



The demand of electrical energy has been increasing day by day. To meet these high demands, reliable and stable transmission facilities are required. Due to certain disadvantages in AC transmission lines such as thermal limits, corona effect, skin effect, etc. HVDC came into existence. HVDC has proved to be more stable and reliable in case of long distances and under water transmission. HVDC lines are also used in asynchronous tie in two or more AC systems to achieve more stability and reliability.

The first commercial HVDC project in the world was put into operation in 1954 and the ratings of HVDC projects have been gradually increased to 12000 MW with direct voltage  $\pm 1100$  kV.

## 1. Key Benefits of HVDC

- More energy transmission over long distances than AC lines
- More economical for long distances power transmission
- Lower losses over long distances
- Less right of way
- Interconnect asynchronous grids
- Controllability
- Firewall of AC fault
- Limit short-circuit capacity
- Enhance system stability

## 2. All-in-one Package Service

NR Electric's full portfolio of products enables us to provide "All-In-One" package service that covers the entire lifecycle of the solution. We value comprehensive services, long-term warranty and long-lasting spare part supply for our customers.

Our complete HVDC solution is composed of system study, system design, manufacturing, integration, FAT, commissioning and maintenance.

Our all over the world subsidiaries and Technical Service Centers (TSC) enable NR Electric to provide effective and efficient services for local customers.

Base on vast experience and strong technical background, NR Electric will provide its state-of-the-art solution to both new project and retrofit one.

### 2.1 System Study

NR Electric's core business is to provide its world-class complete HVDC solution with a strong system study capability including static stability analysis, dynamic stability analysis, transient analysis and etc.

NR Electric has got various advanced platforms for system study, such as PSS/E, BPA, PSASP, EMTDC, RTDS, RT-Lab, ATP-EMTP. Based on platforms above and experienced team, the HVDC solution is optimized progressively until fulfilling all requirements.

### 2.2 System Design

Once the system study is approved by the client, detailed design work will be executed :

- 1) Detailed technical specification of all components, including parameter, performance, quantity, model, standard, etc.
- 2) Engineering, including SLD, layout, earthing system, civil design, control and protection system, lightning protection system, communication system, auxiliary power system, firefighting, GPS system, etc.

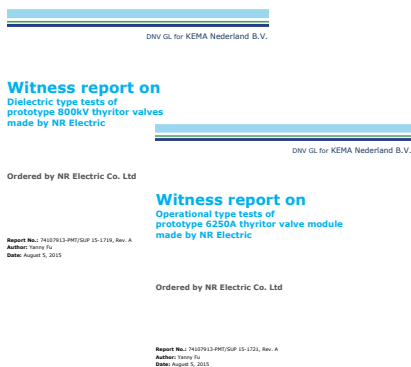
### 2.3 Manufacturing

## 1) PCS-8600 Converter Valve

The most important and major component of HVDC converter station is the converter valve, which represents the core technique of LCC-HVDC transmission. In 2015, NR Electric got witness type test reports on its PCS-8600 series  $\pm 800\text{kV}/6250\text{A}$  UHVDC converter valves by KEMA.

### Features of PCS-8600

- Guaranteed performance by multi physical field analysis platform, including heat field, electric field and force field analysis.
- Built-in platform in converter valve for easy maintenance
- High reliability due to separate design of hydraulic and electrical circuit
- Enhanced safety due to fire resistance materials up to UL94-V0



