Grounding Uncertaincies – A Rational Viewpoint

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Without equal grounding of all facility electrodes, the LPS integrity is hopelessly corrupted. Lightning grounds, AC grounds, DC grounds, multi-point grounds, single-point grounds, computer grounds, signal grounds, SPD grounds, security grounds, etc. etc. *ALL* must be electrically connected (bonded) with one another. Multiple ground paths generate multiple currents. Consequences can range from noise to destructive arcing and flashover in circuits.

Lightning behavior upon grounding reliability is a frequency-dependent event. The lightning spectrum ranges between tens of KHz to several MHZ. A grounding design has to maintain voltage differentials between any two points as low as possible in all this range. Inductive reactance is the major factor determining the impedance of electrodes. High impedance grounding affects the current path and current destination. Total inductance is a result of conductor size, shape and length while mutual inductance is a result of spacing and orientation of nearby conductors. Vertical ground rods are inductive at lower frequencies (5KHz to 500KHz?) and represent an open circuit. Horizontal or radial grounding is capacitive at 1+MHz and represents a short circuit. At Time T = to Zero a capacitor is a short circuit where an inductor is an open circuit. IEEE Std 1692-2011 "IEEE Guide for the Protection of Communications Installations from Lightning Effects" advises that in highly resistive soils over 50% of ground currents can be impressed onto the AC phase and neutral lines. Earth loops and ground potential rise can further aggravate grounding integrity, leading to compromised efficiency of the lightning protection system.

In rocky or sandy soil conditions how to achieve lowest possible impedances where fault currents and lightning present themselves? More information:

1. NWSM 30-4106: www.nws.noaa.gov/directives/sym/pd03041006curr.pdf
2. IEEE 1692-2011: www.ieee.1692-2011.pdf