FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 05-2D-23300-X

SUBSYSTEM NAME: COMM & TRACK: RADAR ALTIMETER
REVISION: 3 08/24/93

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
ASSEM	:	LOWER FUS	SALOW0005
LRU	:	RADAR ALTIMETER ANTENAS	MC481-0072-0005
LRU	:	RADAR ALTIMETER ANTENAS	MC481-0072-0006
LRU	:	RADAR ALTIMETER ANTENAS	MC481-0116-0001
LRU	:	RADAR ALTIMETER ANTENAS	MC481-0116-0002

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
C -BAND ANTENNA, RADAR ALTIMETER

REFERENCE DESIGNATORS: 20V74A78
20V74A79
20V74A80
20V74A81

QUANTITY OF LIKE ITEMS: 4
FOUR

FUNCTION:
PROVIDES FOR THE RECEPTION AND TRANSMISSION OF PRECISION ALTITUDE DATA FOR UPDATES TO CREW DISPLAYS (AVVI & HUD) DURING THE LANDING PHASE OF THE MISSION. ONE TRANSMIT AND ONE RECEIVE ANTENNA PER RADAR ALTIMETER.

PRINT DATE: 08/24/93

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 05-2D-23300-01

REVISION# 3 08/24/93

SUBSYSTEM NAME: COMM & TRACK: RADAR ALTIMETER

ITEM NAME: RADAR ALTIMETER ANTENNAS

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
LOSS OF OUTPUT SIGNAL

MISSION PHASE:

PL	PRELAUNCH
LO	LIFT-OFF
DO	DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
VIBRATION, TEMPERATURE, MECHANICAL SHOCK, CONTAMINATION, MISHANDLING, PIECE PART STRUCTURAL FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF REDUNDANCY.

(B) INTERFACING SUBSYSTEM(S):
NO RADAR ALTIMETER DATA FROM THE FAILED PATH WOULD BE PRESENTED TO THE DISPLAYS.

(C) MISSION:
NO EFFECT.

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(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES (ONE ANTENNA FROM EACH RADAR ALTIMETER SYSTEM). PRECISE ALTITUDE DATA FOR CREW DETERMINATION OF SINK RATE IS REQUIRED FOR SAFE NIGHT LANDING OR LANDINGS ON RUNWAYS WITHOUT MSBLS AND TO PREVENT POSSIBLE VEHICLE DAMAGE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

-DISPOSITION RATIONALE-

(A) DESIGN:
THE C-BAND RADAR ALTIMETER ANTENNA DOES NOT CONTAIN ANY ACTIVE COMPONENTS. THE MC481-0072 ANTENNA IS A LINEAR POLARIZED HORN UNIT. THE MC481-0116 ANTENNA IS A LINEAR POLARIZED PATCH ARRAY UNIT. IT IS MOUNTED ON THE OUTER MOLD LINE (OML) AND PROTECTED BY THE THERMAL PROTECTION SYSTEM DURING RE-ENTRY. THE ANTENNA MEETS OR EXCEEDS MF0004-014 ENVIRONMENTAL SPECIFICATION REQUIREMENTS. THE ORBITER CONTAINS TWO INDEPENDENT RADAR ALTIMETER SYSTEMS, EACH WITH A TRANSMITTING ANTENNA AND A RECEIVING ANTENNA. THE SYSTEMS ARE INDEPENDENT AND CAN OPERATE SIMULTANEOUSLY WITHOUT AFFECTING EACH OTHER. BOTH COMMANDER AND PILOT STATIONS HAVE SWITCHES FOR SELECTING RADAR ALTIMETER 1 OR 2 FOR DISPLAY ON THE AVVI. THE "RA OFF" FLAG WILL APPEAR IF THERE IS LOSS OF POWER, LOSS OF LOCK, DATA BAD, OR AFTER THREE COMMFAULTS.

