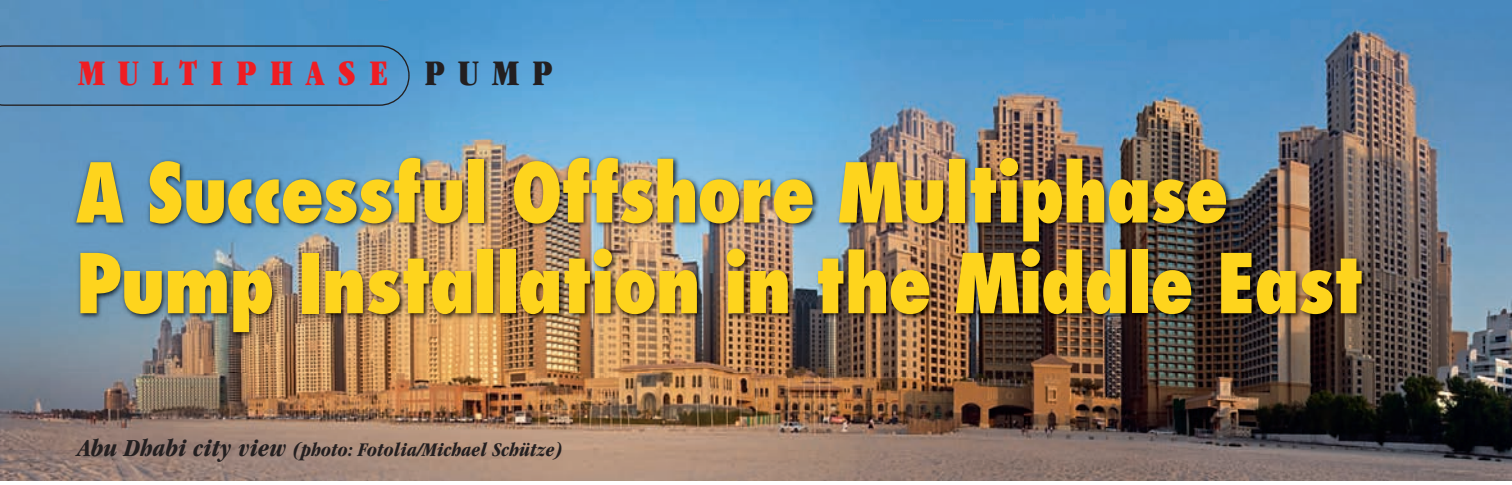
A Successful Offshore Multiphase Pump Installation in the Middle East



Abu Dhabi city view (photo: Fotolia/Michael Schütze)

Multiphase Pumps have been successfully used for onshore and offshore applications worldwide. The technology gained increasing acceptance among the global oil and gas producers for keeping marginal and declining oil fields producing and to reduce flaring as a contribution to a cleaner environment.

BY MANFRED WEISS

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

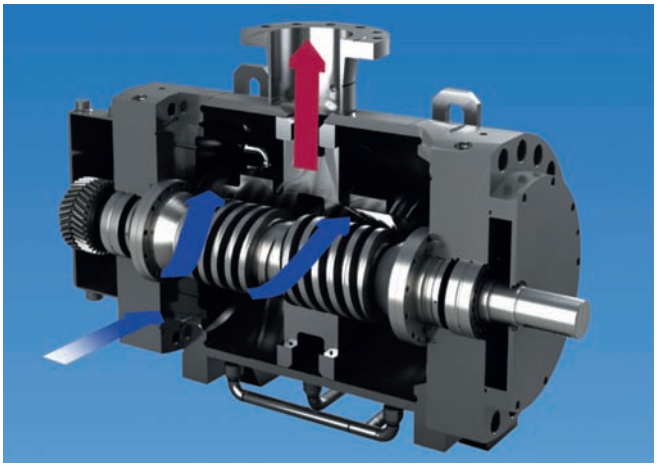
Twin screw multiphase pumps are available for flow rates up to 5,000 m^3/h (755,300 bpd) and differential pressures up to 150 bar (2,175 psi). The pumps are designed to handle high gas volume fractions (GVF) and to tolerate gas slugs with 100 % GVF.

UAE Offshore

One of these installations with twin screw multiphase pumps has been commissioned on a wellhead platform of the United Arab Emirates (UAE) coast line. The United Arab Emirates consist of seven emirates. Abu Dhabi is both the capital and the second largest city of the United Arab Emirates (UAE). The country owns the majority of the UAE hydrocarbon resources.

First explorations for onshore oil started in the 1930's and the first offshore oil was discovered in the late 1950's. Local producers, often in cooperation with major international oil companies developed and operate many offshore fields in the area. The production from these fields is pumped from the Wellhead Platforms to central onshore or offshore facilities for processing, storage and export.

The field with the multiphase pump installation is located a few kilometres offshore of the UAE coastline. The field was discovered in the late 1960's and the oil production commenced in the middle of the 1980's. Around the turn of the century, the production forecasts predicted a decline of the oil production associated with an increase in water cut. To sustain the field's oil production at the current level the implementation of short term development projects were initiated which consisted of installing electrical submersible pumps (ESP) and a multiphase pump (MPP) at selected well head platforms (WHP).



