

FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL HARDWARE
NUMBER: M5-6SS-0127 -X

SUBSYSTEM NAME: ISS DOCKING SYSTEM

REVISION: 0 02/27/98

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:PANEL A6A3	V828-730150
SRU	:HYBRID RELAY	MC455-0135-0002

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

HYBRID RELAY - GROUP 1/2 HOOKS, MOTORS M6/7/8/9 OPEN COMMAND RELAY

REFERENCE DESIGNATORS: 36V73A7A3K1
 36V73A7A3K3
 36V73A7A3K5
 36V73A7A3K7

QUANTITY OF LIKE ITEMS: 4
 (FOUR)

FUNCTION:

WHEN ENERGIZED, CONNECTS POWER TO ONE OF TWO REDUNDANT HOOK MOTORS TO OPEN PMA 2/3 HOOKS. WHEN THE "OPEN" RELAY IS DE-ENERGIZED, IT CONNECTS THE TERMINALS OF THE MOTOR TOGETHER TO DISSIPATE ANY ENERGY STORED IN THE MOTOR.

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 - NON-CIL FAILURE MODE
NUMBER: M5-6SS-0127-02**

REVISION#: 0 02/27/98

**SUBSYSTEM NAME: ISS DOCKING SYSTEM
LRU: A6A3
ITEM NAME: HYBRID RELAY**

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

**FAILURE MODE:
FAILS CLOSED, FAILS TO OPEN, PREMATURELY CLOSSES, SHORTS CONTACT-TO-
CONTACT**

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:	103	DISCOVERY
	104	ATLANTIS
	105	ENDEAVOUR

**CAUSE:
A) PIECE PART 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) N/A
	C) PASS

**PASS/FAIL RATIONALE:
A)**

**B)
SCREEN B IS 'N/A' BECAUSE THE HYBRID RELAY IS CONTAINED WITHIN A STANDBY
SYSTEM.**

C)

- FAILURE EFFECTS -

**(A) SUBSYSTEM:
LOSS OF ABILITY TO CONTROL THE SWITCHING OF THE AFFECTED RELAY CONTACTS.**

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL FAILURE MODE
NUMBER: M5-6SS-0127-02**

(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:

POSSIBLE LOSS OF CREW/VEHICLE AFTER FIVE FAILURES:

- 1) "OPEN" HYBRID RELAY FAILS CONTACT-TO-CONTACT SHORT (I.E. ASSOCIATED CONTACT TO THE ENERGY-DISSIPATING DIODES REMAINS IN THE DE-ENERGIZE STATE) - NO EFFECT.
- 2) ONE OR MORE HOOKS IN THE ACTIVE MECHANISM FAIL TO CLOSE COMPLETELY.
- 3) DIODE SHORT END-TO-END PROVIDING A DIRECT SHORT TO GROUND WHICH TRIP THE CIRCUIT BREAKER UPSTREAM. 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 REDUNDANT MOTOR. LOSS OF PMA UNDOCKING CAPABILITY.
- 5) 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.

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.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS

TIME FROM FAILURE OCCURRENCE TO DETECTION: HOURS

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: MINUTES

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: M5-6SS-0127-02**

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

**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
REDUNDANT PMA HOOK MOTOR WILL OPEN AFFECTED GROUP OF HOOKS AT HALF THE
SPEED AND TWICE THE NORMAL TIME. AFTER LOSS OF NOMINAL UNDOCKING
CAPABILITY WITH THE PMA 2/3 HOOK MOTORS, THE 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**

- APPROVALS -

SS&PAE
DESIGN ENGINEERING

: T. K. KIMURA
: C. J. ARROYO

: *J. Kimura 4-13-98*
: *C. Arroyo*