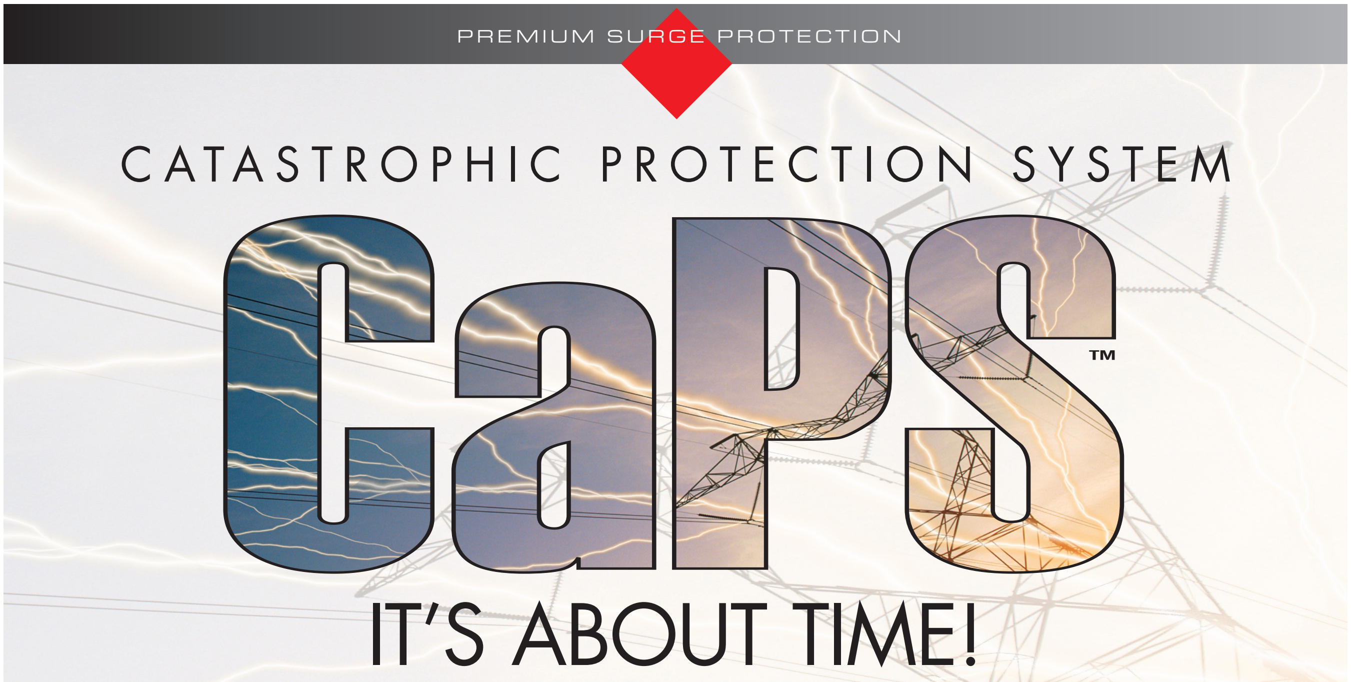

Damaging voltage surges and noise have become an all too common occurrence, including events like power swells (measured in seconds), TOV (temporary over voltages measured in milliseconds) and transient surges (measured in micro and nanoseconds). Power quality experts[1] indicate that these power quality events will continue to get worse as the loading on the North America power grid continues to grow, pushing the limits of the already dated and strained national power grid.

POWER QUALITY DISTURBANCES

While power quality disturbances come from many sources, their destructive ability is generally measured in power which has a function of time. A power quality disturbance from a very small over voltage event can be considerably more destructive than even a local lightning strike – given its application to the unprotected load for thousands of times longer (i.e. milliseconds verses microseconds). While lightning will always be the most obvious source of failed equipment because of its effects on our environment, temporary over voltages and swells will be the most destructive power quality events seen over the next ten years.[1]

The IEEE std 1100-2005 (Emerald Book) indicates when singular or "burst" surges exceed the nominal peak line voltage, they will damage many types of electronic/electrical equipment. Even very small voltage surges applied at sensitive frequencies have been documented to cause damage and, at the very least, disrupt the data and its integrity.[2 - FIPS Pub 94] Demonstrated through many industry tests, electronic and electrical components have been destroyed when exposed to higher voltage and energy events over normal line voltage.[3 - Gallace and Pujol); 4 - Van Keuren]

The industry typically identifies the following power quality events as:

Power Quality Disturbance Type	Time Range	Above Nominal Voltage Range
Over Voltage	> 1 min	1.1 – 1.2
Swell	8 ms – 1 min	1.1 – 1.8
Temporary Over Voltage (TOV)	100 µsec – 8 ms	1.8 – 2.0
Transient Surge	1µsec – 100 µsec	>1.2

Table 1

While there are infinite numbers of sources that contribute to damaging voltage and energy surges, the majority can be broken into two major categories – environmental power quality disturbances and electrical switching surges.

