Offshore power

With HVDC Light® ABB offers the offshore industry an alternative way to provide electrical power to platforms

MATS HYTTINEN – Traditionally, offshore platforms generate their own electricity by burning fossil fuels to run onboard gas turbines and/or diesel-powered generating units. This inefficient method has come under increasing scrutiny and criticism because it creates substantial greenhouse gas emissions, particularly CO_2; consumes large amounts of fuel; and adversely impacts the health and safety of platform workers. Some regions also put a high tax on CO_2 emissions, adding to the steep operating costs of platform generating systems. ABB's HVDC Light is a proven technology providing more efficient power from shore for customers who need reliable power in remote places. As the offshore industry searches for alternative ways to provide platforms with electrical energy, ABB is ready with a solution.

1 The Troll A was the first HVDC Light transmission system installed in an offshore platform.

ABB's HVCD Light is a robust transmission system with a long life cycle that reduces operating and maintenance costs. Such a power-from-shore system helps make the platform a safer, cleaner place to live and work by lowering greenhouse gas (GHG) emissions, risk of fire and explosions on the platform, and noise and vibrations, while maintaining the highest standards of reliability and availability.

Ensuring high availability and lower costs

The offshore industry's main requirement of any power supply solution is high availability, since an emergency shutdown means loss of production capacity and income.

An HVDC Light installation typically has 99 percent availability per year, taking into account both scheduled and forced outages. The lifetime is on average 30 to 40 years, which is higher than a local generation solution. Efficiency rates vary depending on the transmission distance and cable type. With an HVDC Light transmission system there is often more than a 90 percent efficiency rate, compared with the typical range of 15 to 25 percent for a local generation unit.

Coupled with the requirement of high availability is the cost-effectiveness of the transmission system. Each potential user of HVDC Light for offshore power is unique in terms of power rating, distance from the platform to the mainland, sea depth, etc. Initially the cost to install generation on the platform can be lower than the cost to install a power-from-shore system, especially when power ratings are low, the sea route is deep and the distance from the mainland is long. However, by using an electricity supply from the mainland weight and volume on the platform are greatly reduced, enabling significant savings in the long term. A small and compact HVDC Light solution may also enable a complete onshore assembly, with shorter installation and commissioning time, thus further reducing costs.

In terms of operating costs power-from-shore alternatives require less maintenance and shorter maintenance shutdowns. Power-from-shore solutions produce no emissions, so an emissions tax is not paid.

From a health and safety perspective, power-from-shore eliminates all hazards associated with gas-fired rotating equipment operating in the vicinity of platform workers. The reduced risk of a fire or explosion, as well as decreased noise levels and vibrations, are also important workplace improvements.

Technical background

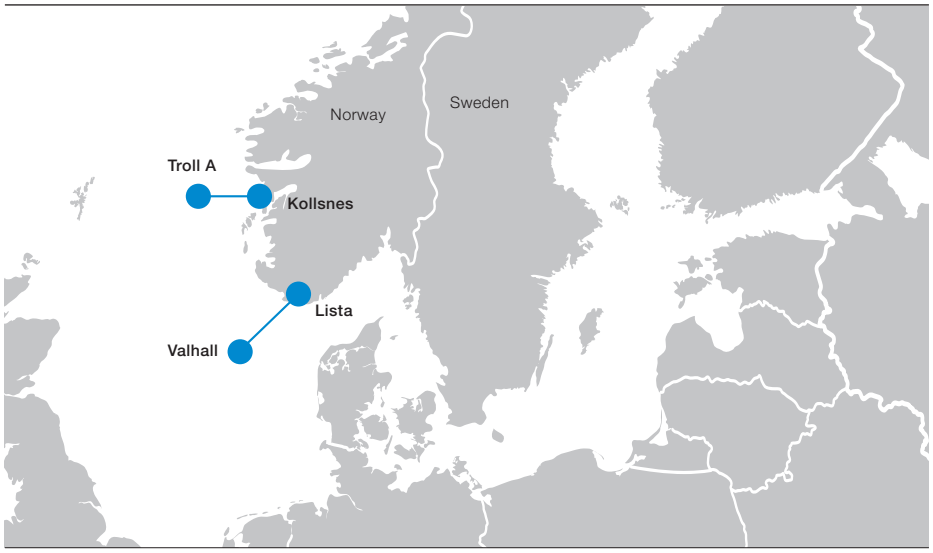
Initially power-from-shore solutions were limited to AC cable systems over short distances (50 to 100 km), or conventional line-commutated HVDC systems. The introduction of HVDC Light with voltage source converter (VSC) technology in the late 1990s opened up the market segment, because VSC technology enables a cost-effective supply of large amounts of power over long distances using robust, lightweight, oil-free cables. Beyond 50 to 100 km, HVDC Light is the only technically feasible solution.

