FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M8-1SS-BM004-X
(DOESN'T APPLY TO PMA2/3 PASSIVE MECH.)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 1 DEC, 1996

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	DOCKING MECHANISM ASSEMBLY	33U.6316.003-09("SOFT" MECH., 3A MISS.)
		RSC-ENERGIA	33U.6316.003-05-001-01 (PMA1 MECH.)
SRU	:	ASSY, ELECTRO-MAGNETIC DAMPER RSC-ENERGIA	33U.6661.006 33U.6661.006
SRU	:	ASSY, ELECTRO-MAGNETIC DAMPER RSC-ENERGIA	33U.6661.007 33U.6661.007

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HIGH ENERGY ELECTRO-MAGNETIC DAMPER ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
THREE (ONE PER BALLSCREW PAIR)

FUNCTION:
A HIGH ENERGY ELECTRO-MAGNETIC DAMPER IS LOCATED BETWEEN EACH ROD OF THE BALLSCREW PAIRS AND IS ENGAGED BY A SOLENOID DRIVEN MECHANICAL LOCK (CLUTCH) DEVICE. ALL THREE DAMPER ASSEMBLIES ARE INTERCONNECTED THROUGH THE KINEMATIC CHAIN TO DAMP OUT RELATIVE PITCH AND YAW ROTATIONAL VELOCITIES OF THE RING FOLLOWING CAPTURE. THESE DAMPERS ARE AUTOMATICALLY ACTIVATED 5 SECONDS AFTER CAPTURE FOR 30SEC TO PMA1 MECHANISM AND ARE MANUALLY TURNED OFF PRIOR TO RING RETRACTION TO THE "SOFT" MECHANISM.

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

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PASSIVE MECH.)

MAINTAINABILITY
REPAIR METHOD - REPLACEMENT.

REFERENCE DOCUMENTS:

33U.6661.006
33U.6661.007
33U.6316.003-09 ("SOFT" MECH.)
33U.6321.004-09 ("SOFT" MECH.)
33U.6316.003-05-001-01 (PMA1 MECH.)
33U.6321.004-05 (PMA1 MECH.)

PRINT DATE: 04/16/97

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM004- 01
(DOESN'T APPLY TO PMA2/3 PASSIVE MECH.)

REVISION# 3 APR, 1997

SUBSYSTEM NAME: MECHANICAL - EDS
LRU: DOCKING MECHANISM ASSEMBLY
ITEM NAME: ASSEMBLY, HIGH ENERGY DAMPER

CRITICALITY OF THIS FAILURE MODE: 2/2

FAILURE MODE:
JAMMING, INCREASED RESISTANCE

MISSION PHASE:
OO ON-ORBIT

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

CAUSE:
CONTAMINATION, STRUCTURAL FAILURE DUE TO MECHANICAL SHOCK, VIBRATION, OR MANUFACTURE/MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

METHOD OF FAULT DETECTION:
VISUAL OBSERVATION - NO CAPTURE INDICATION DURING DOCKING. TELEMETRY DATA ASSOCIATED WITH MOVEMENT OF THE RING (BALLSCREW MISALIGNMENT) IS AVAILABLE TO GROUND PERSONNEL FOR EVALUATION OF A JAMMED DAMPER. A JAMMED DAMPER DURING RING MOVEMENT MAY BE DETECTED VISUALLY BY A MISALIGNED DOCKING RING.

CORRECTING ACTION: NONE FOR A COMPLETE JAMMING OF THE DAMPER. HOWEVER AN INCREASE IN RESISTANCE CAN BE OVERCOME BY THE EXTERNAL FORCES OF DOCKING.

REMARKS/RECOMMENDATIONS:
AN INCREASE IN RESISTANCE CAN BE OVERCOME BY THE EXTERNAL FORCES OF DOCKING.

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM004-01
(DOESN'T APPLY TO PMA2/3
PASSIVE MECH.)

(A) SUBSYSTEM:
A JAMMING OF ONE DAMPER WILL PREVENT/RESTRICT PITCH AND YAW MOVEMENT OF ITS ASSOCIATED BALLNUT PAIR AND SUBSEQUENTLY, RESTRICT PITCH/YAW MOVEMENT OF THE DOCKING RING. AN INCREASED RESISTANCE COULD BE OVERCOME BY THE POWER OF THE DOCKING MECHANISM ASSEMBLY ALLOWING CAPTURE TO OCCUR. HOWEVER, TOTAL JAMMING OF A HIGH ENERGY DAMPER ASSEMBLY WOULD PRECLUDE CAPTURE. DAMAGE SUSTAINED BY THE MECHANISM, DUE TO EXCESSIVE CAPTURE LOADS, COULD PREVENT EXTENSION OR RETRACTION OF THE DOCKING RING.

(B) INTERFACING SUBSYSTEM(S):
A JAMMED DAMPER COULD RESULT IN A MISALIGNED DOCKING RING.

(C) MISSION:
A MISALIGNED RING DURING RING RETRACTION COULD PRECLUDE MATING OF BOTH MECHANISMS AND SUBSEQUENT DOCKING CAPABILITIES RESULTING IN LOSS OF ORBITER (PMA1)/ISS MISSION CAPABILITIES.

(D) CREW, VEHICLE, AND ELEMENT(S):
EXCESSIVE LOADS EXPERIENCED DURING CAPTURE AS THE RESULT OF A JAMMED DAMPER, FOLLOWED BY A FAILURE OF THE SLIP CLUTCH, COULD CAUSE EXTENSIVE DAMAGE TO BOTH ORBITER/PMA1 AND ISS DOCKING MECHANISMS. CREW AND ORBITER/PMA1 STRUCTURE ARE UNAFFECTED BY THESE LOADS.

(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 FOLLOWING A SLIP CLUTCH 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?
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION TO CIRCUMVENT A COMPLETE JAMMING FOLLOWING A SLIP CLUTCH FAILURE. COMPLETE JAMMING OF A HIGH ENERGY DAMPER 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

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM004- 01
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PASSIVE MECH.)

HAZARD(S) DESCRIPTION:
DAMAGE TO BOTH ORBITER/PMA1 AND ISS DOCKING MECHANISMS.

-DISPOSITION RATIONALE-

(A) DESIGN:
DESIGN OF THE DAMPERS PROVIDES SUFFICIENT FREEPLAY BETWEEN SURFACES TO ALLOW FOR TEMPERATURE EXPANSION AND TO PREVENT JAMMING. CLUTCH SURFACES ARE MADE OF STEEL ALLOYS AND ARE AN INTER-MESHING TOOTH DESIGN. THE DAMPING PORTION IS A MAGNETIC FIELD DEVICE. GRAPHITE LUBRICATION IS PROVIDED TO PREVENT MOVING SURFACES FROM STICKING. ALL DAMPER PARTS HAVE A SAFETY FACTOR NO LESS THAN 1.4.

LOAD ANALYSIS HAS SHOWN THAT THE MAXIMUM DOCKING LOADS INCURRED AS THE RESULT OF THIS FAILURE WILL NOT EXCEED EXTERNAL AIRLOCK/ORBITER STRUCTURAL LIMITS.

(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. HIGH ENERGY DAMPER FUNCTIONAL PERFORMANCE TEST
2. VIBRATION TEST
3. 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. 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, CHEMICAL PLATING, SOLDERING, 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 FOR A COMPLETE JAMMING OF THE DAMPER. HOWEVER AN INCREASE IN RESISTANCE CAN BE OVERCOME BY THE EXTERNAL FORCES OF DOCKING.

- APPROVALS -

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