

Surge Arresters: Are they the Solution?

With all the electronic and electrical equipment used in our day to day lives we only realise how much we rely on these systems when they suddenly are not working. This always seems to happen at the most inconvenient time and it is normally at this time that we discover those safety measures we put in place did not work.

Lightning and surge protection is just one of these nasty surprises that can be avoided if correctly installed. Unfortunately there are many ignorant as well as unscrupulous contractors and suppliers who will supply the client with the incorrect solution for their specific problem.

The most common error is that people believe that if the building has external lightning protection installed on the building then the electronic and electrical equipment within the building will be safe. Unfortunately this is not true and in actual fact the SANS 10142-1:2003 states that if external lightning protection is installed on a building then additional internal lightning and surge protection measures need to be implemented. The external lightning protection is only there to offer protection to the building itself (structural protection) and thus does not offer any protection to the equipment within the building. It does help in offering a controlled discharge path to earth and thus can prevent the lightning strike choosing its own dissipation path to earth via the electrical and electronic equipment.

One of the most basic principles of electricity is that when current flows through a conductor it will generate an electromagnetic field around that conductor. The principle of a transformer is that the change in magnetic field of the primary winding cuts through the secondary winding inducing a voltage in the secondary winding. The lightning bolt is nothing more than a large conductor (primary winding) with a massive electromagnetic field around it which can extend for up to 1 kilometre from the actual strike. This means that all the electrical and electronic equipment (secondary winding) will be exposed to a massive expanding magnetic field during the strike and then a second massive collapsing magnetic field once the strike is over. If lightning were to strike within 100 meters of your equipment the induced voltages could be as high as 2000 volts per meter (see attached table). This is the very basic principle as to why equipment suffers damage during a lightning storm even though it may not even be struck directly.

The actual chance of a normal house in South Africa being struck directly by lightning is less than once in 25 years but they will be exposed to the effects of a lightning strike up to 10 times per year. Luckily due to natural screening and shielding offered by buildings, steel conduiting or trunking and cable screens these effects are greatly reduced. Unfortunately with the greater use of plastic trunking, plastic conduiting and unscreened cables (UTP cabling) the natural electromagnetic screening and shielding is lost.

Taking the above into consideration, you would only insist on installing external lightning protection if you were worried that your building was in danger of taking a direct strike but in addition you would insist on adequate screening and shielding, correct earthing especially potential equalisation bonding and surge arresters.

Lightning Induced Voltage at a distance of 0,1, 1 and 10 km

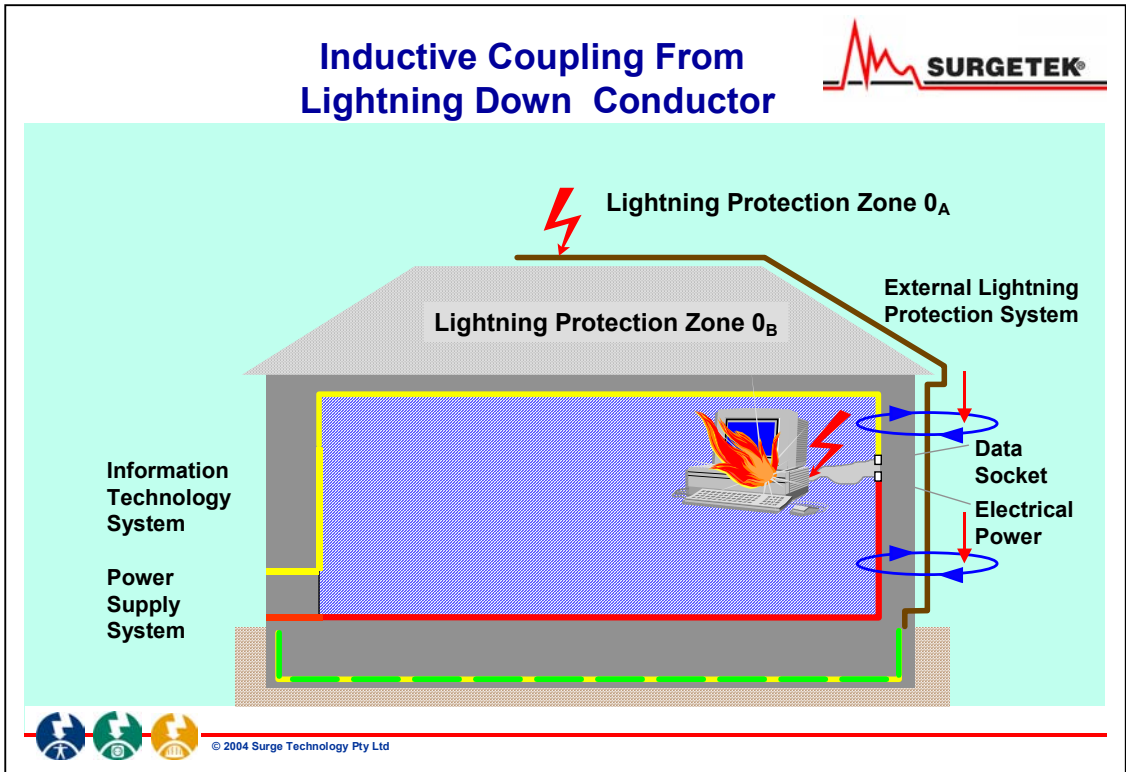
Distance to point of strike km	Electro-magnetic field V/m	Induced voltage in a 1m long cable V
10	110	20
1	1100	200
0.1	11000	2000

