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B/L: 389.00
SYS: 250-TON
BRIDGE
CRANE, VAB

Critical Item: Generator Field DC Input Controller, Main Hoist
(2 Total, 1/Crane)

Find Number: 1FC

Criticality Category: 1, 2

SAA No: 09FY12-005	System/Area: 250-Ton Bridge Crane (#1 & #2)/VAB
NASA Part No: NA	PMN/ Name: K60-0533, K60-0534/ 250-Ton Bridge Crane (#1 & #2)/VAB
Mfg/ Part No: Reflex/ URRK-VIII	Drawing/ Sheet No: 69-K-L-11388/ 15

Function: A solid state assembly which provides DC excitation to the generator field of the motor-generator set (M12-G4). The excitation is proportional to the input supplied from the control potentiometers (R POT, F POT) and is used to drive the DC motors which control the main hoist.

Critical Failure Mode/Failure Mode No:

- High output (not inverted)/09FY12-005.079 (criticality cat. 1)
- High output (Inverted)/09FY12-005.080 (criticality cat. 1)
- No output/09FY12-005.074 (criticality cat. 2)

Failure Cause:

- Board component short, board component open, loss of voltage feedback from the DC drive motor loop.
- Board component short.
- Contamination, corrosion, board component open.

Failure Effect:

- Increasing speed of the DC motors controlling the main hoist. The worst case scenario would be lowering a critical load (SRB segment, Orbiter, or ET) in the slow coarse speed mode, the failure occurring, causing a sudden increase to full coarse speed (maximum coarse speed is 10 ft/min), and the effect being the critical load descending and striking the VAB floor, transporter, work platforms, MLP, or Shuttle Stack resulting in a potential loss of life and/or vehicle, or damage to a vehicle system. Time to effect: seconds.

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- b. Increasing speed, in the opposite direction than commanded, of the DC motors controlling the main hoist. The worst case scenario would be raising a critical load (SRB segment, Orbiter, or ET) in the slow coarse speed mode, the failure occurring, causing a sudden increase to full coarse speed (maximum coarse speed is 10 ft/min) in the lowering direction, and the effect being the critical load descending and striking the VAB floor, transporter, work platforms, MLP, or Shuttle Stack resulting in a potential loss of life and/or vehicle, or damage to a vehicle system. Time to effect: seconds.
- c. No DC excitation voltage to the generator field winding. No output from the generator. No hoist motor torque while the command is being given to raise, lower, or float the load while the brakes are released. The load will descend with regenerative braking at 0.25 ft/min (0.05 in/sec) max (based on maximum load capacity of the hoist, in reality this would descend slower). The worst case would be attempting to lift or float a critical load (SRB segment, Orbiter, or ET) from the stop position, releasing the brakes, the failure occurring, and the effect being the critical load descending and striking the VAB floor, transporter, work platforms, MLP, or Shuttle Stack resulting in possible damage to a vehicle system. Time to effect: seconds.

ACCEPTANCE RATIONALE

Design:

- Voltage feedback from the DC motor armature loop maintains a constant output to the drive motors at $\pm 2\%$. This prevents an overvoltage condition from driving the crane faster than is commanded by the operator.
- Current feedback from the DC motor armature loop prevents the crane from being driven faster than is allowable in maximum coarse speed.
- Current feedback from the generator field winding maintains the proper gating for output to the generator field.
- Output can be regulated and will remain constant each time the crane is being used. This allows for uniformity in expected crane reactions to inputs from the operator.
- Output to the generator field is supplied up to positive or negative 109 volts in response to an input of positive or negative 6 volts.
- Rated power: 4K watts
- Actual power: 2K watts
- Rated temperature: 0 to 50° C.
- Actual temperature: Ambient.

Test:

- a. OMRSD file VI requires verification of proper performance of hoist operational test annually.
- b. OMI Q300B, Operating Instructions, requires all crane systems be operated briefly in all speeds to verify satisfactory operation before lifting operations.

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- c. OMI Q3008, Pre-Operation Setup Instructions, requires current limit checks prior to all major lifts of flight hardware (verifies motor, generator, generator field DC input controller, float control loop and DC power loop components are operational).

Inspection:

- OMI Q6003, Maintenance Instructions, requires an annual visual inspection of the solid state circuit board assemblies for evidence of burning, discoloration caused by overheating, contamination or corrosion.

Failure History:

- The PRACA database was researched and no failure data was found on this component in the critical failure mode.
- The GIDEP failure data interchange system was researched and no failure data was found on this component in the critical failure mode.

Operational Use:

- Correcting Action:
 - 1) The failure can be recognized via the ammeter (lack or increase of current) and the Selsyn (positions change) that is in view of both operators.
 - 2) When the failure indication is noticed, the operator can stop all crane operations by returning the Master Control Switch to neutral or pressing the E-Stop button (releasing the brake switch in float mode).
 - 3) When the high output failure occurs in the fine speed or float mode of operation, the motor generator set will be shut down by an overvoltage protection relay when the voltage in the DC motor loop reaches 115% of the full fine voltage output.
 - 4) Operators are trained and certified to operate these cranes and know and understand what to do if a failure indication is present.
 - 5) During all critical lifts, there is at least one remote Emergency Stop (E-Stop) operator observing the load lift, and can stop the crane if a failure indication is noticed.
 - 6) Operationally, the crane must be operated in the fine or float speed mode if a critical load is within 10 feet of any structure in the direction of travel.
 - 7) During final SRB mate, all crane operations are ceased and final mate is accomplished by use of the 250-Ton Hydra-Set.
- Timeframe:
 - Estimated operator reaction time is 3 to 10 seconds.

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