

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 05-5-B03-6A-01

REVISION#: 8 03/26/96

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)

LRU: E-MULTIPLEXER-DEMULTIPLEXER

CRITICALITY OF THIS

ITEM NAME: E-MULTIPLEXER-DEMULTIPLEXER

FAILURE MODE: 1R2

FAILURE MODE:

LOSS OF OUTPUT

MISSION PHASE:

PL	PRE-LAUNCH
LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT
LS	LANDING/SAFING

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

CAUSE:

PIECE PART FRACTURE, VIBRATION, CONTAMINATION, TEMPERATURE, CHEMICAL REACTION, FAILED EMDM PORT - SEQUENCE CONTROL UNIT (SCU), OR CORE POWER SUPPLY.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) PASS
	C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

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LOSS OF "OF" EMOMS AND ASSOCIATED MEASUREMENTS.

(B) INTERFACING SUBSYSTEM(S):

OF1, OF2, OF3 - LOSS OF ALL MEASUREMENTS ASSOCIATED WITH THAT EMDM.

OF4 - LOSS OF APU DRAIN LINE PRESSURE MONITORING FOR ALL 3 APUS.

(C) MISSION:

NO EFFECT FIRST FAILURE.

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

NO EFFECT FIRST FAILURE. POSSIBLE LOSS OF CREW/VEHICLE AFTER SECOND FAILURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CRITICALITY 1R2 BECAUSE OF THE FOLLOWING REASON:

BOTH MEASUREMENTS (FUEL PUMP DRAIN LINE PRESSURE 1 AND 2) FOR ALL THREE APUS ARE CHANNELIZED THROUGH "OF4" EMDM ONLY, SUCH THAT THE FAILURE OF THIS EMDM WOULD CAUSE THE LOSS OF FUEL DRAIN LINE PRESSURE VISIBILITY FOR ALL THREE APUS. THE FUEL PUMP DRAIN LINE PRESSURE, WHEN TOO HIGH, COULD BE AN INDICATION OF A GROSS FUEL OR OIL LEAK. LOSS OF BOTH MEASUREMENTS FOR A SINGLE APU WOULD OBSCURE INDICATIONS OF A POTENTIALLY CATASTROPHIC FUEL LEAK. A 1/R2 FAILURE. AN APU IN THIS PREDICAMENT WOULD BE STARTED AS A LAST RESORT.

-DISPOSITION RATIONALE-

(A) DESIGN:

ALL PARTS SELECTED FROM MF0004-400 ORBITER PROJECT PARTS LIST (OPPL) WHICH CALLS FOR JANTXV LEVEL PARTS, OR HAVE ADEQUATE DERATING FACTORS OF 25-50% ON HYBRIDS AND TRANSISTORS, 25-30% ON RESISTORS, CAPACITORS AND OTHER COMPONENTS. PARTS THAT DID NOT MEET ORBITER PROJECT PARTS LIST REQUIREMENTS FOR QUALIFICATION, TRACEABILITY SCREENING OR BURN-IN WERE REVIEWED AND WERE FOUND ACCEPTABLE FOR THEIR GIVEN FUNCTIONS.

DESIGN ALSO INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGNS AND CONSTRUCTION PER SPECIFICATION MC615-0004.

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(B) TEST:

EACH UNIT SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ATP) TEST (TP8258000) AT HONEYWELL INCLUDING CONTINUITY, FULL FUNCTIONAL, ACCEPTANCE VIBRATIONAL TEST (AVT), ACCEPTANCE THERMAL TEST (ATT), EXAMINATION OF PRODUCT, INSULATION RESISTANCE TEST, DIELECTRIC STRENGTH TEST, PERFORMANCE, AND POWER VARIATION TEST.

QUALIFICATION TEST (TB258181) COMPLETED AT HONEYWELL INCLUDING FULL FUNCTIONAL, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), HUMIDITY, THERMAL, VIBRATION, THERMAL VACUUM, LIGHTNING, SHOCK, SALT/FOG, 1000 ON/OFF CYCLE LIFE TEST, ACCELERATION, AND EXPLOSIVE/CORROSIVE ATMOSPHERE.

GROUND TURNAROUND TEST: ALL TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

CERTIFICATIONS AND SOURCE INSPECTION TEST REPORTS ARE ON FILE. CASES AND FLATPACKS ARE ENVIRONMENTALLY SCREENED, INCLUDING LOOSE PARTICLE DETECTION IN RECEIVING INSPECTION. ALL HYBRID COMPONENTS ARE LOT SAMPLED IN RECEIVING INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO CLASS 100,000 LEVEL IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

VISUAL INSPECTION IS PERFORMED AT KIT RELEASE. PRINTED WIRING BOARD MICROSECTION ANALYSIS IS PERFORMED AND MONITORED BY INSPECTION. QUALITY CONTROL VERIFIES SOLDERED CONNECTIONS AND ASSEMBLY OF PARTS. TOOL CERTIFICATION AND TENSILE TESTS ARE MAINTAINED. QUALITY CONTROL PERFORMS PRE-CAP VISUAL INSPECTION FOR CLEANLINESS. QUALITY CONTROL VERIFIES CONVEYOR FURNACE PROFILE/TEMPERATURE EVERY 90 DAYS. QUALITY CONTROL VERIFIES ALL FLATNESS AND SURFACE ROUGHNESS FOR PROPER HEAT TRANSFER. THERMAL PROTECTION CONTROLS EXIST FOR ALL SOLDERED CONNECTIONS.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF SELECTED COMPONENTS, I.E., TANTALUM CAPACITORS IS PERFORMED.

CRITICAL PROCESSES

INSPECTION VERIFIES CRIMPING OPERATIONS AND CERTIFICATION. SOLDERING REQUIREMENTS PER NHB5300 4(3A) AND ISCO8800A ARE VERIFIED BY INSPECTION

TESTING

ATP IS OBSERVED AND VERIFIED BY QUALITY CONTROL, INCLUDING AVT AND ATT.

HANDLING/PACKAGING

PROPER GROUNDING OF ELECTRICALLY STATIC SENSITIVE DEVICES WHEN HANDLING IS PERFORMED. PACKAGING AND PROTECTION VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE

(E) OPERATIONAL USE:
PORT MODING TO RECOVER EMDM FUNCTIONALITY IS AVAILABLE DURING ALL MISSION PHASES.

- APPROVALS -

EDITORIALLY APPROVED	: RI	: <u><i>Paul Casanova</i></u>
EDITORIALLY APPROVED	: JSC	: <u><i>TEST APPROVAL: 5-1-96</i></u>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-012_056

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 05-5-B03-5A-02

REVISION#: 8 03/29/96

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)

LRU: E-MULTIPLEXER-DEMUTIPLEXER

ITEM NAME: E-MULTIPLEXER-DEMUTIPLEXER

CRITICALITY OF THIS

FAILURE MODE: 1R2

FAILURE MODE:
ERRONEOUS OUTPUT

MISSION PHASE:	PL	PRE-LAUNCH
	LO	LIFT-OFF
	OO	ON-ORBIT
	DO	DE-ORBIT
	LS	LANDING/SAFING

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

CAUSE:
PIECE PART FAILURE, VIBRATION, CONTAMINATION, TEMPERATURE, CHEMICAL REACTION, ADDRESS CHECK FAILURE, DATA ERROR TO EMDMMODULE, OR ANALOG/ DIGITAL (A/D) CONVERTER FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN	A) PASS
	B) FAIL
	C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS SCREEN B BECAUSE SOURCE OF ERRONEOUS OUTPUT CANNOT BE IDENTIFIED AND MAY BE ACCEPTED AS A VALID DATA.

C)

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE
NUMBER: 05-5-B03-6A-02

(A) SUBSYSTEM:

ALTERATION OF DATA TRANSMITTED TO PCMMU'S/GPC'S. ERRONEOUS OUTPUT APPEARS TO BE VALID.

(B) INTERFACING SUBSYSTEM(S):

CORRUPTION OF ANY OF THREE CPM SUBSTACK DELTA VOLTAGE MEASUREMENTS SUCH THAT THEY APPEAR TO BE NOMINAL.

(C) MISSION:

NO EFFECT.

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

NO EFFECT FIRST FAILURE. POSSIBLE LOSS OF CREW/VEHICLE AFTER SECOND FAILURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

CRITICALITY 1R2 BECAUSE OF THE FOLLOWING REASONS:

A SINGLE UNDETECTED "OF1", "OF2", OR "OF4" EMDM FAILURE IN COMBINATION WITH A SUBSEQUENT UNDETECTED FAILURE IN A FUEL CELL STACK DUE TO HYDROGEN/OXYGEN CROSSOVER CAN RESULT IN POSSIBLE LOSS OF CREW/VEHICLE. PRIMARY METHOD TO DETERMINE CROSSOVER IS CPM DELTA VOLTAGES. BACKUP METHOD (BUS TIE) IS NOT USED WHEN ERRONEOUS OUTPUT OF CPM DATA IS NOT DETECTED.

PRE-LAUNCH

1) OF1 EMDM FAILS GIVING ERRONEOUS OUTPUT VALUES FOR THE MPS HELIUM PRESSURE LCC LIMITS

2) ASSOCIATED REGULATOR FAILS OPEN AFTER TERMINATION OF AFT COMPARTMENT HELIUM HGDS (HAZARDOUS GAS DETECTION SYSTEM) LCC (T-9 MINUTES) AND HELIUM SUPPLY PRESSURE LCC (T-13 SECONDS); THE FAILURE IS NOT REFLECTED IN THE FAILED EMDM OUTPUT TO TLM/GROUND.

REGULATOR OUTLET PRESSURE LCC LIMITS CONTINUES UNTIL T-10 SECONDS. THE HELIUM OUTPUT PRESSURE MEASUREMENTS (MPS E1-REG A, MPS E2-REG B, MPS E3-REG A) ARE CHANNELIZED THROUGH OF1. THE FAILED EMDM WILL NOT REFLECT THE FAILED OPEN REGULATOR CONDITION.

IF AN OF1 CHANNELIZED HELIUM REGULATOR FAILS OPEN AFTER T-13 SECONDS AND THE EMDM HAS FAILED SUCH THAT REGULATORS PRESSURE ARE MASKED, THE RESULTS ARE AN LCC DECEPTION AND LIFT OFF WITH FAILED OPEN REGULATOR. FLIGHT WITH THIS CONDITION MAY RESULT IN OVERPRESSURIZATION OF THE AFT COMPARTMENT (REF. 03-108-0743-01).

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PRINT DATE: 4/18/96

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE

NUMBER: 05-5-B03-6A-02

-DISPOSITION RATIONALE-

(A) DESIGN:

ALL PARTS SELECTED FROM MF0004-400 ORBITER PROJECT PARTS LIST (OPPL) WHICH CALLS FOR JANTXV LEVEL PARTS, OR HAVE ADEQUATE DERATING FACTORS OF 25-50% ON HYBRIDS AND TRANSISTORS, 25-30% ON RESISTORS, CAPACITORS AND OTHER COMPONENTS. PARTS THAT DID NOT MEET ORBITER PROJECT PARTS LIST REQUIREMENTS FOR QUALIFICATION, TRACEABILITY SCREENING OR BURN-IN WERE REVIEWED AND WERE FOUND ACCEPTABLE FOR THEIR GIVEN FUNCTIONS.

DESIGN ALSO INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGNS AND CONSTRUCTION PER SPECIFICATION MC515-0004.

