

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE  
NUMBER: M5-6SS-0903 -X**

**SUBSYSTEM NAME: ISS DOCKING SYSTEM**

**REVISION: 0      02/27/98**

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**PART DATA**

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|     | <b>PART NAME</b>   | <b>PART NUMBER</b>   |
|-----|--------------------|----------------------|
|     | <b>VENDOR NAME</b> | <b>VENDOR NUMBER</b> |
| LRU | :HEATER (ZONE 1)   | MC363-0038-0101      |
| LRU | :HEATER (ZONE 2)   | MC363-0038-0102      |

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

HEATER, 3.25 WATT (ZONE 1), 6.5 WATT (ZONE 2) - EXTERNAL AIRLOCK WATER LINE HEATERS

**REFERENCE DESIGNATORS:** 40V64HR7  
40V64HR8  
40V64HR9  
40V64HR10  
40V64HR11  
40V64HR12  
40V64HR14  
40V64HR15

**QUANTITY OF LIKE ITEMS:** 8  
(SIX - 3.25 WATT, TWO - 6.5 WATT))

**FUNCTION:**

PROVIDE REQUIRED HEAT TO PREVENT WATER LINES FROM FREEZING.

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

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

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SUBSYSTEM NAME: ISS DOCKING SYSTEM

LRU: N/A

ITEM NAME: HEATER (ZONE 1) / HEATER (ZONE 2)

CRITICALITY OF THIS

FAILURE MODE: 1R3

## FAILURE MODE:

FAIL SHORTED (LINE TO LINE)

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 1R1 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 AT LEAST TWO REMAINING PATHS ARE READILY DETECTABLE IN FLIGHT.

C)

## - FAILURE EFFECTS -

## (A) SUBSYSTEM:

LOSS OF ABILITY OF THE AFFECTED HEATER ELEMENT TO PROVIDE HEAT

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

FIRST FAILURE - NO EFFECT. THE SECOND ENERGIZED HEATER CIRCUIT MAINTAINS REQUIRED TEMPERATURE.

**(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:

- 1.2) FIRST HEATER ELEMENT ON WATER LINE 1 FAILS SHORT (LINE TO LINE SHORT REQUIRES FAILURE OF INSULATOR FOR EACH HEATING ELEMENT) - NO EFFECT. SECOND ENERGIZED HEATER ON LINE MAINTAINS REQUIRED TEMPERATURE.
- 3) SECOND ENERGIZED HEATER ELEMENT ON WATER LINE 1 FAILS OPEN - TEMPERATURE OF WATER LINES DECREASES BELOW LOWER TEMPERATURE LIMIT. CREW ALERTED BY FDA ALARM. CREW MEMBER MUST SWITCH IN THIRD HEATER STRING.
- 4) THIRD HEATER ELEMENT ON LINE 1 FAILS OPEN - LOSS OF CAPABILITY TO HEAT ONE OR MORE OF THE SEVEN WATER LINES. THIS MAY LEAD TO WATER FREEZING IN AFFECTED LINE RESULTING IN POSSIBLE LOSS OF NOMINAL WATER SUPPLY TO EMU'S. WORST CASE IF FAILURE OCCURS FOLLOWING AN INITIAL EVA. THEN LOSS OF WATER SUPPLY TO REFILL THE EMU SUBLIMATOR FOR BOTH EMU'S WOULD PRECLUDE SUBSEQUENT EVA CAPABILITIES.
- 5) A FAILURE NECESSITATING 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.

**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 (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM CONTINGENCY EVA (SIXTH FAILURE) TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE.

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- TIME FRAME -

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FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL FAILURE MODE  
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TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: HOURS

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:  
FDA ALARM INDICATING WATER LINE TEMPERATURE BELOW LOWER LIMIT AFTER  
SECOND HEATER ELEMENT ON WATER LINE 1 FAILS OPEN WILL ALERT CREW TO SWITCH  
IN THIRD HEATER STRING.

HAZARD REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:  
N/A

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- APPROVALS -

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SS&PAE  
DESIGN ENGINEER

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C. J. Arroyo