with the MSL-2 systems continued with an attempt to operate the Electromagnetic Levitator (EML) experiment on sample 4. Proper heatup did not occur and the unit was deactivated. No further EML operations were planned. Automated Directional Solidification Furnace (ADSF) operation was also attempted, but it did not indicate proper furnace power levels at the start on sample 4 or when attempted again after stepping to sample 1. At this point in the mission, all GAS payloads had been activated. The Argon Injection and Paper Fiber Formation student experiment activities were also accomplished. One Comet Halley Active Monitoring program (CHAMP) data take was attempted without satisfactory results. An inflight maintenance procedure was not successful in recovering the failed hardware. Consequently, no further CHAMP activities were planned for the remainder of the flight.

Infrared imaging data were taken. The data included cargo bay scenes and a ground track on Hawaii. The infrared imaging observations made the first day were downlinked and the quality of these observations was excellent.

STS 61-C orbit operations continued on schedule during the fourth day with a planned deorbit one day early on January 16. The reaction control system (RCS) hot-fire test and flight control system (FCS) checkout were completed without any anomalies. Day 4 experiment activities included ultraviolet experiment scan operations on three targets plus MSL-2 operations with the EML and ADSF. The most extensive operations were with the IRIE during numerous observational periods.

The flight was extended one day from the flight day 5 planned landing because of unacceptable weather at KSC. In preparation for landing, the payloads had been deactivated and secured. Following waveoff, various activities were undertaken to reactivate payloads and make productive use of the extension day.

The MSL subsystems were re-activated successfully and all subsystems operated nominally until the second deactivation on day 5. During this period, the coolant flow rate to the payload heat exchanger was reduced to low flow. This led to higher than normal temperatures in the MSL subsystems; however, these temperatures were well within acceptable limits.

The IRIE was operated for 45 minutes collecting images of targets of opportunity. Also, the crystal growth and amateur radio experiments of GAS 007 were continued.

Plans for landing at KSC on day 6 were cancelled because of unacceptable weather conditions, and a decision was made to land one revolution later at Edwards AFB, CA. Final stowage and preparation for entry were completed as scheduled and the 232-second deorbit maneuver was initiated at 18:12:54:30 G.m.t. The entry was nominal in all respects. After a 195-degree heading alignment circle maneuver, the Orbiter was landed at 18:13:58:51 G.m.t. on runway 22 at Edwards AFB, CA. Rollout required 10,202 feet and lasted 59 seconds. The postlanding inspection of the Orbiter showed it to be in very good condition.

VEHICLE ASSESSMENT

Marshall Space Flight Center (MSFC) has published a detailed evaluation report covering the elements for which MSFC has design responsibility. That report is MSFC-RPT-1227 - Space Shuttle STS 61-C (32)-Flight Evaluation Report - Shuttle Projects dated January 27, 1986.

SOLID ROCKET BOOSTER

The STS 61-C flight utilized lightweight solid rocket motor (SRM) cases. SRM propulsion performance was normal and within specification limits, with propellant burn rates for both SRM's near predicted values. Solid rocket booster (SRB) thrust differentials were within specification throughout the flight.

The SRB support-post loads data at lift-off showed that footpad compression, tension, and bolt loads were within design allowables and were comparable with loads observed on previous flights. The SRB base-moment calculations, based on mobile launch platform (MLP) support strain data, indicated a maximum bending moment of 95 percent of design during Space Shuttle main engine (SSME) thrust buildup.

All thrust vector control (TVC) prelaunch redlines were met with ample margins. Analyses verified that the TVC subsystem operated normally.

Evaluation of the electrical and instrumentation system indicates that the ignition and separation pyrotechnics fired as planned. The recovery sequence was performed satisfactorily on both SRB's with pyrotechnic initiation capacitor (PIC) firing and system reset properly initiated. All location aids performed normally. All SRB instrumentation measurements performed properly throughout their required flight periods.