(B) TEST:
ACCEPTANCE TEST INCLUDES - EXAMINATION OF PRODUCT FOR STRUCTURAL DEFECTS, VIBRATION (AVT), THERMAL (ATT), HIGH POWER HANDLING, AND RADOME STABILITY. FUNCTIONAL TESTING, INCLUDING RETURN LOSS AND RADIATION PATTERNS, IS PERFORMED BEFORE AND AFTER ACCEPTANCE TESTING. RETURN LOSS IS ALSO PERFORMED BEFORE AND AFTER EACH ACCEPTANCE ENVIRONMENTAL TEST. QUALIFICATION TESTING INCLUDES - EXAMINATION OF PRODUCT, DESIGN SHOCK (MC481-0116 BY SIMILARITY), HIGH POWER VACUUM (MC481-0116 BY SIMILARITY), THERMAL, LIFE, VIBRATION (QAVT AND QVT), EMC, AND RADOME STABILITY. FUNCTIONAL TESTING, INCLUDING RETURN LOSS AND RADIATION PATTERNS, WAS PERFORMED BEFORE AND AFTER QUALIFICATION TESTING. RETURN LOSS WAS PERFORMED BEFORE AND AFTER EACH QUALIFICATION ENVIRONMENTAL TEST. TURNAROUND TEST - INCLUDES VERIFICATION OF RADAR ALTIMETER DATA ACCURACY BY ANALYSIS OF INFLIGHT DATA OR VERIFICATION OF RADAR ALTIMETER LOOP SENSITIVITY FOR LOCK-ON AND BREAK LOCK CONDITIONS - PERFORMED EVERY FLIGHT.

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS. CERTIFICATION RECORDS/TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES AS REQUIRED.

CONTAMINATION CONTROL
DETAILED CLEANING AND CONTAMINATION CONTROL INSTRUCTIONS ARE SPECIFIED ON MANUFACTURING OPERATIONS SHEETS. FINAL ASSEMBLY ON CLEAN BENCH; INSPECTION VERIFIES CLEANLINESS.

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ASSEMBLY/INSTALLATION
DETAILED INSPECTION IS PERFORMED ON ALL ASSEMBLY AND DETAIL PARTS PRIOR TO NEXT OPERATION.

CRITICAL PROCESSES
APPLICATION OF CHEMICAL FILM, PRIMER AND EPOXY COATING, SOLDERING, AND LAMINATION OF RADOME, ARE OBSERVED AND VERIFIED BY INSPECTION.

TESTING
ALL PARTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC, AND ARE ALSO VERIFIED BY ROCKWELL QA OR DCAS.

HANDLING/PACKAGING
SPECIAL CONTAINERS, TOTE BOXES; STORED AND TRANSPORTED IN WOODEN BOXES WITH LIDS AND SURROUNDED BY 3 INCHES OF CUSHIONING. PACKAGING IS VERIFIED BY DCAS.

(D) FAILURE HISTORY:
ALL ACCEPTANCE TEST, QUALIFICATION TEST, FIELD, AND FLIGHT FAILURES WERE REVIEWED. THE MC481-0116-0001 AND MC481-0116-0002 ANTENNAS HAVE NO IDENTIFIED FAILURES AT THIS TIME. THE MC481-0072-0005 ANTENNAS HAVE TWO FAILURES WRITTEN AGAINST THE LOSS OF OUTPUT SIGNAL.

CAR'S AC9681 AND AD0303, RALT #2 WOULD NOT LOCK-ON TO GSE DURING VEHICLE CHECKOUT OF OV103. THE VSWR OF EACH ANTENNA WAS MEASURED AT ROCKWELL, DOWNEY. THE RADIATION PATTERN MEASUREMENTS FOR EACH ANTENNA WERE MADE AT JSC AND NO PROBLEMS WERE FOUND. FAILURES WERE ATTRIBUTED TO THE RF CABLING BETWEEN RALT #2 AND THE ANTENNAS. ALL RALT #2 COAX CABLES ON OV103 WERE REPLACED.

(E) OPERATIONAL USE:
RADAR ALTIMETER DATA IS AVAILABLE AT 5,000 FEET. DE-ORBIT IS NOT ATTEMPTED IF CEILING IS LESS THAN 8,000 FEET (10,000 FEET IF NO MSBLS AVAILABLE) TO ENSURE GOOD VISIBILITY AT LOW ALTITUDE. MOST ORBITER RUNWAYS ARE EQUIPPED WITH MSBLS GROUND STATIONS WHICH PROVIDE A REDUNDANT SOURCE OF LOW ALTITUDE DATA DOWN TO 50 FEET. RADAR ALTIMETER DATA IS DISPLAYED ON HUD AND AVVI NEXT TO NAVIGATION ALTITUDE DATA. CREW CAN ISOLATE A FAILED RADAR ALTIMETER AND THEN SELECT THE OTHER ALTIMETER, IF AVAILABLE, OR DISREGARD RADAR ALTIMETER DATA AND RELY ON NAVIGATION ALTITUDE AND/OR VISUAL CUES.

- APPROVALS -

EDITORIALLY APPROVED	: RI	
EDITORIALLY APPROVED	: JSC	
TECHNICAL APPROVAL	: VIA CR	:S50260Y