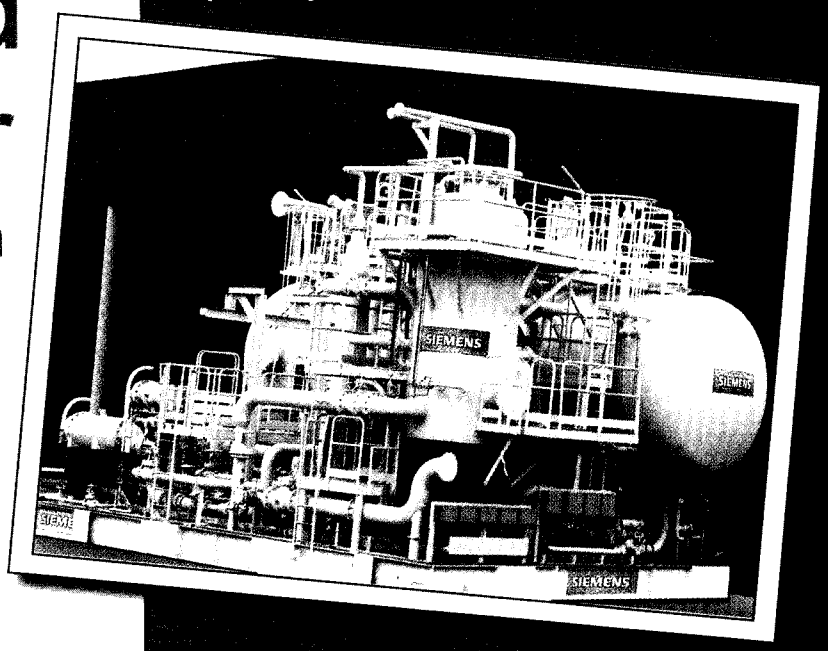
The case study is about the water treatment system used in oil production unit which removes 99.9% of the influent oil and maintains consistent overboard water quality.

Produced Water

Treatment System Ensures Discharge Compliance for Oil Fields

By Alexandra Schmutterer



The challenge

When Total Congo E&P needed produced water treatment for its floating production unit located offshore Congo, it chose a system that would ensure compliance with discharge regulations. The floating production unit, which would service both the Moho and Bilondo oil fiends, was to be moored in a water depth of 600m. Its production capacity would be 90,000 barrels of oil per day (BOPD) by 2010.

During operation, formation water would also be brought to the surface, and that would have to be treated to discharge regulation quality of less than 30ppm oil in water. The produced water rate was expected to peak at 75,000 barrels of water per day (BWPD), but would be lower during early field life. Thus, the water treatment system had to operate throughout all the anticipated flow conditions and motion conditions.

The first deep offshore development to be brought on-stream in the Congo, the Bilondo and Moho reservoirs will be produced using nine producing wells and five water injectors in two submarine clusters. Insulated umbilicals and flowlines will bring the oil to the floating production unit, from which it will be exported via a new 16inch, 80km pipeline to the Total-operated Djeno on-shore terminal.

The Moho field, located 15km off the Congolese coast, was discovered in 1995 in the Jaute-Mer concession in 700m of water. Total has partnered with Chevron Corporation and Societe Nationale des Petroles du Congo on the project.

Solution

The produced water treatment system, supplied by Siemens, consist of a skimmer pre-deoiler, two liquid/ liquid hydrocyclones and a flotation unit. The

produced water is first directed to the pre-deoiler vessel, where bulk oil is removed. The pre-deoiler is a long residence time vessel (up to five minutes at design rates) that has to absorb fluctuations of incoming oil in water up to 7% content under process upset conditions. Water exits the pre-deoiler and passes to the de-oiling hydrocyclones. The hydrocyclones are arranged in a two-vessel parallel configuration to allow for easy adjustment over the field life for gradually increasing produced water rates.

The operating pressure of the system is converted to high centrifugal forces in the hydrocyclones to separate the oil and the water phases. This high efficiency design can reduce the oil in water, leaving the hydrocyclone to less than 40ppm.