ENVIRONMENTAL POWER QUALITY DISTURBANCES

Lightning proves to be the most destructive environmental generator of power quality disturbances. Other environmental induced surges include non-arcing electrostatic discharges (ESD) with varying charge build up between cloud and earth.

While the wives' tale states, "Lightning doesn't strike twice", in reality as many as 40 return strikes have been recorded[5- McCann] with current surges of more than 500kA being seen, but typical surges reaching 20 kA to 40 kA. A typical lightning strike can last between 50μs to 100 μs with most of the damaging energy below 1 MHz (<1.0 μs rise times).

When developing a strategy for power quality protection, it is critical to remember the high-frequency current element of a lightning surge, and that ESD protection requires special wiring and grounding techniques. Wiring and grounding practices for normal construction only consider the electrical safety element followed by NFPA 70 National Safety Code, leaving a building and all contents at serious risk to damage. A power quality strategy includes low-impedance wiring and grounding with the inclusion of a Catastrophic Protection System (CaPS).

Significant levels of current can be found in the area of the grounding electrode during a lightning surge event. The lightning discharge in the earth can actually become ionized by an event, becoming a ground potential rise source (GPR) for damaging surge into a facility through the grounding system.

Power quality events caused by coupling to conductive objects (metal) is also very common. Through inductive, capacitive and magnetic coupling, transients and noise are fixed onto objects. These transients are typically caused by cloud to cloud discharges[6- Boyce] coupled onto both buried and overhead conductors. For every charged cloud there is a reflective opposite charge seen by the earth, called a charge center. When there is cloud to cloud discharge, a similar reflective event on earth follows the cloud activity. This rapid change in charges from the charge centers cause voltage and current surges in overhead and buried conductors.[7-Sunde] This rush for equilibrium in electrical charges can cause arcing and flashes inside a building as different paths and potentials are sought by the charged particles. Based on a building's internal system impedance and protection system installed, this type of power quality event results in simultaneous affects involving power, signal, communications, data, and grounding at varying power levels. Even if lightning is discharged miles away and not seen or heard, often times, this coupling event damages equipment.

ELECTRICAL SWITCHING SURGES

Another example of a source of destructive power quality events come from rapid changes in current flow rates in an electrical system. These surges are typically oscillatory, meaning the ability to couple onto other conductive equipment in the area. A switching surge will also have multiple elements of both high and low frequency, with the highest frequency element found near the source and quickly losing energy as it travels further away from the source, and a low frequency element with a slower rise and fall time allowing propagation throughout a building.

Typical causes of switching surges include:

a) Energizing or de-energizing the reactive element of a power source wiring system
b) Arcing associated with contactors, relays or even loose connections and ground faults
c) Unsynchronized power factor capacitor switching

The dampening effect of the building impedance directly relates to the first-transition time of the surge. While transient surges (typically found in the microsecond to nanosecond range) can be quickly reduced by a factor of two, very little transient attenuation can be expected for longer first-transition timed surges.[8- Martzloff] This longer transient wave will have the appearance of a ring wave in the system and potentially is more damaging then a single surge event. A building protection system should have the ability to protect and survive both fast and more destructive slow power quality events.

PREMIUM SURGE PROTECTION

WHAT IS A CATASTROPHIC PROTECTION SYSTEM (CaPS)?

Current Technology repeatedly demonstrates itself as a leader in protection performance in both the labs and with its tens of thousands of protection systems installed in the field. From this wealth of information, Current Technology has developed a Catastrophic Protection System, or CaPS, using selenium hybrid protection as an effective strategy against power quality events caused by transient surges, temporary over voltage, power swells and noise entering into a building through its service entrance.

While other Metal Oxide Varistor (MOV) based protection manufacturers claim to protect against power quality surge events for durations into the microseconds, only Current Technology's CaPS strategy allows protection from power quality events lasting up to the seconds (millions of times longer then any MOV based protectors). This difference in time will feel like an eternity to equipment loads being stressed by poor quality power. Therefore, while other manufacturer's protection elements are forced into failure or have yet to be turned on because of their design, Current Technology's CaPS strategy will continue to protect against surges throughout the transient surge, TOV or power swell event.[9 - Thomas & Betts Power Solutions]

The following chart (Figure 1) demonstrates both the industry equipment ITI CEBEMA curve (2000) with the protection levels from MOV only verses selenium hybrid technology.

