NEBS: IT'S NOT JUST FOR RBOCs ANYMORE

President – Dan McMenamin and Associates, Inc.
West Deptford, New Jersey, USA

ABSTRACT

Network Equipment Buildings Systems (NEBS) is a set of compliance standards criteria originally developed in the 1970's for the telecommunications industry by Bell Labs. Today the NEBS standards are owned and maintained by Telcordia Technologies, (formerly Bell Communications Research – Bellcore) and published in a family of documents, the principal ones being:

- GR-63-CORE NEBS ™ Requirements – Physical Protection
- GR-1089-CORE Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
- GR-78-CORE Generic Requirements for the Physical Design and Manufacture of Telecommunications Products And Equipment

GR-63[1] and GR-1089[2] catalog a series of compliance test criteria and GR-78[3] is a "road map" to designing and building equipment that will meet the requirements of the first two documents.

Originally funded and owned by the Regional Bell Operating Companies (RBOCs), the Telcordia standards were used by those RBOCs. However, the entire industry benefited from NEBS because most telecommunications equipment manufacturers wanting to sell their goods to RBOCs had to pass the very stringent compliance tests outlined in NEBS. Some manufacturers disliked NEBS because the tests were exhaustive and expensive; however, most RBOCs clung to NEBS because their engineers saw that doing so added value. Equipment certified to pass NEBS is more robust and generally more reliable. NEBS standards results in electronic systems that do not interfere with each other when installed in a common structure with literally thousands of other electronic systems and subsystems and fed by a common dc power bus. Coalesced to its core essence, NEBS equals a more reliable telecommunications network.

Most telephone company central offices are exempt from sprinkler suppression in rooms dedicated for telephone switching and transport equipment. This exemption is because the NEBS physical protection criteria include very exacting standards for fire protection such as the use of highly flame retardant, self extinguishing materials and RBOCs have internal standards for very early warning fire detection systems capable of detecting fire at the incipient stage. This exemption is critical because a water spray in telephone equipment room easily could cripple vital telecommunications services for wide areas. Fire in a central office is a very rare event usually contained to one or two overheating circuit boards. To date, in more than a century of telecommunications deployment, (113 yrs) and 7 significant fires, no one has died as a result of a central office fire. In the US, telephone switching centers are designed to meet or exceed NFPA-76[4], while their cousins in Data Centers must meet NFPA-75[5]. The flame retardancy and self-extinguishing criteria spelled out in NEBS is a significant influence on NFPA-76.

The NEBS standards have been updated many times since their inception. Today, teams of compliance specialists from telephone companies, manufacturers and Telcordia review and update the NEBS standards to ensure that today's standards reflect the industry's needs. Further, an organization of telecommunications carriers have formed an ad-hoc working group called the Telecommunications Carrier Group[6] and hold periodic meetings and conference calls with the goal of ensuring that NEBS standards keep pace with the evolving demands of telecommunications systems.

This paper will explore the various criteria in GR-63 and GR-1089 as they apply to battery and alternative energy storage systems intended for use in the telecommunications network and draw the conclusion that the NEBS criteria not only still offer value-added to the industry, and in fact may be more needed than ever.

INTRODUCTION

When discussing NEBS requirements, the obvious question literally jumps from the page: “What’s in it for me?” NEBS testing is critical and expensive. Manufacturers would prefer to save those dollars. Others fall short of NEBS standards and try to convince their customers that their equipment is “NEBS-enough” or “Near-NEBS” or they’ll tout their products as “Built to NEBS standards” while downplaying that their product may not have been tested to NEBS standards or that they failed some or all of the tests. What does a specifying engineer gain by including NEBS in his or her specs? The short answer is reliability. Products that undergo and pass the various NEBS criteria are rugged, robust equipment that should perform very reliably in the network.

NEBS criteria are layered into three sets of qualifications called Levels 1, 2 and 3.

Level 1
Many telcos will accept NEBS Level 1 compliance as the minimum criteria for proof of concept trials or Beta-tests but generally won’t accept Level 1 for field trials or general deployment of central office equipment. Level 1 defines the level of environmental compatibility needed to preclude hazards and degradation of the network facility and hazards to personnel. Conformance to level 1 does not assure equipment operability or service continuity. Operability criteria are assessed only in Levels 2 and 3.