From the hydrocyclones, the produced water goes to the compact vertical flotation unit, where final polishing of the produced water occurs before it is discharged overboard. The selection of the flotation unit was based on the supplier's previous experience with the customer, and a design that is resistant to motion conditions on a floating production unit. The final water quality is less than 30ppm before discharge, to meet regulatory requirements. The skimmed oil from the pre-deoiler and compact flotation unit, and the rejected oil from the de-oiling hydrocyclone, are routed to a dedicated on-skid collection vessel from which positive displacement pumps are used to route the recovered oil back to the production process.

To make the system as compact as possible, Siemens designed a single structural steel module, with a dry weight of over 120tonnes, to accommodate all the required equipment, vessels, valves, instruments, piping and access ways. Overall skid dimensions are approximately 13m long by 9m wide. The overall height is 8m, a compactness that was only achieved

How the liquid/ liquid hydrocyclone works

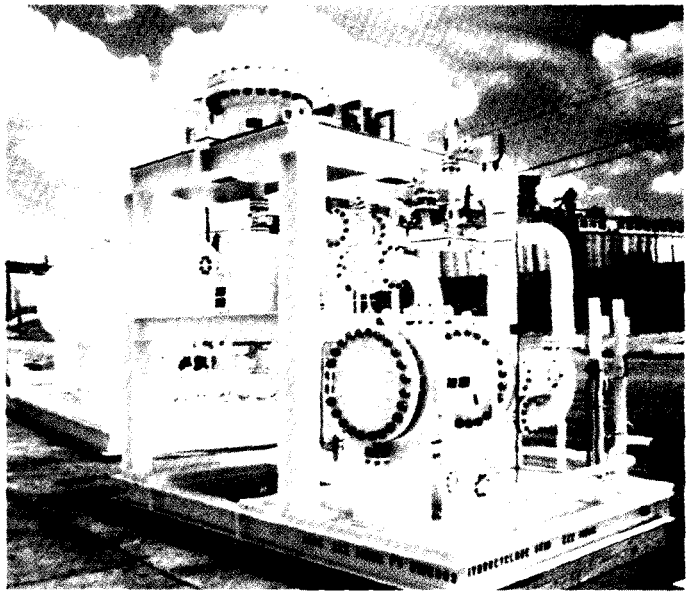
Hydrocyclones operate under system pressure, and use pressure drop as the primary source of energy. Each hydrocyclone liner in a vessel is fed tangentially to initiate a high radial velocity. The spinning motion of the fluid is accelerated by the tapered shape of the hydrocyclone liner, and the spinning motion creates a centrifugal force up to 4,000Gs, which causes the oil and water to quickly separate. The oil forms a core at the axis of the hydrocyclone and is forced out by a centered opening at the inlet end of the hydrocyclone liner. This results in a simple but effective, and very compact, oil/water separator with no moving parts.

The hydrocyclone liners feature twin inlet ports that provide superior hydraulic stability with a straight oil core that is stable even at very low flow rates. The stable core allows the hydrocyclone to achieve higher removal efficiencies that can reduce or eliminate the need for emulsion breaking chemicals. The stability of the oil core enables the hydrocyclone to operate at turndown ratios between 5:1-15:1.

The centrifugal force generated inside the hydrocyclone liner can reach 4,000 times the force of gravity in some applications, nullifying the negative effects on separation caused by wave action on floating systems.

after extensive careful and considered detailed engineering and design. The package can be lifted and placed using a single crane with the supplied lifting beam and associated slings.

To ensure that the package would have minimal performance loss, even under severe motion conditions, the pre-deoiler vessel incorporates a carefully designed internal baffling arrangement, modeled using computerised flow dynamic software. The hydrocyclone is a motion insensitive design, and the compact flotation unit has inherent stability even under severe heave, pitch and roll conditions.



Liquid liquid hydrocyclone

Result

Completed ahead of schedule, the Moho Bilondo project was started up at the end of April 2008.

The produced water treatment system is removing approximately 99.9% of the influent oil and maintaining consistent overboard water quality. The overall system design meets offshore codes and practices, and is safe to operate and easy to maintain.

About the Author

Alexandra Schmutterer is Regional Marketing Communications Manager for Singapore at Siemens Water Technologies.

For further information on the author, write to us at content@eawater.com