

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE
NUMBER:M8-1SS-E039A -X**

**SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM
REVISION: 0 02/12/98**

PART DATA

| | PART NAME VENDOR NAME | PART NUMBER VENDOR NUMBER |
|-----|---------------------------------------|--------------------------------------|
| LRU | :LINES & FITTINGS | M072-643401 |
| LRU | :LINES & FITTINGS | M072-643403 |
| LRU | :LINES & FITTINGS | V828-643050 |
| LRU | :LINES & FITTINGS | V828-643051 |
| SRU | :LINES & FITTINGS MULTIPLE SOURCES | MULTIPLE P/N'S |

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
EMU POTABLE WATER SUPPLY LINES AND FITTINGS**

**QUANTITY OF LIKE ITEMS: 1
ONE SET PER SUBSYSTEM**

FUNCTION:

PROVIDES A SINGLE SUPPLY PATH OF POTABLE WATER FROM THE MID DECK SHUTOFF VALVE TO THE EXTERNAL AIRLOCK EMU ECLSS PANEL. WITHIN THE ECLSS PANEL THIS SINGLE PATH SPLITS INTO TWO PATHS, PROVIDING POTABLE WATER TO EACH OF TWO EMU INTERFACE MECHANICAL FITTINGS. WATER IS USED FOR DRINKING AND EMU COOLING PURPOSES.

REFERENCE DOCUMENTS: VS28-643001
V828-643050
V828-643051
M072-643403

FAILURE MODES EFFECTS ANALYSIS FMEA - NON-CIL FAILURE MODE

NUMBER: M8-1SS-E039A-01

REVISION#: 0 04/17/98

SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM

LRU: EMU POTABLE WATER SUPPLY LINES

CRITICALITY OF THIS

ITEM NAME: LINES & FITTINGS

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,
FATIGUE

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

A)

B)

N/A - REDUNDANCY IS IN STANDBY UNTIL REQUIRED.

C)

METHOD OF FAULT DETECTION:

VISUAL OBSERVATION - WATER BUILDUP IN HABITABLE AREAS.

INSTRUMENTATION - REDUCED OR LOSS OF POTABLE WATER PRESSURE INDICATION
ON THE AWB2D PANEL PRESSURE GAUGE. REDUCED OR LOSS OF WATER PRESSURE
TO EMU'S CAN ALSO BE OBTAINED FROM THE ISSA POTABLE WATER SUPPLY
PRESSURE TRANSDUCER.

CORRECTING ACTION: MANUAL

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CORRECTING ACTION DESCRIPTION:

CREW COULD SHUT OFF POTABLE WATER SUPPLY BY: (1) CLOSING THE POTABLE WATER SHUTOFF VALVE; (2) DISCONNECTING THE QD LOCATED AT THE MICROBIAL CHECK VALVE; OR (3) BY CLOSING SELECTIVE ORBITER WATER TANK ISOLATION VALVES. THEN CREW COULD UTILIZE AN EMU THAT CONTAINS WATER TO PERFORM AN EVA. AN EXTERNAL LEAKAGE OF POTABLE WATER WITHIN MID DECK OR EXTERNAL AIRLOCK COULD BE STOPPED BY CUTTING OUT THE AFFECTED LINE AND SPLICING IN A SECTION OF FLEXIBLE HOSE (FLEXIBLE HOSE & CLAMPS ARE PART OF A CONTINGENCY KIT). TO REDUCE THE USE OF EMU POTABLE WATER CREW COULD MANEUVER ORBITER/ISS SUCH THAT EVA CREWMEMBERS ARE NOT EXPOSED TO THE SUN DURING AN EVA. SINCE THIS FAILURE WOULD RESULT IN LOSS OF POTABLE WATER TRANSFER TO EMU'S AND ISS, CREW COULD EITHER: (1) TAP OFF POTABLE WATER IN THE GALLEY FOR USE BY THE EMU'S AND FOR TRANSFER TO ISS; OR (2) TRANSFER BOTTLES OF POTABLE WATER FROM ORBITER TO ISS. 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 96 BOLTS HOLDING DOCKING BASE TO EXTERNAL AIRLOCK.

