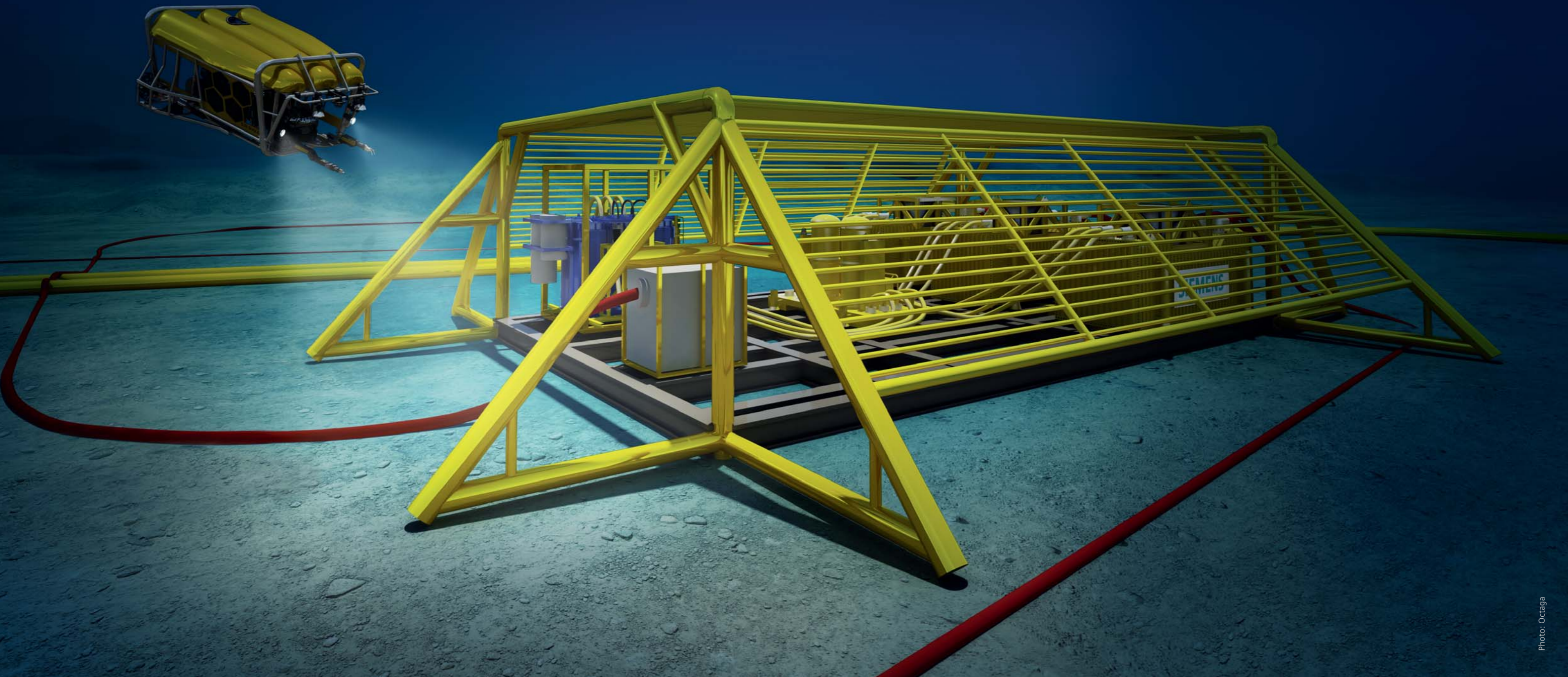


Taking Oil and Gas Technology to New Depths

In science fiction stories such as Jules Verne's *Twenty Thousand Leagues under the Sea* and in television series such as *Sea Quest*, humankind has established undersea cities. Today, the imagination of the world's science fiction writers is beginning to be realized by the innovative leadership at Siemens with the world's first processing and distribution equipment for oil and gas operating on the seabed: the subsea power grid.

