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Protecting Commercial Facilities From Power Surges

Power or voltage surges are brief bursts of energy caused by a sudden change in the electrical conditions of a circuit; they are virtually inevitable. Wherever electrical or electronic equipment is used, power surges can and do occur. While often lasting only a millisecond, power surges can raise the voltage in electronic circuits from a few hundred to as much as several thousand volts. They are one of the most severe, common and immediate dangers to modern, sensitive electronic equipment. In fact, Business Week estimates that power surges cost $26 billion a year in lost time, equipment repair and replacement costs.

WHAT CAUSES POWER SURGES

It is estimated that 60 percent to 80 percent of power surges are caused by events or problems arising within the facility housing the electrical and electronic equipment. The balance are generated by external events that affect the internal electrical system through power cords, telephone lines, and cable, satellite and antenna lines. Events causing surges include:

LOCAL POWER SYSTEM PROBLEMS

Poor power quality is one of the major causes of downtime. The most common source for externally generated surges is the local electric company. Problems and points of failure include faulty wiring by a utility, equipment breakdowns, downed power lines, grid shifting (reallocating stored energy to match demand), and capacitor switching (a routine, daily event). Large users of the same power line at other facilities can also create power surges. Heavy electrical equipment that frequently turns on and off, such as high-powered motors, elevators, or heating/air conditioning equipment, creates sudden, brief demands for power that can upset the steady voltage flow in the electrical system and result in power surges affecting everyone connected to the same power line. Externally generated surges may also be caused when two power lines come into contact with each other as a result of vehicle crashes damaging power poles, fallen tree limbs, ice storms or animals.

LIGHTNING

Power surges caused by direct lightning strikes are rare events, accounting for only two percent of power surge damage. Lightning, however, is a very common occurrence, striking the surface of the Earth about 100 times every second. When lightning directly strikes exposed cables feeding electric equipment, the extremely large, overwhelming power surges it produces are devastating. Importantly, lightning does not need to actually directly hit an object on the ground to induce a power surge. Lightning can create strong electromagnetic fields, which can induce a power surge that affects power, telecommunications and radio frequency transmission lines; these in turn affect electric equipment inside a facility. Due to the low voltages normally used in data transmission cables and the sensitivity of the connected electronics, communications cables are extremely susceptible to induced voltage surges. IBHS has additional valuable information for business and building owners to protect your property from lightning.

EVENTS ARISING WITHIN THE FACILITY

Switching high-powered electrical devices like elevators, air conditioners, refrigerators, pumps, compressors and motors on and off are common causes of internally generated surges. Also, the ignition and interruption of electrical arcs used in welding devices can cause surges, as can the tripping of fuses and circuit breakers. Typically, but not always, these surges are rather small and degrade electrical equipment, rather than destroy it.

WHAT TYPES OF BUSINESSES AND EQUIPMENT ARE AT RISK

Virtually every business relies on modern electronic equipment to some degree – and such equipment can be easily damaged or weakened by surges. Businesses face significant threats if their products or services rely on sustaining continuing operations supported by electronic or telecommunications equipment, or if malfunctions of sensitive electronic equipment change the nature of critical products and/or services. Businesses with electronic systems in hazardous locations, such as potentially explosive atmospheres, obviously are exposed to catastrophic risks. Businesses located in areas with poor local power supplies or where weather conditions make lightning strikes more likely also face increased risk of damage from power surges.

Examples of businesses and equipment at risk include:

- manufacturing operations where there is significant use of motors and other high voltage equipment;

- businesses that depend on computers, and use office equipment such as printers, faxes and photocopiers;

- businesses that use security or alarm systems, telemetry or monitoring networks, bar code scanners, or thermostats;

- healthcare facilities with equipment monitoring and assisting life support systems; and,

- information and order processing operations with heavy reliance on communications.

PROTECTING AGAINST POWER SURGES

Small businesses, manufacturers, multi-national corporations, research facilities, and many other businesses recognize the need to address power surge risks – and the benefits that accrue from doing so. The general approaches to managing power surge risks are relatively straightforward. However, specific applications must be customized to fit the unique needs of diverse operating environments and circumstances. Such applications are most appropriately designed and installed by experienced experts. The basic tools to minimize the impact of power surges are:

- Install surge protection against external sources at the point where external power is supplied to the business.

- Make sure that all systems have a common "ground" and enter the building within a few feet of each other.

- Keep communications and low voltage lines away from power cables within the facility and, when possible, have them cross at right angles.

- Add surge protection at distribution panels within the facility if it includes large motors, welders, etc.

- Add surge protection for individual pieces of sensitive equipment to the power connection and to any communications lines (e.g., phone cords, Internet cables or coaxial cables – cable television or cable Internet type connections).

- Assure Electrical and Telecommunications Systems are Designed and Installed to Minimize Power Disruptions

The appropriate design and installation of the wiring within a facility is extremely important in mitigating surges. A building's electrical system needs to be properly grounded in accordance with the National Electrical Code. All telephone, cable and satellite wires need to be bonded to the same grounding point. Communications cables need be installed with appropriate separation from power cables which can induce surges. Telecommunications rooms need to be wired to minimize electrical disturbances and fitted with electrical equipment, temperature controls and furnishings that dampen the likelihood of disturbances.

INSTALL APPROPRIATE SURGE SUPPRESSION DEVICES

Surge suppression devices regulate the voltage supplied to an electric device either by blocking or diverting voltages above a safe threshold to ground. Surge suppression devices should be installed in a staged, cascaded or layered manner to divert surges of various strengths at different points within an electrical system. Surge suppressors installed at the high exposure service entrances, where power enters the facility, establish the first line of defense against high powered, externally generated surges. These devices will address surges caused by lightning, power company grid switching, power system faults, severe weather, and neighboring facilities.

The second layer of defense is established by installing surge suppressors at the distribution panel, which distributes power throughout the facility. These surge suppressors protect against high to medium surges that may be externally or internally generated. Installing devices at branch panels addresses lower level surges generated by a wide variety of load equipment, including lighting control, office equipment and industrial systems. In addition, some equipment and circuits may require special attention. Process control, sensing and monitoring devices may all require individual protection, including plug-in units installed at point-of-use locations. Telecommunication and data circuits are extremely vulnerable to relatively low-level surges and need to be protected at the point of entry.

There are several manufactures of surge suppression devices which are designed to meet a variety of circumstances and conform to well-developed specifications, guidelines and standards. Selecting the appropriate devices to meet a business' needs obviously depends on performance criteria. Experts, however, emphasize that installation and inspection requirements for devices that fit the business' environment are among the most important factors in selecting appropriate surge protection.

While surge suppression devices are the major tool minimizing surge damage, they cannot prevent damage caused by direct lightning strikes, nor the rarely occurring temporary over-volts cause by severe faults in power company cables.

INSTALL AN UNINTERRUPTIBLE POWER SUPPLY IF DICTATED BY OPERATIONS

Surge suppression devices do not provide back-up power. An uninterruptible power supply is an electrical apparatus that provides emergency power when an input power source fails. This device differs from an emergency power system or standby generator in that it provides near-instantaneous protection from input power interruptions for a relatively short period to allow time to properly shut down protected equipment or bring an auxiliary power source on line. This

type of device is typically used to protect computers, data centers, telecommunications equipment or other electrical equipment where an unexpected power disruption could cause injuries, fatalities, fatalities, serious business disruption or data loss.

STANDARDS AND REFERENCES FOR SURGE PROTECTION

Institute of Electrical and Electronic Engineers – C62 Collection of Guides and Standards for Surge Protection

Institute of Electrical and Electronic Engineers – C62.41 Guide for Surge Voltages in Low Voltage AC Power Circuits

Institute of Electrical and Electronic Engineers – C62.45 Guide on Surge Testing for Equipment Connected To Low Voltage AC Power Circuits

Institute of Electrical and Electronic Engineers (std 1100) Emerald Book

Underwriters Laboratory 96 Standard For Safety-Installation Requirements for Lightning Protection Systems

Underwriters Laboratory 452 Standard for Safety- Antenna Discharge Units

Underwriters Laboratory 497A Standard for Safety-Secondary Protectors for Communication Circuits

Underwriters Laboratory 498 Standard for Safety-Receptacle and Receptacle Plugs (Including Direct Plug-In Devices)

Underwriters Laboratory 544 Standard for Safety-Medical and Dental Equipment

Underwriters Laboratory 1283 Standard for Safety-Electromagnetic Interference Filters

Underwriters Laboratory 1363 Standard for Safety-Temporary Power Taps (Power Strips)

Underwriters Laboratory 1449 Standard for Safety-Transient Voltage Surge Suppressors

National Electrical Manufactures Association LS-1 Low Voltage Surge Protective Devices

Institute of Electrical and Electronic Engineers Emerald Book (std 1100) FIPS 94

Institute of Electrical and Electronic Engineers C62.41 Manufacturers (Allan Bradley, Motorola, other suppliers)

National Electrical Manufactures Association LS-1

National Fire Protection Association 780

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