 PRINT DATE: 04/13/92

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 05-6BB-2107-IM-X

SUBSYSTEM NAME: EPD&C - BRAKE/ANTI SKID
REVISION : 5 04/09/92

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU	:	PANEL L2A1	V070-730272
■ SRU	:	SWITCH, TOGGLE	ME452-0102-7201

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SWITCH, TOGGLE, 2P2P, ANTI-SKID BUS

■ REFERENCE DESIGNATORS: 31V73A2A1S5

■ QUANTITY OF LIKE ITEMS: 1
ONE PER VEHICLE

■ FUNCTION:
MANUALLY SWITCHES ON-OFF ANTI-SKID CONTROL CIRCUIT FOR DC POWER TO ANTI-SKID BUSES FROM THE BRAKE SUB-BUSES. EACH POLE CONTROLS POWER TO ONE ANTI-SKID BUS. ONE POLE POSITION WHEN IN AN OFF POSITION CONTROLS ANTI-SKID-FAIL-LIGHT ON INDICATION. THESE ANTI-SKID BUSES ARE ALSO USED TO PROVIDE POWER TO THE REDUNDANT WEIGHT-ON-WHEEL DETECTORS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: 05-68B-2107-IM-01

REVISION# 5 04/09/92 R

SUBSYSTEM: EPD&C - BRAKE/ANTI SKID
LRU :PANEL L2A1 CRITICALITY OF THIS
ITEM NAME: SWITCH, TOGGLE FAILURE MODE:1R2

■ FAILURE MODE:
FAILS OPEN, SHORTS TO GROUND

MISSION PHASE:
DO OE-ORBIT

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

■ CAUSE:
PIECE PART STRUCTURAL FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY

■ CRITICALITY 1/1 OURING INTACT ABORT ONLY? NO

■ REDUNDANCY SCREEN A) PASS
■ B) PASS
■ C) PASS

PASS/FAIL RATIONALE:
■ A)

■ B)

■ C)

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
LOSS OF ABILITY TO POWER THE ASSOCIATED ANTI-SKID BUS/BOX

■ (B) INTERFACING SUBSYSTEM(S):
LOSS OF ANTI-SKID PROTECTION AND LOSS OF REDUNDANT WEIGHT-ON-WHEEL DISCRETES

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■ (C) MISSION:
FIRST FAILURE - NO EFFECT

■ (D) CREW, VEHICLE, AND ELEMENT(S):
FIRST FAILURE - NO EFFECT

■ (E) FUNCTIONAL CRITICALITY EFFECTS:
CASE 1: 1R2, PPP

REDUNDANT WEIGHT-ON-WHEELS SUBSYSTEM IS EFFECTIVELY LOST DUE TO LOSS OF FOUR OF SIX DISCRETES AFTER FIRST FAILURE. WITH AN ADDITIONAL FAILURE (LOSS OF EITHER CHANNEL B OF PROXIMITY SENSOR ELECTRONIC BOX 1 OR CHANNEL 3 OF PROXIMITY SENSOR ELECTRONIC BOX 2 SIGNAL AFTER APPROACH/LAND INTERFACE), FLIGHT CONTROL WILL BE AFFECTED SINCE WEIGHT-ON-WHEELS IS ERRONEOUSLY CONFIRMED. TESTING AT AMES LABORATORY HAS FOUND THAT THIS SCENARIO WILL RESULT IN DEGRADATION OF AEROSURFACE CONTROL WHICH MAY RESULT IN LOSS OF CREW/VEHICLE.

CASE 2: 1R3, PPP

POSSIBLE LOSS OF CREW/VEHICLE DUE TO TIRE DAMAGE AT TOUCHDOWN. REQUIRES TWO ADDITIONAL FAILURES ("HYD SYS BRAKE ISOL VALVE" SWITCH AND CHECK VALVE FAIL CLOSED RESULTING IN UNCOMMANDED BRAKE PRESSURE) BEFORE EFFECT IS MANIFESTED.

- DISPOSITION RATIONALE -

■ (A) DESIGN:
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

■ (B) TEST:
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

GROUND TURNAROUND TEST
VERIFY SWITCH OPERATION BY MONITORING APPLICABLE BRAKE/SKID CONTROL MEASUREMENTS. THERE IS A TOTAL OF SIXTEEN MDM MEASUREMENTS. TESTS ARE PERFORMED PER PARAGRAPHS:
- V51AF0.010 "BRAKE/SKID ELECTRICAL INTEGRITY CHECK" (EVERY FLIGHT)
- V51AF0.011 "BRAKE/SKID POWER REDUNDANCY TEST" (EVERY FLIGHT)
AND LRU RETEST PER TABLE V51Z00.000.

■ (C) INSPECTION:
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

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■ (D) FAILURE HISTORY:
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

■ (E) OPERATIONAL USE:
CREW PROCEDURE WORKAROUND DOES EXIST TO REMOVE THE SINGLE POINT FAILURE MODE IN THE EVENT OF THE SWITCH FAILURE. REMOVE POWER TO THE PROXIMITY SWITCH ELECTRONIC BOXES VIA CIRCUIT BREAKERS PRIOR TO APPROACH/LAND INTERFACE (10,000 FT ALTITUDE). SOFTWARE FIRST PASS CHECK WILL FAIL ALL SIX SIGNALS. NO WOW WILL BE ANNUNCIATED. THIS MODE IS FLYABLE IN MANUAL MODE (STS-28). DRAWBACK - BRAKE ISOLATION VALVES WILL NOT OPEN UNTIL MANUAL BACKUP (ET SEP/SRB PUSHBUTTONS ARE DEPRESSED TO PROVIDE WOW SIGNALS) POST NOSE GEAR TOUCHDOWN AFTER WHICH ONE-HUNDRED PERCENT BRAKES & NWS ARE AVAILABLE.

- APPROVALS -

RELIABILITY ENGINEERING	T. AI	
DESIGN ENGINEERING	G. A. FINNEMAN	
DESIGN ENGINEERING	P. G. RICHARDSON	
QUALITY ENGINEERING	W. R. HIGGINS	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA EPD&C RELIABILITY		
NASA QUALITY ASSURANCE		
NASA EPD&C SUBSYS MGR		