JANUARY/FEBRUARY 2020

# Paper360°

TAPPI | PIMA AROUND THE INDUSTRY, AROUND THE WORLD

# Safety First: Green Bay Packaging

## PLUS:
## OUTLOOK 2020

**ALSO:**

- Successful Employee Selection
- Excerpt from New Book, *Knocking Bolts*
- Kemira Report on Food Packaging
- Business Cycles – Questions Execs Need to Ask
- P&P Must Play A Role in Mitigating Climate Change

# Continuous 'Hands Off' Insulation Resistance Testing of Critical Motors

JEFF ELLIOTT

**For decades, pulp and paper** plant personnel have performed insulation resistance tests with handheld megohmmeters to prevent motor failures that lead to costly unplanned shutdowns and re-winding repairs, yet these tests only provide a "snapshot" of motor health. In only a few days, motor windings and cables exposed to moisture, chemicals, contaminants, or vibration can become compromised and fail at startup.

Portable megohmmeters also require electrical technicians to manually disconnect the equipment cables and connect the test leads on potentially energized or damaged equipment to perform the manual testing. These tests expose technicians to potential arc flashes when they access the cabinet. In the United States, non-fatal arc flash incidents occur approximately 5 to 10 times per day, with fatalities at the rate of approximately one per day.

With so much at risk, pulp and paper plant managers are recognizing the value of continuous megohm testing and monitoring of insulation resistance that initiates the moment the motor is off until it is re-started again. Armed with this real-time information, maintenance personnel are able to take corrective actions ahead of time to avoid a failure that would interrupt production. This can save pulp and paper mills hundreds of thousands of dollars in repair fees for expensive rewinding and lost production time.

Furthermore, permanently installed automatic testing devices allow for "hands-off" monitoring without having to access cabinets—keeping technicians out of harm's way.

## MOTOR PROTECTION AT THE MILL

Pulp and paper mills rely heavily on motors, though the number and type vary depending on the size of the facility and type of products produced. Thousands of motors can be used in typical pulp and paper plants, with about a third of them being critical in many cases.

Technician checking a Meg-Alert panel.

Critical motors are essentially those that could significantly impair the ability to safely meet business objectives or affect production levels if unexpectedly offline. Such motors can range from feedwater pumps and forced draft fan motors for boilers to water pumps and paper machine pumps. Typical paper mills have 3,000 to 4,000 hp motors for boiler feedwater pumps or paper machine fan pumps. Critical motors can be as large as 15,000 hp for some boiler feedwater pumps.

"We have about 3,800 motors in our plant, such as boiler feedwater pumps and boiler fans, paper machine fan pumps, and mill water supply pumps," says Tim Forrester, maintenance manager of electric power distribution for a large paper mill in the Southeastern US operated by a major global manufacturer. "Quite a few of these motors are critical."

Most pulp and paper plants maintain these motors through time-based preventive maintenance (PM) programs. Insulation resistance tests are typically scheduled on a semi-annual basis—although, given the reduction in personnel at most plants, it may be even less frequent. Still, despite PM programs, motors that are offline or are frequently cycled can be quickly compromised.

"With the large number of motors in a typical paper mill, you are going to have failures," says Forrester. "Because the paper industry is basically a 24/7 process, any production interruption due to a failed critical motor is very costly. A paper mill would usually have about six to eight hours of downtime, costing about US$6,000 an hour, plus critical motor repair costing from US$75,000 to US$100,000. Some large synchronous motors can cost up to US$1,000,000 to replace."

While pulp and paper plants attempt to keep an adequate supply of spare motors on hand, Forrester adds that purchasing a new critical motor can typically take up to 16-20 weeks, or even six to nine months of lead time for large synchronous motors before the mill receives the motor. "You really need to plan ahead to order a new motor from a manufacturer," he says.

To avoid such scenarios, Forrester says that his mill's policy requires that any motor shut down for four hours or more be tested by a megohmmeter before it is started. "Here in the South we have high humidity, and as the motors cool off, they take in moisture. It does not take long for moisture to get into a motor and cause problems. So, the motor must be tested before we start it," he says.

