FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 06-3A-0610 -X

SUBSYSTEM NAME: ACTIVE THERMAL CONTROL

REVISION: 0 02/04/88

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
LRU	: WATER SPRAY BOILER ASSEMBLY	MC250-0019 ITEM 612
SRU	: HYDRAULIC BYPASS/RELIEF VALVE	SV766502-2

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HYDRAULIC BYPASS/RELIEF VALVE

QUANTITY OF LIKE ITEMS: 3
ONE EACH BOILER ASSEMBLY

FUNCTION:
PROVIDES CAPABILITY TO BYPASS THE HYDRAULIC HEAT EXCHANGER SECTION DURING PERIODS WHEN HYDRAULIC COOLING IS NOT REQUIRED AND RELIEF VALVE LIMITS THE PRESSURE DROP ACROSS THE SPRAY BOILER FOR HIGH FLOW CONDITIONS.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 06-3A-0610- 04

REVISION#: 1 08/25/98

SUBSYSTEM NAME: ATCS - WATER SPRAY BOILER
LRU: WATER SPRAY BOILER ASSEMBLY **CRITICALITY OF THIS**
ITEM NAME: HYDRAULIC BYPASS/RELIEF VALVE **FAILURE MODE:** 1R2

FAILURE MODE:
FAILS OPEN, INTERNAL LEAKAGE, (RELIEF VALVE)

MISSION PHASE: DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:
MECHANICAL SHOCK, VIBRATION, CORROSION, CONTAMINATION, PHYSICAL BINDING/JAMMING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) FAIL
B) PASS
C) PASS

PASS/FAIL RATIONALE:
A)
"A" SCREEN FAILS SINCE RELIEF VALVE OPERATION CANNOT BE MONITORED DURING GROUND TURNAROUND.

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF COOLING PERFORMANCE. HYDRAULIC FLUID WOULD BYPASS BOILER DURING LOW FLOW RATES SINCE DELTA P OF RELIEF VALVE IS LOWER THAN HEAT EXCHANGER.

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(B) INTERFACING SUBSYSTEM(S):
POSSIBLE LOSS OR LIMITED RUN TIME OF ONE APU/HYD SYSTEM DUE TO LOSS OF COOLING. LIMITED RUN TIME MAY NOT ALLOW APU/HYD SYSTEM TO SUPPORT ENTIRE ENTRY PHASE. LOSS OF HYDRAULIC LANDING GEAR DEPLOY AND NOSEWHEEL STEERING IF SYSTEM ONE IS LOST. LOSS OF ONE OF THREE HYDRAULIC POWER SYSTEMS TO FLIGHT CONTROL SURFACES AND BRAKES.

(C) MISSION:
NONE - COMMITTED.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.

(E) FUNCTIONAL CRITICALITY EFFECTS:
POSSIBLE LOSS OF CREW/VEHICLE WITH THIS FAILURE PLUS LOSS OF A SECOND APU/HYD SYSTEM.

-DISPOSITION RATIONALE-

(A) DESIGN:
5 MICRON FILTER IS INCORPORATED INTO THE HYDRAULIC SYSTEM CIRCUIT. THE LENGTH/DIAMETER OF POPPET MINIMIZES BINDING/JAMMING. ALL VALVE COMPONENTS ARE COMPATIBLE WITH WORKING FLUIDS. RELIEF VALVE COMPONENT MATERIALS ARE: HOUSING - 347 SS, POPPET - 440C SS, AND GUIDE - TITANIUM. THE RELIEF VALVE, WHICH IS INCORPORATED INTO THE BYPASS VALVE ASSEMBLY, IS A SPRING-LOADED, POPPET-TYPE VALVE WHICH CRACKS AT 49 PSID.

(B) TEST:
QUALIFICATION:

- RELIEF VALVES ARE FUNCTIONALLY TESTED FOR 10,000 CYCLES (CLOSED-OPEN-CLOSED)
- RANDOM VIBRATION TEST (BOILER AND VENT AREA) - ACCELERATION SPECTRAL DENSITY INCREASING AT RATE OF 6 DB/OCTAVE FROM 20 TO 50 HZ; CONSTANT AT 0.01 G SQ/HZ FROM 50 TO 2000 HZ FOR 48 MINUTES/AXIS (100 MISSION

EQUIVALENCY). TEST PERFORMED WITH STORAGE TANK LOADED 100 PERCENT AND AT MAXIMUM OPERATING PRESSURE (FULL GN2 PRESSURE). HYDRAULIC AND APU LUBE OIL CIRCUITS PRESSURIZED TO MAX OPERATING PRESSURE THROUGHOUT TEST. PASS/FAIL CRITERIA: NO DAMAGE OR PERMANENT DEFORMATION; NO ELECTRICAL CIRCUIT INTERRUPTIONS DURING TEST.

- SHOCK TEST - (PER MIL-STD-810, METHOD 516 1, PROCEDURE 1) 18 SHOCKS TOTAL. 6 EACH AXIS, AT 15 G'S PEAK VALUE FOR 11 MS NOMINAL DURATION WITH FULL WATER LOAD. PASS/FAIL CRITERIA: UNIT MUST PASS SUBSEQUENT PERFORMANCE TESTS (INCLUDING DESIGN POINT CHECK).

- PERFORMANCE RECORD TEST INCLUDES:
    - DESIGN POINT CHECK - VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). TESTING INCLUDES A COMPLETE WATER LOAD EXPULSION TEST, PLUS A WATER CARRY OVER EFFICIENCY TEST WHICH COMPARES ACTUAL VS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.

- THERMAL CYCLE TEST - TESTED AT OPERATING CONDITIONS AT 70 TO 275 TO 70 DEG F WITH DWELL OF 10 MINUTES AT EACH LEVEL FOR 5 CYCLES. ALSO TESTED WITH WSB NOT OPERATING AT 70 TO -65 TO 70 DEG F WITH A DWELL OF 3 HOURS AT EACH LEVEL FOR 3 CYCLES. PASS/FAIL CRITERIA: NO DAMAGE OR PERMANENT DEFORMATION. UNIT MUST PASS SUBSEQUENT PERFORMANCE TESTS (INCLUDING DESIGN POINT CHECK).

ACCEPTANCE:

- BYPASS VALVE COMPONENT TESTED PRIOR TO WSB ASSEMBLY AS FOLLOWS: RELIEF VALVE CRACK TEST (SUBASSEMBLY LEVEL), HOUSING PROOF TEST, HYDRAULIC LEAKAGE TEST, PERFORMANCE TEST (FLOW VERSUS DELTA P IN BYPASS/HX POSITION).

- EXAMINATION OF PRODUCT - VERIFICATION OF WORKMANSHIP, FINISH, DIMENSIONS, CONSTRUCTION, CLEANLINESS, IDENTIFICATION, TRACEABILITY LEVEL AND PROCESSES PER DRAWINGS AND MC250-0019 (WSB PROCUREMENT SPEC).

- HYDRAULIC CIRCUIT PROOF TEST - TESTED AT 2250 PSIG FOR 5 MINUTES MINIMUM WITH HYDRAULIC FLUID. PASS/FAIL CRITERIA: NO EVIDENCE OF PERMANENT DEFORMATION AND PASSAGE OF SUBSEQUENT HYDRAULIC CIRCUIT LEAK CHECKS.

- HYDRAULIC CIRCUIT LEAK CHECK - TESTED AT 1500 PSIG WITH HELIUM. PASS/FAIL CRITERIA: NO VISIBLE EVIDENCE OF EXTERNAL LEAKAGE AND NO PRESSURE DECAY

- DESIGN POINT CHECK - VERIFICATION OF WSB SYSTEM OPERATING PARAMETERS DURING POOL BOILING (SEA LEVEL TESTING) AND SPRAY BOILING (AT ALTITUDE). TESTING INCLUDES A COMPLETE WATER LOAD EXPULSION TEST, PLUS A WATER CARRY OVER EFFICIENCY TEST WHICH COMPARES ACTUAL VS THEORETICAL WATER USAGE AT ALTITUDE ONLY WITH A KNOWN HEAT SINK.

GROUND TURNAROUND TEST

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- ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIALS ARE VERIFIED BY LAB ANALYSIS. VERIFICATION OF MATERIAL AND EQUIPMENT CONFORMING TO CONTRACTS IS PERFORMED BY INSPECTION.

CONTAMINATION CONTROL
VERIFY INTERNAL CLEANLINESS OF HYDRAULIC LINES PER SPECIFIED REQUIREMENTS. CONTAMINATION CONTROL PROCESSES AND PLANS AND CORROSION PROTECTION PROVISIONS ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
TORQUING PER DRAWING REQUIREMENTS IS VERIFIED BY INSPECTION. MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. PART PROTECTION, COATING AND PLATING ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
WELDING IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
EXAMINATION OF SURFACE WELDS FOR SURFACE AND SUBSURFACE DEFECTS IS VERIFIED BY X-RAY AND DYE PENETRANT INSPECTION.

TESTING
INSPECTION POINTS PERFORMED DURING ATP ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PROPER HANDLING AND STORAGE ENVIRONMENT IS VERIFIED BY INSPECTION

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:
SHUTDOWN AFFECTED HYDRAULIC SYSTEMS IF HIGH TEMPERATURES DEMAND IT.

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 8-25-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 95-CIL-009_06-3A