PRINT DATE: 11/20/97

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 05-3-12200B -X

SUBSYSTEM NAME: DISPLAYS & CONTROLS

REVISION: 2 11/16/97

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
	: FLT DK AVNS INSTL AREA	
LRU	: DISPLAY DRIVER UNIT	MC409-0023-000X

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
DISPLAY DRIVER UNIT (DDU) - PILOT STATION.

REFERENCE DESIGNATORS: 30V73A2

QUANTITY OF LIKE ITEMS: 1
1 PILOT SIDE

FUNCTION:
PRE-MEDS:
DECODES, PROCESSES, AND DRIVES SUBSYSTEM AND SENSOR SIGNALS TO BE DISPLAYED ON THE ADI, AMI, AVVI, AND HSI. DDU ALSO PROVIDES POWER TO THE ADI SERVOS AND TO THE RHC, NWS, RPTA, SBTC, AND BFC.

MEDS CONFIGURATION:
PROVIDES POWER TO THE ROTATIONAL HAND CONTROLLER (RHC), NOSE WHEEL STEERING (NWS), RUDDER PEDAL TRANSDUCER ASSEMBLY (RPTA), SPEEDBRAKE THRUST CONTROL (SBTC), AND BACKUP FLIGHT CONTROLLER (BFC).

- APPROVALS -

SS&PAE MANAGER	: P. STENGER-NGUYEN	: 12/18/97
SS&PAE	: T. AI	: 11/20/97
DESIGN ENGINEERING	: D. BUENDIA	: for D. Buendia 12/18/97
MEDS SYSTEM	: M. B. WARNER	: 12/11/97
MEDS HARDWARE	: R. SITAPARA	: 12/18/97
JSC MOD	:	: 4/10/98

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 05-3-12200B- 01

REVISION#: 1 08/27/97

SUBSYSTEM NAME: DISPLAYS & CONTROLS
LRU: DISPLAY DRIVER UNIT
ITEM NAME: DISPLAY DRIVER UNIT

CRITICALITY OF THIS FAILURE MODE: 1R3

FAILURE MODE:
LOSS OF DDU FLIGHT CONTROL POWER SUPPLIES (A,B,C). LOSS OF POWER OUTPUT FROM ONE, TWO, OR THREE POWER SUPPLIES.

MISSION PHASE:

PL	PRE-LAUNCH
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:
CONTAMINATION, VIBRATION, SHOCK, PIECE PART FAILURE, TEMPERATURE, LOSS OF INPUT POWER.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) PASS
B) PASS
C) FAIL

PASS/FAIL RATIONALE:
A)

B)

C)
SCREEN C IS FAILED BECAUSE BOTH COMMANDERS AND PILOTS DDU'S ARE COOLED BY ONE COMMON AIR DUCT THE LOSS OF WHICH COULD CAUSE THE FAILURE OF BOTH DDU'S DUE TO OVER-TEMPERATURE.

- FAILURE EFFECTS -

FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL FAILURE MODE
NUMBER: 05-3-12200B-01

(A) SUBSYSTEM:
LOSS OF ONE, TWO, OR THREE DDU POWER SUPPLIES AT PILOT STATION.

(B) INTERFACING SUBSYSTEM(S):
RM SOFTWARE WILL PROTECT AGAINST LOSS OF ONE DDU POWER SUPPLY FOR THE NWS, RHC, SBTC, AND RPTA BY SWITCHING FROM 3 CHANNEL MID-VALUE SELECT TO 2 CHANNEL AVERAGING FOR THESE CONTROLLERS. HOWEVER, BFC ENGAGE CAPABILITY IS LOST AT PILOT STATION WITH ONE POWER SUPPLY FAILURE.

(C) MISSION:
FIRST FAILURE - NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW/VEHICLE DURING CRITICAL FLIGHT PHASES DUE TO LOSS OF ALL CONTROLLER POWER. SCREEN C IS FAILED BECAUSE BOTH COMMANDER'S AND PILOT'S DDU'S ARE COOLED BY ONE COMMON AIR DUCT, THE LOSS OF WHICH COULD CAUSE THE FAILURE OF BOTH DDU'S DUE TO OVERTEMPERATURE.

(E) FUNCTIONAL CRITICALITY EFFECTS:
LOSS OF ONE POWER SUPPLY FROM PILOT'S STATION WILL CAUSE: 1) LOSS OF BFC ENGAGE CAPABILITY AT THAT STATION SINCE DOWN MODE TO BFC REQUIRES ALL 3 DDU POWER SUPPLIES. 2) LOSS OF POWER TO ONE OF THREE REDUNDANT CHANNELS FOR THE RHC, SBTC, AND RPTA, WHICH RESULTS IN RM SOFTWARE SWITCHING FROM 3 CHANNEL MID-VALUE SELECT TO 2 CHANNEL AVERAGING FOR THESE CONTROLLERS. LOSS OF TWO POWER SUPPLIES WILL CAUSE: LOSS OF POWER TO TWO OF THREE REDUNDANT CHANNELS FOR THE RHC, SBTC, AND RPTA, WHICH WILL CAUSE THE SOFTWARE TO DISABLE THE CONTROLLER FUNCTION AT THE PILOT'S STATION. THE PILOT CAN RESELECT THAT FUNCTION ON ORBIT, IF DESIRED. ALSO, THE NWS CLOSED LOOP OPERATION WILL BE LOST BUT CAN BE SWITCHED TO DIRECT MODE VIA THE NWS CONTROL SWITCH ON PANEL L2. LOSS OF THREE POWER SUPPLIES WILL CAUSE: COMPLETE LOSS OF POWER TO RHC, NWS, SBTC AND RPTA AT THAT STATION.

-DISPOSITION RATIONALE-

(A) DESIGN:
EEE PARTS ARE SELECTED FROM OR IN ACCORDANCE WITH MF0004-400 (OPPL) REQUIREMENT. THE HOUSING IS ENVIRONMENTALLY SEALED. UNIT IS DESIGNED TO FLIGHT VIBRATION REQUIREMENTS. THE DDU SHALL HAVE A MINIMUM USEFUL LIFE OF 25,000 HOURS. THIS IS EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10-YEAR PERIOD FROM DATE OF DELIVERY. AVERAGE ORBITAL MISSION DURATION WILL BE 7 DAYS,

HOWEVER, DDU DESIGN SHALL NOT PRECLUDE THE CAPABILITY TO EXTEND ORBITAL STAY-TIME UP TO A TOTAL OF 30 DAYS. PREVENTIVE MAINTENANCE, SERVICING, REPAIR, AND REPLACEMENT OF PARTS SHALL BE CONSISTENT WITH THE SELLER'S TRADEOFF RESULTS, AS APPROVED BY THE BUYER. THE LRU SHALL CONTAIN THE NECESSARY BUILT-IN-TEST CAPABILITY TO DETECT AND REPORT FAILURES WHICH AFFECT OPERATION. THIS BUILT-IN-TEST CAPABILITY IN CONJUNCTION WITH THE INTEGRATED AVIONICS SHALL PROVIDE THE MEANS FOR ACCOMPLISHING FUNCTIONAL PATH FAILURE DETECTION DURING FLIGHT, ALONG WITH THE NECESSARY LRU FAULT ISOLATION TO SUPPORT GROUND TURNAROUND REQUIREMENTS. THE BUILT-IN-TEST CAPABILITY SHALL PROVIDE A 0.95 PROBABILITY OF FAILURE DETECTION.

(B) TEST:
ACCEPTANCE REQUIREMENTS INCLUDE:

EXAMINATION OF PRODUCT
INSULATION RESISTANCE TEST
PERFORMANCE
ACCEPTANCE THERMAL TEST (ATT)
ACCEPTANCE VIBRATION TEST (AVT)
BONDING TEST

AVT

20 TO 80 HZ	INCREASING AT 3 DB/OCTAVE TO 0.04 G SQUARED/HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.04 G SQUARED/HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE FROM 0.04 G SQUARED/HZ AT 350 HZ

ATT

THE DDU SHALL BE THERMAL CYCLED FROM PLUS 70 DEG. F TO PLUS 100 DEG. F TO 0 DEG. F TO 70 DEG. F WITH CONTINUITY MONITORED THROUGHOUT. RATE OF CHANGE SHALL NOT EXCEED 240 DEG. F PER HOUR, NOR LESS THAN 60 DEG. F PER HOUR. DWELL AT EACH LIMIT TEMPERATURE SHALL BE THE TIME REQUIRED TO STABILIZE THE UNITS TEMPERATURE PLUS THE TIME REQUIRED TO CONDUCT ANY PERFORMANCE TEST; HOWEVER, THE MINIMUM TIME SHALL NOT BE LESS THAN 1 HOUR. INPUTS SHALL BE PROVIDED TO ALL FUNCTIONS SO THEY ARE ACTIVE DURING THERMAL TESTS.

QUALIFICATION TESTS INCLUDE:
ACCEPTANCE TEST
POWER
EMC
CABIN ATMOSPHERE
THERMAL CYCLE
VIBRATION
ACCELERATION
THERMAL VACUUM
OPERATING LIFE

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NUMBER: 05-3-12200B- 01

SHOCK

QAVT

20 TO 80 HZ	INCREASING AT 3 DB/OCTAVE TO 0.067 G SQUARED/HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.067 G SQUARED/HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE FROM 0.067 G SQUARED/HZ AT 350 HZ
DURATION	FIVE TIMES AVT MINUTES PER AXIS

QTT

THE DDU SHALL BE THERMALLY CYCLED FIVE TIMES FROM: PLUS 70 DEG. F TO PLUS 120 DEG. F, TO MINUS 20 DEG. F, TO PLUS 120 F, TO PLUS 70 DEG. F. RATE OF CHANGE SHALL NOT EXCEED 240 DEG. F PER HOUR, NOR BE LESS THAN 1 DEG. F PER MINUTE TIME DURATION AT EACH EXTREME TEMPERATURE SHALL BE SUFFICIENT TO ACHIEVE THERMAL STABILIZATION PLUS THE TIME REQUIRED TO CONDUCT FUNCTIONAL TEST, BUT SHALL NOT BE LESS THAN 2 HOURS.

ACCELERATION
PLUS AND MINUS 5 G'S IN ALL MAJOR AXES.

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

(C) INSPECTION:
RECEIVING INSPECTION
RECEIVING INSPECTION PERFORMS A VISUAL EXAMINATION OF INCOMING PARTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL
QC VERIFIES THAT REQUIRED PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. ENVIRONMENTAL SEALING OF UNIT VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
DETAILED INSPECTION IS PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY.

CRITICAL PROCESSES
ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION I.E.; SOLDERING, CONFORMAL COATING... TORQUE VALVES.

TESTING
ALL PARTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC, INCLUDING AVT, ATT, FUNCTIONAL TEST.

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HANDLING/PACKAGING
IN-PROCESS OPERATIONS ARE VERIFIED BY QC TO PROTECT PARTS AND PRECLUDE MISHANDLING. PARTS PACKAGING IS VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(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:
THE FLIGHT CONTROL FUNCTION AND BFC ENGAGE FUNCTION MAY BE TRANSFERRED TO THE COMMANDER'S STATION.

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kimura 8/28/97
EDITORIALLY APPROVED	: JSC	: Adam Werner 9/22/97
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-024_05-3