Operational in Covington

TCS is happy to announce that its new headquarters location in Covington, Louisiana is fully operational. For the past three years, we had been located in New Orleans, just four blocks from the Louisiana Superdome. Our new location is in St. Tammany Parish and is just 35 miles north of New Orleans. Located in a lush Ozone Belt, the Covington area is known for its delightful woods, excellent restaurants and boutique shopping.

While building and settling into our new office has been a priority, we have also been busy expanding our business and adding new personnel. Our most recent consultant addition is Mr. Jack Hart. Jack is now resident in Kansas City, Missouri where he will be assisting TCS partner Dean Hart with projects involving the nine-county Mid America Regional Council.

Implementing a new radio system, soon? If so, you don’t want to miss Jack’s upcoming October article in Mission Critical magazine. Drawing from thirty years of field experience, he offers many useful tips on getting the work done right, the first time!

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WHAT IS WRONG IN THIS PICTURE?

A casual glance might not reveal any problems with the monopole and antenna installation on the right, but nonetheless, complaints about occasional noisy transmissions from this trunked radio site went unresolved for several years.

Do you see what we discovered less than twenty minutes on-site?

Clue #1: The receive antenna (not visible in photo) is mounted at the top of the monopole.

Clue #2: The transmit antennas are mounted on the three side arms.

Clue #3: The area of intended site coverage is to the right of the monopole.

Although engineers, a project manager or two and numerous technical personnel doubtlessly gazed skyward and saw this same view perhaps a hundred times, it didn’t dawn on any of them until well after sign-off that the transmit antenna to the left is directing its radiated energy through the steel monopole!

Whenever the trunked radio channels associated with the mis-installed antenna/sidearm were so assigned, field units in the intended coverage area heard noisy transmissions.

Having a “big picture” view of project goals, coupled with a dose of common sense, is essential and could have prevented the red faces and extra expense of this hugely preventable mistake.

Fire Service Concerns with Digital Voice and Trunking in General

Bring up the topic of 800MHz trunked radio with a group of firemen and the general consensus is they don’t like it. They don’t like what they’ve read about newly installed trunked radio systems having poor building coverage within buildings. That is a reasonable dislike since firefighters spend lots of time fighting fires inside buildings, so reports of poor building coverage instantly translates to a safety concern with them being in the crosshairs.

And, next in the category of dislikes comes the issue of cost….a particularly sensitive topic for those departments that rely heavily on volunteer firefighters. These guys often pay for their own communications gear. How can one argue away the fact that trunked radios are, indeed, three or more times the cost of conventional analog VHF/UHF radios? Surely with the deployment of standards-based Project-25 radio networks, where radios from multiple vendors are capable of interoperable communications, per-unit costs are expected to eventually drop. But, that doesn’t help Today’s fireman operating in Today’s mostly analog APCO-16 World.

Compounding the problem of fire user acceptance of trunked radio technology is a recent member alert issued by the International Association of Fire Chiefs (IAFC) where the APCO Project-25 digital vocoder…the device within radio equipment that converts analog voice into its digital equivalent, and vice versa…can misinterpret the sounds common to a fire scene to the point where voice communications becomes suddenly unintelligible.

According to the Association, distorted audio can result when Project-25 digital radios are operated near power tools, fire apparatus, self-contained breathing apparatus and other equipment typically used by fire fighters.

The Association has formed a Working Group to investigate this newly discovered problem, in cooperation with radio manufacturers, and is developing short and long term solutions. The issue of poor digital audio quality at fire scenes is a major concern for system owners, manufacturers and the radio consultant community. All of us have a stake in getting this problem resolved to the full satisfaction of the Fire Service Community.

For more information on the digital audio problem, please visit the IAFC website: http://www.iafc.org/digitalProblem. Additionally, you are encouraged to read our website articles involving improved communications and coverage for fire operations.
As we saw in Part I, lightning is among the most powerful and destructive natural forces. Although there is no true means that is 100% effective in preventing lightning strike damage, there are steps that can be taken to protect sensitive radio communications equipment from lightning damage.

There exist various methods for radio system designers to consider, each having its proponents. Generally speaking, these are based on shunting as much of the strike’s energy to ground along a designed path that directs the energy away from personnel and equipment as quickly as possible.