The flight structural temperature measurement response was as expected. The SRB thermal protection system (TPS) performed as predicted during ascent with little or no TPS acreage ablation.

The performance of the separation subsystems was normal with all booster separation motors (BSM's) expended and bolts severed. Nose cap jettison, frustum separation, and nozzle jettison occurred normally on each SRB. All drogues and main parachutes were recovered and are reusable.

Analyses indicate that the performance of the Shuttle range safety system hardware for both SRB's and the ET was normal.

A postflight evaluation of the SRM structure to determine the extent of damage revealed the following significant items:

a. A gas path was noted at the 154-degree position of the aft field joint of the left SRM. Soot was found from the 140-degree to the 178-degree position, and soot was found in the primary groove from the 68-degree to the 183-degree (115 degrees arc) position. O-ring damage was noted at the 154-degree position with a maximum erosion depth of 0.004 inch and erosion length of 3.5 inches. The O-ring was affected by heat over a 14-inch length in this area.

b. A gas path was found from the 273.6-degree to the 309.6-degree (36 degrees arc) position of the left SRM nozzle joint. Soot was found in the primary O-ring groove over the entire 360-degree circumference. A potential impingement point was located at the 302.4-degree point; however, no O-ring damage was found.

c. A gas path was found at the 162-degree point with soot in the primary O-ring groove from the 108-degree to the 220-degree (112 degrees arc) point on the right SRM nozzle joint. O-ring damage was found at the 162-degree point with the maximum erosion depth being 0.011 inch and the erosion length being 8 inches. The O-ring was affected by heat over a 26-inch length in this area.

d. A gas path was found on the outer surface of the igniter at the 130-degree point of the left SRM. Soot was found on the aft side of the outer Gasko seal, approaching the primary seal over a 70-degree arc (130 to 200 degrees), and on the outer edge of the inner Gasko seal over a 130-degree arc (110 to 240 degrees), however, no seal damage was found.

e. A gas path was found on the outer surface of the igniter at the 250-degree point of the right SRM. Soot was found on the inside edge of the outer Gasko seal over the entire 360-degree circumference, however, it did not progress beyond the edge of the seal. There was a slight discoloration of the metal on both sides of the seal over the entire 360-degree circumference. There was no soot, and no seal damage found on or near the inner Gasko seal.

EXTERNAL TANK

The external tank propellant loading was accomplished satisfactorily. There was no excessive ice or frost buildup. Flight performance was excellent. Entry was normal with the impact in the footprint as predicted. Tumbling was verified.

All ET prelaunch thermal requirements were met. TPS acreage performance was as expected for the existing ambient conditions. Skin and component temperatures were similar to previous flights.

Two Operations and Maintenance Requirements and Specifications Document (OMRSD) violations occurred during propellant loading. First, liquid hydrogen ullage-pressure transducer no. 1 read approximately 0.9-psia high during fast fill, thus violating a requirement that all 3 transducers must read within 0.8

psia of each other. Second, the lower liquid-hydrogen ullage pressure requirement (40.7 psia) was violated when the pressure cycled to a minimum value of 40.2 psia just prior to transition to reduced flow rates. These violations did not affect vehicle performance.

Liquid oxygen pressure transducer no. 3 experienced intermittent control band dropouts beginning at approximately lift-off + 7.5 minutes for a period of about 8 seconds. This occurrence had no impact on vehicle performance.

SPACE SHUTTLE MAIN ENGINE

All prelaunch purge operations were executed successfully. The launch support ground support equipment (GSE) provided adequate control capability for launch preparation. All conditions for engine start were achieved at the appropriate times.

All three SSME's started properly. Buildup, mainstage, and shutdown performance of all engines was within specifications. The SSME controllers provided proper control of the engines throughout powered flight.

Engine dynamic data generally compared well with previous test and flight data, and no problems were identified.

All on-orbit activities associated with the main engines were accomplished successfully.

