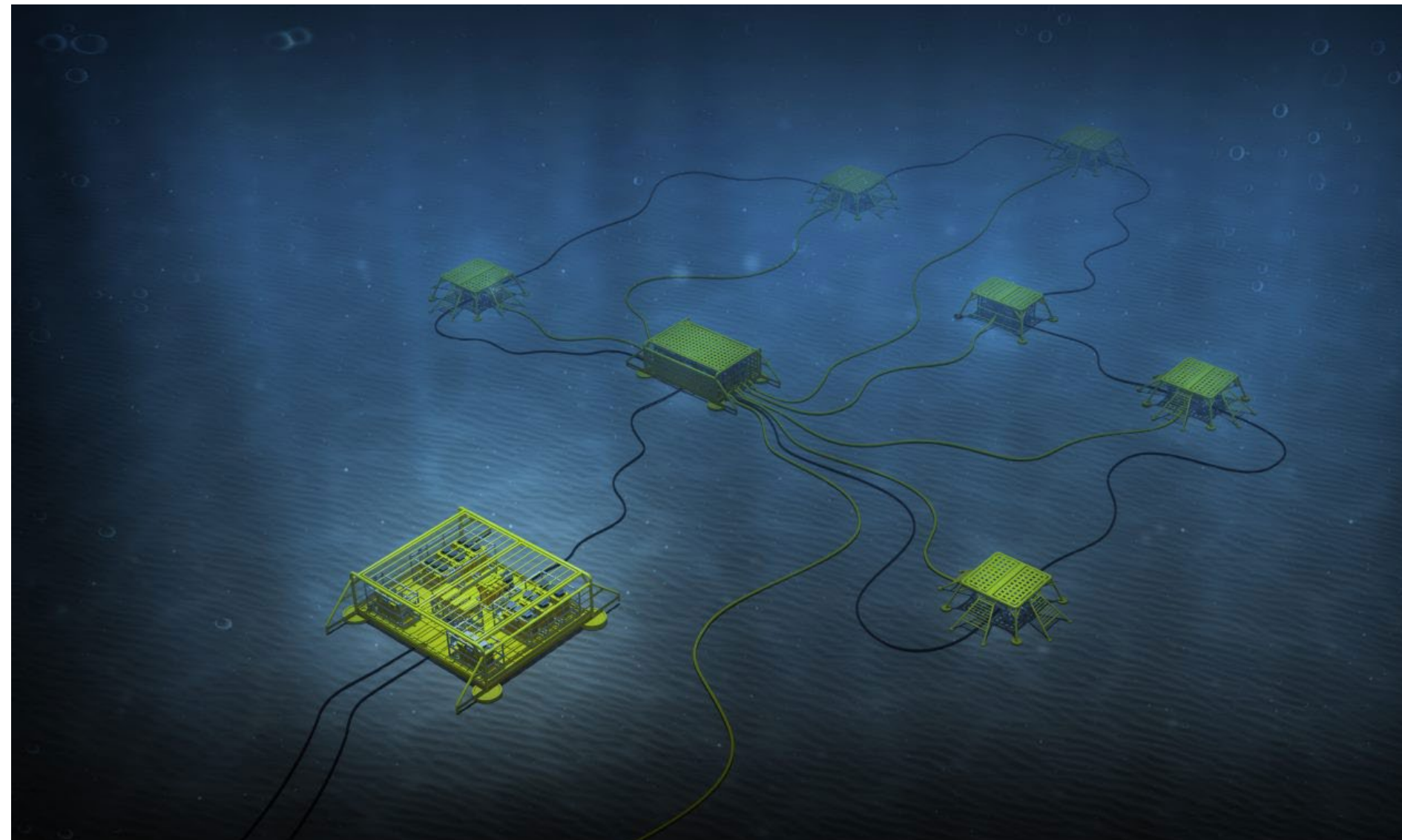

INSUBSEA® Power and Automation

Expanding capacity, extending lifespan
and reducing cost for oil and gas fields

ABB Energy Industries

abb.com/oilandgas



We are making a world of difference by enabling safe, smart and sustainable operations through innovative & integrated solutions that digitalize, automate & electrify the industry. ABB has been a leading innovator in developing the next generation of subsea technologies for our energy customers.

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Challenges facing the offshore sector

“Subsea to market” is a future vision whereby the entire processing plant – production, separation and storage – is relocated to the sea bed, from which oil and gas is piped directly to onshore tanks.

