

Lightning Protection

Railway facilities

Lightning is a natural phenomenon that can have a significant impact on railway facilities. However, these consequences can be avoided with suitable protection against lightning. There are three issues :

- **How to protect data communication systems ?**
- **What is the risk for people close to overhead lines?**
- **What is the feedback on railway electrical facilities in the event of a lightning strike ?**



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1. Data communication systems

Data communication systems are available for various railway projects : whether for high speed trains and urban public transport. They generally consist of an antenna installed on a mast, an energy source and a modem.

These facilities are essentials to ensure rail safety. Thus, it is necessary to make every effort to prevent malfunction of these systems.

Lightning risk has to be taken into account due to direct and indirect damages to facilities. Lightning can strike directly antennas but can also affect other external element (a catenary, a traction substation ...) and cause surges and induced partial lightning currents.

To avoid an interruption of rail operations and to reduce replacement costs of these communication systems in the event of lightning strike, SEFTIM worked with major railway companies to find a solution to these problems. Usually, the risk for human people near a mast is low but when more masts are considered, the risk is not negligible.

- **For protection against direct lightning effects**, the installation of a lightning rod was proposed together with a metallic down conductor, a simplified earthing system as earth rods and a bonding bar. Under certain conditions, defined in the international standard IEC 62305-3, the metallic mast can serve as natural down conductor. It will also be necessary to make some equipotentialities with the metal parts of the equipment.
- **For protection against indirect lightning effects**, it was recommended the installation of coaxial SPD for the protection of coaxial cables and the installation of a Type 1+2 SPD for the protection of power lines. Earthing kits are also used for the coaxial cables.
- **For the protection of people**, two problems have to be taken into account : touch voltage and step voltage. Solutions to these problems are the same as described below in the next point, for people nearby overhead lines.



Dark Territory Wayside Installation
PTC -in-a-Box

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2. Protection of people nearby overhead lines

In case of lightning impact on a catenary, the lightning current will flow to the ground through the various poles that are closest to the point of impact. The risks on these poles are the same as for down conductors of a lightning rod : touch voltage and step voltage. It is usually accepted that without protective measures, people within a radius of 3 m around the poles are in a dangerous situation. If protection of the technical staff may be considered by procedures or lightning warning system, it is difficult to consider emptying a railway platform during stormy weather. Studies have helped to define the risks, their probability of occurrence and the protective measures that have to be set up in case of the poles are too close to the public. This is usually an isolation of the conductor connecting the overhead line and eventually its traction SPD and an equipotential bonding. It can also be an isolation of the earthing system.



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3. Feedback on railway electrical facilities in the event of a lightning strike



Association Protection Foudre

Facilities are usually struck by lightning on the catenary. Our statistical studies have shown that the number of lightning impact on a substation is very small compared to overhead lines. Usually a lightning strike on an catenary leads to very local damage. And mostly, for economic reasons, only important equipment for safety and connection points to substations are protected. Considering this, the choice of the Surge Arrester (technology, design and installation) and its location are important to minimize incoming overvoltage in the substation. But this Surge Arrester may not be enough to protect the entire substation and other SA, coordinated with the first one, are needed. Also Surge Protective Devices on power and communication/control lines are necessary. Feedback shows that telecom/signal systems are the one which is the most frequently destroyed. Lightning risk analysis on the substation, taking into account the power from the high-voltage network and connected catenaries, must be conducted to determine the optimal protection and sources of damage. Following this analysis, a technical study taking into account the sensitive equipment, the dimensions of the substation and the equipment important for safety must be conducted to determine the protection plan including SA and SPD (traction, LV, HV , telecom...) but also a good equipotential bonding and a suitable earthing system.