

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

NUMBER: M8-1SS-BM001-X

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: STRUCTURAL LATCH MECHANISM RSC-ENERGIA	33U.6365.010-04 (PMA 2/3 33U.6365.010-04 ASSEMBLY) 33U.6365.010-07 ("SOFT" 33U.6365.010-07 MECH.) 33U.6365.010-08 (PMA 1 33U.6365.010-08 ASSEMBLY)
SRU	: ASSY, STRUCTURAL HOOK (SLAVE) RSC-ENERGIA	33U.6366.007-02
SRU	: ASSY, STRUCTURAL HOOK (SLAVE) RSC-ENERGIA	33U.6366.008-02
SRU	: ASSY, STRUCTURAL HOOK (DRIVE) RSC-ENERGIA	33U.6366.009-02
SRU	: ASSY, STRUCTURAL HOOK (DRIVE) RSC-ENERGIA	33U.6366.010-02

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
STRUCTURAL HOOK ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 12
TWELVE

FUNCTION:

PERFORMS OPENING AND CLOSING OF ONE ACTIVE HOOK ON ORBITER DOCKING MECHANISM TO OPPOSITE PASSIVE HOOK ON MIR DOCKING MECHANISM. TWELVE STRUCTURAL HOOK ASSEMBLIES ON ORBITER DOCKING MECHANISM ARE PROVIDED, TWO SETS OF SIX HOOK ASSEMBLIES. EACH SET IS CONTROLLED SIMULTANEOUSLY BY ONE ACTUATOR. EACH ACTUATOR IS MECHANICALLY LINKED TO ONE DRIVE STRUCTURAL HOOK ASSEMBLY. A PULLEY CONTAINED ON THE DRIVE ASSEMBLY IS MECHANICALLY LINKED TO A PULLEY ON EACH OF THE FIVE SLAVE HOOK ASSEMBLIES THROUGH A SINGLE MECHANICAL CABLE. ROTATION OF THE DRIVE HOOK ASSEMBLY PROVIDES SIMULTANEOUS ROTATION OF THE FIVE SLAVE HOOK ASSEMBLIES.

EACH STRUCTURAL HOOK ASSEMBLY CONTAINS A HOOK SENSOR OPEN SWITCH WHICH SENSES THE OPEN AND CLOSED POSITION OF THE HOOK. THIS INFORMATION IS DOWNLINKED FOR GROUND MONITORING OF EACH HOOK POSITION. THE STRUCTURAL HOOK ACTUATOR CONTAINS A "HOOK CLOSED" SENSOR, A "HOOK OPEN" SENSOR, AND A "HOOK-IN-BETWEEN" SENSOR TO MONITOR POSITION OF ONE SET OF SIX STRUCTURAL HOOKS. EACH IS DESCRIBED BELOW.

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***HOOK CLOSED* SENSOR.** THE "HOOK CLOSED" SENSOR IS USED TO ILLUMINATE ITS APPROPRIATE "HOOK 1 CLOSED" OR "HOOK 2 CLOSED" INDICATOR ON THE DOCKING CONTROL PANEL. THESE INDICATIONS ARE DOWNLINKED FOR GROUND MONITORING OF EACH SET OF LATCH HOOKS "CLOSED" POSITION. HOOK "CLOSED" SIGNAL IS ALSO UTILIZED BY THE DSCU TO TURN OFF THE STRUCTURAL HOOK ACTUATORS ONCE THE HOOKS HAVE CLOSED.

***HOOK OPEN* SENSOR.** THE "HOOK OPEN" SENSOR IS USED TO ILLUMINATE ITS APPROPRIATE "HOOK 1 OPEN" OR "HOOK 2 OPEN" INDICATOR ON THE DOCKING CONTROL PANEL. THESE INDICATIONS ARE DOWNLINKED FOR GROUND MONITORING OF EACH SET OF LATCH HOOKS "OPEN" POSITION. THESE SIGNALS ARE ALSO USED TO TURN OFF THE STRUCTURAL LATCH ACTUATOR ONCE THE HOOKS HAVE OPENED.

***HOOK-IN-BETWEEN* SENSOR.** THE "HOOK IN-BETWEEN" SENSOR IS USED TO SENSE WHEN EACH SET OF SIX LATCH HOOKS ARE IN A POSITION BETWEEN FULLY OPENED AND FULLY CLOSED. WHEN THE SENSOR IS CLOSED REDUNDANT SIGNALS ARE SENT TO THE DSCU TO STOP MOVEMENT OF THE RING AND TO DE-ENERGIZE THE FIXERS. THE "HOOK-IN-BETWEEN" SIGNAL IS NOT UTILIZED FOR IN-FLIGHT OR GROUND MONITORING PURPOSES. (IT DOESN'T APPLY TO THE PMA 2/3 PASSIVE MECHANISM).

HOOK FINAL POSITION SENSOR. A SENSOR IS CONTAINED IN EACH STRUCTURAL HOOK ASSEMBLY TO INDICATE WHEN THE HOOK HAS REACHED ITS FINAL (CLOSED) POSITION. THE DATA FROM THESE SENSORS IS NOT UTILIZED IN-FLIGHT BUT IT IS DOWNLINKED FOR GROUND MONITORING OF EACH HOOK'S POSITION.

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

MAINTAINABILITY

REPAIR METHOD - NONE (REPAIRING IN MANUFACTURING CONDITIONS ONLY).

