IT'S NOT JUST FOR LIGHTNING...

By Jeff Jowett,
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What we're talking about is grounding. Ask almost anyone not directly involved in ground testing, installation, or maintenance, and the first thing that will come to mind is that grounding is for lightning protection. And chances are that that same person has, at some time or other, made a declaration for purposes of reassurance that goes something like, "There's less chance of that happening than of being hit by lightning!" These two common assumptions (grounding is for lightning; lightning rarely strikes) add up to one colossal misassumption that can prove costly and dangerous.

Grounding is essential for lightning protection, of course. But it has numerous additional applications that guard against electrical disturbances over a wide range of sources. Relatively massive currents and voltages may be associated with breakdowns, short circuits, and ground faults, while no more than milli amp and volt levels can be all that are necessary for "noise", harmonics, or "leakage" to take an electrical system out of service. Against so broad an array of potential problems, it is wise to have all the protection that is practical. And research will show that nearly every solution involves, in one way or another, good grounding.

Don't begin by being cavalier about lightning protection, either. You may experience a strike, indeed! It's not as uncommon as pop jargon makes it out to be. Some areas of the country experience up to 100 thunderstorm days per year, with the national average around 40 to 50 days. Remember, lightning does not have to score a direct hit to be damaging. Induced voltages can travel on power lines for miles, entering structures by any available path to ground, including directly through valuable equipment. The first line of defense against lightning damage includes an effective ground. The National Electrical Code defines "Effectively Grounded" (Article 100) as: "Intentionally connected to earth through a ground connection or connections of sufficiently low impedance [emphasis supplied] and having sufficient current-carrying capacity to prevent the buildup of voltages that may result in undue hazards to connected equipment or to persons."

Simple enough, but don't be cavalier about conformance, either. Merely having a rod, water pipe, or some other metal object connected to the electrical system does not automatically imply an effective ground. To be in compliance, as the definition states, there must be a low impedance path to ground. Testing a ground electrode (this may be a rod, interconnected array, grid, ring, counterpoise, or any of a number of other configurations) may reveal a resistance of hundreds of ohms!

Such conditions are not uncommon. Corrosion may have eroded the sub-surface structure. Freezing and thawing, or previous lightning strokes or fault conditions, may have physically damaged the electrode or separated bonds and welds. The water table may have dropped, rendering the soil higher in resistivity. Water-pipe systems may have been repaired with non-conductive plastic materials. The improvement of the electrical system, including the addition of new, sophisticated equipment, may have placed greater requirements on the grounding protection. The ground may not even have been adequate when it was installed!

In a typical application, installation of an effective ground at a mountaintop weather station reduced loss of sophisticated equipment from a yearly average of $140,000 to virtually zero! Once an effective ground is established, additional benefits become manifest. Foremost among these is the maximum performance of protective devices: fuses and

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MGE UPS SYSTEMS RECEIVES PRESTIGIOUS COMPANY OF THE YEAR AWARD

MGE UPS Systems has been awarded Frost & Sullivan's prestigious 2005 UPS Company of the Year Award. This award is based on numerous factors including the company's business development, competitive strategy and leadership.

"Frost & Sullivan recognizes MGE UPS Systems' effective management, successful new market penetration strategy, innovation capability and outstanding quality of service, all based on a unique customer care policy," says Shaun Dawson, a Frost & Sullivan analyst.

"MGE has become a top player in all national markets in which it operates thereby becoming a truly worldwide company. Offering power protection solutions to a range of end-users from small business to IT and industrial users, MGE has become synonymous with quality and reliability in the field of 'Power Quality' creating an extremely strong brand with customers and the industry."

"This award recognizes our capacity to continually innovate our solutions, process and services providing our customers with innovative power solutions. Customer care is a key characteristic of MGE UPS Systems," says Claude Graff, president & CEO of MGE.

MGE's innovative and successful product line strategy was also honored last year by Frost & Sullivan with its 2005 Product Line Strategy Leadership award.

MGE's global product line includes Uninterruptible Power Supplies (UPSs), inverters, power conditioners, power distribution units, power management software, active harmonic filters, and surge suppressors.

lightning rods

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circuit breakers. When equipment breaks down electrically, shorting to case or ground, it must have a low impedance path to allow sufficient current flow in order to trip protective devices. This is accomplished primarily through the ground conductors tied to the utility neutral at the service entrance. But here again, there is a common misconception that the building ground is of little consequence. Various figures ranging from 85 to 95% are cited for the portion of fault current returning through the system neutral. These are fundamentally correct, and the NEC forbids using the earth as the sole return for fault clearance. But the regrettable inference is that this makes the local ground unimportant. Good grounding is never unimportant! If protective devices were 100% effective, there would be virtually no electrical damage or injury. Since this is not the case, every advantage or improvement is worth maximizing. In one documented instance, an electrician and helper both survived despite the occurrence of a major fault while they were installing a 600 Amp panel on 4000-Amp switchgear. The local ground contributed no small part to the rapid clearance.

Proper grounding ties the electrical system to the earth as a reference (arbitrarily zero potential). This fixes the voltage ratings of electrical equipment, limits the stress on insulation within rated tolerances and thereby reduces the risk to personnel, provides a relatively stable system with minimum transient over-voltages, and facilitates "quick" (milli-seconds) isolation of ground faults. Isn't this worth the investment of appropriate time and attention?

Less sophisticated equipment of 20 years ago could operate with considerable voltage disturbance. But state-of-the-art computer, telecommunications, and process control circuits place increasing demands on power quality. Disturbances below the level of protective trips wreak havoc on sensitive electronics if not diverted readily to ground. Switching power supplies in equipment "chop" the utility wave into narrow operating signals and introduce harmonics into the electrical system. Common "noise" can be mistaken for operating signals, shutting down computers and process controls. And harmonics can circulate endlessly through the system, causing overheating, burnouts, and fires. An effective ground is crucial in getting rid of these hazards. Reported cases include the elimination of production downtime on a metal deposition sputterer, maximized reliability of checkout cash registers, and improved range of telecommunications towers.

And don't overlook the threat of static electricity, either. Non-conductive materials (belts, conveyors, processed paper and textiles) in motion in proximity to electrical circuits can separate large charges that will eventually discharge to ground… right through sensitive circuitry if no better path is available. The propensity for destroying IC chips is only beginning to focus adequate attention on the problem of static. But it can ruin equipment, trigger explosions, and ignite fires. A firm contact between potentially charged surfaces and ground will effectively dissipate this buildup before it can randomly spark to a convenient ground path. One optical manufacturer reported the virtual elimination of circuit card failures on sensitive process-control equipment.

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The local ground provides much more than lightning protection alone. It is a valuable adjunct to the utility ground and can make the difference between a smoothly functioning electrical plant and one plagued by shutdowns and reactive maintenance.

Jeff Jowett is an Applications Engineer with AVO International, a manufacturer of electrical test and measurement equipment, including the Biddle and Megger brands.