GROUND POTENTIAL RISE STUDIES PROTECTING PERSONNEL AND EQUIPMENT AT HIGH VOLTAGE SITES

BACKGROUND

Business models and the "not in my back yard" movement have made it very difficult to find new locations for communication towers. These reasons have resulted in the current practice of utilizing high voltage environments (transmission and distribution towers and substations) as locations. Understanding of the potential hazards posed by high voltage fault conditions to personnel and equipment has become critical.

PROBLEM

Although it rarely happens, there is a definite possibility of a line to ground fault occurring at both transmission and distribution towers and substations. When this fault occurs, the grounding system is required to dissipate thousands of amps. The soil and grounding system cannot immediately dissipate the high fault current. Consequently, a large voltage referred to as a Ground Potential Rise (GPR) will develop.

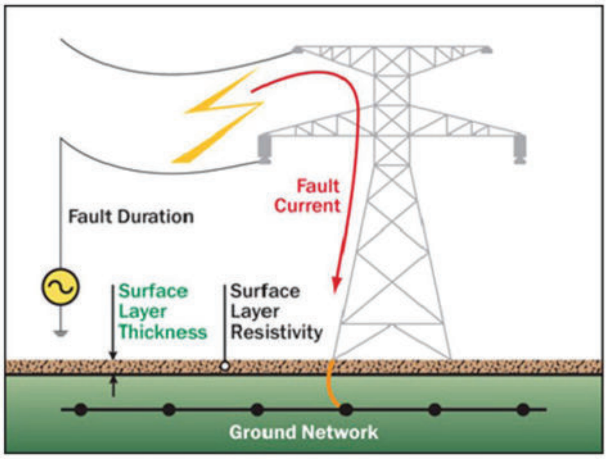
The Ground Potential Rise can be hazardous to both equipment and personnel. Communication sites installed within these high voltage environments are exposed to the same high voltage fault conditions to which the towers and substations are exposed. Additionally, any equipment located "downstream" but attached via copper to the site is also at risk as are the conductors connecting the equipment.

The protection of personnel on substations has been very well developed for many years and is a critical component of substation design. In contrast, only recently has the protection of communication equipment at substations and personnel and communication equipment at distribution towers been considered. Both personnel and equipment require protection from the hazardous and damaging effects of Ground Potential Rise (GPR) and Step and Touch Voltages.

MAKING IT SAFE, COLLECTING DATA

High voltage environments must be properly designed to provide adequate protection for personnel, local and downstream equipment. Making the site safe requires sophisticated software and considerable information. Some of the information required includes fault current data, the size and location of tower foundations, placement and configurations of any existing grounding systems. Also clearing times for faults, (number of cycles before the overcurrent devices activate) are needed along with proximity to other utility structures and towers.

Finally, soil resistivity data must be collected from the site itself. Normally the 4-Point Wenner method of testing is utilized. The Wenner method yields soil resistivity data at multiple depths of the site. Data is required for depths of up to 100 feet as a minimum. Fortunately, you don't have to dig or core that deep, the Wenner method uses probes installed only 8-9 inches into the earth.



Collecting all of the information requires close coordination and cooperation from all involved parties (utility, and engineering firms) from the earliest design stages.

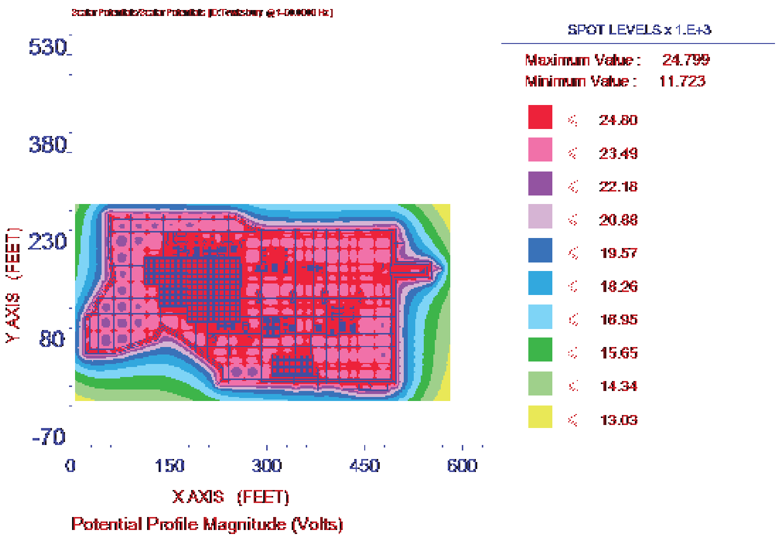
GROUND POTENTIAL RISE STUDIES PROTECTING PERSONNEL AND EQUIPMENT AT HIGH VOLTAGE SITES

MAKING IT SAFE, THE DESIGN

Once all the data is collected, the work continues with the modeling, analysis and design to protect personnel and equipment. The sophisticated software mentioned earlier is used for this purpose. A computerized soil resistivity model of the site along with the installed grounding system is developed. This model yields the performance of the grounding system. The grounding system is normally designed to meet the telecom carrier's ground resistance objective. The grounding system's resistance value (ohms) along with the fault current data (amps) from the utility are used to determine the Ground Potential Rise (GPR) value (ohms x amps).

The step and touch potentials are determined, and actions identified to make the site safe for personnel. In most cases some measures are required. They may include layers of crushed rock or asphalt. In rare cases the soil structure may be such that the native earth provides adequate protection.
The 300 volt line is also calculated. It is the distance from the site where the GPR value has diminished to 300 volts. This point can be from a few feet to thousands of feet.

Strict adherence to industry standards of design and recommended practices, such as IEEE Standards 487, 367 and 80 are critical in designing a site that will provide adequate safety for personnel and equipment. Unfortunately, many professionals involved in communications are simply unaware of the potential hazards that exist in the high voltage environments. Another problem is that utility companies sometimes take for granted that the installers of the communication equipment on their property have met the appropriate design and safety considerations.



CONCLUSION

Understanding and developing a plan for the proper installation of communications sites within high voltage environment is a critical design component. Protecting both personnel and the telecom equipment are the benefits of the GPR process. Grounding and protection of both personnel and equipment can be taken out of the realm of black magic with solid engineering processes and principles.

3547 Voyager Street #204, Torrance, CA 90503
www.lyncole.com | Phone 800.962.2610 | Fax 310.214.1114