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Prospects in the year of the water dragon



Instrumentation and Control

- In-Situ® RDO® optical dissolved oxygen technology

Application Monitoring

- Bentley's CivilStorm software

Market Talk

- Managing director of SIWW, Maurice Neo
- President of Black & Veatch's water business, Cindy Wallis-Lage



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The dangers of harmonics

Harmonic distortion is a type of pollution to the electricity supply that can be hard to detect. Water companies, in particular, operate many loads that are both susceptible to harmonics and which generate harmonics. A harmonic frequency is a multiple of the network frequency, for instance a 250 Hz waveform on a 50 Hz network is the 5th harmonic. A harmonic waveform represents energy that cannot be used by the connected equipment and this can make the equipment behave erratically – motors can overheat or become noisy, cable insulation can break down and meters can give false readings, are some examples.

Harmonics are produced by non-linear loads, such as computer power supplies, fluorescent lights and welding supplies, as well as both AC and DC drives. Water companies tend to have large numbers of AC drives across many sites. Many of these sites are in remote locations with weak supplies and these are particularly prone to harmonics. Also the backup generators used at many sites can be an additional source of, or be susceptible to, harmonics. In addition, many booster stations in built-up areas operate large pump installations that have the potential to distort the network.

Identifying the cause

Harmonics caused by AC drives can be managed and suppressed to a level where they no longer cause a problem, or can be eliminated altogether. However, problems caused by harmonics are frequently not recognised as such. As the user is not aware that the problems are caused by harmonics, inappropriate action is often taken. For instance, cooling systems, higher rated transformers, cables and capacitors are usually thought to be the solutions to such problems. Although such action may limit the problem it does not address the fundamental cause.

Power and automation company ABB offers valuable industrial tips in rectifying this subtle but lethal force that could potentially render discord in the power supply of your plant

Reducing harmonics

Most low voltage AC drives use diode rectifiers which create high levels of harmonics. These have to be mitigated after they have been created. Filtering can be achieved with either a passive or an active filter. A simple line reactor can reduce the harmonic levels; a passive filter will remove some or part of the spectrum; while a more effective way to get rid of harmonics is the active filter, which can target specific harmonic frequencies.

The alternative approach is to use a low harmonic drive. This has an active rectifier and a built-in LCL (inductor-capacitor-inductor) filter. The active rectifier is controlled to eliminate low order harmonics, while the LCL filter suppresses the switching frequency components caused by the rectifiers' semiconductors.

The type of filtering needed depends on the network and on the drive installation. On a 400 V network with just a single drive of no more than 37 kW, meeting the product standard EN 61000-3-12, no additional filtering is needed. A large number of independent small drives are best filtered by an active filter, while a few larger

drives will, in most cases, be best suited for solutions involving low harmonic drives.

Site survey needed

However, it is not just the drives that need to be taken into account. The network also has a great influence and there is no substitute for a skilled pre-installation evaluation, which can save enormous costs.

When M/S Torishima Pump Mfg Co needed 40 low voltage AC drives for use in a variety of water pumping stations and refurbishment projects in Qatar, the company contacted ABB. ABB then set to work in close cooperation with the end user to identify and provide the best technical solutions.

ABB supplied cabinet-built versions of its low harmonic drive in sizes from 160 to 2,700 kW. These drives produce exceptionally low harmonic content in the drive input based on the use of an active rectifier, along with the motor control method, direct torque control (DTC) and the use of an LCL filter, giving a total current distortion of less than five per cent. This is combined with a unity power factor. The electrical system is now more reliable due to avoiding external harmonic filters. Expensive multi-winding transformers were also unnecessary and the cabling was optimised.

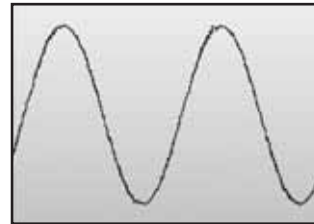
ABB low harmonic drives also helped a UK wastewater pumping station to increase its pumping capacity without causing disturbances on the electrical supply network. Countess Wear wastewater treatment works, operated by South West Water, is located south of Exeter. The site, which is supplied at 11 kV, already had a number of variable-speed drives in operation including a 55 kW ABB AC drive powering the existing treatment works inlet pumps.

Because of the existing drives, the treatment works already had a high harmonic loading on site. The installation of additional drives for the new storm flow pumps threatened to increase this load to unacceptable levels. To solve this potential problem, ABB recommended the installation of a low harmonic drive.

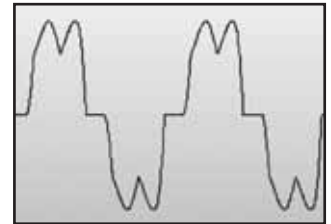
Following installation of the drive and pumps, ABB tested the harmonic distortion, both at the incoming live connection and the cable between the fuses and contactor. Distortion readings were found to be much lower than a normal six-pulse rectifier – around two to



With so many different pumps, fan and other motor-driven applications throughout the water cycle, ABB has an AC drive to match virtually every situation. ABB recently launched a low voltage AC drive, ACQ810, that features several intelligent functions specifically designed to combat challenges faced by pumps.



Network-side current of low harmonic drives.



Network-side current of conventional drives.

three per cent compared with the usual level of 40 per cent.

Kevin Atkin, tendering manager with contract panel builders Blackburn Starling, says, “We asked ABB to help and they calculated what equipment would give us the best possible solution to the problem and meet the regulations. The drive ABB recommended provided the most cost-effective solution to the problem of keeping the harmonics at the lowest possible level.”

There is no need to miss out on the benefits of variable-speed drives just for fear of harmonics. Variable-speed drives can vastly improve the pumping performance in many applications and offer enormous energy savings throughout the water industry. Harmonics can normally be dealt with, as these examples show. However, it is important that the harmonics are actually identified as such. Otherwise, the user risks facing a long, expensive and ultimately unsuccessful battle against an invisible enemy. [WWA](#)



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