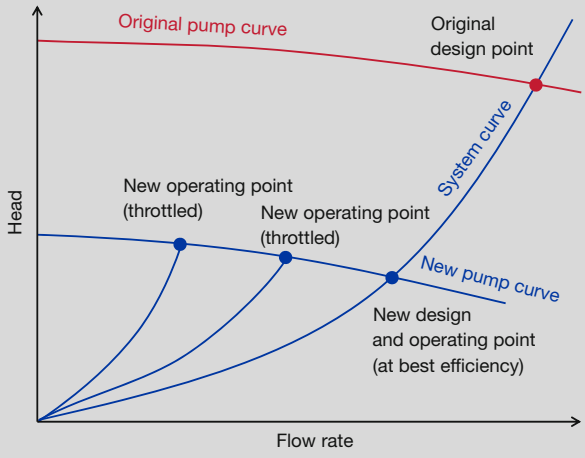
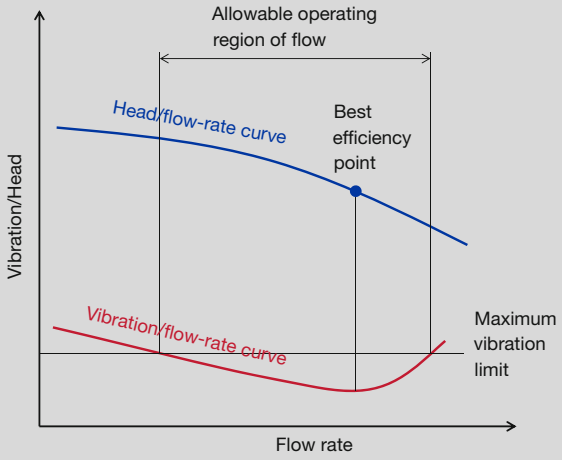
When Things Get Tight

A crude oil transfer pump on an offshore platform in Malaysia needed to be rerated to meet changed working conditions. Sulzer found a retrofit solution that complied with the challenging space and time constraints.

Low oil prices put more pressure on oil producers around the world to extend the life of mature oil fields and to debottleneck existing platforms. This has led to a rise in the global demand for individual and tailored retrofit solutions while—as far as possible—making use of existing pumps as assets. Shell Malaysia operated the Kinabalu platform for approximately 25 years.



1 Principle of flow rate and pressure control with valve throttling.



2 General relationship between flow and vibration: vibration is lowest close to the design point (according to API American Petroleum Institute).

When that contract expired, the platform was handed over to Petronas, who, as the asset owner, subsequently appointed Talisman Malaysia Limited as the operator. Situated at East Malaysia Sabah, Kinabalu produced an average of 7 mboe/d in 2014.

Talisman wanted to continue production, further develop the platform, and improve the recovery of crude oil from the Kinabalu oil fields. The company decided to make a significant investment in upgrading and expanding the existing facilities. The major challenge was to adapt the equipment quickly to the new duties despite limited space on the existing platform while simultaneously avoiding additional shutdowns.

New duties for the pump

Because of reduced output from the wells and changes in the processes, the crude oil transfer pump on the platform needed to deliver much lower flow rates. Furthermore, the pump flow was also expected to vary over the next five years. To avoid bottlenecks, this operation-critical pump—a Sulzer CD pump (BB2 type)—would have to operate at three different duty points going forward. The existing duty, at a flow of 406.8 m^3/h and a related head of 336.7 m, had to be rerated. The new flow was set at 200 m^3/h with an allowable minimum flow of 80 m^3/h at lower required heads. The following duty points were required:

- 112 m^3/h flow rate, 157 m head
- 152 m^3/h flow rate, 148 m head
- 200 m^3/h flow rate, 147 m head

One possible solution to achieve the different operating points would have been to install a variable-frequency drive (VFD). A VFD adjusts the speed of the pump motor and provides an energy-efficient method of reducing the flow rate. However, because of space and weight limitations on the oil platform, such a speed control could not be considered.

Talisman contracted Sulzer to find a suitable retrofit solution that would fit into the fixed-speed drive. Further challenges were:

- Sand carry-over was high.
- The pump mean time between repairs (MTBR) was only 6–8 months.
- The rotor had to be replaced and installed on site during a limited time window of a 30-day platform shutdown.
- A performance test was required to confirm the duty change.

Quick local turnaround

Sulzer provided state-of-the-art hydraulic expertise to offer the customer the best solution with a hydraulic rerate as the centerpiece. Sulzer supplied a new low-flow, low-head hydraulics to meet the various duty

conditions. The major difficulty in meeting three different duty points was resolved by throttling the flow and reducing the pressure using a discharge valve. This made the pump run closest to the best efficiency point (Fig. 1). This method represented the best technical and economic solution under the given space constraints. The losses in energy were minimized. Further, the benefits of running the pump close to the design point reduces vibrations and therefore increases reliability (Fig. 2). A new impeller design ensured a minimum of liquid recirculation so that power would not be wasted.

Special, extremely resistant protective coatings such as SUMEPUMP™ were used on all wetted parts (pump casing, stuffing boxes, impellers, and sleeves). The rotor exchanges were done one after another because of the limited time. Sulzer Singapore worked with a local test bed company to satisfy the customer's requirement on testing. The first pump was successfully commissioned in 2015. The customer was convinced of the added value Sulzer delivered and has already scheduled a second and third pump for retrofit.

Increased reliability

The original pump characteristic reveals that the pump was operating at 406.8 m^3/h at a required head of 336.7 m—already noticeably off the design point. The power rating was at 463 kW.

Thanks to the new hydraulic design, the retrofitted pump allows for a flow up to 200 m^3/h with a required head of 147 m. The other operating flows of 152 m^3/h at 148 m head and 112 m^3/h at 157 m head can be achieved by throttling the flow and reducing the pressure using a discharge valve. This solution does not require any additional expenditure or the space—that is not available on the platform—for a VFD. Also, a minimum continuous flow is viable at 80 m^3/h. The customer installed a liquid control valve (LCV) at the discharge to reduce the head to 148 m and 157 m at the lower flows of respectively 152 and 112 m^3/h. The power consumption was reduced to 140 kW—reducing the energy consumption by 70% to only 30% of the original value while operating at high reliability. This gave the operator the utmost flexibility.

Customer benefit—only changing what's required

The cost- and time-effective solution included changing the rotor design while making use of the existing pump casing, motor, seal plan, and piping arrangement. No hot work—such as welding, grind cutting, etc.—was required on site. Except for the impeller, which needed to be optimized to the new duty, most of the spares were and still are interchangeable. Therefore, the available inventory stock can be used for future maintenance. The existing general arrangement was maintained.

This project shows that retrofitting is both a technical and economical optimization and, consequently, a competitive solution that allows existing equipment to be adapted to evolving needs.

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Retrofits

Retrofits are available for any industrial pump.
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The retrofitted crude oil transfer pump is a radially split between bearings single-stage pump (API BB2 type).