

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE
NUMBER:M5-6SS-0801 -X

SUBSYSTEM NAME: ISS DOCKING SYSTEM

REVISION: 0 02/27/98

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:MO13Q PANEL	VO70-730377
SRU	:TOGGLE SWITCH	ME452-0102-7105
SRU	:TOGGLE SWITCH	ME452-0102-7605

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

TOGGLE SWITCH, 1 POLE, 2 POSITION, MOMENTARY ON - EXTERNAL AIRLOCK WATER SHUTOFF VALVE CIRCUIT

REFERENCE DESIGNATORS: 80V73A143S17

QUANTITY OF LIKE ITEMS: 1
(ONE)

FUNCTION:

OPENS AND CLOSES POTABLE WATER SHUT OFF VALVE.

REFERENCE DOCUMENTS: 1) VS70-840109, SCHEMATIC DIAGRAM - AIRLOCK ENVIRONMENTAL CONTROL SUBSYSTEM

**FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE
NUMBER: M5-6SS-0801-03**

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SUBSYSTEM NAME: ISS DOCKING SYSTEM
LRU: MO13Q
ITEM NAME: TOGGLE SWITCHCRITICALITY OF THIS
FAILURE MODE: 1R3**FAILURE MODE:**
FAILS CLOSED IN THE "OPEN" POSITION, CONTACT-TO-CONTACT SHORT**MISSION PHASE:** OO ON-ORBIT**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR**CAUSE:**
A) PIECE PART STRUCTURAL FAILURE, B) CONTAMINATION, C) VIBRATION, D)
MECHANICAL SHOCK, E) PROCESSING ANOMALY, F) THERMAL STRESS**CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO****CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO**

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS**PASS/FAIL RATIONALE:**
A)

B)

C)

METHOD OF FAULT DETECTION:
POSITION INDICATOR DOES NOT MOVE WHEN SWITCH IS ACTIVATED.**CORRECTING ACTION: NONE**

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CORRECTING ACTION DESCRIPTION:

DESIGN FAULT TOLERANCE: LOSS OF ABILITY TO CLOSE WATER SHUTOFF VALVE WITH THE TOGGLE SWITCH FAILED CLOSED IN THE VALVE "OPEN" POSITION WILL NOT CAUSE A PROBLEM. IT WILL TAKE A SECOND FAILURE (PLUMBING LEAK) FOR WATER TO ESCAPE INTO THE EXTERNAL AIRLOCK.

POTABLE WATER TO EMU'S CAN BE SHUT OFF BY DISCONNECTING THE QD LOCATED AT THE MICROBIAL CHECK VALVE.

REMARKS/RECOMMENDATIONS:

POWER CAN BE REMOVED FROM FAILED SWITCH BY OPENING ASSOCIATED CIRCUIT BREAKER (TO PREVENT MOTOR DAMAGE BY OVERHEATING).

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF CAPABILITY TO CLOSE POTABLE WATER SHUT OFF VALVE.

(B) INTERFACING SUBSYSTEM(S):

FIRST FAILURE - NO EFFECT

(C) MISSION:

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1:

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES:

- 1) TOGGLE SWITCH FAILS CLOSED IN THE "VALVE OPEN" POSITION - LOSS OF ABILITY TO CLOSE AFFECTED EMU AND ISS WATER SUPPLY.
- 2) EXTERNAL LEAKAGE OF POTABLE WATER DOWNSTREAM OF SHUTOFF VALVE - UNABLE TO NOMINALLY STOP INADVERTENT DRAINING OF WATER FROM ORBITER FLASH EVAP SYSTEM WITHOUT PERFORMING A WORKAROUND - CRITICALITY 1R2 CONDITION.

CASE 2:

POSSIBLE LOSS OF CREW/VEHICLE AFTER THREE FAILURES:

- 1) TOGGLE SWITCH FAILS CLOSED IN THE VALVE "OPEN" POSITION - LOSS OF ABILITY TO CLOSE AFFECTED EMU AND ISS WATER SUPPLY.
- 2) EXTERNAL LEAKAGE OF POTABLE WATER DOWNSTREAM OF SHUTOFF VALVE.

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3) POTABLE WATER TANK OUTLET VALVE FAILS OPEN. LOSS OF ABILITY TO SHUT OFF WATER SUPPLY - RESULTS IN WATER IN EXTERNAL AIRLOCK. WATER MIGRATION TO KEEL AREA COULD RENDER RUSSIAN AVIONICS INOPERATIVE, RESULTING IN LOSS OF NOMINAL AND PYROTECHNIC UNDOCKING CAPABILITY.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

CRITICALITY DOWNGRADED FROM 1R2 TO 1R3 DUE TO ADDITIONAL FAULT TOLERANCE PROVIDED BY WORKAROUNDS(S) ALLOWED PER CR S050107W.

CASE 1:

AFTER THE SECOND FAILURE, THE CREW CAN DISCONNECT THE QD LOCATED AT THE MICROBIAL CHECK VALVE TO STOP THE INADVERTENT DRAINING OF THE ORBITER FLASH EVAP SYSTEM. IF UNABLE TO PERFORM WORKAROUND TO DISCONNECT QD (THIRD FAILURE) CREW CAN CLOSE THE APPROPRIATE ORBITER POTABLE AND SUPPLY WATER SYSTEM VALVES TO STOP THE FLOW OF WATER TO THE AIRLOCK. IF UNABLE TO CLOSE VALVES TO ISOLATE EXTERNAL LEAKAGE OF WATER (FOURTH FAILURE) THE CONTINUOUS DRAINING OF ORBITER FLASH EVAP SYSTEM COULD RESULT IN POTENTIAL LOSS OF CREW AND VEHICLE.

CASE 2:

ALTHOUGH THE CRITICALITY REMAINS UNCHANGED AFTER WORKAROUNDS CONSIDERATION (ALLOWED PER CR S050107W), THEY ARE PROVIDING ADDITIONAL FAULT TOLERANCE TO THE SYSTEM.

AFTER THE THIRD FAILURE, THE CREW CAN DISCONNECT THE QD LOCATED AT THE MICROBIAL CHECK VALVE TO STOP THE LEAK. IF UNABLE TO PERFORM WORKAROUND TO DISCONNECT QD (FOURTH FAILURE) AND WATER MIGRATES TO THE EXTERNAL AIRLOCK KEEL AREA AND RENDERS THE RUSSIAN AVIONICS INOPERATIVE, THE CREW WOULD PERFORM EVA TO REMOVE 96 BOLTS FROM THE DOCKING BASE TO CIRCUMVENT THE WORST CASE "DESIGN CRITICALITY" EFFECT. IF UNABLE TO PERFORM EVA (FIFTH FAILURE), POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF ALL UNDOCKING CAPABILITY.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS

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: M5-6SS-0801-03****RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:**

LOSS OF ABILITY TO CLOSE WATER SHUTOFF VALVE WITH THE TOGGLE SWITCH FAILED CLOSED IN THE "VALVE OPEN" POSITION WILL NOT CAUSE A PROBLEM. IT WILL TAKE A SECOND FAILURE (PLUMBING LEAK) FOR WATER TO ESCAPE INTO THE EXTERNAL AIRLOCK. CREW WOULD ALSO HAVE SUFFICIENT TIME TO STOP EXTERNAL LEAKAGE OF POTABLE WATER BEFORE LOSS OF WATER FROM ORBITER FLASH EVAP SYSTEM BECOMES CATASTROPHIC OR BEFORE WATER MIGRATION TO KEEL AREA COULD RENDER RUSSIAN AVIONICS INOPERATIVE, RESULTING IN LOSS OF NOMINAL AND PYROTECHNIC UNDOCKING CAPABILITY.

HAZARD REPORT NUMBER(S): ORBI 276, ORBI 401

HAZARD(S) DESCRIPTION:

ORBI 276 - LOSS OF FLASH EVAPORATION FUNCTION

ORBI 401 - INABILITY TO SAFELY SEPARATE THE ORBITER FROM A MATED ELEMENT

- APPROVALS -

SS&FAE
DESIGN ENGINEERING

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