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Asset Condition Management — Mt motor testing

OVERCOMING A TYPICAL TESTING DILEMMA

We WANT to Test, But We DON'T (really) Want to Find Anything...

George Frey

Being both Instrumentation & Electrical (I&E) planner and electrical testing supervisor can be an uncomfortable position. You want to do your job well and keep the plant running at tip-top shape, but if you find a motor or process problem, you know it will cost money to fix it. It can be the proverbial double-edged sword. For those of us in the electric motor testing business, this is an all too familiar situation. In other words, what are the repercussions of a test failure? How will failing a test affect the motor? Could it be out of commission? How much money is it going to cost to replace or repair? Is higher management going to go along with your findings and be open to doing the right thing?

Figure 1: 100MW generator in Boulder, CO

Figure 2: In-service pump motors in Boulder, CO

To understand these questions better, we must talk about the effects of a test failure. For example, what happens when a test works as it should – and *finds a problem*?

TYPICAL MOTOR TESTING SCENARIOS

An industrial facility awards its motor maintenance and repair contract to a local electric motor repair shop. This shop has the ability to repair and replace defective motors, has trained electricians and motor technicians, and has invested in predictive maintenance motor testing technology.

The shop is contracted to test the population of electric motors during a periodic outage. The motor shop goes about its business; however, the industrial facility has spent little time discussing the effect of finding bad motors. When (and if) the motor shop reports back finding several bad motors, it can create a tense and time-consuming series of complicated events. "We don't have a spare," "you are delaying our restart," "you touched it, you broke it," etc., etc.

If the plant staff has any misunderstanding of electrical testing processes, accusations of "destructive testing" may be thrown around.

The motor shop's stance is: You hired us to find bad motors, and now that we did, you are mad about it!

The best response would be: So now what do we do from here?

MANEUVERING THE MINE FIELD

If it is your job to ensure plant maintenance or motor quality, you know you need to test. So how can you traverse the many pitfalls? Sharing of information is paramount to the success of your testing or predictive maintenance program. Before any testing is done, make sure each individual involved is versed in **the goal of testing and understand the repercussions of that goal.** In a nutshell, the goal of the electrical testing is to identify "bad apples" and repair or remove them from the process – preventing or mitigating the effects of an in-service failure.

Appropriate Testing Levels

If called into a facility for your first baseline testing, give consideration to test voltages. Poorly maintained, aged, or contaminated motors may already be apparent simply by visual inspection. Therefore, lower, yet still searching test voltages may be appropriate. Instead of 2e+1kV, de-rating test voltage to 60 percent to 80 percent may be called for to determine fitness for more sensitive testing.

When doing baseline and maintenance testing, a general rule of thumb for each test is:

- **Kelvin Resistance: A resistive unbalance of one percent or less.**
- **Meg-Ohm: Greater than 100Meg-Ohms for medium voltage motors.**
- **Polarization Index: >1.5, stable readings and review trend history.**
- **Step Voltage: Low levels of leakage current, with linear plotted response.**
- **Surge: Stable response curves/traces without indications of breakdown.**

Food for Thought

1. Use best practice methods to develop cohesive processes for testing.
2. Look closely at the history of plant testing to develop the plan.
3. Have good spares in warehouse or immediately available if needed.
4. Partner with a motor shop or your own supply chain to house critical spares.

