Background

Innovative HVDC technology for energy efficiency and grid reliability

High-voltage direct current (HVDC) is a technology developed by ABB more than 50 years ago to increase the efficiency of power transmission over long distances and improve voltage stability in electricity networks.

HVDC is the most energy-efficient technology available for long-distance bulk power transmission, losing less electricity than conventional alternating current (AC) transmission systems. About 5 percent of the electricity will be lost over a distance of 1,500 kilometers (930 miles) when using an 800 kilovolt (kV) DC line to carry 6 gigawatts (GW). The losses climb to 6 percent with 500 kV DC and about 7 percent with conventional 800 kV AC lines.

Another major advantage of HVDC technology is that it can connect incompatible AC power networks and increase the efficiency and stability of each. HVDC stations convert electricity from AC to DC and then back to AC again, and allow the electricity to flow in both directions so that demand and supply are matched more effectively.

HVDC has negligible electromagnetic fields and requires fewer transmission lines, so less land has to be cleared. Because special equipment is needed to convert electricity from alternating current to direct current, HVDC is cheaper over long distances, typically more than 600 kilometers for overhead lines and more than 50 km for underwater cables.

HVDC Light

ABB has led the development of HVDC since it delivered the first installation in 1954 to carry power between the Swedish mainland and the island of Gotland. A further milestone was achieved in the 1990s with the development of HVDC Light, the technology used in Estlink.

HVDC Light is a new generation of HVDC technology currently offered in lower power ranges (10 – 1,100 megawatts (MW), compared to HVDC systems at 300 - 5,000 MW). The technology offers the same benefits as traditional HVDC and in addition provides more secure power control and quick power restoration in the event of a blackout. It can compensate for fluctuations in power levels,

making it ideal technology for stabilizing irregular electricity flows, such as those generated by wind farms, which can potentially disrupt power networks.

HVDC Light is environmentally friendly, featuring oil-free cables, compact converter stations and cables that can be laid underground as well as underwater. It is the only technology available that allows long-distance underground high-voltage transmission.

HVDC Light is used in the world's longest underground high-voltage interconnection, running 177 kilometers between the Australian states of Victoria and South Australia.

Underground cable was chosen instead of overhead transmission lines to reduce visual and environmental impact, and to protect against Australia's traditional causes of power outages such as lightning, wildlife or bush fires. The Murraylink cable was buried at minimal impact to the environment by plowing a trench in which the power line was laid (see picture).

Other benchmark ABB installations using HVDC Light include the Cross Sound Cable, linking Connecticut and Long Island, which was used to help restore power to the region following the 2003 blackout in the northeastern U.S. ABB in 2005 delivered the world's first HVDC Light link to an offshore platform, helping Norway's Statoil eliminate about 230,000 tons of carbon dioxide emissions annually from its Troll A gas platform.

Leading supplier

ABB has supplied more than half of the HVDC converter stations in the world and has more than 50 HVDC projects commissioned or under construction around the globe. ABB's achievements include the highest voltage in the world (Itaipu, Brazil) at 600 kV; the highest single converter station power rating (Guangdong, China) at 3,000 MW; and the world's longest underground cable (Murraylink, Australia).

The company is on track to complete the 580-kilometer NorNed connection between the grids of Norway and the Netherlands next year, setting a record for the longest underwater power link. It will enable a more efficient use of renewable sources of energy and help save an estimated 1.7 million tons of carbon dioxide emissions every year.

In the Baltic region, there are already a large number of ABB-built HVDC interconnections. They include links between Sweden and Denmark; Norway and Denmark; Sweden and Germany; Denmark and Germany; Sweden, Poland and Germany; and Sweden and Finland.

HVDC Light pictures are available on ABB's Web site news center (www.abb.com/news)