

HVDC insulated power cable links in Denmark

State of the art and future prospects

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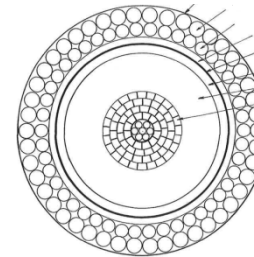
Energinet.dk, Department of Electricity Transmission, usg@energinet.dk





Existing DC links

- **Connection to Sweden (LCC)**
 - Konti-Skan 1 & 2
 - 23 km submarine cable from 1965/1971/1988 – flat type LPOF
 - 250 kV, 250/300 MW, 2x310(2)/2x500 mm² Cu
 - 88 km submarine cable from 1988/1991 – single core MIND
 - 250 kV, 300 MW
- **Connection to Norway (LCC)**
 - Skagerrak 1 & 2
 - 127 km submarine cable from 1976-1977 – single core MIND
 - 250 kV, 250 MW, 800 mm² Cu
 - Skagerrak 3
 - 127 km submarine cable from 1993 – single core MIND
 - 350 kV, 440 MW, 1400 mm² Cu
- **Connection to Germany (LCC)**
 - Kontek
 - 101 km land cables from 1995 – Two core flat type LPOF
 - 400 kV, 500 MW, 2x800 mm² Cu
 - 50 km submarine cable from 2010 – Single core MIND
 - 400 kV, 550 MW, 1850 mm² Cu
- **Connecting Eastern and Western Denmark (LCC)**
 - Great Belt connection
 - 25 km landcable from 2010 – single core, MIND
 - 32 km submarine cable from 2010 – single core, MIND
 - 400 kV, 600 MW, 1600/2100 mm² Cu (sea) 1700 mm² Cu (land)

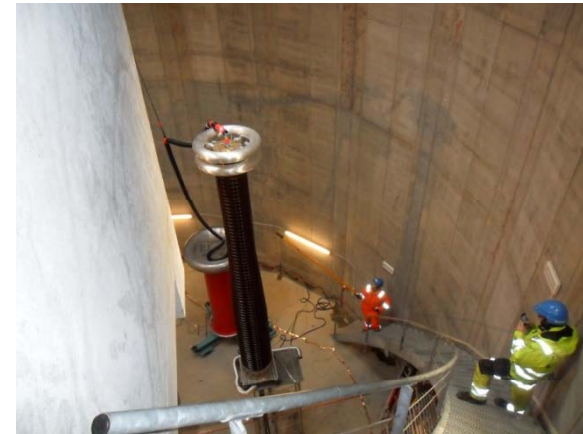


Total: 800 km route of existing DC cables

Technical issues

- **Exchanging old cables, Kontek submarine cable**

- Systematic crack formation in lead sheath resulting in oil leakage from cable joints on submarine cable (joints for every 1000 meters)
- Original cable design (underground and submarine cable): LPOF flat type two core cables under a single lead sheath
- New submarine cable: Single core MIND cable.
- Two types of cables connected via open air terminations placed in buildings in the ground (four landings)



- **Long cable sections, SK4**

- 1600 m long cable sections on land
- Drum size: 7.6 m x Ø4.2 m, up to 106400 kg.
- New cable pulling vehicle under construction

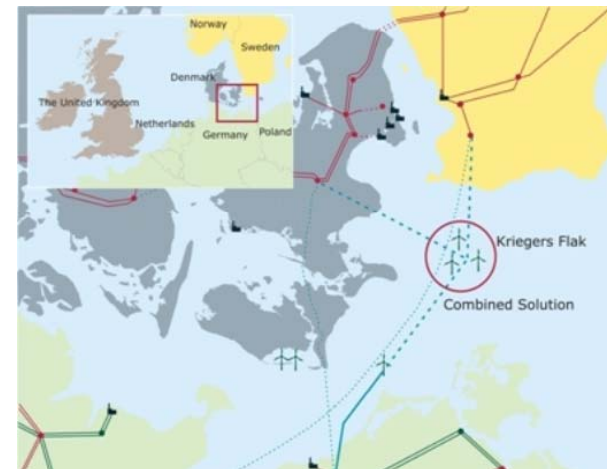
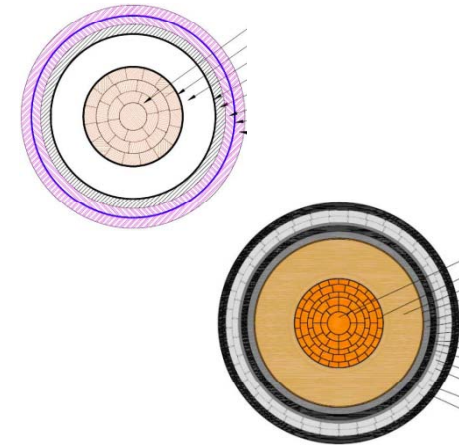


Prospective connections

- **Under construction - Connection to Norway, Skagerak 4 (VSC)**
 - 104 km land cable – single core MIND
 - 140 km submarine cable – single core MIND
 - 525 kV, 715 MW, 1600 mm² Cu

- **Under planning - Connection to the Netherlands, COBRA (VSC)**
 - Either MIND or XLPE
 - 300 km submarine bipole, 25-30 km underground cable
 - ± 250 or ±320 kV, 700 MW

- **Under planning – Kriegers Flak wind farm**
 - Combined grid solution between Germany and Denmark with possibility for Sweden to connect later
 - 150 M€ grant from EU
 - Offshore windfarm , offshore grid
 - 600 MW DC to Denmark and 600 MW DC to Germany



**Thank you for your
attention**