FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 04-2-PP11-IM -X

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)
REVISION: 4 03/03/00

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
LRU	: AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-0491 742211E
SRU	: FUEL PUMP SUNDSTRAND	753707 SAME
LRU	:AUXILIARY POWER UNIT (APU) SUNDSTRAND	MC201-0001-06XX 99167

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
PUMP, FUEL (HYDRAZINE) - POSITIVE DISPLACEMENT (GEAR)

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 3
ONE PER APU

FUNCTION:
TO TRANSFER FUEL AT INCREASED PRESSURE FROM SUPPLY TO DISCHARGE. THE PUMP INCORPORATES A START BY-PASS VALVE FOR STARTING, RELIEF VALVE TO PROTECT AGAINST DOWNSTREAM BLOCKAGE, AND FILTER AT THE OUTLET TO PREVENT CONTAMINATION FROM FLOWING DOWNSTREAM.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 04-2-PP11-IM- 03

REVISION#: 4 03/06/00

SUBSYSTEM NAME: AUXILIARY POWER UNIT (APU)
LRU: AUXILIARY POWER UNIT (APU) CRITICALITY OF THIS
ITEM NAME: FUEL PUMP FAILURE MODE: 1R2

FAILURE MODE:
RESTRICTED START FLOW (START BYPASS VALVE FAILS TO OPEN).

MISSION PHASE: PL PRE-LAUNCH

DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR
"LUBRICANT, KRYTOX, MOD. ONLY"

CAUSE:
INTERNAL MECHANICAL FAILURE, CORROSION, CONTAMINATION.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
NO EFFECT ON APU OPERATION AFTER START. FAILURE TO START ON ORBIT.

(B) INTERFACING SUBSYSTEM(S):
FAILURE TO START ON ORBIT WOULD CAUSE LOSS OF SHAFT POWER TO ONE HYDRAULIC PUMP.

(C) MISSION:
POSSIBLE LAUNCH SCRUB.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT UNTIL SECOND SYSTEM LOST.

(E) FUNCTIONAL CRITICALITY EFFECTS:
1ST FAILURE - UNABLE TO START 1 APU.
POSSIBLE VEHICLE LOSS IF TWO OUT OF THREE APU'S ARE LOST.

-DISPOSITION RATIONALE-

(A) DESIGN:
THE VALVE IS A SIMPLE CHECK VALVE THAT OPENS WHEN THE PUMP OUTLET PRESSURE IS LESS THAN THE INLET. THE DELTA PRESSURE AVAILABLE TO OPEN VALVE VARIES FROM 425 TO 110.

THE FLUID MEDIA AND COMPONENTS ARE MAINTAINED AT CLEANLINESS LEVEL OF 100. THE AIRBORNE HALF TEST POINT AND FILL COUPLINGS CONTAIN 100-MICRON FILTERS WITHIN THEM AND THE 570-1317 GSE FUEL SERVICING UNIT HAS A 10- MICRON FILTER AT ITS OUTLET. A 25-MICRON FILTER IS ALSO AT THE APU TANK OUTLET.

PER REDESIGN, THE START/BYPASS PISTON IS NOW COATED WITH A LUBRICANT, KRYTOX, TO PREVENT STICTION (BINDING DUE TO FRICTION).

(B) TEST:
THE VALVE IS CHECKED IN THE FUEL PUMP ATP PRIOR TO ASSEMBLY INTO THE APU AND IS ALSO VERIFIED IN THE APU ATP.

QUALIFIED AS PART OF APU.

START BYPASS VALVE FUNCTIONED NORMALLY ON IAPU QUALIFICATION TEST FOR 75 HOURS AND DEVELOPMENT TESTS.

LCC: VALVE FUNCTION VERIFIED DURING APU START.

MISSION: DURING APU START FOR ENTRY

OMRSD: VALVE FUNCTION VERIFIED DURING CONFIDENCE RUN (HOT FIRE) ON LAUNCH PAD FOLLOWING EVERY APU INSTALLATION.

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

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 100 IS VERIFIED BY INSPECTION. FLUID SAMPLES ARE ANALYZED FOR CONTAMINATION AND VERIFIED BY INSPECTION. 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. TORQUING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
RADIOGRAPHIC, PENETRANT, AND MAGNETIC PARTICLE INSPECTION FOR SURFACE AND SUBSURFACE DEFECTS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
CHROME PLATING PER SPECIFICATION REQUIREMENTS IS VERIFIED BY INSPECTION.

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:
DURING THE CONFIDENCE RUN OF STS-64, PISTON STICTION IN THE START/BYPASS VALVE CAUSED AN APU START DELAY. THERE WAS NO PROBLEM ON THE SECOND RUN.

(E) OPERATIONAL USE:
REMAINING APU'S GO TO HIGH SPEED AND AUTOMATIC SHUTDOWN INHIBITED TO PRECLUDE AN INADVERTENT SHUTDOWN DEPENDING ON MISSION PHASE.

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- APPROVALS -

SR&QA ENGINEER	: O. HOLT	O. Holt	3/5/00
SR&QA MANAGER	: P. STENGER-NGUYEN	P Stenger	3/16/00
DESIGN ENGINEER	: B. KIM		3/16/00
SUBSYSTEM MGR	: K. SMITH	K Smith	3/16/00
NASA MOD	: J. P. JASON		3/21/00
USA SAM	: M. S. ~~SNYDER~~ Buchanan	M J Buchanan	3/21/00
USA ORBITER	: S. LITTLE	S Little	3/20/00