Proper Implementation of Predictive Maintenance Using ESA

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ALL-TEST Pro

The Company

Figure 2: Ancona, Italy

Easy Tool, a Condition Monitoring Solutions Provider in Italy, works with a paint production facility in Ancona, a city along Italy's Adriatic coast. This paint producer has worked with Easy Tool since 2013, relying on their highly knowledgeable field engineers to perform regular condition monitoring services for the motors, fans, pumps, and mixers operating in their paint production facility. Semi-annually, field engineers from Easy Tool use a variety of technologies to test their equipment. The field engineers perform routine vibration analysis, oil analysis, and energized and deenergized motor testing as part of their predictive maintenance program. In January 2017, a Field Engineer, performing an energized motor test (ESA – Electrical Signature Analysis) using the ATPOL II™ (ALL-TEST PRO On-Line II™) on a 55-kilowatt, 4-pole motor at the paint production facility discovered a significant current imbalance.

Figure 1: ATPOL II Energized Motor Tester

The Application

This 55-kilowatt, 4-pole motor was driving a fan that extracts solvents from the air of the paint production department. This fan is critical for ensuring worker safety. Loss of the fan requires the paint producer to shut down the production process. This critical fan and motor are tested every six months to ensure continue and safe uptime.

The Discovery

The fan has an impeller keyed directly to the motor shaft and is controlled by a variable frequency drive (VFD).

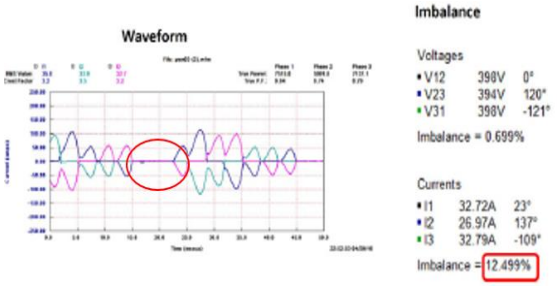

Figure 3: Waveform Display VFD Input Current

The engineer using the ALL-TEST PRO On-Line II™ discovered significant current imbalance in both the input and output current waveforms of the VFD. Figure 3 taken during the 1-minute data acquisition of the 3-phase voltage and current input to the VFD shows there is non-uniform current to the VFD and no current flowing during portions of the rectification process.

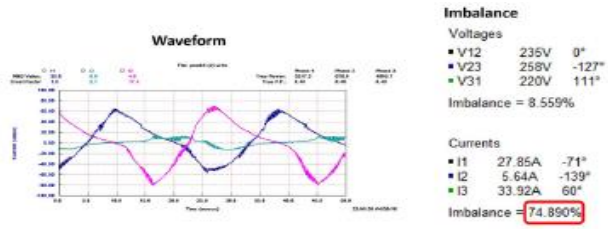

Figure 4: Waveform Display VFD Output Current

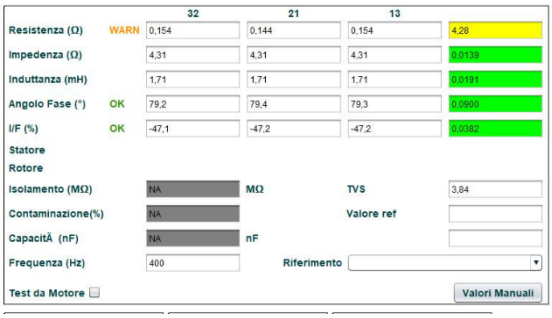

Figure 5: MCA Readings

Figure 4 is the 3-phase current waveform from the output of the VFD which displays a 74.8% unbalance, it also shows the current in phase 2 is <10 amps suggesting a failed IGBT (insulated-gate bipolar transistor). Deenergized MCA™ (Motor Circuit Analysis™) readings were performed on the motor to eliminate the motor as a potential cause of the current unbalance. Figure 5 indicates a small resistance unbalance which indicates connections issues, but all the other measurements showed the winding insulation was in good condition.

The Easy Tools testing engineer Ettore Di Pasquale; "This is not good for the motor – the VFD should supply the fan motor with balanced current. Given such high levels of current imbalance and the absence of several input half-waves, it became clear to me that the motor and fan were fine, but that the VFD needed to be replaced." "It is important to regularly check the health of your critical machinery." He explained that this current imbalance was likely a result of an internal problem with the VFD and recommended the VFD be replaced. Even though the fan could operate with this VFD-driven motor, the motor would eventually become damaged because of the current imbalance.

The Solution

Following Di Pasquale's recommendation, the paint producer had the VFD removed and confirmed that there had been serious damage to the VFD's internal components. The paint producer ordered a new VFD and was able to maintain production while waiting for the new inverter, which took 10 days to arrive. After the new VFD was installed, Di Pasquale went back to the facility to test the fan motor on the new VFD. ESA data taken on both the input and output of the VFD confirmed that replacing the VFD corrected the detected problem and there was balanced voltage and current on both the input and output to the VFD.

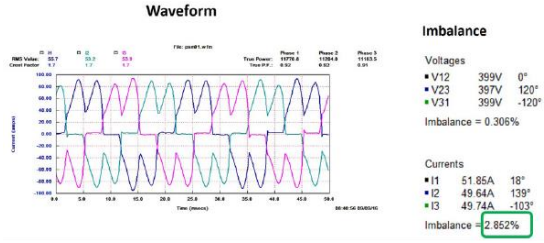

Figure 6: Current Waveform on input of replaced VFD

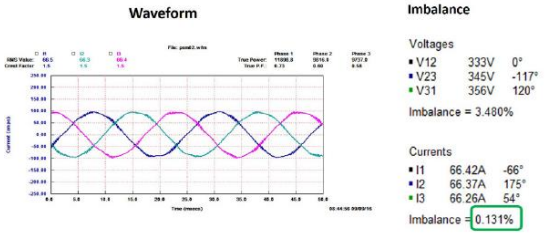

Figure 7: Current Waveform on output of replaced VFD

Lessons Learned

Even though the fan motor had a 74.8% current imbalance, there were no alarm or malfunction warning from the VFD had been triggered. And the VFD appeared to be functioning properly, continued operation of the VFD with faulty diodes, would have failed abruptly - bringing the entire production department to a halt. This paint producer essentially prevented failure of the fan motor, ensuring worker safety, and avoiding lost production and the related downtime expenses. It is important to regularly check the health of your critical machinery. There are easy-to-use portable instruments, like the ALL-TEST PRO On-Line II™ energized motor testing instrument, and the ALL-TEST PRO 5™ or ALL-TEST PRO 7™ MCA™ deenergized motor testers that check the condition of your entire motor system in just a few minutes. By knowing what is really happening with your equipment, you can make smart decisions to keep people safe and to keep your operation running smoothly.

Predictive Maintenance

This displays the proper application of a predictive maintenance program PdM and displays all three phases. ESA detected a problem during the normal first phase or the "Detection phase" of the PdM process an abnormality was detected. On VFD's it is recommended that testing be conducted on both the input and the output of the VFD. This also assisted in the second phase or the "Analysis phase", by testing both input and output of the VFD it clearly showed the fault to be in the drive itself, to confirm the motor was in good condition and had not been damaged MCA™ was performed during the analysis phase prior to ordering a VFD this saved the time and resources required to replace the good motor. ESA is a very powerful PdM tool for equipment being controlled using VFD's in addition to the performing the high and low frequency spectra, it does a simultaneous data capture on all 3 phases of voltage and current and captures the real time display, which is very critical in identifying faults in VFD's. The third phase or "correction and verification phase" was easily and accurately performed with minimal loss of production as a result of the detailed analysis conducted using both MCA™ & ESA.