By Nicholas Newman



Increasingly, energy companies are looking for new sources of oil and gas beneath the world's oceans. Tom Blades, CEO of the Oil and Gas Division of Siemens Energy, explains: "The depletion of onshore reserves is forcing oil and gas companies to exploit fields in the most remote places offshore and at ever greater water depths." In effect, the era of low-cost and easily accessible oil and gas exploration and development is ending, while demand and prices will continue to increase.

Recent events, such as the disruption to Europe's gas supplies in past winters, have raised concerns over energy supply security, encouraging the quest for new oil and gas reserves outside traditional regions. Einar Fasting, Vice President of Marketing at SINTEF Energy Research, Norway, observes: "Energy companies are increasingly looking to deeper waters, off the coasts of North and South

America, northern Norway and West Africa." Technological solutions for safely exploiting oil and gas reserves known to exist in the deep waters off many coastlines are thus in greater demand. Siemens has been working with customers and specialists to develop innovative solutions to meet the operational challenges involved. For example, Norway's Statoil has been developing new oil and gas fields in the remote deep Arctic waters off northern Norway, one of the most extreme operating environments on earth, where subzero temperatures and violent storms pose constant hazards at the surface. Under these conditions, finding the right technological and environmental solutions is vital. One of the main challenges for the industry is finding reliable, safe methods for delivering power for processing oil and gas on the seabed. Siemens, as the world's leading supplier of a complete spectrum of products, ser-

vices and solutions for the oil and gas industry, has developed a safe, innovative and environmentally friendly power delivery solution known as the subsea power grid. It is regarded by many in the industry as a new technological milestone in innovation for the industry. Bjørn Einar Brath, who is responsible for subsea applications in the oil and gas sector at Siemens, says, "It is designed to be easy to install and operate with existing subsea facilities." Using this technology, operators can monitor and maintain equipment remotely, from a dedicated center onshore.

However, subsea power grids and the people who work with them must still contend with inhospitable conditions. "Siemens has had to overcome operational issues like waterproofing equipment and insulating the electrical systems," says SINTEF's Fasting. "This especially applies to the connectors used, since water and electricity obvi-

ously do not mix." He points out that the depths involved mean no divers can be used; instead, maintenance has to be carried out using remotely operated vehicles (ROV). "Actually," he says, "this technology could also prove important for deepwater wind farms, etc." The subsea power grid has been designed so that power can be delivered from a distant seashore power station through a long-distance undersea power cable or from a vessel above using a combined-cycle power plant. Or, as Alan Owen, Director of the Centre for Understanding Sustainable Practice at Robert Gordon University in Aberdeen, Scotland, says, "Such power could also come from a wave-powered floating buoy generating electricity that would be linked to the power grid below. This could be useful in exploiting marginal fields, and would make an interesting tie-in between oil and gas and renewables." When it comes to subsea wells, the re-

Photo: Siemens

"Energy companies are increasingly looking to deeper waters, off the coasts of North and South America, northern Norway and West Africa."

Einar Fasting, Vice President of Marketing at the Norwegian industry consultancy SINTEF

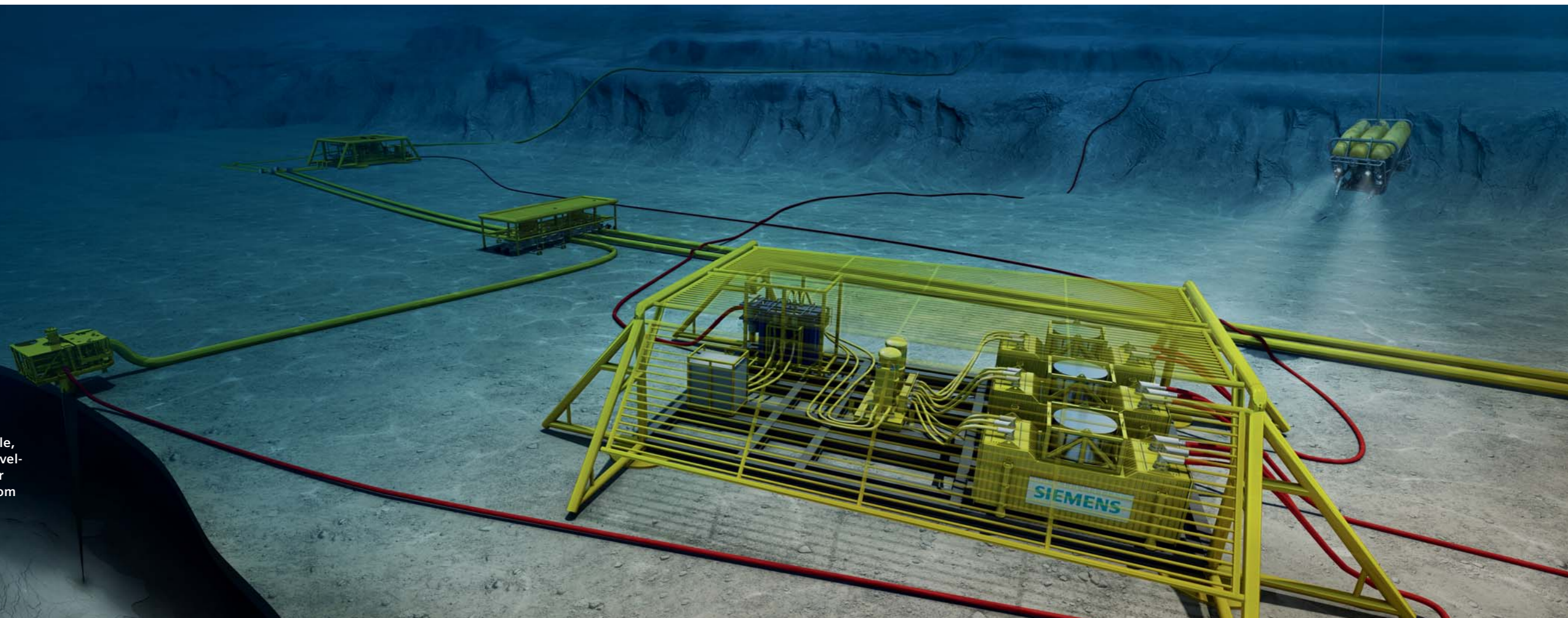
covery gap is another challenge. Subsea wells can be up to 30 percent less productive than surface wells due to the great water pressures and depths involved. The Siemens power grid can act as an enabler in facilitating a reduction of this recovery gap for operators.

The Whole Package

"The Siemens subsea power grid is the first of its kind in supplying power to processing equipment at depths of up to 3,000 meters," says Brath. The package provides the power cables,

transformers, switchgear and variable speed drives to power and control electrical pumps or turbo compressors, separators and other processing equipment that has traditionally been kept on platforms at the surface. "It is a package of our high-quality Siemens components with outstanding MTBF (mean time between failure) values, now tailored for subsea," says Brath. "The customer has a choice of component modules that can be included as part of our subsea power grid. The best way to explain it is that

The subsea power grid: a safe, reliable, environmentally friendly solution developed by Siemens to deliver power for processing oil and gas from the bottom of the world's oceans.



