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District Keeps Big Motors Humming With Insulation Monitoring System

Critical-duty electric motors in water and wastewater service may look good from the outside, but are they really? A survey of motors at the De Pere Wastewater Treatment Plant, De Pere, WI, led to identification of significant potential-problem areas.

"You may assume critical-duty motors are in good shape until you see or hear evidence to the contrary. But that assumption leaves you open to problems," said Plant Operations Manager Mike Kersten.

Power-line spikes, environmental conditions such as moisture and dirt, and aging can deteriorate motor-winding insulation. Taking meg-ohm measurements by hand gives only a snapshot of insulation condition at that moment.

Because of the survey, the De Pere plant has adopted a testing approach in which the large, critical motors for wastewater handling and biomass aeration are continuously monitored while off-line. Automatic insulation resistance testers from Meg-Alert Inc., Minocqua, WI, do the monitoring.

With the testers, declining insulation resistance is spotted, the rate of decline can be logged, and maintenance scheduled accordingly on 150- to 450-hp motors at the plant. The benefits are no tripping of circuit breakers upon motor startup, avoidance of motor-winding burnout and assured availability when needed.

Motors of these sizes aren't usually off-the-shelf items. Ordering times can run into months, so motor protection makes sense, Kersten said.

"In the past, only when we could detect



Each of three 250-hp, 480-volt centrifugal blower motors is monitored by insulation resistance testers.

a mechanical problem, such as noisy bearings, and also when operations would allow us to take the motor out of service, would we send a motor to the shop for full checkout and repair," he said.

Equipment Protected

Equipment monitored at the De Pere plant by automatic insulation resistance testers is:

- Four 150 hp, 480 volt motors on Worthington centrifugal pumps.
- Three 250 hp, 480 volt motors on Roots centrifugal blowers, each delivering 4000 cfm for biomass aeration.
- Four 450 hp, 2300 volt motors on Roots centrifugal blowers, each providing 6250 cfm for biomass aeration.

These 11 motors are not exposed to excessive moisture or other environmental conditions which typically accelerate loss

of electrical insulation quality. However, they must be ready when needed because failure would be costly.

The newly installed automatic insulation resistance testers monitor all four motors. Normally, two of the four motors will operate for 24 hours while the other two are off-line. After each 24-hour interval, operating and off-line pairs are progressively rotated.

150-volt pump motors

These pumping-station motors are powered by Louis Allis variable-speed drives. One motor-scanning automatic insulation resistance tester monitors all four motors. Normally, two of the four motors will operate for 24 hours while the other two are off-line. After each 24-hour interval, operating and off-line pairs are progressively rotated.

The scanning tester installed in the pump-motor control cabinet applies a current-limited 500 vDC test voltage automatically between motor windings and ground.

Test voltage application is sequential among the four motors and repeated at a pre-programmed automatic cycle interval of once every 30 seconds. The tester automatically bypasses on-line motors during its cycle. Current leakage to ground from each off-line motor's windings is monitored by the tester's solid-state comparator circuit.

An insulation resistance decline to 10 meg-ohms triggers a "pre-alarm" to alert maintenance personnel that motor service should be scheduled, although the motor can still be used normally. Only when windings-to-ground resistance drops to 1.5 meg-ohms, the lower limit for safe insulation in this application, is a fault alarm trig-

gered.

This fault alarm also locks out the motor's start circuit and the motor cannot be restarted until the fault condition is cleared. Prohibiting any attempt at restarting ensures that serious damage to the motor cannot occur. Hence, motor repair may be as simple as bake-out and re-clipping the windings rather than more costly rewinding. Scanning continues on the remaining pump motors.

The pre-alarm and fault-alarm points are factory set and based on the characteristics of each application. Testing insulation integrity at 500 vDC has the advantage of approximating the actual operating voltage of 480. A 1 percent accuracy meter displays the meg-ohm reading for the insulation resistance of each motor as each is scanned.

250-hp, 480-Volt blower motors

Each motor for biomass aeration has its own dedicated tester monitoring readiness. These single-motor Meg-Alert testers omit the scanning feature. Otherwise, the three automatic insulation resistance testers are similar to the one scanning tester for the 150-hp pump motors and have the same pre-alarm and fault set points.

Light Emitting Diodes (LEDs) on the testers display motor status. Flashing green shows that testing is underway for the off-line motor, flashing yellow signifies a pre-alarm condition and flashing red indicates a fault and activation of an automatic lock-out of the motor starting circuit. A mechan-

ically latching relay retains the fault indication, in case personnel are absent when the fault occurs.

A self-test/calibrate feature lets maintenance personnel check the testers. The 250 hp and 450 hp blowers have vibration detectors to initiate shutdown in case of a mechanical problem.

450-hp, 2,300-Volt blower motors

Readiness of each motor for biomass aeration also is continuously monitored by automatic insulation resistance testers, one per motor. During monitoring, the current-limited test voltage of 2500 vDC provides an actual-operating voltage evaluation.

Factory settings on the testers are for a



This Meg-Alert insulation resistance tester checks one of three 250-hp centrifugal blower motors. Each motor has its own tester.

pre-alarm at 20 meg-ohms and for a fault indication with motor-start lockout at 3.5 meg-ohms. Surge capacitors and lightning arresters are installed on these motors. Therefore, some of the insulation-test current bleeds off to ground through the capacitors. To compensate for the loss, the pre-alarm and fault resistance setpoints are higher.

Trend Analysis

Maintenance personnel record meg-ohm meter readings for trend analysis of the condition of these critical-duty motors. In addition, the meters on the Meg-Alert tester panels have manually set pointers to provide a bench mark for noting whether motor-insulation resistance is declining relative to the pointer position.

Looking at Results

The De Pere wastewater plant continues to take major steps to achieve an efficient, reliable and cost-effective operation. Adopting automatic insulation resistance testing devices from Meg-Alert was such a step.

The testers give plant management and workers a tool to quickly and safely monitor the electrical condition of critical motors needed to run the De Pere plant. A log of the tester readings permits efficient scheduling of maintenance while avoiding the expense of emergency repairs and downtime.

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