PRINT DATE: 04/11/98

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

SUBSYSTEM NAME: ISS DOCKING SYSTEM

REVISION: 0 02/27/98

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
LRU	:HEATER (ZONE 1)	MC363-0038-0101
LRU	:HEATER (ZONE 2)	MC363-0038-0102

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
NUMBER: M5-6SS-0903-03

REVISION#: 0 02/27/98

SUBSYSTEM NAME: ISS DOCKING SYSTEM
LRU: N/A
ITEM NAME: HEATER(ZONE 1)/ HEATER(ZONE 2)

CRITICALITY OF THIS FAILURE MODE: 1R3

FAILURE MODE:
SHORT TO STRUCTURE (GROUND), SHORT (END TO END)

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 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 TEMPERATURE SENSOR TELEMETRY DATA. UNDER NORMAL OPERATING CONDITIONS, TEMPERATURE SENSOR READINGS FOR EACH ZONE WILL RISE AND FALL TOGETHER. IF A SHORT TO STRUCTURE EXISTS, THEN ONE TEMPERATURE SENSOR READING WILL BEGIN TO CLIMB ABOVE THE NORMAL MAXIMUM VALUE WHILE THE SECOND TEMPERATURE SENSOR WILL FALL BELOW THE NORMAL RANGE UNTIL A SIGNIFICANT GAP DEVELOPS BETWEEN THE TWO TEMPERATURE SENSORS.

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CORRECTING ACTION: MANUAL

CORRECTING ACTION DESCRIPTION:
USING PROCESS OF ELIMINATION, DETERMINE WHICH OF TWO ENERGIZED HEATER CIRCUITS IS AFFECTED, AND REMOVE POWER USING CIRCUIT BREAKER. TURN ON THIRD CIRCUIT USING CIRCUIT BREAKER.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF REDUNDANCY TO PROVIDE HEAT TO THE EXTERNAL AIRLOCK WATER LINES

(B) INTERFACING SUBSYSTEM(S):
FIRST FAILURE - NO EFFECT. THE REMAINING HEATER CIRCUITS CAN PROVIDE THE REQUIRED HEAT.

(C) MISSION:
FIRST FAILURE - NO EFFECT

(D) CREW, VEHICLE, AND ELEMENT(S):
FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:
CASE 1, HEATER SHORT (END TO END):
POSSIBLE LOSS OF CREW/VEHICLE AFTER FOUR FAILURES:

1) SHORT (END TO END) IN HEATER STRING 1 - NO EFFECT. SECOND ENERGIZED HEATER CIRCUIT CAN PROVIDE THE REQUIRED HEAT.
2) THERMOSTAT FAILS OPEN IN HEATER STRING 2 - ONE OR MORE TEMPERATURE SENSORS INDICATES A DECREASE BELOW LOWER TEMPERATURE LIMIT. CREW ALERTED BY FDA ALARM. CREW MEMBER MUST SWITCH IN THIRD HEATER STRING.
3) THERMOSTAT FAILS OPEN IN HEATER STRING 3 - LOSS OF CAPABILITY TO HEAT ONE OR MORE WATER LINES. WATER IN AFFECTED LINES MAY FREEZE. WORST CASE OF 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.
4) 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.

CASE 2, HEATER SHORT TO STRUCTURE (GROUND):
POSSIBLE LOSS OF CREW/VEHICLE AFTER FIVE FAILURES:

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1,2) SHORT TO STRUCTURE (REQUIRES TWO FAILURES - DIELECTRIC BREAKDOWN OF INSULATION AND OUTER SHEATH) IN HEATER STRING 1 - NO EFFECT. SECOND ENERGIZED HEATER CIRCUIT CAN PROVIDE THE REQUIRED HEAT.
3) THERMOSTAT FAILS OPEN IN HEATER STRING 2 - ONE OR MORE TEMPERATURE SENSORS INDICATES A DECREASE BELOW LOWER TEMPERATURE LIMIT. CREW ALERTED BY FDA ALARM. CREW MEMBER MUST SWITCH IN THIRD HEATER STRING.
4) THERMOSTAT FAILS OPEN IN HEATER STRING 3 - LOSS OF CAPABILITY TO HEAT ONE OR MORE WATER LINES. WATER IN AFFECTED LINES MAY FREEZE. WORST CASE OF 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.

CASE 1:
AFTER THE FOURTH FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM CONTINGENCY EVA (FIFTH FAILURE) TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE.

CASE 2:
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.

- TIME FRAME -

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:

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USING THE PROCESS OF ELIMINATION, IT CAN BE DETERMINED WHICH OF THE TWO ENERGIZED HEATER CIRCUITS IS AFFECTED. POWER CAN BE REMOVED BY OPENING THE CIRCUIT BREAKER. THE THIRD HEATER CIRCUIT IS ENERGIZED BY CLOSING ITS CIRCUIT BREAKER.

HAZARD REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:
NONE

- APPROVALS -

SS&PAE	: T. K. KIMURA	: J. Kimura 4-13-98
DESIGN ENGINEERING	: C. J. ARROYO	: