

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

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SUBSYSTEM NAME: ISS DOCKING SYSTEM
LRU: MO13Q PANEL
ITEM NAME: TOGGLE SWITCH

**CRITICALITY OF THIS
 FAILURE MODE: 1R3**

FAILURE MODE:
FAIL OPEN, SHORT-TO-CASE (GROUND)

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)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF CAPABILITY TO OPEN OR CLOSE POTABLE WATER SHUT OFF VALVE.

(B) INTERFACING SUBSYSTEM(S):

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LOSS OF CAPABILITY TO CONTROL POTABLE WATER SHUTOFF VALVE.
LOSS OF ABILITY TO OPEN POTABLE WATER SUPPLY VALVE COULD RESULT IN LOSS OF
EVA CAPABILITIES SUBSEQUENT TO FIRST EVA SINCE WATER IS NOT AVAILABLE TO
COOL BOTH EMU'S.
LOSS OF ABILITY TO CLOSE POTABLE WATER SUPPLY VALVE COULD OCCUR AFTER TWO
ADDITIONAL FAILURES RESULTING IN WATER IN THE EXTERNAL AIRLOCK.

(C) MISSION:

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1:

TOGGLE SWITCH FAILS OPEN WHEN THE WATER SHUTOFF VALVE IS IN THE CLOSED
POSITION.

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES:

- 1) TOGGLE SWITCH FAILS OPEN - LOSS OF POTABLE WATER SUPPLY. 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.
- 2) A FAILURE REQUIRING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION
- INABILITY TO PERFORM A CONTINGENCY EVA TO CORRECT A CRIT 1 CONDITION
COULD RESULT IN A LOSS OF CREW/VEHICLE - CRITICALITY 1R2 CONDITION.

CASE 2:

TOGGLE SWITCH FAILS OPEN WHEN THE WATER SHUTOFF VALVE IS IN THE OPEN
POSITION.

POSSIBLE LOSS OF CREW/VEHICLE AFTER THREE FAILURES:

- 1) TOGGLE SWITCH FAILS OPEN - LOSS OF ABILITY TO CLOSE POTABLE WATER
SHUTOFF VALVE.
- 2) EXTERNAL LEAKAGE OF POTABLE WATER DOWNSTREAM OF SHUTOFF VALVE.
- 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 PROTECHNIC UNDOCKING CAPABILITY - CRITICALITY 1R3 CONDITION.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

CASE 1:

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

AFTER THE SECOND FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A
POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM CONTINGENCY EVA

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(THIRD FAILURE) TO CORRECT A CRIT 1 CONDITION COULD RESULT IN 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: 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:

CASE 1: SINCE EMU POTABLE WATER TANKS ARE FILLED PRIOR TO LAUNCH, CREW COULD UTILIZE AN EMU THAT CONTAINS WATER TO PERFORM AN EVA. TO REDUCE THE USE OF EMU POTABLE WATER, CREW COULD MANEUVER ORBITER/ISS SUCH THAT EVA CREW MEMBERS ARE NOT EXPOSED TO THE SUN DURING AN EVA.

CASE 2: LOSS OF ABILITY TO CLOSE POTABLE WATER SUPPLY VALVE WILL NOT CAUSE A PROBLEM. IT WILL REQUIRE A SECOND FAILURE (PLUMBING LEAK) FOR WATER TO ESCAPE INTO THE EXTERNAL AIRLOCK.

HAZARD REPORT NUMBER(S): ORBI 401

HAZARD(S) DESCRIPTION:

INABILITY TO SAFELY SEPARATE THE ORBITER FROM A MATED ELEMENT.

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- APPROVALS -

SS&PAE
DESIGN ENGINEERING

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