Level 2
Most telcos accept NEBS Level 2 compliance as acceptable for network or power equipment deployed in remote shelters, vaults, outdoor equipment cabinets, customer premise installations and other less-critical applications. Level 2 defines the level of environmental compatibility needed to provide limited assurance of equipment operability within the network facility environment. This assurance of operability is limited to controlled or normal environments as defined by the criteria.

Level 3
Most telcos require NEBS Level 3 compliance for any telecommunications network equipment or power equipment intended for use within a central office. Level 3 defines the level of environmental compatibility needed to provide maximum assurance of equipment operability within the network facility environment. Level 3 criteria provide the highest assurance of product operability and Level 3 are suited for equipment applications which demand minimal service interruptions over the equipment’s life.

PHYSICAL PROTECTION CRITERIA

GR63-CORE[1] covers physical protection issues for telecommunications equipment. These include design ruggedness, fire and flame retardancy, spatial requirements, heat release, seismic and vibration requirements and other criteria. Equipment that passes the NEBS tests in these subject areas tends to be significantly more robust than equipment tested to less stringent standards. The difference can be equated to barreling across a wooded field driving a Humvee as opposed to tackling it in a sedan. Critical community systems such as the telephone network are sorely needed during times of natural disaster or other emergency. A major disaster would potentially be much more disruptive and result in significantly more loss of life and property damage if the telephone network fails during or immediately following the event. Rescue or restoration efforts would be hampered by ineffective communications. The experience of New Orleans and the Mississippi and Alabama Gulf Coast with Hurricane Katrina certainly serves as testament to the necessity for rugged telecom systems. While there isn’t much one can do about central offices physically swept away by tidal waves, certainly telecom systems should be fortified to withstand seismic stresses, nearby vibration from blasting or pile-driving during construction / demolition work and other physical and electrical perils. Most major manufacturers of telecommunications switching equipment offer frames tested to Seismic Zone 4. This fact also is true of the major power equipment vendors[7] but not all of the power equipment vendors.

The spatial requirements section of GR63 essentially provides equipment that will fit into a central office layout of aisles and other equipment rooms or spaces. For example, frameworks need a hole pattern for floor anchors that will permit the anchors to “miss” REBAR embedded into concrete floor slabs.

The frameworks themselves are required to resist seismic motions that would result in frame deformation or overturning. Passing these criteria generally requires rugged, welded steel frameworks rather than bolted frameworks or aluminum frames.

For example, the frames must be anchored well enough to resist a seismic Overturning Moment of Inertia force of 45Kg (99.2 lb) applied to the top of the frame in any direction.

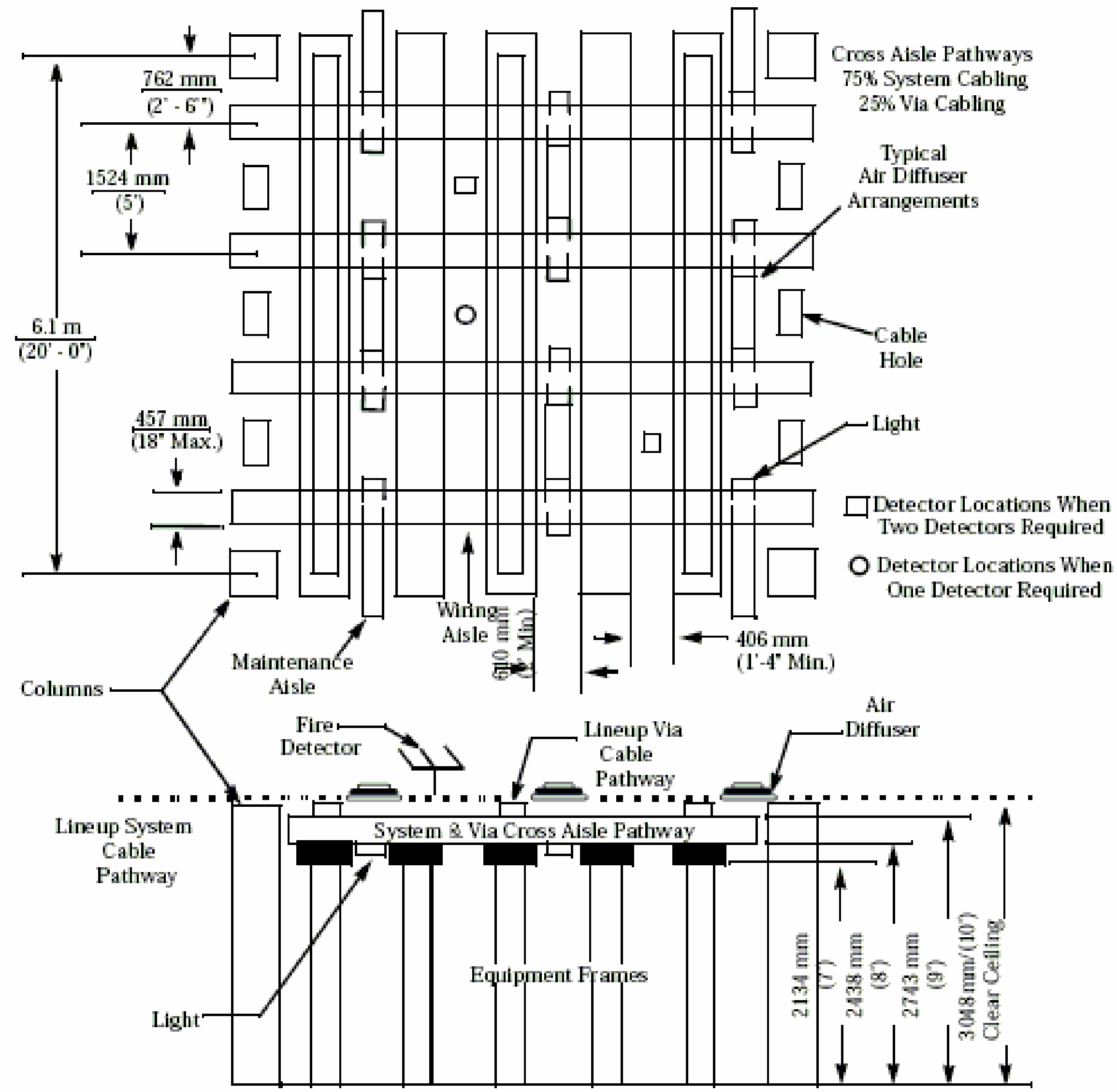

Figure 2-10. Typical Cable Pathways for 305-mm (12-in) Deep Frame Areas (Conventional Cooling System - Air Diffusers)

Excerpt from GR-63 showing typical aisle layouts, smoke detectors etc. (Used with permission – Telcordia Technologies)

Frames must fit through standard central office cargo door openings of 4' Wide by 8' high. Frames must form evenly oriented aisles so that equipment shelves do not project into walking spaces at the front or rear of the frames. A means to shim or level the frames to compensate for floor unevenness must be provided.

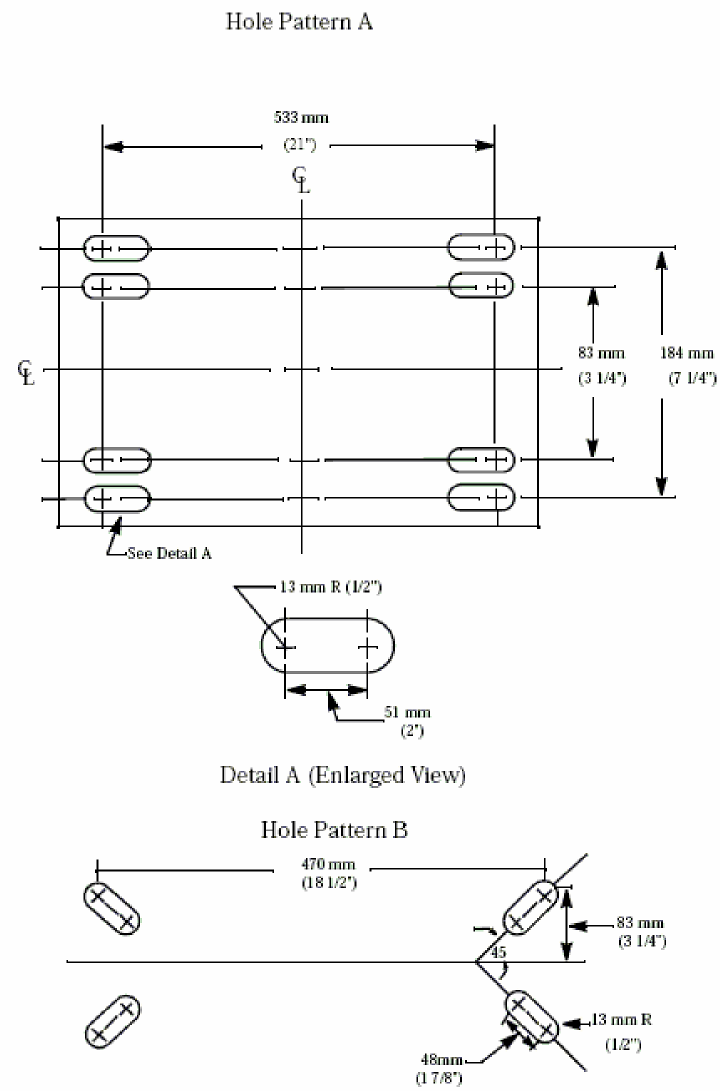

Figure 2-1. Framework Base (Typical) — Floor Anchoring Hole Pattern

O2-7 **[7]** The fronts of the base of all frames should be aligned.

Excerpt from GR-63 showing typical anchor layouts so as to clear rebar in the floor slab (used with permission – Telcordia Technologies)

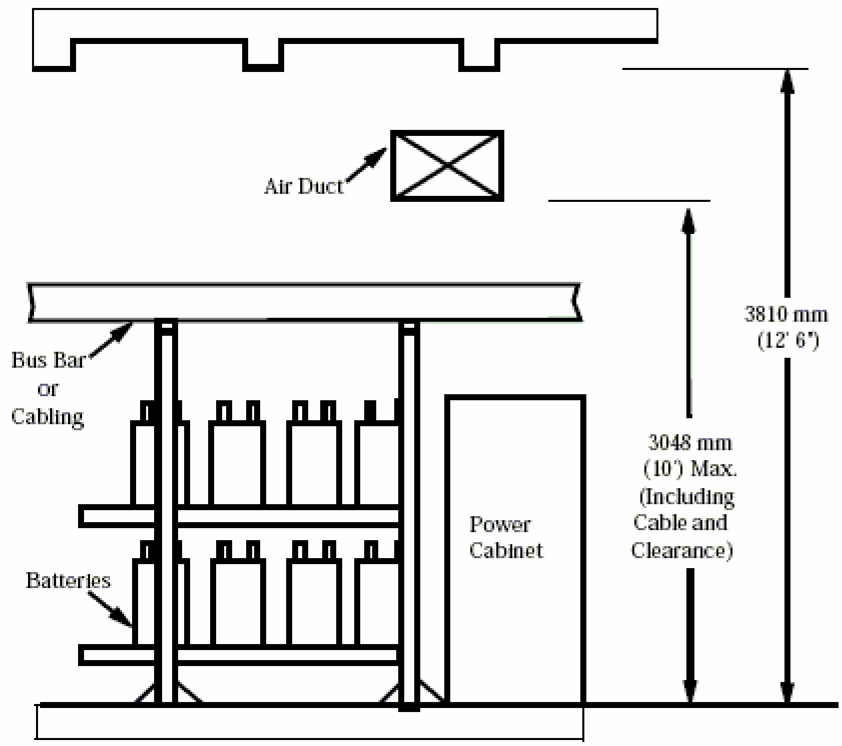

Figure 2-9. Typical Network DC Centralized Power Plant Equipment Area

Excerpt from GR-63 showing typical overhead clearances in power rooms (used with permission – Telcordia Technologies)

Flame Retardancy

The flame retardancy issue is significant. Class C fires (electrical fires) are rare but a fact of life when literally millions of circuits are crammed into relatively small spaces. The ignition of a telecom equipment fire is a bad thing. The spread of such fire is much worse and so the NEBS criteria call for the use of materials that are self-extinguishing in nature. These materials will cease burning when they are removed from the heat source. In the case of a Class C fire, the heat source is the power itself dissipated in Joule I^2R heating across the faulted component. As an example: a circuit board fails causing a short circuit across a component such as a resistor or capacitor and that component begins to burn. The overheating component – or even arcing across parts of that failed component produce large amounts of heat that in turn cause nearby plastics or other elements of "fuel load" for a fire, begin to melt and burn. Due to gravity, much of this now-molten material will fall away from the heat source. The objective is that this molten material must self extinguish within a finite number of seconds so as not to propagate the fire by initiating collateral fires on whatever "fuel" the mass falls onto.

