

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
 NUMBER: 04-1A-0101 -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION: FUEL CELL
 REVISION: 3 03/27/96

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: FUEL CELL POWERPLANT IFC	MC464-0115-3020 807100
LRU	: FUEL CELL POWERPLANT IFC	MC464-0115-3021 808100
LRU	: FUEL CELL POWERPLANT IFC	MC464-0115-3030 814100
LRU	: FUEL CELL POWERPLANT. IFC	MC464-0115-3031 815100

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 FCP NO. 1, 2, 3

REFERENCE DESIGNATORS: 40V45A100
 40V45A200
 40V45A300

QUANTITY OF LIKE ITEMS:
 TWO-RH
 ONE-LH

FUNCTION:
 THREE POWER SOURCES FOR MAIN ELECTRICAL POWER.

FAILURE MODES EFFECTS ANALYSIS FMEA - CIL FAILURE MODE

NUMBER: 04-1A-0101-05

REVISION#: 1 03/27/96

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION: FUEL CELL

LRU: FUEL CELL POWERPLANT

CRITICALITY OF THIS
FAILURE MODE: 1R2

ITEM NAME: FUEL CELL POWERPLANT

FAILURE MODE:

LOSS OF ELECTRICAL CONTACT IN POWER SECTION.

MISSION PHASE:

LO LIFT-OFF
DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

MECHANICAL SHOCK, VIBRATION, CORROSION, THERMAL STRESS, FATIGUE.

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:

LOSS OF REDUNDANCY - INABILITY TO PROVIDE ELECTRICAL POWER FROM FCP'S TO EPD&C.

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(B) INTERFACING SUBSYSTEM(S):

DEGRADATION OF INTERFACE FUNCTION - REDUCED ELECTRICAL POWER SUPPLY TO EPD&C.

(C) MISSION:

NO EFFECT AFTER LOSS OF ONE FUEL CELL. MINIMUM DURATION MISSION INVOKED.
(CAPABILITY EXISTS FOR SAFE RETURN ON 1 OF 3 FUEL CELLS.)

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

NO EFFECT ON CREW OR VEHICLE AFTER LOSS OF ONE FCP. LOSS OF TWO FCP'S DURING ASCENT WILL RESULT IN LOSS OF CREW AND VEHICLE. LOSS OF SECOND FCP DURING DESCENT LOSES CREW/VEHICLE IF INSUFFICIENT TIME IS AVAILABLE FOR AN ELECTRICAL LOAD RECONFIGURATION RESULTING IN THE INABILITY OF THE SINGLE REMAINING FUEL CELL TO SUPPLY ADEQUATE ELECTRICAL POWER.

(E) FUNCTIONAL CRITICALITY EFFECTS:

SAME AS (D)

-DISPOSITION RATIONALE-

(A) DESIGN:

TERMINAL ATTACHMENTS ARE OF STURDY DESIGN. GAGE NO. 0 COPPER WIRE PARALLEL CONDUCTORS ARE USED, SECURED BY SELF LOCKING INCONEL OR STEEL BOLTS. 17 TIERODS COMPRESS AND MAINTAIN RIGIDITY OF POWER SECTION. NICKEL PLATING PROTECTS SEPARATOR PLATES FROM CORROSION AND GOLD OUTER LAYER PROVIDES LOW CONTACT RESISTANCE.

COOLANT ACCUMULATOR IS SIZED TO PRECLUDE POWER SECTION OVERSTRESS DUE TO COOLANT THERMAL EXPANSION. FCP IS DESIGNED TO WITHSTAND STATIC LOADS OF 25G. MOUNTING BRACKETS ARE CAPABLE OF WITHSTANDING LOADS IN EXCESS OF 9G.

(B) TEST:

DIELECTRIC TEST OF 1250 VOLTS RMS AND INSULATION RESISTANCE. ALL CRIMP CONNECTIONS WERE EXPOSED TO VIBRATION AND THERMALLY STRESSED DURING DEVELOPMENT AND QUALIFICATION TEST PROGRAM. THERMAL STRESS EXPOSURE DURING QUALIFICATION AND DEVELOPMENT TESTING UP TO 4133 HOURS.

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DEVELOPMENT VIBRATION TESTING IS GREATER THAN 10 TIMES EQUIVALENT DAMAGE OR ACCUMULATED ENERGY LEVELS. QUALIFICATION VIBRATION WAS CONDUCTED FOR A DURATION EQUIVALENT TO 60 MISSIONS ON AN OPERATING FUEL CELL POWERPLANT.

OMRSD: GROUND OPERATIONS CONTINUALLY VERIFY SATISFACTORY POWER SECTION ELECTRICAL CONTACT DURING FUEL CELL STARTUP AND FUEL CELL PERFORMANCE ON DC BUS OPERATIONS.

(C) INSPECTION:

RECEIVING INSPECTION

DIMENSIONAL INSPECTIONS ARE PERFORMED AT RECEIVING, IN PROCESS, AND ACCEPTANCE SEQUENCES. MATERIAL LOT SAMPLES ARE FORWARDED TO A TEST LAB FOR CERTIFICATION ANALYSIS. WELD FILLER METAL IS CERTIFIED BY LAB TESTING AND MATERIAL CONTROL LAB SPECIFICATIONS.

CONTAMINATION CONTROL

DETAIL PARTS AND ASSEMBLIES ARE SOLVENT CLEANED PER APPROVED PROCEDURES AND DOUBLE BAGGED AS REQUIRED TO PREVENT CONTAMINATION. ASSEMBLY OPERATIONS ARE PERFORMED UNDER CONTROLLED CONDITIONS USING PROCEDURES WHICH MAINTAIN CLEANLINESS AND WHICH SPECIFY APPROPRIATE HANDLING PRECAUTIONS. CLEANLINESS OF OPERATING/TEST FLUIDS IS MAINTAINED THROUGH SAMPLING AND/OR FILTRATION. THE ASSEMBLED FUEL CELL UTILIZES CAPS OR CLOSURES ON ALL FLUID FITTINGS AND THE SHIPMENT/STORAGE OF THE FUEL CELL IS IN A NITROGEN PRESSURIZED METAL SHIPPING CONTAINER.

ASSEMBLY/INSTALLATION

ALL TORQUING OPERATIONS VERIFIED BY QC. CRIMPING TOOLS ARE CALIBRATED BEFORE AND AFTER USE. ALL SOLDER CONNECTIONS ARE VISUALLY INSPECTED AT A MINIMUM OF 4X MAGNIFICATION IN ACCORDANCE WITH NHB 5300.4 (3A).

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION PERFORMED ON ALL WELDS AND WELD REPAIRS.

TESTING

FUNCTIONAL REQUIREMENTS ARE VERIFIED DURING ACCEPTANCE TEST. RESULTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC.

(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 DATA BASE.

THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:

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ONBOARD PROCEDURES MANAGE POWER FOR LOSS OF ONE OR TWO FCP(S).

- APPROVALS -

PAE MANAGER : D. F. MIKULA
PRODUCT ASSURANCE ENGR : L. X. DANG
DESIGN ENGINEERING : MUSTIN, LLOYD
NASA SSMA :
NASA SUBSYSTEM MANAGER :

D.F. Mikula 29 MAR 96
(an) Dang 3/29/96
John ... 3-28-96
St ... 6/16/97
Frank ... 6/16/97