

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1SS-BM006-X
 (DOESNT APPLY TO PMA2/3
 PASSIVE MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: GUIDE RING ASSEMBLY RSC-ENERGIA	33U.6271.011-09(SOFT) 33U.6271.011-05 (PMA1)
SRU	: ASSEMBLY, CAPTURE LATCH RSC-ENERGIA	33U.6322.025 33U.6322.025

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
 CAPTURE LATCH ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
 THREE (ONE PER GUIDE PEDAL)

FUNCTION:

THREE ACTIVE (CAPTURE) LATCHES, ONE ON EACH GUIDE PEDAL OF THE ORBITER DOCKING RING. PROVIDES POSITIVE CAPTURE TO THREE PASSIVE (BODY MOUNTED) LATCHES LOCATED ON THE ISS DOCKING MECHANISM. CAPTURE LATCH ROLLER MECHANISMS MOVE ASIDE DURING CLOSING CONTACT WITH THEIR OPPOSING BODY MOUNTED LATCHES AND ARE SPRING DRIVEN TO LOCK AFTER PASSING THE THREE PASSIVE BODY LATCHES (LUGS). TWO ROLLER MECHANISMS LOCATED ON EACH CAPTURE LATCH ASSEMBLY PROVIDE A REDUNDANT MEANS OF CAPTURE.

UPON RECEIPT OF A "CLOSE CAPTURE LATCH" COMMAND, POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR OPEN" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO EXTEND BOTH ROLLERS OF ONE CAPTURE LATCH ASSEMBLY. A "LATCH INDICATION CLOSED" SENSOR ON EACH ACTUATOR SENSES THE CLOSED POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DOCKING CONTROL PANEL VIA THE DSCU TO ILLUMINATE THE "LATCHES CLOSED" LIGHT WHEN ALL THREE CAPTURE LATCHES ARE CLOSED.

UPON RECEIPT OF AN "OPEN CAPTURE LATCH" COMMAND (FOLLOWING COMPLETION OF THE DOCKING PROCESS), POWER IS APPLIED THROUGH REDUNDANT "LATCH MOTOR CLOSED" SENSOR CONTACT SETS TO A SINGLE ACTUATOR MOTOR TO RETRACT BOTH ROLLERS OF THE CAPTURE LATCH ASSEMBLY FOR UNDOCKING OF THE ISS AND ORBITER (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 MECHANISM). A "LATCH INDICATION OPEN" SENSOR LOCATED ON EACH CAPTURE LATCH ACTUATOR SENSES THE OPEN POSITION OF THE LATCH AND SENDS REDUNDANT SIGNALS TO THE DSCU TO ILLUMINATE THE "LATCHES OPEN" INDICATOR LIGHT ON THE DOCKING

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CONTROL PANEL AND COMMAND RING TO RETRACT WHEN THE SENSOR ON ALL THREE CAPTURE LATCH ACTUATORS IS CLOSED.

THE THIRD CONTACT SET OF EACH "LATCH INDICATION OPEN" AND "LATCH INDICATION CLOSED" SENSOR IS UTILIZED FOR GROUND MONITORING OF CAPTURE LATCH POSITION. CAPTURE LATCH "INITIAL POSITION" IS ALSO DOWNLINKED FOR GROUND MONITORING.

IN THE EVENT A CAPTURE LATCH FAILS TO OPEN, THE MANUAL LATCH/UNBLOCKING DEVICE CONTAINED BEHIND THE CAPTURE LATCH ASSEMBLY WILL PROVIDE MANUAL RELEASE OF THE LATCH. A BUTTON ON EACH SIDE OF THE DEVICE, WHEN DEPRESSED SIMULTANEOUSLY, WILL RELEASE LATCH CONTROL BY THE LATCH ACTUATOR, THUS ALLOWING BOTH CAPTURE LATCH ROLLERS TO RETRACT TO THEIR OPEN POSITION.