Two industry standard tests determine the ability of a material to self extinguish. One is the Underwriter's Laboratories UL94V Vertical Flame Test[8] and the other the ASTM 2863-77 Standard Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics[9] (Oxygen Index).

In the UL 94V classification test, a specimen of certain size constraints is held vertically and a burner flame is applied to the free end of the specimen. The flame is applied for two 10 second intervals separated by the time required for flaming combustion to cease after the first application. A V-0 rating is assigned if burning stops within 10 seconds after two applications of the flame and no flaming drips are observed. A V-1 rating is used when burning stops within 60 seconds, again with no flaming drips. Finally the V-2 is used when the burning stops within 60 seconds, but flaming drips are observed. Ratings of 5VA and 5VB indicate passing very stringent tests where he flame was applied 5 times to the specimen under test. %VA and 5VB are also acceptable for telecom equipment. Note that some materials that fail the Vertical aligned tests are sometimes placed in a horizontal alignment and these "pass" with a rating of HB for Horizontal Burn. Materials with a UL 94 rating of HB are not an acceptable for telecommunications equipment, wiring or cabling.

The industry has made an effort to reduce the cost of testing by harmonizing one test standard with another when doing so made sense and didn't "water down" the standard unreasonably. The UL 94V flame test is now harmonized with other industry tests including IEC 60707, 60695-11-10 and 60695-11-20 and ISO 9772 and 9773, however UL 94V is the test specified in the NEBS criteria and so that's the test rating to which Telephone Company engineers will expect to find.

The ASTM Oxygen Rating test using the ASTM D2863-77 TYPE A is a standard set by the American Society for Testing and Materials (ASTM). ASTM D2863 is a method to determine the minimum concentration of oxygen in an oxygen/nitrogen mixture that will support a flaming burn in a plastic specimen. There is no correlation to real end conditions however this requirement is a very useful test to predict how materials will behave when heated. Per this test standard, the minimum concentration of oxygen/nitrogen mixture is 28%, which is a slightly higher concentration of oxygen than is usually found in atmospheric air. If a material just barely supports flame in an environment of 28% oxygen, it will not support combustion in a "normal" atmospheric condition of roughly 24% O_2. Many plastic parts for telecommunications use are made of PVC for example because PVC has a Limiting Oxygen Index of 32 meaning that it just barely supports a candle-like flame in an atmosphere artificially enriched to 32% oxygen. PVC self-extinguishes very readily in atmospheric oxygen.

ELECTROMAGNETIC COMPATIBILITY AND ELECTRICAL SAFETY

The various tests and criteria under GR-1089-CORE include: ElectroStatic Discharge (ESD), ElectroMagnetic Interference (EMI), lightning and ac power fault, steady state induction, dc potential difference, electrical safety criteria, corrosion, bonding and grounding. Essentially, compliance with GR1089 assures that systems will not become an unintentional transmitter that might interfere with nearby systems, nor an unintended receiver where operational interference might occur. Also, the equipment would be bonded and grounded well enough to be safe for personnel and fault tolerant from energy induced by nearby lightning strikes and will be robust enough to provide reasonable protection from ESD. With the ever-growing "mix" of equipment types in a central office today, the importance that systems not interfere with each other is greater than ever. This statement is true whether the interference radiates or is conducted from one unit to another over the common power bus cabling. Indeed,, some years ago, an "off-the shelf" dc powered fluorescent lighting ballast generated a noise frequency that was conducted over the -48 Volt dc wiring and bus. The electrical noise caused all of the rectifiers (battery chargers) on that power plant to malfunction. Such "Conducted emissions" can cause serious problems in the telephone network and the tests for this type of energy are very critical to network reliability. ESD testing also is critical to assure that normal handling isn't going to damage the equipment. The industry has experienced very critical systems that have failed when a so-called "Sweet-spot" is touched and an ESD event causes the equipment to malfunction, or even a battery cell to explode. For personnel safety and reliable equipment operation in lightning prone areas the bonding and grounding requirements of GR-1089 are both critical and practical.