(B) TEST:

EACH UNIT SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ATP) TEST (TP8258000) AT SPERRY INCLUDING CONTINUITY, FULL FUNCTIONAL, ACCEPTANCE VIBRATIONAL TEST (AVT), ACCEPTANCE THERMAL TEST (ATT), EXAMINATION OF PRODUCT, INSULATION RESISTANCE TEST, DIELECTRIC STRENGTH TEST, PERFORMANCE, AND POWER VARIATION TEST.

QUALIFICATION TEST (T8258181) COMPLETED AT HONEYWELL INCLUDING FULL FUNCTIONAL, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), HUMIDITY, THERMAL, VIBRATION, THERMAL VACUUM, LIGHTNING, SHOCK, SALT/FOG, 1000 ON/OFF CYCLE LIFE TEST, ACCELERATION, AND EXPLOSIVE/CORROSIVE ATMOSPHERE.

GROUND TURNAROUND TEST: ALL TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:**RECEIVING INSPECTION**

CERTIFICATIONS AND SOURCE INSPECTION TEST REPORTS ARE ON FILE. CASES AND FLATPACKS ARE ENVIRONMENTALLY SCREENED, INCLUDING LOOSE PARTICLE DETECTION IN RECEIVING INSPECTION. ALL HYBRID COMPONENTS ARE LOT SAMPLED IN RECEIVING INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS TO CLASS 100,000 LEVEL IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

VISUAL INSPECTION IS PERFORMED AT KIT RELEASE. PRINTED WIRING BOARD MICROSECTION ANALYSIS IS PERFORMED AND MONITORED BY INSPECTION. QUALITY CONTROL VERIFIES AND WITNESSES TORQUE OPERATIONS. QUALITY CONTROL VERIFIES SOLDERED CONNECTIONS AND ASSEMBLY OF PARTS. TOOL CERTIFICATION AND TENSILE TESTS ARE MAINTAINED. QUALITY CONTROL PERFORMS PRE-CAP VISUAL INSPECTION FOR CLEANLINESS. QUALITY CONTROL VERIFIES CONVEYOR FURNACE PROFILE/TEMPERATURE EVERY 90 DAYS. QUALITY CONTROL VERIFIES ALL

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FLATNESS AND SURFACE ROUGHNESS FOR PROPER HEAT TRANSFER. THERMAL PROTECTION CONTROLS EXIST FOR ALL SOLDERED CONNECTIONS.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC INSPECTION OF SELECTED COMPONENTS, I.E., TANTALUM CAPACITORS, IS PERFORMED.

CRITICAL PROCESSES
INSPECTION VERIFIES CRIMPING OPERATIONS AND CERTIFICATION. SOLDERING REQUIREMENTS PER NHB5300.4(3A) AND ISCO8800A ARE VERIFIED BY INSPECTION.

TESTING
ATP IS OBSERVED AND VERIFIED BY QUALITY CONTROL, INCLUDING AVT AND ATT.

HANDLING/PACKAGING
PROPER GROUNDING OF ELECTRICALLY STATIC SENSITIVE DEVICES WHEN HANDLING IS PERFORMED. PACKAGING AND PROTECTION VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE

(E) OPERATIONAL USE:

NONE IF FAILURE UNDETECTABLE. IF DETECTABLE: BUSES WILL BE TIED BETWEEN AFFECTED FUEL CELL AND A NON-AFFECTED FUEL CELL TO MONITOR FUEL CELL LOAD SHARING FOR POSSIBLE FUEL CELL DEGRADATION, REFERENCE ORBITER MALFUNCTION PROCEDURE COMM SRR-10,-11, -13, AND FLIGHT RULE 9-519.

PORT MODING TO RECOVER EMDM FUNCTIONALITY IS AVAILABLE DURING ALL MISSION PHASES.

- APPROVALS -

EDITORIALLY APPROVED :RI
EDITORIALLY APPROVED :JSC
TECHNICAL APPROVAL : VIA APPROVAL FORM

Bill Van Cuyper
Tom Kearney 5-1-96
95-CIL-D13_05-5