

## Surge Protection

### Introduction

With modern society's nearly total dependence on electricity to function, it has become more important than ever to provide protection against power disturbances. In Canada, many provinces are struggling to deal with an aging and overburdened electrical distribution and generation system while at the same time Canadian businesses and individuals are using record levels of electricity to run their operations and lives.

### Typical power system disturbances:

**Surge:** is a short-term increase in voltage, usually lasting from 1/20th of a second up to 2 seconds and typically measures less than 500 volts. A power surge will damage delicate electronic components and cause premature failure, as well as damaging insulation in electrical motors. The damage may not cause immediate failure of the motor or electrical component but it will shorten its life.

**Spike:** is an instantaneous sharp increase in voltage lasting less than 1/1000th of a second but reaching as high as several thousand volts. A spike can cause catastrophic damage by destroying components and data.

**Sag or brownout:** is a short-term decrease in voltage levels. Sags and brownouts can cause frozen computer keyboards and computer system crashes with loss of data. Electric motors are particularly affected by under-voltage, which reduces the efficiency and life span of the motor.

**Blackout:** a sudden and total loss of utility power from the public supply. When power is restored after a blackout, voltages exceeding several times the primary power level may be generated which will cause damage described as a spike above.

The causes of power disturbances can be grouped into two categories: those caused by circuit switching and those due to the environment.

Small power surges can actually happen several times a day when electrical devices start up or shut off and divert electricity to and from other appliances. Larger surges or spikes are often the result of the utility re-energizing or de-energizing its equipment, a tree limb touching a power line, a small animal getting caught in a transformer or lightning striking utility equipment.

Lightning is the most damaging cause of power surges and damage can occur from a direct strike or an induced surge which results when lightning strikes a point away from the electrical system. Induced lightning surges on overhead electrical distribution lines can be as high as 100,000 volts. Electrical surges can enter a building in other ways than over power lines - common water lines or other common utility equipment can be the path of entry to your premises.

### Methods of protection:

#### Grounding:

The first defence to protecting against electrical power disturbances is grounding. Electrical grounding equipment means providing a direct low resistance path for electrical current to return to earth. Electricity will travel the path of least resistance. A single continuous ground which connects all building systems and will direct the current flow back to the earth in a safe manner is the best grounding method.

## **Surge suppression:**

The technical name for these type of devices is a Transient Voltage Surge Suppressor (TVSS). A TVSS connected to critical equipment can protect it from voltage increases. The suppressor “turns on” when a preset voltage is reached, absorbing part of the surge energy and diverting it to ground. It acts like a sponge, soaking up the energy of the surge and dissipating it harmlessly. Once the surge has been dissipated, the suppressor is automatically ready to handle the next surge.

Protection should be considered for electric motors even if the motor has a transformer connecting the motor to open power lines. Surge protection should be placed as close to the motor terminals as possible or located within the starters or supply switchgear, if they are within 100 ft of the motor.

Building surge protection is normally provided by installing the protection device after the main disconnect switch and before the main distribution breaker panel. It may be connected to the main bus bars. It is connected in parallel to the supply lines. Surge protection can also be located within an electrical panel.

Electronic equipment may have surge protection provided by stand-alone units that are connected between the electronic device and the building power, often in the form of a power bar providing a number of protected outlets.

Surge protection is also available for telephone lines and coaxial cables as they can also carry power surges and spikes.

Not all surge protection is alike. There are a variety of protection devices with differing costs and effectiveness. It is important for surge protectors to be compatible with the equipment being protected.

## **Why fuses, circuit or surge relays are not sufficient:**

The speed with which fuses, circuit breakers and surge relays operate may be too slow to be effective against surges. These devices operate in milliseconds while electrical disturbances can be felt by equipment in nanoseconds.

## **Summary:**

Surge protection is an important way of protecting electrical and electronic equipment from some common power disturbances and can improve reliability of this equipment, reducing costly repairs, loss of data and downtime for businesses.

## **Key Action Steps**

- Maintain electrical system proper working order.
- Carry out a risk assessment of critical equipment.
- Ensure all equipment is properly grounded.
- Consider surge protection for building systems as well as individual pieces of equipment.
- Consult experts to determine the best level of protection for your business.
- Make certain your surge protector meets the UL/ULC standard 1449 by looking for a label which states it is UL listed as a Transient Surge Voltage Suppressor.
- Revisit your protection from time to time as you add, upgrade or move equipment.

## **For more information see:**

IEEE Standard 242-1986 Recommended Practice for Protection and Co-Ordination of Industrial and Commercial Power Systems, American National Standards Institute,

UL/ULC 1449 Performance Standards for Surge Suppressors.

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