A prerequisite for effective lightning protection is a good site electrical ground system. The site ground’s design goal should be a measurable 5-Ohms resistance or less between any connected point on the ground bus and earth ground. Further, the interconnection links between equipment cabinets, components, and racks to the shelter’s interior single-point ground should be no greater than 0.01 Ohms. If soil conditions are less than ideal, there are ground enhancement backfill materials and chemical-type electrodes available to bring the ground system as close to ideal as possible.

A complete radio site ground system will provide low resistance bonding of the tower, antennas, transmission lines and the shelter component, itself. Pay close attention to guy wires, incoming telephone lines, standby generators, DC power plants and AC power entrance. To ensure all elements of the radio site operate at the same ground potential, use only compression connectors rated for such service, but, ideally bond all buried and outdoor attachments using exothermic welded joints (i.e. CADWELD®).

Site layout and design can influence a site’s susceptibility to lightning damage. If feasible, locating the tower at least thirty feet from the shelter provides added benefits:
- It increases the inductance of the transmission line between the tower and the shelter.
- It minimizes the magnetic field associated with lightning. This magnetic field can induce currents onto long conductors both outside and inside the shelter. Magnetic field strength drops off as the square of the distance.

If possible, consideration should be made to minimize the height at which RF transmission lines leave the tower. This will reduce the voltage on the transmission line before it enters the shelter.

Now that we have a fundamental understanding of those characteristics necessary for lightning-resistant tower sites, let’s discuss the electrical ground system’s elements in more detail. The exterior ground system consists of ground ring(s) around the equipment shelter and the tower/ice bridge, bonded together with all other metallic structures in the site compound, i.e. fences, generators, etc. Transmission lines should have ground kits installed in accordance with the manufacturer’s or system designer’s instructions.

Exterior grounding conductors should be solid or stranded bare #2 AWG or larger copper wire. Tinned solid copper wire increases corrosion resistance and should be used as a grounding attachment to a galvanized steel tower or guy anchor. The distance between ground rods in the exterior ground ring(s) should be twice the length of the ground rod (where space permits) or between six (6) feet (minimum) and twice the ground rod’s length (maximum). The exterior ground system ground rods can be bare copper-Clad steel, solid copper or hot-dipped galvanized steel; must have a minimum diameter of 5/8 inch; and a minimum length of eight (8) feet. Ground rods should be driven to depth of at least 30 inches below finished grade, or below the frost line, whichever is deeper.

The interior ground system should utilize single-point-grounding of any installed equipment in the shelter. All interior ground conductors should either have a green jacket or green with a yellow stripe jacket. This quickly identifies them as ground conductors. If you must use a conductor with a black jacket, then it must have green tape wrapped around it at points designated by NFPA 70 or local codes. All large-gauge conductors should utilize two-hole lugs with bolts in both holes and lock washers on the nut side. This will prevent the lugs from loosening if tugged on.

A halo ground should be run around the interior perimeter of the equipment shelter utilizing #2 AWG, or larger, insulated, copper conductor. If the halo is connected solely to the transmission line entrance, the halo should be an open loop with an approximate 12” gap in the conductor, ideally on the far wall directly opposite the transmission line entrance. Cable ladder sections must have jumpers at each connection point and the assembly bonded onto the Main Ground Bus/entrance.

The recommended method of grounding equipment cabinets/racks back to the Main Ground Bus is to run a ground bus conductor of #2 AWG or larger, stranded, insulated copper conductor from the Main Ground Bus to each equipment row. This is often called a “home run.” The ends of the ground bus conductor should be left unterminated at the end of the equipment rows. It should never be attached to the cable ladder or tray since this would create a ground loop.

Each equipment cabinet/rack should have a is a #6 AWG, or larger, insulated copper “drop” conductor, bonding the cabinet/rack ground bus to the “home run” conductor. All equipment installed within a cabinet/rack must be individually bonded to that cabinet or rack; do not daisy chain equipment grounds. These connections should be made using #14 AWG, or larger, stranded, copper conductor and appropriate terminations.

Ancillary support equipment and any miscellaneous non-current-carrying conductive objects not already bonded to the Main Ground Bus should be bonded to the split halo ground bus.
using #6 AWG, or larger, stranded, insulated copper conductors. These objects may include; metallic housings, doorframes, conduit, piping, vent covers, exhaust fans, fire suppression systems, metal cabinets or desks, etc.

