Industry News

Consider a submersible pump's VSD carefully

ABB's Martin Richardson highlights some issues to consider when installing a submersible pump system with variable speed drives.

Unlike conventional pump applications, the use of variable speed drives (VSDs) with submersible pumps requires some careful engineering considerations to achieve a long system life and high system reliability.

Martin Richardson, Water Framework Manager at ABB.

Filters: Motors in borehole pumps can have a motor cable length anywhere between 100 and 300m. It is often necessary to fit output reactors or sine filters to reduce the rate of voltage change (du/dt) and the peak motor voltage, which helps to protect the motor from premature failure.

Network distortion: If the VSD uses a simple diode bridge network, distortion can result. This can be avoided if ultra-low harmonic (ULH) drives are used. High rates of voltage change can lead to radio frequency interference unless special care is taken during the installation phase, as the cabling design and install is critical.

Over-speed: During storms, VSDs can be used to increase speed if there is sufficient motor power available. However, it is necessary to check the operational limits of the pump and the motor. As the speed changes, there is a change in noise levels from the pump and motor – higher speed brings greater noise and the potential for vibration. With higher speed, it is necessary to ensure that the net positive suction head available at the pump is still sufficient to prevent cavitation.

Reverse rotation: Without a non-return valve in the discharge, reverse rotation may occur on shutdown. Here the column of fluid can pass back through the pump hydraulics and turn the motor into a generator, causing the VSD to trip. A regenerative drive can feed the power back to the supply network.

Alternatively, a non-return valve can be installed.

Avoiding critical speeds: A VSD increases the risk of the pump or motor reaching a critical speed at which the mechanics vibrate or resonate. Programming the VSD to lock out certain speeds or speed ranges from the continuous operating speed range avoids this.

Motor plate data: A VSD is a source of current and must always be selected based on the motor nameplate current. When using submersible pumps, ignore catalogue kW ratings as these are given for a conventional motor application. It is common for submersible pump

motors to have lower power factor and lower efficiencies than standard motors purely because of their mechanical design.

Motor insulation: Variable speed puts higher voltage stress on a motor's insulation system, so either a reinforced insulation system or a filter between the motor and the drive is recommended.

EMC shield: Submersible motors ensure the lowest impedance path on the shield connection to ground as the water surrounding the housing provides a perfect electromagnetic compatibility (EMC) shield. All metal construction elements have equalised electric potential.

A continuous cable connects the VSD to the motor, thereby completing a Faraday Cage. To reduce the cable length between the pump and VSD, the drive should be installed as close as feasible to the wellhead.

Unscreened cables supplied with the pump package can be problematic for sensors. This issue can be reduced by using a filter, moving the sensor cable away from the drop cable, enclosing cables in steel pilot tubes and using a good screen on the sensors.

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Remote monitoring: Submersible pumps often operate in remote locations. Fitting a sensor to the pump motor will enable remote conditioning monitoring to track parameters such as motor winding temperatures which can affect ageing and lifetime. Do seek advice on which sensor type is right for an application in terms of the screened cabling, monitoring relays and filters.

Generator supply: Borehole pumps demand a reliable power supply so are fed by generators – either permanently or as a backup. The VSD manufacturer should specify the maximum allowable voltage dip at the start and during running. Generators can be a source of, or susceptible to, harmonics and these must be considered when dimensioning feeder cables and the generator itself. As with diode rectifier VSDs, the generator may have to be at least twice as big as the VSD rating.

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