FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-6-E2490 -X

SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL
REVISION: 2 04/30/99

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: EMEC 1 AND 2	MC450-0016-0007 1640-507-1
LRU	: AMEC 1 AND 2	MC450-0016-0009 17850-507-101

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ENHANCED MASTER EVENTS CONTROLLER (EMEC) OR ADVANCED MASTER EVENTS CONTROLLER (AMEC) CRITICAL OUTPUTS, - CORE A AND B PIC INPUTS (ARM, FIRE 1, FIRE 2 COMMANDS)

REFERENCE DESIGNATORS: 54V76A13
55V76A14

QUANTITY OF LIKE ITEMS: 2
TWO EMECS (OR AMECS) PER VEHICLE AND TWO CORES (A AND B) PER EMEC (OR AMEC)

FUNCTION:
EACH ENHANCED (OR ADVANCED) MASTER EVENTS CONTROLLER CORE A OR B PROVIDES REQUIRED SIGNAL OUTPUT TO SUPPLY INDIVIDUAL PYROTECHNIC INITIATOR CONTROLLER (PIC) INPUTS (ARM, FIRE 1 AND FIRE 2) FOR ALL PYRO FUNCTIONS ASSOCIATED WITH SRB IGNITION, SEPARATION AND EXTERNAL TANK/ORBITER SEPARATION. ADDITIONALLY, EMEC'S 1 AND 2 (OR AMEC'S 1 AND 2) ARE PROGRAMMED TO RETRACT ORB/ET UMBILICALS FOR LH2/LOX AFTER MAIN ENGINE CUTOFF. EACH EMEC (AMEC) PROVIDES REDUNDANT POWER TO THE RETRACT INDIVIDUALLY THE LH2 AND THE LOX UMBILICALS - ORB/ET LH2 UMBILICAL HYDRAULIC ACTUATORS 1, 2, AND 3, ORB/ET LOX UMBILICAL HYDRAULIC ACTUATORS 1, 2, AND 3 (REFERENCE ASSOCIATED MEC/PIC CILS: 05-6-2509-01, 05-6-2509-02, 05-6-2510-01 AND 05-6-2510-02).

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 05-6-E2490- 02

REVISION#: 2 04/30/99

SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL
LRU: EMEC 1 AND 2, AMEC 1 AND 2 **CRITICALITY OF THIS**
ITEM NAME: EMEC 1 AND 2, AMEC 1 AND 2 **FAILURE MODE:** 1R3

FAILURE MODE:
PREMATURE OUTPUT OF A CRITICAL (FIRE 2) COMMAND

MISSION PHASE: PL PRE-LAUNCH
LO LIFT-OFF

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? NO

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
"B" SCREEN FAILS BECAUSE EMEC (AMEC) FIRE 2 OUTPUT STATUS NOT INSTRUMENTED.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
FIRST FAILURE RESULTS IN A DEGRADATION OF REDUNDANCY AGAINST INABILITY TO SEPARATE. (SCENARIO ASSUMES FAILURES OCCUR PRIOR TO ARMING. FOR POST ARMING SCENARIO REFERENCE CIL 05-6-E2491-02).

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(B) INTERFACING SUBSYSTEM(S):
SAME AS (A)

(C) MISSION:
FIRST FAILURE - NO EFFECT

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE AFTER FOUR FAILURES:
1) CRITICAL FIRE 1 COMMAND INADVERTENTLY FAILS "ON".
2) FIRE 3 COMMAND FAILS "ON" PROVIDING POWER TO FIRE 2 DRIVER.
3) FIRE 2/3 INTERLOCK OUTPUT FAILS "ON" RESULTING IN AN INABILITY TO CHARGE PIC CAPACITORS.
4) PIC FAILURE OF THE REDUNDANT EMEC (OR AMEC) RESULTING IN THE INABILITY TO INITIATE A CRITICAL EVENT.

-DISPOSITION RATIONALE-

(A) DESIGN:
FUNCTIONAL DESCRIPTION

THE ENHANCED MASTER EVENTS CONTROLLER (EMEC) OR ADVANCE MASTER EVENTS CONTROLLER (AMEC) CONSISTS OF AN INTERFACE WHICH RECEIVES COMMANDS FROM THE GENERAL PURPOSE COMPUTER (GPC'S) VIA SEPARATE MULTIPLE INTERFACE ADAPTERS (MIA'S) AND WHICH TRANSMITS TEST AND MEASUREMENT DATA ON ONE CHANNEL TO ONE OF THE GPC'S. VALID COMMANDS ARE DECODED AND USED TO ENABLE THE REQUIRED PYRO INITIATOR CONTROLLER (PIC) INPUT COMMANDS. THERE ARE A MAXIMUM OF 57 CRITICAL COMMAND DATA WORDS AND ASSOCIATED DRIVERS TO THE INTERNAL AND REMOTE PIC'S. THE ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL (EEE) COMPONENTS FOR EMEC ARE SELECTED IN ACCORDANCE WITH ORBITER PREFERRED PARTS LIST (OPPL) REQUIREMENTS, EXCEPT WHERE THE USE OF NON-OPPL HAD BEEN AUTHORIZED. FOR THE AMEC, THE EEE COMPONENTS ARE SELECTED IN ACCORDANCE WITH ORBITER PROJECT PARTS REQUIREMENTS (OPPR), EXCEPT WHERE THE USE OF NON-OPPR HAD BEEN AUTHORIZED. COMPONENT

APPLICATIONS ARE EVALUATED TO ASSURE COMPLIANCE WITH DERATING REQUIREMENTS.

