SULZER

CASE STUDY

Cutting cost, time and carbon footprint of FPSO relocations

Floating production storage and offloading (FPSO) vessels are used around the world for processing oil and transferring this resource to tankers or pipelines that transport it to refineries. They are positioned close to an oilfield and remain on location until the field is exhausted. Originally designed with a service life of over 20 years, FPSOs represent a huge investment for international oil companies (IOCs) and to maximize their potential, they are refitted and relocated once their current project is completed.

With sustainability being such an important part of modern industry, refurbishment projects can also support corporate goals by enabling the reuse of components where possible, rather than installing all-new equipment, which requires significantly more resources and investment.

Comparing costs

Research carried out by a major IOC compared the investment value for new equipment with the final value of the project and found for onshore installations that project costs were three to five times the equipment value. For offshore locations, this increased to five to seven times the investment. Therefore, the final cost of installing a new USD 5 million pump on an FPSO could be between USD 25 and 35 million.

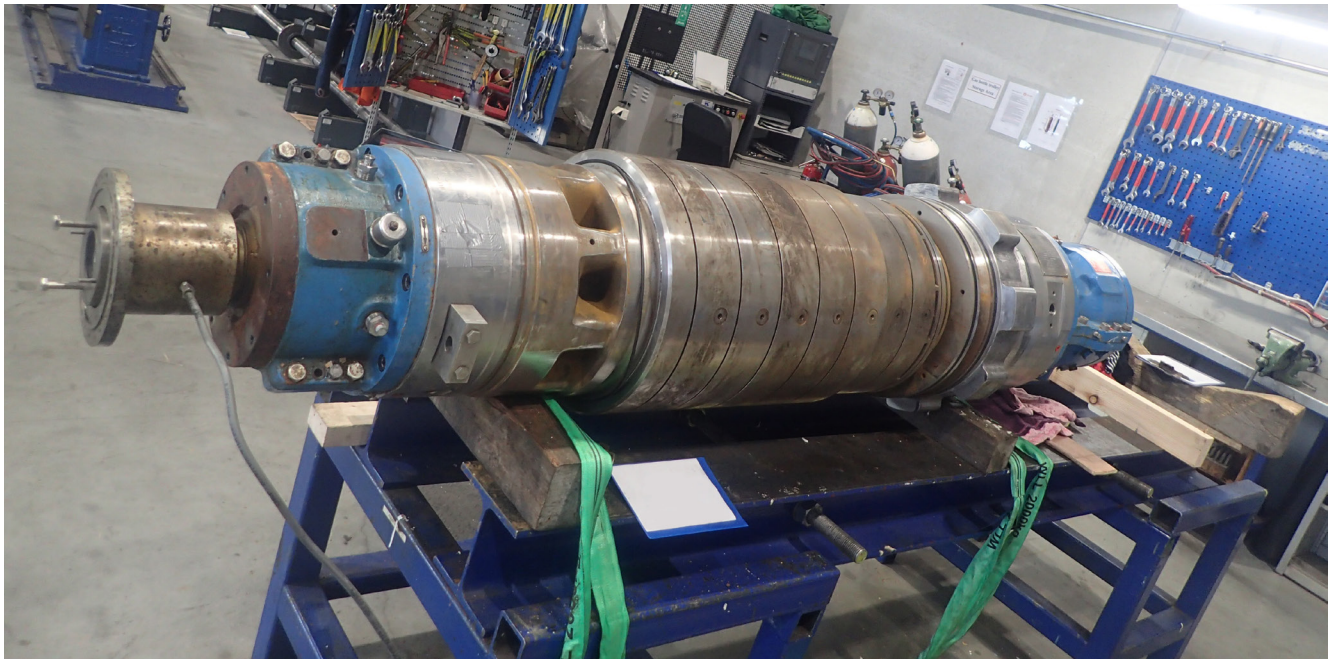
In contrast, a project to retrofit the existing equipment would equate to approximately 60% of the new pump price, but the fact that it will be reinstalled without any further modifications, there are no additional costs. Comparing total project costs makes the retrofit investment just 10% of the whole project to install a new pump in an offshore situation.

Extending the life of critical equipment

Relocation projects begin with every aspect of the vessel being appraised and a scope of works is established to enable all of the upgrades to be quoted and delivered. In many cases, choices need to be made about how the improvements are achieved, such as upgrading pumps with new equipment or modifying the existing assets. However, every solution must be capable of delivering a service life dictated by the contract, which is often around 20-25 years.

With such a long time in service, operators of FPSOs need reassurance that all the new and refurbished equipment will withstand the arduous conditions and deliver reliable operation. Manufacturers and suppliers must not only deliver supreme reliability, but also be capable of supporting their products throughout this period.

Central to the operation of an FPSO are the water injection pumps that are used to pressurize the well and maximize its productivity. These assets are supplied with auxiliary equipment, such as lubrication systems, which must also meet the 25-year operational life. For this reason, every piece of equipment must be scrupulously inspected and refurbished to the highest standard.