**SERVICE IN BETWEEN FLIGHT AND MAINTENANCE CONTROL:
VISUAL INSPECTION, SERVICEABILITY CONTROL, DOCKING WITH CALIBRATING DOCKING MECHANISM.**

MAINTAINABILITY

REPAIR METHOD - REPLACEMENT.

**REFERENCE DOCUMENTS: 33U.6322.025
33U.6271.011-09 ("SOFT")
33U.6271.011-05 (PMA1)**

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

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REVISION# 1 DEC, 1996

**SUBSYSTEM NAME: MECHANICAL - EDS
LRU: GUIDE RING ASSEMBLY
ITEM NAME: ASSEMBLY, CAPTURE LATCH**

**CRITICALITY OF THIS
FAILURE MODE: 1R3**

FAILURE MODE:

ONE CAPTURE LATCH MOTOR "OPEN" SENSOR CONTACT SET FAILS CLOSED OR SHORTS TO GROUND

MISSION PHASE:

OO ON-ORBIT

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

CAUSE:

CONTAMINATION, PIECE PART STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK, VIBRATION, OR MANUFACTURER/MATERIAL DEFECT

CRITICALITY 1/1 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)

N/A - AT LEAST TWO REMAINING PATHS ARE DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:

NONE INITIALLY. ALTERNATING OPEN AND CLOSED CAPTURE LATCH INDICATIONS WHEN POWER IS NORMALLY OR INADVERTENTLY APPLIED TO A CAPTURE LATCH ACTUATOR MOTOR.

CORRECTING ACTION: NONE FOR FIRST FAILURE. IF MULTIPLE FAILURES RESULT IN TWO CAPTURE LATCHES INADVERTENTLY OPENING DURING RING ATTENUATION, CREW COULD OPEN ONE REMAINING CAPTURE LATCH AND FIRE RCS JETS (APPLIES ONLY TO THE ORBITER) TO ENABLE SEPARATION.

REMARKS/RECOMMENDATIONS:

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REDUNDANT CONTACT SETS ARE PROVIDED WITHIN THE MOTOR "OPEN" SENSOR. ONLY ONE "FAILED CLOSED" CONTACT SET IS REQUIRED, ALONG WITH AN INADVERTENT APPLICATION OF POWER, TO CAUSE AN INADVERTENT OPENING OF AFFECTED CAPTURE LATCH. IT TAKES TWO ELECTRICAL FAILURES TO INADVERTENTLY APPLY POWER TO ALL THREE CAPTURE LATCH MOTOR "OPEN" SENSORS.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

A GROUND IS INADVERTENTLY APPLIED TO THE "CLOSED" WINDINGS OF THE AFFECTED CAPTURE LATCH MOTOR. AFFECTED CAPTURE LATCH WILL CYCLE OPEN AND CLOSED WHEN POWER IS NORMALLY OR INADVERTENTLY APPLIED TO CAPTURE LATCH MOTOR. (POWER CAN BE INADVERTENTLY APPLIED TO THE ACTUATOR MOTOR DUE TO AN ADDITIONAL TWO ELECTRICAL FAILURES.)

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING ORBITER SUBSYSTEMS GIVEN THIS FAILURE. HOWEVER, IF THIS FAILURE WERE TO OCCUR ALONG WITH A SIMILAR FAILURE OF A LATCH MOTOR "OPEN" SENSOR ON SECOND CAPTURE LATCH AND TWO ADDITIONAL ELECTRICAL FAILURES RESULTING IN POWER BEING APPLIED TO ALL THREE CAPTURE LATCHES, THEN TWO CAPTURE LATCHES WOULD CYCLE OPEN AND CLOSED. A CYCLING OPEN OF TWO CAPTURE LATCHES DURING RING ATTENUATION COULD POTENTIALLY CAUSE ORBITER/PMA1 AND ISS TO COLLIDE RESULTING IN STRUCTURAL DAMAGE TO THE ORBITER/PMA1 ASSEMBLY.

