

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL HARDWARE  
NUMBER:MB-1SS-E043 -X****SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM  
REVISION: 0 04/08/97**

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**PART DATA**

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|     | <b>PART NAME</b>                                     | <b>PART NUMBER</b>             |
|-----|--|--------------------------------|
|     | <b>VENDOR NAME</b>                                   | <b>VENDOR NUMBER</b>           |
| LRU | :VALVE, SOLENOID LATCHING<br>VALCOR ENGINEERING CORP | ME284-0518-1023<br>V70500-59-1 |

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
ECLSS PANEL EMU POTABLE WATER SUPPLY SOLENOID LATCHING (CONTROL) VALVE****QUANTITY OF LIKE ITEMS: 2  
TWO****FUNCTION:  
ALLOWS FLOW OF POTABLE WATER TO AFFECTED EMU WHEN VALVE IS LATCHED IN  
THE OPEN POSITION. WHEN VALVE IS LATCHED CLOSED, IT PROVIDES EMU  
ISOLATION AGAINST A 40 PSIA MAXIMUM WATER SUPPLY PRESSURE.****REFERENCE DOCUMENTS: VS28-643001**

**FAILURE MODES EFFECTS ANALYSIS FMEA -- NON-CIL FAILURE MODE**  
**NUMBER: M8-1SS-E043-03**

**REVISION#: 1 04/17/98**

**SUBSYSTEM NAME: ECLSS - EMU POTABLE & WASTE WATER SYSTEM**  
**LRU: ECLSS PANEL EMU POTABLE WATER CONTROL VALVE CRITICALITY OF THIS**  
**ITEM NAME: VALVE, EMU POTABLE WATER CONTROL FAILURE MODE: 1R3**

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**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**

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**REDUNDANCY SCREEN**

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

**PASS/FAIL RATIONALE:**

A)

B)

N/A - REDUNDANCY IN STANDBY UNTIL REQUIRED.

C)

**METHOD OF FAULT DETECTION:**

**VISUAL OBSERVATION - WATER BUILDUP IN EXTERNAL AIRLOCK.**  
**INSTRUMENTATION - REDUCED OR LOSS OF POTABLE WATER PRESSURE INDICATION ON THE AW62D PANEL PRESSURE GAUGE. EMU WATER PRESSURE INDICATION CAN ALSO BE OBTAINED FROM THE ISSA POTABLE WATER SUPPLY PRESSURE TRANSDUCER.**

**CORRECTING ACTION: MANUAL**

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**CORRECTING ACTION DESCRIPTION:**

CREW COULD CLOSE SOLENOID LATCHING VALVE LOCATED IN THE MID DECK AREA OR CLOSE SELECTIVE ORBITER WATER TANK ISOLATION VALVES TO ISOLATE LEAKAGE. CREW COULD THEN UTILIZE AN EMU THAT CONTAINS WATER TO PERFORM AN EVA. AN EXTERNAL LEAKAGE CAN ALSO BE STOPPED BY CUTTING OUT THE AFFECTED CONTROL VALVE 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 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 86 BOLTS HOLDING DOCKING BASE TO EXTERNAL AIRLOCK.

**REMARKS/RECOMMENDATIONS:**

WITHIN THE ECLSS PANEL DUAL POTABLE WATER SUPPLY PATHS ARE PROVIDED TO SERVICE THE EMU'S. EACH PATH CONTAINS ONE LATCHING VALVE TO CONTROL FLOW OF POTABLE WATER. WORST CASE SCENARIO IS WHEN POTABLE WATER LEAKAGE OCCURS PRIOR TO FILLING BOTH EMU'S. THIS WATER IS USED FOR DRINKING AND COOLING PURPOSES. THE EMU POTABLE WATER TANK IS FULL PRIOR TO LAUNCH.

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

POTABLE WATER SUPPLY IS DIVERTED BEFORE IT REACHES THE 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. 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 OF POTABLE WATER TO STATION FOLLOWING FOUR FAILURES WOULD RESULT IN LOSS OF MISSION OBJECTIVES ASSOCIATED WITH ISS WATER TRANSFER.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE  
NUMBER: M8-1SS-E043-03****(D) CREW, VEHICLE, AND ELEMENT(S):**

NO EFFECT UNTIL FAILURE OCCURS AFTER INITIAL EVA. THEN INABILITY TO PERFORM A CONTINGENCY EVA TO CORRECT A POTENTIAL CRIT 1 EVENT COULD RESULT 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.

**(E) FUNCTIONAL CRITICALITY EFFECTS:****LOSS OF ORBITER FLASH EVAP SYSTEM:**

FIRST FAILURE (CONTROL VALVE EXTERNALLY LEAKS) - POTABLE WATER IS DIVERTED OUT LEAKY CONTROL VALVE.

SECOND FAILURE (MID DECK SHUTOFF VALVE FAILS TO CLOSE OR INTERNALLY LEAKS)

- UNABLE TO REMOTELY SHUT OFF POTABLE WATER FLOW TO CONTROL VALVE.

THIRD FAILURE (INABILITY TO REMOVE QD AT CHECK VALVE) - INABILITY TO NOMINALLY ISOLATE EXTERNAL LEAKAGE OF POTABLE WATER. INADVERTENT DRAINING OF WATER FROM ORBITER FLASH EVAP SYSTEM. - CRITICALITY 1R3 CONDITION

**LOSS OF CONTINGENCY EVA CAPABILITIES:**

FIRST FAILURE (CONTROL VALVE EXTERNALLY LEAKS) - 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 (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

**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:**

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 POTABLE & SUPPLY WATER SYSTEM VALVES) - UNABLE TO PERFORM WORKAROUND TO ISOLATE EXTERNAL LEAKAGE OF WATER FROM ORBITER POTABLE & SUPPLY WATER SYSTEM. CONTINUOUS DRAINING OF ORBITER FLASH

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**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 POTABLE 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**

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**- TIME FRAME -**

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**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 STOP EXTERNAL LEAKAGE OF POTABLE  
WATER, MANEUVER ORBITER/ISS SUCH THAT EVA CREWMEMBERS ARE NOT EXPOSED**

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TO THE SUN, OR PERFORM WORKAROUNDS TO SEPARATE ORBITER FROM ISS BEFORE AN EXTERNAL LEAKAGE OF 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).

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**- APPROVALS -**

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SS & PAE  
DESIGN ENGINEER

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: S. CASTILLO

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