PRINT DATE: 09/08/93

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL HARDWARE
NUMBER: 04-2-MPU1-X

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)

REVISION: 4 08/09/93

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-02XX 729867XX/754949
LRU	:	AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-03XX 729867XX/754949A
LRU	:	AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-04XX X742211X
SRU	:	MAGNETIC PICKUP UNIT IMO	58284
SRU	:	MAGNETIC PICKUP UNIT IMO	5908321

PART DATA

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
MAGNETIC PICK-UP (SPEED SENSOR). (MPU #1 - SPEED SAFETY CONTROL SENSOR).

QUANTITY OF LIKE ITEMS: 3
ONE PER APU

FUNCTION:
MONITOR TURBINE SPEED TO PROVIDE FEEDBACK TO THE SAFETY MONITORING CIRCUIT OF THE APU CONTROLLER (REFERENCE 04-2-CONTL5-1/-12).

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 04-2-MPU1-11

REVISION: 4 08/09/93

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)
LRU: AUXILIARY POWER UNIT (APU) **CRITICALITY OF THIS**
ITEM NAME: MAGNETIC PICKUP UNIT **FAILURE MODE:** 1R2

FAILURE MODE:
LOSS OF OUTPUT, INTERMITTENT OUTPUT, EXTRANEOUS SIGNALS

MISSION PHASE:

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

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

CAUSE:
INTERNAL FAILURE, BROKEN WIRE, EMI, SHORT TO GROUND CAUSE BY HUMIDITY, SALT FOG.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? YES

AOA	ABORT ONCE AROUND
ATO	ABORT TO ORBIT
RTLS	RETURN TO LAUNCH SITE
TAL	TRANS ATLANTIC ABORT

REDUNDANCY SCREEN
A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF ONE APU. APU RESTART USING INHIBIT MAY BE ATTEMPTED BASED ON FLIGHT PHASE & APU SYSTEM PARAMETERS.

(B) INTERFACING SUBSYSTEM(S):

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 04-2-MPU1-11

LOSS OF SHAFT POWER TO ONE HYDRAULIC PUMP.

(C) MISSION:
ABORT DECISION IS REQUIRED IF FAILURE OCCURS PRIOR TO ENTRY COMMITMENT.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT UNTIL SECOND SYSTEM LOSS. CRITICALITY 1 FOR SSME- INDUCED RTLS, ATO, AOA, OR TAL DUE TO THE POSSIBLE ADDITIONAL LOSS OF ASSOCIATED APU/HYD AND MAIN ENGINE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF VEHICLE IF TWO OUT OF THREE APU'S ARE LOST.

-DISPOSITION RATIONALE-

(A) DESIGN:
BOBBIN TO LEAD WIRE BRAZED. POTTED ASSEMBLY, NO DYNAMIC PARTS. MANUAL OVERRIDE OF FAILURE POSSIBLE (INHIBIT MODE). P/N 5908321 IS FOR UNITS MANUFACTURED IN 1989 AND POST. THEY FEATURE A BOBBIN MADE FROM VESPEL (POLYIMIDE) MATERIAL, IMPROVED TERMINAL POST BRAZING, AND POTTING FILL UNDER VACUUM TO REDUCE VOIDS.

(B) TEST:
ATP PERFORMED AT SUPPLIER INCLUDES INSULATION RESISTANCE (IR), HIGH POT AND CONTINUITY. APU ATP FUNCTIONAL TEST. MAG PICKUP QUALIFIED WITH APU. CERTIFICATION TESTS CONDUCTED WERE - 27 MISSION DUTY CYCLES, THERMAL VACUUM, BENCH SHOCK, FOR A TOTAL OF 41.7 HOURS OPERATION INCLUDING VIBRATION. OMRSD: OUTPUT OF MPU IS VERIFIED DURING THE T-5 MINUTE RUN AND FLIGHT DATA EVERY FLOW.

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

CONTAMINATION CONTROL
CLEANLINESS PER REQUIREMENTS IS VERIFIED BY INSPECTION. CORROSION PROTECTION REQUIREMENTS ARE VERIFIED BY INSPECTION, INCLUDING PASSIVATION OF HOUSINGS, HERMETIC SEAL OF UNIT BY TIG WELD, AND ENCAPSULATION OF THE UNIT.

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

CRITICAL PROCESSES
INSPECTION VERIFIES TIG WELDING, BRAZING, SOLDERING, CRIMPING, HEAT TREATING, AND BRASS FERRULE TIN PLATING.

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

HANDLING/PACKAGING

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE
NUMBER: 04-2-MPU1-11

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

(D) FAILURE HISTORY:
CARS AB9724, AD3459 - MOISTURE CONTAMINATION CAUSED FAILURE. 1983 IMPROVEMENTS TO ADD SHRINK SLEEVING AND POTTING AS CORRECTIVE ACTION FOR THIS FAILURE HAVE BEEN EFFECTIVE IN PREVENTING RECURRENCE OF THIS FAILURE MODE.

CARS AD5037, AD5902 - BROKEN INTERNAL WIRE OF PRE-1983 MANUFACTURED UNITS. IMPROVED POTTING WAS INSTITUTED IN 1983 TO SUPPORT THE WIRE TO HELP PREVENT THIS FAILURE MODE. ADDITIONALLY, IN 1989, A VACUUM PROCESS WAS INSTITUTED TO IMPROVE THE POTTING FILL.

CAR AD7972 - PROTOTYPE UNIT OF THE P/N 5908321 FAILED DUE TO A BROKEN COIL WIRE RESULTING IN A DEVELOPMENT TEST APU EXPERIENCING ERRATIC SPEED VARIATIONS. FAILURE ANALYSIS INDICATED DAMAGED COIL WIRES MOST PROBABLY OCCURRED DURING MANUFACTURING. CORRECTIVE ACTION FOR UNITS BUILT SUBSEQUENT TO S/N V91C013 IS A 20X MAGNIFIED VISUAL INSPECTION PRIOR TO COVERING THE COIL ASSEMBLY.

(E) OPERATIONAL USE:
RESTART USING INHIBIT MAY BE ATTEMPTED BASED ON FLIGHT PHASE.

- APPROVALS -

EDITORIALLY APPROVED	: RI	
EDITORIALLY APPROVED	: JSC	
TECHNICAL APPROVAL	: VIA CR	: S[illegible]70L