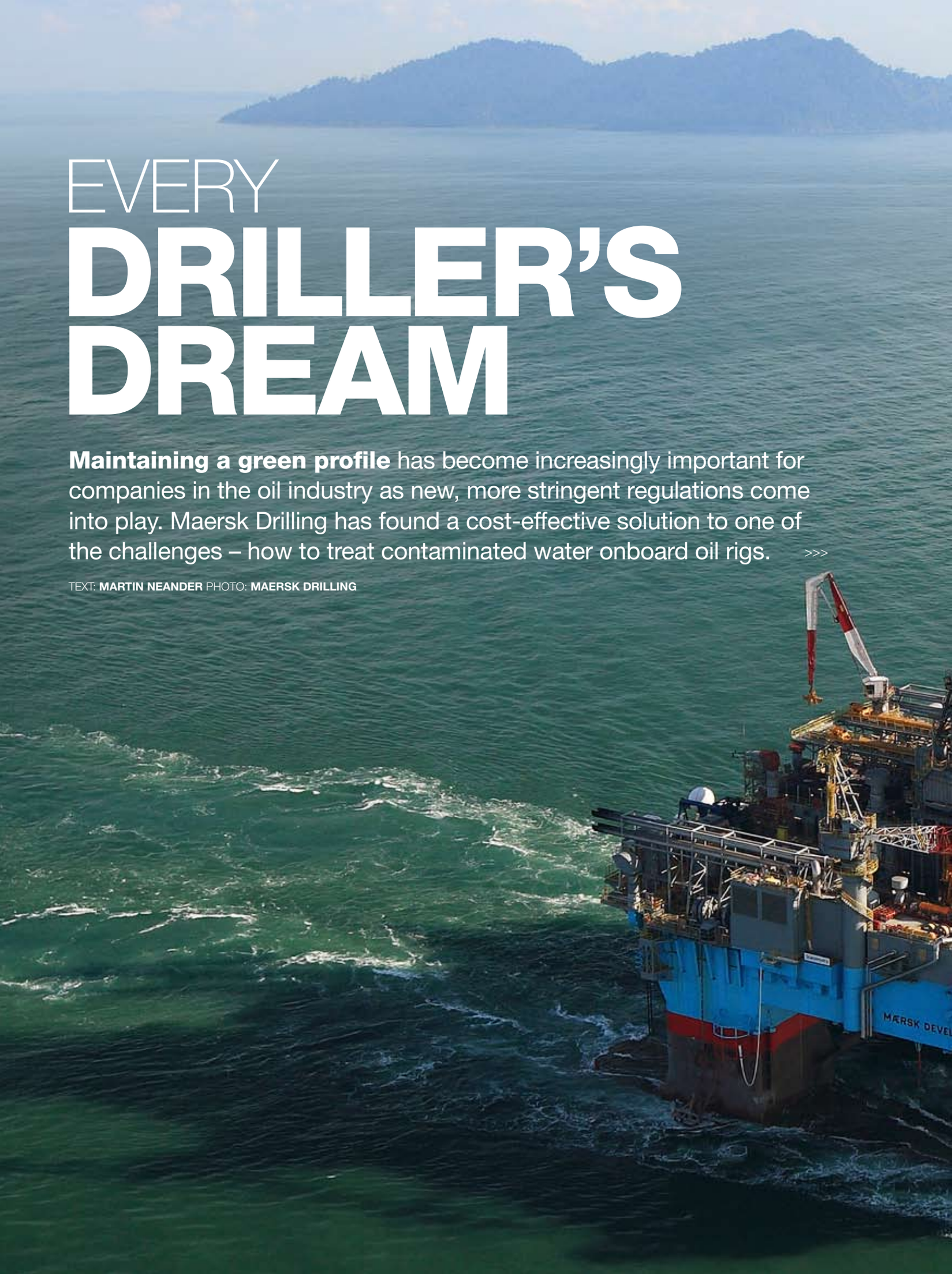
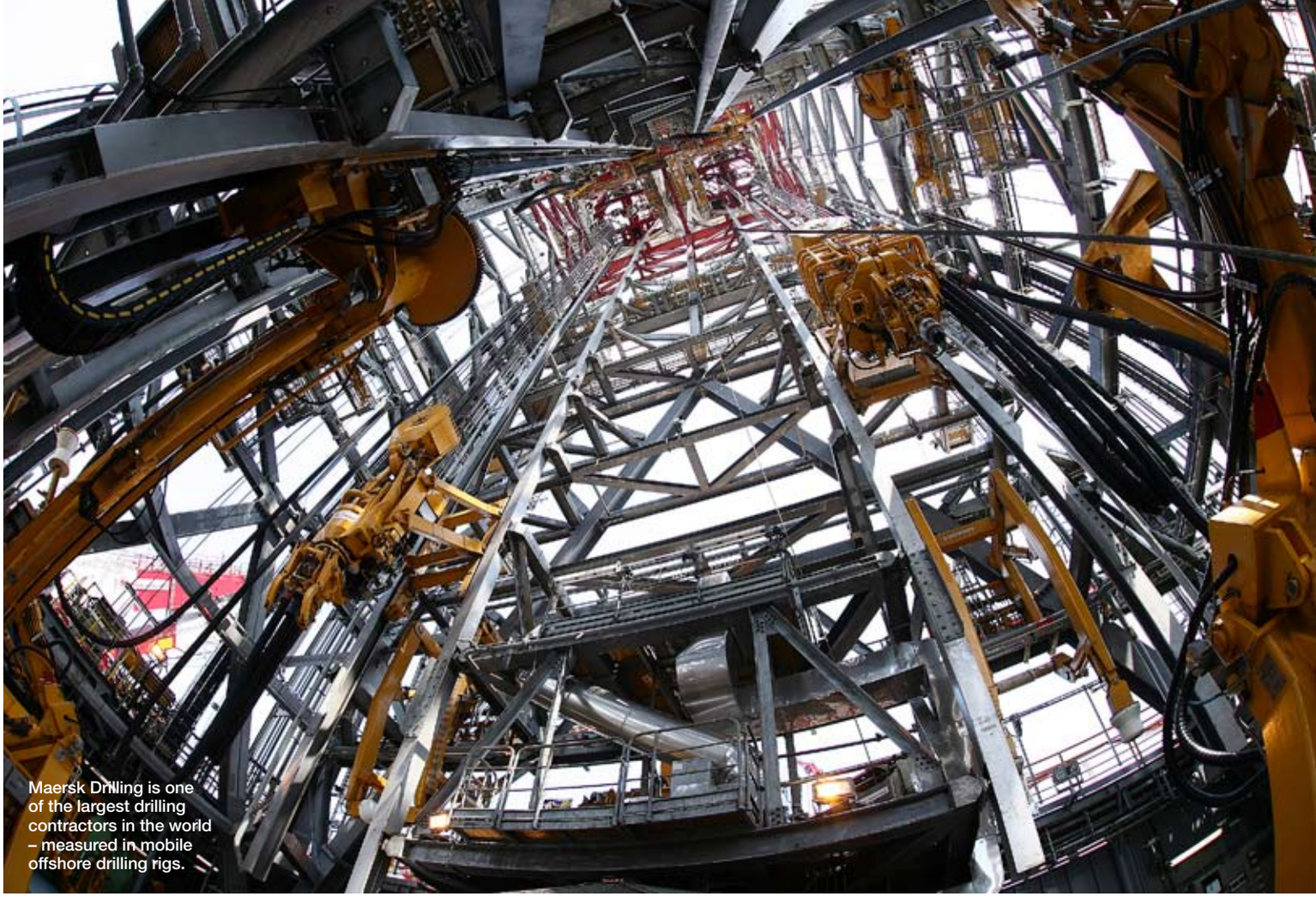
EVERY DRILLER'S DREAM