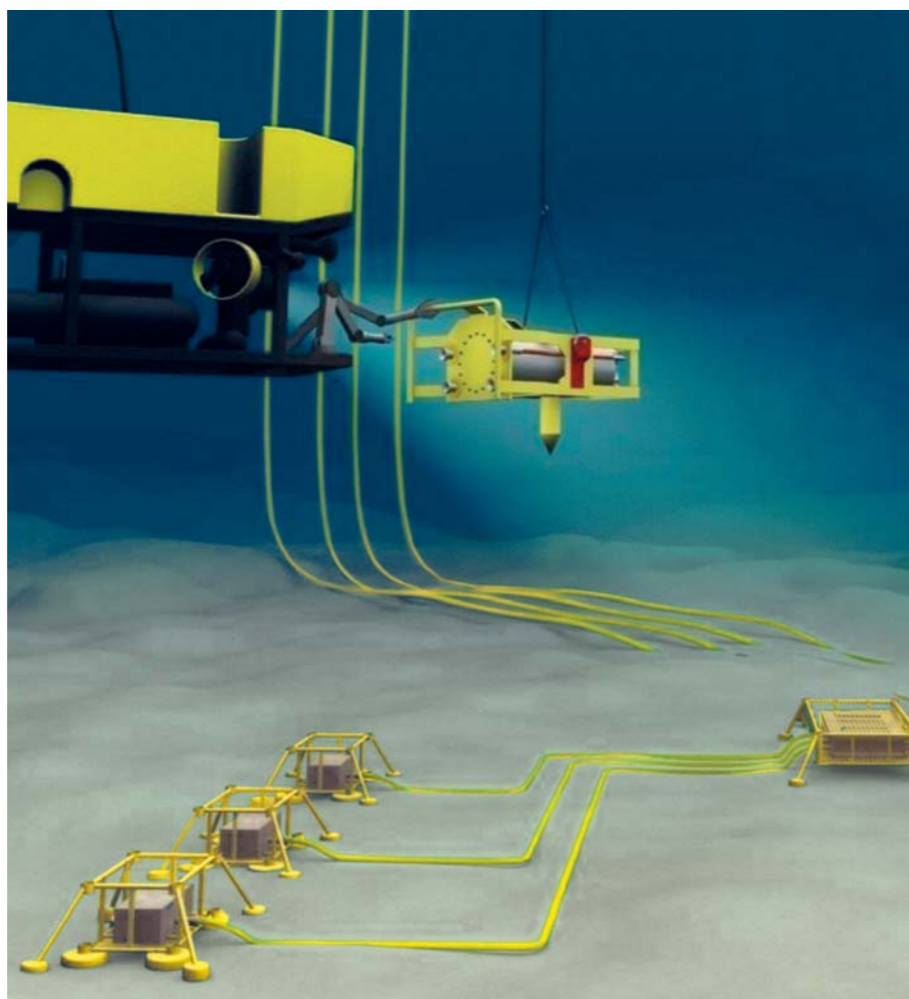
“Such technology should also prove useful in boosting flow rates along long-distance under-sea pipelines.”

Alan Owen, Director of the Centre for Understanding Sustainable Practice, Robert Gordon University, Aberdeen, Scotland

it is like a tray, upon which different units can be placed. However, the various units are modules, with different dedicated functions, that are positioned as required. This tray is piled to the seabed. The components can include equipment for subsea power distribution for oil and gas processing, command and control systems for monitoring equipment, and subsea compression and pumps for boosting the flow of oil and gas along pipelines. The overall design of the subsea power grid framework enables all components to be easily replaced by an ROV.”

The grid’s high-quality components are designed to have an operational life span of some 30 years. They are further designed to be extremely reliable in order to reduce maintenance costs. “Reliability is a very important factor in operators’ purchasing decisions,” says Fasting.

The grid’s subsea control unit includes components for critical applications that require a high level of reliability and availability. It is designed to meet the ever-changing equipment needs of a gas or oil field during its operational life span. It can provide high-speed communication with a distant control center topside. The system uses existing power cables, making dedicated cables unnecessary. The grid has the capability to include components designed to detect gas, monitor sand, and provide



The innovative design of the subsea power grid allows power to be delivered from a distant seashore power station through a long-distance undersea power cable or from a vessel above, using a combined-cycle power plant. Another possibility is a wave-powered floating buoy at the surface – creating a tie-in between oil and gas and renewables.

