Protecting Electronic Equipment

Transient voltages (over/undervoltage) and other power quality anomalies are electrical events colloquially referred to as “power surges.” These events may last less than a second but can have a lasting effect on business operations by damaging critical equipment or electronics.

The following information offers high-level guidance for incorporating power quality protective devices to help limit equipment damage and possible business interruptions.

Installing Surge Protection Devices – Transient Voltage Surge

Transient voltage surges occur when the voltage increases by more than 10 percent of the nominal rating for a very short period, often less than a fraction of a second. These events are typically shorter than the trip time required for circuit breakers or fuses to activate and are one of many irregularities commonly referred to as a “surge” or “spike.”

Transient Voltage Surge Suppressor (TVSS) devices, also known as Surge Protection Device (SPD) are designed to be installed at specific locations on the electric power distribution system between the service entrance and the equipment to be protected. An effective protection scheme employs multiple layers of protection. The following examples are typical TVSS configurations:

- Category A type TVSS: Commonly associated with long branch circuits and indoor receptacles.
  - Should be installed at the power connection of the electronic equipment. For equipment that is plugged into an outlet, the TVSS device is installed between the outlet and the equipment.
  - These are typically seen as surge protection strips, or uninterruptible power supply (UPS) devices, but it should be noted that not all power strips and UPS’s offer surge protection.
- Category B type TVSS: Commonly associated with major feeders, short branch circuits and subpanels.
  - Should be installed on the main switchboard if there is more than 50 feet of electric circuit separation from the main switchboard and the subpanel(s) or equipment to be protected.
  - Should also be installed on sub-distribution panel boards if there is more than 50 feet of electric circuit separation between the distribution panel and the electronic equipment. The additional TVSS installed at the panel board may be necessary to prevent the TVSS installed at the equipment from being overwhelmed.
  - Category B type devices may be included on some distribution panels or may be installed as added equipment on existing panels.
  - TVSS should also be installed on communication lines entering a building from remote transmitters. Signal line TVSS devices designed for this purpose are available.
  - TVSS devices degrade over time as they function to absorb transient overvoltage. To maintain an adequate level of protection, the devices should be replaced periodically as recommended by the manufacturer.

Maintaining Electrical Grounding System

TVSS devices typically operate by diverting surge energy to a ground. A well-maintained grounding system is necessary for a TVSS device to function properly. The grounding system should consist of grounding conductors that connect the equipment and distribution system back to an established electrical ground. The following items should be considered as part of a preventative maintenance program:

- Inspect the grounding system conductors to make sure they are sized to applicable electric codes and are in good physical condition.
- Check for isolated grounds. Electrical equipment should connect to the facility grounding system. Isolated

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grounds may result in electrical damage during surge occurrences.

- Check grounding system continuity from the point of use to the ground and repair broken or high-resistance connections.
- Test the system ground resistance.

Overvoltage Protections

Overvoltage, or voltage swell, occurs whenever the voltage increases by more than 10 percent of the nominal rating for an extended period (i.e., more than 3 seconds to a minute or more). These events are typically associated with a short to ground in one phase of a three-phase system, or loss of a neutral in a single-phase system. This results in a voltage increase on the remaining conductors that may damage electrical and electronic equipment. Electric motors may be particularly susceptible to these events.

- Like with transient voltage events, overvoltage devices may help prevent damage if the voltage exceeds equipment rated capacity. Some equipment may be susceptible to damage caused by overvoltage below the TVSS setting.
- Overvoltage monitoring and trip setting can be used to help prevent damage from overvoltage conditions that occur below TVSS setpoints. Many monitoring devices are available with adjustable settings to protect various equipment and systems. These are typically seen as add-on devices.

Undervoltage Protections

Undervoltage, or voltage sag, occurs whenever voltage decreases by 10 percent or more for an extended period (i.e., more than 3 seconds to a minute or more). Long duration undervoltage is sometimes referred to as a “brownout.” Undervoltage conditions may cause damage to electrical and electronic equipment.

- Due to the way TVSS devices operate, they are ineffective at preventing equipment damage due to undervoltage conditions.
- Undervoltage relays and trips may be used to help prevent damage from undervoltage. These are typically available as an add-on for certain types of circuit breakers or as an addition to distribution equipment.

Single-phase Protections

Single phasing is one of many different types of phase unbalance. For example: phase reversal, phase shift, voltage imbalance, unbalanced single phase loads on a three-phase system, etc. These may not cause complete loss of an entire phase but can still cause higher currents in the remaining phases. When three-phase motors experience a single-phase event, it results in the motor drawing an increased current on the remaining phases which can quickly lead to overheating and damage. Single-phasing can affect sensitive electronics. Electric motors and associated drives, contactors and cabling may also be affected by single-phase conditions.

- Phase unbalance monitoring and trips are available to help prevent damage caused by single-phase events.
- Overcurrent trips may be used on large or critical motors to help prevent damage to these units.

The devices needed to help protect electrical and electronic equipment from damages due to power quality issues vary depending on the complexity of the electrical distribution system, the type of equipment being protected and the specific power quality problems. A qualified electrical engineer experienced with electrical distribution system power quality protective systems should be consulted to determine the appropriate devices for each application.

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