MAIN PROPULSION SYSTEM

All pretanking purges were performed as planned. Liquid oxygen and liquid hydrogen propellant loading, prepressurization, and pressurization systems performed satisfactorily. Ullage pressures were maintained within the required limits throughout the flight.

Main propulsion system (MPS) performance was satisfactory. Trajectory reconstruction indicated that the vehicle specific impulse was near the MPS assessment tag values. At main engine cutoff, liquid oxygen residuals were 849 lb less than predicted, and liquid hydrogen residuals were 106 lb more than predicted.

Feed system performance was normal. The liquid oxygen and hydrogen propellant conditions were within specified limits during all phases of operation, and net positive suction pressure (NPSP) requirements were met.

ORBITER

Orbiter subsystem operation during STS 61-C was excellent with only minor exceptions (table II). The most significant problem occurred during the prelaunch countdown on January 6, 1986.

At launch minus 4 minutes 40 seconds on January 6, 1986, the closed indication for the MPS liquid-oxygen replenish valve was not received. Even though the replenish valve closed indication was not available, the auto sequencer

continued operation using other instrumentation to status the position of the valve. At launch minus 4 minutes 20 seconds, a message indicated that the inboard fill and drain valve did not close and this resulted in the auto sequencer initiating a launch hold. The inboard fill and drain valve was not commanded closed because the replenish valve closed indication was not received.

A continue command was issued at launch minus 2 minutes and 55 seconds that allowed the liquid oxygen terminal count sequencer to open the tail-service mast vent drain valve without closing the Orbiter inboard fill and drain valve. This unknowingly permitted the off-loading of liquid oxygen until the Orbiter inboard fill and drain valve was noted to be open and was then closed. Liquid oxygen prepressurization was initiated; however, the ground helium gas supply was unable to satisfy the control-band pressure requirement because of the ullage-volume increase resulting from the rapid off-loading of liquid oxygen.

During the liquid-oxygen off-loading, it was recognized that the low-level cutoff sensors temporarily indicated dry. This was probably caused by the termination of the helium feedline anti-geyser injector approximately 20 seconds after the tail-service mast drain valve was open.

A hold was initiated at launch minus 31 seconds to review the previous out-of-sequence loading termination and obtain a 5-minute liquid-oxygen drain through the main engines. During the hold, the liquid-oxygen main-engine temperature dropped below the engine-start requirement of 168.3 degrees R by approximately 3 degrees. The countdown was recycled to launch minus 20 minutes and oxygen replenish flow was re-established. The launch was scrubbed when it was determined that the vehicle could not be recycled within the allowable launch window.

PAYLOADS AND EXPERIMENTS

SATCOM-KU SATELLITE

The RCA SATCOM-KU satellite was deployed on time at 12:21:26:29 G.m.t. The range instrumentation aircraft were on station to monitor the payload assist module D-2 firing which was satisfactory. The satellite was placed in geosynchronous orbit and began operating satisfactorily.

MATERIALS SCIENCES LABORATORY

The MSL carrier (support) systems were activated on schedule. Of the three experiments that were a part of the MSL, only the three-axis acoustic levitator (3AAL) operated normally during the first four days of the mission. Of the remaining two experiments - EML and ADSF - only the ADSF operated for a short time on day 2.

HITCHHIKER-G PAYLOAD

The Hitchhiker-G payload, consisting of three individual experiments, operated very satisfactorily throughout the STS 61-C mission. Extra data runs were completed during the mission extension. As an example of the wealth of data obtained, 24 data runs were planned for the capillary pump loop (CPL) and 31 data runs were completed. Also, the particle analysis cameras were operated many more times than planned.

INFRARED IMAGING EXPERIMENT

The IRIE operated very satisfactorily. Downlinked images of the SATCOM deployment as well as images of the ground scenes provided excellent data for evaluation. All planned activities were completed and the experiment was reactivated during the mission extension for data gathering of additional scenes of opportunity.

