FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: 05-5-B08-1 -X

SUBSYSTEM NAME: DATA PROCESSING SYSTEM (DPS)
REVISION: 7 04/14/96

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: ENGINE INTERFACE UNIT CONRAC(LEAR SIEGLER/SMITHS IN)	MC409-0009-0013 7952929-012

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
THREE

FUNCTION:
UPON COMMAND FROM THE GENERAL PURPOSE COMPUTER'S (GPC) THE EIU TRANSFERS COMMANDS TO ITS ASSOCIATED SPACE SHUTTLE MAIN ENGINE CONTROLLER (SSMEC). THE EIU TRANSFERS MAIN ENGINE STATUS DATA TO THE GPC'S, TO AN ONBOARD RECORDER, THE FM S-BAND SYSTEM, AND TO THE T-O (T-ZERO) UMBILICAL.

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LRU: ENGINE INTERFACE UNIT
ITEM NAME: ENGINE INTERFACE UNIT

CRITICALITY OF THIS FAILURE MODE: 1/1

FAILURE MODE:
LOSS OF OUTPUT

MISSION PHASE:
PL PRE-LAUNCH
LO LIFT-OFF

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

CAUSE:
PIECE-PART FAILURE, VIBRATION, CONTAMINATION, TEMPERATURE, CHEMICAL REACTION, OPEN OUTPUT CHANNELS, PERMANENT POWER SUPPLY LOSS, TEMPORARY POWER SUPPLY INTERRUPTION (POWER-ON-RESET), MULTIPLEXER INTERFACE ADAPTER (MIA) AND/OR CONTROLLER INTERFACE ADAPTER (CIA) FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT FIRST FAILURE.

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NUMBER: 05-5-B08-1-01

(B) INTERFACING SUBSYSTEM(S):
SINGLE CHANNEL POWER-ON-RESET (POR) OR LOSS OF SINGLE POWER SUPPLY CAN CAUSE LOSS OF TWO OF THREE MAIN ENGINE COMMAND CHANNELS FOR ONE COMMAND CYCLE. FOR OTHER SINGLE FAILURES, LOSS OF ONE OF THREE MAIN ENGINE COMMAND CHANNELS, POSSIBLY ONE OF TWO STATUS CHANNELS, TWO OF FOUR GPC CHANNELS (CHANNELS 1 & 3 OR 2 & 4), AND POSSIBLY 60 KB TELEMETRY DATA. FOR TWO OR MORE FAILURES, COMMANDS/DATA TO/FROM ASSOCIATED SSMEC ARE LOST.

(C) MISSION:
POSSIBLE LAUNCH OR MISSION ABORT.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
CRITICALITY 1/1 BECAUSE OF THE FOLLOWING REASON.

LOSS OF CREW/VEHICLE DUE TO EIU POWER-ON-RESET OR POWER SUPPLY LOSS DURING LOW LEVEL SENSOR INITIATED MECO RESULTING IN LOSS OF TWO OF THREE MAIN ENGINE COMMAND CHANNELS FOR ONE COMMAND CYCLE. LOSS OF COMMAND CHANNELS MAY RESULT IN VIOLATION OF REQUIREMENT FOR 80 LBS MINIMUM OF LO2 DURING SHUTDOWN (REF. ICD-13M15000, PARA. 4.3.8) CAUSING CAVITATION OF THE HIGH PRESSURE OXIDIZER TURBOPUMP (HPOTP).

CRITICALITY 1R/2 BECAUSE OF THE FOLLOWING REASONS:

MAIN ENGINE OPERATION WILL NOT BE IMPAIRED AS A RESULT OF THE FAILURE OF A SINGLE COMMAND/STATUS CHANNEL. FAILURE OF TWO CHANNELS RESULTS IN LOSS OF COMMAND CAPABILITY TO THE ENGINE.

PRELAUNCH SINGLE FAILURE CAN RESULT IN LAUNCH SCRUB OR PAD ABORT. FOR TWO CHANNEL FAILURES, IF ASSOCIATED ENGINE HAS BEEN STARTED, IT WILL RUN UNTIL DEPLETION RESULTING IN CATASTROPHIC SHUTDOWN UNLESS IT IS MANUALLY SHUT DOWN (SEE OPERATIONAL USE).

ASCENT. INABILITY TO THROTTLE UP FROM MINIMUM COMMANDED THRUST LEVEL CAN LEAD TO AN ABORT. INABILITY TO THROTTLE DOWN MAY INDUCE EXCESSIVE STRUCTURAL STRESS ON VEHICLE AND/OR EXCEED 3G LIMIT. DEPLETION WILL OCCUR OR PREVALVES WILL BE CLOSED ON THE RUNNING ENGINE AT MECO RESULTING IN CATASTROPHIC SHUTDOWN UNLESS IT IS MANUALLY SHUT DOWN (SEE OPERATIONAL USE).

DURING TWO ENGINE ABORT, EIU POWER-ON-RESET OR POWER SUPPLY LOSS DURING LOW LEVEL SENSOR INITIATED MECO CAN RESULT IN LOSS OF CREW/VEHICLE

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 05-5-B08-1-01

DUE TO VIOLATION OF THE NET POSITIVE SUCTION PRESSURE (NPSP) REQUIREMENT (REF. ICD-13M15000 PARA. 4.2.2) CAUSING CAVITATION OF THE HPOTP.