Subsea Power Grids at a Glance

Siemens – one of the world’s leading suppliers of a complete spectrum of products, services and solutions for the oil and gas industry – is developing a safe, innovative and environmentally friendly power delivery solution known as the subsea power grid. It is designed to help meet current and future challenges in oil and gas exploration and development, including:

- Increase in demand and price for oil and gas
- Countering the depletion of onshore reserves that forces oil and gas companies to tap undersea resources
- Extreme operating environments at depths of up to 3,000 meters
- Finding reliable, safe methods for delivering power for processing oil and gas on the seabed
- Waterproofing equipment and insulating the electrical systems

direct electrical heating for flow assurance along pipelines. Flow assurance is vital at operating depths of 3,000 meters, since oil becomes more difficult to pump at the seabed’s low temperatures. “Such technology should also prove useful in boosting flow rates along long-distance undersea pipelines,” predicts Owen.

Adds Brath: “This equipment is designed to operate at extreme depths, under intense water pressure and low temperatures. Its pressure-compensated design will dramatically lower the weight and increase the robustness of our tailor-made subsea solutions.” A further central feature is Siemens’ proprietary seal-less STC-ECO compressor, driven by an integrated electrical drive.

Solutions for the Future of Energy

Siemens has been a leader in the provision of subsea automation (topside) and communication and control solutions for the past 15 years. During this time, it has delivered more than 15 subsea tie-in projects to operators around the world. In 1998, Siemens began supplying Brazil’s energy giant Petrobras with transformers designed to operate in depths of 1,000 meters for the subsea Carapeba oil field, near Rio de Janeiro. It has supplied Norwe-

gian oil company Statoil with control systems that operate at depths of 350 meters for its Snorre project in the North Sea. In a joint project with Shell, Siemens has developed the STC-ECO compressor, suitable for seabed deployment and dirty-gas applications.

The experts expect demand for subsea projects to continue to grow. Says Owen: “Siemens has created a new market likely to be worth hundreds of millions of euros.” Brath observes that in 2009, the subsea market represented 22 billion US dollars in CAPEX and we expect the subsea processing market to grow rapidly in the years to come. In 2000, there were around 3,000 subsea wells in operation throughout the world, and energy consultants Quest and Infield expect this figure to double by 2015. Fasting adds, “This kind of technology is likely to become a standard part of an operator’s budget in the near future in such locations as the deeper parts of the Gulf of Mexico.”

The timeline? Brath says the subsea power grid should be available from 2012 onwards. In preparation, Siemens is adding new subsea competence centers to the one at Trondheim in Norway – one in Houston, Texas, USA, and the other in Rio de Janeiro. These centers are for training staff,

monitoring equipment, and involving clients in product development and operation.

Many decision makers worldwide will welcome the development of a technological solution aimed at the energy challenges of the future. It is truly fascinating how the fantasy of science fiction writers is being transformed into everyday reality.

Nicholas Newman is a freelance journalist who has written for numerous publications, including Engineering and Technology magazine. He is currently the editor of Oxford Prospect magazine.

Glossary

■ **Subsea Power Grids:** These rugged, integrated grids provide power to seabed processing installations at extreme depths of up to 3,000 meters, making recovery of remote energy reserves more cost-efficient. They combine transmission and control & communication elements on a single frame and can be integrated with surface components.

■ **STC-ECO Compressor:** Motor compressor developed by Siemens for use in subsea gas extraction. Its seal-less design brings improved productivity and a better environmental performance while enhancing plant safety through reduced complexity. Due to its durable design, maintenance intervals can be maximized for increased uptime.

■ **Recovery Gap:** Water pressure at extreme depths limits production capacity compared to surface-based installations. This gap can be reduced using durable, integrated subsea power grids.

For further glossary terms, see: www.siemens.com/energy/living-energy

Further Information

www.siemens.com/energy/subsea-power-grid