FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M8-1SS-BM009-X
(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	ASSY, DISPLACEMENT SENS/LOCKING RSC-ENERGIA	33U.5325.005 33U.5325.005
LRU	:	ASSY, DISPLACEMENT SENS/LOCKING RSC-ENERGIA	33U.5325.005-01 33U.5325.005-01
SRU	:	FIXER RSC-ENERGIA	33Y.6662.002-01 33Y.6662.002-01

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISPLACEMENT SENSOR/LOCKING (MAIN DIFFERENTIAL) ASSEMBLY FIXER

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
CONTAINED WITHIN THE EACH DISPLACEMENT SENSOR/LOCKING ASSEMBLY OF THE DIFFERENTIAL, THE FIXER BYPASSES THE SPRING MECHANISM TO ALLOW DIRECT COUPLING OF THE DIFFERENTIAL ASSEMBLY TO LOCK THE DOCKING RING IN ITS ALIGNED POSITION. WHEN POWER IS APPLIED TO THE FIXER WINDINGS A MAGNETIC FIELD IS CREATED WHICH EXTENDS A ROD TO MECHANICALLY COUPLE THE TWO INDIVIDUAL DIFFERENTIAL SEGMENTS TO PROVIDE SYNCHRONIZED ROTATION, (LIMITING RING MOVEMENT IN THE PITCH AND YAW DIRECTIONS), THUS MAINTAINING THE RING IN ITS ALIGNED POSITION (ALIGNMENT IN RESPECT TO ITS OWN MECHANISM). WHEN POWER IS REMOVED, A SPRING RETRACTS THE ROD WHICH UNCOUPLES BOTH DIFFERENTIAL SEGMENTS, ALLOWING THE DIFFERENTIAL TO MOVE NORMALLY.

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

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

REFERENCE DOCUMENTS: 33U.5325.005
33U.5325.005-01
33U.6662.002-01

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM009- 01
(DOESN'T APPLY TO PMA2/3 PASSIVE MECHANISM)

REVISION# 1 DEC, 1996

SUBSYSTEM NAME: MECHANICAL - EDS
LRU: DISPLACEMENT SENSOR/LOCKING ASSEMBLY
ITEM NAME: FIXER, MAIN DIFFERENTIAL

CRITICALITY OF THIS FAILURE MODE: 2R3

FAILURE MODE:
FAILS TO LOCK

MISSION PHASE:
OO ON-ORBIT

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

CAUSE:
STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR MANUFACTURE/ MATERIAL DEFECT, OPEN WINDINGS, SHORT BETWEEN WINDINGS; MECHANICAL JAMMING DUE TO CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
FAILS REDUNDANCY SCREEN "B" SINCE A SINGLE FIXER FAILING TO LOCK (MECHANICALLY) IS NOT DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:
SENSORS WILL MONITOR POWER TO ALL FIXERS AND PROVIDE THE INFORMATION FOR GROUND MONITORING THROUGH TELEMETRY DATA. FLIGHT CREW WOULD NOT BE ABLE TO DETECT A SINGLE FIXER FAILING TO LOCK. HOWEVER, VISUAL OBSERVATION OF THE DOCKING PROCESS MAY DETECT THE EFFECT OF A FAILURE TO LOCK BOTH DIFFERENTIAL FIXERS.

REMARKS/RECOMMENDATIONS:

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM009- 01
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THE DIFFERENTIAL FIXER ALLOWS FOR PITCH AND YAW MOVEMENT OF THE RING ONLY. REDUNDANT WINDINGS, POWERED BY SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF FIXER.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
BOTH DIFFERENTIAL SEGMENTS WILL NOT ROTATE TOGETHER. FIRST FIXER FAILURE - LOSS OF PARTIAL CAPABILITY TO LIMIT PITCH AND YAW MOVEMENT OF THE DOCKING RING. NO EFFECT SINCE THIS MOVEMENT OF THE ENTIRE RING IS LIMITED BY THE REMAINING DIFFERENTIAL FIXER. DYNAMICS OF CAPTURE WILL BE DIFFERENT GIVEN A SINGLE FIXER FAILURE. SECOND FIXER FAILURE - WORST CASE, LOSS OF CAPABILITY TO ALIGN THE DOCKING RING IN THE ROLL AND TRANSLATIONAL DIRECTIONS.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT ON INTERFACING SUBSYSTEMS.

