

Lightning Protection

Data Center

Lightning is a natural phenomenon that can have a significant impact on the environment, the production, the safety of IT services, as well as staff safety on the site. However, these consequences can be mitigated with suitable lightning protection. There are basically three issues :

- **How to protect the data?**
- **How to protect the infrastructure of a data center?**
- **How to ensure continuity of service and avoid economic losses in case of lightning strike?**

1. Data protection in a data center

Data Centers are highly sensitive sites, exposed to cyber and physical attacks. Their protection is essential, so they are equipped with anti-intrusion systems (cameras, motion detector ...) and sophisticated monitoring that must also be protected against lightning and surges. Most of these facilities are located outside the buildings, and sites are generally very extensive, which makes their protection much more complex.

Data communications with outside facilities and customers are made with optical fibers, immune against overvoltages, or wired connections via multi-pair Telecom type buried cables. This last mode of transmission is particularly sensitive to the indirect effects of lightning and surges.

- **For protection against indirect lightning effects on data links** it has been recommended to install Type 1 SPDs for the protection of telecom cables and coaxial SPDs for cameras. Earthing kits are also used for the coaxial cables. Type 2 SPDs are also implemented to protect the Major Safety Equipements



Server room – Numérama.com

2. Protection of infrastructure of data centers



Data Center – Telehouse.fr

There are several high points on these sites, like communication antennas, power generator chimneys etc... These are preferential points for lightning strike. In case of lightning impact, the lightning current will flow to the ground through the various conductive parts (concrete rebars, metal structure), closest to the point of impact. The risks on these high structures are the same as for down conductors of a lightning rod : touch voltage and step voltage, with the added risk of falling concrete blocks.

It is usually known that without protective measures, people within a radius of 3 m around the conductive parts at ground level are in a dangerous situation (this risk increases with height, especially near the point of strike). Protection of the technical people may be considered by :

- ✓ procedures restricting access to high points and terraces,
- ✓ lightning warning system, which effectively reduces the risk for human and also reduces other risks.
- ✓ Isolating people from the earthing systems.
- ✓ isolated down conductors to prevent the spark with the metal parts of the structure of the building thus reducing the risk of damages to concrete parts.

Protection contre la foudre

Data Center

- **For protection against direct lightning effects**, the installation of a lightning protection system (mesh system, lightning or striking rods etc.) has been recommended to obtain a protection radius covering the entire building surface and other sensitive areas such as power generator and chillers. The solution of an isolated lightning protection system on the whole or part of the structures is also a simple way to avoid the implementation of too many Surge Protective Devices on the roof or facade.
- **Optimization of lightning earthing system** : the effectiveness of a lightning earthing system is also a fundamental element. A low impedance earthing is the guarantee of a better protection for the human risk and reduced overvoltages. To achieve this an adapted design is proposed, based on ground resistivity measurements and modeling of the proposed earthing system. Once the earthing system is set-up, earthing measurement at high frequency is performed to characterize the lightning earthing system and it is then possible to deduce the suitable parameters for the SPDs.

3. Protection of power lines and operability keeping

The total loss of electrical power for a Data Center is not allowed, continuity of service being essential. Data Centers require a lot of electrical power (computer center, cooling system etc.) the means used to supply energy are often rated with high power. To compensate the possible loss of power from one source, Data Centers often have multiple power links to the power utility company. As a matter of fact, they generally have several power cables connected to various power distribution stations, thus reducing the risk of primary power failure. Another source of energy is also present based on power generators. UPS backed-up by batteries are also implemented to support Data Center resources in case of fault. However, all these power sources are creating many ways for lightning to enter into the building.



Lightning on power lines. *apfoudre.fr*

Lightning effects are generally observed through the flow of a partial direct lightning current in these lines or through induced voltages.

According to experience feedback, in most of the cases, damages caused by lightning flashes on structures are electrical and electronic damages related to induced surges flowing through the external lines. Metal pipes (water, gas ...) are also carrying surges. Another source of damage is related to lack of equipotentiality between the various services or between the various earthing (for example power source earthing and mainframe 0V earthing).

- **For protection against indirect lightning effects**, it was recommended to install Type 1+2 SPDs (SPDs able to support a portion of a direct lightning surge and also able to protect sensitive circuits) for the protection of the incoming power lines. Earthing metal pipes connected to the building is also necessary in order to achieve an equipotential system. Type 2 SPDs are also required for the protection of computer systems, inverters and sensitive equipment. Recent standards indicate that after 10 m of conductors protection is no longer provided with a single SPD. In practice 10 m is a real maximum and according to the configuration encountered, this distance should be much shorter than 10 m. The study of a data center therefore requires the energy and voltage protection coordination of the various SPDs.