12-67 2820

CLASSIFIED MESSAGE

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FILE INFO 9 JAN 1970

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EVALUATION OF CR-9 (SII) FAILURE

1108 DISIC

SALIENT SYMPTONS: LONGER THAN NORMAL CYCLE TIME FORM OPERATION 1A, BECOMING PROGRESSIVELY LONGER UNTIL FINAL FAILURE BETWEEN OPERATIONS 108B AND 109B. SUDDEN REDUCTION IN MOTOR VOLTAGE (FROM 3.5 TO 2.0V) BETWEEN OPERATIONS 108B AND 109B. ALL OTHER FUNCTIONS NORMAL.

POSSIBLE SIGNIFICANCE OF SYMPTONS: LONGER THAN NORMAL CYCLE TIMES CAN RESULT FROM: 1) EXCESSIVE SYSTEM FRICTION LOAD, 2) INCORRECT FREQUENCY OF DC/AC INVERTER OUTPUT VOLTAGE, OR 3) REDUCED MOTOR TORQUE CAPABILITY RESULTING FROM ERRATIC DC/AC INVERTER OPERATION. SUDDEN REDUCTION IN OUTPUT VOLTAGE FROM 3.5 TO 2.0V WITHOUT FURTHER DEGRADATION INFERS AN OPEN CIRCUIT ON ONE SIDE OF THE PUSH-PULL INVERTER DRIVE.

1) TESTS HERE HAVE PROVEN THAT EXCESSIVE FRICTION LOAD DOES NOT INCREASE STRESS ON DC/AC INVERTER COMPONENTS. THEREFORE, IF SUCH CONDITION EXISTED, IT WOULD NOT HAVE RESULTED IN THE

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EVENTUAL FAILURE OF THE INVERTER PRIOR TO OPERATION 109B.

2) HAD INVERTER FREQUENCY SUFFERED A SIMPLE FREQUENCY SHIFT, THE POSSIBILITY OF THAT FREQUENCY VARYING WITH CONTINUED OPERATION IS ADMISSIBLE, BUT SUCH VARIATION WOULD NOT ACCOUNT FOR THE REDUCTION IN OUTPOUT PRIOR TO OPERATION 109B.

3) ERRATIC FREQUENCY CHANGES OF SUCH NATURE AS TO CAUSE "BREAK-UP" OF THE INVERTER OUTPUT VOLTAGE CAN CAUSE BOTH LOSS OF MOTOR SYNCHRONOUS OPERATION AND FINAL DESTRUCTION OF ONE SIDE OF THE PUSH-PULL OUTPUT DRIVERS DUE TO EXCESSIVE SWITCHING OVER-DISSIPATION. SUCH "BREAK-UP" IS CHARACTERIZED BY ADDITIONAL SWITCHING COMPONENTS (OTHER THAN THE 400 CPS FUNDAMENTAL) APPEARING AT THE INVERTER OUTPUT.

PROBABLE FAILURE: PRODUCTION OF FINAL POWER OUTPUT TO THE MOTOR INVOLVES A TUNING FORK OSCILLATOR, PULSE SHAPING CIRCUITS AND POWER OUTPUT STAGES. THE MOST LIKELY COMPONENT FAILURES CAUSING ERRATIC OUTPUT ARE THOSE ASSOCIATED WITH THE OSCILLATOR AND PULSE SHAPING CIRCUITS. A NUMBER OF INDIVIDUAL COMPONENT FAILURES COULD GIVE RISE TO SUCH FAILURE. INASMUCH AS NO INVERTER-INTERNAL T/M IS AVAILABLE, IT IS IMPOSSIBLE TO PINPOINT WHICH CIRCUIT IS RESPONSIBLE, LET ALONE WHICH COMPONENT.

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THERFORE, IT CAN BE CONLUDED ONLY THAT AN INTERNAL INVERTER FAILURE, RESTRICTED TO APPROXIMATELY 1/2 OF ALL INVERTER COMPONENTS, OCCURRED.

PROBABLE CAUSE OF FAILURE: IT IS NOTED THAT SYMPTONS OF MALFUNCTION OCCURRED FROM THE VERY FIRST OPERATION. A CONFIDENCE TEST OCCURING PRIOR TO MISSION WAS NORMAL. IT WOULD BE REASONALBE TO ASSUME THAT ENVIRONMENTAL CONDITIONS ASSOCIATED WITH LAUNCH WERE RESPONSIBLE FOR THE INITI[redacted] COMPONENT FAILURE OR DEGRADATION WHICH GAVE RISE TO THE EVENTUAL INVERTER FAILURE. OF THESE ENVIRONMENTS, THERE IS LITTLE DOUBT THAT VIBRATION CONSTITUTES THE MOST SEVERE STRESS CONDITION.

CORRECTIVE ACTION: IT IS RECOMMENDED THAT INVERTERS BE SUBJECTED TO RELATIVELY HIGH LEVEL VIBRATION TESTS PRIOR TO USE. THE LEVELS SHOULD BE OF SUFFICIENT MAGNITUDE TO ASSURE THAT THEY EXCEED THE HIGHEST LEVELS ENCOUNTERED DURING LAUNCH.

SIGCEN NOTE: [redacted] ADDED INFO ADDEE PER [redacted] REQ.

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