FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: M4-1BG-LV013-X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION : 0 11/19/92 W

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU	:	SOLENOID VALVE, O2 REACTANT EATON CONSOLIDATED CONTROLS	MC284-0429-4102 74405-4102
SRU	:	SOLENOID VALVE, O2 REACTANT EATON CONSOLIDATED CONTROLS	MC284-0429-4103 74405-4103

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SOLENOID VALVE, O2 REACTANT

REFERENCE DESIGNATORS: 40V45LV013
: 40V45LV023
: 40V45LV024

QUANTITY OF LIKE ITEMS: 3
ONE PER O2 MANIFOLD #1
TWO PER O2 MANIFOLD #2

FUNCTION:
PROVIDES CAPABILITY TO ISOLATE O2 FROM ASSOCIATED FUEL CELL.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-LV013-02

SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION# 1 11/12/91 R

ITEM NAME: SOLENOID VALVE, O2 REACTANT
CRITICALITY OF THIS FAILURE MODE:1R2

FAILURE MODE:
FAILS CLOSED

MISSION PHASE:
LO LIFT-OFF

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

CAUSE:
MECHANICAL SHOCK, VIBRATION

CRITICALITY 1/I DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
SUBSYSTEM DEGRADATION - SYSTEM CAN NO LONGER PROVIDE O2 TO THE ASSOCIATED FUEL CELL.

(B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE FUNCTION - LOSS OF ASSOCIATED FUEL CELL. REDUCED ELECTRICAL POWER SUPPLY TO EPD&C.

(C) MISSION:
NO EFFECT AFTER LOSS OF ONE FUEL CELL. MINIMUM DURATION MISSION

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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.

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE AS A RESULT OF LOSS OF TWO FUEL CELL POWERPLANTS DURING ASCENT.

- DISPOSITION RATIONALE -

(A) DESIGN:
VALVE IS MAGNETICALLY LATCHED OPEN. 50 MICRON ABS FILTER AT THE INLET. VALVE CONTAINS NO SOFT GOODS IN CONTACT WITH THE FLUID. MOVING PARTS ARE GOLD PLATED TO REDUCE FRICTION. HOUSING IS CONSTRUCTED OF CRES 304 TO PREVENT CORROSION. ALL VALVE COMPONENTS ARE COMPATIBLE WITH WORKING FLUIDS. VALVE IS MOUNTED WITH BODY AXIS PERPENDICULAR TO VEHICLE X-AXIS TO MINIMIZE VIBRATION EFFECTS. THIS FAILURE MODE IS ON CAUTION AND WARNING. VALVE IS DESIGNED TO OPEN WITH A MINIMUM OF 18 VOLTS (NOMINAL ORBITER BUS VOLTAGE IS 28 VOLTS).

(B) TEST:
QUALIFICATION TEST VERIFIED NORMAL OPERATION DURING SHOCK (20 G) AND VIBRATION (0.1 G SQ/HZ MAXIMUM RANDOM, +/- 0.25 G PEAK SINUSOIDAL) AND THERMAL OPERATING LIFE TEST (TOTAL OF 3000 CYCLES FROM -284 TO +220 DEG F AT OPERATING PRESSURE).

ACCEPTANCE TEST VERIFIES FUNCTIONAL OPERATION OF MAGNETIC LATCHES AND THAT PRESSURE DROP IS WITHIN LIMITS. VALVE IS VERIFIED CLEANED TO LEVEL 200A BY PARTICLE COUNT AND NON-VOLATILE RESIDUE. VALVE IS FURTHER VERIFIED DURING PANEL MODULAR ASSEMBLY AND SUBSYSTEM CHECKOUT.

CMRSD: VALVE OPERATION VERIFIED EVERY TURNAROUND.

(C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESS CERTIFICATION DOCUMENTS ARE REVIEWED FOR COMPLIANCE WITH PROGRAM REQUIREMENTS.

ASSEMBLY/INSTALLATION
ALL DETAIL PARTS ARE INSPECTED UNDER 40X MAGNIFICATION FOR SURFACE FINISH BURRS AND DAMAGE. THREAD LUBRICATION, TORQUING AND LOCKWIRE IS VERIFIED BY INSPECTION. DOCUMENTATION IS REVIEWED TO VERIFY RECORDING OF SHIM AND GAP DIMENSIONS USED TO OBTAIN AND MEASURE ARMATURE STROKE.

TESTING

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ALL SPRINGS ARE LOAD TESTED AT DETAIL LEVEL AND ARE LOT TRACEABLE. LATCH FORCES ARE CALIBRATED AND VERIFIED BY INSPECTION DURING FINAL ACCEPTANCE OF THE MAGNETIC LATCH. VALVE ACCEPTANCE TEST REQUIREMENTS, INCLUDING INTERNAL/EXTERNAL LEAKAGE AND PRESSURE DROP ARE VERIFIED BY INSPECTION. VALVE PRESSURE DROP/FLOWRATE IS VERIFIED DURING ACCEPTANCE TEST.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE AND SHIPPING PROVISIONS ARE VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

■ (E) OPERATIONAL USE:
CREW WILL PERFORM MAIN BUS TIE, ATTEMPT TO REOPEN REACTANT VALVE, AND SHUT DOWN ASSOCIATED FUEL CELL IF UNSUCCESSFUL.

- APPROVALS -

RELIABILITY ENGINEERING	M. D. WEST	M D. West
DESIGN ENGINEERING	M. M. SCHEIERN	
QUALITY MANAGER	O. J. BUTTNER	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE		