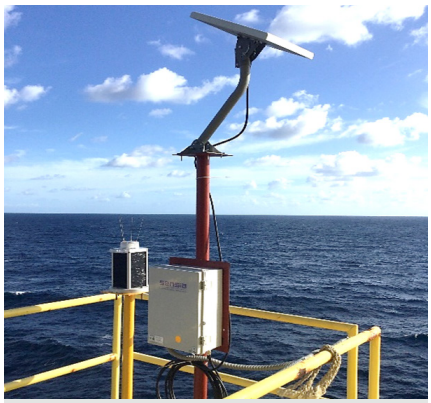
SENSIA
Rockwell Automation + SLB

+ CASE STUDY

Power Analyzer 2.0 enabled safe & unparalleled remote insights into Electro-Mechanical conditional-monitoring to extend ESP run life

Empowering ESP operations: Safe, remote & real-time monitoring insights help extend ESP runlife by 17%.



PA 2.0 on Remote offshore platform

Key Highlights

- Downhole phase-out conditions have been identified remotely in real time which otherwise wouldn't be possible from a regular surface setup.
- Phase-out detection led to a decisive surface voltage correction to reduce stress on the remaining two phases, leading to an ESP run life increment by 17%.
- PA 2.0 avoided the HSE risks of personnel physically being exposed to taking high voltage measurements, to confirm such downhole electrical conditions.
- Shaft Stability Indicator (SSI) which is derived from advanced electrical signature analysis, brings new insights and visualizations of real-time ESP shaft conditions and mechanical integrity.
- PA 2.0 is enhancing the way ESPs are being monitored and operated by customers, by providing in-depth insights to inform decisions throughout the entire lifecycle.

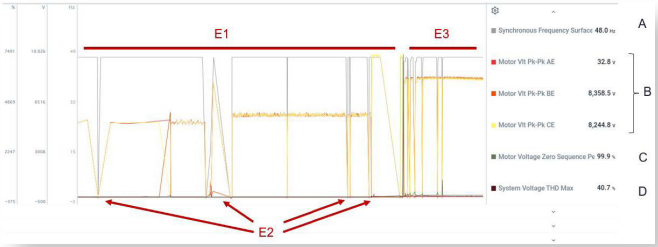
Power Analyzer 2.0 is transforming how Electric Submersible Pumps (ESPs) are monitored and maintained. It gives safe, remote, and real-time insights into the pump's electrical and mechanical health, helping teams spot problems early and take action quickly. In this case, it helped extend the pump's life by showing clear signs of stress and damage that normal systems missed. Even when other sensors failed, PA 2.0 kept working and provided useful data. It also removed the need for risky high-voltage checks. With tools like the Shaft Stability Indicator, PA 2.0 helps teams make smarter decisions and keep operations running smoothly.

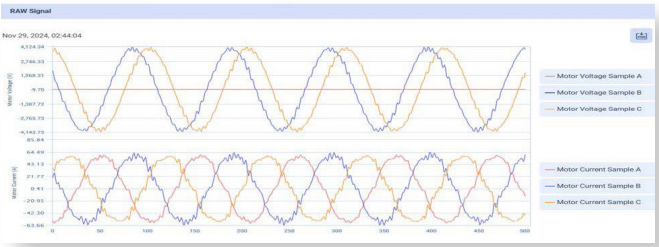
Solution

- PA 2.0 was deployed on a remote offshore well with the objective to monitor electrical and mechanical parameters derived from advanced signal processing of voltage and current (post transformer) measurements.
- After a few months of normal operations, and without any HSE risks of high voltage measurements, PA 2.0 was able to immediately depict grounding of one of the three phases.
- Importantly, even though the downhole sensor data was lost during this grounding event, PA 2.0 continued to deliver key insights independently.
- A clear increase in Total Harmonic Distortion (THD) was visualized from PA 2.0 parameters.
- Another critical PA 2.0 parameter, the motor SSI, showed an increasing trend after the phase-out, indicating higher stress and mechanical instability with the same operating strategy as prior to the fault.
- With the detection of phase-out condition and measured peak-to-peak voltage of three phases in real-time, an informed surface voltage correction was performed by the application engineering team; the voltage adjustment helped reduce the peak-to-peak voltage on the remaining phases, enabling the ESP to continue running in a less stressful, derated condition.
- After this correction and despite the loss of downhole gauge, the ability to continue monitoring e.g., the level of balance with the current, and evolution of SSI helped the client further extend ESP run life.

