

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE
NUMBER:M5-6MR-0016 -X**

SUBSYSTEM NAME: ORBITER DOCKING SYSTEM

REVISION: 2

03/27/98

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:DOCKING SYSTEM POWER PANEL	V828-730150
SRU	:TOGGLE SWITCH	MC452-0102-7601

**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
SWITCH, TOGGLE, 2P2P, MAINTAINED ON - ODS TRUSS LIGHTS FORWARD AND AFT
CIRCUITS**

**REFERENCE DESIGNATORS: 36V73A7A3S11
36V73A7A3S12**

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

**FUNCTION:
THE SWITCHES PROVIDE MANUAL ACTIVATION OF THE TRUSS LIGHT CIRCUITS
FORWARD AND AFT CIRCUITS**

**REFERENCE DOCUMENTS: 1) VS70-953103, INTEGRATED SCHEMATIC - 53AE,
DOCKING LIGHTS**

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

NUMBER: M5-6MR-0016-02

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SUBSYSTEM NAME: ORBITER DOCKING SYSTEM

LRU: DOCKING SYSTEM POWER PANEL

ITEM NAME: TOGGLE SWITCH

CRITICALITY OF THIS
FAILURE MODE: 1R3

FAILURE MODE:

SHORT TO CASE (GROUND)

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 105 ENDEAVOUR

CAUSE:

A) PIECE PART STRUCTURAL FAILURE, B) CONTAMINATION, C) VIBRATION,
D) MECHANICAL SHOCK, E) PROCESSING ANOMALY

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:

LOSS OF TRUSS ASSEMBLY ILLUMINATION CAN BE DETECTED VISUALLY.

CORRECTING ACTION: NONE

CORRECTING ACTION DESCRIPTION:

DESIGN FAULT TOLERANCE: USE REMAINING TRUSS LIGHT (FOR LIGHT FAILED OFF)
FOR GENERAL LIGHTING.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:

ONE FORWARD OR AFT TRUSS DOCKING LIGHT FAILS OFF.

(B) INTERFACING SUBSYSTEM(S):

TOGGLE SWITCH SHORTS TO CASE (GROUND) AND CAUSES THE OPENING OF THE TWO UPSTREAM 10 AMP FUSES POWERING THE AFFECTED PANEL MAIN BUS (MAIN BUS A OR B). THIS CAUSES LOSS OF POWER TO THE CONNECTED PMA 2/3 HOOKS MOTORS AND THE DOCKING BASE VENT VALVE (LOSS OF REDUNDANCY IN DRIVING THE PMA 2/3 HOOKS AND CONTROLLING THE VENT VALVES).

(C) MISSION:

NO EFFECT - FIRST FAILURE

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

NO EFFECT - FIRST FAILURE

(E) FUNCTIONAL CRITICALITY EFFECTS:

CASE 1: (1R3, PPP SCENARIO)

POSSIBLE LOSS OF CREW/VEHICLE AFTER FOUR FAILURES:

- 1) CANNOT CLOSE 6 HOOKS (1 GROUP) ON THE ORBITER SIDE OF THE INTERFACE DURING DOCKING (I.E. HOOK CABLE BREAKS FOR 1 HOOK GROUP) REQUIRING THE USE OF THE CORRESPONDING STANDBY REDUNDANT PMA 2/3 SIDE HOOKS IN ORDER TO DOCK.
- 2) AFTER DOCKING, THE TRUSS DOCKING LIGHT TOGGLE SWITCH SHORTS TO CASE (GROUND) AND OPENS THE TWO UPSTREAM 10 AMP FUSES POWERING PANEL MAIN BUS A. THIS RESULTS IN LOSS OF ABILITY TO ENERGIZE ONE OF THE TWO PMA 2/3 SIDE HOOK MOTORS FOR OPENING THE HOOKS FOR UNDOCKING. REDUNDANT MOTOR IS POWERED BY PANEL MAIN BUS B AND IS AVAILABLE TO OPEN THE HOOKS.
- 3) LOSS OF PANEL MAIN BUS B (POWER CONTACTOR K5 FAILS OPEN) CAUSES LOSS OF ALL POWER TO THE ACTIVE HOOKS IN PMA 2/3 RESULTING IN LOSS OF ABILITY TO UNDOCK NOMINALLY.
- 4) PYROTECHNIC SEPARATION ATTEMPTED FOR UNDOCKING. ONE PYROBOLT FAILS TO INITIATE RESULTING IN LOSS OF CAPABILITY TO IMPLEMENT PYROTECHNIC SEPARATION - LOSS OF UNDOCKING CAPABILITY.

CASE 2: (2R3, PPP SCENARIO)

POSSIBLE LOSS OF MISSION AFTER TWO FAILURES:

- 1) AFTER DOCKING, THE TRUSS DOCKING LIGHT TOGGLE SWITCH SHORTS TO CASE (GROUND) AND OPENS THE TWO UPSTREAM 10 AMP FUSES POWERING PANEL MAIN BUS A. THIS RESULTS IN LOSS OF POWER TO ONE OF THE TWO VENT VALVES RESULTING IN THE LOSS OF REDUNDANCY TO PERFORM VESTIBULE PURGING.
- 2) LOSS OF PANEL MAIN BUS B (POWER CONTACTOR K5 FAILS OPEN) CAUSES LOSS OF POWER TO THE REDUNDANT VENT VALVE RESULTING IN LOSS OF ABILITY TO PURGE THE VESTIBULE OF POSSIBLE CONTAMINANTS (I.E. RESIDUAL HYDRAZINE DURING DOCKING MANEUVERING) PRIOR TO OPENING THE UPPER HATCH.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

CASE 1:

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

AFTER THE FOURTH FAILURE, THE CREW WOULD PERFORM EVA TO REMOVE THE 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: DAY

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?
YE

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

IN ORDER TO USE THE PMA 2/3 SIDE HOOKS SINCE THEY ARE STANDBY REDUNDANT, THERE MUST BE A PRE-EXISTING CONDITION THAT THE ASSOCIATED ORBITER SIDE HOOKS ARE INOPERATIVE. IF IT IS NECESSARY THAT THE PMA 2/3 HOOKS BE USED, TWO SEPARATE DRIVE MOTORS ARE AVAILABLE AND ARE POWERED FROM DIFFERENT PANEL MAIN BUSES FOR OPENING THE HOOKS FOR UNDOCKING.

HAZARD REPORT NUMBER(S): DM20HA04(F)

HAZARD(S) DESCRIPTION:

INABILITY TO SAFELY SEPARATE THE ORBITER FROM A MATED ELEMENT

- APPROVALS -

SS&PAE
DESIGN ENGINEERING

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

: *J. K. Kimura* 4-3-98
: *C. J. Arroyo* 4/8/98