Interpretation of the Electrical Safety Committee – August 2008

When Electrical Equipment is Not A Shock Hazard

Summary

Electrical equipment operating above 50 volts and below 10,001 volts, but incapable of delivering greater than 5 mA of current or an acute energy discharge of 10 joules, are not electrical shock hazards. Secondary hazards such as the persons reaction to receiving a mild shock, such as dropping a tool or stepping off a ladder, exist and must be addressed in work planning. Working on such equipment shall not require lockout tagout or special PPE. The minimal training required is Basic Electrical (HP-OSH-150A) and equipment specific training by the organization.

Relevant Codes Sections

NFPA 70 E

Article 110.8 (B)
Under General Requirements for Electrical Safety Work Practices, NFPA 70 E **article 110.8 (B)** states, "Prior to working on or near exposed electrical conductors and circuit parts operating at 50 volts or more, lockout / tagout devices shall be applied….."

Article 340.5 (1)

Article 340.5 of "Hazards Associated with Power Electronic Equipment" states at 5 mA shock is perceptible, the let go limit is 10 mA, and it takes a 40 mA shock lasting 1 second to cause ventricular fibrillation.

Article 340.5 (7)

Article 340.5 (7) states a capacitive discharge of 1 microfarad at 10 kV (50 joules) may cause ventricular fibrillation.

Discussion / Analysis

Shocks from currents below 5 mA are perceivable. Greater than 99.5 percent of people exposed to this current are able to let go of it. Currents in the range of 20 to 40 mA, passing through the chest, are required to arrest respiration and currents of 40 mA are required for ventricular fibrillation. An upper limit of 5 mA, therefore, would allow working without PPE or LOTO with a safety factor of at least 4. NFPA 70 E states that 50 joules (1 uF@10 kV) "may cause ventricular fibrillation" Selecting 10 joules as an allowable amount of stored energy for is a conservative level for safety with a safety factor of at least 5.

References

Definition: Acute discharge energy is a one time discharge of energy in less than 10 ms.

DOE Handbook-Electrical Safety (DOE-HDBK_1092-2004)
Figure 10.1 *Process for the analysis of circuit hazards*.

This chart indicates that for systems incapable of producing more than 5 mA of current or 10 Joules of acute discharge energy protection against shock hazards is not required. Such systems require protection against secondary hazards only.

IEEE Std 80-2000 IEEE Guide for Safety in AC Substation Grounding
"Current of 1-6 mA, often termed let-go currents, though unpleasant to sustain, generally do not impair the ability of a person holding an energized object to control his muscles and release it."