Generator Windings Pitch

Question: Should You Specify 2/3 - Or 4/5 - Pitch Generator Windings?
Answer: It depends... As non-linear loads make up and increasing portion of total electrical load profile, more thought is being given to dealing with the phenomenon of their harmonics and its effect on gensets, loads, cabling buses, protective relays and circuit breakers. The problem becomes even more complex if the genset is paralleled with the utility when harmonics on the utility line may cause some hard-to-trace problems.

Harmonics Defined

Harmonics are multiples of the sine waveform produced by the generator. For example, 60 Hz is the fundamental waveform, then 180 Hz (60 Hz x 3) is third harmonics, 300 Hz is fifth harmonics, 420 Hz is seventh harmonics, etc. Only odd-numbered harmonics are important in this discussion.

All harmonics affect current waveform. If the waveform change is great enough (most notably in the third harmonic), loads that use the 60 Hz waveform to trigger switching are affected. It can also deceive the genset voltage regulator so it continually "searches" for the correct excitation level to meet the needed voltage. It also can create excessive heat in transformers, UPS and computers, as well as throw off instrument readings.

Although 2/3-pitch generators produce little third harmonics current, they do produce much higher fifth and seventh harmonics when compared with 4/5- and 5/6-pitch generators. This increases heating in motors, which can shorten life.

Best Practices

The best way to deal with harmonics concern is at specification. Present and future load profiles offer some insight into non-linear loads. If it is harmonic-rich, specifications should compensate for it.

If inductive loads make up the majority of the load, 4/5- or 5/6-pitch generators can be used with correct sizing. These generators also result in phase-to-neutral faults much lower than 2/3-pitch unit.

Pitch Pointers

There has been much written and even more speculated about the pros and cons of 2/3-pitch generators vs. 4/5- (and 5/6-) pitch machines. Because the effects of third harmonics on electrical systems are installation-specific, few hard and fast rules apply. However, in general, the following points are consistent across all generator and electrical systems:

1. Third harmonics current is generated almost totally by connected load – computer systems, UPS, variable-speed and fluorescent lighting. Only a negligible amount is produced by the generator, no matter what its winding pitch.
2. Third harmonic currents in identical paralleled gensets are no problem if gensets are carrying equal load. However, it may be a problem if two generators of different pitches are paralleled.
3. While 2/3-pitch generators have very little third harmonic current compared to other pitches, the fifth and seventh harmonics are nearly maximum at 2/3 pitch. Further, if a phase-to-neutral fault (the cause of 65% of all faults) occurs on a 2/3-pitch machine, there will be higher fault currents, with the potential of more system damage and the need for higher interrupting capability circuit breakers - adding cost to the installation.

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Many questions must be answered about an installation before it can be decided which pitch is best for your application. Cashman Power Solutions is ready to recommend the best course of action.