60 years of HVDC

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Dear Reader,

This year, we celebrate the 60th anniversary of the first commercial subsea high-voltage direct current (HVDC) power transmission link – a groundbreaking project that used mercury-arc converters and mass-impregnated high-voltage cables to bring electricity from mainland Sweden to the island of Gotland in the Baltic Sea. Over the course of 25 years, Dr. Uno Lamm and his team at ASEA had researched previously unexplored fields to overcome the challenges of HVDC transmission – work that culminated in the commissioning of the Gotland link in 1954. Since then, more than 170 HVDC projects have been installed around the world, bringing bulk power from distant locations to where it is needed.

HVDC is the technology of choice for transmitting power efficiently and reliably over long distances. It is ideally suited for integrating renewable energy sources situated in remote and challenging locations. The benefits of reliable, long-distance transmission with minimum losses, combined with features like the ability to connect unsynchronized power grids, have opened new opportunities for this versatile technology.

Classic HVDC power transmission technology has come a long way: from the first 20 MW, 100 kV transmission in Gotland to ultrahigh-voltage DC links like the 800 kV Hami-Zhengzhou transmission link in China, with a capacity of 8,000 MW. As part of this ongoing journey, ABB has developed new technologies – eg, line-commutated converters using thyristor-based HVDC valves (up to 1,100 kV) that make low-loss DC power transmission of 10 GW over distances up to 3,000 km viable.

A major advance came in the late 1990s, when ABB introduced HVDC Light. With well over a dozen projects completed, this technology is being successfully deployed in an increasing number of applications, thanks to the parallel development of higher converter voltage and power ratings, IBGT-based semiconductors, and extruded cables with solid polymer insulation. By embedding HVDC Light functionalities into an AC network, voltage support, reactive power compensation, black start, and the performance of existing grid assets can be reinforced.

HVDC connections are currently point-to-point, so a logical next step is to network them. This will optimize network reliability as well as enable balancing of loads, integration of intermittent renewables, lowering of transmission losses and energy trading across borders. The missing link here has always been a low-loss HVDC breaker that acts fast enough to interrupt current and isolate faults. ABB has now developed a solution for this century-old challenge.

Today, ABB remains the market leader in HVDC, with more than half the global installed base and the unique distinction of being the only company in the world with in-house manufacturing of key components like converters, cables and semiconductors, as well as switchgear, transformers and products along the entire power value chain. This special edition of *ABB Review* showcases how ABB keeps its HVDC pioneering heritage alive by remaining at the forefront of this technology and continuing to shape the grid of the future.

Join us on this journey. Happy reading!

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