PRINT DATE: 03/29/96

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 04-1A-0108 -X

SUBSYSTEM NAME: HYDROGEN PURGE ASSY

REVISION: 0 04/07/86

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: VENT LINE HYDROGEN PURGE	V070-454211

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VENT LINE HYDROGEN PURGE.

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
VENTS HYDROGEN FROM FUEL CELLS DURING PURGE OPERATION AND PROVIDES PATH FOR H2 REGULATOR RELIEF VENTING.

PRINT DATE: 03/27/96

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 04-1A-0108- 01

REVISION#: 1 03/27/96

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION: FUEL CELL
LRU: VENT LINE HYDROGEN PURGE
ITEM NAME: VENT LINE HYDROGEN PURGE

CRITICALITY OF THIS FAILURE MODE: 1R2

FAILURE MODE:
PLUGGED, FAILS TO VENT HYDROGEN DURING PURGE OPERATION OR REGULATOR VENTING.

MISSION PHASE:

PL	PRE-LAUNCH
LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT
LS	LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:
CONTAMINATION, HEATER FAILURE (REFERENCE FMEA 04-1A-0143).

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) PASS
B) N/A
C) PASS

PASS/FAIL RATIONALE:
A)

B)
PASSED FOR PURGE OPERATION AND IS N/A FOR REGULATOR RELIEF FUNCTION WHICH IS STANDBY REDUNDANCY.

C)

- FAILURE EFFECTS -

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(A) SUBSYSTEM:
SUBSYSTEM DEGRADATION - POWER OUTPUT FROM ALL AFFECTED FUEL CELL POWER PLANTS WOULD GRADUALLY DEGRADE AND BECOME EVENTUALLY UNUSABLE. INABILITY OF ASSOCIATED PRESSURE REGULATOR(S) TO RELIEVE PRESSURE IF REQUIRED. EXTERNAL LEAKAGE OF FUEL CELL MAY RESULT (REFERENCE FMEA 04-1A-0101-4). SHUTDOWN OF ASSOCIATED FUEL CELL WILL PRECLUDE OVERPRESSURIZATION IF INDIVIDUAL FCP PURGE/VENT LINE BLOCKAGE IS IDENTIFIED.

(B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE FUNCTION - POWER AVAILABLE TO OTHER SYSTEMS WOULD DECREASE.

(C) MISSION:
ABORT DECISION FOR LOSS OF ABILITY TO RELIEVE ALL FCP'S. MINIMUM DURATION FLIGHT INVOKED FOR SHUT DOWN OF SINGLE FUEL CELL (A SINGLE FUEL CELL RETURN FROM ORBIT IS VIABLE PROVIDING NECESSARY BUS CONFIGURATION IS ACCOMPLISHED).

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT - SUFFICIENT TIME FOR ABORT IF REQUIRED. CREW ACTION IS REQUIRED TO SHUTDOWN FUEL CELL IF PRESSURE REGULATOR FAILURE OCCURS REQUIRING RELIEVING CAPABILITY. FUEL CELL OVERPRESSURIZATION COULD RESULT IN CATASTROPHIC FAILURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

-DISPOSITION RATIONALE-

(A) DESIGN:
REDUNDANT LINE HEATER ELEMENTS PROTECT AGAINST BLOCKAGE DUE TO MOISTURE FREEZING. LINES AND HEATERS ARE WRAPPED WITH AN ALUMINIZED TAPE AND ADDITIONALLY PROTECTED BY 1/2 INCH THICK TG 15000 INSULATION, COVERED BY 321 CRES FOIL OR POLYESTER FILM AND POLYIMIDE TAPE.

PURGE LINE INTERNAL DIAMETER IS 0.218 INCH MINIMIZING POTENTIAL FOR BLOCKAGE BY CONTAMINATION.

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(B) TEST:
VACUUM CHAMBER TESTS HAVE VERIFIED THERMAL DESIGN. OV-102 DEVELOPMENT FLIGHT TEST PERFORMED FOR ADDITIONAL THERMAL DESIGN VERIFICATION.

OMRSD: PRELAUNCH GROUND OPERATIONS VERIFY CONTINUOUS FLOW THROUGH CAPABILITY. PURGING ABILITY IS VERIFIED DURING PRELAUNCH AND FLIGHT OPERATIONS. FUEL CELL PURGE HEATERS ARE VERIFIED EACH MISSION CYCLE.

(C) INSPECTION:
RECEIVING INSPECTION
HARDWARE IS INSPECTED IN ACCORDANCE WITH QUALITY PLANNING REQUIREMENTS DOCUMENT, WHICH WAS APPROVED BY NASA. TUBE MATERIAL ISSUED IS VERIFIED BY INSPECTION ON MANUFACTURING ORDERS.

CONTAMINATION CONTROL
PARTS ARE CLEANED PER APPLICABLE SPECIFICATION AND VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
FABRICATION OF TUBING IS PER DRAWING AND FABRICATION SPECIFICATION AND IS VERIFIED BY INSPECTION. INDUCTION BRAZING IS PER SPECIFICATION, INCLUDING VISUAL AND X-RAY INSPECTION. CORROSION PROTECTION IS PER DRAWING AND APPLICABLE SPECIFICATION, INCLUDING ELECTRO-POLISHING TUBE ENDS, AND IS VERIFIED BY INSPECTION.

TESTING
FLOW THROUGH TEST AND CLEANLINESS ARE VERIFIED BY QA AFTER INSTALLATION. PREFLIGHT FUNCTIONAL TEST WILL BE MONITORED TO VERIFY PURGE FLOW RATE IS WITHIN SPECIFIED LIMITS AND LINE HEATERS ARE OPERATIONAL. LEAK TEST IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGED PER APPLICABLE SPECIFICATION AND VERIFIED BY INSPECTION.

(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:
CREW CAN MANUALLY TURN ON PURGE HEATERS TO ELIMINATE POSSIBLE ICE BLOCKAGE. POWER DOWN PROCEDURES MAY BE EMPLOYED TO REDUCE REQUIREMENT FOR PURGING. IF INDIVIDUAL FCP PURGE/VENT LINE BLOCKAGE IS IDENTIFIED AND ATTEMPTS TO REMOVE BLOCKAGE ARE UNSUCCESSFUL, CREW ACTION

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IS REQUIRED TO SHUT DOWN THE ASSOCIATED FCP TO PRECLUDE AN OVERPRESSURIZATION CONDITION.

- APPROVALS -

PAE MANAGER	: D. F. MIKULA	D F Mikula 29mar96
PRODUCT ASSURANCE ENGR	: L. X. DANG	Lan Dang 3/29/96
DESIGN ENGINEERING	: MUSTIN, LLOYD	L. Anderson 3-28-96
NASA SSMA	:	6/16/97
NASA SUBSYSTEM MANAGER	:	Howard A Hopson 6/16/97