RETROFITTING ELECTRIC MOTOR DRIVES AND SYSTEMS

Electrical apparatus service centers can no longer survive on motor repairs alone, even if they are using the latest repair technologies. The simple reason is that there is a shrinking market for motor repairs as our nation continues to evolve from a manufacturing economy into a service economy.

The following two case histories illustrate how a progressive and engineering-driven electromechanical service firm has expanded into retrofitting of electric motor and drive systems. The first case is about 3 sewage stations that had antiquated, and unreliable, electromechanical controls and wound rotor motors for variable speed operation intended to pump effluent to match the incoming flow. The motors were converted to the equivalent of squirrel cage motors and the controls were replaced with solid state devices. The second case involved a multiple pump and motor installation for a large pharmaceutical facility powerhouse. The units were all fixed speed and the discharge piping was subject to severe vibration, termed "water hammer," during the frequent start up of a pump. Variable frequency drives solved the vibration problem by ramping or "soft-starting" each pump motor. In both cases the service firm took the approach of addressing the cause to truly resolve the problem rather than simply performing repairs to correct the effect.

The first case, as mentioned above, relates to three essentially identical sewage lift stations with three 40 horsepower motors and pumps each. The existing electrical equipment was over 30 years old and consisted of wound rotor motors and "liquid rheostats" to provide the variable resistance which allows the motor speed to vary. The service firm had been receiving an ever increasing income from service calls to repair the controls and restore the stations to operation, often outside of normal business hours. To better serve the customer in the long term, it was proposed and the customer approved, replacing the liquid rheostat controls with solid state drives and to modify the motors to operate as squirrel cage machines by shorting out the rotor collector rings. In addition to the new drives, programmable logic controls (PLC) were designed and installed. Wet well level was measured and monitored using analog to digital conversion devices which in turn fed into a microprocessor linked to the PLC.

The service firm handled this project on a turnkey basis, converting the motors, handling the entire engineering design, supplying the controls, removing the existing equipment, and installing the new devices. During the course of the project an additional requirement was that at no time could any of the lift stations be out of operation, a challenge that was met by precise attention to details and planning.

The end results included an immediate end to the off-hours calls to restore stations to operation and a savings of over 20% in electric utility costs by more efficient operation and reduced power demand by running at lower horsepower requirements. The pumps now are capable of matching output flow to input, thus running for long periods without having to shut down and start up. This scenario will extend the operating life of the equipment as continuous operation represents a steady state condition, i.e. stability as opposed to the transient thermal, mechanical, and electrical conditions associated with stopping and starting.

Another feature that was built in to the controls was oversizing to accommodate a future upgrade to 60 horsepower motors and pumps. These will be required when a large office complex is built and feeds into the 3 stations which are in series and sequentially provide a "boost" as the sewage effluent is pumped over mountains to the main sewage treatment plant.

The other motor and drive system case involved a scenario that was not related to age as was the first case. The installation in the second case was less than two years old, but had been plagued with a water hammer problem dating back to the initial startup. If left uncorrected, the vibration from water hammer is capable, and known, to burst pipes.

The same electromechanical service firm which performed the sewage lift stations retrofit was called in on this problem. Initially the service firm was requested to perform a vibration analysis, the results of which indicated that the discharge piping was responding in a manner similar to resonance due to the hydraulic surge impulse created by the across the line start of the pump motors. Solid state "soft-starters" were proposed to the customer. These devices would ramp the motors up in speed in a preset and controlled manner, and do the same at shutdown. An alternative solid state drive system was also proposed, with the additional feature of being able to provide longer durations of operation

at reduced speed and power. The benefits of this technique, like the first case history, are reduced power consumption and greater life and reliability through steadier state operation.

The customer, a major pharmaceutical firm, chose the solid state drives because of the long term reliability and financial considerations, although at a higher first cost. This project was also handled on a turnkey basis. The existing controls were removed and replaced with three new 30 hp variable frequency drives, isolation transformers, and a programmable control to sense and follow the condensate requirements for the powerhouse boilers.

The retrofit was judged an immediate success with the elimination of the water hammer vibration. Although only in operation for a few months, the energy savings have been estimated to date at nearly 10%. The ideal objective of running at least one unit continuously by reducing speed could not be met because there are protracted periods of time when condensate is not generated to supply the pumps. Nevertheless the customer is quite satisfied as the period of time when at least one unit is energized has been increased by 80%.

Both of these case histories illustrate that the modern electrical apparatus service firm is involved in more than just motor repair. Although few possess the breadth of service and engineering capabilities of the firm in these two cases, these are examples of the advanced services that may be available through your local electrical apparatus service center.