Maintain Pumping Systems Effectively

Suggested Actions

Establish a pumping system maintenance program that includes the following:

- Preventive actions
- Predictive actions
- Periodic efficiency testing.

Effective pump maintenance allows industrial plants to keep pumps operating well, to detect problems in time to schedule repairs, and to avoid early pump failures. Regular maintenance also reveals deteriorations in efficiency and capacity, which can occur long before a pump fails. Wear ring and rotor erosions, for example, can be costly problems that reduce wire-to-water efficiency by 10% or more.

The amount of attention given to maintenance depends on how important a system is to a plant's operations. Downtime can be expensive when it affects critical processes. Most maintenance activities can be classified as either preventive or predictive. Preventive maintenance addresses routine system needs such as lubrication, periodic adjustments, and removal of contaminants. Predictive maintenance focuses on tests and inspections that detect deteriorating conditions.

Tip Sheet

Preventive Actions

Preventive maintenance activities include coupling alignment, lubrication, and seal maintenance and replacement. Mechanical seals must be inspected periodically to ensure that either there is no leakage or that leakage is within specifications. Mechanical seals that leak excessively usually must be replaced. A certain amount of leakage is required, however, to lubricate and cool the packing seals. But the packing gland needs to be adjusted if the leakage exceeds the manufacturer's specifications. The packing gland must be replaced if it has to be tightened excessively to control leakage. Overtightening causes unnecessary wear on the shaft or its wear sleeve and increases electric power use. Routine maintenance of pump motors, such as proper lubrication and cleaning, is also vital.

Predictive Actions

Predictive maintenance helps minimize unplanned equipment outages. Sometimes called "condition assessment" or "condition monitoring," it has become easier with modern testing methods and equipment. The following methods apply to pumping systems:

Vibration analysis. Trending vibration amplitude and frequency can detect an impending bearing failure. It can also reveal voltage and mechanical imbalances that could be caused by impeller erosion or coupling problems. Changes in vibration over time are more meaningful than a single "snapshot" of the vibration spectrum.

Motor current signature analysis. Sometimes called "dynamic analysis," this reveals deteriorating insulation, rotor bar damage, electrical system unbalance, and harmonics. It can also pick up system problems such as malfunctioning control

valves that cause flow rate disturbances. Tracking the signature over time is more valuable than a single snapshot.

Lubrication oil analysis. This applies only to large, oil-lubricated pumps, and is an expensive procedure. Oil analysis can detect bearing problems caused by metal particles or chemical changes that result from overheating, and seal problems caused by pumped fluid in the oil. It also provides guidance on proper oil-change intervals.

Periodic efficiency testing. Testing the wire-to-water efficiency and keeping records to spot trends is useful.

Finally, see the checklist of maintenance items below, which can be tailored for many kinds of systems, applications, and facilities.

Basic Maintenance Checklist

- **Packing.** Check for leakage and adjust according to the instructions of the pump and packing manufacturers. Allowable leakage is usually 2 to 60 drops per minute. Add packing rings or, if necessary, replace all the packing.
- **Mechanical Seals.** Check for leakage. If leakage exceeds the manufacturer's specifications, replace the seal.
- **Bearings.** Determine the condition of the bearing by listening for noises that indicate excessive wear, measuring the bearing's operating temperature, and using a predictive maintenance technique such as vibration analysis or oil analysis. Lubricate bearings according to the pump manufacturer's instructions; replace them if necessary.
- **Motor/Pump Alignment.** Determine if motor/pump alignment is within the service limits of the pump.
- **Motor Condition.** Check the integrity of motor winding insulation. These tests usually measure insulation resistance at a certain voltage or the rate at which an applied voltage decays across the insulation. A vibration analysis can also indicate certain conditions within motor windings and lead to early detection of developing problems.

References

ANSI/HI Pump Standards, Hydraulic Institute, 1997-2005.

Pump Life Cycle Costs: A Guide to LCC Analysis of Pumping Systems, Hydraulic Institute & Europump, 2001.

Extend Your Motor s Operating Life, HI/PSM/DOE Tip Sheet, 2006.

Test for Pumping System Efficiency, HI/PSM/DOE Tip Sheet, 2006.

RESOURCES

Hydraulic Institute (HI). Hydraulic Institute, the largest association of pump producers in North America, serves member companies and pump users worldwide by developing comprehensive industry standards, expanding knowledge by providing education and training, and serving as a forum for the exchange of industry information. In addition to the ANSI/HI pump standards, HI has a variety of resources for pump users and specifiers, including Pump LCC and VSP guidebooks, "7 Ways To Save Energy" training program and more. To download FREE executive summaries of HI's "Pump Life Cycle Costs", "Variable Speed Pumping", and an index to ANSI/HI Standards, visit www.Pumps.org and www.PumpLearning.org.

Pump Systems Matter™ (PSM). Developed by the Hydraulic Institute, PSM is an educational initiative created to assist North American pump users gain a more competitive business advantage through strategic, broad-based energy management and pump system performance optimization. PSM's mission is to provide end-users, engineering consultants and pump suppliers with tools and collaborative opportunities to integrate pump system performance optimization and efficient energy management practices into normal business operations.

PSM is seeking the active support and involvement of energy efficiency organizations, utilities, pump users, consulting engineering firms, government agencies, and other associations. For more information on PSM, to become a sponsor, or to download PSM's *FREE Pump System Improvement Modeling Tool*™ (PSIM), an educational tool designed to show pump systems engineers how modeling tools can reduce cost and conserve energy, visit www.PumpSystemsMatter.org.

U.S. Department of Energy (DOE). DOE's Industrial Technologies Program (ITP), through partnerships with industry, government, and non-governmental organizations, develops and delivers advanced energy efficiency, renewable energy, and pollution prevention technologies for industrial applications. ITP has launched the **Save Energy Now** initiative to help the nation's manufacturing facilities continue to thrive during a time of diminished energy supplies and rising costs. As a part of this initiative, ITP is sending DOE Energy Experts to the nation's most energy-intensive manufacturing facilities to conduct 200 Energy Savings Assessments. See www.eere.energy.gov/industry for additional information on DOE's energy efficiency activities.

BestPractices emphasizes opportunities for savings in plant systems such as motor, steam, compressed air, and process heating systems. BestPractices is a part of the Industrial Technologies Program, and offers a variety of resources addressing ways to reduce energy and maintenance costs in industrial process systems. This includes training workshops, software tools, a series of sourcebooks, case studies, tip sheets, and other materials, including several which focus on opportunities in pumping systems. For example, the Pumping System Assessment Tool (PSAT) aids in the assessment of pumping system efficiency and estimating energy and cost savings.

For more information, please contact: EERE Information Center; 1-877-EERE-INF (1-877-337-3463); www.eere.energy.gov/industry/bestpractices.