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Realizing carbon footprint reduction opportunities

Research conducted by Sulzer has shown that within the upstream business, production platforms account for 82% of CO_2 emissions and of these, water injection pumps are responsible for 50% of the power requirement. Therefore, using investment to upgrade these pumps and improve their efficiency can have a significant impact on the overall carbon footprint of an operation.

During the relocation of an FPSO, operators have an opportunity to not only optimize equipment for the new application, but also improve energy efficiency, which directly affects operational costs and the associated carbon footprint. These projects are complex and require considerable expertise to also ensure all the equipment will deliver the expected service life.

Mini case study: Lead by example

In one project, an FPSO is being refitted after completing its current operations to prepare it for relocation in the North Sea. When the vessel was originally built, Sulzer supplied three water injection pump packages: 8-stage pumps designed to deliver 3'500 m head with a flow rate of 350 m^3/hr using a 4.5 MW motor.

Before the vessel can be relocated, it has to undergo a significant refit to enable it to operate in the new location. For example, the new operating environment will require an additional 20 m of height to be added to the bow of the vessel to handle the waves expected in the North Sea. All this work will be carried out in a dry dock and as the original equipment manufacturer (OEM) of the water injection pumps, and a leading expert in pump retrofits, Sulzer has been contracted to deliver the design modifications to the water injection pumps.

Retrofits offer significant benefits compared to procuring replacement pumps. The most obvious is the financial saving – approximately 10% of the cost of a new pump. However, money is not everything, time can often be more important and in cases such as this, Sulzer expects to deliver a pump retrofit in around six weeks. The company's global footprint of engineering facilities ensures that expert support is always close by in projects such as this.

Double duty

Equally important are the efficiency and reliability of the pumps over the next 25 years. To achieve optimum performance, the pumps need to be fine-tuned to their new application. In this case, the specifications called for two duty points – flows between 330 m^3/hr and 387 m^3/hr with a differential head of 1750 m as well as a low flow, high pressure point of 104 m^3/hr at 1960 m head.

To achieve the best solution for this application, Sulzer's engineering team proposed a de-staging of the pump, removing four of the eight stages. De-staging tubes manufactured from Super Duplex stainless steel will be installed to guide the flow between the remaining impellers. This prevents turbulence and maintains pump efficiency.

The reduction in output also equates to reduced power input, in this case, the original fixed-speed, 11 kV, 5.5 MW motor could be replaced with a 3 kV, 3.5 MW unit controlled via a variable speed drive. The original rated power of 4.5 MW will be reduced to 1.8 – 2.0 MW, depending on the operating conditions, while the motor efficiency will increase from 96.4% to 96.9%, all of which makes a considerable saving in energy consumption. This translates directly to a reduction in the carbon footprint associated with each pump. This point is increasingly more important as many governments are imposing environmental taxes, based on associated carbon emissions.

Measure twice, fit once

The reduction in motor power and discharge head enabled the majority of the original components to be retained, but a new lateral analysis of the de-staged unit was carried out, confirming the pump rotor would be laterally stable throughout the operating speed range. Further analyses and calculations relating to the pump and the baseplate were completed to enable Sulzer to present a comprehensive report on the new design.

The lube oil system was also analyzed and due to the reduced speed of the new electric motor, the output needed to be increased slightly to meet the needs of the pump, gearbox and motor. A modification of the lube oil pump increased output by 30%, satisfying the combined demand of the components.

The last piece of the puzzle is the pipework, which needs to be carefully assessed and modified where necessary to avoid costly reworks on site. This can be achieved by different methods. The most cost-effective is to use pipework with ‘green ends’ allowing it to be cut and welded in position on site, achieving a perfect fit. An alternative is to deliver the pipe and fittings to all the pipework to be fabricated on site.

There is a downside to both of these options; any non-destructive testing (NDT), including pressure testing, would have to be done at the site. A further option is to use 3D laser scanning equipment to capture all the dimensions and create a jig to replicate the connections on site. In this way, the pipework spools can be fabricated, welded and hydrotested before being shipped and installed.

Taking advantage of retrofit

The ability to continue using updated equipment that fits back into the original footprint and performs at the best efficiency point has several clear benefits. In many cases, time is of the essence and with refits being completed in dry-docks, it is important to minimize the project time and return the vessel to operation as quickly as possible.

A well-planned retrofit project can be completed within six weeks and minimizes the changes needed to the surrounding pipework infrastructure or the foundations and structural steelwork. There are also significant environmental benefits that can be delivered as part of a retrofit.

Retaining the majority of the original components means there is no requirement to dispose of the original asset, resulting in less waste being generated. In the previously mentioned case study, for example, the electrical motor was the only major item that wasn’t reused and instead recycled. Moreover, the retrofit option requires much less energy and materials to deliver the updated pump, maximizing the sustainability of the project and contributing to the environmental, social and corporate governance (ESG) goals of the company.

With facilities and expertise located around the world, Sulzer is an expert provider of retrofit projects for pumps from any manufacturer. The retrofit team comprises around 60 personnel who have access to all of Sulzer’s design engineering and manufacturing facilities. Combined with the extensive network of service centers, retrofit projects can be delivered anywhere in the world. Working as an engineering partner, Sulzer’s expertise can help IOCs to optimize performance and reduce CO_2 emissions with targeted pump design upgrades.

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