HANFORD LESSONS LEARNED/OPERATING EXPERIENCE

Caution Bulletin

2010-RL-HNF-0035 TN: 2136

Contact with Overhead Lines and Ground Step Potential

Date Published: June 23, 2010

Contractor/ Facility/Organization: DOE Richland Operations

Summary

Equipment operators who contact energized electrical lines should be aware that you and the equipment are at the same potential as the power line, and **immediate action should be taken to back the equipment away/break contact with the energized conductor.** This should be done instead of attempting to exit the vehicle.

Discussion

On March 26, 2010, at the Hanford Site, a excavator accidently contacted a energized 13.8 KV electrical power line. Since the contact was with one phase, the actual contact voltage to ground was 7.96 KV.

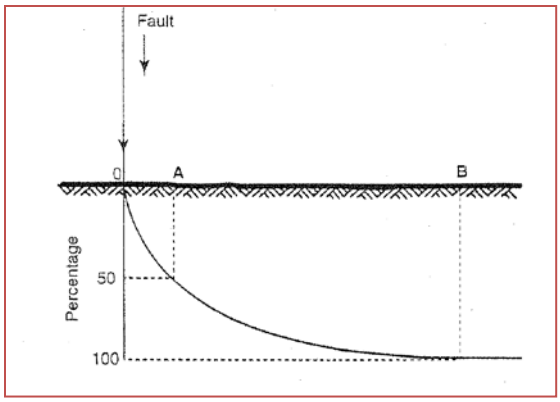
When a Project Safety Representative (PSR) observed the occurrence, and saw sparks emanating from under the excavator at the time it made contact with the 7.96 (phase to ground) power line, he inappropriately responded by driving his vehicle near (approximately 13.5') from the excavator. The PSR stepped out of his truck and moved toward the excavator. Fortunately the excavator driver had backed his equipment away from the power line prior to the PSR's arrival.

Analysis

According to two technical documents (Encyclopedia of Grounding, published by Hubbell Power Systems Incorporated in 2008, and a article entitled "Why Proper Grounding is Vital for Worker Safety, by Clayton C. King Electrical World November 1990), the voltage gradient along the ground is halved for every 2.5 to 3 feet from the electrical voltage source.

The DOE-RL Electrical Subject Matter Expert interviewed Mr. King, and found that his conclusions (described above) were based upon multiple tests using 1.4 KV and 7.2 KV voltages sources. According to Mr. King, the resistivity of the soil used was 18 ohms-cubic centimeter. Considering an area covered by a size 12 shoe size (being approximately .0274 square meters), the ground resistance of the test soil used would be 6.6×10^8 ohm-meter. Based upon IEEE Standard 80-2000 Table 7 *Typical Surface Material Resistivities*, the test soil used as the basis of the rule-of-thumb described above, conservatively represents most dry soils. Also based upon the data provided by this table, most wet soils have a resistivity that is reduced by 10^3.

If the excavator was still energized at 7.96 kV when the PSR stepped out of his truck (approximately 12 feet away) on to damp/wet ground (observed from pictures showing standing water on the associated road soon after the occurrence), the voltage potential would have been approximately 500 volts or more. On the PSR's first step to the excavator approximately the same voltage potential (or more) would have been realized between his two feet.



The distance from the fault to points A and B depend on fault magnitude and soil resistivity.

The PSR was extremely fortunate that the equipment operator took the initiative to back away from the electrical power line before the PSR stepped out of his truck and walked toward the excavator. If the excavator was still in contact with the power line, the PSR would have been severely shocked and possibly killed during his first step.

Lessons Learned

1. For equipment operators who contact energized electrical lines, be aware that you and the equipment are at the same potential as the power line, and immediate action should be taken to back the equipment away/break contact with the energized conductor. This should be done instead of attempting to exit the vehicle. In any event, unless other hazards arise (such as fire, etc.) it is safer to stay within the vehicle until emergency response and utility personnel have safely de-energized the line and verified that it is safe to exit.

2. For other personnel who are in the immediate area, be aware that a voltage gradient exists from the equipment that is contacting the energized electrical source which is at the same voltage potential. Every effort should be made to move away to a safe distance where the ground potential is 50V or less. Using the gradient rule mentioned above, for 13.8 KV phase to phase system a minimum safe distance would be at least 22 feet, and for a for 230 KV phase to phase system a safe distance would be at least 34 feet.

References

Electrical World, November 1990: Why proper grounding is vital for worker safety

Encyclopedia of Grounding for De-Energized Construction & Maintenance, ©Copyright 2008 Hubble Incorporated

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