We're at Battcon, is all this important to a battery guy?
This author believes the answer is "yes." Consider a fairly typical medium-sized urban telephone central office -48 volt dc power plant of 5,000 Amperes load and a 4-hour battery reserve. Such a plant could have twelve (12) parallel strings of 4,000 Ampere Hour cells or more strings of smaller sized batteries. If the main bus or a bay of chargers was to shift during seismic motion and fault to ground, the available fault current from the battery could exceed 300,000 Amperes plus another 6,000 – 10,000 Amperes from the chargers. That much fault current can impose a lot of damage! Further, some -48 Volt dc plants are as large as 10,000 Amperes and/or can have as much as an 8-hour reserve or more with fault currents upwards of a half-million Amperes. Aside from the risk of fire, batteries have lead plates, bridges and other relatively brittle internal structures. These structures should be capable of surviving certain vibration levels without experiencing metallic fractures that could reduce the ampere hour capacity of a battery or even render it completely useless. Additionally, jar fracture or seal failures can reduce battery effectiveness, halt gas recombination leading to cell dry-out, leak free electrolyte or expose accumulated hydrogen to the risk of explosion. Even spill containments can have their issues as evidenced by a fire a couple of years ago in a central office where the absorption bags caught fire and destroyed the battery as collateral damage. Many telcos now insist upon spill containment systems with flame retardant bags and absorption materials. From an ESD perspective, a battery with an ESD "Sweet-spot" isn't going to sell very well after that first cell or the technician who touched it makes a mess of someone's power room.

Because lead acid and Nickel Cadmium batteries are a dense, heavy technology, floor loading is a significant issue. Floor loading is one of the factors that drove most telephone companies to require that Competing Line Equipment Carriers (CLECs) taking up residence in their central offices under FCC mandated Collocation arrangements to use dc power supplied by the Incumbent Line Equipment Carriers (ILEC). Generally, the floor loading needed for batteries is significantly more dense than what is needed for electronic systems. Most central offices have only a limited space available where the floor is built for the high load floor space needed for batteries often in basements or first floors and so the number of battery plants needs to be limited[10]. The same is true of Telecommunications "hotels" and internet "hotels," equipment built to house a number of competing carriers. Generally these installations have centralized dc power plants and lease protected dc power including battery backup to their clients[11]. Newer battery technologies based on Lithium are much lighter and may find themselves moving "upstairs" with the equipment although the fact that some types of lithium battery require external heaters to maintain the high operating temperature needed for that technology, may find conflict with NEBS thermal (heat release) criteria.

How does NEBS square with the development of emerging technologies such as Fuel Cells, Lithium Polymer or Lithium Ion batteries, super-capacitors and other power sources? The manufacturers of new systems generally learn very quickly that the RBOC companies for the most part are going to require NEBS conformity as a condition of purchase[11]. Some manufacturers of Lithium batteries and Proton Exchange Membrane type fuel cells already have tested their products to the NEBS requirements and have found that doing so "gave" them a better product [12, 13,14]. Clearly though, smaller players are having a tough time of justifying to their investors that the NEBS process is going to add cost and time to marketing the product. When equipment fails NEBS tests, this issue may add 2 – 3 months of redesign to the process and cost upwards of 10% of a venture capital money infusion[15]. Venture Capitalists cast a wary eye towards a financial figure they call a "Burn Rate". Simply stated, Burn Rate is the amount of money "burned" before a product is on the market and profitable. Equipment intended for telecom service has a significantly higher Burn Rate than do consumer products or Information Technology systems[16].

NEBS qualified equipment may cost more than equipment not required to meet the more stringent criteria. Is the additional cost justified in a competitive marketplace? This author thinks the answer is "yes," the added cost is more than made up in system reliability and crisis avoidance. Increasingly, telephone companies that are not traditional RBOC companies are specifying NEBS qualification. There's a lot more to competition than the first cost of equipment. A good many telecommunications engineers are learning the hard way that they can't afford the money they "saved" by purchasing equipment based upon first cost versus life-cycle cost. Generally, NEBS qualified equipment typically has a longer life-cycle and causes fewer problems in conflicts with neighboring systems and equipment. One example is in transport equipment and ElectroMagnetic Interference (EMI). A tremendous amount of telecommunications equipment operates on a T-1 Carrier digital line format. T-1 is a bipolar bitstream operating at 1.544 Mb/s. The 100th harmonic of this signal is a direct match for the 155 Mhz radio frequencies used by many fire departments. There are multiplexers and other systems sold into the marketplace that have not met NEBS criteria for radiated or conducted emissions. Also, there are some systems sold that include covers as an extra cost option that some engineers do not buy. The problem is that when T-1 isn't shielded or contained by covers etc, leakage of the T-1 signal can result in "dead-spots" where fire service radios won't work. When Fire Departments report these dead spots to the FCC, they in turn inform the equipment owner that this interfering signal must be shut down until an effective leakage mitigation is in place. A telco is then faced with a daunting and costly problem that could have been avoided by buying NEBS qualified equipment from the beginning.

Survey says?

From a customer retained-revenue viewpoint, NEBS comes out a winner because the fastest growing base of customers in both the US and international markets is cellular service. Of the studies that JD Powers and Associates did on the industry two important factors are revealed. Call quality is a critical component of the Customer Service Index measured by JD Powers and Associates. Customers make purchase decisions based in large part on the quality of service they receive from their service provider. The phone has to work when and where people need it to work. This fact is particularly true in emergencies. During the rescue and clean-up effort from the World Trade Center emergency responders clamored for cell phones from one particular carrier because their network had working service in the area while other carriers were off the air. People have long memories for service quality. The 2005 JD Powers and Associates CSI Report[17] revealed that overall customer satisfaction had slipped a bit but that the least slippage occurred in areas where customers were pleased with the quality and connectivity of their calls. Indeed, the 2003 JD Powers and Associates CSI Report[18] revealed that fully 26% of telephone customers were switching to other carriers, many of them in an attempt to improve their perception of service.

This so called "Churn Rate" of migrating customers deserves serious focus because the cost to acquire each new telephone customer varies somewhere between $300 and $425 US Dollars (2003 valuation) [19]. Multiply that figure by 26% of any telco's customer base and the result becomes disconcerting. Whatever the cost, a wise mechanic invests in the most reliable tools and equipment he or she can find and so should a telephone company.

During his keynote address at the 26th International Telecommunication Energy Conference (INTELEC '04) in Chicago, Verizon Wireless Chief Technology Officer, Dick Lynch made no bones about his vision that he wants customers to perceive his Company's service as markedly different from the others based upon a higher quality of service and a reliable network. In lockstep with that philosophy, Verizon Wireless' advertising is stressing the point that their cadre of employees stand solidly behind the network in order to assure reliability. In the power and battery side of the telecom business, that thinking translates to robust, reliable systems that might cost a few bucks more in first-cost but pay significant dividends in customer retention and reduced life-cycle cost.

Are there too many competing standards between UL, FCC, ANSI, T1E1, NFPA, NEBS, CSA, ICC, ETSI (European) and Asian standards? As mentioned previously the industry is working to harmonize compliance standards to produce test criteria that result in rugged reliable systems[20]. That said, NEBD is a little more stringent than some of the other standards and yet most engineers in the industry readily agree that the areas where NEBS is more stringent are areas where it is important to a rugged, reliable telecommunications infrastructure.

Does every test in the NEBS documents apply to batteries?

Clearly no, not every test in the NEBS criteria apply to a battery – depending on the battery. Many of the NEBS tests are intended for electronics. A couple years ago a vendor had his particular brand of cable lugs tested and then marketed the product as the "only NEBS Level 3 lugs sold in telecom[21]." This marketing strategy demonstrates that their customers said "We want NEBS" and they responded. Certainly there are very few tests in the NEBS documents that would apply to a lug, possibly the sections of GR-1089 that specify copper or plated copper only. Many of the NEBS tests do make sense for batteries and certainly for emerging technologies. Some of the Lithium Polymer batteries for example have electronics built into them and radiated, or conducted EMI issues are possible. Would such a battery be problematic if some noise tone entered the bus from some dc-powered piece of equipment and caused the battery electronics to change parameters? Conversely, what if the electronics in the battery sends an EMI signature that causes malfunction in some piece of equipment that is powered down the bus? Will a vendor's battery handle seismic or vibration stress? If someone is using a pile driver across the road does a telco want a battery that may fracture internally? What about flame retardance? Most telcos insist on flame retardant materials even in the battery jars and covers. These are the kinds of problems that NEBS is designed to sort-out and correct before the products reach the network.