Fully powered and automated subsea oil and gas production facilities, moves platform workers to shore-based control rooms, taking away physical risk, reducing operational and energy costs, cutting marine pollution and simplifying decommissioning.

ABB has more than 50 years of experience in the oil and gas industry and has become an innovative leader in subsea power and automation.

Benefits

- Minimizes capital and operating expenditures through lower project investment and maintenance
- Improves recovery rates
- Extends life of aging assets
- Significantly improves operational safety
- Opens new opportunities to explore longer, deeper and colder fields
- Enables production from remote and smaller fields
- Digital technology that integrates power and automation to provide reliable performance and predict problems before they happen



Pre-studies to front-end engineering and design

Challenge

Today's projects need to be completed on-schedule, on budget and without any risks to personnel or future production.

Solution

With over 30 years' experience in subsea projects, ABB has assembled a team of engineering experts capable of performing a range of consultation services including preliminary project studies through to front-end engineering and design (FEED).

While each customer challenge is bespoke, the ABB team is able to draw on its wealth of know-how to provide a preliminary assessment of the task. ABB offers a pre-study model that ensures its customers' production activities are feasible and profitable in locations that are increasingly further from shore and in ever deeper and colder water.

Once the feasibility work is completed, the FEED study sets out everything that must be accomplished in the execution phase. This is a complete to-do list, including technical requirements, applicable standards, project guidelines, analysis and drawings.

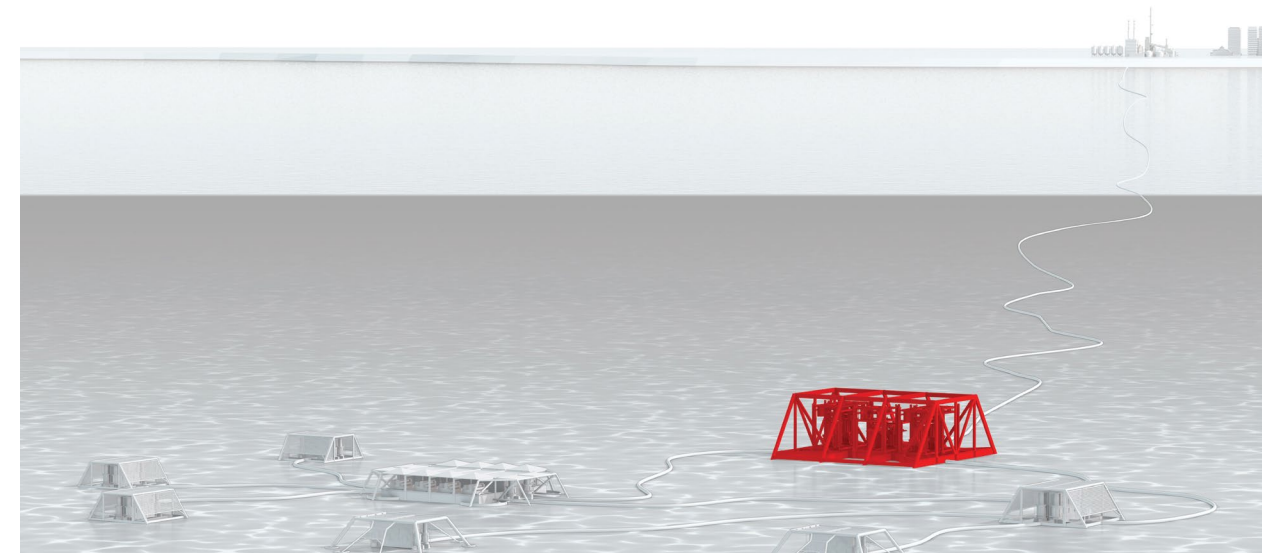
ABB's specialists have a thorough understanding of the power requirements for subsea applications such as boosting and separation, and add high-value expertise to both system and application engineering. Analyzing the system usage under both steady state and dynamic conditions reduces any risks associated with equipment dimensioning.

With electrical system design studies from ABB, offshore operators can be assured that the total subsea electrical system, power network and all components are properly engineered and dimensioned for optimal short- and long-term performance.

ABB's ability to adopt the best approach to a given problem rests on its unrivalled experience of what works in the oil and gas industry. Armed with this knowledge ABB offers a wide range of services in the fields of electrical generation and distribution, automation and optimization, and full range of telecoms and information systems.

