

# Konti-Skan 1

## HVDC Renovation Project

The original Konti-Skan 380 MW HVDC link, built in the 1960s between Sweden and Denmark, was nearing the end of its lifetime. GE was selected to renovate and upgrade Konti-Skan pole 1, making the entire system more efficient.





## Project Highlights

- A financially competitive and technically advanced solution
- Use of state-of-the-art thyristor valves and converter station technology
- Supply of GE's industry leading Series V digital control and protection equipment
- Fully operational converter stations offering total system reliability

## Customer Challenges

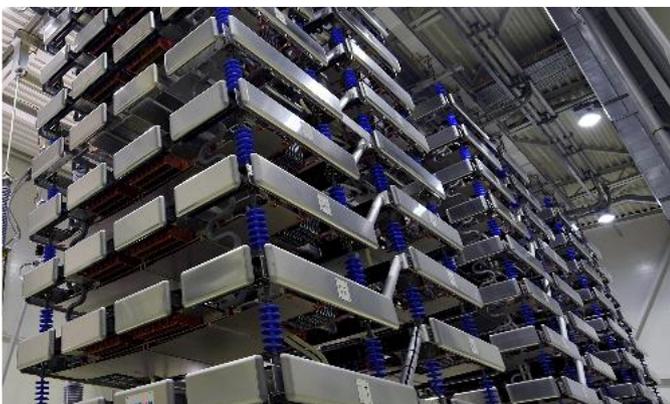
### The Customers

SVENSKA KRAFTNÄT is the owner and operator of Sweden's transmission network, responsible for the national electricity grid and the country's 400 and 220 kV power lines. ENERGINET.DK is the Danish counterpart, who owns and operates the 400 kV transmission network for Denmark and is responsible for the overall security of the supply, including connections to neighbouring countries.

### Upgrade to Innovative Thyristor Based Technology

Originally built in the 1960s, the mercury arc HVDC system of Pole 1 of the Konti-Skan HVDC undersea electricity transmission link was nearing the end of its design life. It was scheduled for replacement and upgrade to match the power rating of Pole 2 in the city of Lindome, built in the 1980s.

GE was selected for a cost-effective replacement with its innovative HVDC thyristor valve technology replacing the old mercury arc system. The scope of this upgrade included new, state-of-the-art thyristor valves in both converter stations in Vester Hassing, Denmark and in Lindome, Sweden.



HVDC thyristor valve technology replacing the old mercury arc system

## Project Overview

Country: Sweden  
 Project: Konti-Skan - Pole 1  
 Customer: SVENSKA KRAFTNÄT  
 Technology: High Voltage Direct Current (HVDC), Line Commutated Converter (LCC)  
 Scope: Two HVDC converter stations consisting of 50 Hz switchyards with harmonic filter bays, converter transformers, thyristor valves and DC filters / smoothing reactors. Power is transmitted via the 90 km submarine link at 285 kV DC, including the section over Laeso Island, with no adverse ecological effects.  
 Rating: 380 MW  
 Delivery Date: 2006

## Pole 1 Technical Characteristics

Rated System Voltage	AC = 420 kV / DC = 285 kV
Rated Power Capacity	P = 380 MW
HVDC Converter Transformers	1 x 203 MVA, 415/111.5 kV, Y-Y 1 x 203 MVA, 415/111.5 kV, Y-Δ
AC Filters	1 x 45 Mvar – 11 <sup>th</sup> /13 <sup>th</sup> double-damped 2 x 66 Mvar – 11 <sup>th</sup> damped
DC Filter	Triple tuned at 12 <sup>th</sup> /24 <sup>th</sup> /42 <sup>nd</sup>
DC Reactor	L = 160 mH

## Customer Opportunity

The submarine cable link, co-operated by Svenska Kraftnät and Energinet.dk, spans the Kattegat seaway between Sweden and Denmark and allows the two countries to exchange power.

When the Konti-Skan connection was originally built, it put an end to independent, country-exclusive energy systems in Scandinavia and reduced the two countries' reliance on individual hydro or thermal sources.

As western Denmark is directly connected to the UCTE European network, Konti-Skan gives Sweden access to energy from continental Europe, providing increased flexibility in dry and wet years and an increased security of supply.

Upgrading their grid management and trading system in a proactive, timely manner provides a more efficient utilisation of imported power – something that is of increasing importance to all energy managers.

This important re-investment program covered the complete renewal of the converter station in Vester Hassing, Denmark, using state-of-the-art technologies. In Sweden, a new converter station with the same specifications was built at Lindome near Gothenburg and required a 25 km extension to the overhead lines from Stenkullen to the new site. A key cost-saving factor to the operation was the reutilisation of the existing submarine cable and overhead transmission lines.

## GE Solution

The new installation included the latest version of GE's HVDC H400 thyristor valves. The H400 have greater power density and were series-connected, fully protected thyristors, each with an 8.5 kV rating and 125 mm diameter. The thyristors are controlled by GE's Series V digital control and protection system, providing fully redundant operations, including monitoring and alarm capabilities.

### Turnkey Solution

GE designed, constructed and supplied all the equipment for the two new converter stations. The two AC systems are interconnected by two HVDC converter stations including two 203 MVA, 415/111.5 kV HVDC converter transformers on both the Swedish and Danish sites: one star-star connected and the other star-delta connected.



203 MVA, 415/111.5 kV HVDC Converter Transformer in Test

### Improved Performance

The rebuild completely revitalises the entire power exchange link, equalising capacity with the existing Konti-Skan pole 2, at 380 MW. This enables both countries to support each other by trading more energy to better balance out power shortfalls and surpluses. GE's Series V digital control technology delivers system security and reliability, as there is no longer the need for recalibration due to 'drift'.

The addition of the bi-pole control system enables high-level and remote control of the Konti-Skan pole 2 as well as the new Konti-Skan pole 1, minimizing current flow in the sea electrode, an environmentally desirable feature.

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Imagination at work