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-BM012-06
(APPLIES ONLY TO THE "SOFT" MECHANISM)

REVISION# 1 JUN, 1999

SUBSYSTEM NAME: MECHANICAL - EDS

LRU: LOW LEVEL DIFFERENTIAL ASSEMBLY
ITEM NAME: SENSOR, AXIAL SLIP CLUTCH LOCKING DEVICE

CRITICALITY OF THIS FAILURE MODE: 2/2

FUNCTIONAL CRITICALITY/ REQUIRED FAULT TOLERANCE/ACHIEVED FAULT TOLERANCE: 3/0/0

FAILURE MODE:
"LOCK" SENSOR CONTACTS FAILS CLOSED OR SHORTS TO GROUND

MISSION PHASE:
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
CONTAMINATION, PIECE PART STRUCTURAL FAILURE DUE TO MECHANICAL/THERMAL SHOCK, VIBRATION, OR MANUFACTURER/MATERIAL DEFECT

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO

REDUNDANCY SCREEN **A)** N/A

B) N/A

C) N/A

PASS/FAIL RATIONALE:
A)

B)
N/A

C)
N/A

METHOD OF FAULT DETECTION:
FAILURE MODE IS DETECTABLE ONLY BY THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR FAILING TO TRANSFER TO ITS LOCKED POSITION POST-CONTACT AFTER A DOCKING RING EXTENSION OR RETRACTION OPERATION HAS BEEN COMMANDED.

MASTER MEAS. LIST NUMBERS: V53X0547E

REMARKS/RECOMMENDATIONS:
WORST CASE SCENARIO OCCURS WHEN SENSOR FAILS CLOSED OR SHORTS TO GROUND AFTER LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR TRANSFERS TO UNLOCKED POSITION. THE ACTUATOR WILL BE PREVENTED FROM TRANSFERRING BACK TO THE LOCK POSITION WHEN A RING EXTENSION/RETRACTION OPERATION IS COMMANDED, WHEREBY THE RING ACTUATOR TORQUE WILL BE TRANSMITTED TO THE LOW TORQUE SLIP CLUTCH.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
A FAILED CLOSED OR SHORTS TO GROUND CONDITION WILL INTERRUPT THE DSCU CONTROL OF THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR, RESULTING IN THE INABILITY TO AUTOMATICALLY TRANSFER THE SLIP CLUTCH LOCKING ACTUATOR TO THE "HARD" OR LOCKED POSITION. IF THE LOCKING ACTUATOR IS NOT LOCKED, THE RING ACTUATOR TORQUE WILL BE TRANSMITTED TO THE LOW TORQUE SLIP CLUTCH.

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

(C) MISSION:
FOR A FAILED CLOSED OR SHORTS TO GROUND CONDITION, THE LOW TORQUE LOCKING ACTUATOR CANNOT BE TRANSFERRED TO THE LOCKED POSITION. THE RING ACTUATOR TORQUE WILL BE TRANSMITTED TO THE LOW TORQUE SLIP CLUTCH. ALTHOUGH THE RING WILL BE ABLE TO MOVE, WORST CASE, THERE WOULD BE INSUFFICIENT RING FORCE TO MATE THE ORBITER ACTIVE MECHANISM WITH THE ISS PASSIVE MECHANISM FOR HOOK CLOSING RESULTING IN LOSS OF DOCKING CAPABILITY (LOSS OF MISSION).

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

(E) FUNCTIONAL CRITICALITY EFFECTS:
N/A

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PASSIVE MECHANISM)

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 2/2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
THE STATION MAY NOT HAVE SUFFICIENT POWER PRODUCTION IN ORDER TO TOLERATE THE FREE DRIFT CONFIGURATION NECESSARY TO PERFORM THE IFM TO DIRECTLY DRIVE THE SLIP CLUTCH TO THE "HARD" OR LOCKED POSITION. UNDOCKING AND SEPARATION WOULD BE REQUIRED IN ORDER TO IMPLEMENT THE IFM. HOWEVER, WORST CASE, THERE MAY BE INSUFFIENT CONSUMABLES REMAINING TO PERFORM A SECOND DOCKING ATTEMPT.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS

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:
WORST CASE, THERE IS NO CORRECTIVE ACTION TO RESTORE THE "HARD" OR LOCKED LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR POSITION.

HAZARDS REPORT NUMBER(S): NONE

HAZARD(S) DESCRIPTION:
N/A

-ADDITIONAL DATA-

-DISPOSITION RATIONALE-

(A) DESIGN:
N/A

(B) TEST:
N/A

(C) INSPECTION:
N/A

(D) FAILURE HISTORY:
N/A

(E) OPERATIONAL USE:
N/A

-DISPOSITION RATIONALE-

(A) DESIGN:
THE SENSOR ASSEMBLY CONTAINS THREE CONTACTS FOR HARD & LOCKED POSITION. TWO ARE USED TO CONTROL THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR; A THIRD CONTACT IS USED FOR ON-BOARD MONITORING OF THE ACTUATOR "HARD" OR LOCKED POSITION. THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR IS COMPLETELY ENCASED TO PREVENT INTRODUCING METALLIC CONTAMINATION AND TO

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PROTECT SENSOR AGAINST ANY MECHANICAL SHOCK THAT COULD CAUSE A FAILED CLOSED CONDITION ON ONE OF TWO CONTACTS.

(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.

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.

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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:
THE CREW CAN PERFORM THE APDS DIRECT DRIVE IFM TO DRIVE THE LOW TORQUE SLIP CLUTCH LOCKING ACTUATOR TO ITS LOCKED POSITION WHILE SOFT MATED TO THE STATION IF THE STATION CAN TOLERATE THE NON-POWER PRODUCING ATTITUDES WHILE IN FREE DRIFT. OTHERWISE, AN UNDOCKING AND SEPARATION WOULD BE REQUIRED IN ORDER TO PERFORM THIS WORKAROUND.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
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(DOESN'T APPLY TO PMA2/3
PASSIVE MECHANISM)

- APPROVALS -

PRODUCT ASSURANCE ENGR.	M. NIKOLAYEVA	
DESIGN ENGINEER	E. BOBROV	
NASA SS/MA		
NASA SUBSYSTEM MANAGER		
JSC MOD		
USA ORBITER, SRQA		
USA SAM		9/20/93