Maintaining a green profile has become increasingly important for companies in the oil industry as new, more stringent regulations come into play. Maersk Drilling has found a cost-effective solution to one of the challenges – how to treat contaminated water onboard oil rigs. >>>

TEXT: **MARTIN NEANDER** PHOTO: **MAERSK DRILLING**



The Maersk Developer on its way to the Gulf of Mexico, where the first factory-built Alfa Laval Phoenix system will be put to use.



Maersk Drilling is one of the largest drilling contractors in the world – measured in mobile offshore drilling rigs.

>>> **RUNNING ENVIRONMENTALLY** safe operations is crucial for companies within the oil industry. Oil spills from both tankers and offshore oil rigs can wreak havoc with the marine environment and cause irreversible harm to a company brand. Not only will the company name be connected to the incident in countless headlines affecting public opinion, but investors may decide to turn their backs as well.

"Produced" waters – formation water, brine, injection water and other technological waters – also pose an environmental hazard, one that increasingly stringent legislation is seeking to eradicate.

When drilling for oil, injection water is pumped into the injection wells in quantities of hundreds of thousands of tonnes to maintain the pressure in the system and push the hydrocarbons toward the producing wells. Formation water and brine are extracted along with oil. All of these waters are typically polluted by oil, natural low-molecular-weight hydrocarbons, inorganic salts and technological chemicals, and must be cleaned before they are discharged into the sea.

