FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER: M6-1SS-BM011-X
(APPLIES ONLY TO THE "SOFT" MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 0 DEC, 1996

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	DOCKING MECHANISM ASSEMBLY RSC-ENERGIA	33U.6316.003-09 33U.6316.003-09
SRU	:	ASSEMBLY, DIFFERENTIAL RSC-ENERGIA	33U.6321.005 33U.6321.005

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
LOW LEVEL DIFFERENTIAL ASSEMBLY

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
THE LOW LEVEL DIFFERENTIAL ASSEMBLY PROVIDES FORCED SUMMED INPUTS TO THE LOW LEVEL SLIP CLUTCH WHICH IS ENABLED BY A LOCKING DEVICE WHEN PERFORMING A SOFT DOCKING. ALSO COUPLES THE EXTEND/RETRACT ACTUATOR OUTPUT TO THE MAIN DIFFERENTIAL ASSEMBLY WHEN THE LOW LEVEL SLIP FUNCTION IS NOT REQUIRED.

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

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

REFERENCE DOCUMENTS: 33U.6321.005
33U.6316.003-09

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM011- 02
(APPLIES ONLY TO THE "SOFT" MECHANISM)

REVISION# 0 DEC, 1996

SUBSYSTEM NAME: MECHANICAL - EDS
LRU: DOCKING MECHANISM ASSEMBLY
ITEM NAME: ASSEMBLY, LOW LEVEL DIFFERENTIAL

CRITICALITY OF THIS FAILURE MODE: 2/2

FAILURE MODE:
BROKEN

MISSION PHASE:
OO ON-ORBIT

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

CAUSE:
UNIVERSAL JOINT FAILURE, STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK OR MANUFACTURE/MATERIAL DEFECT, BROKEN GEAR

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:
INSTRUMENTATION - THE CORRESPONDING DOCKING RING INDICATORS ON THE DOCKING CONTROL PANEL WILL ILLUMINATE TO INDICATE RING POSITION AND ALIGNMENT. VISUAL OBSERVATION - COLLAPSE OF DOCKING RING DURING CAPTURE OR INABILITY TO MOVE THE DOCKING.

REMARKS/RECOMMENDATIONS:
A BROKEN DIFFERENTIAL IS CONSIDERED TO BE VERY REMOTE. ALL COMPONENTS HAVE SAFETY FACTOR > 1.4.

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- FAILURE EFFECTS -

(A) SUBSYSTEM:
EXTEND/RETRACT ACTUATOR IS DISCONNECTED FROM THE MAIN DIFFERENTIAL. INABILITY OF DOCKING MECHANISM TO SUSTAIN A LOAD RESULTING IN A COLLAPSE OF THE DOCKING RING DURING CAPTURE AND CAUSING EXCESSIVE DOCKING LOADS. LOSS OF CAPABILITY TO EXTEND OR RETRACT THE RING TO COMPLETE DOCKING.

(B) INTERFACING SUBSYSTEM(S):
EXCESSIVE LOADS INCURRED DURING DOCKING AS THE RESULT OF THIS FAILURE COULD PROPAGATE TO EXTERNAL AIRLOCK AND ORBITER STRUCTURE.

(C) MISSION:
LOSS OF ORBITER/ISS DOCKING CAPABILITIES FOLLOWING BREAK IN DIFFERENTIAL CHAIN. THE INABILITY TO DOCK WILL RESULT IN LOSS OF ORBITER/ISS MISSION OBJECTIVES.

(D) CREW, VEHICLE, AND ELEMENT(S):
A BROKEN DIFFERENTIAL WILL ALLOW THE DOCKING RING TO COLLAPSE DURING CAPTURE POTENTIALLY CAUSING EXTENSIVE DAMAGE TO ORBITER 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: MINUTES

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

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 CIRCUMVENT THIS FAILURE. A BROKEN DIFFERENTIAL ASSEMBLY IS NOT DETECTABLE UNTIL AFTER CAPTURE, AT WHICH TIME THE RESULTING HIGH LOADS COULD DAMAGE BOTH ORBITER AND ISS DOCKING MECHANISMS TO THE POINT OF PRECLUDING DOCKING.

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HAZARDS REPORT NUMBER(S): ORBI 402B

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

-DISPOSITION RATIONALE-

(A) DESIGN:
A BROKEN LOW LEVEL DIFFERENTIAL IS CONSIDERED VERY REMOTE. COMPONENTS OF THE DIFFERENTIAL CHAIN ARE MADE OF STAINLESS STEEL. SPRING MECHANISMS ARE USED TO REDUCE SPACING BETWEEN GEARS TO PREVENT TEETH BREAKAGE DURING PERIODS OF HIGH LOADS. THE DIFFERENTIAL IS ENCLOSED TO REDUCE THE POTENTIAL FOR STRUCTURAL IMPACT DAMAGE.

(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. GUIDE RING FUNCTIONAL PERFORMANCE TEST
3. AXIAL STIFFNESS IN INITIAL POSITION LOADS TEST
4. RETRACTION FORCE LOAD TEST
5. RESTRAINING FORCE LOAD TEST
6. TRANSLATION CAPABILITY TEST - Y_T & Z_T AXES
7. ROTATIONAL CAPABILITY LOADS TEST - Y_T & Z_T AXES
8. ROTATIONAL CAPABILITY LOADS TEST - X_T AXIS
9. 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. EXTEND/RETRACT MECHANISM LIMIT LOAD TEST
8. EXTEND/RETRACT MECHANISM ULTIMATE LOAD TEST
9. 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.

PRINT DATE: 01/27/97

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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.

CRITICAL PROCESSES
ANODIZING, HEAT TREATING, AND CHEMICAL PLATING 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. CREW WOULD OPEN CAPTURE LATCHES AND FIRE ORBITER RCS JETS TO ENABLE SEPARATION.

- APPROVALS -

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