COMET HALLEY ACTIVE MONITORING PROGRAM

The CHAMP experiment appeared to have failed early in the flight. An inflight maintenance procedure was performed without success.

GETAWAY SPECIAL EXPERIMENTS

Only five of the 11 Get Away Special (GAS) experiments were operated as planned during the STS 61-C mission. Two of the 11 GAS experiments have not reported their results as yet to the GAS Project Manager at Goddard Space Flight Center.

The successful experiments were:

a. G-007 - ALABAMA SPACE AND ROCKET CENTER

The G-007 canister contained four experiments:

1. The solidification of alloys were studied for lead antimony and an aluminum-copper combination.
2. A comparative morphological and anatomical study of the primary root system of radish seeds was conducted.
3. Crystal growth of metallic-appearing needle crystals in an aquaous solution of potassium tetracyanoplatimate was studied.
4. The Marshall Amateur Radio Club provided information on the "Project-Explorer-Payload-Elapsed Time" and the operational status of the experiments during the flight by downlinking data to all amateur radio stations and shortwave listeners around the world.

b. G-449 - ST. MARY'S HOSPITAL LASER LABORATORY

There were four parts to this experiment named JULIE (Joint Utilization of Laser Integrated Experiment):

1. The first, called BMJ, was an experiment to determine the biological effects of neodymium (Nd) and helium-neon (HeNe) laser light upon desiccated human tissue undergoing cosmic radiation bombardment.
2. The second, called Ledajo, was an experiment to determine cosmic radiation effects upon medications and medical/surgical materials.
3. The third, called Bloty, was an experiment to analyze contingencies that develop in blood typing due to zero gravity.
4. The fourth, called Crolo, was an experiment designed to evaluate laser optical protective eyeware materials, which have been exposed to cosmic radiation.

c. G-462, 463, and 464 - GSFC/NASA HEADQUARTERS CODE E

The ultraviolet experiment consisted of two scientific instruments and an avionics assembly mounted in three adjacent canisters. Canister G-464 contained the Bowyer ultraviolet spectrometer from the University of California, Berkeley. Canister G-463 contained the Feldman ultraviolet spectrometer from Johns Hopkins University. Canister G-462 contained the avionics.

d. G-481 - VERTICAL HORIZONS

The objective of this experiment was to determine how unprimed canvas, prepared linen canvas, and portions of painted canvas react to space travel under conditions encountered during Shuttle flight.

e. G-470 - GSFC/U. S. DEPARTMENT OF AGRICULTURE

The purpose of this was to expose wild and laboratory research gypsy moth eggs and engorged female American dog ticks to weightlessness during the Shuttle mission.

The unsuccessful experiments and the reasons for failure were:

a. G-062 - GENERAL ELECTRIC/PENN STATE UNIVERSITY

This experiment was to have measured the effect that convection has upon heat flow in a liquid. The experiment failed for reasons that are unknown at this time.

b. G-332 - BOOKER T. WASHINGTON SENIOR HIGH SCHOOL

The brine shrimp artemia was flown to determine the behavior and physiological effects of microgravity on cysts in space. The experiment failed due to experiment wiring error.

c. G-494 - NATIONAL RESEARCH COUNSEL OF CANADA

The purpose of this experiment was to measure the O and O2 terrestrial nightglow emissions and make Shuttle glow observations. The experiment failed due to internal high-voltage arcing.

d. EMP - GSFC ENVIRONMENTAL MEASURING PACKAGE

The EMP was to measure the response of the GAS bridge to the Shuttle environment during lift-off, on-orbit operations, and landing. This experiment failed to turn on.

The results of the following experiments are unknown at this time.

a. G-310 - USAF ACADEMY/DEPARTMENT OF ASTRONAUTICS

The objective of this payload was to measure the dynamics of a vibrating beam in the zero-gravity environment.

b. G-446 - ALL TECH ASSOCIATES

The purpose of this experiment was to learn what effect gravity has on particle dispersion of packing materials in high performance liquid chromotography analytical columns.

LAUNCH AND LANDING DELAYS

As shown in table III, the STS 61-C mission was originally scheduled for launch on December 18, 1985, but the countdown was behind schedule because of Orbiter closeout work and the launch was rescheduled for December 19, 1985. A turbine overspeed problem developed in the SRB hydraulic power unit, forcing the launch to be rescheduled to January 4, 1986. Subsequent scheduling moved this date to January 6, 1986. Launch vehicle and facility problems delayed the launch to the point that the payload had reached the end of its launch window and the mission was rescheduled for January 7, 1986. Unacceptable weather conditions at Kennedy Space Center (KSC) and the trans-Atlantic abort sites caused a recycle of the launch to January 10, 1986. Because of unacceptable weather again at KSC, the launch was recycled to January 12, 1986. Lift-off occurred at 6:55 a. m. e.s.t. on January 12, 1986.

The landing was rescheduled from January 17 to January 16, 1986, to save turnaround time at KSC. However, unacceptable weather resulted in scheduling the landing for January 17, 1986, at KSC. Again unacceptable weather played a role in delaying the landing until January 18, 1986.

As final preparations were made for a landing at KSC on January 18, 1986, the weather was again determined to be unacceptable. The landing was delayed one revolution and moved to Edwards Air Force Base, California, where it was completed satisfactorily.

STS 61-C DETAILED TEST OBJECTIVES

All Orbiter detailed test objectives (DTO's) assigned to this flight were accomplished with the exception of 0237, Forward Reaction Control System (RCS) Flight Test.

The following DTO's required special test conditions or crew activity.

0237-Forward RCS Flight Test. This DTO required a series of five short programmed test input (PTI)-controlled forward RCS firings during entry as a first step in demonstrating a return-to-launch-site/trans-Atlantic abort forward-RCS dump capability. The DTO was cancelled because it was discovered that the two left-forward RCS thrusters had titanium splitters which could cause ZOT's with the last three PTI's, and a separate concern that the first two PTI's would cause TPS scorching which could impact an already tight turnaround schedule.

0309-Ascent Flutter Boundary Evaluation. This DTO required that structural PTI's be executed during a high Q bar ascent to evaluate the ascent flutter boundary. The ascent was designed to produce a higher Q bar than on previous flights and OV-102 was instrumented for flutter.

0312-ET TPS Performance. This DTO required a +X translation after ET separation so that photographs of the ET TPS could be taken with a 35mm camera mounted in the Orbiter umbilical well.

0321-Crew Compartment Structure Deflection Investigation. This DTO required the crew to measure the distortion of the cabin to determine the cause of locker-door binding problems.

0901-OEX SILTS. The SILTS experiment was operated as planned during entry.

0902-OEX SUMS. The SUMS experiment was operated on orbit as planned and an additional two times during the delays in deorbit. The orbit data were recorded on the OPS 1 recorder and dumped. These data were of high quality. The SUMS was operated during entry as planned.

0903-OEX SEADS. The SEADS experiment was operated as planned during ascent and entry.

The following DTO's required no special test or crew activity other than the operation of operational instrumentation/modular auxiliary data system (OI/MADS) instrumentation and recorders. Postflight analysis of these data will be required. No instrumentation or recorder problems were reported.

0236-Ascent Wing Aerodynamic Distributed Load Verification on OV-102.
0301-Ascent Structural Capability Evaluation.

TABLE I. - STS 61-C SEQUENCE OF EVENTS

Event	Actual time, G.m.t.
APU activation (1)	12:11:50:09
(2)	12:11:50:10
(3)	12:11:50:10
SRB HPU activation command (RH-B)	12:11:54:30.3
MPS start command sequence (engine 3)	12:11:54:53.5
SRB ignition command from GPC (lift-off)	12:11:55:00
MPS throttle down to 85-percent thrust (engine 3)	12:11:55:33.6
Maximum dynamic pressure	12:11:55:56
MPS throttle down to 69-percent thrust (engine 3)	12:11:55:56.6
MPS throttle up to 104-percent thrust (engine 3)	12:11:56:02.8
SRB separation command	12:11:57:07
MPS throttle down for 3g acceleration (engine 3)	12:12:02:28.3
Main engine cutoff (MECO)	12:12:03:22
External tank separation	12:12:03:40
OMS-1 ignition	12:12:05:22
OMS-1 cutoff	12:12:08:06
APU Deactivation (3)	12:12:09:04
OMS-2 ignition	12:12:41:06
OMS-2 cutoff	12:12:43:21
SATCOM deploy	12:21:26:29
FCS (flight control system) checkout - APU 3 activation	15:10:04:54
APU 3 deactivation	15:10:08:56
APU 1 activation	18:12:49:32
Deorbit maneuver ignition	18:12:54:30
Deorbit maneuver cutoff	18:12:58:22
APU 2 activation	18:13:15:10
APU 3 activation	18:13:15:10
Entry interface (400,000 ft.)	18:13:28:03
End blackout	18:13:45:32
Terminal Area Energy Management (TAEM)	18:13:52:46
Main landing gear contact (LH)	18:13:58:51
Nose landing gear contact	18:13:59:07
Wheel stop	18:13:59:50
APU deactivation complete	18:14:11:59

JSC STS 61-C PROBLEM TRACKING LIST FOR OV-102 COLUMBIA FLIGHT 7 AUG. 20, 1987

NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.
1	MPS LO2 FILL AND DRAIN VALVE DID NOT CLOSE AT REPLENISH TERMINATE.	LAUNCH SCRUB 006:12:00:41	FACILITY REPLENISH VALVE CLOSED INDICATORS WERE OFF BUT OTHER INSTRUMENTATION INDICATED REPLENISH VALVE WAS CLOSED. EXTERNAL LO2 LEAK FIXED. MANUAL WORK AROUND DEVELOPED FOR STS 61-C. CHANGED LAUNCH COMMIT CRITERIA AND OMI PROCEDURES FOR STS 51-L. CAR AD0676.	P. COTA CLOSURE IN PROCESS
2	FUEL CELL 1 POWER SOURCE TO ESSENTIAL BUS 1 BC ERRATIC.	PRELAUNCH 010:12:47:25	FUEL CELL 1 VOLTAGE (V45V0100A) READ ERRATIC. FLOWN AS IS. SUSPECT OXIDATION IN FUSE HOLDER. CAR AD0733.	B. STAGG CLOSED 06/10/87
3	APU 1 GEARBOX GN2 PRESSURE (V46P0151A) HIGH.	012:12:10	READ ABOUT 10 PSI HIGH. POSSIBLE LUBE OIL CONTAMINATION. SEE PROBLEM STS-51F-02 AND STS-61A-04 ON OV-099. CHECKED LUBE OIL AT KSC FOUND NO CONTAMINATION. SUSPECT TIGHT SEAL ON NEW APU.	W. SCOTT CLOSED 02/25/87
4	INSTRUMENTATION:			CLOSURE IN PROCESS
A	SSME 2 GH2 OUTLET TEMPERATURE (V41T1261A) FAILED.	012:12:01:28	WENT OFF SCALE HIGH ABOUT 6 MIN. 28 SEC. AFTER LAUNCH. R&R AT KSC WITH IMPROVED SENSOR.	P. COTA CAR 32F001
B	SSME 3 HELIUM SUPPLY PRESSURE (V41P1350C) ERRATIC.	012:11:55:17	TRIGGERED 3 FALSE HELIUM LEAK MESSAGES AFTER LAUNCH. T/S AT KSC. CONSIDERING CHANGING MESSAGE SOFTWARE.	P. COTA CAR 32F012
5	APU'S 1 AND 3 ISOLATION VALVE TEMPERATURES (V46T0173A) AND (V46T0373A) LOW.	012:21:50	APU 3 WENT BELOW 45 DEG F FDA LIMIT. APU 1 WENT LOW. CHANGED ATTITUDE TO MAINTAIN TEMPERATURE. T/S FOUND HEATERS AND INSULATION INSTALLED INCORRECTLY AT KSC AND ISO VALVE 3 LEAKED OIL. R&R ISO VALVE 3 AT KSC. REINSTALL LINE HEATERS AND INSULATION ON ALL 3 APU's AT KSC.	W. SCOTT CAR 32F002 CLOSED 04/01/87
6	APU 3 FUEL LINE SYSTEM B HEATER FAILED.	012:21:50	LINE TEMPERATURE FELL TO 51 DEG F BEFORE SYSTEM A WAS REACTIVATED. WITHIN SPEC. CAR 32F008.	W. SCOTT CLOSURE IN PROCESS
7	VERNIER RCS JETS FIRED EXCESSIVELY.	014:13:25	ALL 6 VERNIER JETS EXCEEDED 1000 COMMANDS/HOUR FIRING RATE DUE TO IMU SWITCHING. SODB LIMIT NOT EXCEEDED. SOFTWARE CR 79144D APPROVED FOR OI-11.	S. MURRAY CLOSED 06/10/87

TABLE II. - JSC STS 61-C (OV-102) PROBLEM TRACKING LIST (CONCLUDED).

JSC STS 61-C PROBLEM TRACKING LIST FOR OV-102 COLUMBIA FLIGHT 7			AUG. 20, 1987	
NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.
8	S-BAND UPPER LEFT AND LOWER RIGHT ANTENNA PERFORMANCE ERRATIC.	014:21:57	MULTIPLE FORWARD LINK DROPOUTS. LINK PERFORMANCE DEGRADED. FOUND CRACKED SOLDER JOINTS ON OUTPUT STRIPLINE OF LOWER RIGHT ANTENNA. CAR'S 32F009 AND 32F010.	D. EGGERS CLOSURE IN PROCESS
9	PAYLOAD BAY COLOR TV CAMERA "D" FLICKERED.	014:22:13	VIDEO FLICKER CLEARED DURING SUBSEQUENT OPERATIONS. WIRE PREVENTED SEATING OF LENS ASSEMBLY CIRCUIT BOARD. FIAR-RCA-TVD-1231.	B. EMBREY CLOSED 04/01/87
10	ECLSS PRESSURE CONTROL SYSTEM 2 OXYGEN FLOW TRANSDUCER (V61R2205A) READ LOW.	015:22:00	MEASUREMENT LOSS RESULTS IN LOSS OF HI O2 FLOW ALARM. FAULTY SOLDER JOINT PREPARATION. CAR 32F003.	J. WHALEN CLOSED 06/10/87
11	WSB 3 SYSTEM A HEATER OPERATION ERRATIC.	016:11:40	TEMP (V58T0365A) WENT BELOW LOW LIMIT, 122 DEG F. TEMP RECOVERED ON SYSTEM B. RETURNED TO A, HEATER RESPONDED BUT FAILED TO OPERATE 21 HOURS LATER. FOUND STRESS FRACTURE OF UNSUPPORTED BRAZED JUNCTION IN HEATER WIRING. CAR 32F011.	L. JENKINS CLOSURE IN PROCESS
12	LEFT RCS OXIDIZER TANK HELIUM REGULATOR LEG B LEAKED.	016:10:20	TANK PRESSURE REACHED 259 PSI, 6 PSI ABOVE PRIMARY REG LOCKUP. KSC FOUND BOTH SECONDARY REGS LEAKED. R&R BOTH REGS. SUSPECT CONTAMINATION.	G. GRUSH CAR 32F007 CLOSURE IN PROCESS
13	WSB 1 SYSTEM A COOLING WATER USAGE RATE HIGH.	018:13:46	BEARING TEMPS LOW. TURNED WSB CONTROLLER A OFF. BEARING TEMPS INCREASED. TURNED ON CONTROLLER B. WSB 1 WATER TANK WAS EMPTY AT TOUCHDOWN. R&R AT KSC. TEST AT VENDOR.	L. JENKINS CAR AD0927 CLOSURE IN PROCESS
14	RIGHT MAIN LANDING GEAR INBOARD BRAKE DAMAGED.	LANDING	BERYLLIUM HAD STRESS CRACKS DUE TO OVERTEMPERATURE IN 5 PLACES INSIDE NUMBER 3 STATOR. NO DYNAMIC-STABILITY DAMAGE. NOT PREDICTED BY ENERGY HISTORIES. MAJOR BRAKE MODS FOR NEXT FLIGHT.	C. CAMPBELL CLOSED 04/01/87

PREPARED BY: _____
ROBERT J. WARD DATE

APPROVED BY: _____
JOSEPH E. MECHELAY DATE

TABLE III - EVENTS ALTERING STS 61-C LAUNCH AND LANDING ACTIVITIES

Miss. Change*	Event	Impact	Remarks
PD	Work could not be completed in the Orbiter aft compartment in time to support a Dec. 18, 1985 launch.	Launch delayed 24 hours rescheduled for December 19, 1985 launch.	Launch reschedule occurred before PRSD loading had started.
PD	Launch scrubbed at T-14 seconds due to an indication that the right SRB HPU was exceeding RPM red line speed limits.	Launch delayed 18 days, rescheduled for January 6, 1986. KSC went to a limited operations mode from 12/24/85 through 1/1/86.	Analysis showed this was a false indication and the HPU had not exceeded redline speed limits. Earliest launch date possible was originally noted as January 4, 1986 but this was revised to January 6, 1986, to provide additional flight crew training time over the holiday period.
PD	Launched scrubbed at T-31 seconds due to accidental draining of approximately 1500 gallons of LOX from ET resulting in LOX temperature redline being exceeded at engine interface. Recovery from this situation extended beyond the launch window for the SATCOM KU-1 satellite.	Launched delayed 24 hours, rescheduled for January 7, 1986.	None.
PD	Bad weather at both TAL sites (Moron, Spain and Dakar, Senegal) and marginal launch weather at KSC culminated in a launch scrub at T-9 minutes.	Launched delayed 48 hours, rescheduled for January 9, 1986.	Two-day delay required to allow time to assure the integrity of MPS low pressure fuel ducts.
PD	A launch pad Liquid Oxygen sensor that had broken off became lodged in a prevalve at ME2. It was determined this sensor had broken during the January 7, 1986, launch attempt.	Launched delayed 24 hours, rescheduled for January 10, 1986.	Sensor failed due to a bad weld, the anomaly was discovered when an anti-slam valve failed to operate on January 8, 1986.

*PD = Delay on Pad; D = Launch Delay; E = Mission Extended; S = Mission Shortened.

TABLE III - EVENTS ALTERING STS 61-C LAUNCH AND LANDING ACTIVITIES

Miss. Change*	Event	Impact	Remarks
PD	Bad weather at KSC.	Launch delayed 48 hours, rescheduled for January 12, 1986.	None.
S	Landing was rescheduled from January 17 to January 16 to save turnaround time at KSC. This early landing attempt was later abandoned due to unacceptable weather at KSC.	None.	None.
E	Bad weather at KSC prohibited landing on originally scheduled landing date (January 17)	Landing was delayed 24 hours, rescheduled for January 18, 1986.	None.
E	Bad weather prohibited landing at KSC on January 18, 1986.	Mission extended one revolution and then landed at EAFB on January 18, 1986. Extra processing time required for next missions using OV-102 due to delay caused by ferry flight operations.	None.

*PD = Delay on Pad; D = Launch Delay; E = Mission Extended; S = Mission Shortened.

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