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Sulzer White Paper

Optimizing pump operations in offshore environments

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Offshore operating environments present some of the toughest challenges to maintenance engineers. In the short-term, ensuring reliability is essential, while in the long-term, adapting performance to meet changing operational requirements is the best method of optimizing efficiency. Working with limited space together with the remote location of most offshore facilities means the task of delivering cost-effective, efficient and durable equipment requires considerable expertise.

The offshore industry faces two main challenges – maintaining the existing assets in the field and adapting equipment so that it is capable of maximizing the yields from oil and gas deposits. In each case industry expertise and engineering innovation will be required to deliver these goals.

Today's challenges

The global market for oil and gas has declined recently and this has placed increased pressure on production platforms. Investment in new equipment may be put on hold in favor of extending the service life of existing assets. At the same time, platforms are looking to reduce operating costs, which may seem at odds with any additional investment in maintenance. However, capital expenditure to improve reliability is most often far outweighed by the costs incurred by an unexpected failure and the subsequent costs of lost production.

Platforms need to deliver output as efficiently as possible, but over time the well profiles change and the equipment involved in delivering the oil to the surface needs to adapt accordingly. As deposits become more difficult to extract, so the equipment involved, such as high energy pumps, needs to be refurbished with rerate projects offering an opportunity for cost-effective improvements.

Meanwhile, maintenance costs need to be kept in check and the adage that prevention is better than cure holds well in this situation. A well-managed, preventive maintenance program is at the center of an efficient operation with the costs easily outweighed by those associated with unexpected downtime.

The offshore industry is under increasing pressure to reduce costs and optimize performance

Focusing on the maintenance of high energy pumps can reduce costs and extend operational life

Condensate booster pump was retrofitted to match performance to the projected performance profile

Advancing technology

While existing equipment on platforms ages, manufacturers continue to develop new technologies that can improve performance and reliability. Advances in materials science and coatings have led to increased durability while the advent of Industry 4.0 offers exciting prospects for asset monitoring.

However, in the current climate, introducing new equipment as a capital project may be beyond budget expectations, but introducing the latest technology should not be out of reach. Fortunately, there is considerable expertise in this area, enabling operators to retrofit improvements that can be accurately costed with a return on investment that meets short-term goals.

Focusing on pumps, which comprise some of the more important assets on a platform, is just the first step in the all-important route to improved reliability and efficiency. By looking at what can be achieved during planned maintenance intervals through integrating new technology and enhanced parts, it is possible to minimize costs and extend operational life.

Case study: Cutting energy and emissions

Originally commissioned in 2001, an oil platform in the North Sea had been in production for nearly 20 years. Over this time the application profile of the pumps had changed, and some had become less efficient, while others were beginning to exhibit increased vibration due to low flow conditions.

Two pumps were involved in condensate export, the main pump, which was a horizontal, diffuser barrel design, and a centrifugal booster pump, which supported the main export pump. Essentially, the booster pump had some vibration issues because it was operating at a flow well below the design point for this pump. Meanwhile, the main pump was generating too much head and, as a result, it was consuming considerably more energy than was necessary.

Engaging Sulzer, an expert in pump design and manufacturing, proved to be the best decision for this issue. The production profile for the platform was assessed and projected over the next 25 years. This showed that performance would be reducing year on year, so Sulzer proposed several hydraulic changes to both the booster pump and the main export pump.

Tight schedule

The operator would only allow the pumps to be off the platform for a maximum of eight weeks, which left a tight timeframe to complete the engineering, detailed design, manufacturing, rebuild and installation.

The proposed design changes were assessed using computational fluid dynamics (CFD). This included reducing the number of stages in the main pump from seven to only two. To maintain a smooth flow path through the sections where the impellers had been removed, Sulzer installed transfer tubes which were designed and manufactured in-house. The modified design was verified using rotodynamic analysis to ensure that the pump would operate with acceptable vibration levels.

Having completed the installation, the customer confirmed that the vibration levels from the pumps were satisfactory and the energy consumption had been reduced by 800 kW, equating to a saving of more than USD 1 million per year, which puts the payback in a short period of time. The corresponding reduction in CO2 from the operation also helped to meet local targets.

Case study: Re-tasking high energy pumps

Another example of optimizing pump assets is to ensure any change in the application is achieved with the utmost efficiency. For instance, a high-energy pump that had been switched from sea water injection (SWI) to produced water re-injection (PWRI) duty causing heavy internal erosion, which resulted in a rapid loss of performance and pump failure every 6 months.

Sulzer repaired the damaged barrel casing cover, modified the balance drum diameter to reduce axial thrust and applied specialized coatings to the wearing parts, including the impellers, diffusers and stage casings. The result of the re-engineering of the pump was an increased service life of 3 years, enhanced performance and a reduction in annual maintenance costs of 80%.

In this case, the costs associated with the initial pump failure could have been avoided if a more pre-emptive strategy had been employed. By assessing the characteristics of the pump and its suitability for PWRI, the modifications could have been implemented before the change in application was instigated.

The BLUE BOX™ solution combines advanced analytics, machine learning and decades of experience to identify under-performing assets

Optimizing data

Operations that involve pumps capture a range of process data, but in many cases it is only used to assess the current state of operation. Temperature probes, vibration sensors, flowmeters and pressure transducers all play a role; how the collated information is used varies between each production operation.

Data on reliability, performance and efficiency is vital to understanding the condition of the pumps on the platform. The information can be used to identify assets that will benefit most from additional investment, ensuring the most cost-effective distribution of capital.

Asset monitoring is a very useful tool and in many cases this information is available remotely as well. However, by combining live data with historical information and applying advanced data analytics, it is possible to take the next step and enable a proactive maintenance regime.

Predicting maintenance issues

Of course, the validity of the analysis is dependent on the data quality, which must have a continuous reality check. It takes an expert understanding of how the physical equipment design is represented in a digital format, to avoid false positives and react to true intelligence.

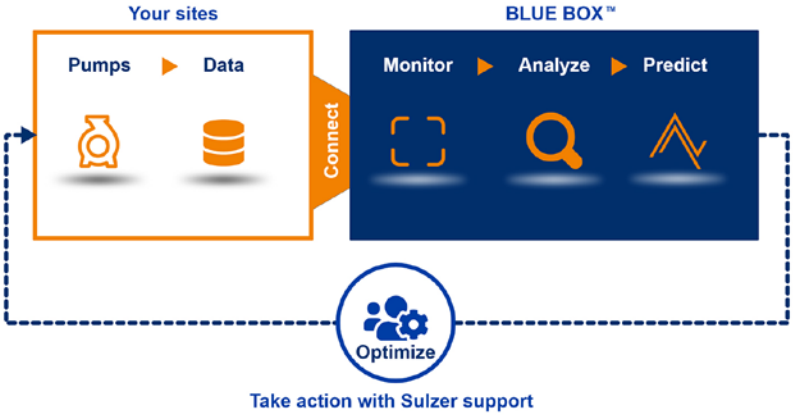
Sulzer leverages unsupervised machine learning techniques, where the models are trained with the recent operational history of the pumps together with physical pump modeling. The BLUE BOX™ solution combines advanced analytics, machine learning and over 180 years of pump design expertise as well as in-depth application knowledge to deliver accurate information with supporting evidence to enable decision-makers to make a well-informed choice.

Without an in-depth understanding of pumping systems and the lack of any other alarms, some operators may choose not to follow the decision support delivered from a predictive maintenance system. The benefits of these systems are only achieved if the operator trusts the information being delivered.

