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PUBLIC SAFETY Communications

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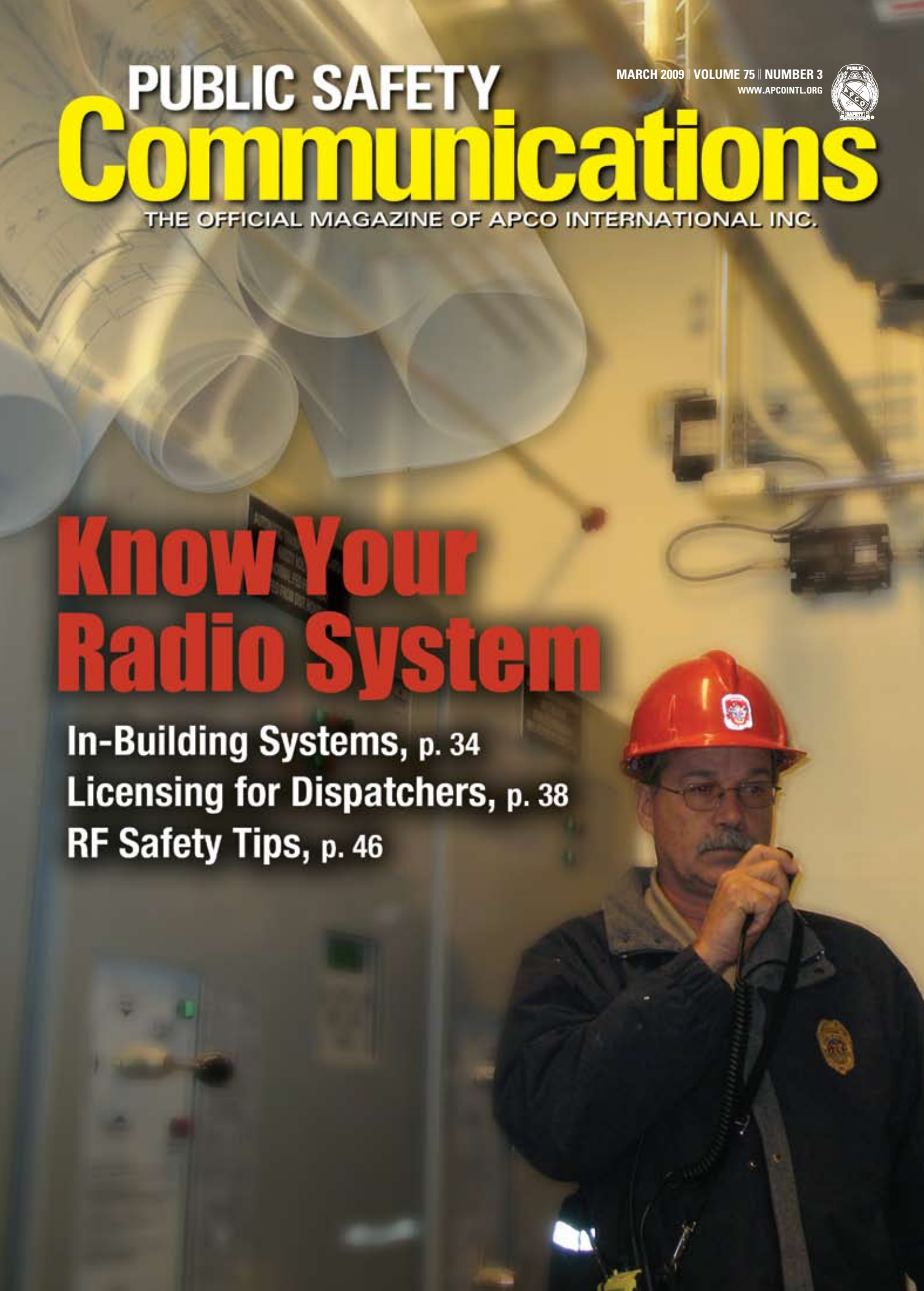
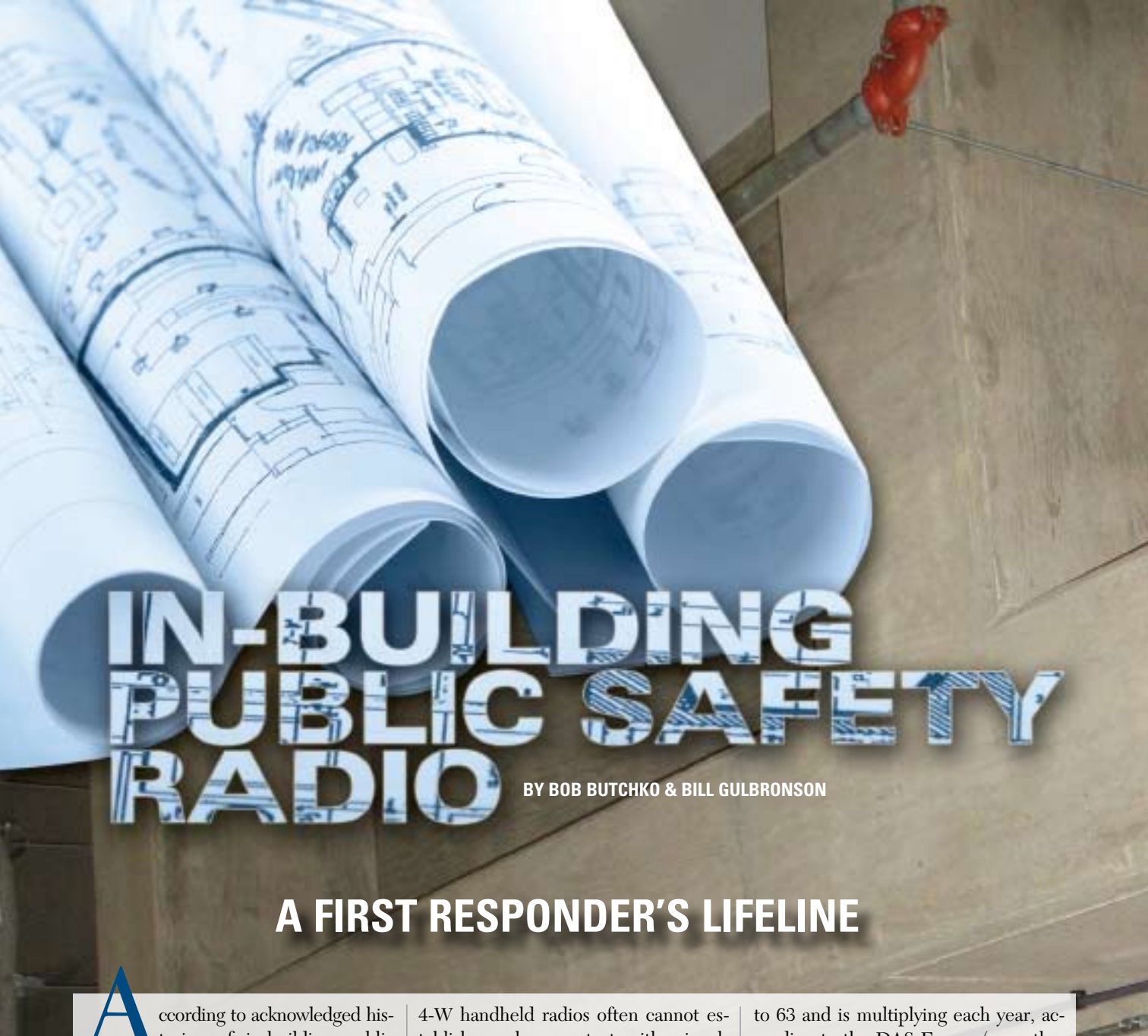


