Flooding & MV Outages

Why It's Usually the Splice—Not the Cable

Introduction

Flooding, rising groundwater levels, and extreme weather events are increasingly challenging the reliability of underground medium-voltage (MV) distribution systems. Conditions once considered exceptional are becoming part of normal operating reality for many electric utilities. Despite this shift, the root causes of MV outages during flood events are often misunderstood.

Field experience and post-event investigations consistently show that MV cables themselves typically withstand prolonged exposure to water. Failures are far more likely to occur elsewhere in the system. This document explains why cable splices represent the dominant weak point during flooding events and why splice reliability is critical to building flood-resilient MV distribution networks.

Flooding as a Long-Term Operating Condition

Climate-driven changes have altered the operating environment for underground power infrastructure. Longer periods of saturated soil, elevated groundwater levels, and repeated wet-dry cycles create continuous environmental stress on MV systems.

In many regions, flooding is no longer an occasional risk but a long-term operating condition that must be addressed through engineering design, material selection, and asset management strategies. Under these circumstances, network reliability is determined not by average performance, but by how components perform under prolonged exposure to moisture and hydrostatic pressure.

What Survives Flooding—and What Doesn't

Modern MV cable insulation systems, such as XLPE (cross-linked polyethylene), are designed to withstand long-term moisture exposure. Numerous flooding events have demonstrated that cables often remain electrically intact even after extended submersion.

By contrast, failures tend to be concentrated in cable splices, terminations, and cable accessory systems. These failures may occur during the flood event itself or develop months later as delayed outages caused by moisture ingress.

This distinction is critical. When flooding results in outages, the cable is rarely the limiting factor. The splice is.

Why Cable Splices Are Inherently More Vulnerable

Unlike a continuous cable, a splice combines multiple materials, geometries, and interfaces within a confined space. It introduces transitions between insulation systems, conductive components, mechanical support elements, and external sealing systems.

Under wet conditions, water does not need to penetrate the bulk material to cause damage. Instead, it exploits interfaces, microvoids, and imperfections in the sealing system.

Once water enters a splice, several degradation mechanisms may occur:

- Reduced insulation resistance
- Increased dielectric losses
- Initiation of partial discharge activity
- Accelerated thermo-electrical aging

These processes often develop gradually and remain undetected until failure occurs, making splice reliability a hidden but critical factor in MV system performance.

Lessons from Major Flood Events

Investigations following major flood events in different regions reveal a consistent pattern. During large-scale flooding incidents, underground MV cables generally remained operational, while failures were concentrated at splices and terminations.

Urban flood-risk assessments have identified interfaces and cable accessory systems as primary points of water ingress. In regions exposed to repeated flooding, age-related cracking and inadequate splice sealing have been identified as leading causes of outages.

Across geographic regions and network types, the engineering conclusion remains the same: robust, void-free, and properly sealed splices are essential to preventing both immediate and delayed failures caused by water exposure.

Implications for Asset Management

Treating flooding primarily as a cable issue can result in incomplete risk mitigation and misdirected investments. Improving flood resilience requires shifting attention from the cable itself to the splice as a system-critical component.

For asset managers and utility decision-makers, this means:

- Including splice design and sealing systems in flood-risk assessments
- Prioritizing splice technologies validated for long-term water exposure

- Recognizing that splice performance often determines outage risk, repair costs, and restoration times

Flood-resilient MV networks are built at the connection—not in the conductor.

Conclusion

Flooding rarely causes MV outages because the cable itself fails. Instead, failures typically originate at splices, where interfaces, sealing performance, and aging mechanisms converge. As flooding becomes a normal operating condition in many regions, splice reliability must be treated as a primary design and asset-management consideration rather than a secondary detail.

Continue Exploring

If flooding is a real operating condition in your service territory, understanding splice behavior is only the starting point. Further technical guidance can help utility engineers and asset managers better understand splice failure mechanisms, flood-resilient design practices, and practical selection criteria for MV splice systems deployed in waterlogged environments.