SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM :ELECT POWER DIST & CONT FMEA NO 05-6 -2132 -1 REV:05/16/88

ASSEMBLY :FWD PCA-1, 2, 3
P/N RI :V070-763320,340,360
P/N VENDOR:
QUANTITY :9
:NINE
:

CRIT.FUNC: 1R
CRIT. HDW: 2

VEHICLE EFFECTIVITY:	102 X	103 X	104 X

PHASE(S): PL LO X OO X DO X LS

REDUNDANCY SCREEN: A-PASS B-PASS C-PASS

PREPARED BY:			APPROVED BY:	APPROVED BY (NASA):
DES	R	PHILLIPS	DES	SSM
REL	M	ROVE	REL	REL
QE	J	COURSEN	QE	QE

ITEM:
CONTROL BUS, FORWARD POWER CONTROL ASSEMBLIES 1, 2, 3

FUNCTION:
SUPPLIES 28 V DC POWER FOR LOGIC LEVEL CONTROL OF CRITICAL ORBITER LOADS. EACH CONTROL BUS (AB1, AB2, AB3, BC1, BC2, BC3, CA1, CA2, CA3) HAS THREE REDUNDANT MAIN DC BUS POWER SOURCES SUPPLIED VIA TWO 5-AMP RPC'S AND ONE 5-AMP FUSE IN SERIES WITH A DIODE AND A 10-AMP CIRCUIT BREAKER.

FAILURE MODE:
LOSS OF POWER

CAUSE(S):
PIECE PART FAILURE, VIBRATION, PROCESSING ANOMALY

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

(A) LOSS OF ONE OF NINE CONTROL BUSES.

(B) LOSS OF REDUNDANT CONTROL BUS POWER TO CRITICAL LOADS.

(C) POSSIBLE EARLY MISSION TERMINATION.

(D) FIRST FAILURE - NO EFFECT.

(E) POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF TWO OR MORE CONTROL BUSES NECESSARY FOR THE OPERATION OF CRITICAL LOADS AFTER SECOND FAILURE (LOSS OF ANOTHER CONTROL BUS).

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DISPOSITION & RATIONALE:
(A)DESIGN (B)TEST (C)INSPECTION (D)FAILURE HISTORY (E)OPERATIONAL USE:

(A,B,C,D) DISPOSITION AND RATIONALE

(A) DESIGN

THE ORBITER CONTROL BUSES ARE UNIQUE AMONG THE ELECTRICAL POWER BUSES. THERE ARE NINE CONTROL BUSES, EACH ONE HAVING ALL THREE MAIN DC BUSES AS POWER SOURCES. THE CONTROL BUSES ARE NOT LOCATED WITHIN ANY ONE ORBITER ELECTRICAL ASSEMBLY; THEY ARE DISTRIBUTED THROUGHOUT THE CREW COMPARTMENT.

TWO OF THE THREE SOURCES FOR EACH CONTROL BUS ORIGINATE FROM REMOTE POWER CONTROLLER'S (RPC'S) CONTAINED IN FORWARD POWER CONTROLLER ASSEMBLIES (FPCA'S). THERE ARE A TOTAL OF NINE 5-AMP RPC'S (3 PER FPCA) ACTING AS CONTROL BUS SOURCES. THE OUTPUT OF EACH RPC IS CONNECTED THROUGH DIODES TO TWO CONTROL BUSES, ONE IN PANEL MA73C TO PANEL O6. EACH CONTROL BUS CONSISTS, THEN, OF THE WIRING, CONNECTORS AND TERMINAL BOARDS USED TO ROUTE THE BUS THROUGH THE VARIOUS PANELS.

THE THIRD SOURCE FOR EACH CONTROL BUS ORIGINATES IN CIRCUIT BREAKER PANEL R15. THREE 10-AMP CIRCUIT BREAKERS ON PANEL R15 ARE USED TO CONTROL MAIN DC BUS A, B AND C POWER. THE OUTPUT OF EACH OF THESE BREAKERS IS ROUTED TO PANEL R2 WHERE IT IS CONNECTED THROUGH DIODES TO THREE 5-AMP FUSES. THE OUTPUT OF EACH FUSE IS THEN CONNECTED TO ONE OF THE NINE CONTROL BUSES AS IT IS ROUTED THROUGH PANEL R2.

THE CONTROL BUS DESIGN RESULTS IN A VERY RELIABLE BUS STRUCTURE IN THAT AT LEAST TWO WIRING BREAKS ARE REQUIRED BEFORE POWER IS LOST TO ANY PORTION OF THE DISTRIBUTED BUS. THE EFFECTS OF SHORTING THE CONTROL BUS WIRING TO GROUND (STRUCTURE) VARY SOMEWHAT DEPENDING ON WHERE ALONG THE DISTRIBUTED BUS THE SHORT OCCURS. BECAUSE OF THE CURRENT-LIMITING EFFECTS OF THE LONG WIRE RUNS INVOLVED, IT IS LIKELY THAT AT LEAST SOME PORTION OF A CONTROL BUS WILL REMAIN POWERED IN THE EVENT OF A SHORT.

THE WIRING, CONNECTORS AND TERMINAL BOARDS COMPRISING THE CONTROL BUS ARE ALL DESIGNED, FABRICATED, CERTIFIED AND INSTALLED IN ACCORDANCE WITH APPLICABLE ORBITER REQUIREMENTS.

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(B) TEST

QUALIFICATION/CERTIFICATION

QUALIFICATION/CERTIFICATION TESTS PERFORMED AT THE NEXT ASSEMBLY LEVEL (CREW COMPARTMENT PANELS) 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
RANDOM VIBRATION (0.03 g^2/HZ, 48 MINUTES/AXIS)	X		X			

ACCEPTANCE AND SCREENING

ACCEPTANCE TESTING AT THE NEXT ASSEMBLY (CREW COMPARTMENT PANELS) INCLUDES:

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
ISOLATION TEST (2 MEGOHMS)	X				X	
FUNCTIONAL TEST	X				X	

GROUND TURNAROUND TEST

VERIFY CONTROL BUS SOURCES BY MONITORING CIRCUIT BREAKER POSITIONS, POWER STIMULI COMMANDS, DISCRETE EVENTS, AND BUS VOLTAGES. 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.

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(C) INSPECTION (CONTINUED)

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

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

(E) OPERATIONAL USE

NONE