

# HVDC Projects and Activities

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Joerg Dorn, [joerg.dorn@siemens.com](mailto:joerg.dorn@siemens.com)  
Power Transmission  
and Distribution



## Neptune, USA, 2007

<b>Customer</b>	Neptune RTS
<b>Project name</b>	Neptune
<b>Location</b>	New Jersey/New York Long Island
<b>Type of plant</b>	Long distance Sea Cable
<b>Power rating</b>	660 MW, monopolar
<b>Transmission dist.</b>	105 km
<b>Voltage levels</b>	500 kV DC, 230/345 kV, 60 Hz
<b>Thyristor voltage</b>	Direct-light-triggered 8 kV



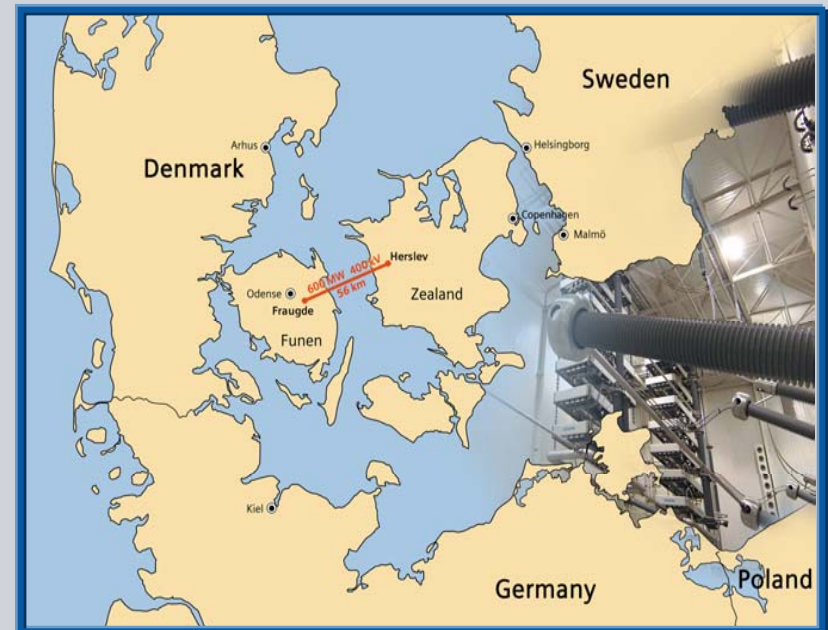
# Ballia - Bhiwadi, India, 2009

<b>Customer</b>	<b>Powergrid Corporation of India Ltd.</b>
<b>Project name</b>	<b>Ballia-Bhiwadi</b>
<b>Location</b>	<b>Uttar Pradesh province to Rajasthan province</b>
<b>Type of plant</b>	<b>Long distance transmission</b>
<b>Power rating</b>	<b>2500 MW, bipolar</b>
<b>Transmission distance</b>	<b>800 km</b>
<b>Voltage levels</b>	<b>500 kV DC, 400 kV, 50 Hz</b>
<b>Thyristor voltage</b>	<b>Direct-light-triggered, 8 kV</b>
<b>Number of thyristors</b>	<b>3600</b>



# Storebælt, Denmark, 2010

<b>Customer</b>	Energinet.dk
<b>Project name</b>	Storebælt
<b>Location</b>	The islands Funen (Fyn) and Zealand (Sjælland) in Denmark
<b>Type of plant</b>	Submarine cable transmission
<b>Power rating</b>	600 MW, monopolar
<b>Transmission distance</b>	56 km
<b>Voltage levels</b>	400 kV DC, 400 kV, 50 Hz
<b>Thyristor voltage</b>	Direct-light-triggered, 8 kV
<b>Number of thyristors</b>	1440

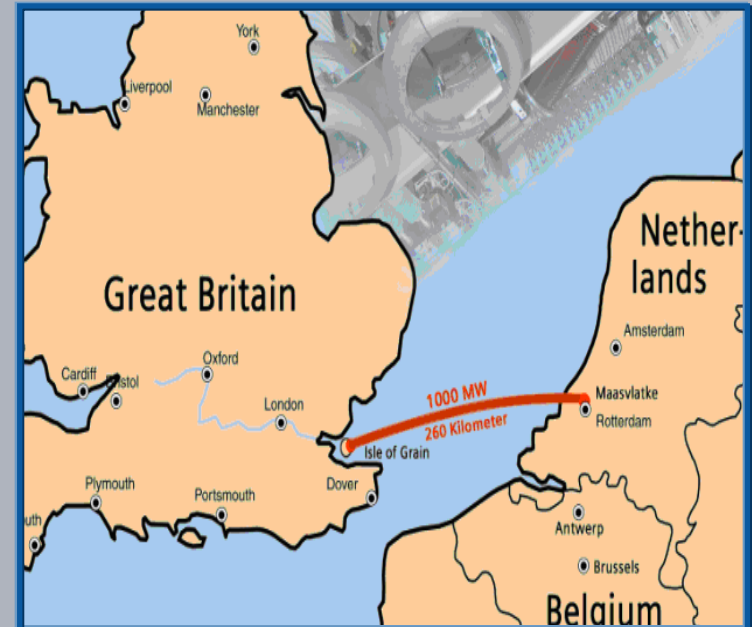




# BritNed, UK – Netherlands, 2010\*

\*Subject noticed to proceed

<b>Customer</b>	BritNed Development Ltd.
<b>Project name</b>	BritNed
<b>Location</b>	Isle of Grain on the southern bank of the Thames Estuary in UK and Maasvlakte west of Rotterdam in the Netherlands
<b>Type of plant</b>	Submarine cable transmission
<b>Power rating</b>	1000 MW, monopolar
<b>Transmission distance</b>	Approximately 200 km
<b>Voltage levels</b>	450 kV DC, 400 kV, 50 Hz
<b>Thyristor voltage</b>	Direct-light-triggered, 8 kV
<b>Number of thyristors</b>	3360



# Yunnan - Guangdong, China, 2010

<b>Customer</b>	China Southern Power Grid Co., Ltd.
<b>Project name</b>	Yunnan-Guangdong $\pm 800$ kV UHVDC Transmission Project
<b>Location</b>	Province Yunnan to province Guangdong
<b>Type of plant</b>	Long distance transmission
<b>Power rating</b>	5000 MW, bipolar
<b>Transmission distance</b>	1418 km
<b>Voltage levels</b>	800 kV DC, 525 kV, 50 Hz
<b>Thyristor voltage</b>	Direct-light-triggered, 8 kV
<b>Number of thyristors</b>	5760





**800 kV DC Bushing in Test Field**



# DC Reactor Testing

**SIEMENS**

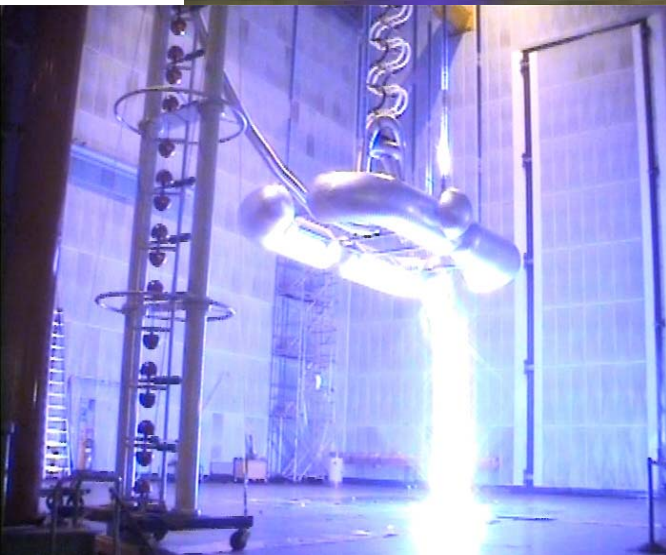
**800 kV DC  
3,125 A  
75 mH  
28 tons !**



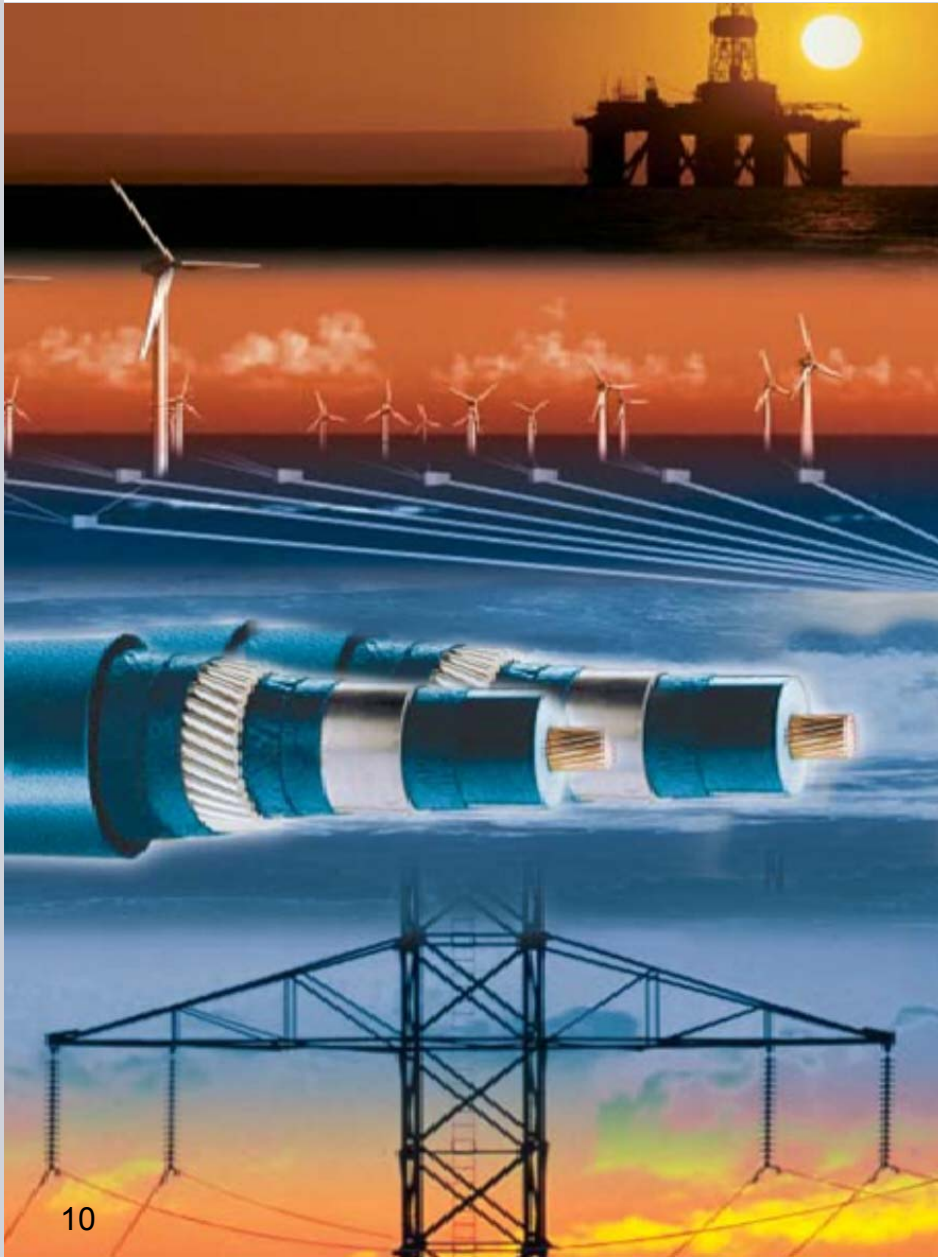


# “Snapshots” from **DC Valve Tower** Testing

**SIEMENS**



**Dielectric Testing of Valve-Support Structure**



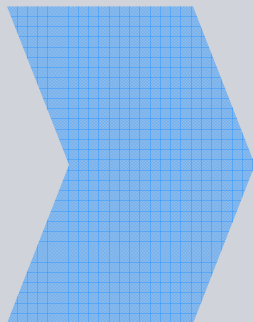
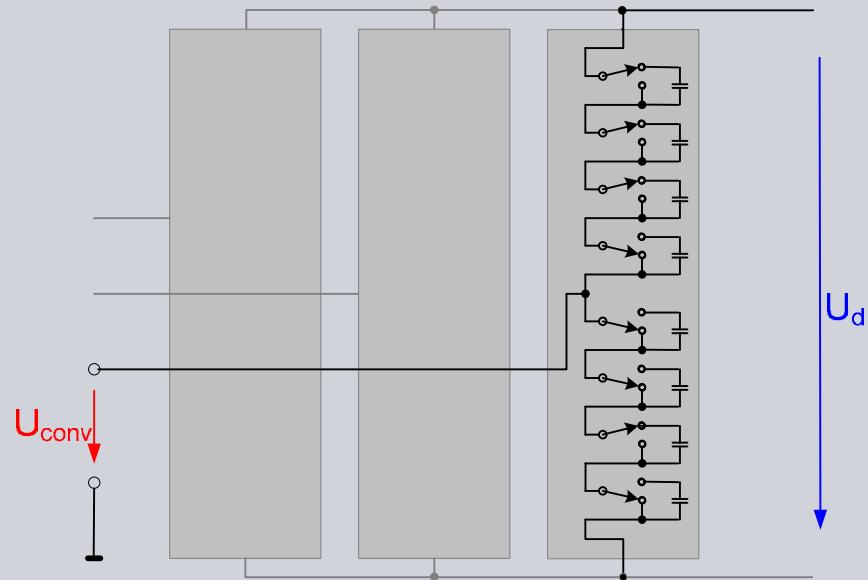
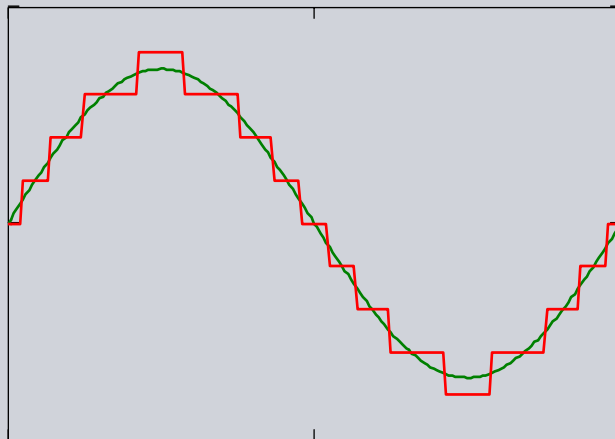
# HVDC

with VSC -

# HVDC PLUS

# HVDC PLUS Development

## The Modular Multilevel Converter - MMC



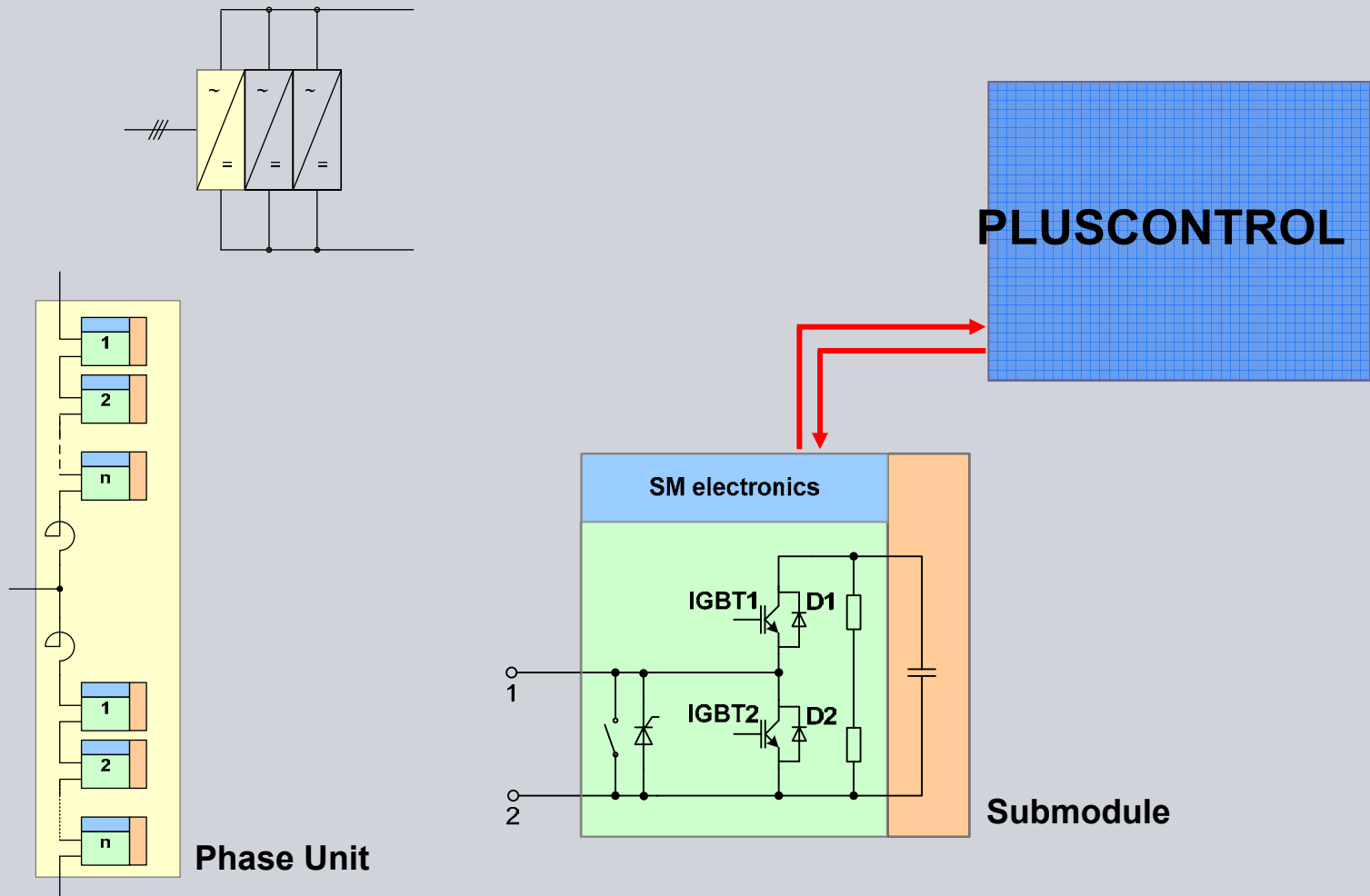
**Low generation of harmonics**

**Low HF noise**

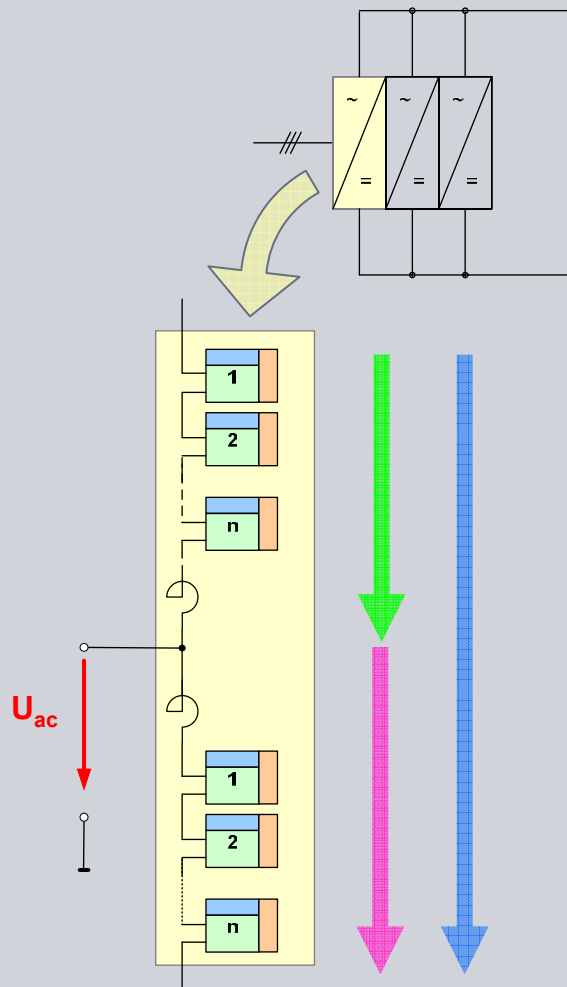
**Low switching losses**



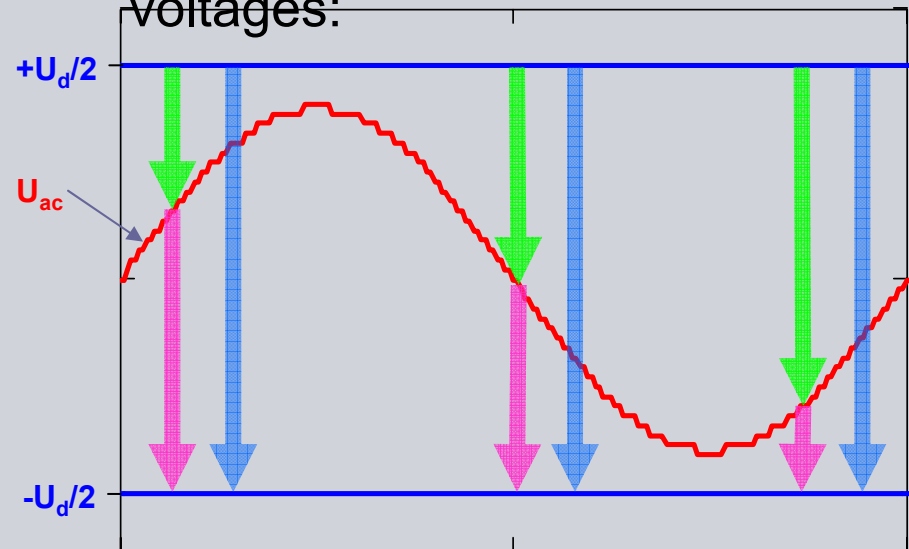
# Submodule Control



# Voltage generation

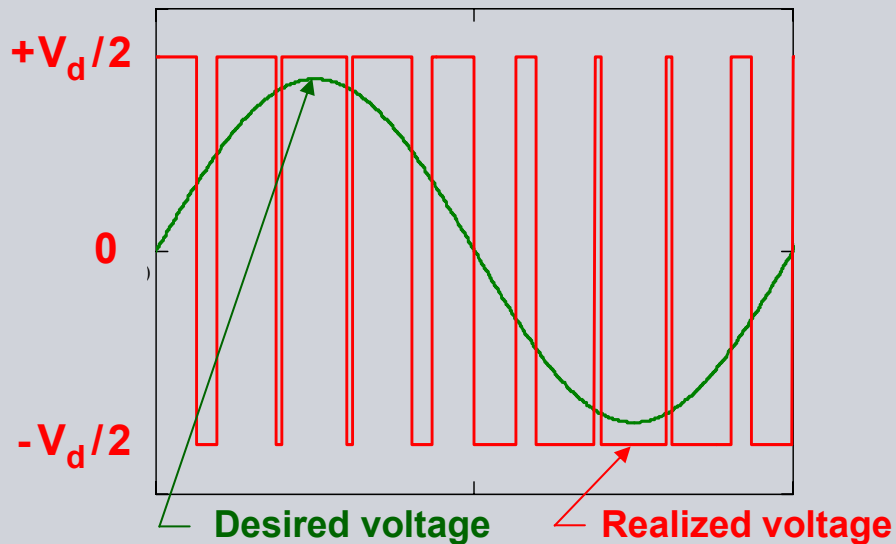


AC and DC voltages controlled by converter leg voltages:

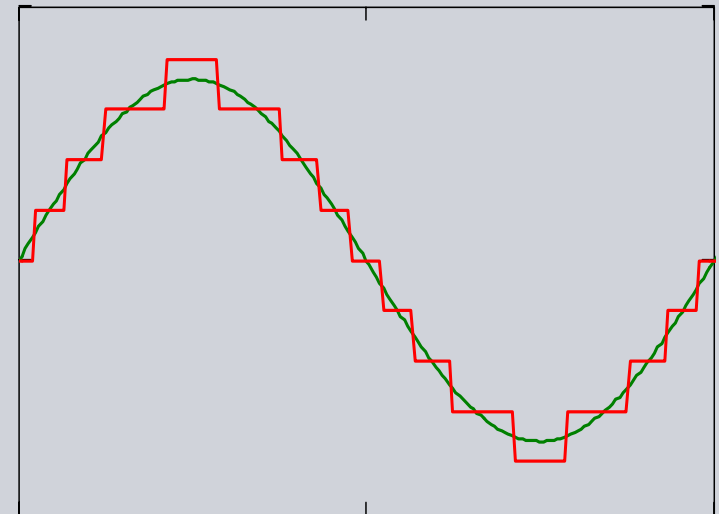


# Two-level and Multilevel-Technology

## Two-level technology



## Multilevel technology



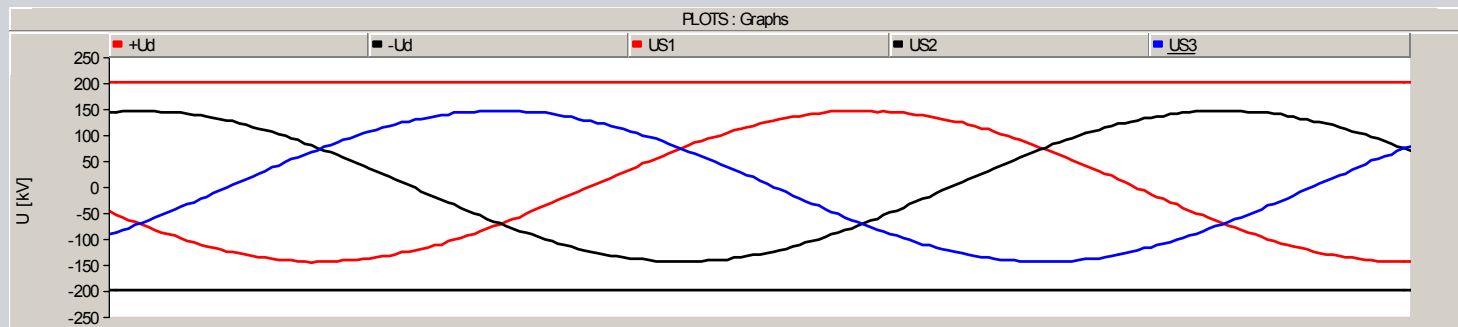
**High harmonic Distortion**  
**High Stresses resulting in HF Noise**

**Low Generation of Harmonics**  
**Low HF Noise**  
**Low Switching Losses**

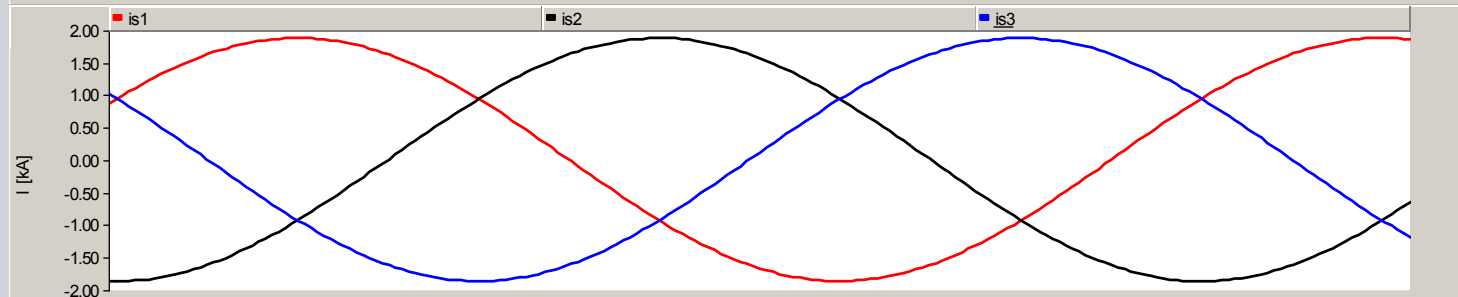


# Steady-state simulations of MMC

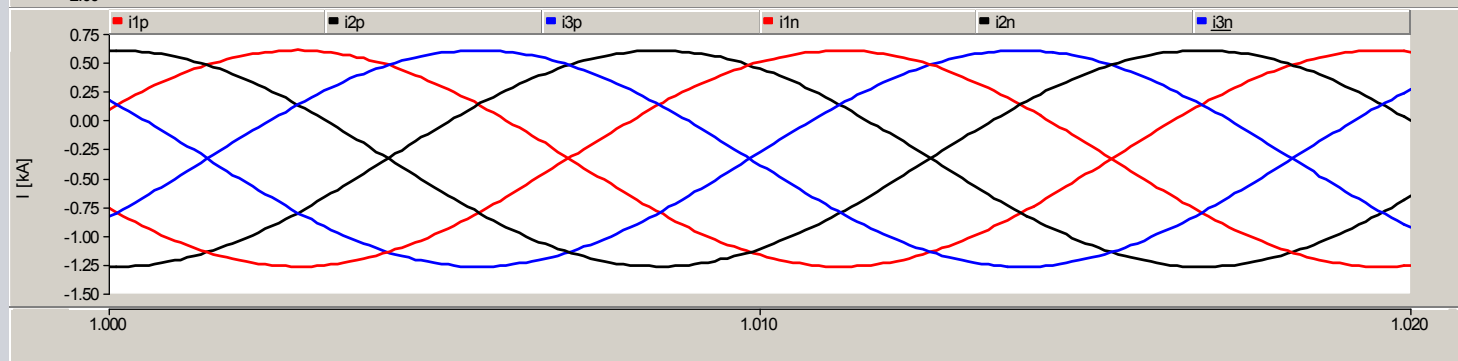
AC and DC terminal voltages

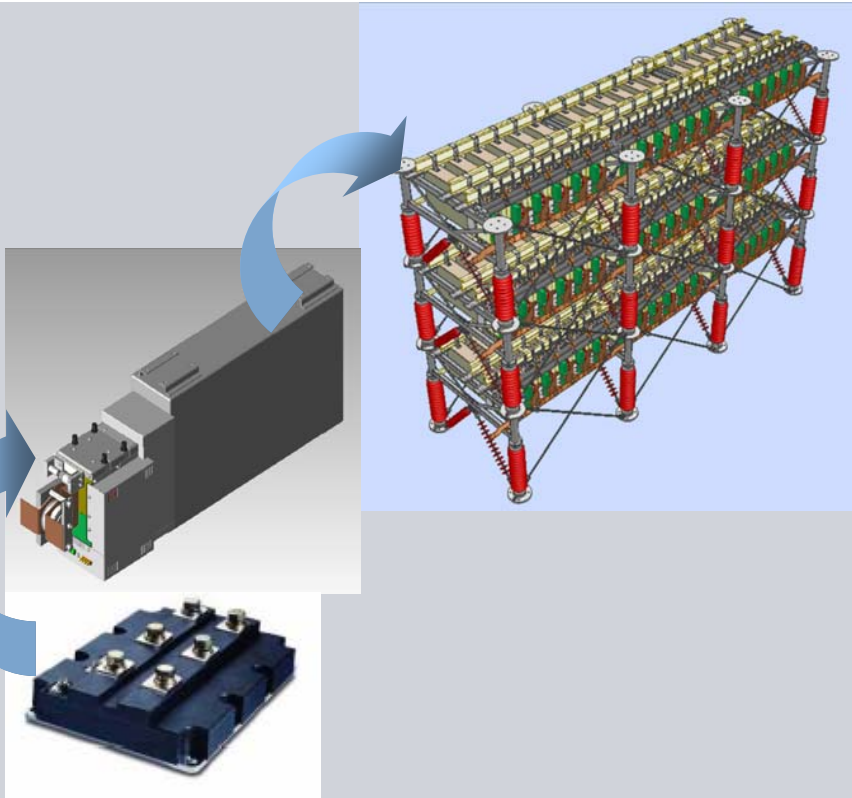


AC currents



Converter Phase Leg currents





- **Compact Modular Design**
- **Less Space Requirements**
- **Advanced VSC Technology**

DC cable transmission

DC overhead line transmission

Back-to-Back systems

Multi-terminal systems

STATCOM operation



**Thank you very much  
for your attention**