Over Voltage (Vrms)

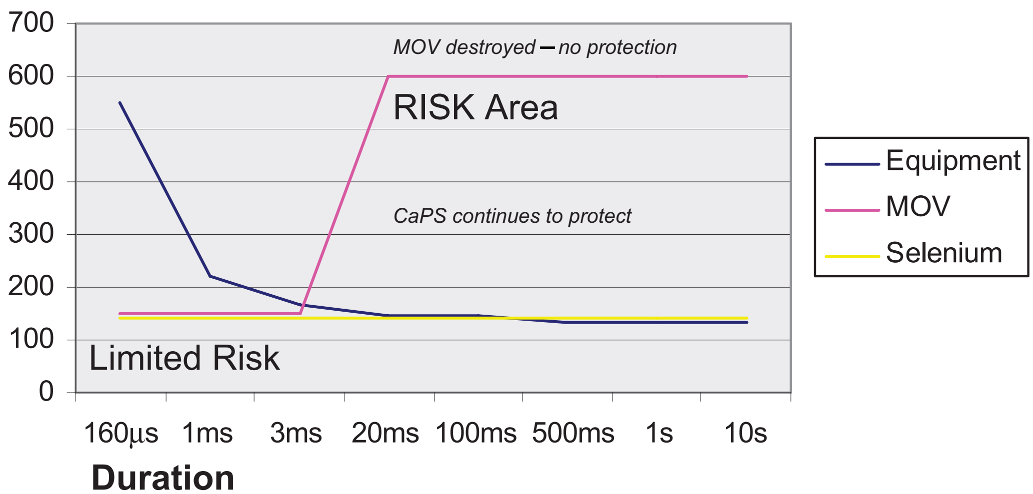

Figure 1

As Figure 1 demonstrates, any voltage / time event that exceeds the equipment manufacturer specification is seen as an equipment risk area. While the CEBEMA curve provides equipment manufacturers a guideline for robustness required by electronic equipment, it is only providing a minimum design requirement. Not only are power quality events on the rise, but equipment failures are steadily increasing, as well. While MOV only technology provides adequate protection against transient surge events that happen in the nano and microseconds, the MOV's will literally destroy themselves when power quality over voltage events last into the milliseconds.

Using a selenium hybrid based protection solution protects against transient surges, and is also actively diverting dangerous currents to ground caused by both TOV and voltage swell events.

HOW SHOULD CURRENT TECHNOLOGY CaPS BE USED?

CaPS is all about better power quality protection for your sensitive equipment. IEEE C62.41 states that the best approach for total protection is using a cascaded approach with the installation at multiple locations of the electrical system of the facility. By using Current Technology's CaPS strategy, surge protection starts BEFORE the surge actually enters the building. The Select 2 CaPS Protector is the only protector in the industry rated as both a Surge Arrestor and Surge Protection Device. When multiple protector units are deployed with SLc at the main and SLc secondary panels in a cascaded strategy, a facility has the most versatile power quality protection system against transient surges and noises, and also has the ability to protect and survive against TOV and power swell events caused by abnormal voltages.(10 – UL1449 ver2)

As Figure 2 demonstrates, a cascaded concept can also include protection down stream in your building power distribution system. This means that your load risk building evaluation should include power quality protection inside and outside of your building.

Areas of concern should always include any power and telephone/data access points coming into a building structure.

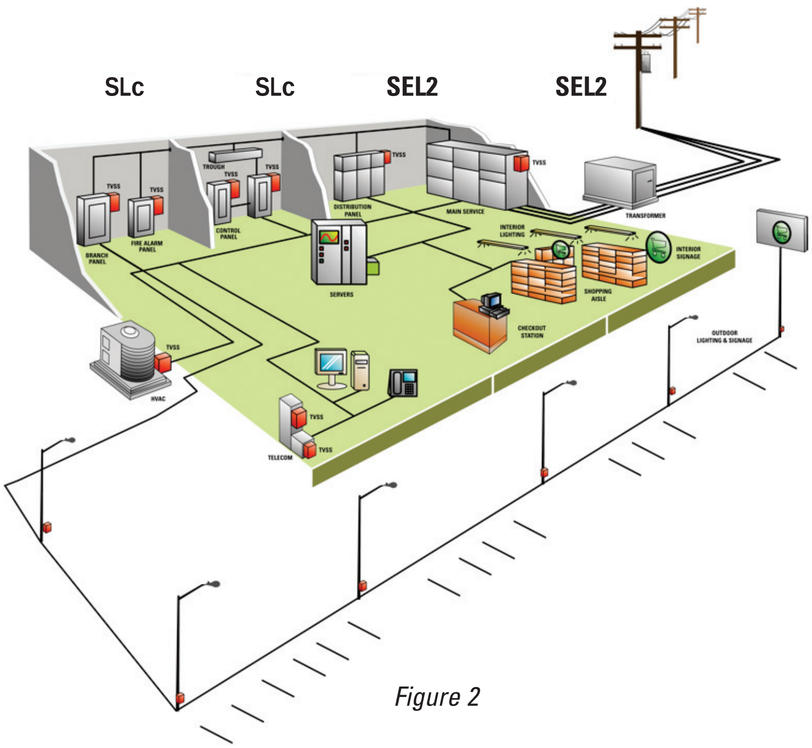

Figure 2

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