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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

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ATTACHMENT
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SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ SRU :	COUPLING	MC621-0038-0500/0300
■	SYMETRICS	592002

PART DATA

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
COUPLING, APU GEARBOX LUBE OIL FILL (MOX6), VENT (MOX5), DRAIN (MOX4),
LUBE OIL SEAL CAVITY DRAIN (TPX9), PURGE (TPX8) AND WATER SPRAY
BOILER LINE (MOX7)
- QUANTITY OF LIKE ITEMS: 18
ONE AS DESCRIBED ABOVE PER APU
- FUNCTION:
 - (1) TO PROVIDE INTERFACE BETWEEN GROUND SERVICING EQUIPMENT AND APU FOR
LUBE OIL SERVICING.
 - (2) TO MAINTAIN PROPER SEAL AFTER SERVICING AND CHECKOUT.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

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SUBSYSTEM: AUXILIARY POWER UNIT (APU)

ITEM NAME: COUPLING

CRITICALITY OF THIS
FAILURE MODE: 1R3

- FAILURE MODE:
EXTERNAL LEAKAGE

MISSION PHASE:

PL PRELAUNCH
 LO LIFT-OFF
 OO ON-ORBIT
 DO DE-ORBIT
 LS LANDING SAFING

- VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
 : 103 DISCOVERY
 : 104 ATLANTIS
 : 105 ENDEAVOUR

- CAUSE:
SEAL DAMAGE, PIECE-PART FAILURES, CORROSION, CONTAMINATION

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

- REDUNDANCY SCREEN A) FAIL
 ■ B) FAIL
 ■ C) PASS

PASS/FAIL RATIONALE:

- ~~A) CAP ACTS AS REDUNDANT SEAL~~ *DURING GROUND TURNAROUND BECAUSE*
 CAP SEAL IS NOT READILY CAPABLE OF CHECKOUT IN THE FIELD
NO TEST SORT OR EQUIPMENT IS PROVIDED

- ~~B) NOT DETECTABLE IN FLIGHT AS NO MEASUREMENT BETWEEN POPPET AND CAP SEALS~~ *LOSS OF EITHER OR*
 EXIST. *DETECTABLE IN FLIGHT.*

- C)

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- FAILURE EFFECTS -

- (A) SUBSYSTEM:
POSSIBLE LOSS OF ONE APU SYSTEM BEFORE MISSION COMPLETION.
- (B) INTERFACING SUBSYSTEM(S):
POSSIBLE LOSS OF SHAFT POWER TO ONE HYDRAULIC PUMP, ^{OR DUMPING OF} LUBE OIL IN AFT COMPARTMENT.
- (C) MISSION:
ABORT DECISION IS REQUIRED, IF FAILURE OCCURS PRIOR TO ENTRY COMMITMENT.
- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT UNLESS SECOND APU SYSTEM IS LOST. LUBE OIL IGNITION IS CONSIDERED UNLIKELY SINCE ALL APU SYSTEM HOT SURFACES ARE INSULATED AND GAPS ARE COVERED WITH ALUMINIZED TAPE. (IGNITION TEMPERATURE IS 760 DEG F). POSSIBLE FIRE/EXPLOSION DUE TO HYDRAZINE IN AFT COMPARTMENT IF FUEL PUMP SHAFT SEAL LEAKS AND DUAL SEALS SEPARATING FUEL AND OIL CAVITY LEAK.
- (E) FUNCTIONAL CRITICALITY EFFECTS:
1ST FAILURE - LEAKAGE OF OIL PAST DUAL POPPET SEALS NO EFFECT.
2ND FAILURE - LEAKAGE OF OIL PAST CAP SEAL RESULTING IN LOSS OF LUBRICATION AND APU.
3RD FAILURE - LOSS OF SECOND APU RESULTING IN LOSS OF CREW/VEHICLE.

- DISPOSITION RATIONALE -

- (A) DESIGN:
COUPLING IS CONSTRUCTED OF 17-4PH CRES WITH A SPRING MADE OF 17-7 PH. THE POPPET AND CAP SEALS BACK UP EACH OTHER AND ARE FLUOROCARBON O'RINGS. THE END FITTING IS A DUAL SEAL DYMATUBE OF 17-4 PH CRES. HEAT TREATED 145 KSI TENSILE.
- (B) TEST:
THE COUPLING AND CAP ARE LEAK CHECKED AND PROOFED DURING ATP. THE COUPLING AND CAP WITHSTOOD 500 PSIG BURST TEST AT 160 DEG F AND VIBRATED AT 22G RMS. A CAPPED COUPLING WAS TESTED UNDER THERMAL VACUUM CONDITION (360 DEG F) WITH LUBE OIL. DYMATUBE FITTING QUALIFIED BY RESISTOFLEX FOR 200,000 IMPULSE CYCLES UP TO 4,500 PSI AT 400 ~~216~~ F -65 DEG F, 12,000 PSI BURST PLUS SINE VIBRATION AT +/- 0.41G TO +/- 10 G FOR 3 HR IN 20 MIN SWEEPS FROM 6 - 2000 CPS. ^{DEG} ~~UMRSD~~:
PRESSURE DECAY LEAK TEST ON LUBE SYSTEM IS PERFORMED AFTER SERVICING

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EVERY FLOW.

- (C) INSPECTION:
RECEIVING INSPECTION
MATERIAL AND PROCESSES CERTIFICATIONS ARE VERIFIED.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. PARTS PASSIVATION
AND OTHER CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
MANUFACTURING, ASSEMBLY, AND INSTALLATION REQUIREMENTS ARE VERIFIED BY
INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY
INSPECTION.

CRITICAL PROCESSES
HEAT TREATMENT IS VERIFIED BY INSPECTION, INCLUDING ROCKWELL HARDNESS
TEST.

TESTING
TEST EQUIPMENT AND TOOL CALIBRATION ARE VERIFIED BY INSPECTION. ATP IS
WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING, PACKAGING, STORAGE, AND SHIPPING PROCEDURES ARE VERIFIED.

- (D) FAILURE HISTORY:
TEST POINT QD LEAKED DURING SEAL CAVITY DRAIN FLUSH (CAR AC5748).
LEAKAGE WAS CAUSED BY A CONTAMINANT OF UNKNOWN SOURCE.

- (E) OPERATIONAL USE:
SHUT DOWN APU BASED ON SYSTEM TEMPERATURES ^{AND/OR PRESSURES} AND FLIGHT PHASE. REMAINING

TWO SHOULD GO TO HIGH STRESS AND SHUT DOWN IN A...

- APPROVALS -

RELIABILITY ENGINEERING:	D. R. ATAPATTU	:	<i>[Signature]</i>
DESIGN ENGINEERING	: J. R. MUNROE	:	<i>[Signature]</i>
QUALITY MANAGER	: D. J. BUTTNER	:	<i>[Signature]</i>
NASA RELIABILITY	: <i>[Signature]</i> 1/23/92	:	<i>[Signature]</i>
NASA SUBSYSTEM MANAGER	:	:	<i>[Signature]</i> 1/24/92
NASA QUALITY ASSURANCE	:	:	<i>[Signature]</i>