FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 02-2A-011101 -X

SUBSYSTEM NAME: FLIGHT CONTROL - RUDDER SPEED BRAKE
REVISION: 2 07/18/94

PART DATA

	PART NAME **VENDOR NAME**	**PART NUMBER** **VENDOR NUMBER**
LRU	: POWER DRIVE UNIT ASSEMBLY	MC621-0053-0068
SRU	: SWITCHING VALVE	MC621-0073-0001

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
VALVE, SWITCHING (PRESSURE SELECTOR VALVE ASSEMBLY)

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
PRIORITY TYPE, PRESSURE ACTUATED VALVE ACCEPTS THREE HYDRAULIC SYSTEM PRESSURES AND PROVIDES HYDRAULIC POWER TO THE CONTROL SERVOS FROM ANY ONE OF THE IN-TOLERANCE SYSTEMS IN ORDER OF PRIORITY. (PROVIDES ELECTRICAL OUTPUT SIGNAL TO INDICATE SPOOL POSITION).

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE
NUMBER: 02-2A-011101- 02

REVISION#: 3 08/07/98

SUBSYSTEM NAME: FLIGHT CONTROL - RUDDER SPEED BRAKE
LRU: POWER DRIVE UNIT ASSEMBLY **CRITICALITY OF THIS**
ITEM NAME: SWITCHING VALVE **FAILURE MODE:** 1/1

FAILURE MODE:
EITHER SPOOL FAILS/JAMS IN INTERMEDIATE POSITION

MISSION PHASE:
LO LIFT-OFF
DO DE-ORBIT
LS LANDING/SAFING

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

CAUSE:
CONTAMINATION, JAMMED

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF RUDDER/SPEED BRAKE CONTROL.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE NUMBER: 02-2A-011101-02

(B) INTERFACING SUBSYSTEM(S):
NONE

(C) MISSION:
POSSIBLE LOSS OF MISSION
PRELAUNCH - LAUNCH SCRUB IF FAILURE OCCURS PRIOR TO T-31 SECONDS. THE PROBLEM WOULD BE DISCOVERED DURING FLIGHT CONTROL AEROSURFACE PROFILE POSITION CHECK.
REENTRY - RUDDER CONTROL IS REQUIRED FROM MACH 5 DOWN THROUGH MACH 1 PRIOR TO SUBSONIC SPEEDS AND LANDING OPERATIONS.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF RUDDER/SPEED BRAKE FUNCTION DURING ENTRY. PRIOR TO DE-ORBIT, THE APU'S ARE STARTED SEQUENTIALLY, CAUSING THE SWITCHING VALVE TO CHANGE POSITION. IF THE VALVE JAMMED IN THE INTERMEDIATE POSITION, THE RUDDER/SPEED BRAKE WOULD BE DISABLED.

(E) FUNCTIONAL CRITICALITY EFFECTS:
PRELAUNCH CHECKOUT WILL ASCERTAIN CORRECT POSITION OF SWITCHING VALVES PRIOR TO LAUNCH.
POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF RUDDER/SPEED BRAKE FUNCTION DURING ENTRY. PRIOR TO DE-ORBIT, THE APU'S ARE STARTED SEQUENTIALLY, CAUSING THE SWITCHING VALVE TO CHANGE POSITION. IF THE VALVE JAMMED IN THE INTERMEDIATE POSITION, THE RUDDER/SPEED BRAKE WOULD BE DISABLED.

LOSS OF CREW/VEHICLE IF SWITCHING VALVE BLOCKS PRESSURE AND RETURN PORTS AFTER LOSS OF AN APU OR LOSS OF A HYDRAULIC SYSTEM (1R2).

-DISPOSITION RATIONALE-

(A) DESIGN:
SPOOL/SLEEVE 440C MATERIAL, HARDENED AND LAPPED FOR MATCHED SET. SPOOL GROOVED TO CLEAR SILTING. FORCE DEVELOPED ON SPOOL IS IN EXCESS OF 1,000 LBS. FAILURE OF SECONDARY SWITCHING VALVE TO MOVE TO PROPER POSITION IS IMMEDIATELY DETECTABLE VIA POSITION SWITCHES. 5 MICRON HYDRAULIC SYSTEM FILTRATION FOR REMOVAL OF POTENTIALLY JAMMING CONTAMINANTS.

(B) TEST:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE
NUMBER: 02-2A-011101- 02

QUALIFICATION: 20,000 SWITCHING CYCLES PERFORMED ON THE SWITCHING VALVE. THE POWER DRIVE UNIT WAS VIBRATED TO FLIGHT LOADS. THE POWER DRIVE UNIT WAS STABILIZED AT -65 DEG F FOR 3 HOURS AND THEN THE TEMPERATURE WAS ELEVATED TO THE OPERATING TEMPERATURE OF +35 DEG F AND FURTHER TESTING WAS CONDUCTED WITHIN THE OPERATING RANGE OF +35 DEG F TO +255 DEG F. 100,000 PRESSURE IMPULSE CYCLES AT EACH SUPPLY AND RETURN PORT, AT 230 DEGREES F. SUPPLY PORTS WERE CYCLED FROM 3,000 TO 4500 PSIG TO 1500 PSIG TO 0 PSIG, BACK TO 750 PSIG. VERIFIED THAT ALL PARTS WERE WITHIN ACCEPTABLE LIMITS DURING DISASSEMBLY AND INSPECTION AT COMPLETION OF QUALIFICATION.

ACCEPTANCE: FOUR SWITCHING VALVE CYCLES AT HIGH (MAIN PUMP) AND LOW (CIRCULATION PUMP) PRESSURES. PERFORMANCE TEST VERIFIES SWITCHING VALVE IS OPERATIONAL. FLUID FROM ACTUATOR IS VERIFIED TO MEET CLEANLINESS LEVEL 190 PER MA0110-301.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
MATERIALS AND PROCESSES CERTIFICATION VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS.

NONDESTRUCTIVE EVALUATION
PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES
CRITICAL /CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

CONTAMINATION CONTROL
ASSEMBLY AREA CLEANLINESS IS VERIFIED BY CONTAMINATION CONTROL PLAN. COMPONENTS ARE PRECLEANED PRIOR TO ASSEMBLY. PARTS AND TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. END ITEM FLUID SAMPLE IS VERIFIED PRIOR TO ACTUATOR DELIVERY.

TESTING
ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED.

(D) FAILURE HISTORY:

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE NUMBER: 02-2A-011101- 02

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:
NONE

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 8-18-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 95-CIL-009_02-2A