War stories

Unless he or she has only been in the telecom business a short time, nearly every telco person in the room remembers many critical instances and circumstances when the telecommunications network stood tall in the face of adversity. The rugged reliability that NEBS standards ensure are a compelling factor in those success stories.

During a prolonged summer wave of heat and humidity in the mid 1980's, a Philadelphia central office lost cooling to its upper eight (of 15) floors when the drive motor for a 120-Ton centrifugal chiller experienced a catastrophic failure and it would take almost a week to obtain replacement parts and get the refrigeration back on line. The telephone systems affected by the HVAC failure included switching and transport for more than 60,000 lines, 75,000 special services circuits, all mobile telephone services in and around Philadelphia, network TV and radio between the various television studios and their transmitting facilities (antenna farm) and also the transmission path for all major TV networks routing South from New York City. Also affected were military circuits, Maritime Radio telephone, Safety and Calling, all Special Operator functions and the dc power plant that fed everything mentioned herein. Of the 60,000 lines affected, some 7,000 were for the city government of Philadelphia and all the various emergency and municipal services needed to cope with the heat wave and the telephone systems of several downtown hospitals. Among the special service circuits affected included bank data circuits, ATMs, traffic light controllers, fire alarm signaling, military circuits, Air traffic controller data circuits and on and on.

While failure is not an option in such circumstances, failure looms as a very distinct possibility. In the case of this HVAC failure despite temperatures that caused chunks of expanding plaster to fall from the ceilings, the only service failure experienced was the loss of some recorded announcements in one of the switching systems. So for a couple of hours when customers mis-dialed, they didn't hear the familiar announcement telling them what they did wrong.

When a significant earthquake struck San Francisco in 1989, most telephone systems kept working. The Admiral Nimitz Freeway and literally hundreds of homes and office buildings collapsed trapping thousands of people and ruptured gas mains burned throughout the city. The telephone system continued to operate, a fact that helped save many lives. One dramatic demonstration came when a fireman – in the rubble of a home – picked up a melted telephone set and heard dial tone.

Perhaps one of the most compelling success stories for telecom occurred on nine-eleven at 140 West Street in New York City following the horrific collapse of the World Trade Center "Twin towers". Tower debris and I-beams fell into the telephone building literally tearing away the exterior walls and windows and leaving cabling and air ducts hanging out over the sidewalks below. Inside, the raised floors had buckled and switching equipment frames tilted like so many dominos waiting to fall, but for the cabling and racking holding them up. This switching system continued carrying vital traffic until the batteries drained. Once power was restored the system came right back into service. Wall Street was up and running the following Monday, a credit to the rugged robustness of the equipment and a Herculean effort by the people who responded to this attack against our country. Again the ruggedness wrought into the NEBS qualifications had produced a system that served the community in its time of real need.

Conclusions

Batteries may be a commodity product to a battery manufacturer, but they are part of a system when they are installed into the network. As part of that system they need to meet the demands of that system and increasingly that means qualifying the applicable NEBS tests. Technology may make NEBS easier to pass for some vendors. Obviously a fifty pound Lithium product is going to be easier to brace against seismic forces than several hundred pounds of lead.

Apart from the muffled screams of a few venture capitalists and hot-to-trot marketing guys the most significant sound in the telecom equipment marketplace remains the quiet, steady voice of the guy with the purchase orders asserting "It needs to be NEBS qualified." With increasing numbers of non-RBOC telephone equipment buyers joining that chorus increasingly the vendor companies are responding in-kind. The companies who dug-in their heels until this NEBS business blows over are finding themselves selling to a smaller audience. The NEBS standards have evolved over the course of thirty-plus years and are not "blowing over" anytime soon. While everyone freely admits that NEBS adds cost and despite declining Capex budgets in the telcos, NEBS remains a requirement. Many telcos are driving down the cost of equipment by flexing the muscles gained through mergers and increased volume buying power. Competition remains keen in telecom. The playing field is more level than it ever was before and the rules of engagement closer scrutinized. Especially in the wireless marketplace the strategies are trending away from their customers saying "give me cheapo telephone service" to "give me reliable, high quality telephone service with oodles of features." So far as NEBS is concerned with telcos, for the foreseeable future, the outlook is that the vendor community must lead, follow or get out of the way. NEBS is a 600 pound gorilla and it's getting a little stronger each year.

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