

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2005C -3 REV:05/16/88

ASSEMBLY :MAIN DC DISTR ASSY	ABORT: RTLS	CRIT.FUNC: 1R
P/N RI :V070-764230		CRIT. HDW: 2
P/N VENDOR:	VEHICLE 102 103 104	
QUANTITY :1	EFFECTIVITY: X X X	
:ONE	PHASE(S): PL LO X OO X DO X LS	
:		

PREPARED BY:	REDUNDANCY SCREEN: A-PASS B-PASS C-PASS	APPROVED BY (NASA):
DES R PHILLIPS	APPROVED BY:	SSM <i>[Signature]</i> 10/5/88
REL M HOVE	DES <i>[Signature]</i>	REL <i>[Signature]</i> 7/22/88
QE J COURSEN	REL <i>[Signature]</i> 7-22-88	QE <i>[Signature]</i> 10/5/88

ITEM:

BUS, MAIN DC - MAIN DC BUS C

FUNCTION:

DISTRIBUTES PRIMARY 28 VDC POWER FOR ASSOCIATED MAIN BUS C LOADS.
40V76A33

FAILURE MODE:

LOSS OF OUTPUT, LOSS OF MAIN DC BUS C

CAUSE(S):

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

EFFECT(S) ON:

(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE (E) FUNCTIONAL
CRITICALITY EFFECT:

(A) LOSS OF BUS VOLTAGE.

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

(D) NO EFFECT FOR FIRST FAILURE. CRIT 1 FOR RTLS ABORT BECAUSE THE 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 01-0B, STS-26) PROTECTS AGAINST LOSS

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EFFECT(S) ON (CONTINUED):

(A)SUBSYSTEM (B)INTERFACES (C)MISSION (D)CREW/VEHICLE (E)FUNCTIONAL
CRITICALITY EFFECT:

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.

(E) POSSIBLE LOSS OF CREW/VEHICLE WITH SECOND FAILURE VIA ONE OF THE FOLLOWING SCENARIOS:

(1) SECOND FAILURE - LOSS OF SECOND MAIN DC BUS OR FUEL-CELL-TO-MAIN BUS CONTACTOR. RESULTS IN UNDERVOLTAGE CONDITION TO CRITICAL LOADS DURING ASCENT OR ENTRY.

(2) SECOND FAILURE - FORWARD OR AFT RCS LEAK DURING FIRST STAGE WHICH PRECEDES THE LOSS OF MAIN DC BUS C. FOLLOWING A LEAK, ALL FORWARD OR AFT RCS TANK AND MANIFOLD ISOLATION VALVES ARE CLOSED. A SUBSEQUENT LOSS OF MAIN DC BUS C PRECLUDES THE RE-OPENING OF NON-LEAKING RCS PLUMBING FOR ET SEPARATION. THE RESULT IS THE LOSS OF ALL FORWARD OR AFT RCS JETS AND POSSIBLE RE-CONTACT WITH THE ET DURING SEPARATION.

DISPOSITION & RATIONALE:

(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE

(A,B,C,D) DISPOSITION AND 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 (QQCS76, 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:

05-6-18

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(B) TEST (CONTINUED)

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

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
CAUSES a Piece part failure d Mechanical shock b Contamination e Processing anomaly c Vibration f Thermal stress						
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 °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 ⁻⁶ TORR, 200 °F, 7 HOURS)	X					X

ACCEPTANCE AND SCREENING

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

TEST	CAUSE CONTROL					
	a	b	c	d	e	f
CAUSES a Piece part failure d Mechanical shock b Contamination e Processing anomaly c Vibration f Thermal stress						
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 ² /HZ, 1 MINUTE/ AXIS)	X		X		X	
VISUAL EXAMINATION	X				X	
FUNCTIONAL	X				X	

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(B) TEST (CONTINUED)

GROUND TURNAROUND TEST

VERIFY ACTIVATION OF ORBITER MAIN DC BUS C FROM THE MAIN BUS C GROUND SUPPLY. COMMAND THE ORBITER MAIN DC BUS C "ON", AND MONITOR THE STIMULI COMMANDS, DISCRETE EVENTS, AND BUS VOLTAGE. TEST IS PERFORMED FOR ALL FLIGHTS.

(C) INSPECTION

RECEIVING INSPECTION (FAILURE CAUSE e)

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 MLO303-0029 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.

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(D) FAILURE HISTORY

THERE HAVE BEEN NO FAILURES OF A MAIN DC BUS IN THE SHUTTLE ORBITER PROGRAM.

(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.