IEEE PES 2008
HVDC & FACTS Subcommittee

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Recent Siemens' HVDC Activities

Yuriy Kazachkov
Siemens PTI

660MW – 500kV in operation since July 2007 – Commercial Operation Neptune RTS

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Costumer	Neptune RTS
Project Name	Neptune RTS
Location	Sayreville, NJ Long Island, NY
Power Rating	660MW
Type of Plant	HVDC Classic Monopole, metallic return 67 mi (51 mi Submarine Cable)
Voltage Levels	500kV DC 230kV/ 345 AC, 60Hz
Type of Semi-conductors	LTT 8kV (1872)

LIPA saved over $20 million last summer by using the new Neptune HVDC cable to bring power to Long Island during the peak summer season in July, August, and September.

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Sayreville HVDC Converter Station

2500MW – 500kV
awarded March 2007 – Power Grid Corp. of India

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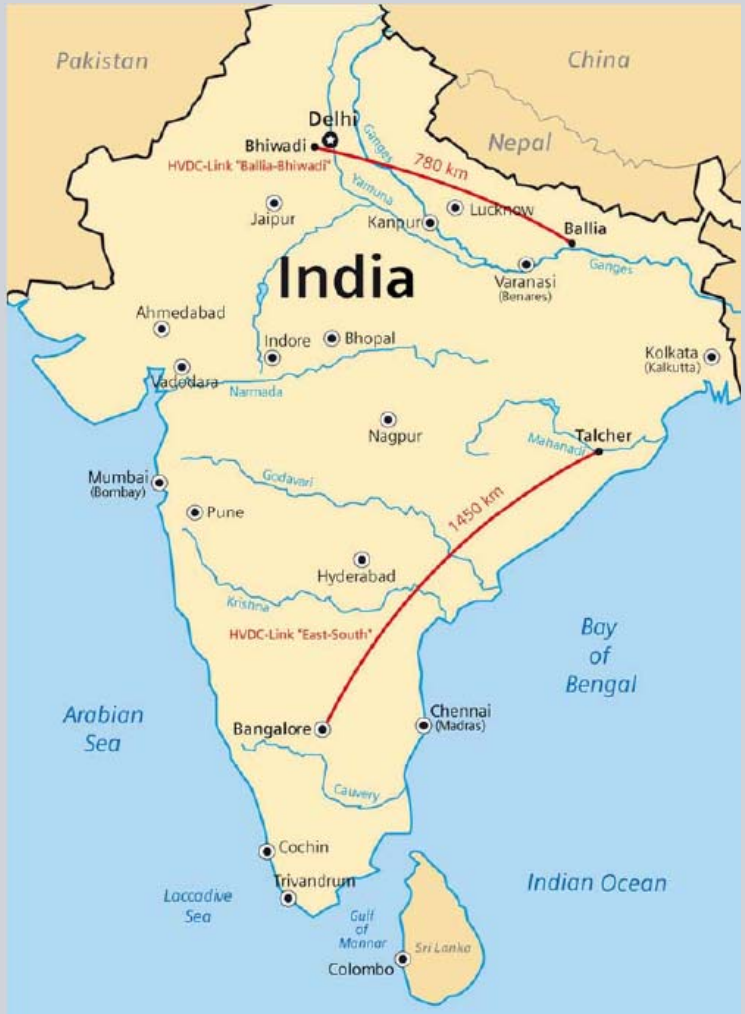

Costumer	**Power Grid Corp. of India Ltd.**
Project Name	**Ballia-Bhiwadi**
Location	**Uttar Pradesh Province** **Rajasthan Province**
Power Rating	**2500MW**
Type of Plant	**HVDC Classic Bipole** **800km Long**
Voltage Levels	**± 500kV DC** **400kV AC, 50Hz**
Type of Semi-conductors	**LTT 8kV (3600)**

600MW – 400kV
awarded May 2007 – Energinet/ Storebælt HVDC

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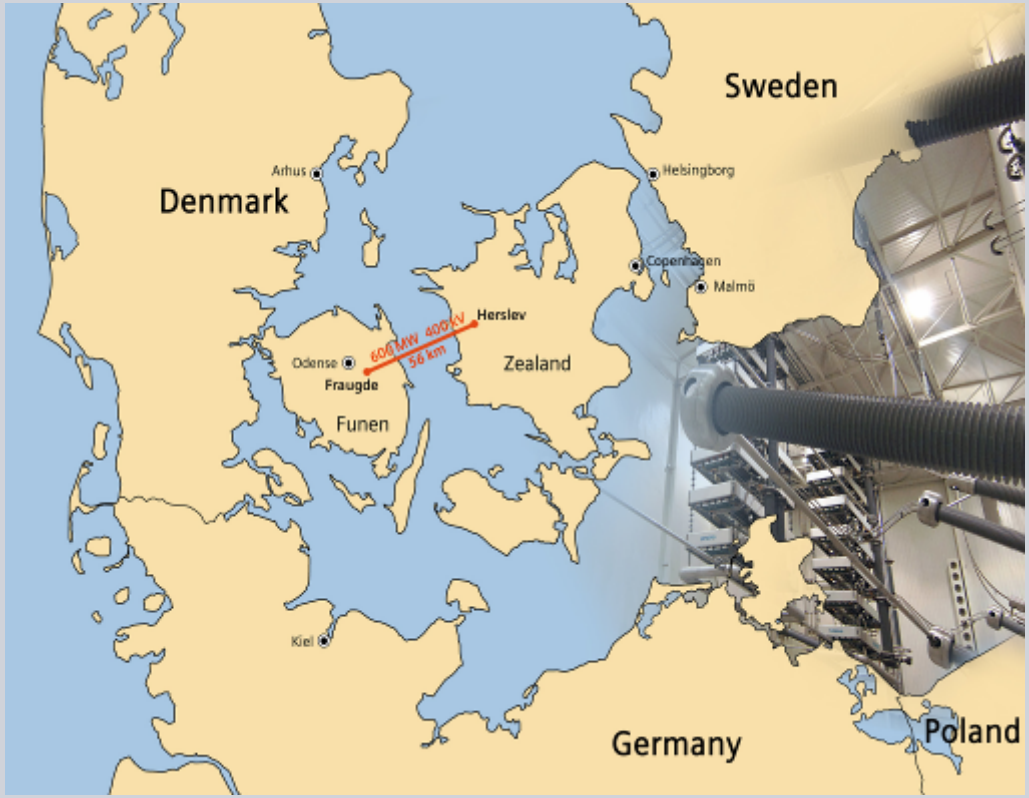

Costumer	Energinet.dk
Project Name	Storebælt
Location	The Island Funen and Zealand in Denmark
Power Rating	600MW
Type of Plant	HVDC Classic Monopole 56km Submarine Cable
Voltage Levels	± 400kV DC 400kV AC, 50Hz
Type of Semi-conductors	LTT 8kV (1440)

5000MW – 800kV awarded June 2007 – China Southern Grid Company

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Costumer	China Southern Power Grid
Project Name	Yunnan - Guangdong
Location	Chuxiong City/ Yunnan Zengcheng City/ Guangdong
Power Rating	5000MW
Type of Plant	Long Distance Bipole 1418km
Voltage Levels	± 800kV DC 525kV AC, 50Hz
Type of Semi-conductors	LTT 8kV (5760)

1000MW – 450kV
awarded June 2007 – National Grid and TenneT

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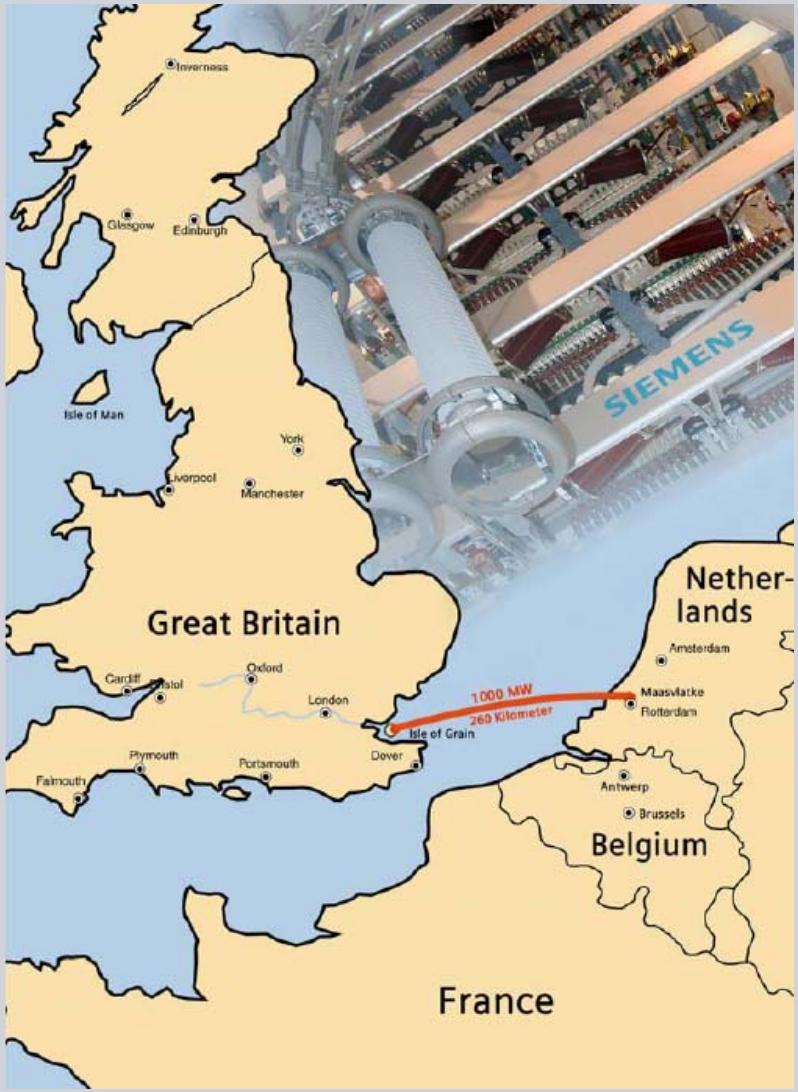
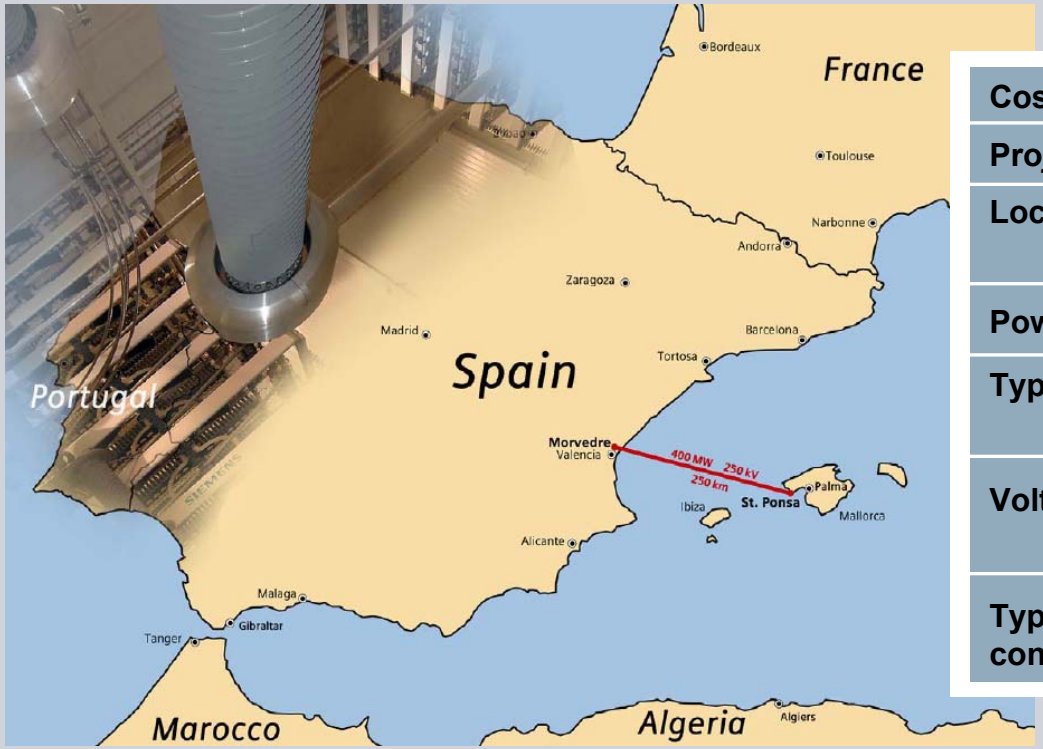


Costumer	BritNed Development Ltd
Project Name	BritNed
Location	Isle of Grain, UK Maasvlakte, NL
Power Rating	1000MW
Type of Plant	HVDC Classic Bipolar 260km Submarine Cable
Voltage Levels	± 450kV DC 400kV AC, 50Hz
Type of Semi-conductors	LTT 8kV (3360)

400MW – 250kV
awarded October 2007 – Red Eléctrica de Espana (REE)



Costumer	Red Eléctrica de Espana
Project Name	Cometa
Location	Spain – Mallorca
Power Rating	2 x 200MW
Type of Plant	HVDC Classic Bipole 250km Submarine Cable
Voltage Levels	± 250kV DC 400kV / 230kV AC, 50Hz
Type of Semi-conductors	LTT 8kV

