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- 02
(DOESN'T APPLY TO PMA2/3 PASSIVE MECHANISM)

REVISION# 1 DEC, 1996

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

CRITICALITY OF THIS FAILURE MODE: 2/2

FAILURE MODE:
FAILS TO UNLOCK

MISSION PHASE:
OO ON-ORBIT

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

CAUSE:
MULTIPLE SPRING FAILURES DUE TO MECHANICAL/THERMAL SHOCK OR MANUFACTURE/MATERIAL DEFECT, JAMMED ROD DUE TO CONTAMINATION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)
N/A

B)
N/A

C)
N/A

METHOD OF FAULT DETECTION:
NONE PRIOR TO CAPTURE. ANALYSIS OF TELEMETRY DATA TO EVALUATE A FAILURE TO CAPTURE MAY IDENTIFY A LOCKED FIXER AS THE CAUSE. SENSORS WILL MONITOR POWER TO ALL FIXERS AND PROVIDE THE INFORMATION FOR GROUND MONITORING THROUGH TELEMETRY DATA.

REMARKS/RECOMMENDATIONS:
THE DIFFERENTIAL FIXERS CONTROL PITCH AND YAW MOVEMENT OF THE RING ONLY. THE PRELOAD ON THE SPRING ALLOWS FOR TWO BREAKS TO OCCUR AND STILL ALLOW RING ALIGNMENT. FIXER IS NORMALLY IN UNLOCKED POSITION.

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) — CIL FAILURE MODE
NUMBER: M8-1SS-BM008- 02
(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)

(A) SUBSYSTEM:
LOSS OF CAPABILITY TO MOVE ONE SEGMENT OF THE DIFFERENTIAL INDEPENDENT OF THE OTHER. DOCKING RING BECOMES LESS MOVEABLE IN THE PITCH AND YAW DIRECTIONS DURING CAPTURE IF FAILURE OCCURS PRIOR TO CAPTURE. NO EFFECT ON MATING OF THE TWO DOCKING MECHANISMS IF FAILURE OCCURS AFTER RING RETRACTION FOLLOWING CAPTURE.

(B) INTERFACING SUBSYSTEM(S):
EXCESSIVE LOADS INCURRED DURING DOCKING, AS THE RESULT OF A SINGLE DIFFERENTIAL FIXER BEING LOCKED PRIOR CAPTURE. COULD PROPAGATE TO EXTERNAL AIRLOCK AND ORBITER/PMA1 STRUCTURE.

(C) MISSION:
A SINGLE LOCKED FIXER ADDS STIFFNESS TO THE RING WHICH AFFECTS DYNAMICS OF CAPTURE. WORST CASE IS THE INABILITY TO PERFORM CAPTURE GIVEN A FAILURE TO UNLOCK A SINGLE FIXER, RESULTING IN THE LOSS OF DOCKING CAPABILITIES. LOSS OF ORBITER (PMA1)/ISS MISSION OBJECTIVES WITH FAILURE TO PERFORM DOCKING.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT ON CREW AND ORBITER/PMA1 STRUCTURE. HOWEVER, EXCESSIVE LOADS COULD CAUSE DAMAGE TO BOTH ORBITER/PMA1 AND ISS DOCKING MECHANISMS.

(E) FUNCTIONAL CRITICALITY EFFECTS:
N/A

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 THIS FAILURE SINCE A SINGLE FIXER BEING LOCKED IS NOT DETECTABLE UNTIL AFTER CAPTURE, AT WHICH TIME THE RESULTING HIGH LOADS COULD DAMAGE BOTH ORBITER/PMA1 AND ISS DOCKING MECHANISMS TO THE POINT OF PRECLUDING DOCKING.

HAZARDS REPORT NUMBER(S): ORBI 402B

HAZARD(S) DESCRIPTION:

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM009- 02
(DOESN'T APPLY TO PMA2/3
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DAMAGE TO BOTH ORBITER/PMA1 AND ISS DOCKING MECHANISMS.

-DISPOSITION RATIONALE-

(A) DESIGN:
DIFFERENTIAL FIXERS ARE NORMALLY UNLOCKED WHEN POWER IS REMOVED BY A SPRING THAT RETRACTS THE ROD. DESIGN OF THE SPRING IS SUCH THAT MULTIPLE BREAKS ARE REQUIRED TO LOSE ITS CAPABILITY. THE PRELOAD ON THE SPRING ALLOWS FOR TWO BREAKS TO OCCUR AND STILL PERMITS THE FIXER TO FUNCTION PROPERLY. FIXERS ARE NORMALLY IN THE UNLOCKED POSITION. A FAILURE TO UNLOCK A FIXER CAN OCCUR MECHANICALLY DURING RING MOVEMENT TO IT'S INITIAL POSITION PRIOR TO CAPTURE. FIXERS ARE LOCKED WHENEVER THE RING IS MOVED.

LOAD ANALYSIS HAS SHOWN THAT IN THREE OF THE SIX DOCKING CASES MODELED, THE DOCKING RING DID NOT CAPTURE AS THE RESULT OF A SINGLE DIFFERENTIAL FIXER BEING ENGAGED PRIOR TO CAPTURE.

(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. VIBRATION TEST
2. AXIAL STIFFNESS IN INITIAL POSITION LOADS TEST
3. TRANSLATION CAPABILITY TEST - Y_T & Z_T AXES
4. ROTATIONAL CAPABILITY LOADS TEST - Y_T & Z_T AXES
5. ROTATIONAL CAPABILITY LOADS TEST - X_T AXIS
6. THERMAL VACUUM TEST

DOCKING MECHANISM QUALIFICATION TESTS:
1. TRANSPORTABILITY STRENGTH TEST
2. VIBRATION TEST
3. SHOCK-BASIC DESIGN TEST
4. THERMAL VACUUM TEST
5. SIX-DEGREE-OF-FREEDOM TEST
6. SERVICE LIFE TEST
7. FIXER ULTIMATE LOAD TEST
8. 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

- APPROVALS -

PRODUCT ASSURANCE ENGR.	:	M. NIKOLAYEVA	: [signature]
DESIGN ENGINEER	:	E. BOBROV	: [signature]
NASA SS/MA	:		: [signature]
NASA SUBSYSTEM MANAGER	:		: [signature]
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