Know Your Radio System



IN-BUILDING PUBLIC SAFETY RADIO

BY BOB BUTCHKO & BILL GULBRONSON

A FIRST RESPONDER'S LIFELINE

According to acknowledged historian of in-building public safety radio, Jack Daniel, the first in-building ordinance was put into effect in the City of Burbank, Calif., in 1991. Since 9/11, there has understandably been a heightened focus on providing first responders with completely reliable radio communications regardless of the location or situation during emergency events. To date, much of the focus has been on communication among intergoverning jurisdictions—first responder interoperability. Now, attention is being paid to providing the same guaranteed level of clear, reliable communications services to first responders wherever they are within large residential or commercial buildings: in-building public safety radio.

First responders who solely rely on 4-W handheld radios often cannot establish, or lose contact with, signals in difficult signal-propagation environments, such as building elevator lobbies, basements, garages or any areas where reception is weak or absent. The installation of a correctly designed and installed in-building public safety radio system resolves these issues. Commonly these building-wide or "enterprise systems" are referred to as distributed antenna systems (DAS). Other designations include radio enhancement, signal booster or repeater systems.

More and more government entities around the nation are requiring these services be provisioned and certified before new buildings can be occupied. In 2002, 11 jurisdictions in the U.S. had enacted or proposed signal booster ordinances. That number has now grown to 63 and is multiplying each year, according to the DAS Forum (www.thedasforum.org), a nonprofit organization based in Alexandria, Va., dedicated to the development of the DAS component of the nation's wireless network.

These early-adopter municipalities have broken ground for others to follow, but now there is nothing to stop your city or county from making sure you have loud-and-clear communications anywhere in a building during an emergency event. As announced late in 2008, the NFPA 1 Fire Code 2009 Edition gives you a technically correct and legally sound in-building radio system regulation template for inclusion in local fire codes. (See Annex O: In-Building Public Safety Radio Enhancement Systems.) This has been expected for some time and should make it much

easier to incorporate such regulation into local fire codes, accelerating rapid adoption in the U.S.

WHY IS IN-BUILDING AMPLIFICATION NEEDED?

Adequate in-building communications can provide the public safety firefighter, police officer and/or emergency medical responder and the public they serve critical voice communications into and out of any structure, regardless of size, location, design complexity or building materials used. In the past, this communications link almost always suffered in some way due to the lack of signal penetration from the outdoor macro emergency communications system. Although most municipal emergency communications systems in the country are robust and fit for their intended purpose, radio signals simply don't penetrate sub-grade spaces, such as parking garages, regardless of adequate or even superior outdoor/clear-air signal strength.

To compound the situation, new construction requirements, such as LEED 1 building design, and the construction industry's laudable desire to be "green" may, in some ways, increase attenuation and further negatively affect the ability of any municipality's emergency communications signal to penetrate and be distributed within a newly constructed building.

HOW DOES IT WORK?

The clear air emergency 800-MHz signal is captured by a rooftop mounted antenna. Cables direct the donor signal down to a bidirectional amplifier (BDA), where the now weakened signal is amplified and distributed to all areas of the structure via the DAS. This is the *downlink*.

Whenever a first responder keys their emergency radio, a strategically located antenna, which is part of the DAS, picks up the transmission and carries it to the BDA to be amplified/reenergized and then broadcast out of the same rooftop antenna to the macro system. This is called the *uplink*. Of course, all of this happens in fractions of a second.

WHAT STRUCTURES REQUIRE AMPLIFICATION?

Most ordinances apply to all newly constructed commercial buildings. Amplification is almost always needed on sub-grade floors, parking garages and floors in buildings greater than 25,000 square feet. Also, this amplified coverage will be required per floor, and to all floors of buildings greater than three vertical stories in heights of Type I and II construction. These requirements generally do not apply to areas within an individual dwelling unit.

PHOTOS BOB BUTCHKO

A roof-mounted antenna serves as the anchor point for an in-building public safety radio system.

HOW ARE BUILDINGS TESTED?

Tests should be made by using the locally designated control frequencies within the stated band and coordinated with the municipality's public safety comm center. Guidelines for these measurements should include using a service monitor with unity gain antennas on a small ground plane. A variance of no more than 3 dB between simultaneous measurements should be allowed. The signal strength, both downlink (inbound) and uplink (outbound), should be measured on each and every floor above- and belowground, including stairwells, basements, penthouse facilities and the structure's parking areas. The structure to be tested should be divided into 50-foot grids, and the measurements should be taken at the center of each grid. In police substations and fire command posts the grids should be subdivided into four 25-foot grids in place of each 50-foot grid.