Benefits

- ABB can take the lead in the initial planning of the work, or can advise consultants and contractors.
- ABB can help to establish the design criteria, and because it knows the capability of its factories, the company can make sure that everything that is designed can be fulfilled within the time stated.



Subsea power

Challenge

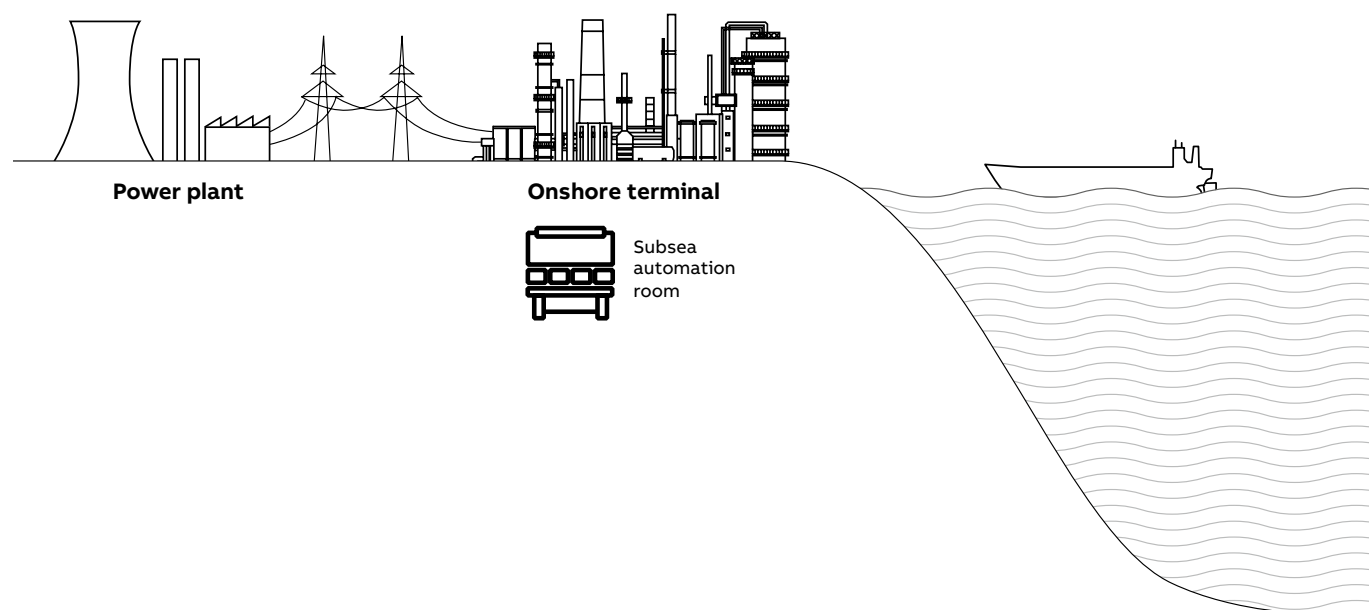
Conventional oil and gas production is based on platforms tied to the seabed or “floaters” that can maintain a fixed position above it. This topside arrangement is potentially a risk to the people who staff it, and it requires a great deal of infrastructure, from the steel or concrete platforms itself to the pipelines and cables for power transmission and distribution. Multiple systems need to be integrated and then operated at the bottom of the sea. At the end of its life, all this must be taken away for disposal on shore.

Solution

ABB is a leading supplier of electrification solutions to the oil and gas industry and offers a range of specialized electric power systems, drives and services for critical, further and deeper water production equipment. The equipment must operate at immense pressures in a highly corrosive environment with little or no maintenance.

Benefits

Supporting this is ABB Ability solutions which enable oil and gas companies to explore deeper resources and increase profitability and reliability of operations through process controls that communicate with, and automate, the equipment operating on the seabed.



Long step-out system

Challenge

Future oil and gas reservoirs are located at increasing distances and depths from shore and reaching them brings high cost and risk, low efficiency and poor reliability.

Solution

ABB's INSUBSEA® long step-out system includes drives for seabed compressors and pumps that can sit up to 150 km away from topside infrastructure. The system is based on ABB's standard frequency converters and specially designed transformers, adapted to meet the stringent requirements of topside or subsea installation.

The systems, which are customized, provide a low-cost solution to brownfield extensions and a cost-effective solution to greenfield developments. Long step-out systems apply to:

- Re-use and upgrade of existing infrastructure
- Tie-in of remote pockets of resources
- Increased production capacity, recovery rates, and tail production
- Shore-to-subsea developments

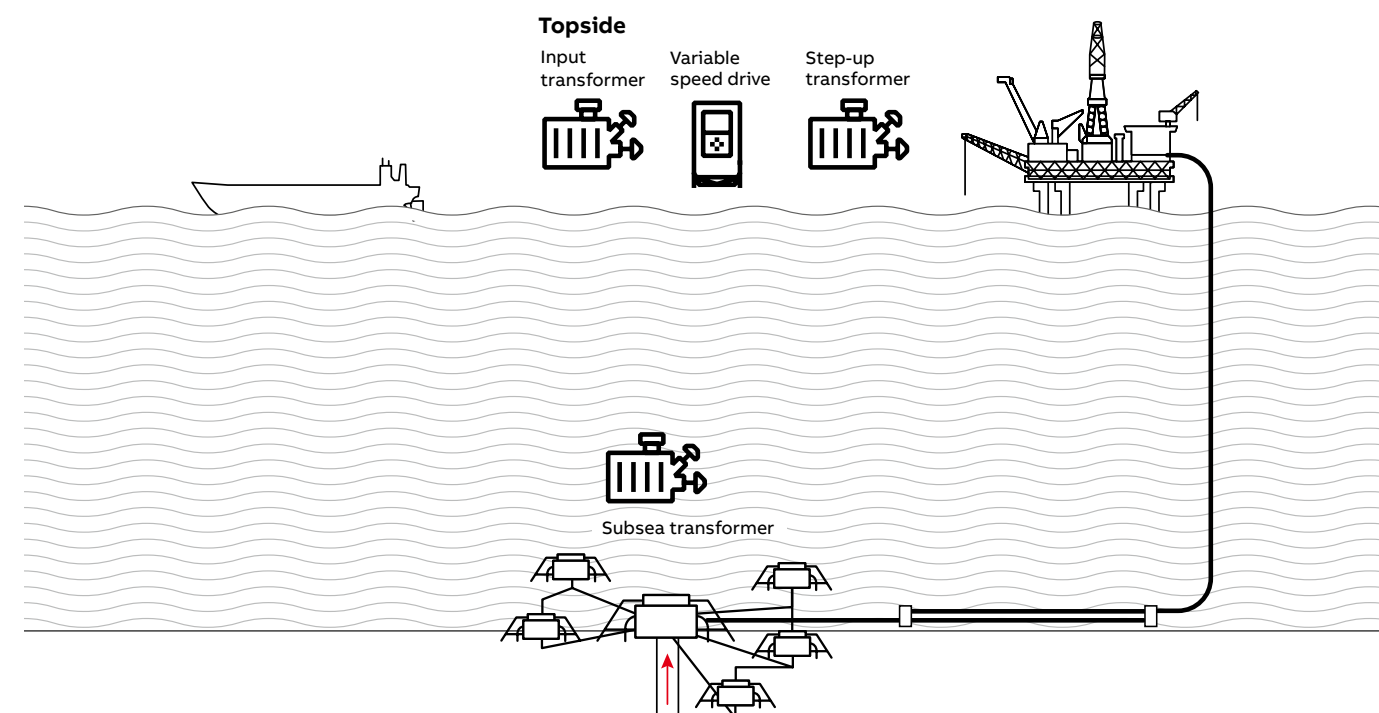
- Subsea processing
- Deepwater developments
- Export applications

Benefits

- Improved cost efficiency
- Increased production and flow assurance
- Minimized risk and environmental impact
- Extended capacity and lifespan of oil and gas fields

Åsgard – new world record from ABB

Åsgard is on the Haltenbanken of Norway in water depths of 240-310 m. Gas and condensate from the Midgard and Mikkell reservoirs are transported through long distance flow lines to the Åsgard B platform. ABB provides the power to the world's first subsea gas compression system. The system will be able to send 15 MVA at 189 Hz over 43 km. That sets a new world record for distance, voltage and frequency between a drive on a floating production facility and seabed compressor.



Direct electrical heating

Challenge

Formation of wax and hydrates occurs at low temperature and high pressure and leads to blocked pipelines. The petroleum industry spends over US\$ 700 million each year to prevent it in wells, pipelines and equipment.