LOSS OF MULTIPLE EIU'S PREVENTS PROPER MPS RESIDUAL DUMPS DURING RTLS AND TAL ABORTS CAUSING A HAZARDOUS CONDITION.

-DISPOSITION RATIONALE-

(A) DESIGN:
ALL PARTS ARE MIL-STD-883 LEVEL B PARTS, SCREENED AND BURNED-IN PRIOR TO INSTALLATION AND ARE DERATED 25% TO ORBITER PROJECT PARTS LIST (OPPL) REQUIREMENTS. EIU'S DESIGNED FOR QUAD REDUNDANCY IN GPC INTERFACES, TRIPLE REDUNDANCY IN MAIN ENGINE CONTROLLER INTERFACES, AND DUAL REDUNDANT POWER. DESIGN ALSO INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGNS AND CONSTRUCTION PER SPECIFICATION MC409-0009.

(B) TEST:
EACH UNIT SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ATP) TEST (7101257) AT VENDOR INCLUDING EXAMINATION OF PRODUCT, INSULATION RESISTANCE TEST, DIELECTRIC STRENGTH TEST, ACCEPTANCE VIBRATION TEST (AVT), ACCEPTANCE THERMAL TEST, FUNCTIONAL, AND POWER VARIATION TEST.

QUALIFICATION TEST (7101326) COMPLETED AT VENDOR INCLUDING FULL FUNCTIONAL, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), SALT/FOG, HUMIDITY, VIBRATION, THERMAL VACUUM, SHOCK, LIGHTNING AND OPERATING LIFE TEST.

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

(C) INSPECTION:
RECEIVING INSPECTION
CERTIFICATES OF COMPLIANCE FOR MECHANICAL PROPERTIES, CHEMICAL COMPOSITION, RADIOGRAPHIC, AND DYE-PENETRANT INSPECTION OF PROCURED CASTINGS ARE MAINTAINED. CERTIFICATES OF COMPLIANCE ARE MAINTAINED FOR MULTI-LAYER BOARD TEST RESULTS INCLUDING MICROSECTION ANALYSIS. AGE SENSITIVE LOG MAINTAINED. EXTRUSIONS VISUALLY INSPECTED UNDER MAGNIFICATION. VISUAL/DIMENSIONAL EXAMINATION OF ALL INCOMING PARTS IS PERFORMED

CONTAMINATION CONTROL
QUALITY CONTROL VERIFIES PROPER CLEANLINESS PROCEDURES ARE MAINTAINED.

ASSEMBLY/INSTALLATION
DETAILED INSPECTION PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY. SOLDERING/CRIMPING OPERATIONS VERIFIED. CONFORMAL COAT PREPARATION AND

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COATING VERIFIED. TORQUE VERIFIED. ALIGNMENT/DIMENSIONAL INSPECTION CHECKS DURING CARD CONNECTOR ASSEMBLY.

CRITICAL PROCESSES
ALL SOLDERING PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION PER NHB5300.4(3A).

TESTING
ALL TESTS, SET UPS AND RESULTS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND STORAGE PROCEDURES AND EQUIPMENT VERIFIED BY QUALITY CONTROL. ELECTROSTATIC DISCHARGE PREVENTION METHODS VERIFIED BY QUALITY CONTROL.

(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:
FLIGHT RULES AND CREW PROCEDURES CALL FOR MANUAL ENGINE SHUTDOWN FOR COMMAND PATH FAILURES. DURING PAD ABORT, THE CREW WILL SHUT DOWN THE ENGINE FOLLOWED BY THE GROUND LAUNCH SEQUENCER (GLS) CLOSING THE PREVALVES. FOR ASCENT, THE CREW WILL SHUT DOWN THE ENGINE AND THE GPC'S WILL CLOSE THE PREVALVES. FOR ASCENT, THIS PROCEDURE IS ONLY USEFUL IF THE FAILURE CAN BE DETECTED EARLY ENOUGH PRIOR TO MECO (BEFORE THE LAST 30 SECONDS). COMMAND PATH FAILURE IS ONLY DETECTABLE VIA TELEMETRY. GROUND FLIGHT CONTROLLER WOULD DETECT A COMMAND PATH FAILURE IF NO CHANGE IN GH2 OUTLET PRESSURE OCCURS WHEN THROTTLE COMMANDS ARE ISSUED DURING 3G THROTTLE DOWN OR FINE COUNT. THE GH2 OUTLET PRESSURE IS DOWNLINKED VIA OI MDM AND DOES NOT GO THROUGH THE EIU. THE CREW ASSUMES A COMMAND PATH FAILURE IF THEY HAVE HAD AN INDICATION OF A DATA PATH FAILURE DURING THE LAST 30 SECONDS PRIOR TO MECO OR MCC CANNOT CONFIRM COMMAND PATH EXISTENCE.

- APPROVALS -

EDITORIALLY APPROVED	: RI	Boulanger
EDITORIALLY APPROVED	: JSC	Pam Sisser 5-1-96
TECHNICAL APPROVAL	: VIA APPROVAL FORM	96-CIL-013 05/5