The below PA 2.0 trends further explain the findings from this case study:

Overall Period (Drive Integrity)-Trend#1



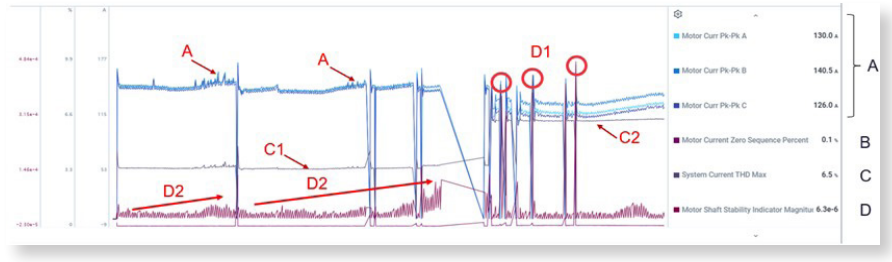


E2 There were more than 10 shutdowns during the entire period.

E3 Phase A was grounded, leading to immediate alarms on elevated single and multipoint leakage indicators. Multiple parameters further confirmed this condition; the measurement value dropped from 5800 (pk-pk, AE) to 10V indicating that the delta from phase to ground was almost zero, remotely proving the insulation on this phase was compromised. The same was confirmed from waveform and phasor diagrams.

Point 1 – The phase A is grounded and phase C jumped from 5800 to 9800 V (Pk-Pk F-G). After a surface adjustment this phase goes back to 8300 V (Pk-Pk F-G).

Motor - Cable Integrity trends:



- A There are several motor current spikes (between 3% to 6%) from all three phases that could be associated with an operation or well condition, but it is not correlated with any other electrical parameter or intake pressure. This specific parameter could just be detected with this special analysis of current waveform.
- B After the damage to voltage Phase A, the leakage indicators such as the current positive sequence % rose significantly, indicating damage to the electrical system.
- C1 The current total harmonic distortion elevated from 3.5% to 6.5% after the event of grounded phase. It shows that although the current is balanced, the waveform of the three phases was affected by the fact just two phases are energizing the stator windings.
- D1 After the new electrical condition of entire system, there were some severe spikes on Shaft Stability Indicator, confirming the extra mechanical stress the motor is facing under one grounded phase.
- D2 One of the unique parameters that could be trusted indicating possible anomaly in the electro-mechanical condition was the SSI, which has been monitored since the very first startup, to track runaway tendencies and relative stability of the ESP string. Adjustments to operations have been performed based on feedback through the SSI.

Conclusion:

The confirmation of the grounded phase in this study brought out significant benefits of PA 2.0 coupled with Avalon:

Firstly, with regards to HSE, it eliminated the safety hazards of having a local high voltage measurement task to confirm the electrical concerns, saving both life, time and deployment costs of offshore logistics.

Secondly, the insights collected from PA 2.0 for troubleshooting enabled the application engineer to take immediate action about changing electrical conditions in real-time and re-adjusting the pump operation (surface voltage in this case) which helped in extending run life by 17% in this case.

Thirdly, the most critical, shaft stability indicator (SSI) helped with real time correlation of electro-mechanical condition of the entire ESP system affecting the motor shaft, independently despite the sensor data being lost.

Power Analyzer 2.0 is positively disrupting the way ESP monitoring is done and helping both service providers and operators with unique yet powerful insights to take informed decisions in real time to extend run life, leading to production sustenance and effective workover planning.