

## Automatic insulation testers reduce motor repairs and startup time

Windings in plant motors deteriorate, especially when they are exposed to damp conditions or sit idle for long periods. If a motor with poor insulation is started, the windings could fail, requiring an expensive and time-consuming rewind. For a 4160-V motor, rewind costs range up to \$40,000.

Traditionally, deteriorating insulation is detected by reading winding-to-ground resistance prior to motor startup. But this task costs time and money because electricians with portable meggers—devices that measure insulation resistance directly—must be dispatched to the switchgear, circuit breakers opened and locked out, readings taken by hand, data relayed to control-room operators, and the circuit breakers returned to service. Besides the time delay, manual megger readings raise the possibility of electrical shock to personnel.

San Diego Gas & Electric Co (SDG&E) has found a better solution. The utility installed in-line insulation-resistance testers to automatically monitor critical powerplant motors. After a successful trial

period, SDG&E now has more than 100 of the automatic testers operating at its Encina and South Bay stations (Fig 3).

"Before going to automatic insulation-resistance testing, portable meg-ohmmeters were used," explains Dan Eklund, SDG&E senior engineer (Fig 4). "Some of our most critical motors are on circulating water pumps, which are outdoors on a deck, next to the ocean. They have canvas covers and heaters, but the motors are always subject to the salt/fog atmosphere. Without a heater, insulation resistance can drop to zero overnight."

To eliminate the manual megger readings, a committee of SDG&E engineers and maintenance crews decided to retrofit all medium-voltage motors (2400- to 4160-V) with automatic testers supplied by Meg-Alert Inc, Minocqua, Wis. The committee also retrofit the testers to five critical 480-V motors on each of nine generating units—five at Encina and four at South Bay. Applications included circulating-water pumps, condenser hot-well pumps, turning gears for turbines, fire pumps, and

service-water pumps. As Eklund explains, "The resistance testers are wired into the circuit so that they come on automatically when a motor shuts down, remain on as long as the motor is idle, and shut off when the motor starts."

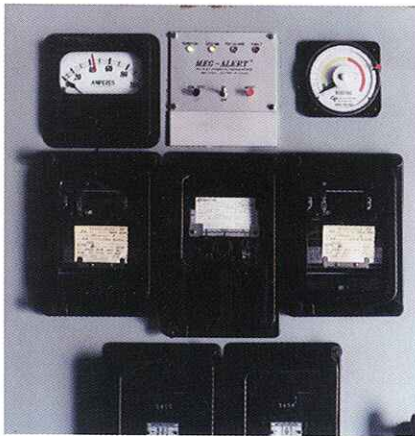
The testers connect to the "B" phase at the motor contactor or generator breaker, and to the equipment ground. They apply a fixed dc test voltage which, unlike portable meggers, is approximately the same as motor-operating voltage. This method more accurately indicates insulation deterioration. The testers measure current leakage to ground, which corresponds to dielectric strength of winding insulation. Test current is limited to 350-microamps to prevent over-stressing the insulation.

The testers send a "first-level" alarm—indicated by a flashing yellow light enunciated in the control room—when winding-to-ground resistance drops to a programmed setpoint. The setpoint is adjustable from 0.5 to 30 mega-ohm; SDG&E selected 20 mega-ohm for its 4160-V motors, because they can still be started safely at this setpoint.

If resistance drops to a second setpoint, the tester enunciates a "final-level" alarm—indicated by a flashing red light—and automatically locks out the motor from starting. A meter displays actual resistance reading.

SDG&E personnel report that the new testing system has met expectations. Maintenance and repair costs for motors are reduced, time is saved, and the inconvenience of dispatching electricians with portable meggers has ended. In addition to detecting poor insulation-resistance on motor windings, the testers have detected faulty motor heaters. The tester readings go to zero, alerting SDG&E electricians to the need to replace or upgrade the heaters.

The system even detected a problem unrelated to individual motors. Eklund explains: "In one instance, work was going on in the switchgear room where automatic testers are installed. The doors were open overnight, so they actually got moisture in the switchgear. The tester detected it and triggered the alarm because the tester measures the entire circuit."



3. Manual megger readings have been replaced by in-line testers that automatically monitor the condition of winding insulation in critical motors (above)

4. Automatic testers, installed at two San Diego Gas & Electric stations, have red-yellow-green flashing lights to continuously indicate winding-insulation condition

