

On July 4, 2025, while the USA celebrated Independence Day, the Czech Republic experienced a major power outage that affected millions in the capital city of Prague and several parts of the country. The incident, triggered by the fall of a 400 kV transmission line conductor, revealed critical vulnerabilities in the grid's ability to manage contingency scenarios.

In a N-1 event, if a power line trips, the power it was carrying is instantly redistributed to neighboring lines. These lines must be able to carry the additional load without overheating or sagging beyond safety limits, or they risk failing in turn and triggering a wider blackout. Same goes for substations and other assets, of course.

The Czech July 4th failure caused a short-circuit and led to the immediate shutdown of the affected line. Unfortunately, the adjacent lines, already operating near capacity, could not absorb the sudden redistribution of power. As a result, nine of the country's 44 primary substations were taken offline, causing a cascade effect and disrupting electricity supply to homes, hospitals, industries, and transportation systems.

This incident highlights the fragility of aging and heavily loaded infrastructures in the context of growing electrification and climate volatility and should make us question how robust power grids really are.

The compelling case for a more resilient and efficient power grid

As with previous blackouts in Chile and Spain, some commentators were quick to blame renewable energy, citing the Green Deal and the overload from German solar farms as contributing factors. While the energy transition is a hot and legitimate discussion topic, attributing such events to renewables alone often reflects an ideological bias. This kind of shortcut in reasoning can lead to a «mental blackout» that diverts attention from the underlying structural weaknesses of our grids and delays meaningful, evidence-based solutions.

While this particular outage did not result in injuries or major accidents, it serves as a powerful warning. As the local media Český Rozhlas put it, «this blackout, which fortunately had no serious consequences, is a useful reminder that the world does not always behave the way we want it to». In today's interconnected and increasingly electrified world, even minor disruptions can lead to major vulnerabilities if the infrastructure is not equipped to handle stress events.

Simple solutions can make a real difference

Composite core conductors offer dramatically improved thermal performance and mechanical stability. In N-1 scenarios, these HTLS conductors can carry up to twice more current than traditional metallic conductors without violating sag or clearance limits.

If the adjacent lines in the Czech system had been equipped with composite HTLS conductors, they would have had the thermal headroom and mechanical resilience to absorb the temporary overload without tripping. This added flexibility is critical for modern grid reliability, especially in meshed transmission networks where the failure of one line can ripple across borders, such as in Europe, the USA or India.

In a grid increasingly fed by intermittent renewables and decentralized sources, the ability to safely push more current through existing corridors is a strategic advantage!

Beyond emergency scenarios, HTLS conductors improve overall grid efficiency. At normal operating conditions, their lower sag and higher conductivity reduce resistive losses by around 30%, which translates into long-term energy savings and lower CO_2 emissions.

A wake-up call for grid operators?

The Czech blackout is not an isolated event. It is a preview of the challenges power systems across Europe and the world will continue to face. As demand for electricity grows and systems become more interdependent, grid resilience must be rethought from the ground up. Conductor technology is a foundational piece of that puzzle.

At Epsilon Cable, we work with TSOs and DSOs across the globe to upgrade their grids with composite HTLS conductors relying on a strong and thermally stable carbon fiber core, helping them meet N-1 security standards and future-proof their networks.

The July 4 incident underscores the urgent need for investment in smarter, stronger transmission lines. And with advanced conductors, the grid won't just be able to survive a fault: it will also be more efficient in the process.



***About the Author*, Alexandre LULL**
Alexandre is Managing Director of Epsilon Composite. After studying composite materials, aerospace engineering and business management, he began his career in the Airbus group, before joining Epsilon Composite. He is closely involved in the activities of Epsilon Cable to support the modernisation of electrical infrastructures. As a leader, Alexandre is focused on developing the company's global performance, integrating extra-financial criteria and sustainable development into its strategy.