The International Maritime Organization regulations say that water discharged from drilling rigs can contain a maximum of 15 parts per million of oil. But countries and regions also apply their own legislation, which companies in the oil industry must abide by, and the stringency of this legislation varies.

MAERSK DRILLING IS one of the largest drilling contractors in the world – measured in mobile offshore drilling rigs – and operates a worldwide fleet of drilling rigs and mobile production units for oil companies to rent. The company has made environmental improvements a part of its overall strategy.

"To live up to our strategy," says Gregers Kudsk, vice president and CTO, Maersk Drilling, "we run a comprehensive environmental performance programme, which forms the baseline for our plans to reduce emissions and the total impact on the environment as a result of our activities."

Part of that commitment is to clean the dirty water onboard the company's oil rigs.

Offshore rigs operate with large volumes of mixtures of oil, water and solids, and the mixtures are often in the form of complex emulsions that are difficult for traditional separation systems to tackle. Cleaning under marine conditions is a complicated technical task.

A common solution is to store the water onboard the rig until it can be shipped to shore for cleaning. This is usually paid for by the oil companies and can cost as much as 600,000 euros in a year to clean roughly 3,000 cubic metres of contaminated water.

"For Maersk Drilling it has been important for our rig operations to find a solution that can deal with all sources of water contamination directly onboard our rigs," says Ulrik

▶ Facts

WORLDWIDE OPERATIONS

Maersk Drilling is part of the AP Moller–Maersk Group and is one of the largest drilling contractors in the world – measured in mobile offshore drilling rigs. Other company facts:

- Founded in 1972
- Headquarters in Lyngby, north of Copenhagen, in Denmark
- Offices in 11 countries
- 9,500 employees worldwide
- 26 oil rigs in use in the North Sea, Brunei, Dubai, Caspian Sea, Gulf of Mexico and other regions.

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> **ULRIK FRIIS,** *head of Technical Support, Maersk Drilling*

Friis, head of Technical Support at Danish Maersk Drilling. "These sources include bilge water, tank cleaning, deck drains and drill-floor drains."

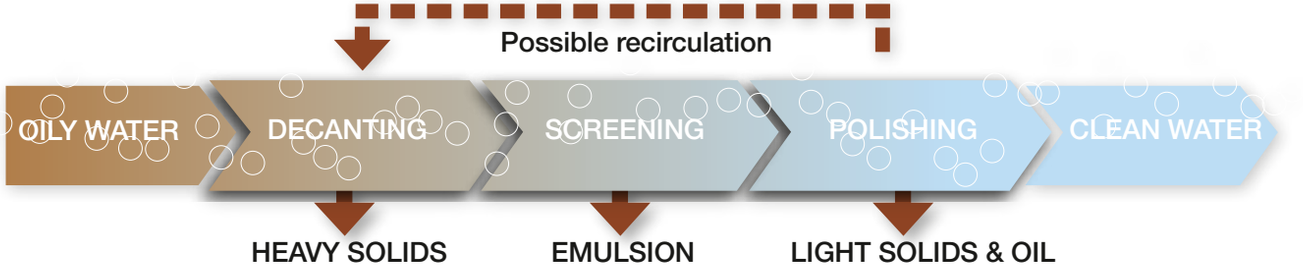
Solutions for cleaning contaminated water onboard the oil rigs include static filtering units, mechanical separation and chemical treatment, all inadequate for cost-effective processing of oily, contaminated water. Gravity settling is a slow, ineffective approach that requires plenty of space and large quantities of chemicals. Filtration systems can only separate solids from liquids, and have limited capacity. Centrifugal separation alone cannot remove all the types of contamination in widely varying concentrations and at different flow rates.

"The static filtering is cheaper to use than mechanical separation," says Friis. "But it's also my experience that filtering alone is not as efficient as a separation technique. The drill mud creates different kinds of emulsions, which filtering solutions can't handle in a good way."

MAERSK DRILLING HAD tested a chemical treatment system that Friis says was very efficient, but the high operational cost and the use of chemicals were major drawbacks. Maersk Drilling wanted to determine whether a screening solution using chemicals could be combined with a mechanical Alfa Laval system for cleaning contaminated water onboard oil rigs, which was already onboard its deepwater semi-submersible drilling rig in the Caspian Sea, the Maersk Explorer. Maersk Drilling invited Finnish chemicals company Kemira and Alfa Laval to carry out tests.

The final outcome was a new system called Alfa Laval Phoenix, which involves a decanter centrifuge module, a screening module and a disc stack centrifuge module. >>>

▶ The Alfa Laval Phoenix system



Clean water in three steps

The Alfa Laval Phoenix contaminated water treatment system combines different separation cleaning techniques in one system.