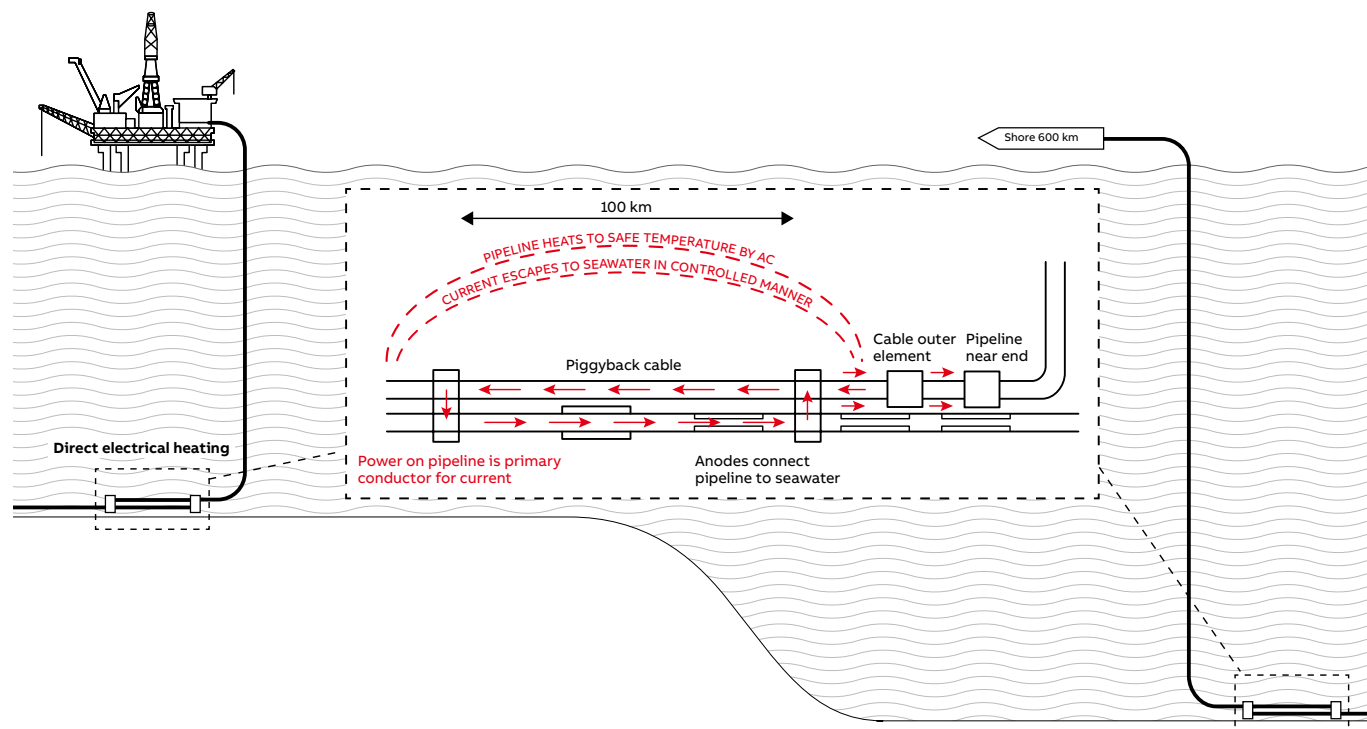
Solution

Direct electrical heating (DEH) system prevents the formation of hydrate and wax in flowlines and pipelines, without the use of chemicals. ABB's INSUBSEA® DEH systems consist of a tailor made topside package installed in the platform's local equipment room (LER), or delivered as a complete module/ containerized solution. The package contains transformer, compensation unit, symmetration unit, control and protection products.

Benefits

- Extends equipment lifetimes
- Shortens site construction schedules
- Increases the cost efficiency and reliability of systems
- Environmentally friendly solution
- Reduces CAPEX by eliminating looped flowlines for dead oil circulation
- Reduces OPEX by lowering chemicals injected into flowline and time required to restart after shutdown

Gulfaks DEH pipeline heating system - ABB provided all electrical and control products, conforming to international standards, from transformer to output cable connection. In addition, ABB is responsible for design and in-house engineering. The system was delivered in 2014.



