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A company becomes its own customer with outstanding results. In the process, a new motor repair shop certification program is born.

Electric motors, whether AC or DC, will vary considerably in construction, operation, and performance. All share a distinction, though, in usually rating high on reliability incident reports.

The "bad news" is that this was the case at an SKF plant in Hanover, PA. The "good news" is that solutions were found, valuable lessons were learned and a new program was launched by SKF to provide others in the industry with the tools and expertise to help keep electric motors performing with minimal problems and downtime.

Regardless of type, electric motors experiencing failure will usually be subject to one of three common failure modes (although the root causes for each mode may differ):

- Failure to start when required;
- Gradual performance degradation in service; or
- Catastrophic in-service failure.

Any and all of these modes will drive unwanted downtime and unanticipated costs, which was the situation in the SKF plant in Hanover. Here, it was liquid-cooled motors to power grinding machines that were under-performing. Many were failing regularly and most were vibrating above normal levels, based on periodic vibration analysis conducted at the facility. In an effort to avert catastrophic failure and attempt to preserve uptime, motors were replaced (and rebuilt) immediately when changes in their vibration spectrum were charted. Unfortunately, this chain of events had become routine, expensive and time-consuming, especially since many of the motors were being replaced every few months. A short-term approach, it further failed to identify root causes of the problems that could have pointed the way to remedial actions.

Expediting a solution

A catalyst to expedite a solution came with an internal SKF program (the "PRE-FORM Project") launched with the goal to establish ever-higher quality and precision standards for all SKF facilities worldwide. In Hanover, the program, in part, required that overall vibration levels of the grinding machines would have to be reduced and that the performance of the electric motors

would have to be enhanced to help contribute to improved plant output and quality.

Striving to meet these goals, Hanover turned for outsourced expertise and ultimately commissioned one of its own for the task: SKF Reliability Systems of San Diego, CA. The SKF factory, in fact, became an SKF customer. In the process, new standards and specifications were implemented with strong results. Moreover, an even stronger partnership was forged among all parties, including motor repair shop and plant maintenance personnel.

Unearthing the root cause
Experience tells us that most in-service electric motor failures result from mechanical problems. Possible non-bearing causes abound. These can include windings, wiring, grease or seal failures that, in turn, may result in bearing failures (although bearings are not the root cause).

There often can be additional bearing-related issues involving lubrication (too much, too little, or contamination), misalignment, unbalance, looseness or vibration, among other known influences. Improper motor use and inadequate maintenance can add to potential problems and premature bearing failure.

The initial quest to find answers for the prevailing motor failures in Hanover proved especially vexing as documented in a maintenance-log timeline for one of the motors:

- 2/20: Motor identified as "going bad."
- 2/28: The motor failed (locked up) within days. Shaft end bearing showed excessive heat from locking up, making it difficult to determine exact cause of failure. Independent motor repair shop rebuilt motor and repaired shaft. Motor was re-installed.
- 4/17: Motor began showing early signs of same conditions encountered in previous failure. This time the motor was pulled earlier for inspection. It was determined that the bearing clearance (internal) appeared to have been reduced, causing 360° ball tracking and increasing internal temperature (which would lead to premature failure). The shaft end bearing was replaced and the motor was re-installed.
- 6/08: The motor showed trend toward failure for a third time and was sent to the repair shop for complete rebuild and precision G.4 balance. Motor was re-installed.

The search for solutions can be difficult without the proper "tools." Thus, in tackling the many symptoms and causes of in-service failures of the motors at Hanover, the team adopted a

comprehensive Root Cause Failure Analysis (RCFA) approach.

RCFA serves as a structured investigation seeking to identify the true cause of a problem, the cause-and-effect relationships and the actions necessary to prevent repetition. Improvement activities resulting from RCFA studies may suggest machine design improvements, targeted training for operations or maintenance staff and/or provision of specialist equipment for monitoring and maintenance of machinery. In short, RCFA actions can help remove the "guesswork" factor.

Partners in progress

Specialists from SKF Reliability were engaged to conduct a wide range of RCFA services. These included vibration analysis when mechanical problems were encountered; balancing of electric motor pulleys for machine tools and auxiliary equipment, shafts and couplings; and alignment of machine-tool components with digital laser equipment.

As a result, several factors were found to contribute to the repeated motor failures. They included inappropriate bearings (these were replaced with types more suited for the motor application); contamination (remedied by upgrading the sealing function in the motor); misaligned shaft and housing fits (corrected by rewriting specifications for fits and follow-through documentation); and rotor unbalance, on both new and old motors (prompting new requirements to promote balanced systems).

Among the improvement activities recommended in the RCFA, SKF also took an unusual step in training, equipping and certifying the independent electric motor repair shop. This helped strengthen the relationship between customer and service provider and forge a true partnership. The shop was trained to trace root causes of motor failures; mount and install bearings correctly using state-of-the-art tools and techniques; and perform precision maintenance. Both parties jointly developed a specification/process as an established guide to service the motors.

Certification program for shops

The outcome in Hanover (in concert with the global SKF Trouble-Free Operation Program) led to the creation and industry-wide rollout of a unique training and certification program. The "SKF Certified Electric Motor Service" program is available for leading electric motor service shops seeking to gain value-added competence and a competitive edge in the crowded marketplace.

This certification focuses on the four key factors that influence bearing life: product quality, environment, installation, and maintenance. Providers completing this extensive training program earn recognition as "SKF Certified" and are equipped to help improve plant productivity by virtually eliminating premature failure of electric motor bearings.

For end-users, certified shops offer unprecedented access to advanced technologies and expertise, improved quality and increased uptime. The shops are fully supported with specialized bearing tools and lubricants specifically designed for SKF bearings; sophisticated bearing dismounting and mounting equipment; SKF engineering support and technical services (including failure analysis); and high-quality bearings and components.

In Hanover, electric motor reliability at the grinding machines is no longer an issue and measurable savings have been realized. The plant has reduced the total cost of motor maintenance by almost 40 percent and technicians now can spend more time implementing focused procedures instead of puzzling over problems.

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