One challenge the paper mill faced with manual megohmmeters is that the devices did not always provide the necessary consistency due to subjectivity between technicians. "Manual megohmmeter testing introduces a lot of room for human error because it is subject to the technician's interpretation," says Forrester.

Another problem was that the devices could only provide spot-checking, which lacks accuracy as soon as environmental conditions such

Multiple Meg-Alert panels for motors.


A view inside a motor control cabinet with Meg-Alert.

as temperature or humidity change. Instead, the mill needed automatic, continuous megohmmeter testing to eliminate human error and ensure greater accuracy, according to Forrester.

So, when one of the paper mill's engineers discovered a continuous testing and monitoring device, the Meg-Alert, Forrester says it was tested and installed on a critical standby pump that required the ability to start immediately, if needed.

"Ever since then we have successfully used the [automatic continuous] testing device on any medium-voltage motor application that is not continuously running," says Forrester. "Over the years, we have saved many motors with it. Preventing even one critical motor failure can pay for the device many times over."

The Meg-Alert unit is permanently installed inside the high voltage compartment of the MCC or switchgear and directly connects to the motor or generator windings. The unit senses when the motor or generator is offline and then performs a continuous dielectric test on the winding insulation until the equipment is re-started.

The unit functions by applying a non-destructive, current-limited, DC test voltage to the phase windings and then safely measures any leakage current through the insulation back to ground. The system uses DC test voltage levels of 500, 1,000, 2,500, or 5,000 volts that meet the IEEE, ABS, ANSI/NETA, and ASTM International standards for proper testing voltage based on the operating voltage of the equipment.

The test does not cause any deterioration of the insulation and includes current-limiting technology that protects personnel.

## HANDS-OFF MONITORING

The continuous monitoring system also allows for a hands-off approach that does not require service technicians to access control cabinets to perform a manual insulation resistance test. Instead, an analog meter outside on the control cabinet door shows the insulation resistance megohm readings in real time.

The meter also indicates good, fair and poor insulation levels through a simple "green, yellow, red" color scheme. When predetermined insulation resistance set point levels are reached, indicator lights turn on to signal an alarm condition and automatic notifications can be sent out to the monitoring network. Continuous monitoring can also show if the heaters used to maintain thermal temperatures and prevent condensation are working properly.

"It is so valuable knowing the health of your motor's insulation system, and you get some predictive maintenance capability, too," says Forrester. "We have set up most of our Meg-Alert units so if we get a low megohmmeter reading, it will alarm in the control room. Then maintenance can investigate the issue before a motor failure. I have never had a negative event with these units."

## PREVENTING ARC FLASHES

According to Forrester, enhancing employee safety and preventing potential harm from arc flash was another key factor behind the decision to install the continuous insulation resistance testing and monitoring devices.

Arc flashes are an undesired electric discharge that travels through the air between conductors or from a conductor to a ground. The flash is immediate and can produce temperatures four times that of the surface of the sun. The intense heat also causes a sudden expansion of air, which results in a blast wave that can throw workers across rooms and knock them off ladders. Arc flash injuries can include third degree burns, blindness, hearing loss, nerve damage, cardiac arrest, and even death. Potential causes of an arc flash listed by NFPA 70E include "improper use of test equipment."

Although de-energizing equipment before testing and wearing appropriate personal protective equipment is recommended, the best solution is to eliminate the need to access control cabinets to perform insulation resistance tests.

"Permanently-installed testing devices like Meg-Alert allow hands-off testing and monitoring without having to access electrical cabinets, which keeps technicians out of harm's way," says Forrester. "That adds tremendous value."

According to Forrester, at least four other mills have contacted him regarding use of the continuous hands-off insulation resistance testing devices, and their popularity is growing at the company's other pulp and paper mills. "We have basically made these units standard at our mill, and they really should be an industry standard practice for any non-continuous medium voltage motor, or any critical NEMA motor," he concludes.

*Jeff Elliott is a Torrance, CA-based technical writer. He has researched and written about industrial technologies and issues for the past 20 years. Learn more about Meg-Alert at www.megalert.com.*