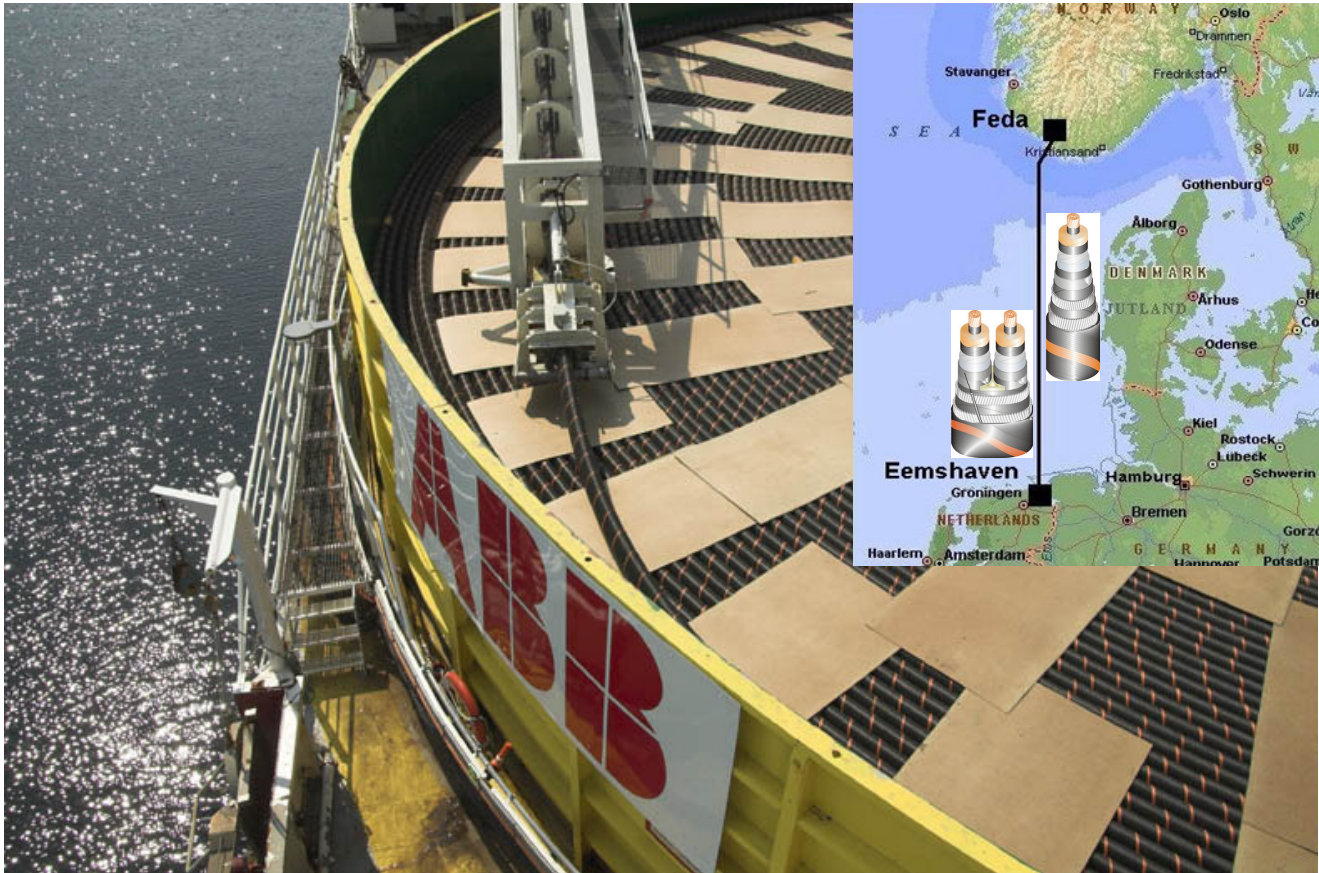


Submarine Cable Link

The NorNed HVDC Connection, Norway – Netherlands



Cable data

Voltage	± 450 kV DC
Power	700 MW
Route length	580 km
Insulation	MI
Conductor	270 km 2 x 790 mm ² Cu (flat cable) 2 x 150 km 700 mm ² Cu (single core cable)
Weight	84 kg/m flat cable 37 kg/m single core cable
Customer	Statnett, Norway and TenneT, Netherlands
Completion year	2008