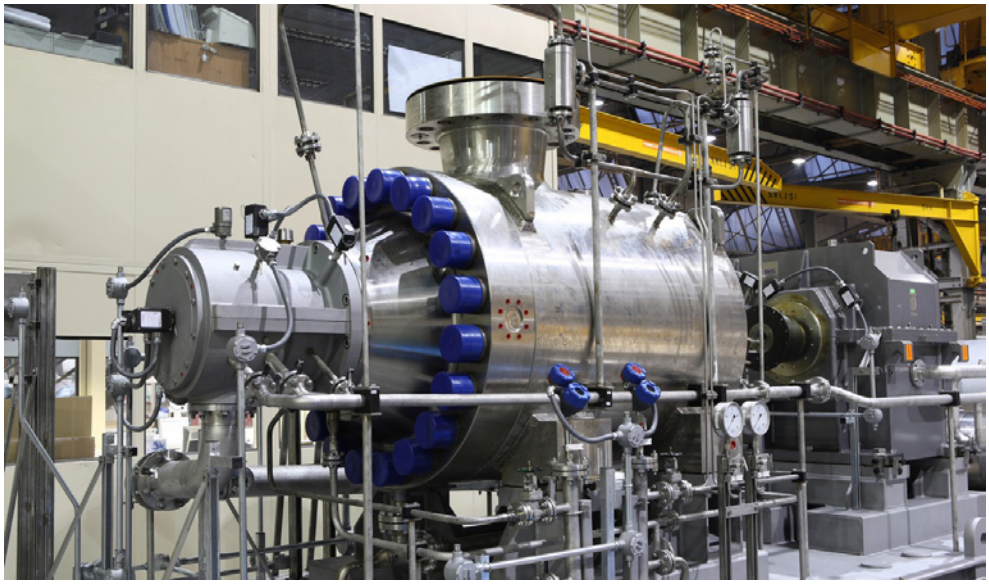
Essential knowledge

Sulzer has bolstered the digital aspect of its solution with equipment optimization specialists (EOS), who engage with the operator and address the need for technical ability and experience to complement the delivered insights. For example, when an anomaly is detected, they can offer expert advice to the operator and enable an action plan to be formulated. Collaboration between site personnel and the EOS allows the options to be defined, along with the required actions, timings and benefits.

Sulzer's BLUE BOX is a good example of how machine learning can be combined with extensive pump knowledge that comes from being an original equipment manufacturer (OEM) to enable optimization actions to be planned, keeping costs to a minimum and avoiding downtime wherever possible.



Collaboration between site personnel and pump specialists allows the required actions, timings and benefits to be defined



Large offshore pumps can benefit from predictive maintenance and optimization of performance

Leading technology

Sulzer's pumps have a reputation for excellent performance, reliability and ease of maintenance. The latest in cutting-edge technology has seen the world's first 40'000 hour impeller life guarantee on a high energy injection pump. Meanwhile, the boundaries of performance continue to be pushed, with 27 MW injection pumps and working pressures exceeding 800 bar now setting the benchmark.

Design expertise and experience is also translated into the development of maintenance solutions that can improve durability and reliability, while operating in the harshest of environments. Sulzer engineers can deliver turnkey solutions for any pumping application including repairs and refurbishments to damaged equipment.

Cutting-edge design and manufacturing facilities offer 3-dimensional laser scanning and reverse engineering capabilities that can create spare parts for any pump and refine them for today's applications. Beyond pump maintenance and repair, Sulzer also provides a complete electromechanical service for high voltage motors and generators as well as turbines and other rotating equipment.

Conclusion

At a time of increased economic challenges, it is important to optimize the performance of existing assets to minimize running costs and achieve a lean operation. Further advantages can be gained by reviewing the existing asset management system and assessing the benefits of extending its functionality.

Moving from preventive maintenance to a predictive maintenance regime can highlight assets that require attention before the situation adversely affects productivity. In this way, maintenance costs are optimized while output is achieved as efficiently as possible.

By working in partnership with an expert in this field, one that has decades of experience and is leading the industry with technological firsts, it is possible to maximize the potential of existing assets and adapt performance to meet future demand efficiently.