Three phase motor failure

Application Note

Power Quality **Case Study**

Measuring tools: Fluke 434 Power Quality Analyzer

Features: Scope, Unbalance, Harmonics

For three years in a row, a particularly large three-phase motor would fail twice a year. The facility maintenance manager called in both the electrical contractor and the motor manufacturer, who pointed fingers at each other but failed to resolve anything on site. The facility was left in the middle, with no corrective action, cyclical motor repair costs, and lost production from the repeated downtimes.

Tired of what was clearly a pattern failure, the facility manager hired an independent consultant. The consultant told the facility manager he would perform a complete power quality survey of the electrical distribution system feeding the motor, determine its operating characteristics and work from there to solve the problem.

Measurements

The consultant connected his Fluke 434 three-phase hand-held power quality analyzer to the circuit supplying energy to the motor and pushed the View Config button. The diagram confirmed that his connections were proper and that the power type was three-phase Delta (Fig. 1).

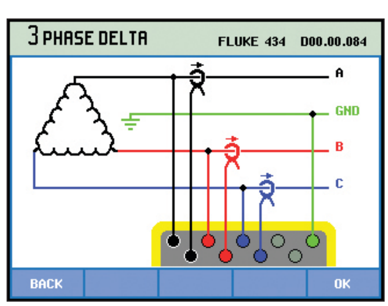

Fig. 1 Three phase Delta

From there, he pushed the Scope button and looked at waveforms and numeric values for all three phases. Judging by the differences between the magnitudes at the top of the screen, there appeared to be a balance problem between the phases (Fig. 2).

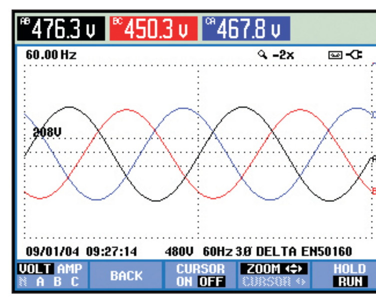

Fig. 2 Unbalance voltage wave

To gather more information, he switched to the numeric readout on the Voltz/Amps/Hertz screen. The current reading there was even higher and still unbalanced (Fig. 3).

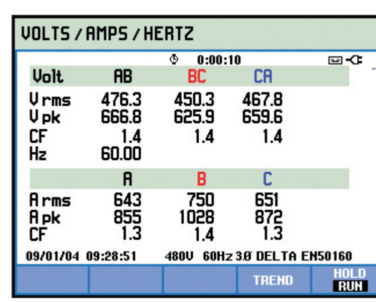

Fig. 3 Unbalance voltage wave

Switching to the Unbalance screen, he checked the voltage and current values as well as the phase diagram, to see if the motor was operating within acceptable limits (Fig. 4–6).

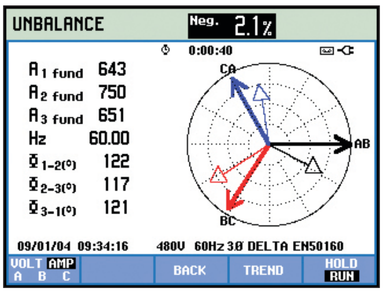

Fig. 4 Unbalanced phaser amp

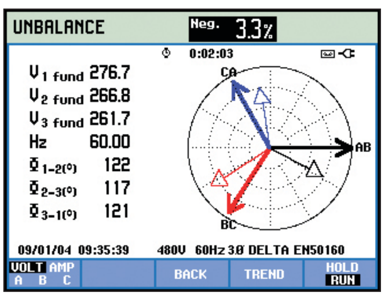

Fig. 5 Unbalanced phaser volt

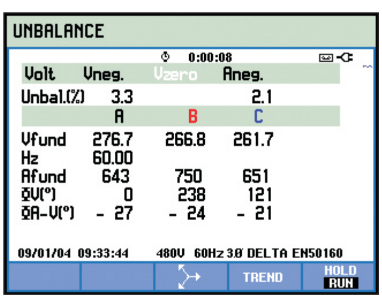

Fig. 6 Unbalanced table

Lastly, to cover his bases, he selected Harmonics from the menu to make sure frequencies weren't contributing to the problem (Fig. 7 & 8).

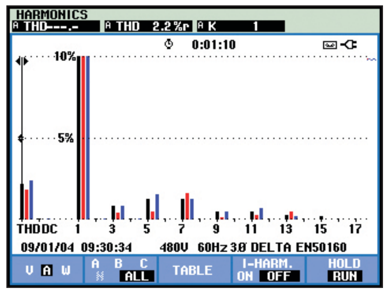

Fig. 7 Harmonics

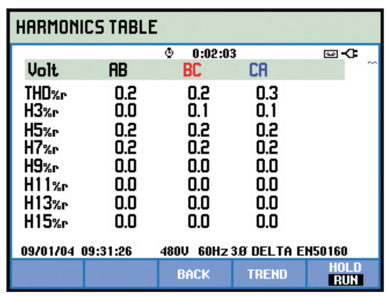

Fig. 8 Harmonics table

Analysis

From his unbalance measurements, he could see that an unbalance was causing an excessively large phase current value. He checked the motor specifications and confirmed that phase current exceeded the motor's FLA (Full Load Amperage) rating. Looking at the data for all three phases, he traced the current unbalance to excessive loading on one voltage phase.

The consultant traced the voltage unbalance to a set of equipment installed three years ago. It turned out that all of the internal single-phase loads were connected to the same phase. That last new equipment installation caused such a significant power system voltage unbalance that it created a current unbalance at the motor, increasing the operating temperature of the conductors and motor windings to beyond the limits.

Conclusion

To resolve the situation, the consultant balanced the internal single-phase loads between the three phases, reducing the overall voltage unbalance and consequently, the current unbalance at the motor. This also reduced the elevated phase current value and operating temperature at the motor.

He took new benchmark measurements for future monitoring, transferred all of his saved screens to his computer and printed a before-and-after report for the facility maintenance manager.

While not a power quality expert, the manager could see the difference between the screens. Now he understood why power quality measurements needed to be taken before and after new equipment installation. All of the motor repair and downtime costs had been un-necessary. When the consultant suggested setting up a regular preventive maintenance schedule, the manager agreed.

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Fluke Corporation
PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa (31 40) 2 675 200 or
Fax (31 40) 2 675 222
In Canada (800)-36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: http://www.fluke.com/

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