Subsea power distribution system

Challenge

Operators are already interested in extracting oil and gas in considerably longer and deeper areas than currently achievable. Given the inaccessibility of such environments, life cycles will need to be longer, with lower maintenance and higher reliability. This calls for an electric power supply that works reliably and economically in a subsea environment.

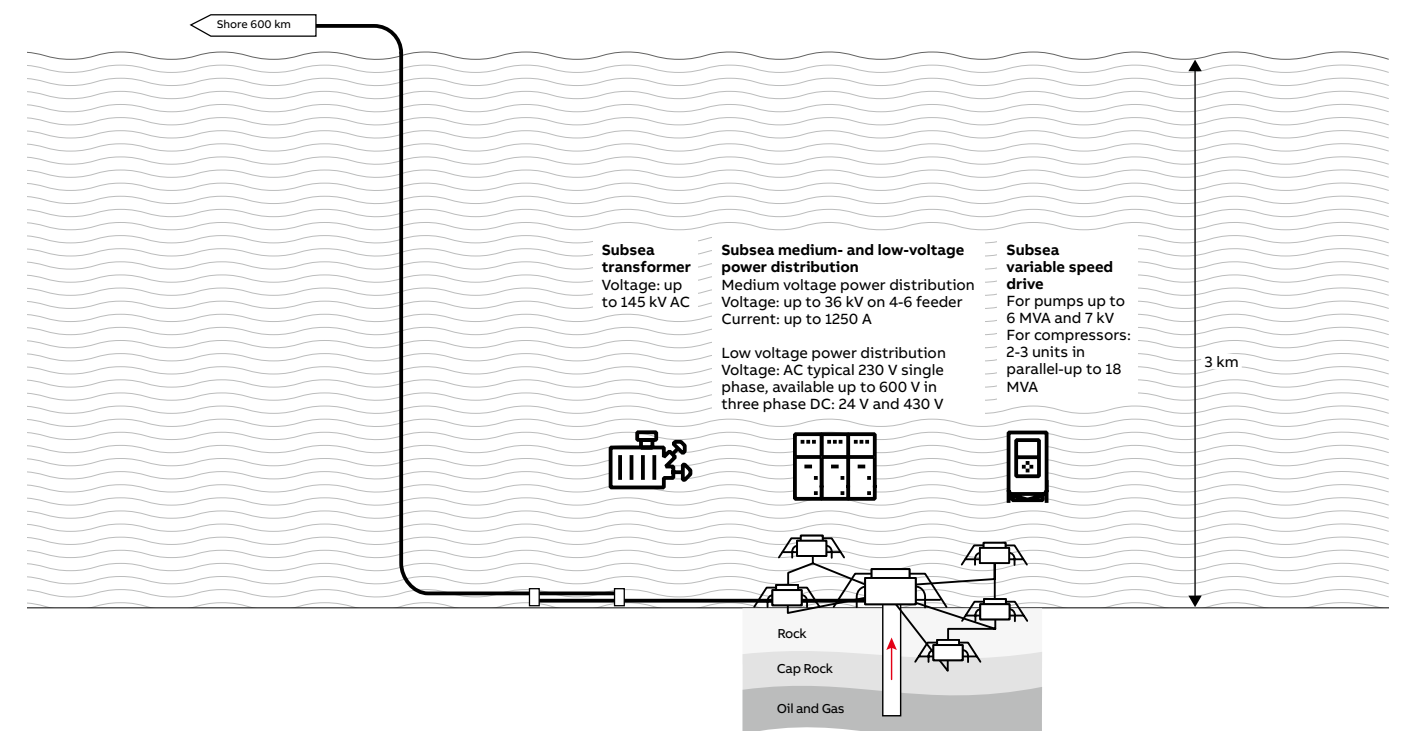
Solution

Today the demand is for subsea electrical power supply system's able to transmit, distribute and control electrical power in the megawatt range. ABB is designing systems that can transmit electrical power to every location requiring energy via a single subsea power cable, as opposed to the present-day use of individual cables to carry power separately to subsea consumers.

ABB's new subsea AC power distribution system will enable up to 100 MW from shore to be transmitted up to 600 km, to power equipment at depths of up to 3,000 m.

Benefits

- Fully automated system can operate for 30 years with little or no maintenance.
- Greater flexibility with respect to the step-out distance from the supply point, the number of consumers, step-wise system extensions, and solutions to fundamental electrical problems involving harmonics and load start-up phenomena.



