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- 01
(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:
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/THERMAL SHOCK 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) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)
N/A

B)
N/A

C)
N/A

METHOD OF FAULT DETECTION:
A TOTALLY JAMMED DIFFERENTIAL (ON ACTUATOR SIDE) CAN BE DETECTED THROUGH VISUAL OBSERVATION AND AFFECTED DOCKING CONTROL PANEL INDICATIONS BY A-- LOSS OF RING EXTENSION, RING ALIGNMENT, RING CAPTURE, OR RING RETRACTION. THIS INFORMATION IS ALSO PROVIDED FOR GROUND MONITORING OF THE DOCKING PROCESS.

REMARKS/RECOMMENDATIONS:
COMPLETE JAMMING OF THE DIFFERENTIAL ASSEMBLY IS CONSIDERED TO BE VERY REMOTE. ALL COMPONENTS HAVE SAFETY FACTOR > 1.4. WORST CASE CONDITION IS WHEN TOTAL JAMMING OCCURS ON THE ACTUATOR SIDE OF THIS DIFFERENTIAL.

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE NUMBER: M8-1SS-BM011-01 (APPLIES ONLY TO THE "SOFT" MECHANISM)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
AN INCREASED MOMENT OF RESISTANCE COULD BE OVERCOME BY THE POWER OF THE DOCKING MECHANISM ASSEMBLY ALLOWING THE RING TO BE EXTENDED, ALIGNED, OR RETRACTED. HOWEVER, TOTAL JAMMING OF THE LOW LEVEL DIFFERENTIAL (ON ACTUATOR SIDE) WOULD PRECLUDE RING EXTENSION, ALIGNMENT, CAPTURE, OR RETRACTION DEPENDING ON WHEN FAILURE OCCURS.

(B) INTERFACING SUBSYSTEM(S):
EXCESSIVE LOADS INCURRED DURING DOCKING AS THE RESULT OF A JAMMED DIFFERENTIAL ASSEMBLY (ON ACTUATOR SIDE) COULD PROPAGATE TO EXTERNAL AIRLOCK AND ORBITER STRUCTURE.

(C) MISSION:
AT THE STAGE OF DOCKING, EXTERNAL FORCES COULD OVERCOME AN INCREASED MOMENT OF RESISTANCE IN WHICH CASE DOCKING CAN BE COMPLETED. HOWEVER, IN THE EVENT OF COMPLETE JAMMING ON THE ACTUATOR SIDE OF THIS DIFFERENTIAL, DOCKING WOULD BE IMPOSSIBLE. EXCESSIVE LOADS INCURRED DURING CONTACT COULD CAUSE DAMAGE TO ORBITER AND ISS DOCKING MECHANISMS RESULTING IN THE INABILITY TO EXTEND OR RETRACT DOCKING RING. THE INABILITY TO MOVE RING TO MATE BOTH MECHANISMS WILL RESULT IN LOSS OF DOCKING AND SUBSEQUENT LOSS OF ORBITER/ISS MISSION OBJECTIVES.

(D) CREW, VEHICLE, AND ELEMENT(S):
EXCESSIVE LOADS EXPERIENCED AS THE RESULT OF A JAMMED DIFFERENTIAL (ON ACTUATOR SIDE) COULD RESULT IN DAMAGE TO ORBITER AND ISS DOCKING MECHANISMS. CREW AND ORBITER 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.)

- 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

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RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION TO CIRCUMVENT A COMPLETE JAMMING. COMPLETE JAMMING OF THE DIFFERENTIAL ASSEMBLY IS NOT DETECTABLE UNTIL AFTER CAPTURE, AT WHICH TIME THE RESULTING HIGH LOADS COULD DAMAGE BOTH ORBITER AND ISSA DOCKING MECHANISMS TO THE POINT OF PRECLUDING DOCKING.

HAZARDS REPORT NUMBER(S): ORBI 402B

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

-DISPOSITION RATIONALE-

(A) DESIGN:
DESIGN OF THE DIFFERENTIAL PROVIDES SUFFICIENT FREEPLAY BETWEEN SURFACES TO ALLOW FOR TEMPERATURE EXPANSION AND TO PREVENT JAMMING. WHERE APPROPRIATE GRAPHITE LUBRICATION IS PROVIDED TO PREVENT SURFACES FROM STICKING. DIFFERENTIAL IS ENCLOSED TO REDUCE CONTAMINATION POTENTIAL. JAMMING CAN BE COUNTERACTED BY STRENGTH OF STRUCTURAL PARTS WHICH HAVE A SAFETY MARGIN NO LESS THAN 1.4.

(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. 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.

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(C) INSPECTION:
RECEIVING INSPECTION
ALL 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.

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 FOR A COMPLETE JAMMING. HOWEVER AN INCREASE IN RESISTANCE CAN BE OVERCOME BY THE POWER OF THE DOCKING MECHANISM OR BY THE EXTERNAL FORCES OF DOCKING.

- APPROVALS -

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