FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: M8-1SS-BM012-X
(APPLIES ONLY TO THE "SOFT" MECHANISM)

SUBSYSTEM NAME: MECHANICAL - EDS

REVISION: 2 JUN.1999

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	ASSY, LOW LEVEL DIFFERENTIAL	33U.6321.005
		RSC-ENERGIA	33U.6321.005
SRU	:	LOCKING DEVICE	33U.6635.054
		RSC-ENERGIA	33U.6635.054

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
LOW TORQUE AXIAL SLIP CLUTCH LOCKING DEVICE SENSOR

REFERENCE DESIGNATORS: SQ7

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
THE LOW TORQUE AXIAL SLIP CLUTCH LOCKING DEVICE LOCKS AND UNLOCKS THE LOW TORQUE AXIAL SLIP CLUTCH FROM THE RING KINEMATIC CHAIN. FOLLOWING RING EXTENSION TO THE RING INITIAL POSITION, POWER IS APPLIED TO THE LOW TORQUE LOCKING DEVICE ACTUATOR MOTORS TO UNLOCK THE LOW TORQUE SLIP CLUTCH, ALLOWING RING COMPLIANCE FOR DOCKING CONTACT. UPON AN EXTENDING OR RETRACTING COMMAND TO THE DOCKING RING FOLLOWING DOCKING CONTACT, POLARITY OF THE POWER TO THE LOCKING ACTUATOR MOTORS IS REVERSED TO LOCK THE LOW TORQUE SLIP CLUTCH. TORQUE FROM THE RING DRIVE ACTUATORS IS TRANSFERRED TO THE RING DRIVE KINEMATIC, AND NOT TO THE LOW TORQUE SLIP CLUTCH. THE LOCKING ACTUATOR IS AUTOMATICALLY CONTROLLED BY THE DSCU WITH RING INITIAL POSITION SENSORS AND SLIP CLUTCH LOCKING DEVICE SENSOR FEEDBACK.

A SENSOR ASSEMBLY CONTAINING SIX CONTACTS IS LOCATED WITHIN THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR. REDUNDANT LOCK (ENGAGED) SENSOR CONTACTS PROVIDE INDICATION TO THE DSCU THAT THE SLIP CLUTCH IS IN THE "HARD" MODE. REDUNDANT UNLOCK (DISENGAGED) SENSOR CONTACTS PROVIDE INDICATION TO THE DSCU THAT THE SLIP CLUTCH IS IN THE "SOFT" MODE. THE REMAINING TWO CONTACTS ARE PROVIDED FOR MONITORING PURPOSES.

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

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

REFERENCE DOCUMENTS: 33U.6321.005
33U.6635.054

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: M8-1SS-BM012- 01
(APPLIES ONLY TO THE ORBITER "SOFT" MECHANISM)

REVISION# 1 JAN, 1997

SUBSYSTEM NAME: MECHANICAL - EDS
LRU: LOW LEVEL DIFFERENTIAL ASSEMBLY
ITEM NAME: DEVICE, AXIAL SLIP CLUTCH LOCKING

CRITICALITY OF THIS FAILURE MODE: 2/2

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 WIRES, SHORT BETWEEN WIRES; 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) 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 - SENSORS LOCATED ON LOCKING ACTUATOR WILL DOWNLINK STATUS OF SLIP CLUTCH TO GROUND STATION. DURING STRUCTURAL MATING OF ORBITER & ISS DOCKING MECHANISMS A FAILURE TO LOCK THE LOCKING DEVICE COULD BE DETECTED THROUGH VISUAL OBSERVATION - INABILITY TO MATE BOTH DOCKING MECHANISMS FOR STRUCTURAL LATCHING. A SENSOR WILL MONITOR POWER TO LOCKING DEVICE AND PROVIDE THE INFORMATION FOR GROUND MONITORING THROUGH TELEMETRY DATA.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1SS-BM012- 01
(APPLIES ONLY TO THE ORBITER "SOFT" MECHANISM)

REMARKS/RECOMMENDATIONS:
LOCKING DEVICE IS MANUALLY CONTROLLED BY A SWITCH ON THE DOCKING CONTROL PANEL. IT IS UTILIZED TO LOCK OUT THE LOW LEVEL SLIP CLUTCH DURING MATING AND STRUCTURALLY LATCHING OF THE DOCKING MECHANISM INTERFACE. SLIPPAGE OF THE LOW LEVEL CLUTCH WILL OCCUR WHEN AXIAL LOADS ARE GREATER THAN 300 +/-50 KG.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
AXIAL LOADS DURING STRUCTURALLY MATING OF ORBITER AND ISS DOCKING MECHANISMS WILL NOT EXCEED 300 +/- 50 KG. WORST CASE, INABILITY TO MATE DOCKING MECHANISMS FOR STRUCTURALLY LATCHING THE INTERFACE.

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

(C) MISSION:
INABILITY TO STRUCTURALLY LATCH THE ORBITER/ISS INTERFACE WILL RESULT IN LOSS OF DOCKING CAPABILITIES AND SUBSEQUENT LOSS OF MISSION OBJECTIVES.

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

(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 TO HOURS

TIME FROM FAILURE OCCURRENCE TO DETECTION: 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 THE LOCKING DEVICE.

HAZARDS REPORT NUMBER(S): NONE

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1SS-BM012-01
(APPLIES ONLY TO THE ORBITER "SOFT" MECHANISM)

HAZARD(S) DESCRIPTION:
N/A

-DISPOSITION RATIONALE-

(A) DESIGN:
THE LOCKING DEVICE ALLOWS DOCKING LOADS TO BE ABSORBED EITHER BY THE LOW LEVEL SLIP CLUTCH OR THE EXTEND/RETRACT ACTUATOR FRICTIONAL BRAKE. REDUNDANT WINDINGS, POWERED BY SEPARATE SOURCES, ARE PROVIDED FOR LOCKING OF THIS DEVICE. SINCE THIS LOCKING DEVICE IS ELECTRICALLY ACTUATED, A FAILURE TO LOCK WOULD MOST LIKELY OCCUR DUE TO AN ELECTRICAL FAILURE RATHER THAN A MECHANICAL ONE. THE LOCKING DEVICE IS COMPLETELY ENCASED TO PREVENT THE INTRODUCTION OF CONTAMINATION LARGE ENOUGH TO CAUSE THE LOCKING DEVICE TO JAM IN THE UNLOCKED POSITION.

(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. STRUCTURAL HOOK PERFORMANCE TEST
4. VIBRATION 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. STRUCTURAL HOOK SIMULTANEOUS LOADS TEST
8. STRUCTURAL HOOK COMPONENT LOADS 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.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: M8-1SS-BM012-01
(APPLIES ONLY TO THE ORBITER "SOFT" MECHANISM)

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, 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	:
DESIGN ENGINEER	:	E. BOBROV	:
NASA SS/MA	:		:
NASA SUBSYSTEM MANAGER	:		:
JSC MOD	:		: