ENGINEERING TOMORROW

Case story

New VLT® AQUA Low Harmonic Drive improves **power quality** and provides **efficient pumping** in New Zealand irrigation fields

Farming is a major industry in the Canterbury region of New Zealand with a mixture of pastoral and horticultural farming covering most of the broad plains of Canterbury. With hot and dry summers, irrigation is used extensively to improve production. The snow-fed rivers and substantial groundwater reserves provide the water essential for fertile land.

Efficient use of water is an integral part of environmentally sustainable farming. Danfoss, the leading supplier of energy efficient variable speed drives in this region, understands the end user's requirements. John Graham, Sales Engineer from the Christchurch branch of Danfoss New Zealand, says "The farmers want an efficient and reliable irrigation system. The features of the VLT® AQUA Drive FC202 dedicated for pumping allow for systems to be designed with less additional monitoring and control equipment. The high efficiency and reliability of the drive means reduced costs and peace of mind for the farmer."

Improving power quality on the network

There are thousands of variable speed drives installed in the region and one electrical distributor, Electricity Ashburton, took the proactive approach to improving power quality on the distribution network. Electricity Ashburton services an area of 3500 km2, 2852km of network lines and 16800 line connections. During the irrigation season, rural irrigation loads form 70-80% of the peak load. Variable speed drives comprise 50% of irrigation installations. Field measurements indicated the current and voltage distortion levels significantly higher than expected, with THVD levels of greater than 10% not uncommon. The high concentration of non-linear loads was causing problems within the network. Electricity Ashburton released a new rural network harmonics standard based on IEEE519-1992 to improve the quality of the network supply now and in the future.

Meeting the standards

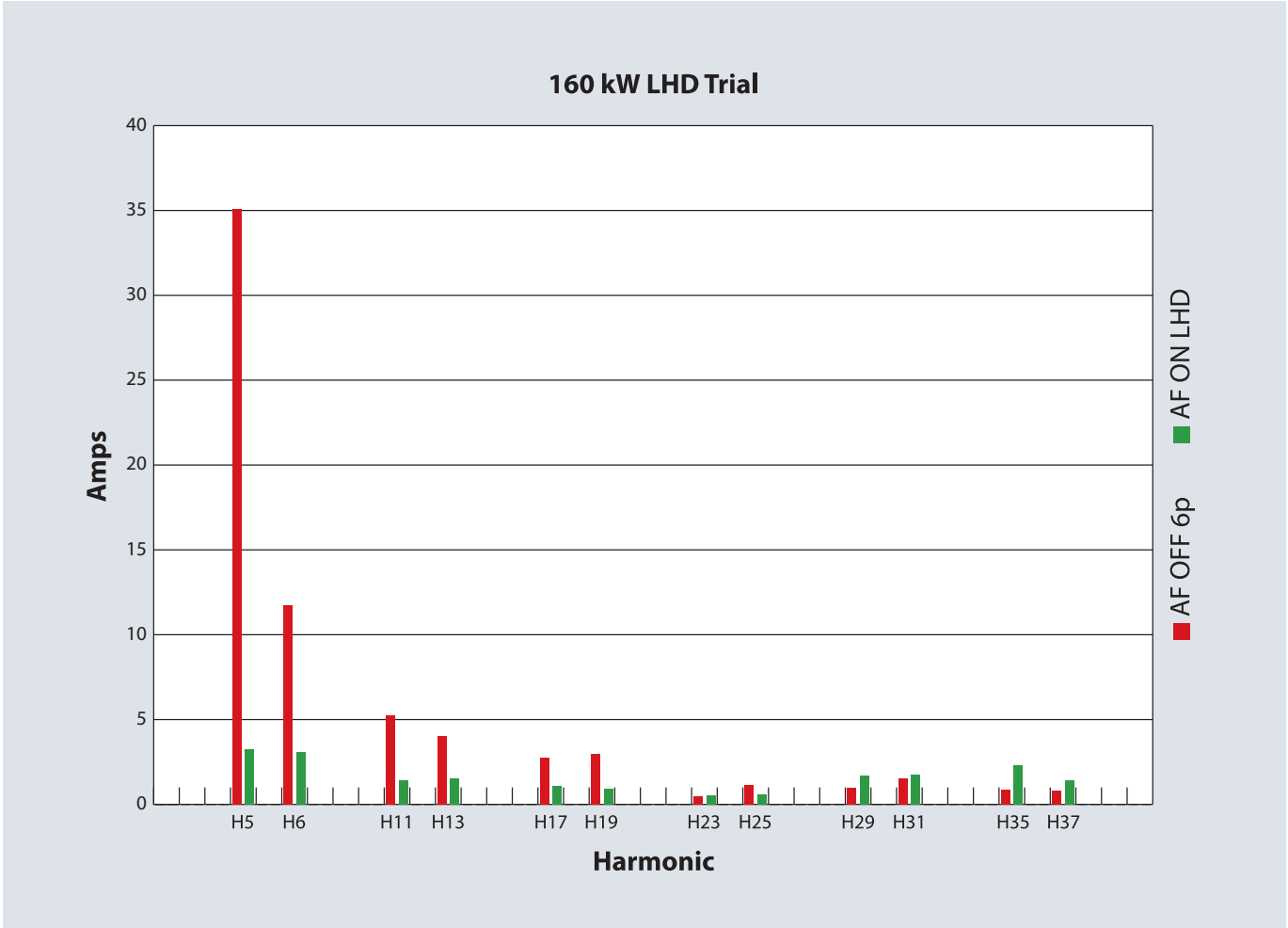
On most pumping stations the variable speed drive, pump and motor consume the largest part of the electrical power. With the existing fault levels and relatively small transformers feeding these pumping stations, short circuit ratios are typically below 20 or between 20 and 50. These short circuit ratios require either 5% or 8% Total Demand Distortion according to IEEE519-1992, and the variable speed drive would require to produce almost the same percentages of Total Harmonic Current Distortion, THiD, for the site to comply with Electricity Ashburton's standard.