Required level of signal coverage:

- Signal measurement should be required to be -95 dBm or better at a given point.
- The entire building should be 95% or above covered (including all underground levels, basement, elevator lobbies, stairways, etc.) 95% of the time.

If the above requiremners are satified, the in-building signal amplification system will, at minimum, provide coverage at delivered audio quality (DAQ) 3.4 level or above. DAQ 3.4 is defined as "speech understandable without repetition; some noise/distortion present."

Important note: -95 dBm is considered the threshold at which "speech understandable without repetition; some noise/distortion present" is 95% guaranteed in all conceivable emergency conditions.

Eric Parker, an Alexandria, Va., police department radio technician, inspects a new building just outfitted with a public safety radio amplification system. He takes thousands of readings and then determines if -95 dBm signal strength is present in at least 90% of the structure.

COMPLIANCE

Radio coverage and in-building signal amplification systems must be tested and inspected by approved individuals and the local authority (i.e., fire inspectors, radio shop personnel, etc.). The fully documented results of the testing and inspection should be certified to the code official prior to issuance of an occupancy permit.

When an in-building system is installed, all active components should

ideally be tested once during a 12-month period. If communications have degraded or if tests fail to demonstrate adequate system performance, restoration should be made to ensure compliance with the original approval criteria.

FIRST RESPONDERS

For first responders, in-building systems to enhance radio signals may make the difference between life and death. Police, fire and EMS personnel are frequently called upon to respond to emergencies inside buildings and are often the first to know that a building has poor radio reception.

"We have been pushing for these in-building radio systems for some time," says Mark Barrick, a fire inspector for Montgomery County. "They will definitely save lives."

"Loud-and-clear radio communications during any emergency are indispensable," says Neal Hobbs, a fire inspector for Montgomery County, Md. "The last thing any firefighter wants to hear is that loud 'bonk' when your radio cannot get into the system; it's really frightening and can be life-threatening. These in-building amplification systems will be a first responder's lifeline for sure."

Mark Barrick, a fire inspector for Montgomery County, Md., says in-building radio systems will definitely save lives.

THE REAL ESTATE DEVELOPERS

The reality is that in the commercial development and construction world, someone must pay for the design and installation of these systems. That burden falls on the real estate developers in most cases.

Mike Kearny, a senior VP at The JBG Companies, one of metro D.C.'s largest and most respected developer, put things in perspective: "As a commercial real estate developer, [I always make] safety a top priority. These new in-building public safety radio requirements are like the advent of sprinkler systems several decades ago. Distributed antenna systems are now another part of the life-safety infrastructure of any new commercial building. The JBG Companies are proud to do their part to ensure first responder communications in our projects."

THE VENDOR COMMUNITY

As the rapid adoption of in-building public safety radio systems moves toward standard practice, there will be a groundswell of companies that desire to go after these projects. As a word of caution, these systems are not a matter of mounting antennas and pulling cable. *These systems need to be carefully designed to provide the correct signal coverage throughout the entire building. They must never degrade or interfere with the emergency communications system as a whole and create an optimal "interference-free" in-building RF environment.* For example, the careful planning of antenna positions allows for a low-attenuation radio link, thus greatly reducing fading effects. Excellent radio links are achieved with low downlink and uplink transmit powers.

These in-building DASs should be engineered and installed by those competent and experienced in wireless and communication systems, specifically those that have installed public safety systems in a variety of challenging or mission-critical

The radio signal is intercepted by a rooftop-mounted antenna, and cables direct it through the building via the DAS, where the weakened signal is then amplified by a BDA and distributed to all areas via cable and indoor antennas.

environments. A valid FCC license should be made available if testing is done on frequencies different from police, fire or emergency medical frequencies. Many municipalities also require a professional engineering seal to complete the compliance paperwork.

The challenge for CRE developers and government organizations is to find expert and experienced vendors that can design an in-building enterprise system to ensure the building is not only first responder ready to the letter and spirit of the regulations, but also able to create efficient designs with cost savings in mind. ||PSC||

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