

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL HARDWARE
NUMBER:M8-1SS-E050 -X**

**SUBSYSTEM NAME: ECLSS - ISS POTABLE WATER TRANSFER SYSTEM
REVISION: 2 02/12/98**

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:LINES & FITTINGS	V828-643050
LRU	:LINES & FITTINGS	V828-643051
LRU	:LINES & FITTINGS	MC276-0054-3001
LRU	:LINES & FITTINGS	MC276-0054-3002
SRU	:LINES & FITTINGS MULTIPLE SOURCES	MULTIPLE P/N'S

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ISS POTABLE WATER TRANSFER LINES AND FITTINGS**

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

FUNCTION:
PROVIDES A SINGLE SUPPLY PATH OF POTABLE WATER FROM A TEE LOCATED ON THE EMU POTABLE WATER SUPPLY LINE TO A QUICK DISCONNECT LOCATED AT THE ISS PMA/NODE INTERFACE FOR USE BY THE INTERNATIONAL SPACE STATION (ISS). POTABLE WATER IS USED FOR DRINKING AND ISS EMU COOLING PURPOSES.

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

FAILURE MODES EFFECTS ANALYSIS FMEA - NON-CIL FAILURE MODE

NUMBER: M8-1SS-E050-01

REVISION#: 1 04/17/98

SUBSYSTEM NAME: ECLSS - ISS POTABLE WATER TRANSFER SYSTEM

LRU: ISS POTABLE WATER TRANSFER 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 EXTERNAL AIRLOCK AND/OR PMA.
 INSTRUMENTATION - REDUCED OR LOSS OF POTABLE WATER PRESSURE INDICATION
 ON THE AW82D PANEL PRESSURE GAUGE OR EMU ITSELF. IN-FLIGHT AND GROUND
 ISS POTABLE WATER PRESSURE INDICATIONS CAN BE OBTAINED FROM THE ISSA
 POTABLE WATER SUPPLY PRESSURE TRANSDUCER.

CORRECTING ACTION: MANUAL

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: M8-1SS-E050-01**

CORRECTING ACTION DESCRIPTION:

CREW COULD SHUT OFF POTABLE WATER SUPPLY TO THE SPACE STATION BY: (1) CLOSING THE MID DECK POTABLE WATER SHUTOFF VALVE; (2) DISCONNECTING THE QD LOCATED AT THE MICROBIAL CHECK VALVE; OR (3) CLOSING SELECTIVE ORBITER WATER TANK ISOLATION VALVES. AN EXTERNAL LEAKAGE OF POTABLE WATER CAN ALSO BE STOPPED CUTTING OUT THE AFFECTED LINE AND SPLICING IN A SECTION OF FLEXIBLE HOSE (FLEXIBLE HOSE & CLAMPS ARE PART OF A CONTINGENCY KIT). SINCE THIS FAILURE AFFECTS POTABLE WATER SUPPLY TO THE EMU SERVICE PANEL, CREW COULD MANEUVER ORBITER/ISS SUCH THAT EVA CREWMEMBERS ARE NOT EXPOSED TO THE SUN DURING AN EVA TO REDUCE THE USE OF EMU POTABLE WATER OR UTILIZE AN EMU THAT CONTAINS SUFFICIENT WATER TO PERFORM AN EVA. SINCE THIS FAILURE RESULTS 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 ISS FROM THE EMU POTABLE WATER SUPPLY LINE. THERE IS NOT ISOLATION BETWEEN THE POTABLE WATER SUPPLIED TO THE SPACE STATION AND THE POTABLE WATER SUPPLIED TO THE EMU ECLSS PANEL.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

POTABLE WATER SUPPLY IS DIVERTED BEFORE IT REACHES THE SPACE STATION.

(B) INTERFACING SUBSYSTEM(S):

POSSIBLE INCREASED USE OF POTABLE WATER. POTENTIAL FOR WATER BUILDUP IN EXTERNAL AIRLOCK AND/OR PMA. INCREASED USE OF POTABLE WATER FOLLOWING FIFTH FAILURE COULD POTENTIALLY DRAIN ORBITER FLASH EVAP SYSTEM. LOSS OF POTABLE WATER SUPPLY TO EXTERNAL AIRLOCK EMU SERVICE PANEL 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. 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: M8-158-E050-01**

(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. POTENTIAL IMPACT TO SPACE STATION OPERATIONS. 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 (EXTERNAL LEAKAGE OF POTABLE WATER) - WATER IS DIVERTED AWAY FROM EMU ECLSS PANEL AND SPACE STATION. WORST CASE - 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 (LINE OR FITTING 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:

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE
NUMBER: M8-1SS-E050-01**

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

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE
NUMBER: M8-1SS-E050-01**

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 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 -

SS & PAE
DESIGN ENGINEER

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