Perfect Laser Technologies

TECHNICAL BULLETIN # 30

Lightning strikes and Eskom's incompetence

Electrical damage can happen in a flash.

Lightning can get to whatever is in its path, from appliances to electronics or an entire electrical distribution board - and a voltage surge from Eskom when initiating or returning from loadshedding can cause the same damage. Each item could wind up in an insurance claim. Fortunately, we only have to deal with equipment that we supply or service.

With a lightning strike, the policyholder may be able to prove a direct strike occurred because of burning or charring where the lightning entered an outdoor object. In some cases, lightning may hit the ground or taller items, including trees, flagpoles, or other structures. The energy can keep traveling after the initial impact.

Power surges from Eskom, however, are more difficult to prove. I know that some technical claims adjusters will not believe that an item (such as a laser tube) can be damaged by a power surge when the high voltage power supply appears to be intact and undamaged.

What tends to be forgotten is that an HT power supply is also directly connected to the mains - and is subject to Eskom fluctuations, and although the power supply may still work after a loadshedding surge, the surge itself may cause massive transient spikes in the output to the tube, thus damaging it.

Electrically powered equipment is prone to damage if any surge enters the electrical system - and anything plugged into or connected to these components could sustain damage.

Surge protectors are key to controlling how much excess energy an item receives. Remember though, that a surge protector can only protect the equipment that is plugged into it. These don't completely prevent damage, though they could reduce the impact.

Nobody seems to want to spend money on a "proper solution" to power surges, but you need a surge protector anyway, with or without load shedding. It won't keep the lights on, and it won't even keep your electronics working during load shedding like a UPS (Uninterruptible Power Supply) would, but it can offer some level of protection. But if you buy the cheapest one you can find, you are asking for trouble.

Not all surge protectors are of a high standard, and many manufacturers aren't really transparent about how helpful their devices may be in the event of a lightning strike or power surge. Technically, a power surge occurs when the normal mains voltage increases for three nanoseconds or more (in some countries with stable power grids they're fairly rare).

Aside of course for lightning strikes (which most of these devices claim to protect against), surges occur when Eskom switches off (and on) your power.

Most of the times this happens, devices such as computers, decoders, routers, and televisions may still be connected to the mains. Voltage fluctuation can easily damage components in electronic devices, and even if the surge doesn't immediately destroy your electronics, repeat surges will damage anything over time.

A good quality surge protector will divert "extra" electricity away from your equipment, and can save your sensitive electronics. But not all surge protectors are created equal - in fact some offer protection only marginally better than nothing at all.
Establishing how good a particular surge protector is, can be difficult, but generally speaking, the more you spend, the more protection you'll get. This means that the el-cheapo surge protectors sold at most electronics and hardware stores in South Africa may not be offering as much protection as they promise.

There are four key things to look out for when buying a surge protector:

1. Joules
A Joule is a measure of energy released over a period of time. For example, an average lightning strike releases about one billion Joules of energy over a fraction of a second.

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A surge protector Joule rating indicates how much energy it can absorb before it fails. The higher the number of Joules, the greater the surge protection provided. Go for the highest Joule rating (1000 minimum, but 2000 and above is better) that you can afford for any computer equipment.

If the Voltage rises above an acceptable level, the surge protector suppresses the excess Voltage to prevent it from causing harm. Specifically, internal components called MOVs (Metal Oxide Varistors) will absorb the excess Voltage and divert it safely to the ground wire, preventing it from reaching the connected equipment.

2. Clamping Voltage
Clamping Voltage refers to the Voltage level at which the surge protector begins to attenuate or reduce the surge. The best surge protectors feature a clamping voltage of 300 Volts or less, but no more than 400 Volts is acceptable in most cases.

3. Response time
This determines the length of time your equipment is exposed to the surge before protection kicks in. Look for a surge protector that responds in less than one nanosecond.

4. UL Rating
Look for both the UL mark (a symbol consisting of a circle inscribed with "UL") and a specific rating of "UL Listed," or, even better, "UL 1449 Listed" or "UL 1449 Revision 2."

These marks indicate that the surge protector has undergone rigorous safety and performance testing by the Underwriters Laboratory and meets the minimum performance rating for surge protectors. Surge protectors without this mark or with only the label "UL" or "UL tested" offer insufficient surge protection capabilities - although this has no official recognition in South Africa.

Unfortunately, many plug manufacturers and retailers in South Africa neglect to mention all of these figures, or they bury them in complex acronyms and numbers that most average consumers aren't able to understand. Instead, they tend to shift the focus onto terms like "heavy duty rating", and focus on 'features' like "overload protection" and "comes in different colours".