Cut-away of a high pressure multiphase pump (illustrations: Leistritz Pumpen)

Cost-Effective Technology

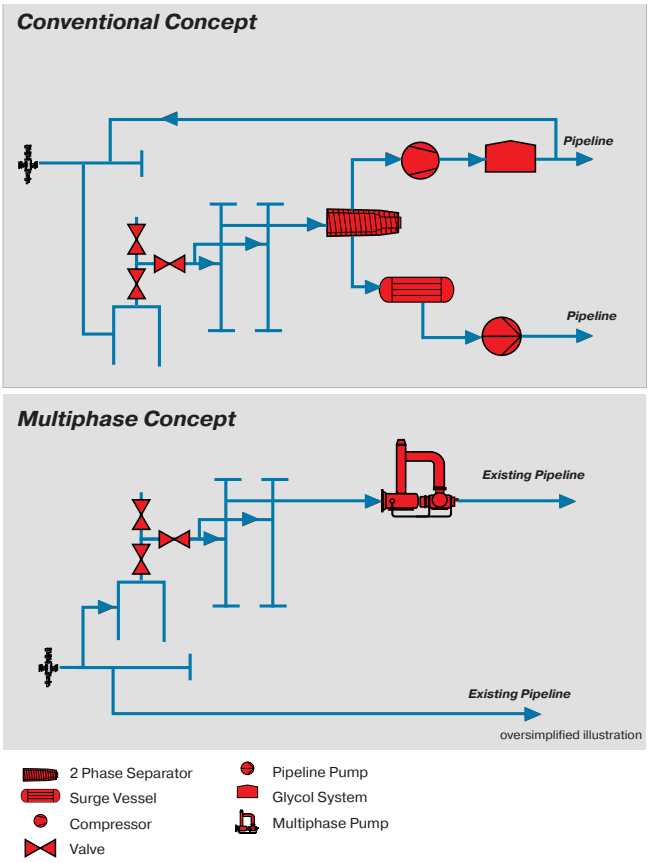
The engineers proposed multiphase pumps as a cost-effective technology to transport multiphase fluid via a single pipeline instead of separating oil, water and gas at gathering stations and exporting oil and gas through separate pipelines to central production facilities. Multiphase pumps are essentially 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.

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 the following advantages:

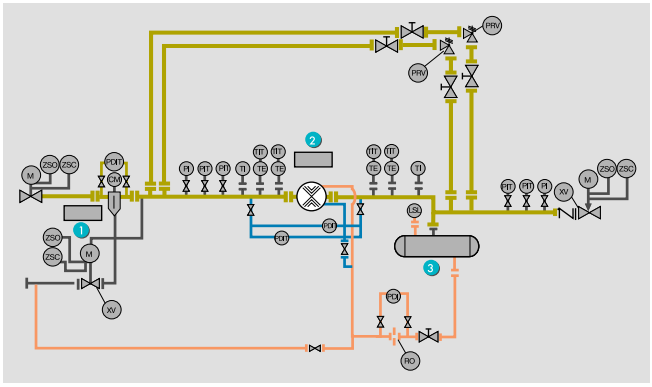
- Reduction of installation space requirements due to less equipment.
- Reduction of operation and maintenance interfaces due to less equipment.
- Reduction of manpower due to the fact that MPP installations are suitable for remote control and require no permanent manning.

Further arguments for the installation of multiphase pump technology are:

- De-bottlenecking of existing flow lines by maximising the throughput.
- Integration of low and medium pressure wells into a high pressure manifold/separator.
- 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.
- Production restoration of dead wells by reduction of the well back pressure.
- Maximum utilisation of existing production facilities on a declining field by adding production from remote wells.
- Elimination of flaring and gas recovery by boosting the unprocessed well stream to central separation facility.



Piping and instrumentation diagram (P&ID) of conventional and multiphase concepts



Typical P&ID of a multiphase pump skid as installed on the wellhead platform

- 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 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. Therefore, it was 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 who could meet both the project specification and the required footprint.

Hydrogen Sulphide, Chloride

Due to the H_2S 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 stainless steel, meeting the requirements of NACE MR0175. The casing insert (liner) is wear resistant coated with Stellite®. The pump shafts are 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 fil-

Multiphase pump skid on the multiphase pump test bed
(photos: Leistritz Pumpen)

ter protects the pump internals from wear and damages by solids travelling with the multiphase fluid from the wells.

Before shipment to the United Arab Emirates, 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 tests have been witnessed by the representatives of the end customer.

The multiphase pump skid has been successfully commissioned during the third quarter 2008. A new production manifold was installed to separate the flow between the high pressure flowing wells 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.

Offshore platform with a multiphase pump
(photo: Leistritz Pumpen)

Successfully Completed

When the project started a couple of years after the turn of the century, experiences with multiphase pumping technology in the Middle East were only marginal. 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 as successfully completed by both the operator and the manufacturer and supplier of the Multiphase Pump System. ■

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