REMARKS/RECOMMENDATIONS:

A SINGLE PATH PROVIDES POTABLE WATER TO THE ECLSS PANEL. WITHIN THE ECLSS PANEL DUAL POTABLE WATER SUPPLY PATHS ARE PROVIDED TO SERVICE EMU'S. WORST CASE SCENARIO IS WHEN POTABLE WATER LEAKAGE OCCURS IN THE SINGLE PATH, PRIOR TO FILLING ALL EMU'S. THIS WATER IS USED FOR DRINKING AND COOLING PURPOSES. THE EMU POTABLE WATER TANK IS FULL PRIOR TO LAUNCH. POTABLE WATER PRESSURE IS LOW.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

POTABLE WATER SUPPLY IS DIVERTED BEFORE IT REACHES THE ECLSS PANEL OR EMU FITTINGS.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT FIRST FAILURE. INCREASED USE OF POTABLE WATER FOLLOWING FIFTH FAILURE COULD POTENTIALLY DRAIN ORBITER FLASH EVAP SYSTEM. POTENTIAL FOR WATER BUILDUP IN EXTERNAL AIRLOCK, CREW CABIN MID DECK, OR PAYLOAD BAY DEPENDING ON WHERE LEAKAGE OCCURRED. NO INITIAL EFFECT - LOSS OF POTABLE WATER SUPPLY COULD RESULT IN LOSS OF EVA CAPABILITIES SUBSEQUENT TO FIRST EVA SINCE WATER IS NOT AVAILABLE TO COOL BOTH EMU'S.

(C) MISSION:

NO INITIAL EFFECT. WORST CASE, LOSS OF CAPABILITY TO PERFORM A SECOND PLANNED EVA DUE TO LOSS OF POTABLE WATER TO ALL EMU'S. LOSS OF MISSION OBJECTIVES ASSOCIATED WITH PLANNED EVA'S SUBSEQUENT TO INITIAL EVA. LOSS

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OF POTABLE WATER TO STATION FOLLOWING FOUR FAILURES WOULD RESULT IN LOSS OF MISSION OBJECTIVES ASSOCIATED WITH ISS WATER TRANSFER.

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

LOSS OF POTABLE WATER FOR USE BY EMU'S FOLLOWING FOURTH FAILURE, WHEN REQUIRED, WOULD LOSE CONTINGENCY EVA CAPABILITIES RESULTING IN LOSS OF CREW AND VEHICLE. INADVERTENT DRAINING OF ORBITER FLASH EVAP SYSTEM FOLLOWING FIFTH FAILURE COULD RESULT IN LOSS OF CREW AND VEHICLE. WATER BUILDUP IN EXTERNAL AIRLOCK DURING IVA COULD RENDER RUSSIAN AVIONICS INOPERATIVE RESULTING IN THE INABILITY TO NOMINALLY SEPARATE ORBITER AND ISS FOLLOWING THREE FAILURES.

(E) FUNCTIONAL CRITICALITY EFFECTS:

LOSS OF ORBITER FLASH EVAP SYSTEM:

FIRST FAILURE (EXTERNAL LEAKAGE OF POTABLE WATER) - INADVERTENT DRAINING OF WATER FROM ORBITER FLASH EVAP SYSTEM. NO EFFECT UNTIL LEAKAGE CANNOT BE STOPPED.

SECOND FAILURE (UPSTREAM EMU/ISS POTABLE WATER SHUTOFF VALVE FAILS TO CLOSE OR INTERNALLY LEAKS) - UNABLE TO NOMINALLY STOP INADVERTENT DRAINING OF WATER FROM ORBITER FLASH EVAP SYSTEM WITHOUT PERFORMING A WORKAROUND. - CRITICALITY 1R2 CONDITION

LOSS OF CONTINGENCY EVA CAPABILITIES:

FIRST FAILURE (EXTERNAL LEAKAGE OF POTABLE WATER) - WORST CASE IF FAILURE OCCURS FOLLOWING AN INITIAL EVA. THEN LOSS OF WATER SUPPLY FOR COOLING ALL EMU'S WOULD PRECLUDE SUBSEQUENT EVA CAPABILITIES. POTENTIAL LOSS OF CONTINGENCY EVA OPERATIONS. - CRITICALITY 1R2 CONDITION.

LOSS OF ORBITER/ISS UNDOCKING CAPABILITIES:

FIRST FAILURE (EXTERNAL LEAKAGE OF POTABLE WATER) - 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

LOSS OF WATER TRANSFER TO STATION:

FIRST FAILURE (EXTERNAL LEAKAGE OF POTABLE WATER) - WATER IS DIVERTED AWAY FROM SPACE STATION. LOSS OF MISSION OBJECTIVES ASSOCIATED WITH ISS WATER TRANSFER. - CRITICALITY 2/2 CONDITION

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

LOSS OF ORBITER FLASH EVAP SYSTEM:

THIRD FAILURE (UNABLE TO PERFORM WORKAROUND TO DISCONNECT QD) - UNABLE TO STOP INADVERTENT DRAINING OF ORBITER FLASH EVAP SYSTEM USING THIS QD.

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FOURTH FAILURE (INABILITY TO BYPASS LEAK USING FLEX LINE) - UNABLE TO STOP INADVERTENT DRAINING OF ORBITER FLASH EVAP SYSTEM USING TAPE.
FIFTH FAILURE (UNABLE TO STOP FLOW OF WATER TO AIRLOCK BY CLOSING APPROPRIATE ORBITER WATER TANK ISOLATION VALVES) - UNABLE TO PERFORM WORKAROUND TO ISOLATE EXTERNAL LEAKAGE OF WATER FROM ORBITER POTABLE & SUPPLY WATER SYSTEM. CONTINUOUS DRAINING OF ORBITER FLASH EVAP SYSTEM COULD RESULT IN POTENTIAL LOSS OF CREW AND VEHICLE. - CRITICALITY 1R3 CONDITION.

LOSS OF CONTINGENCY EVA CAPABILITIES:

SECOND FAILURE (INABILITY TO BYPASS LEAK USING FLEX LINE) - UNABLE TO STOP EXTERNAL LEAKAGE OF POTABLE WATER.

THIRD FAILURE (INABILITY TO TAP POTABLE WATER FROM GALLEY) - UNABLE TO RESTORE WATER FLOW TO EMU SERVICE PANEL.

FOURTH FAILURE (UNABLE TO PERFORM WORKAROUND TO MANEUVER ORBITER/ISS) - EVA CREWMEMBERS WOULD BE EXPOSED TO THE SUN DURING AN EVA REQUIRING EMU SUBLIMATORS TO BE ON RESULTING IN AN INCREASED USE OF EMU POTABLE WATER. LOSS OF POTABLE WATER SUPPLY TO EMU'S WOULD PRECLUDE SUBSEQUENT EVA'S.

FIFTH FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM CONTINGENCY EVA TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE - CRITICALITY 1R3 CONDITION.

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 HOLD DOCKING BASE TO EXTERNAL AIRLOCK) - INABILITY TO SEPARATE ORBITER FROM ISS RESULTING IN POSSIBLE LOSS OF ORBITER AND CREW. - CRITICALITY 1R3 CONDITION

LOSS OF WATER TRANSFER TO STATION:

SECOND FAILURE (INABILITY TO BYPASS LEAK USING FLEX LINE) - UNABLE TO RESTORE WATER FLOW TO SPACE STATION.

THIRD FAILURE (INABILITY TO TAP POTABLE WATER FROM GALLEY) - LOSS OF WATER TRANSFER TO SPACE STATION USING EXTERNAL FLEXIBLE HOSE.

FOURTH FAILURE (INABILITY TO TRANSFER POTABLE WATER BOTTLES) - LOSS OF ALL POTABLE WATER TRANSFER CAPABILITIES TO STATION RESULTING IN LOSS OF RELATED MISSION OBJECTIVES. - CRITICALITY 2R3 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**

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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 STOP EXTERNAL LEAKAGE OF POTABLE WATER, MANEUVER ORBITER/ISS SUCH THAT EVA CREWMEMBERS ARE NOT EXPOSED TO THE SUN, OR PERFORM WORKAROUNDS TO SEPARATE ORBITER FROM ISS BEFORE AN EXTERNAL LEAKAGE OF EMU POTABLE WATER BECOMES CATASTROPHIC OR PERFORM ALTERNATE MEANS OF TRANSFERRING POTABLE WATER TO THE STATION BEFORE TRANSFER LOSS BECOMES CRITICAL TO COMPLETING MISSION OBJECTIVES.

HAZARD REPORT NUMBER(S): ORBI 276, ORBI 401, FF-09

HAZARD(S) DESCRIPTION:
LOSS OF FLASH EVAPORATION FUNCTION (ORBI 276), INABILITY TO SAFELY SEPARATE ORBITER FROM MATED ELEMENT (ORBI 401), INABILITY TO SAFELY PERFORM EVA (FF-09).

- APPROVALS -

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