

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL HARDWARE
NUMBER: M5-6SS-0925 -X**

SUBSYSTEM NAME: ISS DOCKING SYSTEM

REVISION: 0

02/27/98

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:MID POWER CONTROL ASSEMBLY 1	VO70-764400
LRU	:MID POWER CONTROL ASSEMBLY 2	VO70-764430
SRU	:GENERAL PURPOSE RELAY	MC455-0129-0004

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

GENERAL PURPOSE RELAY, 25-AMP - EXTERNAL AIRLOCK STRUCTURE HEATER
POWER, ZONES 1, 2, AND 3

REFERENCE DESIGNATORS: 40V76A25A3K5
40V76A26A3K5

QUANTITY OF LIKE ITEMS: 2
(TWO)

FUNCTION:

CONNECTS MAIN A(B) POWER TO THE EXTERNAL AIRLOCK STRUCTURE HEATER
CIRCUITS.

REFERENCE DOCUMENTS: 1) VS70-640109, SCHEMATIC DIAGRAM - AIRLOCK
ENVIRONMENTAL CONTROL SUBSYSTEM

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

NUMBER: M5-6SS-0925-02

REVISION#: 0 02/27/98

SUBSYSTEM NAME: ISS DOCKING SYSTEM

LRU: MID PCA 1(2)

ITEM NAME: GENERAL PURPOSE RELAY

CRITICALITY OF THIS

FAILURE MODE: 1R3

FAILURE MODE:

FAILS CLOSED, FAILS TO OPEN, PREMATURELY CLOSES, 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) PASS
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

METHOD OF FAULT DETECTION:

REVIEW OF HEATER CIRCUIT TELEMETRY DATA

MASTER MEAS. LIST NUMBERS: V54T0135A
 V54T0136A
 V54T0137A

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CORRECTING ACTION: MANUAL

**CORRECTING ACTION DESCRIPTION:
CREW CAN DE-ENERGIZE UPSTREAM POWER SOURCES**

- FAILURE EFFECTS -

**(A) SUBSYSTEM:
NO EFFECT - RELAY IS NORMALLY CLOSED.**

**(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 INJURY TO CREW AFTER FIVE FAILURES:

- 1) GENERAL PURPOSE RELAY FAILS CLOSED - LOSS OF ABILITY TO DE-ENERGIZE THE CIRCUITS.
- 2) ASSOCIATED ZONE 1 OR 2 (UPPER EXTERNAL AIRLOCK) CONTROL THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO CONTROL THE HEATERS BETWEEN THE SET POINT TEMPERATURES (55 TO 75 DEG. F).
- 3) ASSOCIATED ZONE 1 OR 2 OVER TEMPERATURE THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO AUTOMATICALLY DE-ENERGIZE CIRCUIT WHEN UPPER SET TEMPERATURE IS REACHED. AFFECTED HEATER FAILS ON.
- 4) ERRONEOUS OUTPUT OF TEMPERATURE SENSOR INDICATING LOWER THAN ACTUAL TEMPERATURE WHICH WILL NOT TRIGGER THE FDA ALARM WHEN THE HEATER ZONE TEMPERATURE SENSOR RISES ABOVE 113 DEG. F (UPPER FDA LIMIT). HEATER CONDUCTION TO THE SECOND TEMPERATURE SENSOR MAY NOT BE IN SUFFICIENT TIME TO TRIGGER THE FDA ALARM.
- 5) LOSS OF ABILITY OF GROUND PERSONNEL TO RECEIVE DOWNLINKED TEMPERATURE MEASUREMENT DATA - LOSS OF ABILITY TO DETECT HEATER SYSTEM FAILURES AND INFORM CREW TO PERFORM CORRECTIVE ACTION. POSSIBLE INJURY TO CREW DUE TO BURNS UPON CONTACT WITH STRUCTURE HEATED ABOVE HOT TOUCH TEMPERATURE (113 DEG.F).

CASE 2:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE
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POSSIBLE LOSS OF CREW/VEHICLE AFTER FIVE FAILURES:

- 1) GENERAL PURPOSE RELAY FAILS CLOSED - LOSS OF ABILITY TO DE-ENERGIZE THE AFFECTED HEATER CIRCUITS.
- 2) ZONE 3 (KEEL) CONTROL THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO CONTROL THE AFFECTED HEATERS BETWEEN THE SET POINT TEMPERATURES (55 TO 75 DEG. F).
- 3) ASSOCIATED ZONE 3 OVER TEMPERATURE THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO AUTOMATICALLY DE-ENERGIZE THE CIRCUIT WHEN UPPER SET TEMPERATURE IS REACHED. AFFECTED HEATER FAILS ON.
- 4) ERRONEOUS OUTPUT OF TEMPERATURE SENSOR INDICATING LOWER THAN ACTUAL TEMPERATURE WHICH WILL NOT TRIGGER THE FDA ALARM WHEN THE HEATER ZONE 3 TEMPERATURE SENSOR RISES ABOVE 113 DEG. F (UPPER FDA LIMIT).
- 5) LOSS OF ABILITY OF GROUND PERSONNEL TO RECEIVE DOWNLINKED TEMPERATURE MEASUREMENT DATA - LOSS OF ABILITY TO DETECT HEATER SYSTEM FAILURES AND INFORM CREW TO PERFORM CORRECTIVE ACTION. POSSIBLE LOSS OF RUSSIAN AVIONICS ON PALLET DUE TO THE EXCEEDANCE OF THE UPPER CERTIFICATION TEMPERATURE LIMIT (122 DEG. F MAXIMUM DURING OPERATION) RESULTING IN LOSS OF NOMINAL 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 2:

AFTER THE FIFTH FAILURE, THE CREW WOULD PERFORM IFM TO DRIVE THE HOOK MOTORS. IF THE IFM IS NOT SUCCESSFUL (SIXTH 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 (SEVENTH 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: HOURS

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: HOURS

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

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

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DESIGN FAULT TOLERANCE: ASSOCIATED CONTROL THERMOSTAT WILL MAINTAIN TEMPERATURE WITHIN LIMITS WHILE THE OVER TEMPERATURE THERMOSTAT WILL DE-ENERGIZE THE POWER CIRCUIT TO THE HEATERS WHEN THE UPPER SET TEMPERATURE IS REACHED.

HAZARD REPORT NUMBER(S): CASE 1: ORBI 404 (STATUS - OPEN), CASE 2: ORBI 401

HAZARD(S) DESCRIPTION:

CASE 1: IVA CREW HAZARDS DUE TO ISS ODS (CAUSE D - HOT SPOTS).
CASE 2: INABILITY TO SAFELY SEPARATE ORBITER FROM A MATED ELEMENT.

- APPROVALS -

SS&PAE
DESIGN ENGINEERING

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