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Exploring Factors That Impact the Lifespan on a Telecoms Site

WHITE PAPER

NATALIA KONONOVA – SEPTEMBER 2022

Penned by Delmec energy consultant Natalia Kononova, our latest white paper examines the many factors that can impact asset lifespans on telecoms sites around the world.

Introduction

At Delmec, our role is to provide solutions that work in the short and long term. That means doing more than just ensuring the accuracy of the design, the quality of the build and the best fit of the equipment. We also work hard to define and trace the expected lifespan of each asset on site, so that our clients have a clear understanding of what they're dealing with, today and tomorrow too.

In this paper, we'll look at some of the major factors that can affect the expected useful life of what is commonly referred as telecom passive infrastructures (TPIs). The telecom sector has been at the forefront of technological development of late, driven by constant research and innovation, as well as its crucial role in our everyday life.

At the same time, many major telecom providers are grappling with stronger customer demand and expectation, increasing CAPEX, rising market competition, and flat or even declining revenues. Mobile operators need to deploy new technologies to provide customers with the latest services but WACC and ROIC — acronyms that until a few years ago were relegated solely to the finance department — are now omnipresent in every rollout. As a result, CAPEX and OPEX optimization is a must.

As a direct consequence, the correct estimation of a network asset's lifespan is now a crucial element in the evaluation of any business plan. It's essential that any MNO can access this information, as it simultaneously affects both the quality of services and the asset book value.

What are telecom assets and why are they so important?

In their normal course of business, telecom operators constantly deploy and replace a portfolio of physical assets, but they can be largely grouped into two main categories:

1. **Active equipment**

   These are all the electrical and electronic devices that enable cellular mobile signal propagation. This category includes base station antennas, microwave dishes, radio access network stations and RRUs.

2. **Passive infrastructures**

These are the elements that are necessary for a cell site. Units that fit the profile of passive equipment include telecom steel structures, foundations, standby generators, power systems, solar system, air-condition units, shelters, and power cabinets, etc.

In this paper, Delmec will examine only passive infrastructure elements and the factors that can have a negative effect on their lifespan.

Passive equipment lifespan and factors that affect them

- **Self-supported structures (towers, monopoles, masts, or poles)**

Self-supported structures in telecommunications are typically designed for a 50-year return period wind speed. Their useful life is normally stated at 25 years in finance books to account for their depreciation.

Some of these structures are exposed to harsh environmental conditions, such as extreme winds, high air salinity, ice or high temperatures. All of these factors can drastically affect the lifespan of steel structure if proper maintenance is not performed.

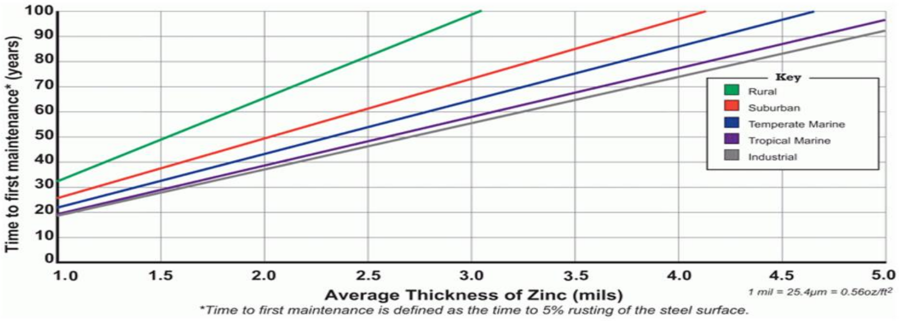
- **Steel corrosion**

The corrosion of a steel structure is defined as the deterioration of the material that results from a reaction with its environment. The main effect of the corrosion is the creation of iron oxide (rust) on its surface, with consequent loss of material from the steel members. Hot-dip galvanisation of steel structures is a common solution adopted by the telecom industry for corrosion protection.

Hot-dip galvanisation is the most effective superficial treatment for steel structures, but it doesn’t prevent corrosion — it just slows it down. The pure zinc layer is used as a sacrificial anode through the formation of white rust (mainly zinc hydroxide). However, in highly corrosive environments — for example, coastal regions, highly industrial or heavily polluted areas — the rate of depletion of the protective layer increases and with it the possibility of exposed steel interacting with oxygen and water. Once initiated, the corrosion rate will increase and if no action is taken, its affected steel members will have to be replaced.

Category	Average corrosion rate (μm/year) *1	Average corrosion rate (μm/year) *2
Urban industrial area	1.3	1
Rural area	0.63	
Coastal area	1.5	2

*1 Source: Japan Galvanizers Association, results for atmospheric exposure tests (1992–1997), JIS H 8641 "Hot Dip Zinc Galvanized Coating".
*2 Estimates normally used by the NTT Technical Assistance and Support Center (see nationwide map, **Fig. 5**).



Time to First Maintenance

One only has to look to France for a clear example of how effective that action can be: the Eiffel Tower was built as a temporary structure in 1889 for the World's Fair, but it's still standing today as one of the world's most recognisable monuments because of proper preventive maintenance.

- **Extreme weather conditions**

Telecom steel structures are designed in accordance with country-specific structural codes that state the basic wind speed for each region.

Such values are extrapolated using a probabilistic approach involving wind measurements collected in nationwide meteorological stations over a period of years. Based on the type of service the structures provide and the risk associated with a possible failure, a specific return period amplification factor is used. For telecom structures, the commonly specified return period is 50 years.

This doesn't mean that winds in any given day cannot exceed such design value: as mentioned, it is a probabilistic analysis and this cannot account for outliers.

As an example, no towers are designed for a direct hit from a tornado, as the cost associated with building structures that could withstand such wind speed would be simply uneconomical.

- **Concrete foundation**

It's a challenge to determine the life expectancy of anything that has been buried and uninspected for a long period of time. A properly-designed and built foundation should provide a minimum of 25 years of service. There are only a few factors that can affect such value: fluctuations in the water table or presence of sea water (i.e., a chloride attack), or expansive soil (i.e., damage to a concrete slab). In reality, the main reason for premature failure of concrete foundation is poor implementation. The most common causes identified in foundation inspections are honeycombing (due to a lack of vibration of concrete) and insufficient concrete cover of steel rebars. Both shortcomings enhance the risk of concrete reinforcement corrosion and consequent spalling and delamination.

- **Diesel generators**

The useful life of a diesel generator is expressed in running hours. A direct conversion between running hours and years is not possible unless it is identified in the actual use of the asset. Diesel generators can be used as a replacement of the mains (prime or continuous running) or as a back-up in case of the mains failure (standby).

A back-up generator cost is normally depreciated over a period of eight years in the majority of telecom operators' books. In reality, this timespan is underestimated, assuming 20,000 hours as an expected useful life for such an asset and 1,000 running hours per year between testing and actual use. On the other hand, a continuous running generator will reach the 20,000 hours mark in less than two and a half years.

Ultimately, the life expectancy of any diesel generator will depend on two major factors: generator dimensioning and preventive maintenance practices.

I. Dimensioning

Contrary to common belief, an over-dimensioned engine will not outlast a right-sized one. Running at low load for a long period of time can lead to 'wet stacking', a condition in which unburnt fuel passes into the exhaust system, because of insufficient engine pressure (idling). For efficient combustion a diesel engine should not be run under 60% of its rated power output. Wet stacking can drastically reduce the lifespan of an engine, therefore proper dimensioning is vitally important to ensure optimum asset utilisation.

II. Maintenance

Manufacturers specify maintenance schedules for each subcomponent, and it is essential to follow them, not only to protect the manufacturer warranty, but also to safeguard the engine's health. Consumables like air, oil and fuel filters normally need to be replaced every 500/1000 running hours, except where harsh environment conditions require shorter replacement intervals.

- **Batteries**

Similar to diesel generators, the life expectancy of rechargeable batteries is measured in cycles and not in years. The type of batteries and their actual use ultimately drives the expected useful life in years.

