RAYCAP ARTICLE

How to Prepare 5G Cellular Sites for Climate Extremes

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Climate change creates more challenging environments for small cells

Climate change is increasing weather extremes

The industry is well aware that critical cellular infrastructure must be protected. In particular, higher heat, wind shear and incidence of lightning will all become bigger threats to the operation of 5G equipment in small cell and macro cell sites. Manufacturers of equipment and enclosures for these sites must perform careful thermal analysis, ensure mechanical strength of poles, and build in overvoltage protection (OVP) solutions.

Our warming atmosphere is spawning more severe weather events that impact critical infrastructure including 4G/5G wireless networks that are scattered in cities and rural areas from coast to coast. We can see the evidence in increasingly higher temperatures. In 2021, an early summer heatwave broke records in multiple states across the U.S. West, with temperatures above 100° for days on end. At the same time, the 2021 hurricane season went down as one of the most active, with the count of 21 storms well above the historical average of 14.

Similarly, lightning strikes are predicted to become more prevalent with global warming, increasing 50% over this century. For example, a severe lightning storm broadsided the central and northern portions of California with more than 15,000 lightning strikes during the weekend of August 15th, 2020.[1]

Small cell sites need careful thermal analysis for higher temperatures

First, let's consider the impact of higher temperatures on 5G sites. Within urban environments, 5G equipment often requires concealment to remain inconspicuous to passers-by. In addition, it is often mounted in small cell enclosures on light poles and buildings to optimize line of sight and signal quality for mmWave and C-band radios. As a result, the enclosures can be small and densely packed with equipment – both in pole-toppers and shrouds mounted on pole sides or buildings.

Doing a thermal analysis of performance of these 5G sites under increasing temperatures is crucial for long-term viability of the equipment. Engineers can look for hot-spots and move equipment around in the enclosure to improve air flow and lower operating temperatures. Sometimes that isn't enough. For example, Raycap performed thermal analysis on small cell integrated poles for Arlington County, VA to ensure that the small cells could withstand that region's high summer temperatures. To ensure consistent performance, they added an active ventilation system to the final designs.

Small cell poles and enclosures need to stand against higher force winds

A warming atmosphere is generating more storms that are more powerful. The weather events often last longer, move farther inland, bringing high winds to more areas, and become key considerations for 5G sites mounted on existing utility poles. Each major municipality will have regulations on pole wind shear strength depending on the expected intensity of their storms—figures that will only increase in the future.

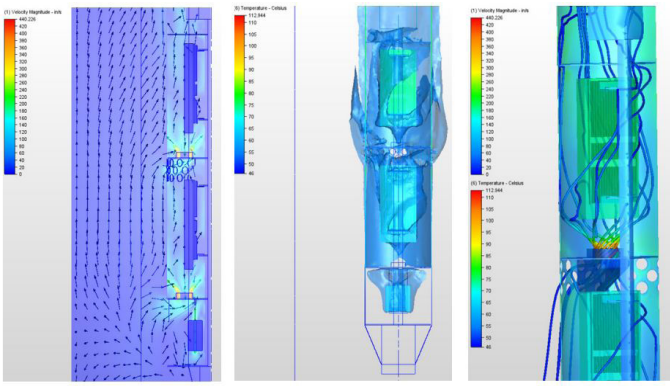

Figure 1. Example thermal analysis on a small cell pole

Carriers and integrators need to consider the impact of equipment loads on small cell poles while also considering municipality regulations. The pole toppers are more exposed, but they hold a smaller, lighter array of cellular equipment such as 4G antennas and 5G radios. Mid-pole mounted shrouds contain 4G radios and other active electronic equipment and so are heavier, but their position puts less strain on the pole. An existing utility pole may also have other equipment (such as cable broadband boxes), lighting, and decorative banners. Therefore, it has become more critical to run structural analysis to determine whether the pole will hold all its loads during high levels of winds.

Integrated small cell poles need to perform under the same requirements. Fortunately, these bespoke products can be engineered to meet structural load and other needs. For example, Raycap designed a street lighting pole for the country's Southeastern region, which had 170 mph maximum wind load requirements.[2] As a result, for this project, we adapted our standard integrated pole design to use a thicker wall pipe and more robust steel than other parts of the country. We have this level of control because we manufacture our integrated poles at our N. Charleston, S.C. facility.

[1] *https://calmatters.org/environment/2021/09/california-fires-lightning/*

Figure 2. Raycap integrated small cell lightpole in Miami Florida

Small cell electronics needs strict protection from lightning strikes

Increased likelihood of lightning means more strikes on cellular towers and building-mounted sites. The threat is most significant in urban areas, where tall structures increase lightning strikes by 150%. While the lightning strike's energy is dangerous, the fast impulse of energy creates destructive surges in adjacent conductors through magnetic induction, capacitive coupling, or direct galvanic connection. Such indirect effects are even more common and can travel through power mains to nearby equipment, causing significant damage if not mitigated adequately through effective surge protection measures. There is a need for effective overvoltage protection (OVP) on tall towers and adjacent structures alike.

While many of today's radios incorporate some internal protection against a voltage surge, that is not nearly enough to protect the radio and associated electronics from the energy from a lightning strike. And, if a power surge has infiltrated the radio enclosure, it is already too late.

That's why cellular installations—towers, building-mounted, and pole-mounted—must include a fully considered lightning protection system (LPS) and external surge protection integrated into the power system for the site. For example, Raycap's Strikesorb® technology is a unique OVP solution that ensures vital equipment does not experience downtime due to lightning or other power surge events.

Strikesorb incorporates a distribution grade metal oxide varistor (MOV) to handle larger surges without affecting performance. The voltage level applied to the equipment during a surge event (let-through voltage) needs to be low and as close as possible to the nominal operating voltage level. Strikesorb technology is an essential component in protecting cell site equipment, due to its very low let-through voltage characteristics.

Raycap makes it easier to deploy surge protection through its AC Disconnects (the RSCAC and RSx-Series at 120/240 VAC), industry standard load centers that provide robust overvoltage surge protection for the AC power circuits for today's small cell radio systems. Suitable for use as service equipment (SUSE) with no conditions per UL and NEC, they provide dual (L1 to N) (L2 to N) protection for up to 16 AC circuits depending on the model.

Climate change requires more rigorous design and engineering for 5G small cells

Lightning, wind, and heat will increase as our climate changes, even as the telecom industry rolls out advanced 5G services on macro towers, buildings, and small cells. Therefore, experienced professional design and engineering are required at the buildout stage to ensure that wireless sites can operate reliably under present and expected conditions in the future.

Figure 3. Specialized AC Disconnects from Raycap feature Strikesorb to help protect small cell sites from damage caused by electrical surges

About Raycap

Raycap is an international manufacturer and technology leader with decades of experience providing innovative infrastructure solutions for customers in the telecom, energy, defense, transportation, and other industrial markets. Its solutions protect mission-critical applications and ensure the best possible system availability. The company's product portfolio includes lightning and surge protection technologies, structured cabling and connectivity solutions, power management systems, custom enclosures, cabinets, and wireless network concealments. Since its founding in 1987, the company has experienced continuous growth. Its engineering expertise, test laboratories, and multiple manufacturing facilities guarantee quality, reliability, and innovation. Product design, testing, and approval processes comply with all international safety standards. Raycap operates in the United States, Germany, Greece, Cyprus, Slovenia, and Romania.

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[2] https://www.raycap.com/wp-content/uploads/2021/01/Raycap-Case-Study_Miami-.pdf

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