

## FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M5-SMB-2027-G -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO. GENERIC

REVISION: 9 04/16/96

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**PART DATA**


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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: PANEL R1A2	V070-730276
LRU	: PANEL A15	V070-730372
LRU	: PANEL A11A1	V070-730732
SRU	: SWITCH, TOGGLE, 3P3P	ME452-0102-7306

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

SWITCH, TOGGLE, 3P3P, MAINTAINED ON - LH2 TANKS 1 THRU 9 HEATER "A" AND "B" CONTROL

REFERENCE DESIGNATORS:

- 32V73A1A2S11
- 32V73A1A2S12
- 32V73A1A2S19
- 32V73A1A2S20
- 32V73A1A2S24
- 32V73A1A2S25
- 36V73A11A1S4
- 36V73A11A1S5
- 36V73A15S7
- 36V73A15S8
- 36V73A15S16
- 36V73A15S17
- 36V73A15S21
- 36V73A15S22
- 36V73A15S26
- 36V73A15S27
- 36V73A15S31
- 36V73A15S32

**QUANTITY OF LIKE ITEMS:**

TWO PER LH2 TANK HEATER SYSTEM

**FUNCTION:**

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PROVIDES MANUAL CONTROL OF POWER TO THE LH2 TANK HEATER ELEMENTS "A"  
AND "B" FOR THE "AUTO/OFF/ON" MODES.

## FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE

NUMBER: M5-6MB-2027-G- 03

REVISION#: 9 04/16/96

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC

LRU: PANEL R1A2

CRITICALITY OF THIS

ITEM NAME: SWITCH, TOGGLE, 3P3P

FAILURE MODE: 1R3

## FAILURE MODE:

FAILS CLOSED IN "AUTO" POSITION

MISSION PHASE:        PL    PRE-LAUNCH  
                           LO    LIFT-OFF  
                           OO    ON-ORBIT  
                           DO    DE-ORBIT  
                           LS    LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:    102    COLUMBIA  
     103    DISCOVERY  
     104    ATLANTIS  
     105    ENDEAVOUR

## CAUSE:

PIECE PART STRUCTURAL FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN        A) PASS  
                                   B) FAIL  
                                   C) PASS

## PASS/FAIL RATIONALE:

A)

B)

REDUNDANCY SCREEN "B" FAILS BECAUSE THE TANK HEATER CONTROL SWITCH IS NORMALLY IN THE "AUTO" POSITION DURING CRYO TANK USE. FAILURE CANNOT BE DETECTED UNTIL SWITCH IS OPERATED.

C)

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
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**(A) SUBSYSTEM:**

DEGRADATION OF REDUNDANCY AGAINST CONTINUOUS POWERING OF A TANK HEATER.

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

LOSS OF ABILITY TO COMMAND THE AFFECTED LH2 TANK HEATERS TO "MANUAL" MODE OR TO THE "OFF" STATE. THE MINIMUM TIME REQUIRED FOR TANK RUPTURE TO OCCUR EXCEEDS 35 HOURS STARTING FROM WHEN THE AFFECTED TANK RESIDUAL LEVEL IS REACHED. POWER-DOWN OF THE ASSOCIATED MAIN BUS PRECLUDES THE CONTINUOUS ENERGIZING OF THE AFFECTED HEATERS.

**(C) MISSION:**

NO EFFECT - FIRST FAILURE

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

NO EFFECT - FIRST FAILURE

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

POSSIBLE LOSS OF CREW/VEHICLE DUE TO THE FOLLOWING SCENARIO:

(FOR LH2 TANKS 1, 2 & 4) 1) SWITCH FAILS CLOSED IN THE "AUTO" POSITION - NO EFFECT, 2) ASSOCIATED OUTPUT HDC IN THE "AUTO" MODE CONTROL CIRCUIT FAILS "ON" - AFFECTED LH2 TANK HEATER FAILS "ON", AND 3) RELIEF PORT PLUGGED, . . .

(FOR LH2 TANKS 3 & 5) STEPS 1 THRU 3 ABOVE, AND 4) SECOND RELIEF PORT PLUGGED, . . .

(FOR LH2 TANKS 6 THRU 9) STEPS 1 THRU 4 ABOVE, AND 5) PALLET MDCA MOTORIZED SWITCH WHICH SUPPLIES DC POWER TO THE PALLET FAILS CLOSED, . .

RESULTING IN OVERPRESSURE AND POSSIBLE TANK RUPTURE.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

**(B) TEST:**

GROUND TURNAROUND TEST

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ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD. THE OMRSD DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE. IF THERE IS ANY DISCREPANCY BETWEEN THE GROUND TESTING DATA PROVIDED BELOW AND THE OMRSD, THE OMRSD IS THE MORE ACCURATE SOURCE OF THE DATA.

SWITCH IS VERIFIED INFLIGHT DURING LH2 TANK HEATER CABIN SWITCH TEST. PERFORM GROUND TURNAROUND TEST.

(TANKS 1-5) WHEN VALID VERIFICATION IS UNOBTAINABLE IN FLIGHT.

(TANKS 8-9) PRIOR TO FIRST EDO FLIGHT. WHEN VALID VERIFICATION IS UNOBTAINABLE IN FLIGHT.

**(C) INSPECTION:**

REFER TO APPENDIX A, ITEM NO. 1 - TOGGLE SWITCH

**(D) FAILURE HISTORY:**

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED IN APPENDIX A IS NO LONGER BEING KEPT UP-TO-DATE.

**(E) OPERATIONAL USE:**

PER FLIGHT RULE 9-581F A CRYO HEATER THAT CONTINUES TO BE POWERED AFTER PLACING ITS CORRESPONDING SWITCH IN THE "OFF" POSITION WILL BE DEACTIVATED BY PERFORMING ONE OF THE FOLLOWING (CIL):

1. AN H2 HEATER WILL BE DEACTIVATED BY DROPPING THE MAIN BUS THAT POWERS THE HEATER. THE MAIN BUS WILL BE BROUGHT UP FOR ENTRY IF THE TANK QUANTITY ALLOW CONTINUOUS HEATER OPERATION WITHOUT VIOLATING HEATER TEMPERATURE LIMITS.
2. THE CREW CAN PERFORM THE PROCEDURE "CRYO TANK HEATER FUSE REMOVAL" LOCATED IN THE INFLIGHT MAINTENANCE (IFM) CHECKLIST. THE PROCEDURE WILL OPEN THE AFFECTED PANEL (R1, A11 OR A15) AND REMOVE THE TWO AFFECTED FUSES THAT ALLOW CONTROL BUS POWER TO THE DOWNSTREAM RPC'S IN THAT HEATER CIRCUIT. EITHER PROCEDURE WILL BE GIVEN THE SAME PRIORITY IN TROUBLESHOOTING - I.E. BOTH ARE UNDESIRABLE AND MAY/WILL HAVE AFFECTS ON ADDITIONAL ORBITER SYSTEMS.

- APPROVALS -

PAE MANAGER	: P. STENGER-NGUYEN	<i>P. Stenger-Nguyen</i>
PRODUCT ASSURANCE ENGR	: J. NGUYEN	<i>J. Nguyen</i>
DESIGN ENGINEERING	: T. D. NGUYEN	<i>T. D. Nguyen</i>
EDITORIALLY APPROVED	: JSC	<i>J. S. Casey</i>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	95-CIL-012_M5-6MB