The system features three separate modules, each designed to remove specific contaminants from the water stream in order to tackle the different separation requirements: a decanter centrifuge module, a screening module and a disc stack centrifuge module.

The decanter centrifuge deals with the initial stage in the treatment process, focusing on solids removal.

The following screening stage is a combination of mechanical separation and chemical dosing, although the system is built to minimize chemical consumption. In this step emulsion composed of small colloidal particles and droplets bound together are removed. Finally the disc stack centrifuge is used to separate low concentrations of oil and fine particles.

"The screener can remove some of the viscous oil without clogging up," says Ulrik Friis, head of technical support at Danish Maersk Drilling. "This makes the job easier for the disc stack centrifuge. While all three components remove different kinds of contaminations, they can help and complement each other for the best result."

The Alfa Laval Phoenix system ensures that all water leaving the system is cleaned to the appropriate level. A three-way valve with an oil-in-water monitor at the outlet of the system recirculates water that contains more than 15 parts per million of oil back into the system to be processed again.

The system is also built to minimize energy consumption.

"The payback time for the Phoenix system is 13 to 14 months," says Franck Gregoire, business manager for oily water treatment at Alfa Laval. "This is based on a cost–payback analysis we have done, looking at issues such as investment costs, partnering services, consumables and chemicals. We compared the Phoenix to the next best alternative, which was to collect all the water in large tanks and ship for treatment onshore." ■

"We have had good experiences from Alfa Laval's system on Maersk Explorer, and we are looking forward to seeing the new system in action in the Gulf of Mexico."

ULRIK FRIIS, *head of technical support, Maersk Drilling*

Maersk Drilling has 26 oil rigs in use around the world. The company has made environmental improvements a part of its overall strategy.

>>> Says Franck Gregoire, business manager for oily water treatment at Alfa Laval, "Maersk Drilling specified how it wanted the system to work, and we provided our expertise on how to separate different liquids. So we really developed the new system in conjunction with the customer."

The Phoenix system works in three steps: First a decanter removes the bulk of the solids, then a screener unit removes the emulsions, and finally the disc stack centrifuge takes away the oil and the rest of the solids.

The three-step solution was first installed in a retrofit version onboard the Maersk Explorer. It proved to be both robust and flexible. Later the first factory-built Phoenix system was installed on Maersk Developer, a new-built highly advanced deepwater development semi-submersible rig that will go into operation in mid-2009 in the Gulf of Mexico with StatoilHydro as its first customer.

"The reason for installing Phoenix on our Maersk Developer oil rig is that we have had good experiences from Alfa Laval's system on Maersk Explorer," Friis says. "And we are looking forward to seeing the new system in action in the Gulf of Mexico."

He says the difference between the retrofit unit on Maersk Explorer and the new Phoenix on Maersk Developer is that the new system provides better system control. "On the new Phoenix unit the different parts are more aligned to work together," he says. "It will be highly intuitive to use, and operations are much more automated."

APART FROM THE FACT that Phoenix can save a lot of volume, space and weight on drilling rigs – the use of Phoenix requires a 30-cubic-metre feed tank for the oily water, in contrast to an ordinary storing tank, which normally must be big enough to hold 300–500 cubic metres of dirty water – Friis points out that the contaminated water treatment onboard will be attractive to oil companies, because they will no longer have the cost of shipping the dirty water onshore. "This is an advantage for Maersk when we negotiate contracts with oil companies," Friis says.

New Phoenix systems will also be installed on two similar semi-submersible rigs that are being built at the Keppel Fels shipyard in Singapore. The first one of the two will be used in Australia by oil company Woodside and will go into operation in spring 2010.

Expectations of the new system are high. "If Phoenix turns out to be a success, there is the possibility that it will become standard on our drilling rigs in the future," says Friis. ■

▸▸ www.alfalaval.com/here/watertreatment/maersk

▸ Facts

RIGOROUS LEGISLATION

- The International Convention for the Prevention of Pollution from Ships, known as MARPOL, is valid for marine activity. The convention is adopted by the International Maritime Organization (IMO). MARPOL 73/78 deals with the prevention of contamination from vessels.
- The requirements for oil separation and filtration equipment are safeguarded by the Marine Environment Protection Committee (MEPC), which is a subsidiary of the IMO. As of 2003, resolution MEPC.107 (49) states that oil separation and filtration equipment must be able to purify oil-contaminated and emulsified wastewater to an oil concentration below 15 parts per million – 0.0015 percent by volume.
- There is also various national and regional legislation that must be taken into account. Norway, for example, is putting pressure on oil companies and drilling contractors to comply with its legislation, implementing severe sanctions for non-compliance.