REFERENCE DOCUMENTS: 33U.6121.036-07
33U.6201.008-05-004 (PMA 1 ASSEMBLY)
33U.6201.008-08 (PMA 2/3 ASSEMBLY)
33U.6201.008-09 ("SOFT" MECHANISM)
33U.6365.010-04 (PMA 2/3 ASSEMBLY)
33U.6365.010-07 (PMA 1 ASSEMBLY)
33U.6365.010-08 ("SOFT" MECHANISM)
33U.6365.007-02
33U.6365.008-02
33U.6365.009-02
33U.6365.010-02

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

NUMBER: M8-1SS-BMD01-10
 (DOESN'T APPLY TO PMA2/3 PASSIVE

MECHANISM)

REVISION# 1 DEC, 1996

SUBSYSTEM NAME: MECHANICAL - EDS
 LRU: STRUCTURAL LATCH MECHANISM
 ITEM NAME: ASSEMBLY, STRUCTURAL HOOK

CRITICALITY OF THIS
 FAILURE MODE: 1R3

FAILURE MODE:

ONE HOOKS "IN BETWEEN" 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, VIBRATION, OR 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 FIRST, SECOND, AND THIRD FAILURE. FOURTH FAILURE (SECOND CONTACT SET FAILURE OF SECOND SENSOR) CAN BE DETECTED THROUGH VISUAL OBSERVATION - RING CONTINUES TO MOVE AND "FIXERS OFF" INDICATOR LIGHT ON THE DOCKING CONTROL PANEL IS NOT ILLUMINATED WHEN REQUIRED. LOSS OF "LATCHES OPEN" INDICATION ON DCP SINCE CAPTURE LATCHES COULD FAIL TO OPEN AS THE RESULT OF THESE FAILURES.

CORRECTING ACTION: NONE UNTIL FAILURE OF BOTH CONTACT SETS ON BOTH ACTUATOR "IN-BETWEEN" SENSORS. THEN CREW CAN UTILIZE EACH CAPTURE LATCH MANUAL LATCH/UNBLOCKING DEVICE TO OPEN THE CAPTURE LATCHES. IF CAPTURE LATCH CANNOT BE MANUALLY OPENED, CREW COULD PERFORM EVA TO REMOVE 96 BOLTS (APPLIES ONLY TO THE ORBITER MECH.).

REMARKS/RECOMMENDATIONS:

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MECH.)

EACH SWITCH CONTAINS TWO CONTACT SETS ALL FOUR OF WHICH WOULD HAVE TO FAIL TO LOSE THE HOOK 1 AND 2 "IN BETWEEN" SIGNAL TO THE DSCU. THESE SIGNALS FROM BOTH SWITCHES ARE REQUIRED TO AUTOMATICALLY STOP RING MOVEMENT AND DE-ENERGIZE THE FIXERS.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FIRST/SECOND FAILURE (BOTH ACTUATOR 1 IN-BETWEEN SENSOR CONTACT SETS FAIL OPEN) - LOSS OF "HOOK 1 IN BETWEEN" SIGNAL TO DSCU. THIRD/FOURTH FAILURE (BOTH ACTUATOR 2 IN-BETWEEN SENSOR CONTACT SETS FAIL OPEN) - LOSS OF "HOOK 2 IN BETWEEN" SIGNAL TO DSCU AND SUBSEQUENT INABILITY TO TERMINATE RING RETRACTION.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:

NO EFFECT ON MISSION SINCE INTERFACE IS SEALED WITH CLOSING OF STRUCTURAL HOOKS.

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

NO EFFECT UNTIL MANUAL LATCH/UNBLOCKING DEVICE FAILS TO RELEASE A SINGLE CAPTURE LATCH WHILE RING IS RETRACTED. THEN NOMINAL ORBITER/ISSA SEPARATION IS QUESTIONABLE (NOMINAL UNDOCKING IS NOT PLANNED TO THE PMA1 ASSEMBLY).

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST/SECOND FAILURE (BOTH ACTUATOR 1 IN-BETWEEN SENSOR CONTACT SETS FAIL OPEN) - LOSS OF "HOOK 1 IN BETWEEN" SIGNAL TO DSCU.
 THIRD/FOURTH FAILURE (BOTH ACTUATOR 2 IN-BETWEEN SENSOR CONTACT SETS FAIL OPEN) - LOSS OF "HOOK 2 IN BETWEEN" SIGNAL TO DSCU AND SUBSEQUENT INABILITY TO TERMINATE RING RETRACTION. RING RETRACTION FORCE COULD PREVENT CAPTURE LATCHES FROM BEING POWERED OPENED.
 FIFTH FAILURE (MANUAL LATCH/UNBLOCKING DEVICE FAILS TO RELEASE ASSOCIATED CLOSED CAPTURE LATCH) - INABILITY OF ORBITER TO NOMINALLY SEPARATE FROM ISS (APPLIES ONLY TO THE ORBITER MECH.).

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

THE WORKAROUND TO PERFORM AN EVA TO REMOVE 98 BOLTS APPLIES ONLY TO THE ORBITER MECHANISM AND HAS NO EFFECT ON THE CRITICALITY OF THIS FAILURE MODE. CRITICALITY REMAINS AT 1R3.

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- TIME FRAME -

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 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 MECH.).

HAZARDS REPORT NUMBER(S): ORBI 401A

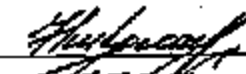
HAZARD(S) DESCRIPTION:

INABILITY TO SEPARATE ORBITER AND ISS.

- APPROVALS -

PRODUCT ASSURANCE ENGR.
DESIGN ENGINEER

: M. NIKOLAYEVA
: E. BOBROV

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