NR's MVDC Solution

±10kV JiangDong MVDC for optimizing distribution network

Introduction

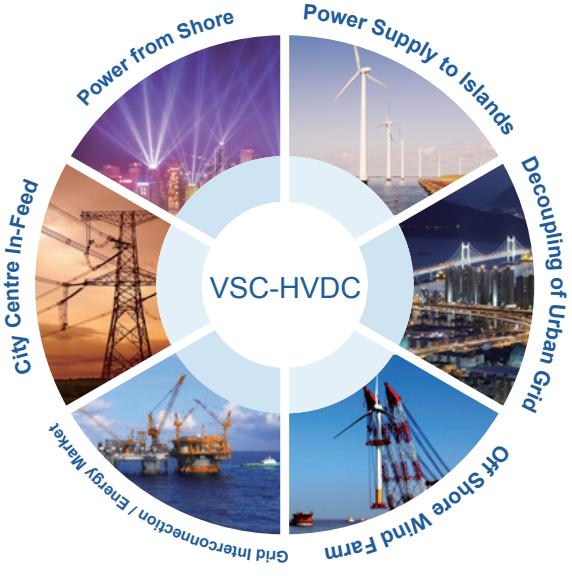
HVDC is a well proven technology designed for long distance bulk power transmission, asynchronous grids interconnection etc., due to its advantages like less right-of-way, no stability issues as AC grid, controllable power flow and firewall against AC faults.

Currently, there are two main HVDC technologies, Line-Commutated-Converter (LCC) HVDC and Voltage-Sourced-Converter (VSC) HVDC. VSC-HVDC is latest HVDC technology with unique advantages:

- Independent control of active & reactive power
- Smaller footprint compare to LCC-HVDC
- Less harmonics
- Black start capability
- Operation in weak or passive grids

Due to these advantages, VSC-HVDC is appropriate solution for:

- Grid interconnection
- Power transmission and energy trade
- Islands or weak grids connection
- City center in-feed
- Onshore and offshore renewables assess
- Power from shore



Recently new distribution solution is required because of rapid growth of distributed power generation. MVDC (Medium voltage VSC-HVDC) is the proven economical and reliable solution. Besides the advantages as high voltage VSC-HVDC, MVDC also shows dedicated benefits regarding distribution network:

- Bidirectional power flow control
- Transmission capability increase by converting existing AC link to DC
- Reactive power compensation to AC grid
- Renewable power penetration

Presently, several MVDC projects are executing worldwide.

Project Overview

JiangDong new city is situated in Xiaoshan district of Hangzhou city, with a total area of 500km², large scale industrial zone and PV/renewable generation are situated within this region, increasing the demand for the power generation capacity, reliability and power quality.

Power distribution in the region primarily relies on AC distribution grid networks which confronts operational challenges listed below:

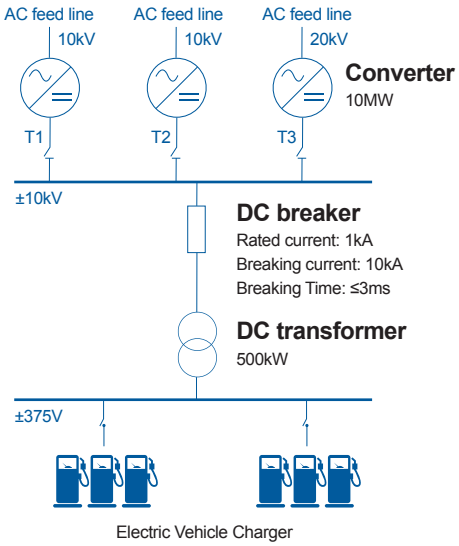
- Inadequate power supply capability around and between distribution zones. Amongst different supply zones, especially near the zones boundary , there are often shortages of power supply and deficient distribution reliability.
- Advance electrical equipment demands higher power quality. As an example, JiangDong new city' s impact loads will result in a huge voltage drop and other issues involving power quality, greatly impacting the normal operation of electronic chips and associating devices.
- Uncontrollable power flow between 20kV and 10kV distribution networks. 10kV network is incapable of power, while the 20kV grid is surplus.
- The demand for PV generation and other distributed renewable integration is rising. More and more rooftop photovoltaic generation projects are constructed in JiangDong new city.
- Electric Vehicle charger is a representative for the constant increase of DC load. The existing chargers go through the two steps of charger and DC/DC to charge the battery of vehicles and suffers from greater losses.

Through a feasibility study, the construction of a MVDC link in JiangDong new city is selected, which connects 10kV and 20kV networks, directly supply power for DC loads and enhance the renewable energy penetration capability. JiangDong MVDC project will bring the following benefits:

- Interconnection across different distribution zones, improving power supply reliability. Conventional power distribution system suffers a certain time power outage due to automatic power sources switch over when faults occur. While MVDC can achieve continuous power supply by fault ride through capability.
- Prompt dynamic active and reactive power control, improving power quality and eliminating adverse influence of impact loads.
- Bidirectional power flow control between 20kV network and 10kV network.
- Regulation of AC voltage and enhancement of renewable power penetration capability. MVDC makes renewables supply power to proximal loads to reduce power loss of transmission.
- DC/DC power supply, increases energy utilization.

The Solution

JiangDong MVDC is composed of three ±10kV/10MW back to back converter valves, DC circuit breakers and DC transformers. It connects 20kV and 10kV AC distribution networks.



When fault occurs at MVDC circuits, DC circuit breaker will isolate the fault and healthy parts operate continuously. Meahwhile, operational experiences of DC circuit breaker are accumulating .

Renewable generation or DC loads can be directly connected to MVDC network through DC transformers, it achieves optimal utilization of renewable energy by active power flow control.

Jiangdong MVDC project is unmanned operation and compact container design.

Parameters of converter valve, DC transformer and DC circuit breaker are as below:

Converter	
AC voltage	20kV/10kV
DC voltage	±10kV
Rated capacity	10MW
DC transformer	
Primary DC voltage	±10kV
Secondary DC voltage	±375V
Rated capacity	500kW
DC breaker	
Rated current	1kA
Breaking current	10kA
Breaking time	≤3ms

Jiangdong MVDC project is almost completed site commissioning and scheduled to put into commercial operation in October 2018.

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