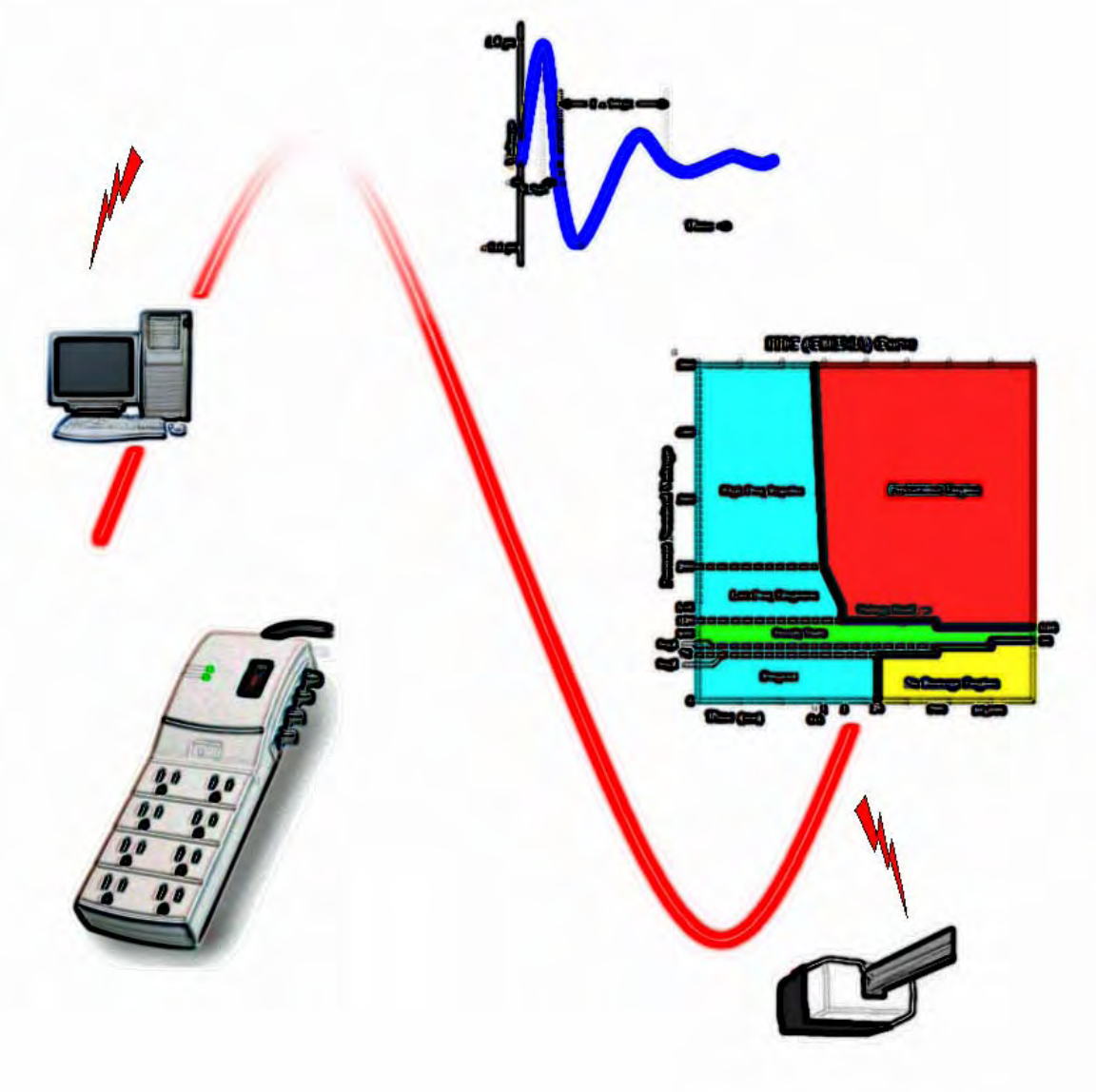
Secondary Surge Protection

An Online Continuing Education Course for Engineers

Course Number: E-3015

Credit: 3 Hours / 3 PDH / 3 CPD

Secondary Surge Protection



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Introduction

From an electric utility perspective, secondary surge protection means protecting the secondary of a distribution transformer from damaging overvoltage conditions. From a residential consumer's perspective, secondary surge protection concerns mitigating the effects of overvoltages on appliances, computers, and other household electrical appliances.

The sophistication of computer controlled equipment found in homes today rivals the processing capability of business computer centers just a few short years ago. And these business computer rooms had special requirements for "clean" power whereas the typical residential home is exposed to all types of varying voltage conditions that can harm equipment.

There are numerous terms used to describe secondary voltage problems including, surges, spikes, noise, sags, swells, undervoltages, overvoltages, and outages. In fact, power quality is generally defined by the terms regulation, isolation, suppression, harmonics, noise, grounding, and interruptions. Figure 1 is a graphic of potential power quality issues.

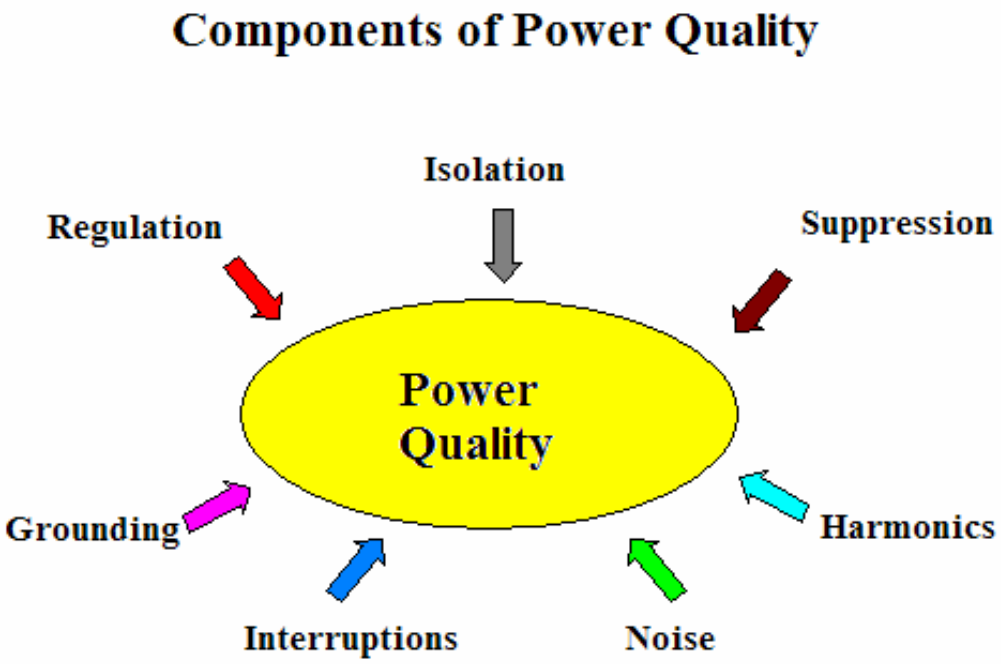

Figure 1

Suppression includes methods to control spikes and transients. For our purposes we will define a spike as a short-term overvoltage condition of less than two per-unit of the normal voltage and a transient surge as any short-term overvoltage in excess of two per-unit. Regulation involves keeping sags and swells within acceptable limits. A swell is an

increase in voltage, at the power frequency, for durations from one-half cycle to one-second. In contrast, sag is a reduction in voltage, at the power frequency, for durations of one-half cycle to a one-second. Harmonics are integer multiples of the fundamental power frequency and are caused by non-linear loads such as switching power supplies, etc. Noise is a low-energy random signal that appears on the voltage or current wave. Noise may be caused by fluorescent ballasts, door bell transformers, electric heating elements, etc.

The most common form of secondary voltage condition is a transient surge followed by spikes and over/under voltage conditions. See the adjacent chart for the incident rate of the various types of power line disturbances. It is interesting that the combination of spikes and surges total 88% of the typical power line disturbances.

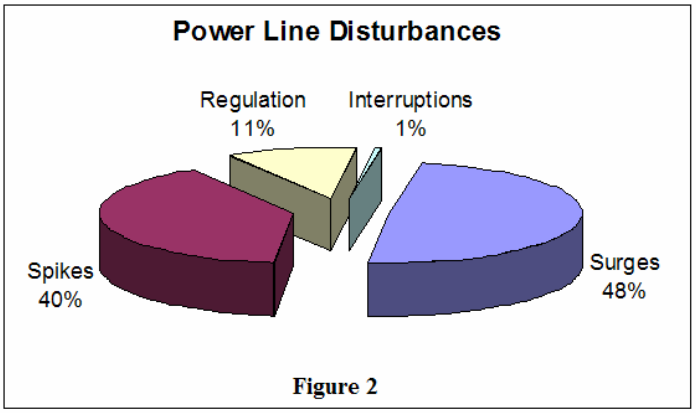

Figure 2

In the first section of this course we will look at the most common cause of transients, which is lightning. Subsequent sections will cover the basics of transients, transient voltage surge system (TVSS) equipment, standards, and the application of TVSS equipment to residential applications.

I. Lightning

Each year lightning is responsible for numerous deaths in the U.S. and millions of dollars in property damage to utility equipment and consumer electronics.

Since 1989 a lightning detection network has been in place over the continental 48 states. During this time, an average of 20,000,000 cloud-to-ground flashes has been detected every year. In addition, about half of all flashes have more than one ground strike point, so at least 30 million points on the ground are struck in the US. There are roughly 5 to 10 times as cloud to ground flashes.

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The f , and lifting ir above in the atmosp is cold. T thunde anythin air is pushe s into liqu doesn't cool off s gets into the colder atmosph than the air around it. Since it is less dense, it will sta being pushed. Then more water vapor turns into liquid in the air mass and the air mass warms up more and rises even faster until all of the water vapor is gone and the air mass eventually reaches a point in the atmosphere where it isn't warmer than the environment.

Strong updrafts and down drafts occur with regularity, even within small thunderstorms. The updrafts transport water droplets up into the cloud, while ice particles descend from the frozen upper regions of the cloud. As they do, they bump and collide with each