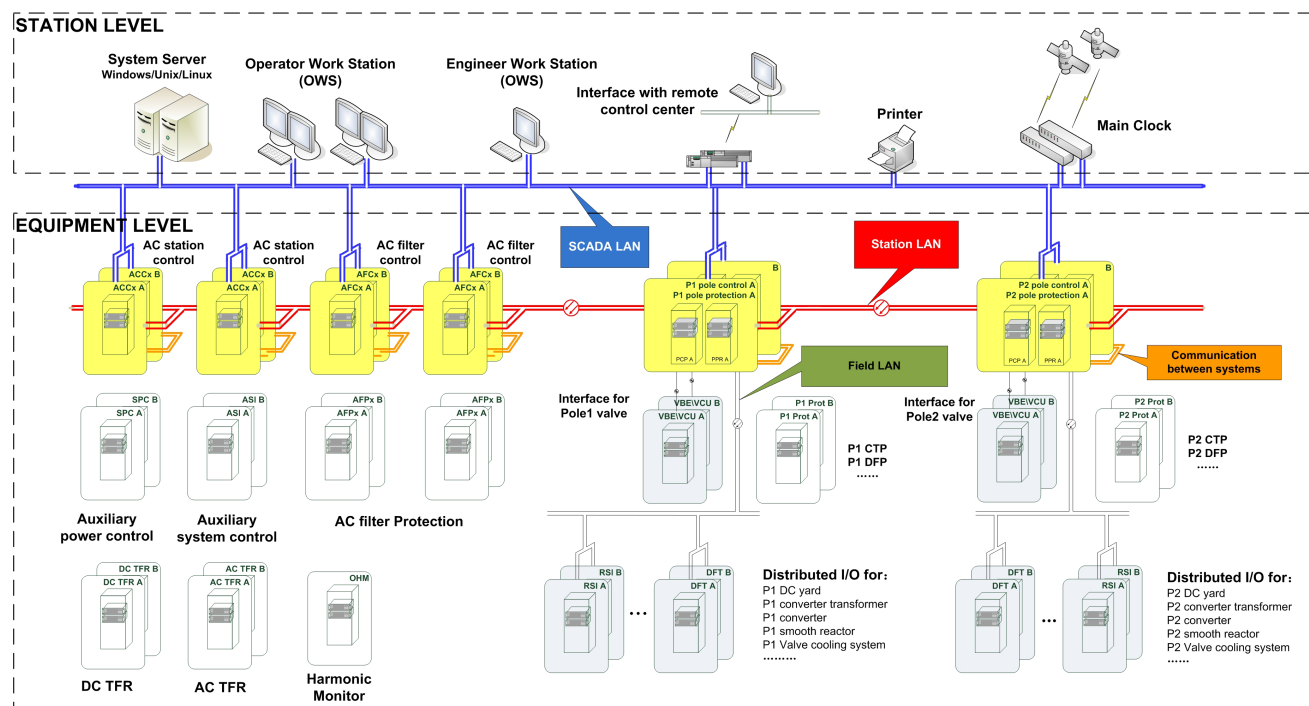
PCS-8600 Converter Valve



## 2) PCS-9550 Control and Protection System

The control & protection system adopts a hierarchical and distributed structure. The C&P system is divided into station level and equipment level. The station level includes SCADA system and the equipment level includes control and protection units, I/O interface and distributed field bus.

The design of each cell aims at mutual independency to achieve minimum information exchange between different cells and to eliminate the influence of fault in one cell on the normal operation of others.



#### Features of PCS-9550

- High reliability due to redundant configuration and seamless switchover
- Embedded and modular design, plug and play systems
- Good EMC capability
- Redundant power supply to each rack
- Self-diagnosis and online monitoring
- Remote software download and maintenance
- Fault record and monitoring
- Compliance with IEC 61850

### 3) PCS-9250 Electronic Instrument Transformer

NR Electric's electronic instrument transformer is one of the greatest breakthrough technologies being used in HVDC transmission. It directly converts AC/DC field voltage and current to digital signals and send to control and protection devices via optic fiber.

#### Features of PCS-9250

- High measurement precision
- Simple and reliable optical-fiber insulation
- Wide frequency scope and good dynamic property of harmonics
- High reliability by dual sampling and comparison technique
- Stable operation by low-power-consumption design
- Self-diagnosis



ECT



EVT

## 2.4 Integration

NR Electric has every capability to integrate the complete HVDC system solution. After verification and approval of technical specification of all equipment and thorough study, NR Electric can outsource components from open market. NR Electric can provide its own experienced quality control team or professional third party depending upon requirements from the client.

## 2.5 FAT

Equipment manufactured by NR Electric will be comprehensively tested in factory before delivery to ensure reliability and shorten commissioning time. NR Electric lab is CNAS certified and has skilled and experienced team to safe guard the quality of final HVDC products.

### 1) Thyristor Valve Test

The synthetic platform is applied to perform comprehensive thyristor valve test and to ensure high performance of HVDC products. This includes:

- Simulation of real operation
- Performance test
- Verification of design structure

Parameter of synthetic platform

DC Voltage	DC current	Fault current	Impulse DC Voltage
100kV	8kA	90kA	300kV







## 2) Insulation test

High voltage testing facility can implement  $\pm 2400\text{kV}$  DC, 4800kV Lightning surge test

## 3) Control and Protection Test

NR Electric is equipped with world-class real time and dynamic simulation test facilities. By these facilities, control and protection system will implement comprehensive test.



DC HV lab



RTDS and RT-LAB

## 2.6 Commissioning and Maintenance

NR Electric's local engineering teams are always working in close cooperation with end users to reduce commissioning time and cost. This service enables customers to work with our factory trained technical staffs to support commissioning and maintenance efforts of HVDC solutions and provide hands-on trouble shooting for you to effectively run the HVDC.

## 3. Case Study

### Changji-Guquan UHVDC Project

DC Voltage (kV)	Capacity (MW)	Type	Length of OHL (km)	Expected service time
$\pm 1100$	12000	Bipole	3324	2018

### Project Overview

NR Electric awarded an UHVDC order -  $\pm 1100\text{kV}/12000\text{MW}$  Changji-Guquan project, maximum capacity and highest DC voltage to date in China.

This project will enable coal-fired power in Xinjiang province to be transmitted to load centre – Anhui province. In addition to two converter stations, transmission line with length of 3324km will also be constructed which is also longest in China till 2016.

### Project Background

To control air pollution, State Grid corporation of China made a formulation of “4 HVAC + 4 HVDC power transmission”. This formulation aims for Energy Base Development in west part of China, reducing pollutant emission. The Changji- Guquan HVDC link is one of the planned transmission projects.