Care must be taken that all connections between equipment and the single point ground exhibit low impedance. If crimp connections are necessary, ensure the proper crimp tool is used. If installing, for instance, a ring terminal/screw connection, ensure that a star washer is used for proper mechanical integrity and that any paint at the contact area is scraped before connection is made. Any connections involving dissimilar metals should be coated with an antioxidant compound to prevent corrosion.

Proper surge protection must be installed on all incoming cable connections to the shelter. This includes coaxial antenna surge protectors connected mounted to the Main Ground Bus. Surge protectors should be installed on copper telephone POTS/T1 lines and any external alarm wiring, i.e., generator, fuel, perimeter intrusions, etc.

Attention to detail cannot be stressed enough. A single missed or poorly installed bonding connection can negate all the time (money) and effort invested to protect your communications system. Ongoing testing/verification of the ground system should be added to the routine preventive maintenance schedule of your communications system. A clamp-on resistance meter (AEMC model 3711 or equivalent) can be used to verify continuity and check for high resistance connections in the grounding system.

Visual inspection for corrosion and “hands-on” checks of all connections should be done periodically to ensure that attachment hardware and fasteners are in sound mechanical condition. Taking all of these suggestions into consideration, in concert with a comprehensive plan to install and maintain an effective electrical ground and surge suppression system, will pay huge dividends in enhanced personnel safety and network reliability.

When evaluating radio user equipment for suitability within a new radio network, all eyes focus on the manufacturer’s supplied specification literature. This single document defines electrical performance, available features and how the equipment is likely to survive when used in environmentally hostile environments.

Electrical specifications are rooted by established test procedures and performance benchmarks well established in the industry. The bulk of these are defined by the Electronics Industry Association (EIA); the Federal Communications Commission and others. Mechanical specifications, while not technically mandated by any licensing agency, are geared to military expectations and more specifically MIL STD 810. This series of standards prescribe test procedures to certify a level of performance when specimen devices (in this case, radio gear) are subjected to hostile environments that include:

- High/Low temperature extremes;
- Mechanical shock and vibration;
- Prolonged storage;
- High humidity;
- Corrosive atmospheres;
- Blowing rain

It is relatively easy for those purchasing new radios to conduct meaningful electrical performance tests to verify conformance to published specs. That is, suitable test equipment is available on the market whose operating characteristics are traceable to nationally-recognized standards. Such equipment is readily accessible as it is the foundation of every professional two-way radio shop operating today. But, who ever tests fielded radios for compliance with the manufacturer’s impressive durability claims?

Next to no one.

The reason why is that the equipment needed for such verification is highly specialized, expensive and not readily available. So, most simply take the manufacturer’s word that their product conforms to published standards. Perhaps for most agencies, that word is good enough. Yet, two of our Midwest clients feel differently. Since 1997, some clients in the Kansas City area have requested our assistance in completing independent testing of random samples of public safety radio equipment.

The results through the years have been a mixed bag. Some equipment has performed as
advertised. Others had fallen short, particularly with respect to the very stringent blowing rain test. This is a very aggressive test, indeed: a rain rate of four inches per hour, driven at a rate for forty miles per hour. The radio and battery pack are subjected to these tests on four faces for at least one hour per face.

In all cases, manufacturers have been very cooperative in correcting manufacturing problems related to seen deficiencies. All employ stringent testing to assure compliance, but things change once a design is contracted out to manufacture. That right, most radio suppliers do not build their user radio products entirely in-house. Many use outside contract manufacturing firms and, in their quest to improve processes and efficiencies, contractors make subtle changes to assembly processes that unknowingly undermine mechanical performance. This we have learned through witnessing test results over many years is the root cause for specimen sets of radios failing their mechanical performance tests.

The good news is that radio manufacturers have been keen to make process changes and tighten quality control whenever these deficiencies have been reported. The bad news is that without such independent testing, one never knows if the radios just purchased truly meet specification. In some instances, it may not matter….not many folks ever subject themselves and their radios to the rigors of a blowing rain test!

But, firemen do. For them, potentially the relative effects of a blowing rain test could occur on any major fire incident. Any radio or battery that sustains water intrusion is a costly maintenance problem, at best….or, a mission-crippling failure at worst.

Just food for thought.