Utilising offshore multiphase pumps

We look at the successful implementation by multiphase pumps and systems specialist Leistritz Pumpen GmbH of multiphase pumps on a project in the UAE

THE USE OF multiphase pumps in both onshore and offshore applications has been experiencing an increasing acceptance among oil and gas producers thanks to the technology's role in keeping marginal and declining oil fields producing, as well as acting to reduce flaring.

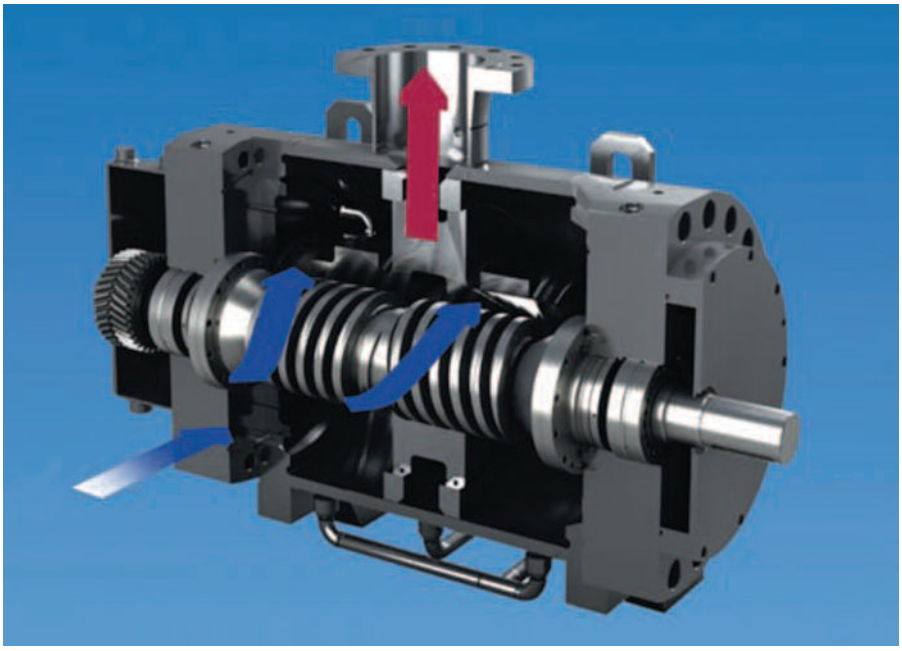
An offshore installations in the UAE commissioned the use of twin screw multiphase pumps on a wellhead platform. The multiphase pump installation on the field, which began production in the mid-1980s, was designed to sustain production at its current level. The implementation of short-term development projects on the field consisted of the installation of electrical submersible pumps (ESP) and a multiphase pump (MPP) at selected well head platforms (WHP).

The majority of multiphase pumps in operation today are based on twin screw pump technology. These self-priming pumps are hydraulically balanced and of a double volute design. The possibility of speed variation by means of variable frequency drives offers a wide operating envelope.

Twin screw multiphase pumps are available for flow rates up to 5,000 m3/h (755,300 bpd) and differential pressures up to 150 bar (2,175 psi). The pumps are designed to handle high gas volume fractions (GVF) and to tolerate gas slugs with 100 per cent GVF.

Cost-effective technology

Engineers working on the UAE project proposed multiphase pumps as a cost-effective technology to transport multiphase fluid via a single pipeline, instead of separating oil, water and gas at gathering stations and exporting oil and gas through separate pipelines to central production facilities. Multiphase pumps are essentially a means of adding energy to the unprocessed well stream, which enables liquid/gas mixtures to be transported over longer distances without the need for prior phase separation.



Cutaway of a high pressure multiphase pump (Image: Leistritz Pumpen GmbH)

Pumping the multiphase fluid directly to the central processing facility eliminates the requirement for separators, heater treaters, pumps, compressors and storage tanks at the in-field gathering stations and offers a range of advantages, including the reduction of installation space requirements due to less equipment. It also offers a reduction of operation and maintenance interfaces due to less equipment, and a reduction of manpower, as MPP installations prove to be suitable for remote control and require no permanent manning.

Further arguments for the installation of multiphase pump technology include the de-bottlenecking of existing flow lines by maximising the throughput, as well as the integration of low and medium pressure wells into a high-pressure manifold/separator.

