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

SUBSYSTEM NAME: MECHANICAL - TUNNEL/AIRLOCK
REVISION: 2 9/15/95

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	SEAL, PRESSURE	V075-332430-001(QTY-3)
	:	SEAL, PRESSURE	V075-332430-002(QTY-3)
	:	SEAL, PRESSURE	V075-332430-003
	:	SEAL, PRESSURE	V076-534053-001
	:	SEAL, PRESSURE	V076-534053-002
	:	SEAL, PRESSURE	V828-342170-001(QTY-2)
	:	SEAL, PRESSURE	V828-342170-002(QTY-4)

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
STRUCTURE PRESSURE SEAL

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 18
EIGHTEEN (2 PER STRUCTURAL INTERFACE AT 9 PLACES)

FUNCTION:
REDUNDANT V075-332430 SEALS INTERFACE AT FIVE PLACES: (1) BETWEEN TUNNEL ADAPTER FORWARD END FLANGE AND INTERNAL AIRLOCK (BULKHEAD 576 AFT FACE); (2) BETWEEN TUNNEL ADAPTER AND FORWARD ADAPTER ASSEMBLY; (3) BETWEEN EXTERNAL AIRLOCK FORWARD ADAPTER AND EXTERNAL AIRLOCK; (4) BETWEEN EXTERNAL AIRLOCK AND EXTERNAL AIRLOCK AFT ADAPTER; (5) BETWEEN EXTERNAL AIRLOCK UPPER BULKHEAD AND UPPER CYLINDER.

REDUNDANT V076-534053 SEALS INTERFACE BETWEEN EXTERNAL AIRLOCK UPPER CYLINDER AND VESTIBULE TUNNEL.

REDUNDANT V828-342170 SEALS INTERFACE AT THREE PLACES: (1) BETWEEN FORWARD TUNNEL ASSEMBLY AND BELLOWS; (2) BETWEEN BELLOWS AND EXTERNAL AIRLOCK FORWARD ADAPTER; AND (3) BETWEEN EXTERNAL AIRLOCK AFT ADAPTER AND SPACELAB TUNNEL.

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NOTE - THE STRUCTURAL SEALS ALONG SPACELAB TUNNEL (AFT OF THE EXTERNAL AIRLOCK AFT ADAPTER) ARE SUPPLIED BY MDAC AND ARE NOT ANALYZED IN THIS FMEA. REDUNDANT 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 MECHANICAL FMEA/CIL ON ENERGIA BUILT HARDWARE.

REFERENCE DOCUMENTS: V075-332430
V076-534053
V628-342151
V628-342154
V628-342170

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

REVISION# 2 9/15/95

SUBSYSTEM NAME: MECHANICAL - TUNNEL/AIRLOCK
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: 104 ATLANTIS

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

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

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

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT - LOSS OF REDUNDANCY. SECOND O-RING SEAL FAILURE WILL RESULT IN LOSS OF ISOLATION BETWEEN EXTERNAL AIRLOCK 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 EXTERNAL AIRLOCK, VESTIBULE TUNNEL, TUNNEL ADAPTER, INTERNAL AIRLOCK, CABIN, AND SPACELAB (MIR 1 ONLY) WITH "A" HATCH, FIFTH HATCH, EXTERNAL AIRLOCK AFT HATCH (MIR 1 ONLY) AND EXTERNAL AIRLOCK UPPER OPEN.

(C) MISSION:
NO EFFECT FIRST FAILURE. SECOND O-RING SEAL FAILURE WILL RESULT IN EARLY MISSION TERMINATION IF FAILURE OCCURS PRIOR TO DOCKING WITH MIR OR PRIOR TO COMPLETION OF IVA.

(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 STRUCTURE PRESSURE SEAL FAILURE - NO EFFECT, LOSS OF REDUNDANCY.
SECOND STRUCTURE PRESSURE SEAL FAILURE - LOSS OF CONSUMABLES IN HABITABLE VOLUME RESULTING IN EARLY MISSION TERMINATION.
THIRD FAILURE (ADDITIONAL SINGLE SEAL FAILURE WITHIN HABITABLE VOLUME) - EXCESSIVE LOSS OF HABITABLE PRESSURE WITH ALL HATCHES OPEN. SAFETY OF ORBITER AND MIR CREW AND VEHICLE JEOPARDIZED UPON LOSS OF CONSUMABLES. POSSIBLE LOSS OF PRESSURE IN MIR IF SECOND FAILURE OCCURS WHILE EXTERNAL AIRLOCK UPPER HATCH IS OPEN.

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

(F) RATIONALE FOR CRITICALITY DOWNGRADE:
NONE. UTILIZING WORKAROUND TO CLOSE HATCHES TO ISOLATE LEAKAGE HAS NO EFFECT ON THE CRITICALITY OF THIS FAILURE MODE. CRITICALITY REMAINS A 1R3 FOR MULTI-MIR.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: MINUTES

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: SECONDS TO MINUTES

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?
YES

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RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:
CREW WOULD HAVE SUFFICIENT TIME TO CLOSE APPROPRIATE HATCH(S) TO ISOLATE LEAKAGE FROM THE CREW CABIN VOLUME BEFORE EXCESSIVE LEAKAGE BECAME CATASTROPHIC.

HAZARDS REPORT NUMBER(S): ORBI 511

HAZARD(S) DESCRIPTION:
LOSS OF HABITABLE PRESSURE.

- APPROVALS -

PRODUCT ASSURANCE ENGR.	:	M. W. GUENTHER	: M. W. Guenther
DESIGN ENGINEER	:	T. S. COOK	: T S Cook