

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER:M5-6SS-0123 -X**

**SUBSYSTEM NAME: ISS DOCKING SYSTEM**

**REVISION: 0 02/27/98**

**PART DATA**

	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	:PANEL A6A3	V828-730150
SRU	:TOGGLE SWITCH	ME452-0102-7406

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
TOGGLE SWITCH, 3 POSITION, CENTER OFF, FOUR POLE - ACTIVATES RELAY TO OPEN OR CLOSE PMA 2/3 HOOKS.

**REFERENCE DESIGNATORS:** 36V73A7A3S13  
36V73A7A3S14

**QUANTITY OF LIKE ITEMS:** 2  
(TWO)

**FUNCTION:**  
ACTIVATES RELAY TO OPEN OR CLOSE PMA 2/3 HOOKS.

**REFERENCE DOCUMENTS:** 1) VS70-953103, INTEGRATED SCHEMATIC - 53JA, 53JC, 53JE, 53JG; PMA 2/3 PASSIVE MECHANISM GROUP 1/2, SYS A/B HOOKS CONTROL

**FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE**

NUMBER: M5-6SS-0123-02

REVISION#: 1 03/30/00

SUBSYSTEM NAME: ISS DOCKING SYSTEM

LRU: PANEL A6A3

ITEM NAME: TOGGLE SWITCH

CRITICALITY OF THIS

FAILURE MODE: 1R3

**FAILURE MODE:**

FAILS CLOSED, CONTACT-TO-CONTACT SHORT

MISSION PHASE: OO ON-ORBIT

	VEHICLE/PAYLOAD/KIT EFFECTIVITY:	102	COLUMBIA
		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) FAIL
	B) N/A
	C) PASS

**PASS/FAIL RATIONALE:****A)**

SCREEN "A" FAILS BECAUSE TOGGLE SWITCH CONTACT-TO-CONTACT SHORT IS NOT CAPABLE OF BEING CHECKED OUT DURING NORMAL GROUND TURNAROUND WITH NO VEHICLE DESIGN MODIFICATION.

**B)**

SCREEN B IS "N/A" BECAUSE THE TOGGLE SWITCH IS CONTAINED WITHIN A STANDBY SYSTEM.

**C)****- FAILURE EFFECTS -****(A) SUBSYSTEM:**

LOSS OF ABILITY TO ACTIVATE THE RELAY TO OPEN OR CLOSE THE PMA 2/3 HOOKS.

**(B) INTERFACING SUBSYSTEM(S):**

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INABILITY TO OPEN/CLOSE AFFECTED GROUP OF PMA 2/3 HOOKS USING ASSOCIATED MOTOR. REDUNDANT PMA HOOK MOTOR WILL OPEN AFFECTED GROUP OF HOOKS AT HALF THE SPEED AND TWICE THE NORMAL TIME.

**(C) MISSION:**

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE - NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

CASE 1: 1R3, FNP

POSSIBLE LOSS OF CREW/VEHICLE AFTER FIVE FAILURES:

- 1) TOGGLE SWITCH SHORTS CONTACT-TO-CONTACT ENABLING THE "CLOSE" RETURN PATH.
- 2) ONE OR MORE HOOKS IN THE ACTIVE MECHANISM FAIL TO CLOSE COMPLETELY.
- 3) HYBRID RELAY USED TO CLOSE PMA HOOKS FAILS CLOSED AFTER INTERFACE SEALED BETWEEN ISS AND ODS - NO EFFECT. WHEN "OPEN HOOKS" COMMAND IS ISSUED BY THE CREW, "OPEN" CIRCUIT BREAKER WILL TRIP BECAUSE OF THE DIRECT SHORT TO GROUND. UNABLE TO OPERATE ONE PMA HOOK MOTOR IN THE "OPEN HOOKS" DIRECTION. REDUNDANT PMA HOOK MOTOR WILL OPEN AFFECTED GROUP OF HOOKS AT HALF THE SPEED AND TWICE THE NORMAL TIME.
- 4) LOSS OF REDUNDANT MOTOR. LOSS OF PMA UNDOCKING CAPABILITY.
- 5) ONE ODS PASSIVE HOOK PYRO FAILS TO FIRE. LOSS OF ODS PYROTECHNIC UNDOCKING CAPABILITY.

CASE 2: 1R3, PNP (NON-CIL)

POSSIBLE LOSS OF CREW/VEHICLE AFTER FOUR FAILURES:

- 1) TOGGLE SWITCH FAILS CLOSED IN THE "CLOSE" POSITION AFTER SEALING INTERFACE OR (WORST CASE) - UNABLE TO OPERATE ONE PMA HOOK MOTOR IN THE "OPEN" DIRECTION. REDUNDANT PMA HOOK MOTOR WILL OPEN AFFECTED GROUP OF HOOKS AT HALF THE SPEED AND TWICE THE NORMAL TIME.
- 2) ONE OR MORE HOOKS IN THE ACTIVE MECHANISM FAIL TO CLOSE COMPLETELY.
- 3) LOSS OF REDUNDANT MOTOR. LOSS OF PMA UNDOCKING CAPABILITY.
- 4) ONE ODS PASSIVE HOOK PYRO FAILS TO FIRE. LOSS OF ODS PYROTECHNIC UNDOCKING CAPABILITY.

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

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

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

CASE 1:

AFTER THE FIFTH FAILURE, 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 (SIXTH FAILURE), POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF ALL UNDOCKING CAPABILITY.

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CASE 2:  
AFTER THE FOURTH FAILURE, 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.

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**- TIME FRAME -**

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**TIME FROM FAILURE TO CRITICAL EFFECT: HOURS**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES**

**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:  
DESIGN FAULT TOLERANCE: REDUNDANT PMA 2/3 HOOKS "OPEN" MOTOR CIRCUIT IS OPERATIONAL. AFTER LOSS OF NOMINAL UNDOCKING CAPABILITY WITH THE PMA 2/3 HOOK MOTORS, CREW CAN INITIATE ODS PASSIVE HOOK PYROS FOR UNDOCKING.**

**HAZARD REPORT NUMBER(S): ORBI 401**

**HAZARD(S) DESCRIPTION:  
INABILITY TO SAFELY SEPARATE ORBITER FROM A MATED ELEMENT**

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:  
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH**

**(B) TEST:  
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH**

**GROUND TURNAROUND TEST  
CASE 1:  
NONE**

**CASE 2:  
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.**

**(C) INSPECTION:  
REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH**

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**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

**(E) OPERATIONAL USE:**

CASE 1:

AFTER THE FIFTH FAILURE, PERFORM EVA TO REMOVE 96 BOLTS HOLDING DOCKING BASE TO ODS.

CASE 2:

AFTER THE FOURTH FAILURE, PERFORM EVA TO REMOVE 96 BOLTS HOLDING DOCKING BASE TO ODS.

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**- APPROVALS -**

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S&R ENGINEERING	: T. K. KIMURA	: <i>T. K. Kimura 5/2/00</i>
S&R ENGINEERING ITM	: P. A. STENGER	: <i>P. A. Stenger 5/2/00</i>
DESIGN ENGINEERING	: W. T. POCKLINGTON	: <i>William T. Pocklington 5/3/00</i>
SUBSYSTEM MANAGER	: W. T. POCKLINGTON	: <i>William T. Pocklington 5/3/00</i>
EPD&C SUBSYS MANAGER	: R. L. PHAN	: <i>R. Phan 5/8/00</i>
SR&QA	:	: <i>Khong 5/12/2000</i>
NASA DCE	:	: <i>J. O. Mearns 5/12/00</i>
MOD	:	: <i>Michael C. ... 5/15/00</i>
USA SAM	:	: <i>R. D. ... 5/16/00</i>
USA ORBITER ELEMENT	:	: <i>Seamus ... 5/14/00</i>