ABB project content

HVDC cable and accessories for 420 km
HVDC converter stations



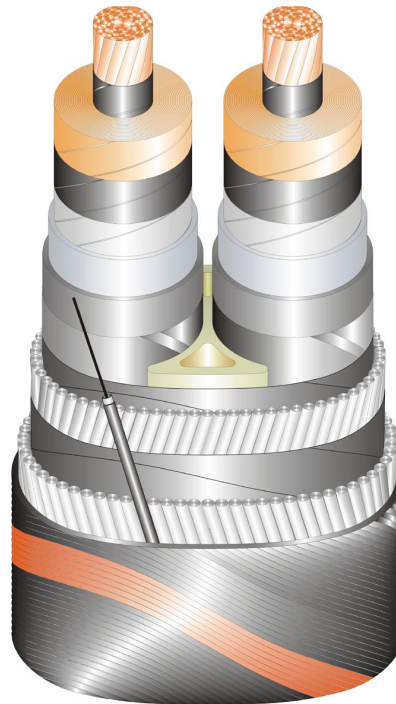
The 580 kilometer-long NorNed link is the longest submarine high-voltage cable in the world. This HVDC transmission link is connecting the power grids of Norway and the Netherlands and will enable power trading between the two countries as well as increasing the reliability of electricity supply. The NorNed project was undertaken by the two state-owned power grid companies, Statnett in Norway and TenneT in the Netherlands.

1. Stretching over 580 km, it is the longest submarine HVDC cables ever constructed.
2. At 700 MW, the cable is one of the most powerful HVDC cables in commercial operation.
3. With 450 kV DC this cable, together with other HVDC cables such as the Baltic Cable between Sweden and Germany and the SwePol Cable between Sweden and Poland (both produced by ABB), have the highest voltage rating of all existing submarine HVDC cables.

ABB's role in the project was to supply 420 km cables as well as the converter stations at both ends. The wide range of know-how within the ABB Group, was vital for the rapid and successful development and completion of the project.

The Cable

The NorNed cable is a MI cable: mass-impregnated, non-draining, paper-insulated HVDC cable. Two different designs are used for the shallow part of the route: a twin-core cable and a single-core cable. Both cable types have copper conductor/conductors consisting of concentric layers of keystone-shaped strands, optimizing a smooth surface with very compact construction.



A layer of semi-conducting carbon paper on the surface of the conductor eliminates any possible unevenness, which would otherwise increase the field-strength locally. Outside the paper insulation is a conductive layer of carbon and metallized paper. A hermetically sealed lead sheath with a PE jacket protects the insulation from moisture or water penetration. The mechanical strength of the cable is provided by steel tape and two layers of steel-wire armour. The steel wires are applied in opposite directions to form a counter-helix, which eliminates any torsional stress. An outer serving of bitumen-bonded polypropylene yarn protects the cable from corrosion.

Production

The NorNed cable was manufactured in our Karlskrona factory, which is specially designed to cater for the production of long, powerful, submarine high voltage cables. The cable was produced in six

continuous lengths of up to 154 km of single-core and 75 km of twin-core flat MIND cable which minimizes the need for jointing operations over long cable interconnections.

Cable Route

The cable route begins with a land section of 1.5 km from Eemshaven Converter Station in the Netherlands to the shore. A twin-core cable runs for a distance of 270 km out from the Dutch coast and then split into conventional single core cables from thereon.

Installation

The submarine cable, produced at ABB, weighs some 35,000 metric tons. Since no cable-laying ship can cope with such a weight, the cable was laid in sections, joined with five field splices. All sections of the cable were loaded directly on board the laying ship at our factory's port at Karlskrona. To be able to handle the twin-core cable, specially designed handling equipment was utilized on the cable laying vessel. After laying the cable was trenched into the sea-bed to bury it for protection. Close to the Dutch coast it was buried to a depth of 3 m, and then to 1 m along the rest of the route. In parts of the route where the nature of the sea-bed prevents trenching, it was protected by rock dumping.

Commissioning

The NorNed HVDC link will be ready to begin operation in the end of 2007

ABB AB High Voltage Cables	Telephone +46 455 556 00	Telefax +46 455 556 55	E-mail sehvc@se.abb.com
SEHVC M-063E			