PRINT DATE: 07/09/97

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER:M8-1SS-E048 -X

SUBSYSTEM NAME: ECLSS - EMU OXYGEN RECHARGE SYSTEM
REVISION: 0 04/08/97

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:VALVE, O2 CONTROL CARLETON TECHNOLOGIES	MC250-0004-0006 1-4-00-51-27

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ECLSS PANEL EMU OXYGEN CONTROL VALVE

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
ALLOWS FLOW OF OXYGEN TO AFFECTED EMU SERVICE PORT WHEN VALVE IS IN THE OPEN POSITION. WHEN VALVE IS CLOSED, IT PROVIDES EMU ISOLATION AGAINST OXYGEN SUPPLY PRESSURE. VALVE IS NORMALLY OPEN DURING EMU SERVICING.

REFERENCE DOCUMENTS: VS26-643001

FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE
NUMBER: M8-1SS-E048-02

REVISION#: 0 04/08/97

SUBSYSTEM NAME: ECLSS - EMU OXYGEN RECHARGE SYSTEM
LRU: ECLSS PANEL EMU OXYGEN CONTROL VALVE **CRITICALITY OF THIS**
ITEM NAME: VALVE, EMU OXYGEN CONTROL **FAILURE MODE:** 1R3

FAILURE MODE:
FAILS TO CLOSE, INTERNAL LEAKAGE

MISSION PHASE:
LO LIFT-OFF
DO ON-ORBIT
DO DE-ORBIT

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

CAUSE:
CONTAMINATION, CORROSION, MECHANICAL SHOCK, EXCESSIVE VIBRATION, PHYSICAL BINDING/ JAMMING, MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:
A)

B)
N/A - VALVE IS IN STANDBY UNTIL REQUIRED.

C)

METHOD OF FAULT DETECTION:
NONE UNTIL AN EMU IS CONNECTED AND EITHER THE O2 SHUTOFF VALVE IS OPEN OR UNTIL THERE IS AN O2 LEAK DOWNSTREAM OF THE CONTROL VALVE.
(1) THEN "FAILS TO CLOSE" FAILURE MODE CAN BE DETECTED THROUGH: (A) VISUAL OBSERVATION BY AN INCREASE USE OF OXYGEN SUPPLY; AND (B) INSTRUMENTATION BY A CONTINUOUS EMU OXYGEN PRESSURE INDICATION ON THE EMU ITSELF.
(2) THEN "INTERNAL LEAKAGE" FAILURE MODE CAN BE DETECTED THROUGH: (A) VISUAL OBSERVATION BY AN INCREASE IN THE TIME IT TAKES TO FILL EMU OXYGEN TANKS OR BY AN INCREASE USE OF OXYGEN SUPPLY; AND (B) INSTRUMENTATION BY AN- EMU OXYGEN PRESSURE ANOMALY ON AW82D PANEL PRESSURE GAUGE OR ON EMU ITSELF.

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CORRECTING ACTION: MANUAL

CORRECTING ACTION DESCRIPTION:
CREW COULD TURN OFF OXYGEN TO THE EMU O2 FITTINGS/QUICK DISCONNECTS BY CLOSING THE OXYGEN SHUTOFF VALVE LOCATED IN THE MID DECK OR BY DISCONNECTING THE AFFECTED EMU. SUBSEQUENT FAILURE TO CLOSE THE SHUTOFF VALVE WOULD REQUIRE ORBITER HIGH PPO2 AND LEAK ISOLATION TROUBLESHOOTING. THERE IS NO WORKAROUND TO LOSS OF EVA CAPABILITIES IF EMU OXYGEN SHUTOFF VALVE IS CLOSED TO ISOLATE AN EXTERNAL LEAK.

REMARKS/RECOMMENDATIONS:
WITHIN THE ECLSS PANEL DUAL OXYGEN SUPPLY PATHS ARE PROVIDED TO SERVICE THE EMU'S. EACH PATH CONTAINS ONE VALVE TO CONTROL FLOW OF OXYGEN. EACH EMU CONTAINS TWO PRIMARY AND TWO SECONDARY TANKS ALL OF WHICH ARE FILLED PRIOR TO LAUNCH. WORST CASE SCENARIO IS WHEN AN EXTERNAL LEAKAGE CONDITION (DOWNSTREAM OF THIS VALVE) ACCOMPANIES THIS FAILURE. CONTROL VALVES ARE NORMALLY CLOSED UNTIL EMU'S REQUIRE SERVICING (O2 RECHARGING). EFFECTIVITY OF THE "INTERNAL LEAKAGE" FAILURE MODE IS DURING LIFT-OFF, ON-ORBIT, AND DE-ORBIT MISSION PHASES, WHERE AS, THE EFFECTIVITY FOR THE "FAILS TO CLOSE" FAILURE MODE IS ONLY DURING ON-ORBIT OPERATIONS.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
UNABLE TO INDIVIDUALLY ISOLATE OXYGEN FLOW TO EACH ECLSS PANEL EMU FITTING.

