

## 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**

NUMBER: M8-1SS-BM006- 12  
 (DOESN'T APPLY TO PMA2/3  
 PASSIVE MECHANISM)

REVISION# 1 DEC, 1996

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

CRITICALITY OF THIS  
 FAILURE MODE: 1R3

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**FAILURE MODE:**

ONE CAPTURE LATCH MOTOR "CLOSED" SENSOR CONTACT SET FAILS OPEN

**MISSION PHASE:**

OO ON-ORBIT

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

**CAUSE:**

CONTAMINATION, STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR  
 MANUFACTURE/MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO

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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:**

VISUAL OBSERVATION - AFFECTED CAPTURE LATCH FAILS TO OPEN FOLLOWING "OPEN"  
 COMMANDS FROM THE AVIONICS OR DOCKING CONTROL PANEL - LOSS OF "LATCH  
 OPEN" INDICATION ON DOCKING CONTROL PANEL. CREW COULD VISUALLY DETERMINE  
 POSITION OF CAPTURE LATCHES DURING IVA.

**CORRECTING ACTION:** NONE GIVEN A FAILURE OF THE FIRST CONTACT SET. CREW  
 COULD RELEASE A CLOSED CAPTURE LATCH USING IT'S MANUAL LATCH/UNBLOCKING  
 DEVICE FOLLOWING SECOND CONTACT SET FAILURE. SEPARATION CAN BE POSSIBLE  
 WITH A SINGLE CLOSED CAPTURE LATCH BY EXTENDING THE DOCKING RING (NOMINAL  
 UNDOCKING IS NOT PLANNED TO PMA1 ASSEMBLY). ALL CAPTURE LATCHES MUST BE  
 OPEN TO ENSURE SEPARATION WHEN THE DOCKING RING IS IN IT'S FULLY RETRACTED  
 POSITION. A FAILURE TO OPEN ONE OR MORE CAPTURE LATCHES WOULD REQUIRE  
 CREW TO STRUCTURAL LATCH BOTH MECHANISMS AND PERFORM EVA TO REMOVE THE

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE**  
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**PASSIVE MECHANISM)**

96 BOLTS HOLDING THE DOCKING BASE TO THE EXTERNAL AIRLOCK (APPLIES ONLY TO THE ORBITER MECHANISM). THIS WILL ALLOW ORBITER/ISS SEPARATION.

**REMARKS/RECOMMENDATIONS:**

REDUNDANT CONTACT SETS PROVIDE POWER TO A SINGLE ACTUATOR MOTOR TO OPEN ONE CAPTURE LATCH ASSEMBLY. ONLY ONE CONTACT SET IS REQUIRED TO ENABLE POWER TO THE MOTOR. CAPTURE LATCHES ARE OPENED (RETRACTED) UPON COMPLETION OF THE DOCKING PROCESS AND MUST BE OPEN PRIOR TO SEPARATION OF BOTH MECHANISMS (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 ASSEMBLY).

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

FIRST CONTACT SET FAILURE - NO EFFECT. SECOND CONTACT SET FAILURE - "OPEN LATCH" POWER TO AFFECTED CAPTURE LATCH ACTUATOR MOTOR IS LOST. AFFECTED CAPTURE LATCH CANNOT BE OPENED AUTOMATICALLY (USING AVIONICS) OR REMOTELY (USING DOCKING CONTROL PANEL). CAPTURE LATCH WOULD THEN HAVE TO BE MANUALLY OPENED USING ITS MANUAL LATCH/UNBLOCKING DEVICE.

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

NO EFFECT ON INTERFACING SUBSYSTEMS.

**(C) MISSION:**

NO EFFECT ON DOCKED MISSION OBJECTIVES SINCE OPENING OF CAPTURE LATCHES IS NOT REQUIRED UNTIL MISSION OBJECTIVES ARE MET AND ORBITER/ISS SEPARATION IS REQUIRED ( AND NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 MECHANISM).

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

NO EFFECT FIRST AND SECOND CONTACT SET FAILURE. INABILITY TO NOMINALLY SEPARATE ORBITER AND ISS FOLLOWING FAILURE TO MANUALLY OPEN ONE OR MORE CAPTURE LATCHES COULD RESULT IN LOSS OF CREW AND VEHICLE (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 ASSEMBLY).

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

FIRST FAILURE (ONE CONTACT SET ON LATCH MOTOR "CLOSED" SENSOR FAILS OPEN) - NO EFFECT. SECOND FAILURE (REMAINING CONTACT SET ON LATCH MOTOR "CLOSED" SENSOR FAILS OPEN) - AFFECTED CAPTURE LATCH CANNOT BE OPENED AUTOMATICALLY (USING AVIONICS) OR REMOTELY (USING DOCKING CONTROL PANEL). THIRD FAILURE (MANUAL LATCH/UNBLOCKING DEVICE FAILS TO RELEASE FAILED CLOSED CAPTURE LATCH) - WORST CASE, FOR ORBITER (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 ASSEMBLY), WHEN RING IS FULLY RETRACTED, ORBITER AND ISS CANNOT BE NOMINALLY SEPARATED. ATTEMPTED SEPARATION WITH CAPTURE LATCHES CLOSED, WITH RING FULLY RETRACTED, COULD DAMAGE ORBITER AND/OR ISS DOCKING HARDWARE.

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

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

FOURTH FAILURE (INABILITY TO EXTEND DOCKING RING) - UNABLE TO ENABLE SEPARATION FOR ORBITER WITH A SINGLE CLOSED CAPTURE LATCH.

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**PASSIVE MECHANISM)**

FIFTH FAILURE - INABILITY TO EVA TO REMOVE 96 BOLTS (APPLIES ONLY TO THE ORBITER MECHANISM) - WORST CASE, INABILITY TO SEPARATE ORBITER FROM ISS RESULTING IN LOSS OF CREW/VEHICLE.

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**- TIME FRAME -**

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**TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS**

**TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS**

**TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: MINUTES TO HOURS**

**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 EXTEND DOCKING RING TO ENABLE SEPARATION (NOMINAL UNDOCKING IS NOT PLANNED TO PMA1 ASSEMBLY) WITH A SINGLE CLOSED CAPTURE LATCH OR PERFORM AN EVA TO REMOVE THE 96 BOLTS HOLDING THE DOCKING BASE TO THE EXTERNAL AIRLOCK BEFORE CREW/VEHICLE ARE LOST (APPLIES ONLY TO THE ORBITER MECHANISM).

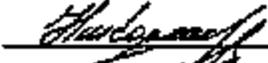
**HAZARDS REPORT NUMBER(S): ORBI 401A**

**HAZARD(S) DESCRIPTION:**  
 INABILITY TO SEPARATE ORBITER AND ISS.

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**- APPROVALS -**

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DESIGN ENGINEER	:	E. BOBROV	:	