

Improving UPS and generator set compatibility



By Gary L. Olson
Director, Power Systems Development
Cummins Power Generation
Minneapolis, Minnesota

Our energy working for you.™

The ultimate goal of 7x24 facility designers is to deliver electrical systems that are 100 percent operational and reliable under all conditions.

In trying to meet that challenge, designers face the issue of optimizing the compatibility between the uninterruptible power supply (UPS) and standby generator sets. Designers can maximize the reliability of their systems by employing the following recognized solutions to UPS and generator set compatibility.

Use conservatively designed alternators

Since a UPS is a non-linear load, the harmonic currents produced by the UPS can sometimes cause alternator overheating. To solve this, designers should specify alternators with not more than 105°C temperature rise at the rated output of the generator. Dramatically oversizing the generator set (two to three times UPS rated kVA) has been found to be unnecessary. Alternator suppliers have varying recommendations, but, in general, sizing the alternator at 15–20 percent larger than is required for a linear load of similar magnitude will often prove to be a good solution. Designers also recognize that, within limits, alternators can be oversized without oversizing generator engines, thus eliminating light load operation problems with engines that are too large.

Specify maximum allowable alternator subtransient reactance

The harmonic currents also cause voltage waveform distortions that are typically more pronounced while operating on generator sets than while operating on the utility service. The voltage waveform distortion is greater on the generator set than on the utility because of the generator's higher internal impedance. In order to make the generator equal in impedance to the utility, it would need to be much larger than is practical. Consequently, the system designer is often forced to estimate the amount of harmonic distortion that is acceptable—often with little solid guidance. Specifying a maximum allowable alternator subtransient reactance will result in the best practical performance that can be achieved and allow proper evaluation of proposals from various manufacturers.

Use digital excitation controls

Voltage waveform distortion can disrupt the operation of the generator set voltage regulator. The use of a three-phase sensing digital voltage regulator, separate

excitation power system such as a permanent magnet generator (PMG), and pulse width modulation in the AVR (automatic voltage regulator) can eliminate these problems, making the generator set almost immune to AVR misoperation due to distortion.

Set slew rates with generator equipment

Designers recognize that generator set frequency will never be as constant as the utility, and load changes will cause transient voltage and frequency excursions that can be disruptive to UPS equipment. Settings of UPS equipment for slew rates that are achievable with generator equipment (3–5 Hz/sec) can minimize alarm conditions.

Use programmed transition

Occasionally, UPS equipment can be disrupted by transfer switch operation. Operating the transfer switch too quickly between energized sources may cause rectifier failures or misoperation. Simple and commonly available “programmed transition” (short time delays in open position) or fast closed-transition transfer has solved this issue.

Be careful of filters

Most UPS equipment incorporates filters to minimize the impact of the waveform distortion caused by the nonlinear characteristic of the UPS. While the filters are perfectly functional on utility-powered systems, they can cause problems for generator sets, because alternators have relatively limited ability to absorb excess kVAR generated by the filters when operating at light load levels.

When exposed to greater reverse kVAR than the alternator can absorb, the machine will lose control of voltage, causing high levels of voltage at system loads, or the UPS may not stay connected for long enough to ramp on its rectifier.

These problems can be resolved by avoiding application of leading power factor loads on a generator set by having more balanced loads applied in sequence to the generator set, or by turning off the filter until loads on the UPS reach a point where it is critically needed.

By following these guidelines, system designers can improve the compatibility between UPS and generator sets, helping to improve the reliability of their standby power systems.



**Power
Generation**