Schlumberger

Phase-Shift Transformer Solves ESP Operating Challenge, Eliminating 8 Months of Deferred Production for Assala

Recommended VSD operating procedure minimizes harmonic distortions in input power and prevents generator tripping

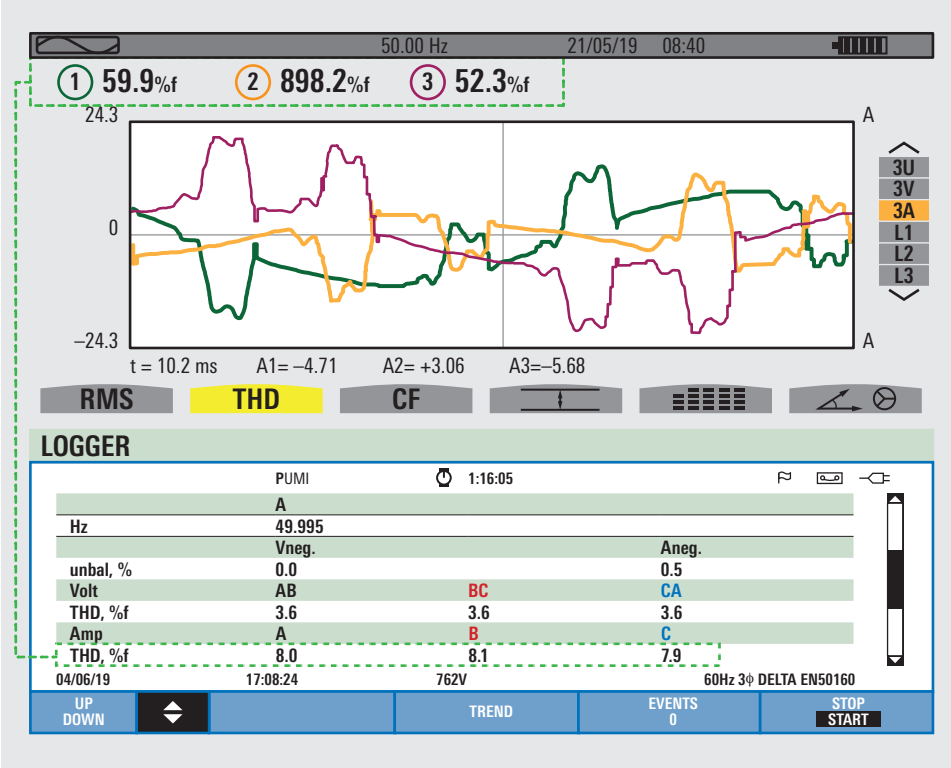
Assala Gabon SA, a subsidiary of Assala Energy, is working to enhance production and increase the life cycle of several mature oil fields. As part of this exercise, the company is installing ESPs in multiple wells.

VSD operating challenge

A Schlumberger electric submersible pump (ESP) was installed in Well GA-09 with a 12-pulse SpeedStar SWD* variable speed drive (VSD) at surface. VSDs generate considerable harmonics, which can have a detrimental effect on all elements in the supply chain, including generators and motors. Compared with a 6-pulse VSD, the 12-pulse version more than halves the total harmonic distortion (THD) created at the input, decreasing electrical stresses and heating effects on connected systems. The plan was to supply the VSD from an 11-kV central power station with the help of a stepdown phase-shift transformer. However, the power station commissioning was delayed by several months.

What was tried first

A portable 400-V generator was connected directly to the VSD as an interim measure. The phase-shift transformer was required to operate the VSD in 12-pulse mode, but it could not be used because the voltage did not need stepping down. Consequently, the VSD had to be modified to a 6-pulse version. Several attempts were made to run the system, but the generator would trip, fuses in the VSD auxiliary transformers at the input would blow, and operation was impossible. Systematic troubleshooting indicated that when the VSD was running, increasing the target frequency above 41 Hz raised THD levels to more than 60% at the VSD input. The result was excessive reactive power inside the generator, causing it to trip. Oversizing the generator further or using third-party line filters could not guarantee success.



Installing a phase-shift transformer between the VSD and generator—per recommended procedure—reduced the high level of harmonic distortion (top) to a low 8% (bottom). This enabled the generator to run without tripping, initiating ESP operation 8 months before the permanent power station was commissioned.

What Schlumberger recommended

Using the VSD in 12-pulse mode with a phase-shift transformer, as designed, was the optimal and proven solution. Schlumberger brought in a skid incorporating a transformer and VSD from another location in Africa and after slight modifications, connected it to Assala's generator.

What Assala achieved

The pump was successfully started at 40 Hz and frequency was gradually increased to 50 Hz. THD dropped to about 8% and operation proceeded smoothly with no more interruptions due to power quality. The ESP increased oil production by 500 bbl/d, providing more than USD 7 million in revenue over the 8 months to the projected completion of the power station.

Delighted with the solution, Assala ordered another eight phase-shift transformers to avoid delays in additional planned workovers. Projected time savings of 4 months per well for the next seven wells translate to an estimated revenue of USD 25 million. Once the power station is commissioned, the stepdown transformer will be deployed and the phase-shift transformers reassigned to other fields that do not have such stations.