

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE
 NUMBER: 05-6-2345B-X

SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION AND CONTROL

REVISION: 1 03/22/94

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
[LRU	: MAIN DC DIST ASSY 2	VO70-764220
[SRU	: SHUNT, DC AMMETER	VO70-764258

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 SHUNT, DC AMMETER, (50MV, 500A) - FUEL CELL 2 RETURN LINE

REFERENCE DESIGNATORS: 40V78A32R11

QUANTITY OF LIKE ITEMS: 1
 ONE, MAIN DC DISTR ASSY 2

FUNCTION:
 SENSES LOAD CURRENT IN FUEL CELL 2 RETURN LINE AND PROVIDES
 PROPORTIONAL VOLTAGE TO THE AMMETER ELEMENT.

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LRU: MAIN DC DIST ASSY 2
ITEM NAME: SHUNT, DC AMMETER

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:
OPENS, OPEN ELEMENT

MISSION PHASE:

LO LIFT-OFF
OO ON-ORBIT
DO De-ORBIT

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

CAUSE:

STRUCTURAL FAILURE (MECHANICAL STRESS, VIBRATION), CONTAMINATION,
ELECTRICAL STRESS, THERMAL STRESS, PROCESSING ANOMALY

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES
RTLS RETURN TO LAUNCH SITE

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF MAIN DC BUS SOURCE FROM AFFECTED FUEL CELL

(B) INTERFACING SUBSYSTEM(S):

LOSS OF POWER TO AFFECTED BUS LOADS, ASSOCIATED INVERTERS AND 3 PHASE AC
BUS SET. AFFECTED BUS LOADS INCLUDE FORWARD AND AFT OMS/RCS AC MOTOR
VALVES.

(C) MISSION:

EARLY MISSION TERMINATION - LAND AT NEXT PRIMARY LANDING SITE OPPORTUNITY.

(D) CREW, VEHICLE, AND ELEMENT(S):

FIRST FAILURE - NO EFFECT

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(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF SECOND MAIN DC BUS, FUEL-CELL-TO-MAIN-BUS CONTACTOR OR SHUNT ~~DURING ENTRY~~ RESULTING IN UNDERVOLTAGE TO CRITICAL LOADS.

Loss of Power

CRIT 1 FOR RTLS ABORT BECAUSE LOSS OF ANY AC BUS PRIOR TO OMS/RCS INTERCONNECT LEAVES RCS TANK ISOLATION VALVE OPEN DURING RTLS OMS PROPELLANT DUMP. SINCE DUMPING OMS PROPELLANTS THROUGH RCS JETS NORMALLY SUPPLIED FROM THE AFFECTED OPEN TANK ISOLATION VALVE WOULD RESULT IN DUMPING RCS PROPELLANTS ALONG WITH OMS PROPELLANTS, AND MANUALLY CLOSING THE ASSOCIATED MANIFOLD ISOLATION VALVES AFTER THE OMS PROPELLANT DUMP BEGINS WOULD RENDER THOSE RCS MANIFOLDS UNUSABLE FOR ET SEPARATION. "SMART INTERCONNECT" SOFTWARE (CR'S 59126H AND 89210B, EFFECTIVITY 01-8B, STS-26) PROTECTS AGAINST LOSS OF AFT RCS MANIFOLDS BY DESELECTING THE AFFECTED RCS JETS FOR THE OMS PROPELLANT DUMP. DISABLING HALF OF THE AFT RCS JETS FOR OMS PROPELLANT DUMP REDUCES THE DUMP CAPABILITY AND MAY RESULT IN AN INCOMPLETE OMS RTLS PROPELLANT DUMP WITH A POSSIBLE VIOLATION OF LANDING CONSTRAINTS FOR WEIGHT AND/OR CENTER OF GRAVITY.

-DISPOSITION RATIONALE-

(A) DESIGN:

THE DC AMMETER SHUNT IS A LIGHTWEIGHT, EXTERNAL-INSTRUMENT-TYPE DEVICE PROVIDING A 50 MV OUTPUT AT ITS 500 AMPERE CURRENT RATING. THE SUPPLIER'S (WESTON) CONFIGURATION IS MODIFIED BY REMOVING THE SHUNT BASEPLATE AND MOUNTING THE SHUNT DIRECTLY ON THE MAIN DC DISTRIBUTION AND CONTROL ASSEMBLY (MDCA) BASEPLATE.