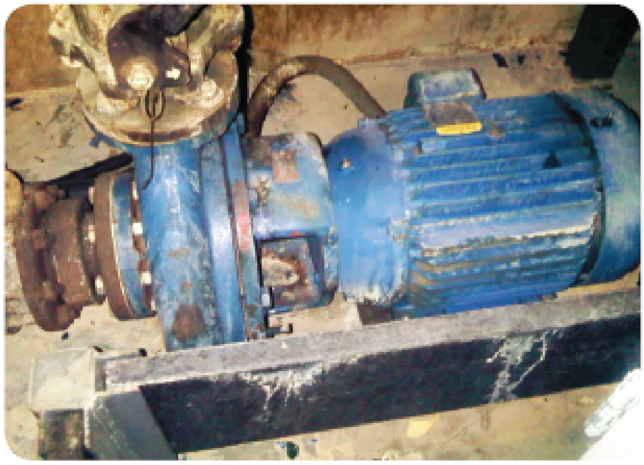

Figure 3: In-service pump motor detected 33 percent resistive unbalance

From a motor shop doing the testing to upper management that is signing off on the contract for testing, everyone needs to fully understand. Full disclosure and review of the testing history, including test reports (if available) of past problems, such as cables, gear box and bearing issues, or motor stalling/tripping problems, need to be discussed. If testing reports are unavailable or have not been kept, the best course of action is to obtain a baseline of motor testing. A battery of tests can be performed at appropriate levels that will provide valuable information on each without decreasing any remaining life in the motors. Once a baseline is established, further testing can be done to find potentially failing motors.

Another discussion prior to testing is to ensure that all testing standards have been reviewed and are fully understood. These IEEE standards include, but are not limited to, IEEE 43, IEEE 95, IEEE 112, IEEE 118, IEEE 522 and IEEE 1415. These testing standards, established by the Institute of Electrical and Electronics Engineers, give a good framework to testing and offer the basis for moving forward in an effective manner. Once there is a general understanding of the goals and processes, guidelines for testing can be developed for all parties involved.

IN A NUTSHELL, THE GOAL OF THE ELECTRICAL TESTING IS TO IDENTIFY "BAD APPLES" AND REPAIR OR REMOVE THEM FROM THE PROCESS – PREVENTING OR MITIGATING THE EFFECTS OF AN IN-SERVICE FAILURE

BASELINE TESTING AND APPROPRIATE LEVELS OF TESTING VOLTAGE

Once all guidelines have been discussed and decided, baseline testing can commence. Testing theory usually dictates that testing be done in an increasingly rigorous manner. In this manner, the motor receives only the tests that it can withstand and doesn't get tested further upon a finding with a less rigorous test. Here's an analogy to better understand this concept:

If you see a road sign saying the bridge is out, pull over and take a look. Don't just keep driving and go off into the creek!

Testing, with an eye towards gathering a baseline, should be performed in this order:

Kelvin Resistance: This measurement does not stress the motor or the windings, so it is unlikely that any type of failure would occur from performing it. The downside is that it is not an electrical insulation test.

Meg-Ohm: Even if a motor winding is severely contaminated, this test has an infinitesimally small risk of further weakening a motor's ability to run. It may be appropriate to start at a very low voltage, e.g., 250V DC, and look at results before rising to higher voltages used on medium/high voltage motors (>1000V DC Meg-Ohm test) Unacceptable results tell you everything you need to know. No need to continue to more sensitive tests.

Polarization Index (PI) (on larger motors): This has the same type of infinitesimally small risk as the Meg-Ohm test since it is typically performed at the very same test voltage. Unacceptable results tell you everything you need to know. No need to continue to more sensitive tests.

DC Step Voltage: This test can be performed in two ways: As a step-up to line voltage to see how the motor insulation reacts, guiding the decision to go to higher voltage, or as a proof test to determine the validity of the insulation. Some companies (properly) employ very rigorous proof tests during an outage and between intervals perform a less rigorous DC Step Voltage to a lower, prescribed level.

Surge: A step surge method can be employed to lessen the effect of finding a problem. Sometimes, information can be gleaned from simply running a surge test to line voltage. It can show instability of the waveform and emit partial discharge readings. These are often indications of weakness within the motor.

ANOTHER DISCUSSION PRIOR TO TESTING IS TO ENSURE THAT ALL TESTING STANDARDS HAVE BEEN REVIEWED AND ARE FULLY UNDERSTOOD

Motor testing is a process-driven necessity that keeps industrial facilities running smoothly and effectively. When testing results become a problem simply because there is a finding, there is a lack of communication and misunderstanding of the goal of testing. With every action, there is a clear reaction. If communication is strong and everyone is on the same page, avoiding potholes and doing the right thing is easier. Yes, finding bad motors can be very painful, however, not finding them and having them fail in operation is a lot more painful to the bottom line. Coming up with a clear and concise method is your best bet and will garner greater success. If everyone understands the reasons behind the set goals and what the true meaning behind testing really is, the finding of bad motors can be a blessing instead of a curse.

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