There are multiple types of batteries, each of them optimised for a specific application and depending on the technology they are built upon, they can sustain from a few hundred cycles (VRLA) to thousands (Li-ion), all the way to millions (supercap).

Various factors can influence the lifespan of the batteries:

I. Temperature

Temperature has a detrimental effect on all types of batteries. VRLA is the most susceptible; their rated capacity is specified at 25°C and expected cycles will halve every five-degree temperature increase up to a max of 45°C. At the same time, VRLA performance declines with temperatures below 10°C. Lithium and supercap are also affected by temperature, but the effect is limited within the commonly accepted temperature range (up to 45°C).

II. Depth of discharge (DoD)

How deeply batteries are discharged during each cycle directly impacts their lifespan — the deeper the discharge, the smaller the number of expected cycles. For example, with lead-acid batteries a 50% DOD will result in double the number of cycles expected if they reach 80% DOD. VRLA that reach 100% DOD are not recoverable. Lithium batteries are less susceptible to damage due to excessive depth of discharge, but most manufacturers recommend not to discharge above 80% DOD.

III. Partial state of charge.

Unless specifically engineered, VRLA batteries need to be recharged immediately after discharge and kept fully charged at float voltage to prevent sulfation in a process called the conditioning phase. Incomplete charge cycles have a limited impact on lithium batteries due to their internal battery monitoring system (BMS).

IV. Electrolyte Loss.

All deep-cycle batteries contain an electrolyte solution that enables the internal chemical reaction. In the specific case of flooded lead-acid batteries (commonly used in the past on renewable energy applications), the electrolyte solution can evaporate — therefore periodical refill is needed to prevent battery failure.

Lithium batteries and VRLA also contain an electrolyte solution but as they are sealed they are not in need of any maintenance.

- **Solar system**

The latest solar system has a guaranteed lifespan of 20 to 30 years, and after that period the performance drops below 80% of the nominal. However, there isn't necessarily a specific point at which it must be replaced. There are a variety of elements that contribute to the productivity of a solar panel. The following factors in particular can decrease life expectancy of the solar system:

I. Degradation

This is a critical factor in how long solar panels last. NREL data shows that solar panels have a degradation rate of roughly 0.5% per year. After 20 years of use, a solar panel would be capable of producing roughly 90% of the electricity it produced when it was new.

II. Climate.

Extreme weather can reduce the life of a solar panel. If installed in areas with cold temperatures, heavy rain, snow and hail, or sandstorms, the solar panels' lifespan will reduce faster.

III. Maintenance.

Solar panels last longer when they are well-maintained. Panels may degrade more quickly if they are dirty, have debris on them or don't undergo regular maintenance.

- **Power cabinets**

The majority of outdoor cabinets are designed for a 10-year life span. This refers to the outer shell and the internal power system components. In reality, constantly increasing power consumption — not least the introduction of 5G — is forcing telecom operators to write off such equipment a lot earlier. The common issues are limited upgradability of power system output and insufficient heat dissipation (cooling capacity).

Conclusion

The life expectancy of passive infrastructure assets in mobile telecom sites is affected by a variety of factors.

Correct choice of technology, proper dimensioning and appropriate maintenance are all key to optimising the lifespan of an asset. If the first two factors are part of the design phase, maintenance is the only variable in which telecom operators can take an active preventive and corrective role. Collecting historical records and tracking equipment performance can help identify failure patterns and implement the appropriate corrective actions.

Selection of technology and dimensioning is a far more complex exercise. It sits in between telecom operators' strategy and vendors' technology evolution. Often an asset becomes obsolete due to changes in the requirements set by the combination of the two, and not because it reaches its end of life.

Lastly, changes in regulations can have huge repercussions on existing infrastructures as well. For example, there are now max noise emissions for diesel generators, updated building codes or wind maps for telecom towers, and environmental programs on lead acid batteries.

All of this means that the sands shift regularly, but the priority remains the same here in Delmec: safeguarding our clients' portfolios, assets, and quality of service. To do this, we work with the brightest and best minds in the telecoms industry, all dedicated to making sure that every site is in tip-top condition, for this financial year, and for many more thereafter.