PRINT DATE. 03/22/94

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 05-6-2005B-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	:	BUS, MAIN DC BUS B	VO70-764220

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
BUS, MAIN DC - MAIN DC BUS B

REFERENCE DESIGNATORS: 40V76A32

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
DISTRIBUTES PRIMARY 28 VDC POWER FOR ASSOCIATED MAIN BUS B LOADS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: 05-6-2005B-03

REVISION# 1 03/22/94
SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION AND CONTROL
LRU: MAIN DC DISTRIBUTION ASSEMBLY CRITICALITY OF THIS
ITEM NAME: MAIN DC BUS B FAILURE MODE: 1R2

FAILURE MODE:
LOSS OF OUTPUT, LOSS OF MAIN DC BUS B

MISSION PHASE:
LO LIFT-OFF
OO ON-ORBIT
DO DE-ORBIT

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

CAUSE:
PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS

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 BUS VOLTAGE

(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.

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF SECOND MAIN DC BUS OR FUEL CELL-TO-MAIN-BUS CONTACTOR ~~DURING ENTRY~~ RESULTING IN UNDERVOLTAGE ~~TO~~ / Loss of power CRITICAL LOADS.

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 OI-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:
EACH OF THREE MAIN DC BUSES IS ESTABLISHED AND CONTAINED WITHIN ONE OF THREE MAIN DISTRIBUTION AND CONTROL ASSEMBLIES (MDCA'S). SUB-BUSES TO THE MAIN DC BUS CONTAINED IN OTHER ASSEMBLIES ARE ALL FUSED IN THE MDCA AND ARE NOT CONSIDERED A PART OF THE MAIN DC BUS FOR THIS CIL. EACH MAIN DC BUS CONSISTS PHYSICALLY OF SEVERAL SHORT LENGTHS OF SILVER-BEARING, HIGH-CONDUCTIVITY COPPER BAR STOCK (QQC576, TYPE 110) APPROXIMATELY 0.125 X .750 INCHES IN CROSS SECTION JOINED TOGETHER AT VARIOUS POINTS BY TERMINAL STUDS ON THE MOTOR-DRIVEN POWER CONTACTORS, INSULATED STAND-OFF MOUNTING HARDWARE OR BY A SHORT LENGTH OF AWG 1/0 COPPER WIRE WITH HIGH-CURRENT CRIMP LUGS ON EACH END. THE BUS ALSO INCLUDES TWO LENGTHS OF AWG 1/0 COPPER WIRE WHICH CONDUCT FUEL CELL POWER TO THE MOTOR-DRIVEN POWER CONTACTORS.

THE PHYSICAL CONSTRUCTION FOR THE MAIN DC BUS MAKES IT EXTREMELY RUGGED AND VIRTUALLY IMMUNE TO FAILURE FROM VIBRATING OPEN OR BEING SHORTED TO GROUND (STRUCTURE). THE BUS IS FURTHER PROTECTED FROM BEING SHORTED TO GROUND THROUGH THE APPLICATION OF A SILICONE RUBBER RTV CONFORMAL COATING TO ALL EXPOSED SURFACES AFTER ASSEMBLY.

(B) TEST:

QUALIFICATION/CERTIFICATION

CERTIFICATION AT THE NEXT ASSEMBLY:

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(B) TEST (CONTINUED)

CERTIFICATION TESTS AT THE NEXT ASSEMBLY LEVEL WITHIN THE MAIN DISTRIBUTION AND CONTROL ASSEMBLY INCLUDE:

CAUSES
a Piece part failure
b Contamination
c Vibration
d Mechanical shock
e Processing anomaly
f Thermal stress

TEST	CAUSE CONTROL a	b	c	d	e	f
QUALIFICATION ACCEPTANCE VIBRATION (QAVT AT 0.67 g^2/HZ, 5 MIN/AXIS)	X		X			
RANDOM VIBRATION (FLIGHT AT 0.023 g^2/HZ, 84 MIN/AXIS)	X		X			
THERMAL CYCLING (1 X 10^{-6} TORR, 6 CYCLES -45 TO 165 ^{o}F, 3 HOURS MIN AT EACH TEMPERATURE EXTREME)	X					X
DESIGN SHOCK (20G PEAK, 11 mSEC, 3 DROPS/AXIS, 18 TOTAL)	X			X		
THERMAL VACUUM (1 X 10^{-5} TORR, 200 ^{o}F, 7 HOURS)	X					X

ACCEPTANCE AND SCREENING

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

CAUSES
a Piece part failure
b Contamination
c Vibration
d Mechanical shock
e Processing anomaly
f Thermal stress

TEST	CAUSE CONTROL a	b	c	d	e	f
INSULATION RESISTANCE (100 MEGOHMS AT 500 VDC)	X	X			X	
DIELECTRIC WITHSTANDING VOLTAGE (500 VDC, 2 mA LEAKAGE CURRENT)	X	X			X	
VIBRATION (AVT, 0.04 g^2HZ, 1 MINUTE/ AXIS)	X		X		X	
VISUAL EXAMINATION	X				X	
FUNCTIONAL	X				X	

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(B) TEST (CONTINUED)

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION (FAILURE CAUSE a)

RECEIVING INSPECTION PERFORMS VISUAL AND DIMENSIONAL EXAMINATIONS OF ALL INCOMING PARTS. TEST REPORTS AND RECORDS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL (FAILURE CAUSE b)

A GOOD HOUSEKEEPING AREA IS VERIFIED FOR ASSEMBLY. THE CONTACT SURFACES OF ALL ELECTRICAL TERMINATIONS ARE VERIFIED TO BE FREE OF ALL FOREIGN MATTER. ASSEMBLIES ARE VERIFIED TO BE FREE OF CHIPS, LOOSE HARDWARE, OIL, GREASE, OR OTHER FOREIGN MATTER, AND QUALITY CONTROL (QC) INSPECTION IS PERFORMED PRIOR TO FINAL CLOSE OUT OF THE UNITS.

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

ASSEMBLY PROCESSES ARE MONITORED AND CONTROLLED BY ML0303-0029 WHICH ESTABLISHES THE REQUIRED TECHNIQUES FOR ALL PHASES OF BOX COMPONENT AND HARNESS FABRICATION. DETAILED INSPECTION IS PERFORMED ON PARTS PRIOR TO THE NEXT ASSEMBLY OPERATION. WIRE AND CABLE PREPARATION AND PROPER HARNESS FABRICATION ARE VERIFIED. TORQUE VALUES APPLIED AND TORQUE TOOL NUMBERS ARE RECORDED IN THE MANUFACTURING OPERATION RECORDS.

CRITICAL PROCESSES (FAILURE CAUSE b,e)

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION. THE CRITICAL PROCESSES ARE SOLDERING, CRIMPING, CONFORMAL COATING, POTTING AND ELECTRICAL BONDING.

TESTING

THE ACCEPTANCE TEST PROCEDURE IS OBSERVED AND VERIFIED BY QC, INCLUDING PRE-TEST, FUNCTIONAL AND VIBRATION.

HANDLING/PACKAGING (FAILURE CAUSE c,d)

PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

FAILURE HISTORY IS TRACKED IN THE PRACA SYSTEM.

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(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	K. L. Preston 3/29/94
PRODUCT ASSURANCE ENGR	: T. KIMURA	T. Kimura 3/22/94
DESIGN ENGINEERING	: J. GULSBY	J. Gulsby 3/26/94
NASA SSMA	:	[illegible] 6/30/94
NASA SUBSYSTEM MANAGER	:	[illegible] 6/20/94