POPULAR SCIENTIFIC ABSTRACT

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Analysis of Electronic Loads on Electrical Measurements, Power Quality and Billing

In the last decades, the loads connected to the electrical system have changed significantly with the advent of electronic circuits devices. Furthermore, new technologies have emerged and become more and more ubiquitous, such as electric vehicles, photovoltaic systems and automation and control devices. Many of these loads are nonlinear and responsible to insert harmonic distortions that propagate through different locations, especially in low voltage distribution grids with residential and commercial consumers. Moreover, harmonic distortions affect the electrical system in different ways. Although extensive literature can be found, especially from the power quality area, there are still many open questions regarding nonsinusoidal systems. There is a need of understanding the impacts of nonlinear loads in electrical systems and how they interfere with the measurement and billing process. It is proposed a new electrical energy billing method, which aims to fill the gaps found in the existing literature. The studies are based on computational simulations. In addition, measurements in the field and in laboratory were developed using three revenue meters from different manufactures together with a power quality and energy analyzer. In all cases, the IEEE 1459-2010 power theory is used as a reference. For the studies, common loads found on residential and commercial consumers were used, such as electronic lamps (CFL and LED), TV Set, notebooks, and air conditioners. A programmable AC power source is also used, to control de signal applied on the experimental setup. The individual and collective effects of certain electronic loads were observed. The results show that harmonic interaction, both between loads and between loads and the system, in general, contributes to reducing the final distortion levels. This explains why there have not been major problems in the electrical system, despite the significant increase in nonlinear loads. However, a given set of

loads can contribute to extrapolate the limits established on different literature standards (especially the IEEE Std. 519), depending on the system's characteristics, such as the rated power of the transformers, voltage level, short-circuit, circuits length, load profile, the section of conductors, etc. It is shown the importance of understanding and mitigating the effects of nonlinear loads on the electrical system. Regarding the electrical energy billing, it is necessary to update the current rules, aiming to adapt the systems with nonsinusoidal characteristics, so it is fair for both consumers and utilities.