Danfoss already has solutions for the small and medium power variable speed drives in the form of the Advanced Harmonic Filters, AHF, that provide 5% or 10% THiD at full load. For the high power drive range, Danfoss recently developed the VLT® AQUA Low Harmonic Drive consisting of a standard VLT® AQUA Drive FC 202 and integral active harmonic filter – a world's first. Working with local electrical solutions provider, Nairn Electrical, Danfoss installed a 160kW VLT® AQUA Low Harmonic Drive on a submersible pump in Rakaia, in central Canterbury.

Test results

The drive was operated with and without the integral active filter. On the day the measurements were taken, the peak irrigation season had not started and background Total Harmonic Voltage Distortion levels were approximately 4%. A spectrum, consisting of the typical 6 pulse drive harmonics, with and without the filter in operation is shown in the graph below.

The 160kW drive was connected to a 300kVA transformer, fed from 22kV with a fault level of approximately 60MVA. The THiD from the spectrum in the figure equates to 38.75% for the standard 6 pulse drive and 3.47% for the VLT® AQUA Low Harmonic Drive. The resultant THiD levels when the integral active filter of the VLT® AQUA Low Harmonic Drive is operating are within the limits of IEEE519-1992.



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Improved efficiency

The benefits of the VLT® AQUA Low Harmonic Drive go beyond the improvement in harmonic mitigation. By reducing harmonics the RMS current is reduced, improving efficiency of the site further. The power consumed by the motor was 125kW yet without the integral active filter in operation, 202A was drawn. With the integral active filter operating only 183A was drawn for the same motor power.

A 160kW VLT® AQUA Low Harmonic Drive installed on a submersible pump in Rakaia, in central Canterbury, New Zealand.

Easy installation

As the drive is supplied in one enclosure the installation is not different from a standard variable speed drive. Gary Roxburgh from Nairn Electrical says "The LHD provides the existing water application functions of VLT AQUA Drive combined with integral harmonic filtering in one enclosure. The installation time is the same as a standard 6 pulse VSD, and with one extra parameter to programme for the integral active filter, commissioning time is almost the same as a standard 6 pulse VSD."
Having the product suitable for the application and meeting the local standards is only part of the solution. "The service and support provided by Danfoss ensures our customers trouble-free operation of their irrigators" Gary adds.

Improving the energy efficiency of a pumping system has been the fundamental driver for Danfoss in developing the VLT® AQUA Drive. Danfoss has met the challenge of increasing demand on improved power quality with the VLT® AQUA Low Harmonic Drive.

VLT® AQUA Low Harmonic Drive

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