Subsea automation

Challenge

Subsea automation is complex, partly because machines with different functions from different vendors have to be integrated into a single system and partly because more functionality is being relocated to the seabed.

One of the obvious problems posed by working in deep water is that the equipment is inaccessible. This puts a premium on the systems that tell an operator what is going on 3 km below their feet, and allow them to detect and correct problems before they interrupt the production process.

Solution

ABB supplies ultra-high-speed controllers for demanding subsea applications through to highly flexible human-machine interface (HMI) solutions for seamless integration to topside control systems.

Its System 800xA distributed control system integrates subsea and topside equipment and allows engineers to run their entire operation

from one screen. It also enables remote communication and monitoring and control operations for subsea factories. Engineers can manage entire operations from a modern onshore control room that may be some 600 km away.

To keep pace with these developments, ABB is continuously refining its technology. For example, previously the trend was to separate distributed (DCS) and master control systems (MCS). As the industry matures, operators are moving to a more cost-efficient integrated version, and although ABB still delivers DCS, MCS and standalone systems, the company is increasingly developing its products to meet that need. And, to solve the interoperability problem posed by different IT protocols, ABB remains active in MDIS (The MCS-DCS Interface Standardization network) – a group that is working towards standardized and streamlined interfaces.

Benefits

- Optimizes plant performance
- Reduces risks out of sight of the control room
- Minimizes downtime



Going the distance Subsea Power System Joint Industry Project (JIP)

“Moving the entire oil and gas production facility to the seabed is no longer a dream. Remotely operated, increasingly autonomous, subsea facilities powered by lower carbon energy are more likely to become a reality as we transition towards a new energy future,” Dr. Peter Terwiesch, President of ABB Process Automation



Powering the seabed for a new energy future

In 2019, ABB rapidly changed the offshore oil and gas industry by proving its world-first subsea power distribution and conversion technology system. The progress was possible through the \$100 million research, design and development joint industry program (JIP) with prominent energy companies Equinor, Total and Chevron. The groundbreaking subsea technology makes oil and

gas production feasible at depths of 3000 meters and distances of up to 600 kilometers. There is potential for substantial energy savings with reduced carbon emissions using power from shore and integration with renewable energy sources. This innovation is part of the transition to a safe, smart and sustainable energy future.

Global references

					Direct Electrical Heating	Engineering	Integration & Interface	Medium - voltage Switchgear	Project execution	Service	Subsea automation & control	Subsea transformer	Topside control	Topside system	Topside transformer	Variable speed drive
Year	Project name	Owner/operator	EPC/Client	Location												
Ongoing	Johan Castberg FEED	Statoil		Norway												•
Ongoing	Sleipner Utgard Study	Statoil	One Subsea	Norway												•
2016	Sleipner Sigyn Upgrade	Statoil	FMC Technologies	Norway												•
2015	Gulfaks Rimfaksdalen	Statoil	FMC Technologies	Norway												•
2015	Snøhvit Extension	Statoil	GE	Norway												•
2015	Draugen Extension	Shell	FMC Technologies	Norway												•
2015	Aasta Hansteen	Statoil	Aker Solutions	Norway												•
2014	Svalin	Statoil	Aker Solutions	Norway												•
2013/2014	Gulfaks Sør Olje	Statoil	FMC Technologies	Norway						•						•
2013	Knarr	British Gas	FMC Technologies	Norway												•
2012/2013	Goodwyn	Woodside Australia	FMC Technologies	Australia							•					•
	Ormen Lange Mid North Development	Shell	FMC Technologies	Norway												
2012	Gulfaks	Statoil	Framo Eng	Norway	•	•		•			•	•				
2011/2012	Visund Sør	Statoil	FMC Tehcnologies	Norway							•	•				
2009/2012	Ekofisk Victor Alfa-Bravo	ConocoPhilips Norway	FMC Tehcnologies	Norway						•	•	•				
2011	Goliat	ENI Norway	Aker Solutions	Norway							•	•				•
2011	Åsgard	Statoil	Aker Sotutions	Norway	•			•	•	•	•	•	•			•
2011	Tordis Upgrade	Statoil	Vetco Gray	Norway							•	•				
2010/2011	Jack St.Malo	Chevron	Aker Solutions	US Gulf of Mexico							•	•				
2009/2010	Kitan	ENI Australia	FMC Technologies	Australia							•	•				
2010	Tordis New TCU	Statoil	GE Vetco Grey	Norway												•
2009	Ekofisk Viktor A	ConocoPhillips no	FMC Technologies	Norway												•
2008	Åsgard / Kårstø K-lab	Statoil		Norway	•			•								
	Ormen Lange Compression Pilot	Statoil	Aker Subsea Ltd	Norway												
2008	Ormen Lange Southern Field Development	Shell	FMC Technologies	Norway												•
2007	Tordis IOR	Statoil	FMC Technologies	Norway							•	•				
2007	Rev/Armada	British Gas UK	FMC Technologies	UK							•	•				
2007	Vincenet	Woodside Australia	FMC Technologies	Australia							•	•				
2007	Blane	BP Norway	Aker Solutions	Norway							•					
2007	Blane / Ula	BP Norway	Aker Solutions	Norway												•
2006/2009	Tyrihans	Statoil	Aker Solutions	Norway	•			•			•	•				•
2006	Skifaks/Rimfaks	Statoil	FMC Technologies	Norway							•	•				
2005/2014	Snøhvit	Statoil	Vetco Gray	Norway							•	•	•			
	Ormen Lange	Shell	Aker Solutions, FMC Technologies	Norway	•	•			•	•	•	•	•	•		
2003	Sleipner Vest Alfa Nord	Statoil	FMC Technologies	Norway												•
2003	Judy Joanne	ConocoPhillips UK	FMC Technologies	UK												•

					Direct Electrical Heating	Engineering	Integration & Interface	Medium - voltage Switchgear	Project execution	Service	Subsea automation & control	Subsea transformer	Topside control	Topside system	Topside transformer	Variable speed drive
Year	Project name	Owner/operator	EPC/Client	Location												
2003	Skirne Byggve	TotalFinaElf /Hydro	FMC Technologies	Norway												•
2003	Ceiba full field	Amerada Hess	Framo	Africa	•							•				
2003	Judy Joanne	ConocoPhilips UK	FMC Technologies	UK							•	•				
2003	Sleipner West	Statoil	FMC Technologies	Norway							•	•	•			
2002	Na-Kika	Shell	Framo	Gulf of Mexico								•				
2002	Ceiba C3/C4	Amerada Hess	Framo	Africa	•							•				
	SCRAMS Implementation															
2001	Gulfaks	Statoil	Kongsberg Offshore	Norway												•
2001	Heimdal Vale subsea	Norsk Hydro	FMC Technologies	Norway												•
2000	Terra Nova	Petro Canada	Terra Nova	Norway												•
2000	Ringhorn /Balder	Esso	Ringhorn /Balder	Norway							•					•
1999	Gulfaks Phase 2	Statoil	Kongsberg Offshore	Norway												•
1999	Girassol	TotalFinaElf	Kongsberg Offshore	Angola												•
1999	Troll Pilot	Troll Pilot	Vetco Grap	Norway	•	•		•								•
1988	Topacio	ExxonMobil	Framo	Equatorial Guinea	•							•				
	Gulfaks SCRAMS Development															
1998	Gulfaks SCRAMS Development	Statoil	Kongsberg Offshore	Norway												•
1998	Troll Pilot	Statoil	ABB Offshore Systems	Norway												•
1998	Tordis Extension 2	Hydro	ABB Offshore Systems	Norway												•
1998	Bouri	Saga	Kongsberg Offshore	Libya												•
1998	Djambala Sounda	Agip	Kongsberg Offshore	Africa												•
1997	Gulfaks Sør /Rimfaks	Statoil	Kongsberg Offshore	Norway												•
1996	Tordis East	Saga	Seatec Ltd	Norway												•
1996	Balder	Esso	Seatec Ltd	Norway												•
1994	Tordis Subsea	Saga	FSSL Ltd Offshore	Norway												•
1992	Sleipner A Subsea	Statoil	Kongsberg Offshore	Norway												•
1991	Draugen Subsea	Shell	Kongsberg Offshore	Norway												•
1991	Draugen	Shell		Norway	•			•						•	•	
1989	Oseberg C subsea	Hydro	FSSL Ltd	Norway												•
1988	TOGI Electronic Test Unit	Hydro	Aker Hughes	Norway												•
1986	Tommeliten	Statoil	Hughes Offshore	Norway												•

Expand the capacity, extend the lifespan and reduce the cost for your oil and gas fields: ABB's INSUBSEA® technology takes you deeper, longer and colder.