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(B) TEST:

QUALIFICATION/CERTIFICATION

CERTIFICATION TESTING AND ANALYSIS ARE COMPLETED AND APPROVED. QUALIFIED TO MIL-S-61B. CERTIFICATION TESTS INCLUDE:

CAUSES		CAUSE CONTROL					
a Piece part failure b Contamination c Vibration		d Mechanical shock e Processing anomaly f Thermal stress					
TEST	a	b	c	d	e	f	
VISUAL AND MECHANICAL EXAMINATION		X			X		
VOLTAGE DROP		X			X		
DIELECTRIC WITHSTANDING VOLTAGE		X			X		
SUSTAINED LOAD		X			X		
OVERLOAD CYCLING	X				X	X	
MECHANICAL SHOCK	X			X			

QUALIFICATION/CERTIFICATION TEST PERFORMED AT THE NEXT ASSEMBLY LEVEL (MDCA) INCLUDE:

CAUSES		CAUSE CONTROL					
a Piece part failure b Contamination c Vibration		d Mechanical shock e Processing anomaly f Thermal stress					
TEST	a	b	c	d	e	f	
ACCEPTANCE	X	X	X		X	X	
QUAL/ACCEPTANCE (QAVT AT 0.067 g ² /HZ)	X		X		X		
RANDOM VIBRATION (0.023 g ² /HZ, 84 MIN)	X		X		X		
THERMAL VACUUM (75 TO 165 °F, 6 CYCLES FOR 72 HOURS TOTAL)						X	
DESIGN SHOCK (20G, 3 DROPS/AXIS)				X			
VISUAL EXAMINATION	X	X			X		

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ACCEPTANCE AND SCREENING

ALL PRODUCTION UNITS ARE SUBJECTED TO 100% SCREENING TESTS WHICH INCLUDE:

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
VISUAL AND MECHANICAL EXAMINATION CALIBRATION OF RESISTANCE		X			X X	

ACCEPTANCE TEST AT THE NEXT ASSEMBLY (MAIN DC DISTRIBUTION AND CONTROL ASSEMBLY):

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
FUNCTIONAL CONTINUITY INSULATION RESISTANCE VIBRATION (0.04 g ² /HZ)	X	X X X	X		X X X	

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION (FAILURE CAUSE b,e)

RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATIONS OF INCOMING PARTS. RAW MATERIAL CERTIFICATIONS ARE OBTAINED AND VERIFIED BY RECEIVING INSPECTION.

CONTAMINATION CONTROL (FAILURE CAUSE b)

PARTS ARE ASSEMBLED IN A LAMINAR FLOW MODULE WITHIN A CONTROLLED WORK AREA.

ASSEMBLY/INSTALLATION (FAILURE CAUSE a,b,e)

ASSEMBLY AND INSTALLATION OPERATIONS ARE MONITORED AND VERIFIED BY INSPECTION.

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CRITICAL PROCESSES (FAILURE CAUSE b,e)

CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION. THE CRITICAL PROCESS IS SOLDERING.

TESTING

SCREENING TESTS ARE MONITORED AND VERIFIED BY INSPECTION. THE SCREENING TESTS PERFORMED ARE A VISUAL AND MECHANICAL EXAMINATION AND A CALIBRATION OF RESISTANCE.

HANDLING/PACKAGING (FAILURE CAUSE c,d)

PACKAGING IS PERFORMED PER APPLICABLE REQUIREMENTS AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

FAILURE HISTORY IS TRACKED IN THE PRACA SYSTEM.

(E) OPERATIONAL USE:

FOR FUEL CELL ELECTRICAL SOURCE LOSS, POWER CAN BE RESTORED WITH A MAIN BUS TIE TO ANOTHER MAIN BUS. PRESENT FLIGHT RULES DO NOT PERMIT BUS TIEING TO A DEAD BUS UNTIL AFTER SRB SEPARATION. ONBOARD PROCEDURES MANAGE POWER FOR LOSS OF ONE FUEL CELL MAIN DC BUS.

- APPROVALS -

PAE MANAGER : K. PRESTON
PRODUCT ASSURANCE ENGR : T. KIMURA
DESIGN ENGINEERING : J. GULSBY
NASA SSMA :
NASA SUBSYSTEM MANAGER :

K. Preston 3/21/94
T. Kimura 3/22/94
J. Gulsby 3/20/94
David Gage 6/20/94
Michael Smith 6/20/94