

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.6121.038-07
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

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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 "CLOSED" SENSOR CONTACT SET FAILS CLOSED

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) PASS
 C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

METHOD OF FAULT DETECTION:

ASSOCIATED DOCKING CONTROL PANEL "HOOKS 1 OR 2 CLOSED" INDICATION WOULD BE PRESENT WHEN NOT REQUIRED. TELEMETRY DATA WILL INDICATE PROPER HOOK POSITION.

MASTER MEAS. LIST NUMBERS: V53X0763E
 V53X0764E

CORRECTING ACTION: TELEMETRY DATA CAN BE UTILIZED TO DETERMINE HOOKS POSITION GIVEN A PREMATURE SHUTDOWN CONDITION ON AFFECTED STRUCTURAL HOOK ACTUATOR. IF FIRST FAILURE IS DETECTED PRIOR TO DOCKING CREW COULD DROP LOGIC BUS A TO ALLOW THE AUTOMATIC STRUCTURAL LATCHING SEQUENCE TO CONTINUE OR HAVE THE ISSA CREW CLOSE ITS TWELVE STRUCTURAL HOOKS TO INSURE STRUCTURAL/SEAL INTEGRITY BETWEEN BOTH MECHANISMS. IF FIRST FAILURE OCCURS DURING RING ATTENUATION CREW COULD STOP AUTOMATIC SEQUENCE AND CONTINUE SEQUENCE IN MANUAL MODE TO PRECLUDE AN INADVERTENT CAPTURE

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LATCH OPEN COMMAND. FOLLOWING INADVERTENT OPENING OF CAPTURE LATCHES DURING RING ATTENUATION CREW COULD FIRE RCS TO INITIATE SEPARATION.

REMARKS/RECOMMENDATIONS:

SWITCH CONTAINS THREE CONTACT SETS ONLY ONE OF WHICH WOULD HAVE TO SHORT TO GET A "HOOK 1 OR 2 "CLOSED" INDICATION ON THE DCP. THE THIRD CONTACT SET PROVIDES FOR TELEMETRY DATA. THIS SIGNAL IS ALSO UTILIZED BY THE DSCU TO TURN OFF THE STRUCTURAL LATCH ACTUATORS ONCE THE HOOKS HAVE CLOSED.

- FAILURE EFFECTS -

(A) SUBSYSTEM:

INADVERTENT "HOOKS 1 OR 2 CLOSED" SIGNAL TO DSCU. "HOOKS 1 OR 2 CLOSED" INDICATOR LIGHT ON DOCKING CONTROL PANEL IS ERRONEOUSLY ILLUMINATED. PREMATURE SHUTDOWN OF ASSOCIATED STRUCTURAL HOOK ACTUATOR RESULTING IN FAILURE TO CLOSE ONE GANG OF SIX HOOKS. ONLY SIX OF THE TWELVE STRUCTURAL HOOKS WOULD BE CLOSED.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT ON INTERFACING ORBITER SUBSYSTEMS GIVEN THIS FAILURE. HOWEVER, IF THIS FAILURE WERE TO OCCUR ALONG WITH A SHORTS TO GROUND CONDITION ON A SINGLE CONTACT SET OF ONE "READY TO HOOK" SENSOR RING WOULD EXTEND OUT FOR 10 SECONDS AND ALL THREE CAPTURE LATCHES WOULD INADVERTENTLY OPEN. AN INADVERTENT OPENING OF THE CAPTURE LATCHES DURING RING ATTENUATION COULD POTENTIALLY CAUSE ORBITER OR PMA1 AND ISSA TO COLLIDE RESULTING IN STRUCTURAL DAMAGE TO THE ORBITER.

(C) MISSION:

CREW WOULD BE AWARE THAT ONLY SIX HOOKS ARE CLOSED THROUGH TELEMETRY DATA. WORST CASE, CREW DECISION TO ABORT DOCKING WOULD RESULT IN LOSS OF MISSION OBJECTIVES.

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

NO EFFECT FIRST FAILURE. POTENTIAL LOSS OF CREW AND VEHICLE IF A SHORTS TO GROUND ON ONE "READY TO HOOK" SENSOR CONTACT SET ACCOMPANIES THIS FAILURE DURING RING ATTENUATION.

(E) FUNCTIONAL CRITICALITY EFFECTS:

FIRST FAILURE (ONE HOOKS "CLOSED" SENSOR CONTACT SET FAILS CLOSED) OCCURS PRIOR TO STRUCTURALLY LATCHING INTERFACE - PREMATURE SHUTDOWN OF ASSOCIATED STRUCTURAL HOOK ACTUATOR RESULTING IN FAILURE TO CLOSE ONE GANG OF SIX HOOKS. POSSIBLE LOSS OF MISSION FOLLOWING FAILURE TO UTILIZE TWELVE ISSA HOOKS.

SECOND FAILURE (ONE "READY TO HOOK" SENSOR CONTACT SET SHORTS TO GROUND) ACCOMPANIES FIRST FAILURE DURING RING ATTENUATION - INADVERTENT OPENING OF ALL THREE CAPTURE LATCHES RESULTING IN POTENTIAL COLLISION BETWEEN ORBITER AND ISSA

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:

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

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES TO HOURS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: SECONDS

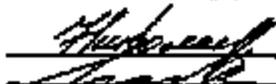
**IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
YES**

**RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
CREW HAS AMPLE TIME TO FIRE RCS JETS TO AVOID A POTENTIAL COLLISION BETWEEN ORBITER AND ISSA.**

HAZARDS REPORT NUMBER(S): ORBI 402A

**HAZARD(S) DESCRIPTION:
UNCONTROLLED/INADVERTENT COLLISION BETWEEN ORBITER AND ISSA.**

- APPROVALS -

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