HVDC Light does not need any short-circuit power to operate, which makes it an ideal technology to start up and energize offshore platforms and allows for fully independent control of both active and reactive power. The technology ensures smooth energization and startup, and precise control of the platform's power system.

During a black start, active and reactive power is automatically adjusted according to the ongoing power need of the platform. The HVDC Light link will balance the load generation automatically as new loads are connected, instantly changing the transmitted power according to the size of the load.

Title picture
Valhall HVDC Light field platforms

2 Troll A and Valhall transmission links



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The optimum balance between the size of the platform module, equipment cost, engineering work and risks must be evaluated in each specific installation. Specific arrangements and optimizations of the main circuit equipment may be necessary to achieve desired compactness.

In addition, the system design must ensure that maintenance activities have an absolute minimum effect on system operation. With HVDC Light, maintenance time – especially work that requires interrupting the power transmission – can be minimized by exchanging whole modules or components, instead of repairing them, and by introducing redundant systems whenever technically or economically justified.

Troll A

The Troll A precompression project delivered to Statoil in the North Sea and commissioned by ABB in 2005 was the first HVDC Light transmission system ever installed in an offshore platform ➔ 1. It is located in the Troll oil and gas field about 65 km west of Kollsnes, near Bergen, Norway ➔ 2. This field contains almost 40 percent of total gas reserves on the Norwegian continental shelf, and is the cornerstone of Norway's offshore gas production.

The groundbreaking solution delivers two independent systems, each producing 42 MW of power from the Norwegian mainland to power a high-voltage variable-speed synchronous machine installed on the platform to drive compressors that maintain gas delivery pressure, compensating for falling reservoir pressure.

The system eliminates GHG emissions from the Troll A platform. ABB's HVDC Light solution was selected because of its positive environmental effects, the long cable distance under water and the compactness of the converter achieved on the platform.

The electrical drive system that Statoil and ABB developed has met all performance expectations. The ABB motorformers – a very-high-voltage motor and generator – installed on a platform compressor skid have performed well and operate at lower than expected vibration levels.

In 2011, ABB was awarded a second power-from-shore contract from Statoil for the Troll A platform, this time to provide 100 MW to power two additional compressor drive systems. This HVDC Light transmission system is scheduled to go into operation in 2015.

Valhall

The Valhall HVDC Light power-from-shore transmission system was commissioned in October 2011 to replace gas turbines on British Petroleum's (BP) linked multiplatform complex in the North Sea, about 294 km from the Norwegian mainland ➔ 2. The Valhall HVDC Light system is capable of delivering 78 MW to run the offshore oil-and-gas field facilities, though most customers need only roughly half the power.

The project is part of a redevelopment scheme to increase production at the 30-year-old complex and equip it for another 40 years of service. Improvements include a new production and hotel platform that require more electric power than is currently available. ABB is responsible for the system engineering and the design, and is supplying the HVDC Light system.

According to BP the benefits gained from using ABB's HVDC Light power-from-shore technology, as opposed to conventional gas-turbine generators, are considerable. Operating and maintenance costs have been significantly lowered. Each year 300,000 t of CO_2 and 250 t of NO_X emissions have been eliminated. Working conditions have improved and no emissions tax is applied. Maintenance is minimal, simple, remote and safe, which reduces the need for the constant presence of offshore crews.

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