Additional benefits include the integration of marginal fields or remote tie-backs to existing facilities, segregated production schemes of medium and low pressure wells by using dedicated multiphase pumps, and production restoration of dead wells by reduction of the well back pressure.

The technology offers the maximum utilisation of existing production facilities on a declining field by adding production from remote wells, as well as the elimination of flaring and gas recovery by boosting the unprocessed well stream to central separation facility and the reduction of unstable flow regimes in multiphase pipelines to higher superficial velocities.

Multiphase pumps are designed to operate with variable suction pressures. This is a major advantage over conventional separation systems featuring compressors which are designed to operate solely at a pre-determined fixed inlet pressure level.

Wellhead platform installation

For the installation of the multiphase pump on the UAE project the operators chose production facilities on a wellhead platform with six wells. There were three low pressure wells intermittently flowing or not flowing at all due to the high pressure from the remaining wells into the common manifold. It was therefore considered technically and commercially feasible to install a multiphase pump at the wellhead platform connecting the low pressure wells.

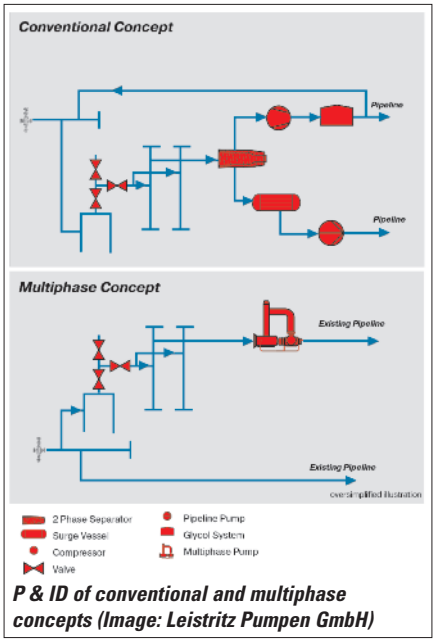
The multiphase pump system which is now installed on the wellhead platform consists of the following components:

- The pump skid with the multiphase pump, the electric motor, the lube and seal oil system, an automatic filter, the liquid management system, the on-skid piping with motor operated valves and the on-skid instrumentation.
- The air conditioned and pressurised control container for the VFD, PLC etc.
- The transformer.
- The low-voltage distribution board (LVDB).

The space available for the installation of the multiphase pump system on the wellhead platform represented a major challenge. Due to the small surface area for the equipment, the skid had to be designed as compact as possible. Since there were no close limitations in the equipment height it was possible to install pump and drive above the liquid management system in order to reduce the width of the skid. Another challenge was the small space provided for the transformer. However, finally a manufacturer was found that could meet both the project specification and the required footprint.

Hydrogen sulphide, chloride

Due to the H2S concentration and the high chloride content of the produced water, all wetted parts of the pump and the further skid components are made from duplex



P & ID of conventional and multiphase concepts (Image: Leistritz Pumpen GmbH)

stainless steel, meeting the requirements of NACE MR0175. The casing insert (liner) is wear-resistant coated with Stellite®. The pump shafts are also sealed by double acting, balanced mechanical seals in back-to-back arrangement.

In case of slug flow, the liquid management system provides sufficient liquid seal to the area between screw tips and casing insert to guarantee uninterrupted production. Pump bearings, timing gears and the mechanical seals are lubricated and cooled by a combined lube and seal oil system which is also accommodated on the pump skid. The automatic filter protects the pump internals from wear and damages by solids travelling with the multiphase fluid from the wells.

Before shipment to the UAE, the pump skid and all accessories were extensively tested on the multiphase pump test bed of the pump and system manufacturer and the premises of the selected sub-vendors. All

P Multiphase Pump Skid on the Multiphase Pump Test Bed (Photo: Leistritz Pumpen GmbH)

tests have been witnessed by the representatives of the end customer.

The multiphase pump skid was successfully commissioned during the Q3 2008. A new production manifold was installed to separate the flow between the high pressure and the low pressure flowing wells. The low pressure wells are connected to the suction line of the multiphase pump, resulting in a reduction in back pressure for the weak wells and, hence, a considerable increase in production.

Project completed

When the project started a couple of years after the turn of the century, there was limited experience with multiphase pumping technology in the Middle East. The application presented serious challenges in view of the design for the restricted space available and the selection of the construction materials.

After almost four years of operation, the installation can be considered a success by the operator, manufacturer and supplier of the Multiphase Pump System. ■