400MW – 200kV awarded September 2007 – Trans Bay Cable Project, USA

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Costumer	**Trans Bay Cable LLC**
Project Name	**Trans Bay Cable Project**
Location	**Pittsburg, CA San Francisco, CA**
Power Rating	**400MW**
Type of Plant	**59-mile HVDC PLUS Submarine Cable**
Voltage Levels	**± 200kV DC 230kV/ 138kV AC, 60Hz**
Type of Semi-conductors	**IGBT (5184)**

Trans Bay Cable Project, USA
World's 1st VSC HVDC with Modular Multilevel Converter (MMC) Technology

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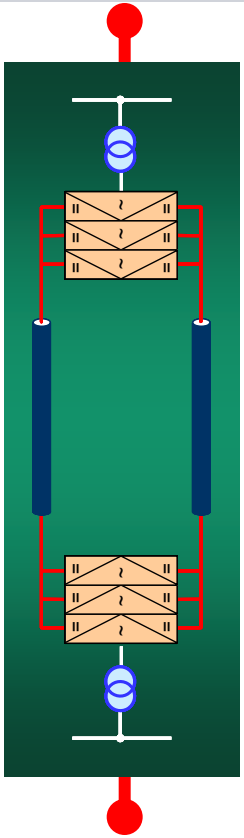
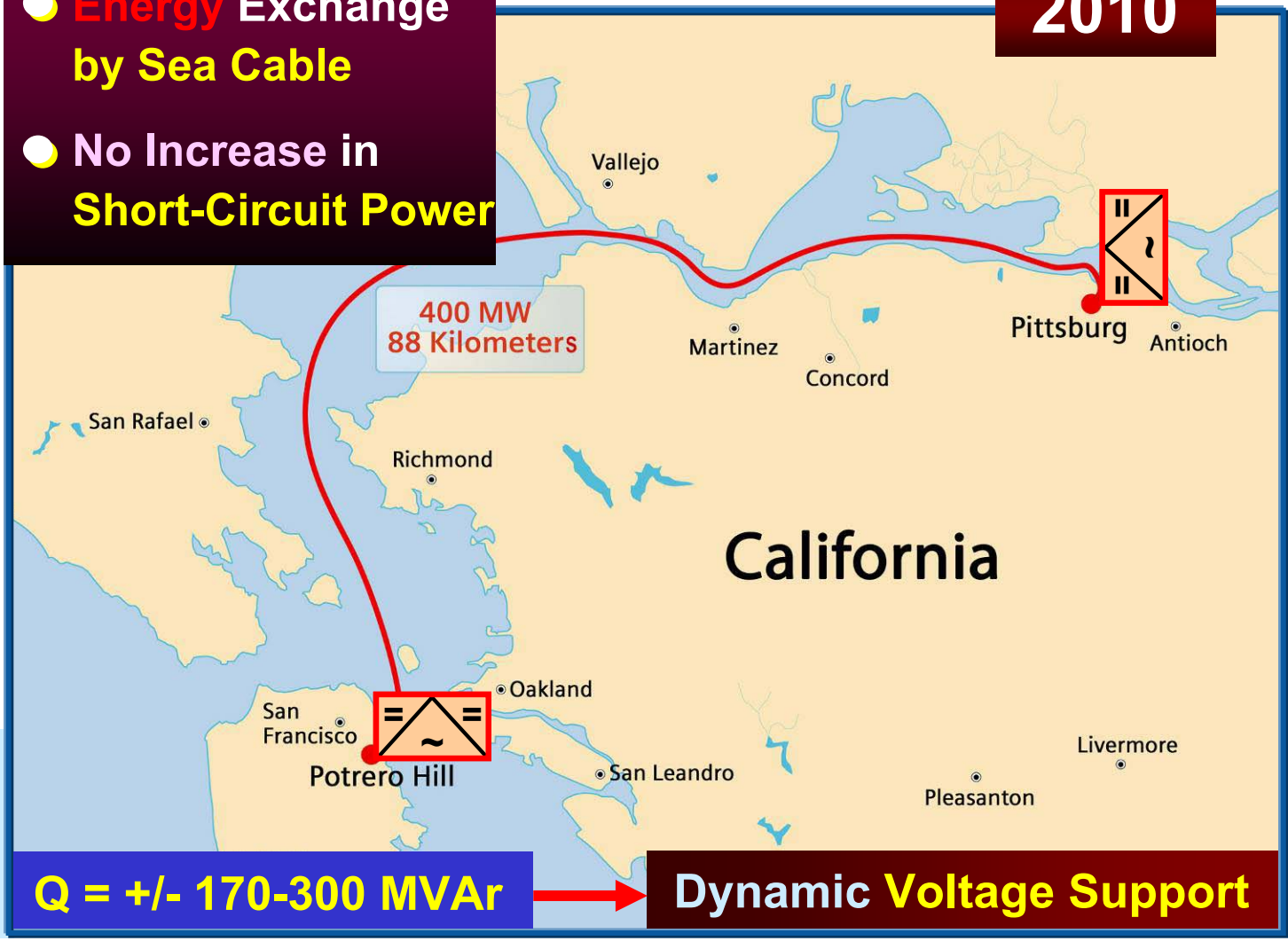


- Energy Exchange by Sea Cable
- No Increase in Short-Circuit Power

2010



P = 400 MW, ± 200 kV DC Cable

Q = +/- 170-300 MVAr → Dynamic Voltage Support

Benefits of Trans Bay Cable Project:
by-passing existing O/H Transmission

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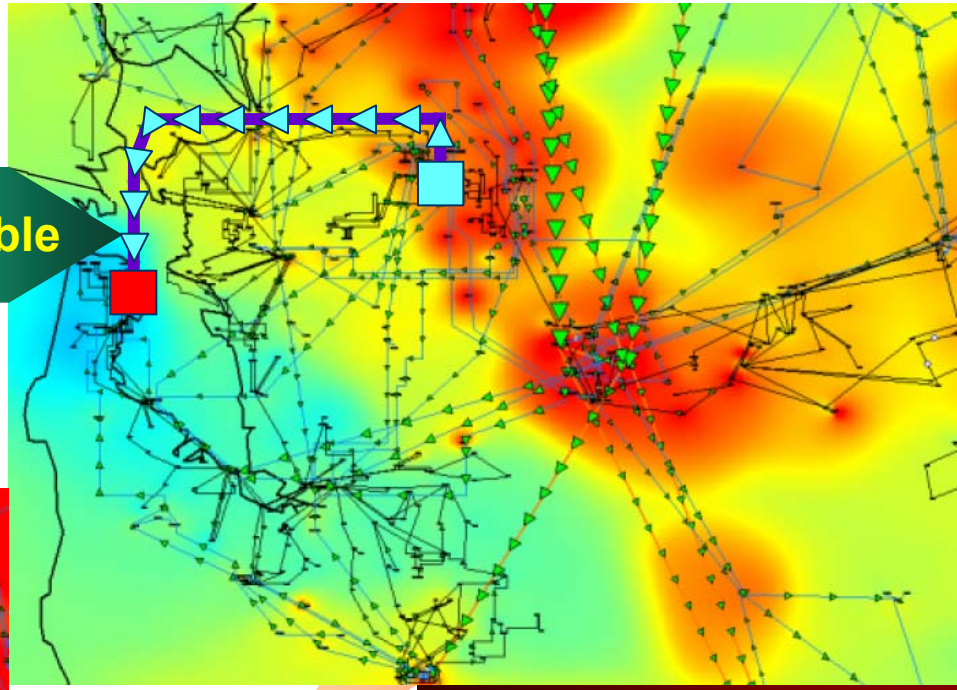
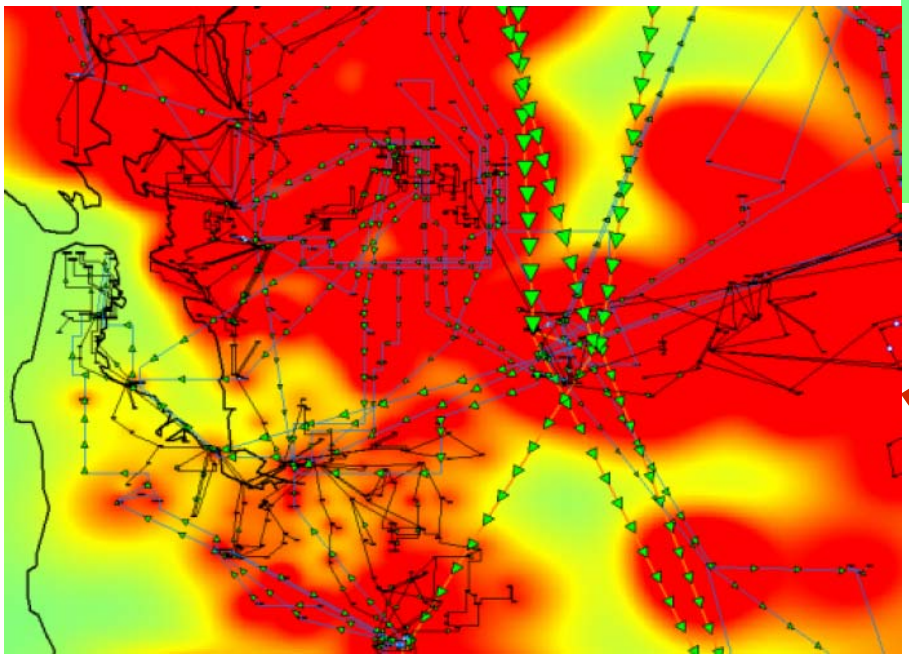
Transmission Constraints after TBC



Transmission Constraints before TBC



Significant Improvements

HVDC PLUS makes it feasible

Trans Bay Cable Project, USA

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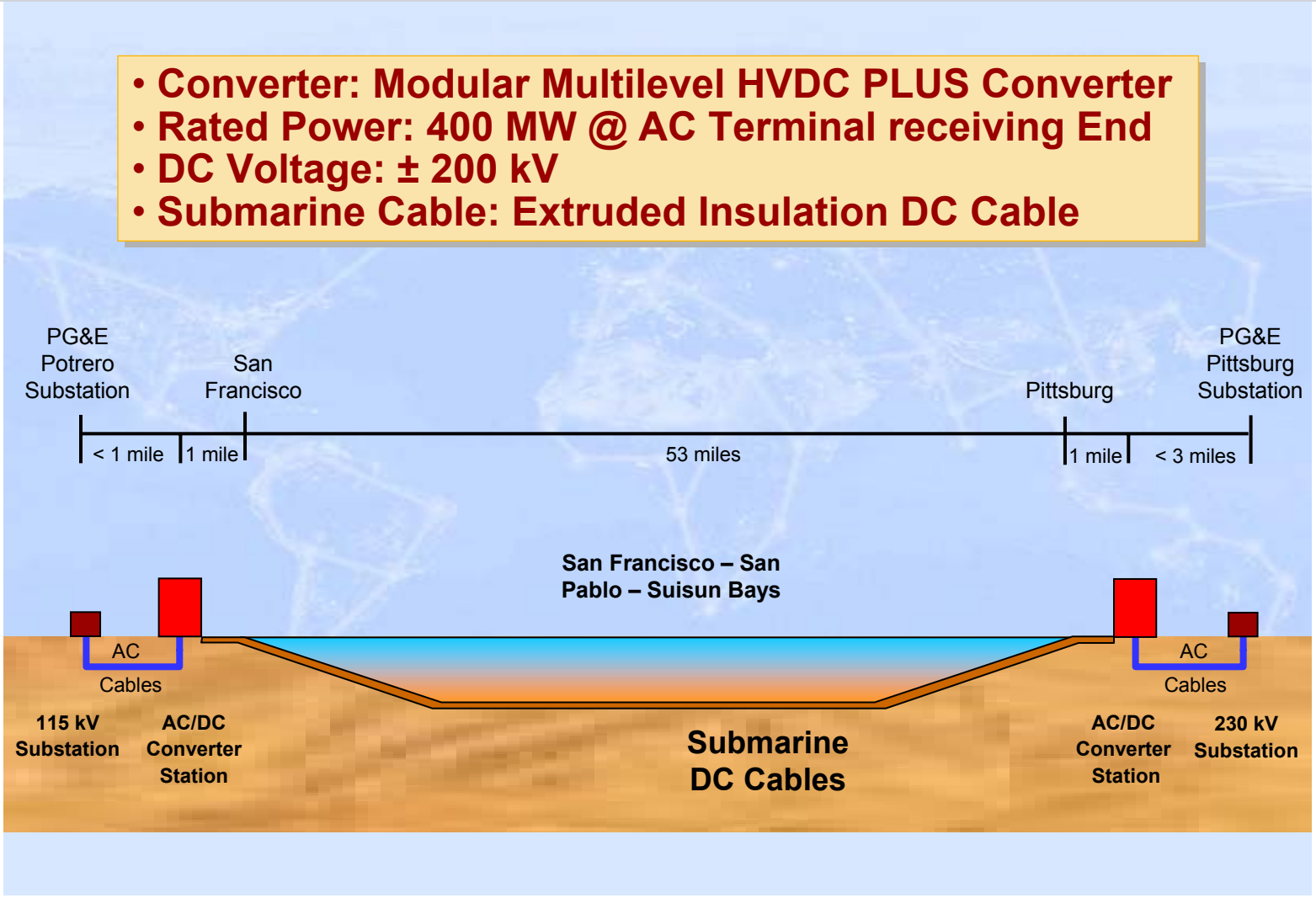
World's 1st VSC HVDC with ± 200 kV XLPE DC Cable

- Converter: Modular Multilevel HVDC PLUS Converter
- Rated Power: 400 MW @ AC Terminal receiving End
- DC Voltage: ± 200 kV
- Submarine Cable: Extruded Insulation DC Cable



The Evolution of HVDC PLUS and VSC Technology

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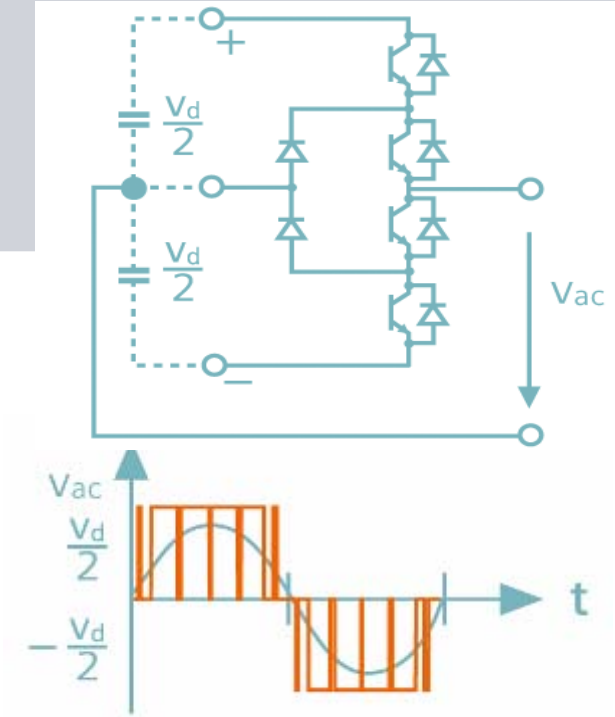
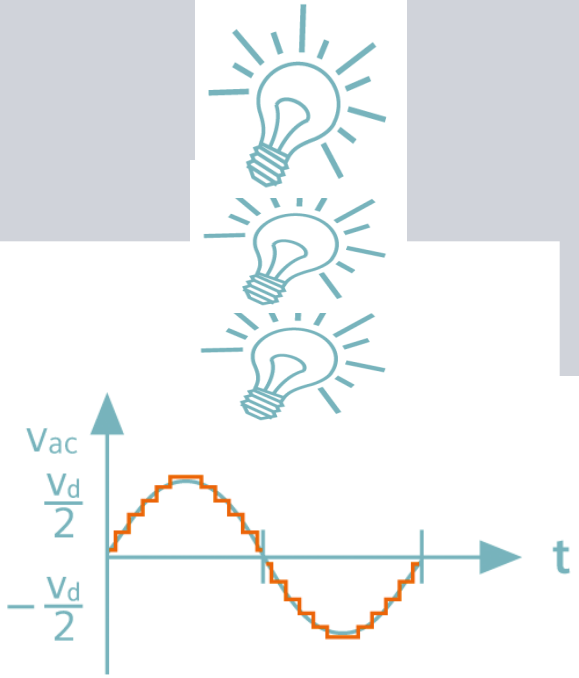
Three-Level



Multilevel

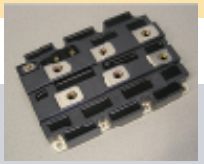


Power Electronic Devices:

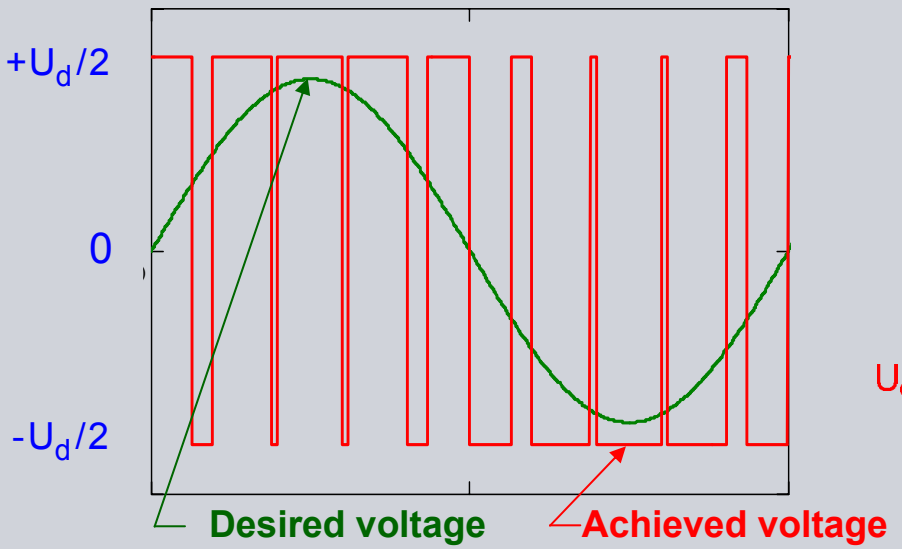
GTO /IGCT Module

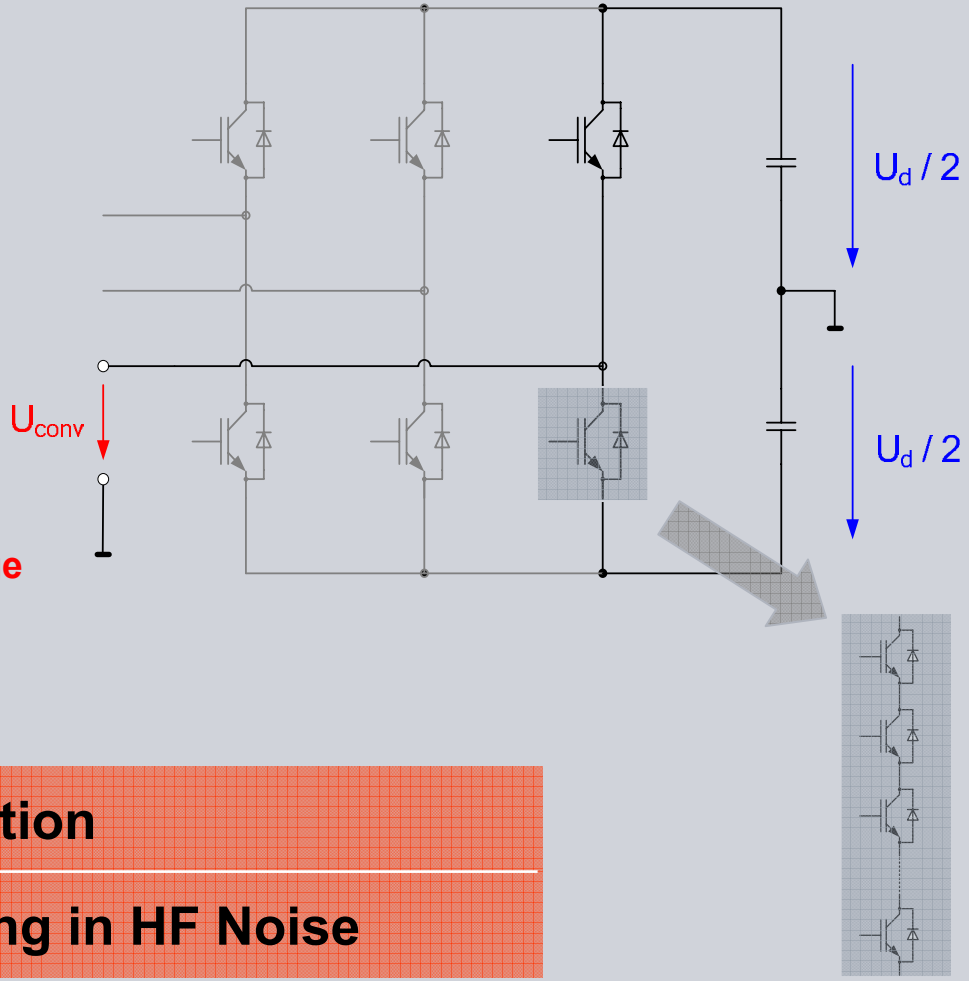
IGBT in Power Pack

IGBT



VSC Technology – 2 or 3 Level





High harmonic Distortion

High Stresses resulting in HF Noise

The Advanced Multilevel Approach:

MMC – Modular Multilevel Converter

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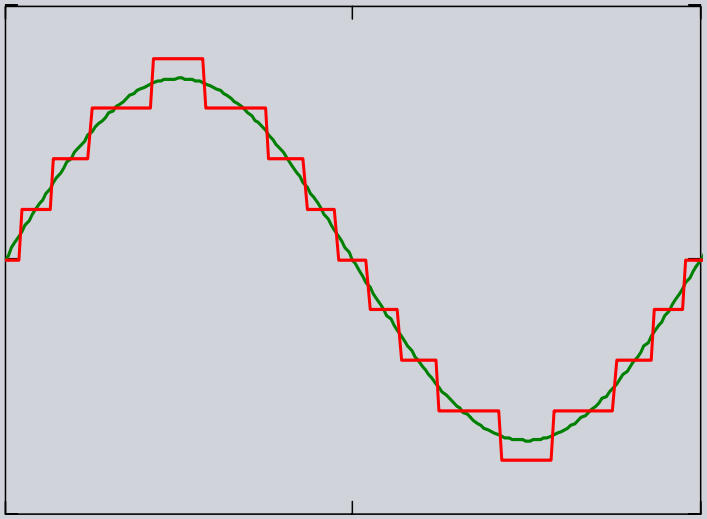
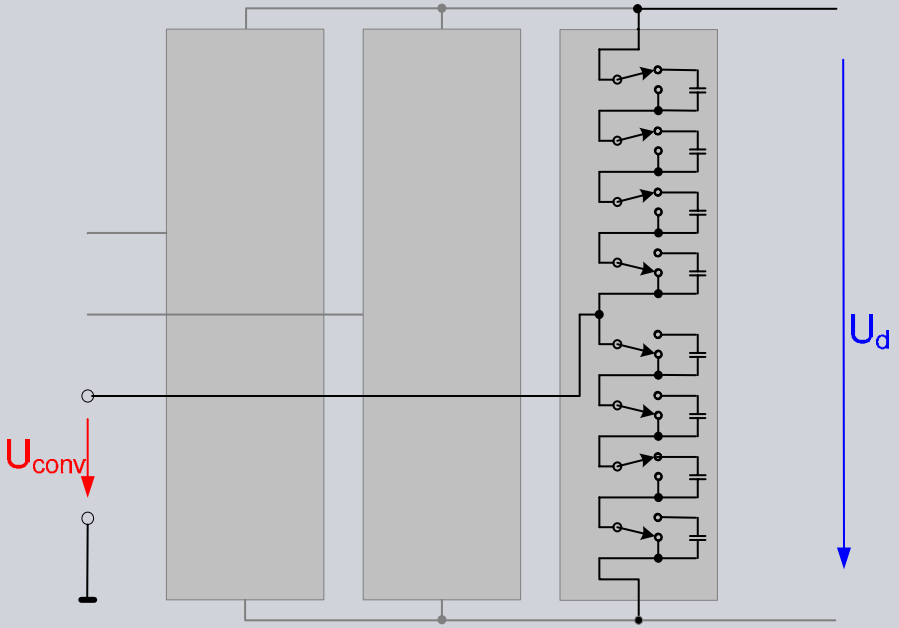




Small Converter AC Voltage Steps

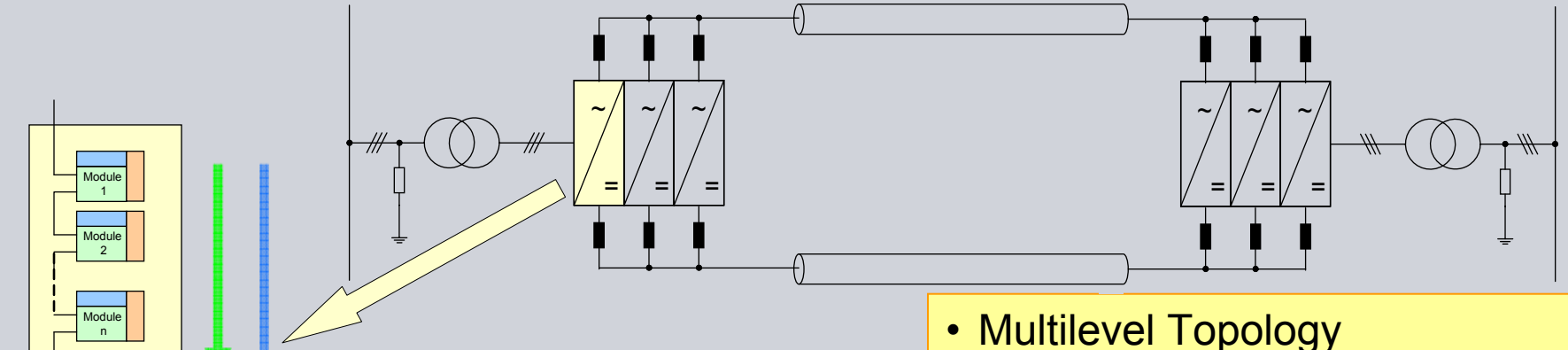
Low Rate of Voltage Rise

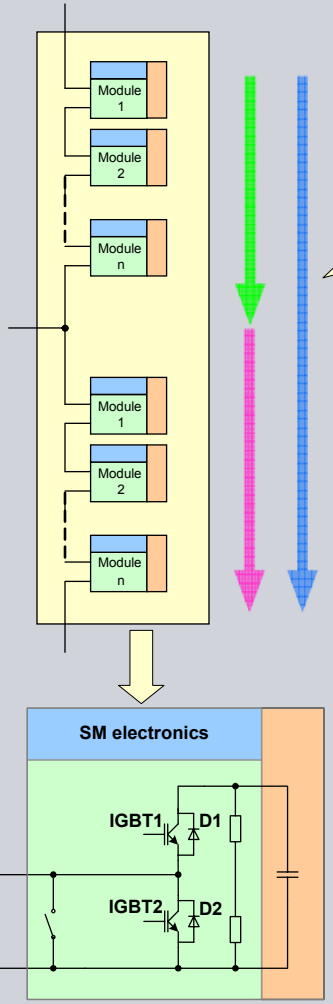
Low Generation of Harmonics

Low Level of HF Noise

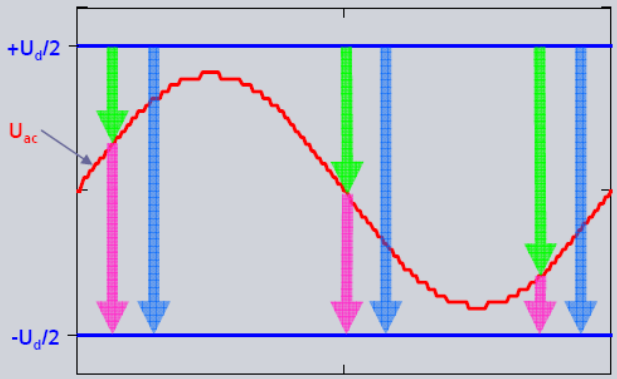
Low Switching Losses

Features and Benefits of HVDC PLUS



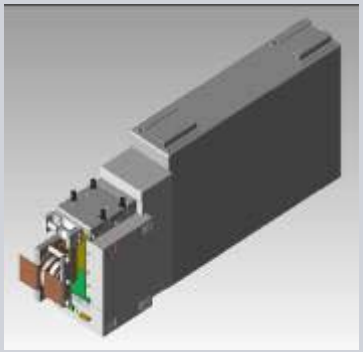


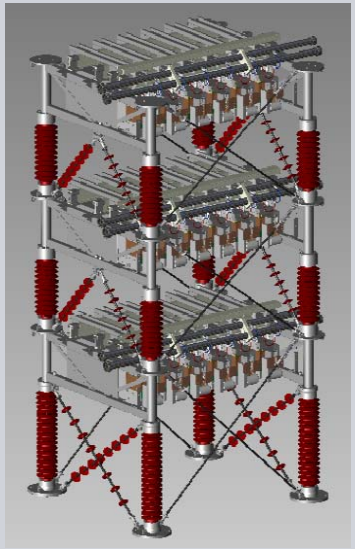
AC and DC voltages controlled by converter leg voltages:

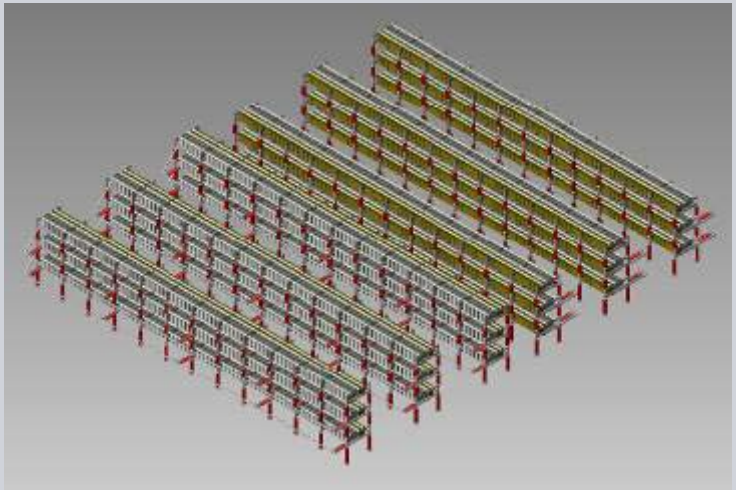


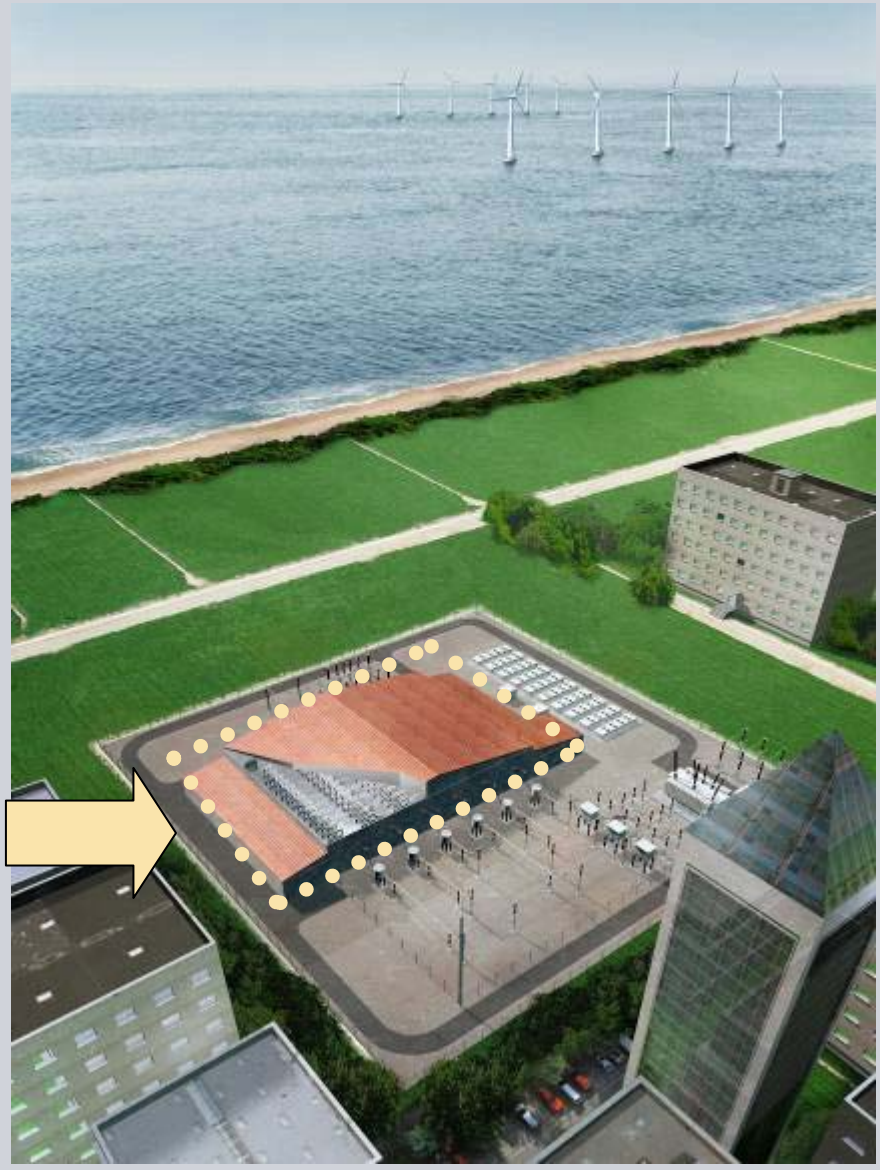
- Multilevel Topology
- Modular Concept
- Standard Power Electronics
- Compactness of Station Design
- Low Switching Frequency
- Elimination of high Frequency Stresses
- Conventional AC Transformers
- Proven Siemens WinTDC core hardware

HVDC PLUS

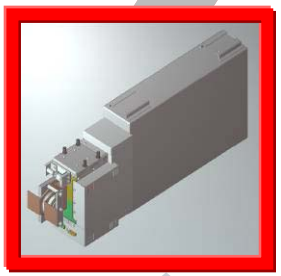


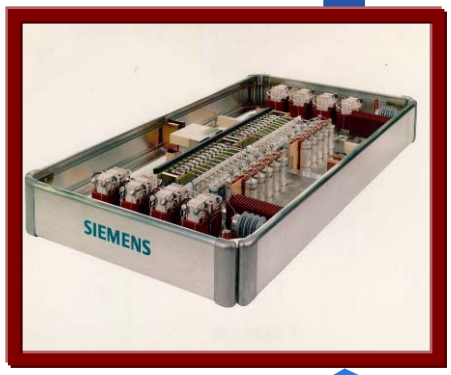


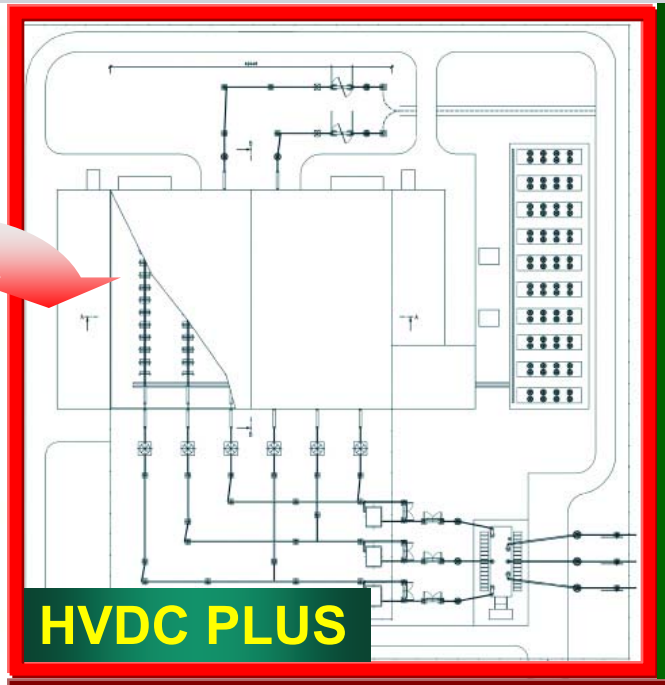




Benefits of HVDC PLUS







HVDC PLUS

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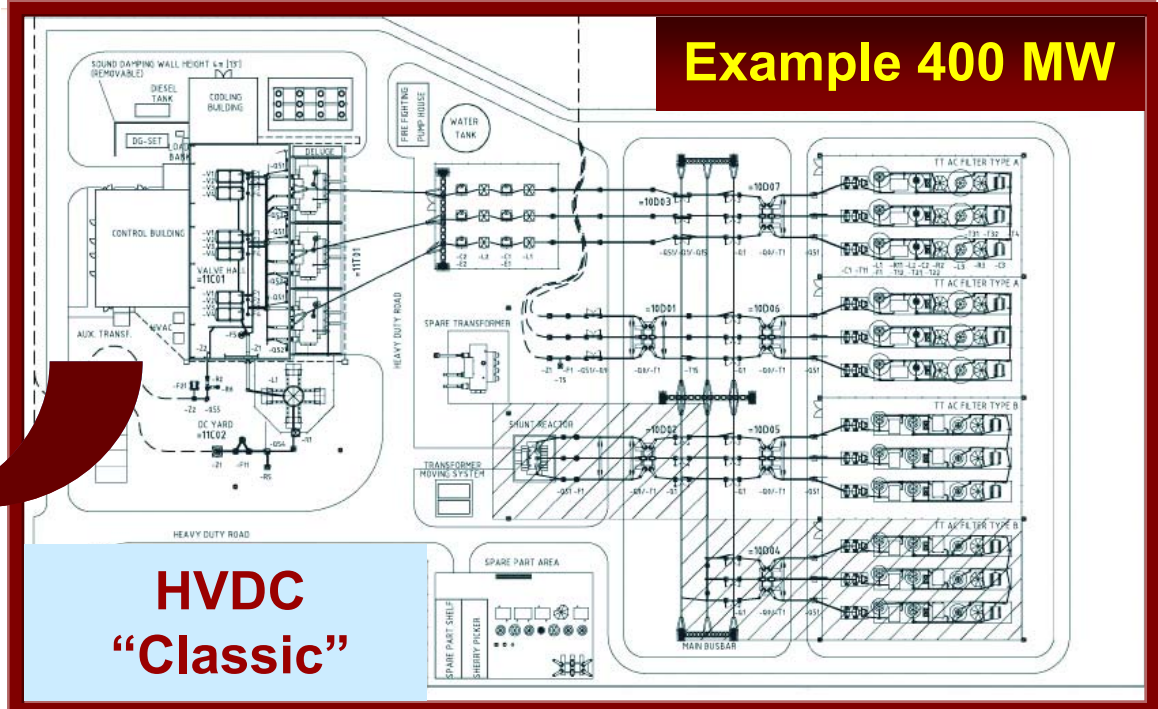
Space Saving

Example 400 MW



HVDC "Classic"

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Many Thanks ….. Questions?