Voltage surge: protecting sensitive electronic equipment

Introduction

Personal computers, servers, microprocessor-based controllers, telephone switchboards, robotics, cash registers systems... the list goes on. All of these are electronic equipment types named in loss reports where the cause of the damage was a voltage surge.

Most voltage surges are weather-related caused by lightning strikes on the electric utility’s distribution system. Other causes are possible, such as a high-tension line falling on a lower voltage distribution line, or surges from switching or current zero forcing caused by over-current device operation. The cause of the voltage surge is not the issue as much as is the absence or presence of surge protection. If your sensitive electronic equipment is not properly protected, it will be damaged. A well-designed surge protection scheme can help to prevent damage to expensive equipment and even costlier business interruption.

Installing surge protection devices

Your facility electric distribution system should be provided with lightning arresters at the service entrance on the primary bushings of the utility transformer. The secondary bushings of the transformer should also be equipped with lightning arresters if the secondary bushings or feeder conductors are exposed to lightning strikes. If you own the transformer the lightning arresters are your responsibility. A properly designed, properly installed, and well maintained lightning arrester system will protect most of your connected electrical equipment.

The service entrance lightning protection is your first line of defense, but lightning arresters alone are not enough to protect sensitive electronic equipment. To get the additional protection needed, Transient Voltage Surge Suppressor (TVSS) devices are recommended for installation at certain locations on the electric circuit between the service entrance and the appliance to be protected. TVSS devices are available in a variety of designs for specific locations on the electric power distribution system. TVSS devices designed for use on data circuit lines are also available. Before installing these devices, always specify underwriters’ Laboratory (UL) listed TVSS devices. Then:

- Install TVSS devices at the power connection of the electronic appliance. For cord set powered equipment this is at the power outlet. Use TVSS device designed for use at this location – Category A type.
- Install TVSS devices on each sub-distribution panel board if there is more than 50 feet of electric circuit separation between the panel board and the electronic equipment. If the distance is 50 feet or more the voltage surge wave can be reflected back. The voltage magnitude of the wave will double at the point of reflection, which is the end point where the appliance is located. The TVSS at the panel board is necessary to prevent the TVSS at the appliance from being overwhelmed. Use panel board TVSS devices designed for this location – Category B type.
- Install a TVSS device on the main switchboard if there is more than 50 feet of electric circuit separation from the main switchboard and the appliances to be protected. Use main switchboard TVSS device designed for this location – Category B type.
- Install TVSS devices on the copper signal lines coming into the building from remote transmitters. Use signal line TVSS devices designed for this purpose.

Maintaining electrical grounding system

TVSS devices connect between the power conductors or signal conductors and the system ground to divert surge energy ground. A well maintained grounding system is necessary for TVSS devices to function properly. Your grounding system should consist of grounding conductors that connect the appliance and distribution equipment back to a driven ground rod located at the service entrance. Larger facilities will have a buried grounding mat in the main substation. Check these items:

- Test your system ground resistance at the grounding rod. There are several methods. The most common is to use a “fall of potential” setup. The National Electric Code specifies a maximum ground resistance of 25 ohms but this is too high to adequately protect electronic equipment against surge damage. For TVSS devices to work correctly the ground resistance should be 5 ohms or less.
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- Driving additional ground rods and bonding them together, burying a ground plate, or treating the soil with salts can reduce ground resistance.

- Do not use isolated grounds. All equipment grounding should connect to the facility grounding system using copper conductors. Otherwise, damaging potential differences can arise during surge occurrences.

- Inspect the grounding system conductors to make sure these are all sized to National Electric Code Article 250-93.

- Check grounding system continuity from the point of use back to the ground rod and repair any broken or high resistance connections that exceed a few micro-ohms.

Proper surge protection can make a difference to the status of your equipment when a power surge occurs. Sensitive electronic equipment can be damaged if not properly protected, irrespective of the cause of the surge. A well-designed surge protection plan can help protect expensive equipment from damage and business interruption. Consider seeking the advice of a professional to evaluate your premises and electrical system to ensure the electronic equipment has the proper voltage surge protection.

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