(C) MISSION:
POTENTIAL LOSS OF DOCKING FOLLOWING SECOND FIXER FAILING TO LOCK.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST FIXER FAILURE - LOSS OF PARTIAL CAPABILITY TO LIMIT PITCH AND YAW MOVEMENT OF THE DOCKING RING. SECOND FIXER FAILURE - WORST CASE, LOSS OF CAPABILITY TO ALIGN THE DOCKING RING IN THE ROLL AND TRANSLATIONAL DIRECTIONS FOR MATING AND STRUCTURAL LATCHING OF THE INTERFACE. LOSS OF CAPABILITY TO PERFORM DOCKING RESULTING IN LOSS OF MISSION OBJECTIVES.

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

(F) RATIONALE FOR CRITICALITY CATEGORY DOWNGRADE:
N/A (THERE ARE NO WORKAROUNDS TO CIRCUMVENT THIS FAILURE.)

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS TO MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
N/A

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION TO A FAILURE TO LOCK BOTH FIXERS.
HAZARDS REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:

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N/A

-DISPOSITION RATIONALE-

(A) DESIGN:
THE DIFFERENTIAL FIXER ALLOWS FOR PITCH AND YAW MOVEMENT OF THE RING ONLY. REDUNDANT WINDINGS, POWERED BY SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF FIXERS. DIFFERENTIAL ASSEMBLY IS COMPLETELY ENCASED TO PREVENT THE INTRODUCTION OF CONTAMINATION LARGE ENOUGH TO CAUSE THE FIXER TO JAM IN THE UNLOCKED POSITION.

LOAD ANALYSIS HAS SHOWN THAT THE CENTERING SPRINGS WILL HELP ALIGN THE RING.

(B) TEST:
REFER TO "APPENDIX B" FOR DETAILS OF THE FOLLOWING ACCEPTANCE AND QUALIFICATION TESTS OF THE DOCKING MECHANISMS RELATIVE TO THIS FAILURE MODE.

DOCKING MECHANISM ACCEPTANCE TESTS:
1. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. FIXER FUNCTIONAL PERFORMANCE TEST
4. RETRACTION FORCE LOADS TEST
5. VIBRATION TEST
6. THERMAL VACUUM TEST

DOCKING MECHANISM QUALIFICATION TESTS:
1. ELECTRICAL CIRCUIT VERIFICATION TEST
2. INSULATION ELECTRICAL RESISTANCE TEST
3. TRANSPORTABILITY STRENGTH TEST
4. VIBRATION TEST
5. SHOCK-BASIC DESIGN TEST
6. THERMAL VACUUM TEST
7. SIX-DEGREE-OF-FREEDOM TEST
8. SERVICE LIFE TEST
9. FIXER LIMIT LOAD TEST
10. FIXER ULTIMATE LOAD TEST
11. DISASSEMBLY INSPECTION

OMRSD - TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
COMPONENTS ARE SUBJECTED TO A 100% RECEIVING INSPECTION PRIOR TO INSTALLATION.
CONTAMINATION CONTROL
CORROSION PROTECTION PROVISIONS AND CONTAMINATION CONTROL VERIFIED BY INSPECTION. CHECK OF ROOM CLEANLINESS; PARTS WASHING AND OTHER OPERATIONS OF THE TECHNOLOGICAL PROCESS WHICH PROVIDES CLEANLINESS ARE VERIFIED BY INSPECTION.

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CRITICAL PROCESSES
ANODIZING, HEAT TREATING, SOLDERING, CHEMICAL PLATING, AND CURING VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
TORQUE, ADJUSTMENTS AND TOLERANCES ACCORDING TO TECHNICAL REQUIREMENTS OF THE DRAWINGS ARE VERIFIED BY INSPECTION.

TESTING
ATP/QTP/OMRSD TESTING VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING/PACKAGING PROCEDURES AND REQUIREMENT FOR SHIPMENT VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
DATA ON TEST FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING OF ODS DOCKING MECHANISMS CAN BE FOUND IN PRACA DATA BASE.

(E) OPERATIONAL USE:
NONE. LOCKED FIXER ON THE REMAINING DIFFERENTIAL WILL RESTRICT PITCH AND YAW MOVEMENT OF THE RING. ALIGNMENT MAY BE LOST FOLLOWING FAILURE OF BOTH FIXERS. HOWEVER THE CENTERING SPRINGS AND DOCKING MECHANISM HYSTERESIS WILL DAMP OUT RELATIVE MOVEMENT OF THE RING AND HELP KEEP RING ALIGNED. THIS ASSUMES THAT NO RING OSCILLATIONS EXIST PRIOR TO RETRACTING THE RING FROM IT'S FORWARD POSITION.

- APPROVALS -

PRODUCT ASSURANCE ENGR.	:	M. NIKOLAYEVA	:
DESIGN ENGINEER	:	E. BOBROV	:
NASA SS/MA	:		:
NASA SUBSYSTEM MANAGER	:		:
JSC MOD	:		: