PFISTERER

Compact Lines

Aesthetic and economical. For advanced electricity grids.

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Groundbreaking energy transition technology.

The energy transition calls for the uprate and/or upgrade reinforcement of existing overhead lines and the construction of new electricity corridors. At the same time, citizens' increasing sensitisation to the energy transition is having a tangible effect. Approval procedures are drawn-out and the costs of implementation are soaring.

These issues can be solved in part by a versatile and environmentally friendly technology that has proven effective in many places: The compact line.

Compact lines: Numerous advantages. One acceptable alternative.

Compared with conventional overhead lines, compact lines offer a series of proven benefits – irrespective of whether they are installed using standard lattice pylons or innovative round pylons. These advantages are particularly effective within the current climate where the public is increasingly interested in widely accepted and cost-efficient solutions.

Compact lines are narrower.
The right of way (ROW) corridor along an overhead line depends on the insulating spacing between the individual phase conductors and the pylon.

In overhead lines with single suspension strings, the conductors are suspended from just one point on the crossarm [figure 1a]. Windy conditions can therefore cause them to swing to either side, calling for larger insulating spacing.

In pylons with insulated crossarms, the conductors are fixed to the crossarm [figure 1b], so that they cannot swing sideways at the attachment point. As a result, they are correspondingly shorter in length than a metal crossarm, **thereby reducing the corridor width by up to 50 % or more in special cases.**

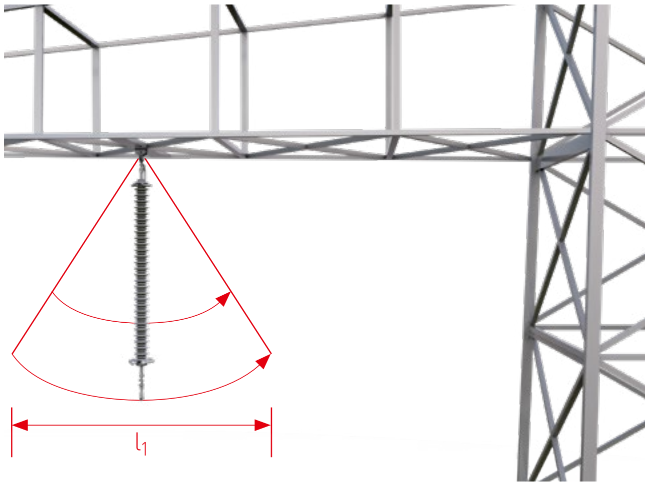

Figure 1a: Conventional overhead lines are suspended freely and require greater insulating spacing as a result. Compact lines secure the conductors in place, keeping the insulating spacing to a minimum.

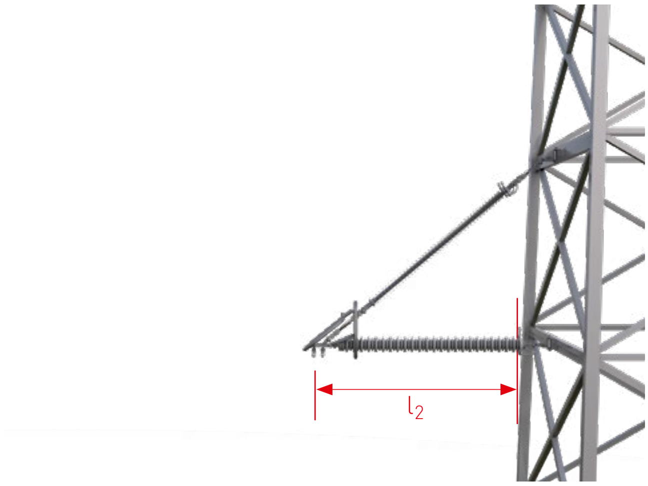

Figure 1b: Compared with an existing solution, a compact line reduces the corridor width by 50 % or more in special cases.

Compact lines have a lower level of radiation.
Overhead lines are predominantly operated as three-phase AC systems, in which the electromagnetic fields of the parallel conductors compensate each other out up to a certain extent. The degree to which they do so is determined by the distance between the conductors: The further apart they are, the weaker the effect, and vice versa.

In compact lines, the conductors are substantially closer together than in conventional overhead lines. The electromagnetic field exposure around the overhead line is therefore considerably lower. The actual reduction in exposure depends on the overhead line's design. The simulation displayed in figure 2 reduces the **field stress by 85 %.**

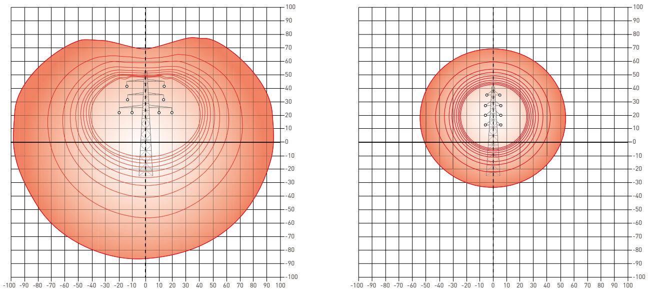

Figure 2: Compact lines reduce the electromagnetic field stress.

Compact lines are more efficient.
A crucial factor for the transmission capacity of long overhead lines is the surge impedance. The lower this impedance, the higher the so-called natural transmission capacity. Due to the smaller spacing of the conductors, the surge impedance in compact lines is significantly lower than in comparable standard lines. **As a result, compact lines can achieve transmission capacities that are 15 to 20 % higher.**

Compact lines are more reliable.
Conductors are secured to crossarms with insulators. Conventional overhead lines have often one insulator per conductor, whereas compact lines use two insulators. This has a direct impact on **supply reliability:** If an insulator should break, a standard line will immediately fail. However, in a compact line, the second insulator holds the conductor in place, thereby maintaining the power supply.

Compact lines are economical.

The use of composite insulators improves performance under sudden load impact, in which the ceramic insulators would break (since they are brittle). Insulated crossarms for higher voltage levels are typically designed with at least two composite insulators (post and long rod), which reduces the likelihood of a conductor being dropped.

At first glance, the investment costs for a compact line appear to be higher, as it requires the use of special insulators. The smaller phase spacing increases the strength of the electrical field, which must be taken into account in the design of the string elements.

Nevertheless: **A compact line does not have to cost more.** Due to the pylons' more compact size, the cost of their materials and construction can be up to 50 % lower. In addition, the saving made by the reduced width of the ROW corridor is an important aspect both financially and in terms of approval time.

Compact lines provide aesthetic solutions.

Compact lines can achieve even more: Since they are constructed independently of standard lattice pylons, opportunities for designing new, more visually appealing solutions are opening up – a key aspect given the strong public perception of infrastructure projects and growing civic interest.

While lattice pylons are often deemed an eyesore, round pylons can be used to implement **astonishingly aesthetic designs for overhead lines – symbolic of advanced grid development and empirically higher tolerance potential.**

Netherlands: The TenneT Wintrack system reduces exposure to electromagnetic radiation by 60 %.

Overhead line projects using innovative round pylons, such as those successfully implemented in the Netherlands and Denmark, prove that revolutionising overhead lines is worth it. **The result: Broader public acceptance and easier approval procedures.**

Tested and service-proven, compact lines are shaping the future.

The first compact lines were built in the 1970s. They gained significance during the 1990s when composite insulators became available, which were used for higher strength requirements. The known advantages of composite insulators open up new opportunities for the visual and technological design of a compact line. Compact lines are used right up to the highest voltage level. After more than 30 years' operational experience, the concept of making lines more compact using posts or insulating crossarms is now regarded as extremely effective technology. **Their increasing use around the world proves that compact lines with composite insulators are at the forefront of modern technology.**

PFISTERER – Your partner for compact lines.

PFISTERER has been a pioneer in the field of silicone composite insulators for over 40 years. This wealth of experience includes the design and manufacture of the entire insulator string. We single-handedly provide complete solutions for ambitious projects, based on comprehensive consultation and planning, as well as simulations and tests in our own laboratories.
We have pooled our silicone insulator expertise into a specialist publication, "Silicone composite insulators" – with a whole chapter dedicated to compact lines (Springer-Verlag, ISBN 978-3-642-15315-8).

References

Country	Voltage level	Year
Switzerland	420/123 kV	1998
Israel	420 kV	2002
UAE	420 kV	2006
The Netherlands	420 kV	2009
Denmark	420 kV	2012
Spain	245/123 kV	2013
England	420 kV	In development
Austria	420 kV	In development

Dubai: Compared with an existing solution (left), this compact line (right) reduces the corridor width by 80 %.

Denmark: New pylon design with rigid, asymmetric V-shaped string increases acceptance of overhead lines.

Netherlands: Wintrack.

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