(B) INTERFACING SUBSYSTEM(S):
NO INITIAL EFFECT UNTIL AN EXTERNAL LEAKAGE DOWNSTREAM OF THIS VALVE OCCURS. THEN INABILITY TO ISOLATE LEAKAGE WOULD RESULT IN AN INCREASE USE OF ORBITER CONSUMABLES.

(C) MISSION:
NO EFFECT UNTIL AN EXTERNAL LEAK DOWNSTREAM OF THIS VALVE OCCURS. THEN INCREASE USE OF O2 DUE TO AN EXTERNAL LEAKAGE COULD RESULT IN EARLY MISSION TERMINATION. CLOSING OF THE UPSTREAM O2 SHUTOFF VALVE TO ISOLATE A DOWNSTREAM LEAK WOULD LOSE THE CAPABILITY TO RECHARGE O2 SYSTEMS IN ALL EMU'S RESULTING IN LOSS OF EVA CAPABILITY. POSSIBLE LOSS OF MISSION OBJECTIVES ASSOCIATED WITH LOSS OF PLANNED EVA'S.

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(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE. AN UNCONTROLLED LEAKAGE DOWNSTREAM OF THIS VALVE COULD RESULT IN INADEQUATE O2 SUPPLY TO LES STATIONS. LOSS OF LES SUPPORT CAPABILITY MAY RESULT IN LOSS OF CREW IF UNCONTROLLED LEAK RATE PROHIBITS LES SYSTEM PRESSURIZATION AND LES IS REQUIRED. CLOSING OF THE UPSTREAM O2 SHUTOFF VALVE TO ISOLATE A DOWNSTREAM LEAK WOULD LOSE THE CAPABILITY TO RECHARGE O2 SYSTEMS IN ALL EMU'S RESULTING IN LOSS OF EVA CAPABILITY. POSSIBLE LOSS OF CREW AND VEHICLE IF CONTINGENCY EVA IS REQUIRED.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST FAILURE (VALVE FAILS TO CLOSE OR INTERNALLY LEAKS) - INABILITY TO INDIVIDUALLY CONTROL OXYGEN FLOW TO EACH ECLSS PANEL EMU FITTING. - NO EFFECT UNTIL A DOWNSTREAM LEAK OCCURS.
SECOND FAILURE (EXTERNAL LEAKAGE DOWNSTREAM OF VALVE) - CLOSING OF UPSTREAM O2 SHUTOFF VALVE IN THE MID-DECK WOULD RESULT IN LOSS OF CAPABILITY TO RECHARGE ALL EMU O2 SYSTEMS RESULTING IN LOSS OF EVA CAPABILITIES AND LOSS OF MISSION OBJECTIVES ASSOCIATED WITH PLANNED EVA'S - CRITICALITY 2R3 CONDITION.
THIRD FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM AN EVA TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R3

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
OR THIRD FAILURE (INABILITY TO CLOSE O2 MID-DECK SHUTOFF VALVE) - POTENTIAL BUILDUP OF OXYGEN IN EXTERNAL AIRLOCK. INCREASED USE OF ORBITER CONSUMABLES COULD RESULT IN EARLY MISSION TERMINATION. - CRITICALITY 2R3 CONDITION.
FOURTH FAILURE (INABILITY TO ISOLATE LEAKAGE) - GROSS EXTERNAL LEAKAGE RESULTS IN INADEQUATE O2 SUPPLY TO LES STATIONS. LOSS OF LES SUPPORT CAPABILITY MAY RESULT IN LOSS OF CREW IF LEAK RATE PROHIBITS LES SYSTEM PRESSURIZATION AND LES IS REQUIRED. NOTE - IN AN 8.0 PSIA HOLE IN CABIN CONTINGENCY MODE, AN EXTERNAL LEAK ALLOWING FLOW INTO THE CABIN MAY NOT BE CATASTROPHIC SINCE THERE IS A POSSIBILITY OF SAFELY BREATHING CABIN AIR, INTO WHICH THE O2 IS LEAKING, BY RAISING LES VISOR. WORST CASE FAILURE WOULD BE IN CASE OF CONTAMINATED CABIN ATMOSPHERE, WHEN LEAKAGE PREVENTS ADEQUATE FLOW TO LES STATIONS AND CABIN AIR MAY NOT BE SAFE FOR BREATHING. POTENTIAL LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

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TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
WORST CASE IS WHEN THE MID-DECK O2 SHUTOFF VALVE IS CLOSED TO ISOLATE AN EXTERNAL O2 LEAK. THEN THERE IS NO WORKAROUND TO LOSS OF EVA CAPABILITIES AS THE RESULT OF INABILITY TO RECHARGE O2 SYSTEMS ON ALL EMU'S.

HAZARD REPORT NUMBER(S): ORBI FF-09, ORBI 270, ORBI 299

HAZARD(S) DESCRIPTION:
INABILITY TO SAFELY PERFORM EVA (FF-09), INABILITY TO SUPPLY O2 TO CABIN/CREW (ORBI 270), FLAMMABILITY THREAT IN CABIN DUE TO O2 LEAKAGE FROM ARS OR OTHER SYSTEMS (ORBI 299)

- APPROVALS -

SS & PAE	:	M. W. GUENTHER	:
DESIGN ENGINEER	:	K. J. KELLY	: