Subsea Electrification Solutions

ABB is a leading supplier of electrification solutions to the Oil & Gas industry and offers a range of specialized electric power systems, drives and services for critical subsea production equipment.
Stimulating subsea oil and gas reservoirs effectively through boosting, injection and compression is critical for achieving stable production and extending the feasibility of the field. For reservoirs with long step-out distances, powering the subsea equipment that performs these functions is no easy task, and requires electrical equipment that is powerful, rugged and reliable.

Producing oil and gas from reservoirs located at long distances from land is a costly proposition that presents many challenges to offshore operators. Going subsea with long reach from shore or remote platform can be a very cost-efficient solution as it may eliminate the need for a fixed or floating topside installation. To help operators achieve efficient electric power supply and control at long step-out distances, ABB offers a product portfolio of highly developed electrical products and associated services tailored for subsea production applications.

Produced and backed by ABB

ABB subsea solutions are based on our standard frequency converters and special designed transformers, adapted to meet the stringent requirements of topside or subsea installation. All ABB subsea equipment is backed by the resources of our global product support organization as well as our dedicated subsea electrification specialists.

Innovative subsea solutions

ABB is an innovator in subsea electrical solutions and has been involved in the development of subsea electrical equipment for many years. Feasibility studies on subsea components began in 1984 and the first commercial subsea transformer was delivered in 1998. Since then, ABB has delivered variable speed drive systems and transformers to some of the largest and most advanced offshore developments in the world.

A highly qualified supply partner

With long experience and in-depth expertise, ABB is a valuable resource to our customers. We offer solutions ranging from straightforward equipment supply to full project management of the total subsea electrification network - from fixed or floating production units to subsea pipelines, wellheads or even downhole. With each ABB delivery, our customers gain a highly qualified service and support partner to ensure that our products perform to our customers’ expectations throughout the lifecycle of the field.

ABB works continuously to develop new solutions that will allow for subsea operations in deeper waters and at further distances from land or topside facilities than ever before.
For subsea electrical consumption applications, ABB provides topside variable speed drives and transformers designed to extend step-out distances and reduce subsea cabling. Well proven ABB topside electrification systems ensure reliable, efficient power supply to subsea power consumers and provide substantial cost savings by reducing subsea component and cabling requirements.

**Topside Variable Speed Drives**

Based on the market-leading ABB ACS800/1000/5000 AC drive series, topside drive systems are air or liquid-cooled and feature high robustness in a compact size. Depending on load characteristics, the topside drive system provides a step-out distance of up to 47 kilometers. All components are tested, qualified and meet international standards and marine classification requirements. Typical selection of frequency converters includes:

- ACS800 LV drive for load up to 2 MVA with 14 km reach-out distance, 11kV transmission voltage
- ACS1000 MV drive for 2-4 MVA load, 31 km reach-out distance, 25kV transmission voltage
- ACS5000 MV drive for 8 MVA load, 47 km reach-out distance, 36-52 kV transmission voltage

**Topside Transformer**

The input transformer can be for 6, 12 or 24 pulse converter input. The step-up transformer is tuned for optimal voltage in the umbilical. The special developed topside transformer from ABB is combining input and step-up transformer into one single tank. It is of a high temperature design. This gives a significant reduction of weight and volume compared to ordinary transformer solutions. It can be delivered with an integrated earth fault monitoring system for the umbilical. The transformer can be delivered with Ex certificate.

**Subsea Transformers**

Subsea transformers from ABB are engineered to provide great performance and cost benefits for offshore developments that have subsea rotating equipment located at long distances from the power supply point. For subsea installations where increased voltage is required, ABB subsea transformers provide all the power needed in a safe and reliable manner.
Subsea electrical applications with long step-out distances are susceptible to problems such as harmonic distortion and voltage drops, which can result in inadequate performance or even failure of the electrical equipment. To minimize these risks, ABB provides advanced modeling and simulation of the complete subsea electrical system and all components.

Dynamic simulation of subsea electrification systems identifies and simulates conditions that may have an adverse effect on the performance of the equipment, and determines the most efficient way to counteract these situations before they occur. By increasing system performance and availability under all conditions, simulation and analysis of the subsea electrical system can contribute significantly to more stable operations and increased production.

**System Design Studies**

**Project facts:**
- **Field Operator:** StatoilHydro
- **Application:** Subsea Raw Sea Water Injection
- **Tie-in distance:** 31 km
- **Host platform:** Kristin

**ABB Supply:**
- Combined topside transformers
- Subsea transformers
- ACS1000 topside frequency converter
- Application Control Software
- System Studies
  - Design basis for study
  - Time domain simulations
  - Breakaway torque calculations
  - Load flow calculations
  - Fault analysis
  - THD calculations

**Steady state calculations**
- Fundamental load-flow of each system component
- Voltage drop within the system in steady state for a defined load condition
- System impedance curve
- Transfer function of motor voltage/converter voltage
- Flux correction factor

**Start-up calculations**
- Calculate boost factor for motor, subsea transformer and step-up transformer for defined breakaway torque
- Verify start current
- Verify that the specified breakaway torque is achieved during start-up

**Calculation results**
- Voltages and currents at different points in the system
- Harmonic analysis of voltages at different points in the system
- Transformer flux at start-up

**Dynamic Simulations**
- Verify that the specified breakaway torque is achieved during start-up
- Voltage stresses at the various points in the system (peak voltage values)
- Dynamic performance with respect to voltage drops and variations

**Project Profile**

**Åsgard Minimum Flow Project - “Subsea Gas Compression”**

ABB is proud to be a part of the world’s first full-scale subsea compression test at StatoilHydro’s Kårsto Laboratory (K-Lab) at the Kårsto gas processing plant in western Norway. For the Åsgard Minimum Flow Project, ABB has submitted subsea electrical equipment for full scale testing, analysis and qualification for a subsea compression application to boost gas production from the Midgard and Mikkal area. Project parameters include a tie-in distance of 47 km, an 8MVA compressor and a 200 Hz motor.