FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL HARDWARE
NUMBER:M8-1SS-M017 -X

SUBSYSTEM NAME: MECHANICAL - SEALS

REVISION: 1 05/31/96

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:SEAL, PRESSURE	V075-332430-001(QTY-2)
	:SEAL, PRESSURE	V075-332430-002 (QTY-2)
	:SEAL, PRESSURE	V075-332430-003
	:SEAL, PRESSURE	V075-332430-004
	:SEAL, PRESSURE	V075-332430-005
	:SEAL, PRESSURE	V075-332430-006
	:SEAL, PRESSURE	V828-342170-001 (QTY-6)
	:SEAL, PRESSURE	V828-342170-002 (QTY-6)
	:SEAL, PRESSURE	V076-534053-001
	:SEAL, PRESSURE	V076-534053-002

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
STRUCTURE PRESSURE SEAL

QUANTITY OF LIKE ITEMS: 22
TWENTY-TWO (2 PER STRUCTURAL INTERFACE AT 11 PLACES)

FUNCTION:
REDUNDANT SEALS INTERFACE AT SEVEN PLACES: (1) BETWEEN TUNNEL FORWARD FLANGE AND 576 BULKHEAD; (2) BETWEEN TUNNEL AFT FLANGE AND BELLOWS; (3) BETWEEN BELLOWS AND EXTERNAL AIRLOCK FORWARD ADAPTER; (4) BETWEEN EXTERNAL AIRLOCK FORWARD ADAPTER AND EXTERNAL AIRLOCK; (5) BETWEEN EXTERNAL AIRLOCK AND EXTERNAL AIRLOCK AFT ADAPTER; (6) BETWEEN EXTERNAL

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AIRLOCK UPPER BULKHEAD AND UPPER CYLINDER; AND (7) BETWEEN EXTERNAL AIRLOCK UPPER CYLINDER AND DOCKING BASE.

WHEN A PRESSURIZED PAYLOAD IS INSTALLED WITHIN THE PAYLOAD BAY, REDUNDANT SEALS INTERFACE AT FOUR PLACES: (1) BETWEEN EXTERNAL AIRLOCK AFT ADAPTER AND FWD BELLOWS; (2) BETWEEN FWD BELLOWS AND TUNNEL ADAPTER; (3) BETWEEN TUNNEL ADAPTER AND AFT BELLOWS; AND (4) BETWEEN AFT BELLOWS AND PRESSURIZED PAYLOAD TUNNEL.

NOTE 1 - THE STRUCTURAL SEALS BETWEEN VESTIBULE TUNNEL AND DOCKING MECHANISM AND ON DOCKING MECHANISM ITSELF ARE PROVIDED BY THE RUSSIAN VENDOR, RSC-ENERGIA, AND THEIR FMEAS ARE CONTAINED IN THE ISS MECHANICAL FMEA/CIL ON ENERGIA BUILT HARDWARE (RA-22).

REFERENCE DOCUMENTS:
V075-332430
V828-431003
V828-341010
V828-342154
V828-342170
V828-342202

FAILURE MODES EFFECTS ANALYSIS FMEA – NON-CIL FAILURE MODE
NUMBER: M8-1SS-M017-01

REVISION#: 1 04/08/97

SUBSYSTEM NAME: MECHANICAL - SEALS
LRU: SEAL, STRUCTURE PRESSURE
ITEM NAME: SEAL, STRUCTURE PRESSURE

CRITICALITY OF THIS FAILURE MODE: 1R3

FAILURE MODE:
LEAKAGE (O-RING SEALS)

MISSION PHASE: OO ON-ORBIT

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

CAUSE:
AGING/OXIDATION/SUBLIMATION, CONTAMINATION/FOREIGN OBJECT/DEBRIS, DEFECTIVE PART MATERIAL OR MANUFACTURING DEFECT, INADEQUATE/EXCESSIVE/UNEVEN SEAL COMPRESSION LOADS, MISHANDLING, THERMAL DISTORTION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) N/A
C) PASS

PASS/FAIL RATIONALE:
A)

B)
N/A - AT LEAST TWO REMAINING PATHS ARE DETECTABLE IN FLIGHT.

C)

METHOD OF FAULT DETECTION:
INSTRUMENTATION/PHYSICAL OBSERVATION - LOSS OF PRESSURE (CONSUMABLES) IN HABITABLE VOLUMES.

CORRECTING ACTION: MANUAL

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CORRECTING ACTION DESCRIPTION:
NONE FIRST FAILURE. CREW COULD ISOLATE LEAK BY CLOSING THE APPROPRIATE HATCH(S) FOLLOWING FAILURE OF REDUNDANT SEAL.

REMARKS/RECOMMENDATIONS:
THE LEAK TEST PORT AT THE STRUCTURAL INTERFACE TO THE EXTERNAL AIRLOCK FORWARD AND AFT ADAPTERS PROVIDES THE CAPABILITY TO VERIFY THE INTEGRITY OF EACH SEAL PRIOR TO LAUNCH.

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT - LOSS OF REDUNDANCY. SECOND O-RING SEAL FAILURE WILL RESULT IN LOSS OF ISOLATION BETWEEN ODS AND OUTSIDE ATMOSPHERE.

(B) INTERFACING SUBSYSTEM(S):
NO EFFECT FIRST FAILURE. FAILURE OF REDUNDANT SEAL WILL PROVIDE LEAK PATH TO OUTSIDE ATMOSPHERE RESULTING IN LOSS OF CONSUMABLES IN HABITABLE VOLUMES WITH 576 BULKHEAD HATCH AND EXTERNAL AIRLOCK UPPER HATCH OPEN.

(C) MISSION:
NO EFFECT FIRST FAILURE. SECOND O-RING SEAL FAILURE WILL RESULT IN EARLY MISSION TERMINATION IF OCCURS PRIOR TO DOCKING WITH SPACE STATION OR PRIOR TO COMPLETION OF IVA. LOSS OF CAPABILITY TO PERFORM PLANNED EVA AFTER SECOND SEAL FAILURE.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT FIRST FAILURE UNTIL LOSS OF REDUNDANT SEAL AND AN ADDITIONAL SEAL FAILURE WITHIN HABITABLE VOLUME, AT WHICH TIME EXCESSIVE LOSS OF CONSUMABLES MAY JEOPARDIZE CREW SAFETY.

(E) FUNCTIONAL CRITICALITY EFFECTS:
FIRST O-RING FAILURE - NO EFFECT, LOSS OF REDUNDANCY ONLY.

SECOND O-RING FAILURE - POSSIBLE EARLY MISSION TERMINATION DUE TO LEAKAGE TO OUTSIDE ATMOSPHERE RESULTING IN AN INCREASED USE OF CONSUMABLES. IF SECOND FAILURE OCCURS WHEN ORBITER/SPACE STATION ARE DOCKED, POSSIBLE LOSS OF PRESSURE IN SPACE STATION WHEN EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

THIRD FAILURE (ADDITIONAL SINGLE SEAL FAILURE WITHIN HABITABLE VOLUME). IF FAILURE OCCURS:
(3A) DURING DOCKED IVA ACTIVITIES EXCESSIVE LOSS OF CONSUMABLES CAN JEOPARDIZE CREW SAFETY.

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(3B) DURING EVA, POSSIBLE LOSS OF EVA CREWMEMBERS IF ODS VOLUMES CANNOT BE REPRESSURIZED FOR RETURN TO CREW CABIN. (EVA CREWMEMBERS MUST REMAIN IN AIRLOCK UNTIL LANDING). - CRITICALITY 1R3 CONDITION.
(3C) DURING NON-DOCKED OPERATIONS, LOSS OF PRESSURE WITHIN ODS. LOSS OF SUBSEQUENT EVA CAPABILITIES IF ODS CANNOT BE REPRESSURIZED RESULTING IN LOSS OF MISSION OBJECTIVES ASSOCIATED WITH PLANNED EVA'S. - CRITICALITY 2R3 CONDITION.

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 1R3

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
(4A) - FOURTH FAILURE (INABILITY TO CLOSE 676 BULKHEAD HATCH) - FAILURE TO ISOLATE LEAKAGE FROM CREW CABIN RESULTING IN POTENTIAL LOSS OF CREW AND VEHICLE.
(4C) - FOURTH FAILURE (FAILURE NECESSITATING AN EVA TO PREVENT A POTENTIAL CATASTROPHIC SITUATION) - INABILITY TO PERFORM A CONTINGENCY EVA TO CORRECT A CRIT 1 CONDITION COULD RESULT IN LOSS OF CREW AND VEHICLE.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
THERE IS NO CORRECTIVE ACTION IF THIRD FAILURE OCCURS DURING AN EVA AND EXTERNAL AIRLOCK CANNOT BE REPRESSURIZED FOR EVA CREW'S RETURN TO CREW CABIN.

HAZARD REPORT NUMBER(S): ORBI 511, ORBI 405, FF-09

HAZARD(S) DESCRIPTION:
LOSS OF HABITABLE PRESSURE WHEN ORBITER AND SPACE STATION ARE NOT DOCKED (ORBI 511). EVA CREW HAZARDS DUE TO ISS ODS (ORBI 405). INABILITY TO SAFELY PERFORM EVA (FF-09).

- APPROVALS -

SS & PAE	: M. W. GUENTHER	:
DESIGN ENGINEER	: T. S. COOK	: