

Managing Motor Systems

Written by Terrence O'Hanlon, ReliabilityWeb.com, and John Machelor, Consultant
Sunday, 01 July 2001 10:36

Increase reliability and decrease energy costs by managing the entire motor-driven system.

It is a typical day at Acme Manufacturing Corp. as a 200 hp compressor is becoming unreliable and is unable to meet production demands for air.

In previous years, Acme would have decided to purchase a new compressor, a larger 250 hp model, at the lowest cost possible to meet its horsepower needs. This approach is typically known as the "first cost" driven approach. Life cycle costs or actual process requirements are not evaluated with this type of approach. Typically, no energy savings are achieved.

This time, Acme has done something different. Acme started an active Motor Systems Management (MSM) program, and it now looks at optimizing the entire motor system when replacing a component of that system. Before deciding how to meet the demand for air, Acme performs an audit of the entire system.

The audit results in the purchase of two 75 hp high efficiency compressors with automatic sequencing controls, the reduction of plant air pressure by 10 psi, the identification and repair of air system leaks, and the installation of a new efficient air dryer as well as a larger receiver tank. A 40 percent energy savings is generated, and the process has as much compressed air as it requires. This system approach is the key to an effective MSM program.

Why manage your motor systems?

According to the U.S. Department of Energy, motor-driven systems account for almost 70 percent of industrial electricity use with over \$30 billion per year spent by U.S. industries. For some process-intensive industries such as pulp and paper and refining, up to 90 percent of the electricity used is to power motor-driven systems.

In today's climate of rising energy costs and uncertain energy supplies, managing such a large percentage of electrical usage makes sense.

What is MSM?

MSM is a plan used to maintain electric motor systems at optimal performance. By following an

Managing Motor Systems

Written by Terrence O'Hanlon, ReliabilityWeb.com, and John Machelor, Consultant
Sunday, 01 July 2001 10:36

MSM program, a company ensures that its motor systems are optimized, which will increase reliability and reduce energy consumption thus conserving electricity.

MSM programs can vary from simple and inexpensive to extensive and more costly. Each program is tailored to the specific needs of a company, taking into account that some of the elements of an MSM program may already be in place at a company. Regardless of the approach taken, the main goal of the program is to achieve payback on investment as soon as possible. Once this goal is realized, all future savings go right to a company's bottom line.

What follows are the key elements of a typical MSM program prioritized to reflect the goal of quickest investment payback.

1. Review of existing motor systems

An assessment of any current MSM practices is taken. The assessment includes a review of written policies, procedures, specifications, and motor inventories, and also interviews with key staff.

A walk-through motor system assessment is done to identify all essential and critical motor systems and to observe their condition. An essential motor system is defined as one that, should it fail, shuts down an entire production operation until that system is repaired and back on-line. A critical motor system is defined as one which, should it fail, significantly cripples a production operation until that system is repaired and back on-line.

2. Personnel training

To be effective, an MSM program will require personnel who are trained in various aspects of motor systems including installation, maintenance, and repair. It is important to assess what training will be required near the beginning of the program in order to plan the training resources that will be needed.

3. Motor inventory database

In order to manage motor systems effectively, a database is required to identify and inventory all essential and critical motors, their locations, nameplate data, repair history, and general operating profiles. There are a number of commercially available computer programs designed specifically for motor inventorying.

Many computerized maintenance management systems (CMMS) have adequate capabilities to process the required data. A low-cost alternative is to use a spreadsheet type of computer program.

4. Pending failures and urgent system problems

The focus here is on diagnosing and solving immediate urgent problems that may be resulting in regular and premature failure, unplanned downtime, and excessive wastes of energy and materials. This is an excellent time to employ root cause failure analysis (RCFA) that determines the root or underlying cause of repetitive failures. RCFA should be used on all failing components of a motor system from the power source to the process. RCFA is most effective when applied to systems or components which are experiencing repetitive failures after short life cycles.

An effective way to get management's attention is to set up an MSM pilot program in an area that is experiencing a high number of motor system or component failures. Such an area will already be a thorn in the side of management. Success of MSM in reducing or eliminating failures with related cost avoidance and energy savings will almost certainly get management's attention. Full management support for MSM in other areas will automatically follow.

5. Preventive maintenance

Preventive maintenance tasks involve making periodic scheduled inspections of motor systems and components to determine their condition as well as to perform required maintenance. Any observed developing problems should be corrected immediately.

Some examples of these tasks are lubricating bearings, aligning components, making visual and audio observations, and cleaning components of contaminants, dirt, moisture, etc. An added benefit of preventive maintenance measures is that most of them result in very short or immediate payback times with little required investment.

6. Predictive maintenance

A majority of the failures associated with rotating equipment are mechanical in nature with bearing failures leading the list. Failures of mechanical components including bearings are rarely inherent to the components themselves but mostly come from outside sources. Vibration analysis can identify pending failures on rotating equipment which are caused by factors such as misalignment, imbalance, under or over lubrication, or contamination. Infrared thermography and oil analysis (tribology) follow close on the heels of vibration analysis as the best tools to identify impending mechanical failures. These three disciplines also complement each other well so that often a problem uncovered by one can be verified by using one or both of the others.

Motor circuit evaluation provides a detailed analysis of motor circuit condition. These portable units feature diagnostic tools that evaluate all five of the motor's fault zones: power circuit, insulation, stator, rotor, and air gap.

It cannot be over emphasized that proper training of personnel in any predictive maintenance technology is imperative to a successful MSM program.

7. The MSM plan

Develop a dynamic motor systems management plan. Implementation of the plan will help you reduce motor system failures, but when they do occur, you will be prepared to quickly and effectively manage those situations.

Managing Motor Systems

Written by Terrence O'Hanlon, ReliabilityWeb.com, and John Machelor, Consultant
Sunday, 01 July 2001 10:36

Prepare an MSM document to provide guidance through the entire life cycle of the motor systems including:

- Motor purchase policy and specifications
- Preparation and use of a motor inventory
- Evaluation of staff training needs
- Motor repair/replace decision making
- Motor repair policy and specifications
- Preventive and predictive maintenance programs
- Root cause failure analysis
- Inspection methods and frequency

Finally, remember to track, record, and report to upper management the cost savings, cost avoidance, and energy savings resulting from MSM operational improvements. By getting the right amount of attention and speaking in terms of real dollars saved, your new Motor Systems Management program should have a long and prosperous future. **MT**

[John Machelor](#) is a consultant in motor systems management, P.O. Box 2954, Radford, VA 24143; (540) 639-4271. He has held senior engineering and engineering management positions with Westinghouse Electric, Kollmorgen, Lincoln Electric, and General Electric. A free online presentation by Machelor titled "Effective Motor System Management" is available at www.rcm-1.com/