

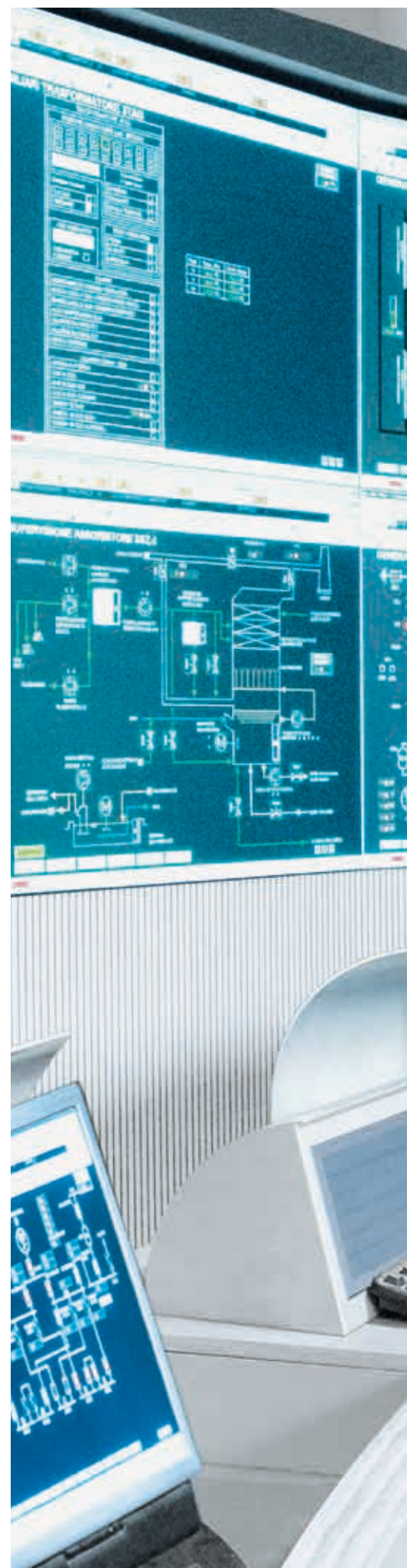
Power factors

Power quality – problems and solutions

NICOLE NÄGELE, SOPHIE BENSON-WARNER – Modern society has become dependent on a continuous supply of clean electrical power. But the power supplied by the grid is not always clean, or continuous, and measures have to be taken to mitigate this. The first step in designing the power protection solution to do this is to understand the types of power quality problems on the incoming supply and the nature of the loads to be connected.

Title picture

When problems occur in the supply of electrical power to complex or critical installations, uninterruptible power supplies keep good quality power flowing to essential equipment.







Sophisticated technology has reached into every aspect of our lives to provide enormous benefits in terms of lifestyle, business, infrastructure and health. Accepting these benefits, however, increases reliance on electrical power – and often that power has to be completely free from interruption or disturbance for things to run smoothly.

The consequences of large-scale power disruption can be dramatic. In the United States, considerable analysis regarding the costs of power quality problems has

age sags are much more common and, cumulatively, very expensive. Grid investment, of course, can improve grid performance but it is impossible to completely protect against all eventualities.

A power grid is never perfect and it is susceptible to voltage swells and drop-outs as well as sags. Some industrial loads are relatively immune to these voltage fluctuations (switched-mode power supplies, drives, motors, etc.) and may require no additional power protection, especially if they are not critical. Of course, they are vulnerable when the

ABB's PCS100 Power Converter System product portfolio includes products that offer very high efficiency and low ongoing cost of ownership.

been carried out. Outages and voltage sags, for instance, cost Americans an estimated \$150 billion a year in spoiled food, lost productivity and other costs, according to data from the Galvin Electricity Initiative [1]. Outages tend to be relatively infrequent, but expensive. Volt-

power fails altogether. Others, such as critical systems or continuous process equipment where an outage results in significant restart time, do need protection. Certain loads, such as sensitive measurement or medical equipment, can be sensitive to events even within the normal grid tolerance of +/- 10 percent and these need special consideration.

Grid upgrades can improve power quality: Overhead cables that are susceptible to interference from trees, lightning and storm damage can be upgraded or routed underground; protection systems can be improved; and grids can be laid out in a ring configuration.

It is often possible to reduce the incidence of voltage outages, but sags are more difficult to eliminate. In a highly connected grid, any grid fault will propagate, impacting negatively on sensitive loads. Even the very best electricity grids

requirements associated with batteries or other storage media deter industrial and commercial companies from fully protecting their entire load against voltage fluctuations. A trade-off always had to be made between event frequency and consequent financial consequences on the one hand, and the installation and operating costs on the other.

However, ABB's PCS100 Power Converter System product portfolio includes products that offer very high efficiency and low ongoing cost of ownership → 1.

These offer shorter payback times and now make it more attractive to install mitigation equipment.

Often, some loads do not require protection whereas others require voltage conditioning and very critical

loads require UPS protection. Segregating loads accordingly when designing an electrical system can considerably reduce costs and result in an optimized solution.

Other power quality problems

Voltage sags and outages tend, quite rightly, to be the primary focus of remedial efforts, but they are not the only costly voltage-related power quality problems that can be encountered. In some supplies, particularly in emerging economies, other problems such as surges, voltage imbalance and grid frequency variations can cause major problems with connected loads. Here, ABB's double-conversion UPS and PCS100 Static Frequency Converter (SFC) product would be used to improve supply quality.

Problems can also manifest themselves in the current drawn by the customers' loads. Harmonics and power factor issues are the major areas of concern here and these can also be mitigated by ABB products, including the PCS100 STATCOM-I, which functions rather like a static VAR compensator.

Current harmonics and power factor issues can be mitigated by ABB's PCS100 STATCOM-I, which functions rather like a static VAR compensator.

Surges, voltage imbalance and grid frequency variations can be dealt with by ABB's double conversion UPS and PCS100 Static Frequency Converter.

in the world have a level of residual power quality issues as there is always an economic limit to what can be achieved. Usually, the most economic solution after the feasible grid upgrades have been completed is for electricity consumers to employ voltage conditioning schemes or uninterruptible power supply (UPS) protection for sensitive loads. The cost of these is often borne by the consumer: It may be that the power quality problems arise in the utility supply, but the consumers, due to the nature of their loads, may be demanding a much higher quality of supply than is practicable. Clearly though, the utility has an obligation to provide voltage at a certain level of quality and there may be some discussion on the cost of customer-specific grid upgrades.

Not only is there the upfront capital cost of mitigation equipment and its installation, but there are also ongoing costs. On top of maintenance costs come efficiency costs, as no equipment is 100 percent efficient. In addition, the equipment must be reliable and maintainable to ensure performance and availability, so care must be taken in its selection.

Historically, the high electrical losses of traditional dual-conversion UPSs (4 to 8 percent) and the high maintenance

Nicole Nägele

Newave SA, an ABB company
Quartino, Switzerland
nicole.naegele@ch.abb.com

Sophie Benson-Warner

ABB Discrete Automation and Motion
Napier, New Zealand
sophie.benson-warner@nz.abb.com

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- [1] Galvin Electricity Initiative. (2010, July 1). Galvin Electricity Initiative: Heat Wave-Related Blackouts Preventable with Smarter, More Reliable Electricity Grid. [Online]. Available: <http://www.galvinpower.org/%20media/releases/heat-wave-related-blackouts-preventable-with-smarter-more-reliable-electricity-grid>