PHYSICAL DESCRIPTION

THE DESIGN INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGN AND CONSTRUCTION PER SPECIFICATION MC450-0016.

THE CERTIFIED PART NUMBER FOR EMEC IS MC450-0016-0007, AND THE CERTIFIED PART NUMBER FOR AMEC IS MC450-0016-0009.

DESIGN EVOLUTION

THE -0007 (EMEC) CONFIGURATION INCORPORATED EXTENSIVE REDESIGN AND UTILIZED CURRENT TECHNOLOGY IN COMPONENTS AND ASSEMBLY WITH A NEW BOX MECHANICAL DESIGN WHICH WOULD BE PHYSICALLY INTERCHANGEABLE WITHOUT MODIFICATION WITH THE -0006 CONFIGURATION AND WOULD BE FUNCTIONALLY TRANSPARENT IN FLIGHT AND DURING GROUND TEST. THIS ENHANCED MEC (EMEC) WEIGHS LESS, REQUIRES LESS POWER, AND UTILIZES FEWER COMPONENTS THAN THE -0006 CONFIGURATION.

THE -0009 (AMEC) CONFIGURATION IS SIMILAR TO THE -0007 (EMEC) CONFIGURATION IN DESIGN REQUIREMENTS, MECHANICAL CONSTRUCTION, ELECTRICAL INTERFACES, MANUFACTURING PROCESSES, PRODUCTION TECHNIQUES & SEQUENCES, AND MATERIALS EXCEPT FOR CIRCUIT BOARD SOLDERING USING CONVECTION REFLOW RATHER THAN VAPOR PHASE REFLOW FOR THE EMEC. THE AMEC HAS SAME LOGIC AS EMEC, BUT PARTIONED IN FEWER HIGH-DENSITY ELECTRICAL PROGRAMABLE LOGIC DEVICES (EPLD'S).

(B) TEST:
QUALIFICATION/CERTIFICATION

CERTIFICATION TESTING AND ANALYSIS FOR THE EMEC'S ARE COMPLETED AND APPROVED. QUALIFICATION TESTING (QUAL TEST REPORT C90-682/701) INCLUDING FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), THERMAL VACUUM, AND LIFE HAS BEEN PERFORMED.

CERTIFICATION TESTING FOR THE AMEC'S INCLUDED FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, AND ELECTROMAGNETIC COMPATIBILITY (EMC). THERMAL VACUUM AND LIFE ARE CERTIFIED BY SIMILARITY AND ANALYSIS.

ACCEPTANCE AND SCREENING

EACH UNIT IS SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ALO-5138) AT THE REPAIR CENTER INCLUDING VISUAL EXAMINATION, FULL FUNCTIONAL, ACCEPTANCE THERMAL TEST (ATT) AND ACCEPTANCE VIBRATION TEST (AVT).

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

(C) INSPECTION:
RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES ALL INCOMING PARTS AND MATERIALS, INCLUDING PERFORMANCE OF VISUAL AND DIMENSIONAL EXAMINATIONS, IN ACCORDANCE WITH REQUIREMENTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

A CONTROLLED WORK AREA IS UTILIZED FOR ASSEMBLY AND TEST. QUALITY CONTROL (QC) VERIFIES PROPER MAINTENANCE OF CLEANLINESS CONTROL.

ASSEMBLY/INSTALLATION

INSPECTION POINTS ARE DETERMINED BY QUALITY ENGINEERING IN ACCORDANCE WITH APPLICABLE REQUIREMENTS AND ARE DOCUMENTED ON INSPECTION PLANNING. WORK STATION DISCIPLINES ADHERED TO AND OBSERVED MORE THAN FIVE TIMES PER WEEK BY QC.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY QC AS PROCESS CONTROL SURVEILLANCE ACTIVITY (OPERATIONS AUDIT). THE CRITICAL PROCESSES ARE SOLDERING, BONDING OF COMPONENTS FOR MECHANICAL STABILITY/THERMAL CONDUCTIVITY, COMPONENT PLACEMENT, WIRE ROUTING, AND CRIMPING. FORMAL CERTIFICATION FOR SOLDERING AND QUALIFICATION FOR CRIMPING ARE MAINTAINED.

TESTING

ACCEPTANCE TESTS, INCLUDING VIBRATION, THERMAL AND INSULATION RESISTANCE (IR), ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING

HANDLING OF CMOS/MOS DEVICES TO PRECLUDE ELECTROSTATIC DISCHARGE (ESD) VERIFIED BY QC. PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

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CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

MC450-0016-0007 CONFIGURATION

FAILURE MODE: PREMATURE OUTPUT

FOR THE -0007 CONFIGURATION, THERE HAS BEEN NO FAILURE DOCUMENTED FOR THE FAILURE MODE OF PREMATURE OUTPUT.

MC450-0016-0009 CONFIGURATION

FAILURE MODE: PREMATURE OUTPUT

FOR THE -0009 CONFIGURATION, THERE HAS BEEN NO FAILURE DOCUMENTED FOR THE FAILURE MODE OF LOSS OF OUTPUT.

(E) OPERATIONAL USE:
NONE

- APPROVALS -

SS&PA ENGINEER	: T. AI	: 4/30/99
SS&PAE MANAGER	: P. STENGER-NGUYEN	: 5/4/99
EPD&C SUBSYSTEM MANAGER	: R. PHAN	: 5/2/99
HARDWARE SSM	: P. VU	: 4/30/99
USA SAM	:	: 6/2/98
USA PROJECT MANAGER	:	: 5/18/99
NASA MOD	:	: 5/18/99