Source: Clark, O.; Gavender, R. : Lightning Protection for Microprocessor based Electronic Systems. Record of Conference Papers Industrial Applications Society, 36th Annual Petroleum and Chemical Industry Conference 11-13 Sept. 1989, San Diego, CA, USA

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Ref 01

In addition to the above the following diagram indicates how even with external lightning protection installed the lightning surge currents flowing to earth via the down conductors will induce a voltage into both power and signal cables (data or telephone). In this case the lightning strike will be right against your building and less than 1 meter away from you cabling and thus you can easily anticipate that you will massive voltages induced into your systems.



Should the building have external lightning protection installed then the surge arresters must be designed to withstand the effects of a direct lightning strike and the energy of these induced lightning surge currents. The codes specify that these surge arresters must be able to withstand a surge using the wave shape (10/350) or be suitable for use from Zone 0_A to Zone 1. Many products are available for power protection which can meet this criteria but there are very limited data or signal line protectors on the market which can offer this level of protection. Thus if at all possible one should try and limit the use of metallic cables that leave the building and rather make use of Fibre Optic links or alternative methods where possible. If this is not possible then you must ensure that the cables are correctly screened by making use of metallic trunking or conduiting which must be earthed to be able to act as an electromagnetic shield.

Another problem is ensuring the correct energy co-ordination of surge arresters (this was covered in a previous article). Although the product used may be certified for use as a Class 1 protector, as it withstands the test criteria, the amount of energy that it lets through under direct lightning conditions is too high thus causing damage to down stream surge arresters that may be fitted in sub electrical distribution boards or even in the equipment itself.

Many people are under the impression that if they have a UPS installed they will be protected against the effects of lightning and switching surges. Once again this is not always true as the primary function of the UPS is to ensure that your equipment will receive power in the event of a power failure or secondly to offer a stabilised power supply should your site be exposed to voltage fluctuations. In many cases the surge protection offered by the UPS is very limited and cannot offer the required level of protection.

Many people are of the impression that if they install surge protection plugs they will be adequately protected. These protectors are normally classified as Class 3 arresters and are thus actually designed to offer protection against surges and spikes induced into the cabling within the building. SANS 10142-1:2003 specifically states that Class 3 arresters can only be used in conjunction with upstream Class 2 arresters. These means that for these plug in type devices to be able to offer the required level of protection and be able to withstand the surge currents for which they are designed they need to have Class 2 arresters installed in the main electrical distribution board.

Another very common error we find is that people ask their friendly technician who works on their systems about the need for surge and lightning protection. This may not be the best person to be asking as they could be hoping that you will suffer damage and they can make extra revenue when they are called in to repair your systems damaged by lightning. Secondly they may be an expert in their specific field but not in the field of surge and lightning protection. It is very common to hear that people are told to only protect the cables that leave the building but the fact that the cables within the building are very long and thus exposed to induced voltages and hence are over looked.

You can buy the best surge and lightning protection products available on the market but if they are incorrect installed they will not be able to offer the required level of protection. It is for this reason that it is important that you ensure that you are having the products professionally installed by competent people.

Too many people wait until they have suffered damage before they consider installing some form of protection. It is a known fact that lightning is generally seasonal and some years the storms are worse than others. One thing that you can be sure of is that your equipment will definitely be exposed to surge and lightning induced voltages and currents and hence you need to allow adequate protection. Seeking expert advice could save you and your company a lot of money in preventing damage to equipment not to mention the loss in revenue due to lost man hours and trying to re-install systems.

Ref 01 Source: Clark, O.; Gavender, R. : Lightning Protection for Microprocessor based Electronic Systems.
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