

Skagerrak

Interconnecting grids, Upgrade



An excellent example of the benefits that can be achieved through interconnections.

The Skagerrak HVDC transmission system comprises several HVDC links which together provide a total of 1,640 MW transmission capacity between Kristiansand in southern Norway and Tjele on Denmark's Jutland peninsula. The link is owned by Statnett in Norway, and Energinet.dk in Denmark.

Skagerrak 1&2 rated 500 MW was commissioned in 1976-77 and Skagerrak 3, rated 440 MW, became operational in 1993. The latest Skagerrak project was awarded to ABB in 2011, and comprises a fourth link using HVDC Light technology which will operate in a bipole mode together with the Skagerrak 3 HVDC Classic link and a control system upgrade of the latter. This is the first time an HVDC Classic and an HVDC Light link will be tied together in such a bipole configuration. This is possible because of ABB's advanced MACH control system, which was also used for a Skagerrak 1-2 upgrade in 2007.

The new link will boost transmission capacity between the mainly hydroelectric-based Norwegian system and the wind and thermal power-based Danish system by an additional 700 MW with a voltage rating of 500 kV. It will enable both networks to add more renewable energy to their energy mix, and to use electricity more efficiently.

The system will help overcome distance and grid constraints while ensuring robust performance, power quality and minimal electrical losses. In the rare case of a power system outage, the technology's 'black-start' capability allows for a fast network restoration using power from the other end of the link. These factors were essential in the selection of the HVDC Light technology for the fourth Skagerrak HVDC link.



Main data:

Commissioning year:	Pole 4 and upgrade pole 3: 2014 Pole 2 upgrade: 2007 Pole 3: 1993 Pole 1&2: 1976-77
Power rating:	Pole 4: 700 MW Pole 3: 440 MW Pole 1+2: 500 MW
No. of poles:	4 (2 bipoles)
AC voltage:	Pole 4: 400 kV (Kristiansand), 400 kV (Tjele) Pole 3: 300 kV (Kristiansand), 400 kV (Tjele) Pole 1&2: 300 kV (Kristiansand), 150 kV (Tjele)
DC voltage:	Pole 4: 500 kV (HVDC Light) Pole 3: 350 kV (HVDC Classic) Pole 1&2: 250 kV (HVDC Classic)
Length of DC submarine cable routes:	Skagerrak 4: 140 km Skagerrak 1-3: 127 km
Length of DC land cable route:	Skagerrak 4: 104 km
Length of DC overhead line:	Skagerrak 1-3: 113 km
Main reason for choosing HVDC:	Length of sea crossing, asynchronous link. For pole 4, HVDC Light was chosen for its premier power quality features.
Application:	Interconnecting grids, Upgrade

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