So the need for a good surge protector is clear, but what about a UPS (Uninterruptible Power Supply) - do you need one?

You can buy a cheap UPS, but like anything else in life, you get what you pay for.

Here is what to look out for:
1. VA Rating

The required VA Rating depends on the load current of the equipment you intend plugging into the UPS. To calculate the VA Rating, multiply the Amps of the equipment (normally indicated on a label on the rear of the equipment or in the technical manual) with the Mains Voltage (normally 220V), and divide by the PF (Power Factor) of the equipment.

At nominal supply Voltage, the PF of computer and laser equipment is normally 0.6, so, if you are running a small CO2 laser (PLT-3040 / PLT-6040) and a (plugged into mains) notebook or PC off your UPS, you will use say 2 Amps at maximum output.

If your mains Voltage is 220V and the PF is 0.6, you can calculate -

2A x 220V = 440W / 0.6 PF = 734VA.

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An 850VA UPS will just cover this, but for future expansion or additional equipment (say an internet router and a LED light for example) and to not stress the UPS by running at maximum load all the time, you should add at least 20% capacity. Therefore a 1000VA UPS (1KVA) - or larger - should be considered.

If more computers, other equiment or larger lasers are used, add all the Amps together and do the calculation. So, if you are running a medium CO2 laser (PLT-6040HQ / PLT-960HQ / PLT-1390) and a (plugged into mains) notebook along with a desktop PC, an internet router, a light and a phone charger off your UPS, you will use say 4 Amps at maximum output.

If your mains Voltage is 220V and the PF is 0.6, you can calculate -

4A x 220V = 880W / 0.6 PF = 1467VA.

A 1500VA UPS will just cover this, but for future expansion or additional equipment (say another PC for example) and to not stress the UPS by running at maximum load all the time, you should add at least 20% capacity. Therefore a 2000VA UPS (2KVA) - or larger - should be considered.

2. Backup Time

The backup time will be proportional to the load that is connected to the UPS. The higher the load, the less the backup time. You could have a backup time of as little as 2 minutes (which will allow you to shut down the equipment connected to the UPS before the power fails), or many hours of backup time so you can keep your equipment running until mains power returns - all depending on the batteries used.

A longer backup time and higher protection levels obviously costs more than short backup times and lower protection levels.

3. UPS Types and Protection

The level of protection you want will determine which of these is most suited to your needs.

The main consumer UPS types are:

a) Off-Line Modified Sinewave

Equipment runs off the mains via a limited AC filter under normal conditions. When the power fails, this type of UPS system switches over to a simple inverter to provide mains-like power for a short time to allow you to shut down the equipment. The backup time is normally short and will depend on the VA rating (see definition above) of the UPS, the amount of power your equipment draws from it and the batteries used in the UPS.

This type of UPS will give you very limited or no protection against power surges or spikes. Typical backup time is around 3 – 10 minutes. Mostly, the backup time can't be extended as additional batteries are not usually supported.

This type of system is aimed at the SOHO market and is mainly used when you have repeated, short power failures (not really for load shedding) but a reasonably good mains supply. Not recommended for critical applications or areas where there is bad or high fluctuating mains supply or load shedding. Not ideal for computer equipment.

Cost: Low
Power Level: From about 600VA to 1200VA
Protection level: 0 – 10%

b) Line Interactive Pure Sinewave

This type of system will usually provide a bit more time to save work and shut down your equipment after an unplanned power failure and is also designed to regulate the output voltage and prevent (mostly) spikes and surges from reaching sensitive equipment (computers, internet routers, printers laser machines etc.).

Backup time will depend on the VA rating of the UPS, the amount of power your equipment draws from it and the batteries used in (or connected to) the UPS. Typical backup time is around 5 – 15 minutes. Some models can be fitted with additional batteries which can extend the backup time to several hours.

Recommended for semi-critical applications and small sized business - ***IF*** the UPS output is pure sinewave (line interactive systems are also available in stepped squarewave or modified sinewave).
Recommended for computer equipment.

Cost: Medium
Power level: From about 800VA to 3000VA
Protection level: 10 – 50%

c) Online Pure Sinewave

This type of system will provide the best value protection and backup on power failure for critical applications. Your equipment is always running on battery-produced power (which is connected to - and charged - by the mains) and it is not directly connected to the mains.

The pure sinewave output ensures the cleanest, most compatible AC output for computers and other critical loads. Typical backup time is around 5 – 15 minutes. Plug-in external battery packs are available to extend the backup time to several hours. Aimed at the professional and upper business market, this is the recommended solution for laser machines and computers, with the highest protection level available.

