PCS-9550

LCC-HVDC Control and Protection System

A conventional HVDC control and protection system is a key part in guaranteeing the overall performance of the HVDC thyristor-based transmission system. It contributes to safe and steady system operation, provides flexible operating modes and accurate control effects, helps to clear fault and assists in system recovery during system disturbances.

A well-designed control and protection system can maximally exert the advantages of conventional HVDC transmission technology in the following aspects:

- Long -distance large-capacity power transmission
- Underground or underwater cable transmission
- Asynchronous interconnection of an AC system

The PCS-9550 control and protection system is designed based on very powerful and flexible building blocks built with a state-of-art UAPC platform and connected by high performance fiber optic communication links. It brings the biggest convenience to new and retrofit HVDC transmission projects.

The design criterion for the control system is to reach 100% reliability for the transmission system. The NR Electric's HVDC control and protection system is equipped with parallel redundancy at all levels. All system parts that are involved in the power transfer of the HVDC link are made redundant.

System Configuration

The whole HVDC control and protection system is built in hierarchical and distributed structure, which is divided into station level and equipment level. Station level includes SCADA system. Equipment level includes control and protection units, I/O interface and distributed field bus. The station level and equipment level are communicated via SCADA LAN network that is also redundant. While the control and protection units

and their I/O interfaces are connected through optical field bus.

A complete PCS-9550 HVDC control and protection system can be divided into the following sub-systems:

- Interface with remote control center, e.g. state dispatching center, provincial dispatching center and remote central control. This sub-system consists of tele-control workstations and Remote Terminal Units (RTUs) for point-to-point communication with remote control centers.

- Operator Control System
  The operator control system is so called SCADA system. It consists of station LAN, operator workstations (OWS), engineer workstations (EWS), SER terminals, system servers, station synchronization system, etc. The operator control system is used as the man-machine interface during HVDC operation and has the following functions:
  - Receiving and executing operation orders from operators or dispatch center
  - Monitoring and processing failure information or abnormal operation status
  - Event sequence record and event alarm within the whole station
  - Synchronization and time calibration for all sub-systems within the station
  - Parameter adjustment for DC control system
  - History data documentation
  - Emergent stopping of AC and DC systems
  - Management of converter station documents and programs
  - Fundamental training functions

- AC/DC Station Control System
  AC/DC station control system consists of main computers and distributed I/O. The DC station control is assembled with the pole control system. The main functions of this system are:
  - Sequence control of the equipment in AC and DC switchyard
  - Execute trip commands initiated by protections
  - Open or close filter banks following order from pole control system
  - Interlock
  - Collect and manage the alarm signals of main/auxiliary equipment

- DC Control System
  The DC control system implements the control of bipolar, single pole and converter unit. It consists of main control computers, distributed field buses and distributed I/O. The redundant system configuration is adopted for each pole to achieve the following functions:
  - Generate control pulse for converter valves
  - Maintain the synchronization between control pulse and commutation voltage

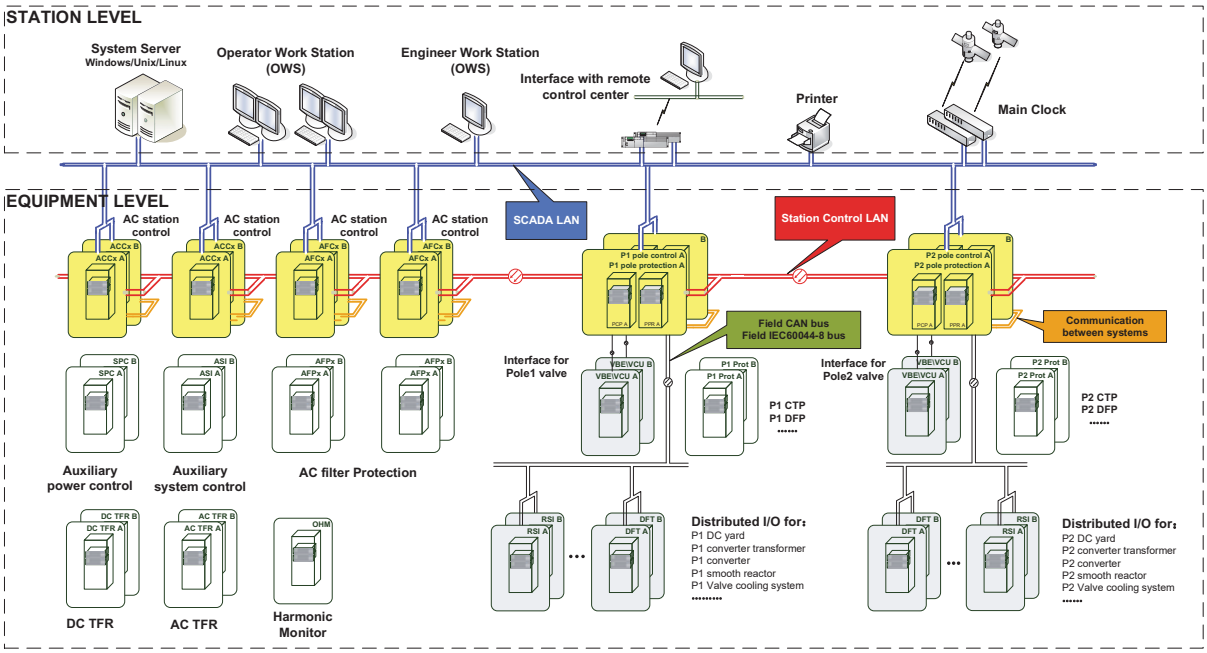

Figure 1 LCC HVDC Control and Protection Structure

- Keep interval equal between control pulses
- Deblock/block converter valve with smooth and stable startup/shutdown
- Regulate triggering angle of converter valves within the designed range to satisfy the ordered amount of power/ current.
- Adjust converter transformer tap changers according to the operation status of the AC and DC system
- Implement sequence control of HVDC system

- DC Protection System
  DC protection system ensures the safe operation of the whole HVDC system. It includes pole protection (PPR), DC filter protection (DFP), converter transformer protection (CTP) and AC filter protection (AFP).

  The HVDC control and protection system supports connection to electronic measuring devices, which receive digital measurement signals via optical fiber.

Features

- The design of HVDC control and protection system aims at 100% availability and the whole system is built in redundant structure. The reliable and complete duplicate design ensures that the normal operation of the HVDC system can be immune to any single failure.
- Full digital type - all complex control and protection functions are realized by software precisely.
- High compatibility performance.
- Experience of cooperating with different types of valves.
- Visual programming and debugging tools with cross platform capability.
- High-performance distributed system with the fastest interrupt response time of 25μs.
- Efficient heat dissipation - system without rolling fans.
- High-accuracy measuring system with synchronous sampling technology;
- Optical – media-based field bus of high interference immunity, less use of cables.
- Systematic electromagnetic shielding design, high interference immunity.
- All parts in the system are in redundant design, including I/O devices.
- Self-supervision function and fast switch-over in 2ms.
- Flexible configuration of protection, easy to realize duplicate, redundant or two-out-of-three configuration.
- Compatible with IEC 61970 standard and fully supports IEC 61970 CIM graphic-model-database integration technology.
- Supporting many standard communication protocols such as IEC-61850, IEC-60870-5-101, IEC-60870-5-102. IEC-60870-5-103, IEC-60870-5-104, IEC-60870-6 (TASE 2).
- Events are distinctively in different colors according to its emergency degree and visual program is convenient for debugging.
- Independent harmonic supervision system.
- Modular design, easy to function expansion.
- Tele-control system can be chosen between UNIX/LINUX server or embedded unit system.