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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: M4-1BG-PD032-X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC

REVISION: 1 11/12/91

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■	LRU	DISCONNECT, H2 HRZNTL DRAIN FAIRCHILD	MC276-0010-0280 75371000-0280
■	LRU	DISCONNECT, H2 HRZNTL DRAIN FAIRCHILD	MC276-0010-1280 75371000-1280

PART DATA

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISCONNECT, H2 HORIZONTAL DRAIN
- REFERENCE DESIGNATORS: 40V45P0032
- QUANTITY OF LIKE ITEMS: 1
ONE PER VEHICLE
- FUNCTION:
PROVIDES H2 HORIZONTAL DRAIN CAPABILITY TO GROUND SUPPORT EQUIPMENT.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-PD032-01

SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC
LRU :DISCONNECT, H2 HRZNTL DRAIN
ITEM NAME: DISCONNECT, H2 HRZNTL DRAIN
REVISION# 1 11/12/91 R
CRITICALITY OF THIS FAILURE MODE:1R3

■ FAILURE MODE:
FAILS OPEN OR INTERNAL LEAKAGE

MISSION PHASE:

- LO LIFT-OFF
- CO ON-ORBIT
- DO DE-ORBIT
- ~~LS LANDING SAFING~~

■ VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

HL

■ CAUSE:
MECHANICAL SHOCK, VIBRATION, CONTAMINATION

■ CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

- REDUNDANCY SCREEN A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

- A)
- B)
REDUNDANCY SCREEN B - POPPET SEALING INTEGRITY IS NONVERIFIABLE DUE TO INSTALLATION OF FLIGHT CAP.
- C)

- FAILURE EFFECTS -

■ (A) SUBSYSTEM:
NO EFFECT AFTER FIRST FAILURE. A FLIGHT CAP IS INSTALLED ON DISCONNECT WHICH PROVIDES A SECONDARY SEAL.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
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- (B) INTERFACING SUBSYSTEM(S):
SAME AS (A)
- (C) MISSION:
SAME AS (A)
- (D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (A)
- (E) FUNCTIONAL CRITICALITY EFFECTS:
LEAKAGE AS A RESULT OF AN ADDITIONAL FAILURE OF THE ASSOCIATED H2 FLIGHT CAP, MAY RESULT IN LOSS OF ALL THREE FUEL CELL POWERPLANTS (LOSS OF CREW/VEHICLE) DUE TO LOSS OF SYSTEM PRESSURE IF BOTH MANIFOLD ISOLATION VALVES FAIL TO CLOSE.

- DISPOSITION RATIONALE -

- (A) DESIGN:
POPPET IS SPRING-LOADED CLOSED, SYSTEM PRESSURE AIDS IN SEALING POPPET, POPPET TRAVEL IS PERPENDICULAR TO LAUNCH ACCELERATION FORCES. LAPPED METAL-TO-METAL SEAT. LOCKING PRESSURE CAP PROVIDES A DUAL SEAL. 10 MICRON FILTER AT GHC INLET. ALL COMPONENTS COMPATIBLE WITH WORKING FLUIDS. BODY IS CONSTRUCTED OF INCONEL 718 CORROSION RESISTANT STEEL.
- (B) TEST:
QUALIFICATION TESTS INCLUDED; MECHANICAL SHOCK (20 G AT 330 PSIG), SINUSOIDAL VIBRATION (+/- 0.25 G PEAK), RANDOM VIBRATION (1.0 G SQ/HZ FOR 34 MINUTES AND 0.5 G SQ/HZ FOR 14 MINUTES), AND THERMAL CYCLED (4 TIMES FROM CRYO TEMPERATURE TO +350 DEG F, 5 OPERATIONAL CYCLES PER THERMAL CYCLE), AND OPERATING CYCLES (2000 AT BOTH -423 DEG F AND AMBIENT TEMPERATURE).

ACCEPTANCE TESTS INCLUDE; PROOF PRESSURE TEST IN THE UNMATED MODE AT 480 PSIG FOR A MIXIMUM OF 5 MINUTES. LEAK TEST FOR INTERNAL LEAKAGE PAST POPPET AT 330 PSIG AND THE POPPET SPRING FORCE VERIFIED WITH THE DISCONNECT'S INTERFACE SIDE PRESSURIZED AT 20 PSIG, WITH THE DOWNSTREAM SIDE VENTED TO ATMOSPHERE.

GMRSD: LEAK CHECK PERFORMED EVERY TURNAROUND.
- (C) INSPECTION:
RECEIVING INSPECTION
TEST REPORTS AND MATERIALS CERTIFICATIONS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

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CONTAMINATION CONTROL

ALL INTERNAL PARTS AND INTERNAL SURFACES OF THE DISCONNECT SHALL BE CLEANED TO LEVEL 200A OF MA0110-301.

THEY ARE FLUSHED WITH FREQ. PRIOR TO MATING.