Cost: High
Power level: From about 800VA to 100KVA (or more with paralleled systems)
Protection level: 100%

UPS systems are not designed to be located outside. They should be indoors in a relatively cool area and low humidity (less than 70%). The life span of the batteries will be greatly reduced in warmer areas.

Standard UPS batteries are normally either sealed maintenance free, or semi-sealed maintenance free, and have a useable life of 3 – 5 years. Long life batteries (8 -10 years useable life) are also available - but significantly more expensive.

We supply a range of UPS devices. Please contact us for recommendations.

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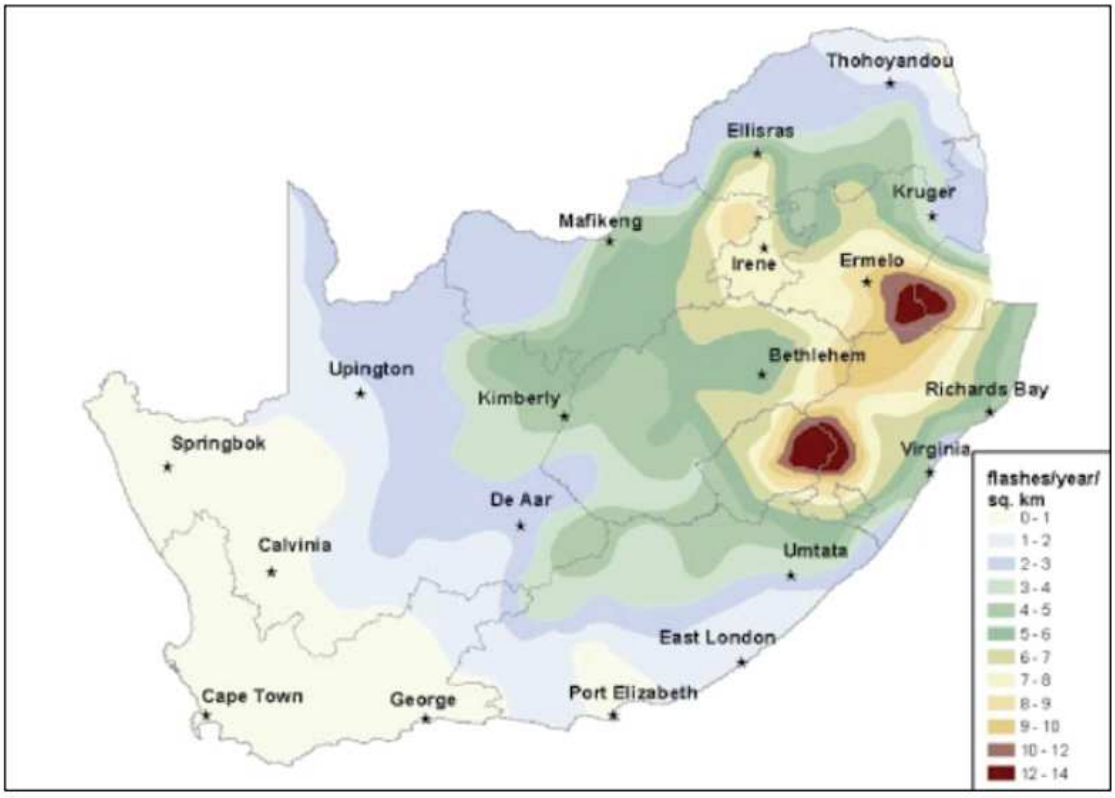
If you decide not to purchase a decent surge protector and a UPS, consider that apart from our mostly clueless and unreliable power utility that constantly "sheds load", South Africa has one of the highest ground flash densities in the world. Lightning related deaths in this country are about four times higher than the global average.

Lightning is the result of the electric charge separation generated by the interaction between cloud water and cloud ice in the atmosphere. The most frequent lightning flashes occur within the atmosphere in the form of cloud-to-cloud flashes but the most destructive are the cloud-to-ground flashes.

The average flash packs enough energy to keep a 100W incandescent light bulb lit for three months. The flash of light heats the air around it to nearly 28 000°C, which is hotter than the surface of the sun. The scorching heat forces the air to expand in an explosion of thunder.

This ground-flash density chart provides a good insight into the regional distribution of lightning shown as ground-flashes per year, per square kilometer.



The insurance industry uses this data to verify lightning damage claims because ***false claims are estimated at 30% of their R500-million annual payout***. They also need accurate climatology to identify lightning-prone locations to assess the risk.

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