

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL HARDWARE
NUMBER:M8-1SS-E044 -X**

**SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM
REVISION: 0 04/08/97**

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:VALVE, SOLENOID LATCHING VALCOR ENGINEERING CORP	ME284-051B-1023 V70500-59-1

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ECLSS PANEL EMU WASTE WATER RETURN SOLENOID LATCHING (CONTROL) VALVE**

**QUANTITY OF LIKE ITEMS: 2
TWO**

**FUNCTION:
ALLOWS FLOW OF WASTE WATER FROM AFFECTED EMU WHEN VALVE IS LATCHED
IN THE OPEN POSITION. WHEN VALVE IS LATCHED CLOSED, IT PROVIDES EMU
ISOLATION AGAINST A 40 PSIA MAXIMUM WASTE WATER RETURN PRESSURE.**

REFERENCE DOCUMENTS: VS28-643001

FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE

NUMBER: M8-1SS-E044-03

REVISION#: 1 04/17/98

SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM

LRU: ECLSS PANEL EMU WASTE WATER RETURN VALVE

CRITICALITY OF THIS

ITEM NAME: VALVE, EMU WASTE WATER RETURN

FAILURE MODE: 1R3

FAILURE MODE:
EXTERNAL LEAKAGE

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

CORROSION, MECHANICAL SHOCK, EXCESSIVE VIBRATION, 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 BECAUSE REDUNDANCY IS IN STANDBY UNTIL REQUIRED.

C)

METHOD OF FAULT DETECTION:

WHEN AN EMU IS CONNECTED EXTERNAL LEAKAGE CAN BE DETECTED THROUGH VISUAL OBSERVATION (WASTE WATER BUILDUP IN EXTERNAL AIRLOCK). ALSO FAILURE CAN BE DETECTED DURING AN EVA (EXTERNAL AIRLOCK DEPRESSURIZATION) BY A LOSS OF CREW CABIN PRESSURE.

CORRECTING ACTION: MANUAL

CORRECTING ACTION DESCRIPTION:

CREW COULD CONTINUE TO UTILIZE WASTE WATER REMOVAL SYSTEM DEPENDING ON MAGNITUDE OF LEAKAGE OR STOP LEAKAGE IN RETURN PATH BY DISCONNECTING

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EMU OR BY CUTTING OUT THE AFFECTED CONTROL VALVE AND SPLICING IN A SECTION OF FLEXIBLE HOSE (FLEXIBLE HOSE & CLAMPS ARE PART OF A CONTINGENCY KIT). CREW COULD ALSO UTILIZE REDUNDANT PATH TO SERVICE ALL EMU'S. ORBITER/ISS CAN ALSO BE MANEUVERED SUCH THAT THE EVA CREWMEMBERS ARE NOT EXPOSED TO THE SUN.

IN THE EVENT BOTH NOMINAL UNLATCHING AND PYRO SYSTEMS FAIL TO SEPARATE ORBITER FROM STATION, AS A RESULT OF WATER IN THE KEEL AREA, CREW COULD: (1) PERFORM IFM TO DRIVE HOOKS OPEN; OR (2) PERFORM EVA TO REMOVE 98 BOLTS HOLDING DOCKING BASE TO EXTERNAL AIRLOCK.

IN THE EVENT A PRESSURE LEAK PATH OCCURS, DURING EVA, BETWEEN THE EXTERNAL AIRLOCK AND CREW CABIN AS A RESULT OF THIS FAILURE CREW COULD: (1) DEMATE THE EMU DRAIN QD; OR (2) REMOVE THE TOP PLATE OF THE URINE DIVERTER VALVE, PLUG UP THE FEEDTHROUGH FROM THE WASTE WATER LINE, AND REINSTALL THE TOP PLATE TO PREVENT AN EXTERNAL LEAKAGE OF HABITABLE PRESSURE THROUGH THE EMU WASTE WATER LINE.

REMARKS/RECOMMENDATIONS:

WITHIN THE ECLSS PANEL DUAL WASTE WATER RETURN PATHS ARE PROVIDED TO SERVICE THE EMU'S. FAILURE WOULD NOT BE DETECTED UNTIL AN EMU IS ATTACHED TO THE WASTE WATER TRANSFER PORT. WORST CASE SCENARIO IS WHEN WASTE WATER LEAKAGE OCCURS FOLLOWING INITIAL EVA. THERE ARE FOUR EMU'S AVAILABLE TO PERFORM AN EVA. A PLANNED EVA REQUIRES THE USE OF A MINIMUM OF THREE EMU'S (FOR THREE EVA CREWMEMBERS) WHILE A CONTINGENCY EVA REQUIRES A MINIMUM OF TWO EMU'S (FOR TWO EVA CREWMEMBERS). THE WASTE WATER RETURN LINE BETWEEN THE EXTERNAL AIRLOCK ECLSS PANEL AND URINE DIVERTER VALVE IS ONLY 0.25 INCHES IN DIAMETER. AN EXTERNAL LEAKAGE OF CABIN PRESSURE THROUGH A 0.25 INCH DIAMETER LINE WOULD NOT EXCEED THE AIR MAKEUP CAPABILITIES OF THE ORBITER ARPCS.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

WHEN EMU IS CONNECTED, FOLLOWING AN EVA, WASTE WATER FROM AFFECTED RETURN PATH IS DIVERTED BEFORE IT REACHES THE ORBITER WASTE WATER SYSTEM. POTENTIAL LEAK PATH OF CREW CABIN PRESSURE INTO A DEPRESSURIZED EXTERNAL AIRLOCK DURING EVA.

(B) INTERFACING SUBSYSTEM(S):

POTENTIAL FOR WASTE WATER BUILDUP IN EXTERNAL AIRLOCK WHEN EMU IS CONNECTED FOLLOWING AN EVA. WORST CASE - INABILITY TO REMOVE WASTE WATER FROM ALL EMU'S (LOSS OF ISOLATION BETWEEN BOTH WASTE WATER RETURN PATHS). FOLLOWING AN EVA, COULD RESULT LOSS OF CAPABILITY TO UTILIZE AFFECTED EMU'S FOR SUBSEQUENT EVA'S.

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CREW CABIN PRESSURE LOSS - NO EFFECT UNTIL AN EVA IS PERFORMED AND EXTERNAL AIRLOCK IS DEPRESSURIZED. THEN CREW CABIN PRESSURE WILL BE DIVERTED THROUGH THE WASTE WATER RETURN LINE, VIA THE URINE DIVERTER VALVE, RESULTING IN AN INCREASE USE OF CONSUMABLES.

(C) MISSION:

ISOLATION BETWEEN EXTERNAL AIRLOCK AND CREW CABIN IS LOST. NO EFFECT UNTIL AN EVA IS PERFORMED. THEN LOSS OF CREW CABIN PRESSURE THROUGH THE WASTE WATER RETURN LINE WHEN EXTERNAL AIRLOCK IS DEPRESSURIZED. POSSIBLE LOSS OF MISSION DUE TO INCREASED USE OF CONSUMABLES.

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

NO INITIAL EFFECT. INABILITY TO REMOVE WASTE WATER FROM EMU'S, WHEN REQUIRED, COULD LIMIT USE OF AFFECTED EMU'S IN PERFORMING A CONTINGENCY EVA TO CORRECT A POTENTIAL CRIT 1 CONDITION. WATER BUILDUP IN EXTERNAL AIRLOCK DURING IVA COULD RENDER RUSSIAN AVIONICS INOPERATIVE RESULTING IN THE INABILITY TO NOMINALLY SEPARATE ORBITER AND ISS.

(E) FUNCTIONAL CRITICALITY EFFECTS:

LOSS OF CREW CABIN PRESSURE:

FIRST FAILURE (EMU WASTE WATER CONTROL VALVE EXTERNALLY LEAKS) - NO EFFECT UNTIL EXTERNAL AIRLOCK IS DEPRESSURIZED TO PERFORM AN EVA. THEN CREW CABIN PRESSURE WILL LEAK THROUGH THE EMU WASTE WATER LINE INTO A DEPRESSURIZED EXTERNAL AIRLOCK. INCREASE USE OF CONSUMABLES COULD RESULT IN EARLY MISSION TERMINATION. - CRITICALITY 2/2 CONDITION

LOSS OF CONTINGENCY EVA CAPABILITIES:

FIRST FAILURE (FIRST WASTE WATER CONTROL VALVE EXTERNALLY LEAKS) - WASTE WATER IS DIVERTED OUT LEAKY VALVE BEFORE IT REACHES THE ORBITER WASTE WATER TANKS. NO EFFECT, SINCE REDUNDANT WASTE WATER PATH CAN BE UTILIZED TO SERVICE ALL EMU'S.

SECOND FAILURE (SECOND WASTE WATER CONTROL VALVE EXTERNALLY LEAKS) - INABILITY TO REMOVE WASTE WATER FROM ALL EMU'S. WORST CASE IF FAILURE OCCURS FOLLOWING AN INITIAL EVA. THEN LOSS OF CAPABILITY TO REMOVE WASTE WATER WOULD PRECLUDE SUBSEQUENT EVA CAPABILITIES. POTENTIAL LOSS OF CONTINGENCY EVA OPERATIONS. - CRITICALITY 1R3 CONDITION.

LOSS OF ORBITER/ISS UNDOCKING CAPABILITIES:

FIRST FAILURE (CONTROL VALVE EXTERNALLY LEAKS) - POTENTIAL BUILDUP OF WATER WITHIN EXTERNAL AIRLOCK. WATER MOLECULES COULD MIGRATE TO THE RUSSIAN AVIONICS BOXES LOCATED IN THE KEEL AREA RENDERING THEM INOPERATIVE. (RUSSIAN BOXES ARE NOT HERMETICALLY SEALED.) LOSS OF RUSSIAN AVIONICS WOULD TAKE OUT BOTH NOMINAL UNLATCHING AND BACKUP PYRO CAPABILITIES RESULTING IN LOSS OF NOMINAL UNDOCKING. - CRITICALITY 1/1 CONDITION

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

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(F) RATIONALE FOR CRITICALITY DOWNGRADE:

LOSS OF CREW CABIN PRESSURE:

SECOND FAILURE (INABILITY TO DEMATE EMU DRAIN QD) - UNABLE TO STOP LEAKAGE OF CREW CABIN PRESSURE USING THIS WORKAROUND.

THIRD FAILURE (INABILITY TO PERFORM IFM TO REMOVE URINE DIVERTER VALVE AND PLUG UP THE WASTE WATER FEEDTHROUGH) - CREW CABIN PRESSURE CONTINUES TO LEAK INTO A DEPRESSURIZED EXTERNAL AIRLOCK. INCREASED USE OF CONSUMABLES COULD RESULT IN EARLY MISSION TERMINATION. - CRITICALITY 2R3

LOSS OF CONTINGENCY EVA CAPABILITIES:

THE WORKAROUNDS TO BYPASS A LEAK USING A FLEX LINE OR MANEUVER ORBITER/ISS SUCH THAT THE CREWMEMBERS WOULD NOT BE EXPOSED TO THE SUN DOES NOT IMPACT THE 1R3 CRITICALITY OF THIS FAILURE MODE.

LOSS OF ORBITER/ISS UNDOCKING CAPABILITIES:

SECOND FAILURE (INABILITY TO PERFORM IFM TO DRIVE HOOKS OPEN) - INABILITY TO SEPARATE ORBITER ACTIVE DOCKING MECHANISM FROM ISS PASSIVE DOCKING MECHANISM.

THIRD FAILURE (INABILITY TO PERFORM EVA OR REMOVE 96 BOLTS HOLDING DOCKING BASE TO EXTERNAL AIRLOCK) - INABILITY TO SEPARATE ORBITER FROM ISS RESULTING IN POSSIBLE LOSS OF ORBITER AND CREW. - CRITICALITY 1R3 CONDITION

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: MINUTES

**IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
YES**

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

CREW WOULD HAVE SUFFICIENT TIME TO UTILIZE REDUNDANT WASTE WATER LINE, SPLICE IN A FLEXIBLE LINE, MANEUVER ORBITER/ISS SUCH THAT EVA CREWMEMBERS ARE NOT EXPOSED TO THE SUN, OR PERFORM WORKAROUNDS TO SEPARATE ORBITER FROM ISS OR STOP A PRESSURE LEAK BEFORE PROBLEM BECOMES CATASTROPHIC TO CREW SAFETY OR CRITICAL TO MISSION SUCCESS.

HAZARD REPORT NUMBER(S): ORBI 401, FF-09

HAZARD(S) DESCRIPTION:

INABILITY TO SAFELY SEPARATE ORBITER FROM MATED ELEMENT (ORBI 401), INABILITY TO SAFELY PERFORM EVA (FF-09).

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- APPROVALS -

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