(C) MISSION:

NO EFFECT ON INITIAL DOCKING. PRIOR TO SECOND DOCKING IF FAILURE OCCURS WHEN "OPEN" POWER IS NORMALLY APPLIED TO CAPTURE LATCH ACTUATOR MOTOR, CONTINUOUS CYCLING OF CAPTURE LATCH OPEN AND CLOSED COULD PREVENT ONE CAPTURE LATCH FROM LATCHING TO ITS OPPOSING ISS BODY MOUNTED LATCH. WITH ONLY TWO CAPTURE LATCHES CLOSED RING RETRACTION IS POSSIBLE BUT MATING OF THE TWO DOCKING MECHANISMS FOR STRUCTURALLY LATCHING OF THE INTERFACE IS QUESTIONABLE. WORST CASE, LOSS OF STRUCTURAL LATCHING CAPABILITIES AND SUBSEQUENT LOSS OF MISSION OBJECTIVES.

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

POTENTIAL LOSS OF CREW OR VEHICLE DUE TO UNCONTROLLED CLOSING PARAMETERS FOLLOWING FIFTH FAILURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST FAILURE (MOTOR "OPEN" SENSOR CONTACT SET FAILS CLOSED) - A GROUND IS INADVERTENTLY APPLIED TO THE "CLOSED" WINDINGS OF THE AFFECTED CAPTURE LATCH MOTOR. PRIOR TO SECOND DOCKING IF FAILURE OCCURS WHEN "OPEN" POWER IS NORMALLY APPLIED TO CAPTURE LATCH ACTUATOR MOTOR, CONTINUOUS CYCLING OF CAPTURE LATCH OPEN AND CLOSED COULD PREVENT ONE CAPTURE LATCH FROM LATCHING TO ITS OPPOSING ISS BODY MOUNTED LATCH. WITH ONLY TWO CAPTURE LATCHES CLOSED RING RETRACTION IS POSSIBLE BUT MATING OF THE TWO DOCKING MECHANISMS FOR STRUCTURALLY LATCHING OF THE INTERFACE IS QUESTIONABLE. WORST CASE, LOSS OF STRUCTURAL LATCHING CAPABILITIES AND SUBSEQUENT LOSS OF MISSION OBJECTIVES. - CRITICALITY 2/2 CONDITION.

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SECOND AND THIRD FAILURES (TWO ELECTRICAL FAILURES RESULTING IN POWER TO THE AFFECTED CAPTURE LATCH ACTUATOR MOTOR) - AFFECTED CAPTURE LATCH WILL CYCLE OPEN AND CLOSED WHEN NOT REQUIRED.

FOURTH FAILURE (MOTOR "OPEN" SENSOR CONTACT SET FAILS CLOSED ON SECOND CAPTURE LATCH) OCCURS DURING RING ATTENUATION - INADVERTENT OPENING OF TWO CAPTURE LATCHES. WORST CASE, IF FAILURE OCCURS DURING RING ATTENUATION, A POTENTIAL COLLISION BETWEEN ORBITER/PMA1 AND ISS EXISTS.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

FIFTH FAILURE - INABILITY TO FIRE RCS (APPLIES ONLY TO THE ORBITER). CREW IS UNABLE TO STOP A POTENTIAL COLLISION BETWEEN ORBITER AND ISS. WORST CASE, DAMAGE RESULTING FROM COLLISION COULD RESULT IN LOSS OF CREW AND VEHICLE.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: SECONDS

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

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:

CREW HAS AMPLE TIME TO FIRE RCS JETS (APPLIES ONLY TO THE ORBITER) TO AVOID A POTENTIAL COLLISION BETWEEN ORBITER AND ISS.

HAZARDS REPORT NUMBER(S): ORBI 402B

HAZARD(S) DESCRIPTION:

UNCONTROLLED/INADVERTENT COLLISION BETWEEN ORBITER AND ISS.

- APPROVALS -

PRODUCT ASSURANCE ENGR. : M. NIKOLAYEVA
DESIGN ENGINEER : E. BOBROV

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