ASSEMBLY/INSTALLATION

DISCONNECT BODY ORIFICE, POPPET STEM DIAMETERS, AND OTHER CRITICAL DIMENSIONS ARE VERIFIED BY INSPECTION. TORQUES AND SURFACE FINISH ARE VERIFIED. LOG OF CLEAN ROOM AND TOOL CALIBRATION ARE VERIFIED. SEALS ARE VISUALLY EXAMINED PRIOR TO INSTALLATION FOR DAMAGE AND CLEANLINESS. ALL CLEANED SUBASSEMBLIES SHALL BE HANDLED IN A CLASS 100,000 CLEAN ROOM AS DEFINED IN FED-STD-209.

CRITICAL PROCESSES

PARTS PASSIVATION AND ALL WELDS ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE TESTING

WELDS ARE FLUORESCENT PENETRANT INSPECTED, USING LDX COMPATIBLE PENETRANT MATERIAL.

TESTING

THE POPPET EXPERIENCES INTERNAL LEAKAGE TEST AND POPPET SPRING FORCE TEST DURING THE ATP WHICH IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:

CAR NO. A89963-010 H2 KSC, OV-102, GROUND CHECK *
 A89964-010 O2 KSC, OV-102, GROUND CHECK
 AC1526-010 O2 KSC, OV-102, GROUND CHECK
 AC5971-010 H2 KSC, OV-102, GROUND CHECK
 AC7021-010 O2 KSC, OV-102, GROUND CHECK *
 AC9914-010 H2 KSC, OV-104, GROUND CHECK
 AD1160-010 H2 KSC, OV-102, GROUND CHECK

THREE O2 AND 4 H2 FILL AND VENT DISCONNECTS HAVE BEEN REPORTED LEAKING. LEAKAGE HAS BEEN ATTRIBUTED TO CONTAMINATION FROM THE WORKING ENVIRONMENT IN ALL CASES.

* - IN TWO CASES, LEAKAGE FELL WITHIN SPECIFICATION ONCE THE DISCONNECT WAS CYCLED OR FLUSHED.

NOTE: A GENERAL REQUIREMENT HAS BEEN INCORPORATED IN THE FILE III EPG/PRSD QMRSD REQUIRING THE FLUSHING OF ALL AMC/GHC INTERFACES WITH FREQ. TF PRIOR TO DISCONNECT MATING.

CAR NO. AB1934-010 SUPPLIER, QUALIFICATION
 AB3544-010 SUPPLIER, QUALIFICATION

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AB3607-010 SUPPLIER, QUALIFICATION

TWO H2 FILL AND VENT AND AN H2 HORIZONTAL DRAIN DISCONNECT EXHIBITED OUT OF SPECIFICATION LEAKAGE PAST POPPET DURING ITS QUALIFICATION TEST. THE CAUSE OF LEAKAGE WAS THE RESULT OF A PITTED POPPET SEAT AREA. THIS CONDITION WAS DETERMINED TO BE A RESULT OF CONTAMINATION WHICH WAS INTRODUCED BY THE SUPPLIER. CORRECTIVE ACTION INCLUDED IMPLEMENTING FILTERS INTO THE SUPPLIER'S TEST SETUPS.

CAR NO. A5841-010 SUPPLIER, ATP
AN O2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION FLOW PAST POPPET WITH THE DISCONNECT'S INTERFACE SIDE PRESSURIZED AT 20 PSIG. THE POPPET SPRING SHOULD HAVE PREVENTED FLOW. THE OUT OF SPECIFICATION LEAKAGE WAS CAUSED BY EXCESS CONTAMINANTS WITHIN THE UNIT WHICH WAS DETERMINED TO HAVE BEEN INTRODUCED DURING ASSEMBLY. CORRECTIVE ACTION INCLUDED CAUTIONING PERSONNEL TO MAINTAIN CLEANLINESS DURING ASSEMBLY AND HANDLING OF DISCONNECTS.

CAR NO. A6041-010 SUPPLIER, ATP
AN H2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION LEAKAGE PAST POPPET DURING ITS ACCEPTANCE TEST. THE LEAKAGE WAS DETERMINED TO BE CAUSED BY A SCRATCH ON THE POPPET FACE. CORRECTIVE ACTION INCLUDED CAUTIONING ASSEMBLY PERSONNEL TO EXERCISE ADDITIONAL CARE IN HANDLING OF CRITICAL PARTS.

CAR NO. A88472-010 SUPPLIER, ATP
AN O2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION POPPET LEAKAGE DURING ITS ACCEPTANCE TEST. THE PROBLEM WAS CLOSED AS AN ATP SCREENABLE FAILURE.

- (E) OPERATIONAL USE:
NO CREW ACTION AFTER FIRST FAILURE. AFTER SECOND FAILURE, CREW WOULD ISOLATE LEAK BY CLOSING MANIFOLD VALVES AND SHUTTING DOWN FUEL CELL POWERPLANT #3.

- APPROVALS -

RELIABILITY ENGINEERING:	M. D. WEST	:	<u>M D West</u>
DESIGN ENGINEERING	M. M. SCHEIERN	:	<u>M M Scheiern</u>
QUALITY MANAGER	O. J. BUTTNER	:	<u>O J Buttner</u>
NASA RELIABILITY		:	<u>[Signature]</u>
NASA SUBSYSTEM MANAGER		:	<u>[Signature]</u>
NASA QUALITY ASSURANCE		:	<u>[Signature]</u> 4/1/92