



PCS-9570

Fixed Series Compensation (FSC)

The fixed series compensation plays an important role in the intelligent network due to its effect on transmission lines, especially with long distances. It can increase the power capacity of the transmission network and optimize power flow dispatching, reduce power losses and make full use of power supply at the minimum generation cost.

NR Electric's PCS-9570 fixed series compensation offers complete FSC solutions. NR's PCS-9570 consists of capacitor, metal oxide arrester (MOV), damping circuit, spark gap, bypass switch, series compensator platform, electronic transducers, FSC protection & control system, etc.

The PCS-9570 series products are designed based on years of experience in the protection and control solutions for HVAC relay protection. The AC digital sampling, based on electronic transformer measurement, effectively solves the interference problem on site. The protection and control model based on IEC61850 standards can implement sequence control of the substation series compensators to automatically switch-in or switch-over capacitor banks with series compensators, so as to optimize the power flows and improve transmission capacity in digital substations. The series products are mainly applicable in the AC transmission lines of 66kV~1000kV.

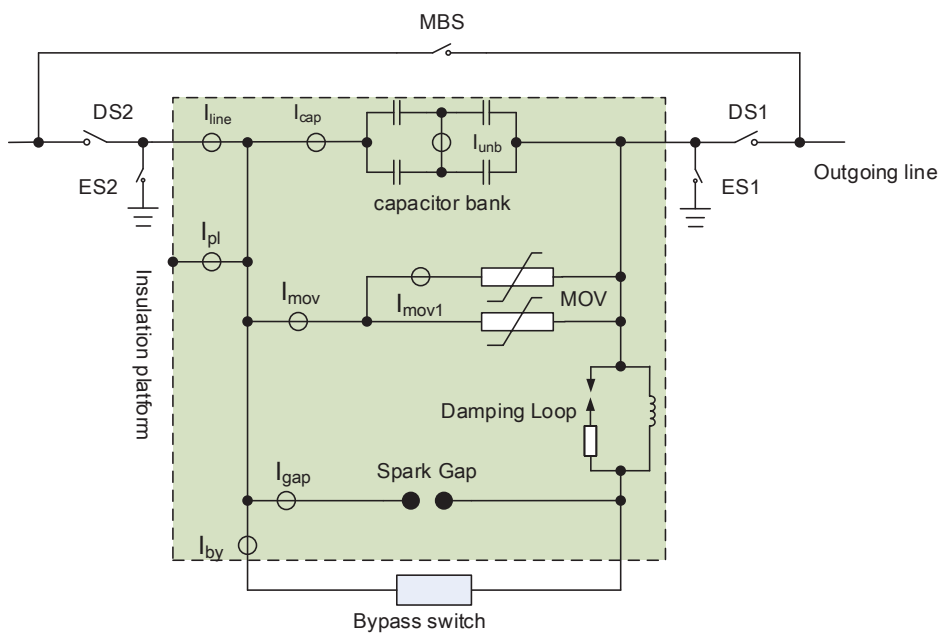


Figure 1 Series Compensation Single Line Diagram



Figure 2 220kV Fixed Series Compensation Site

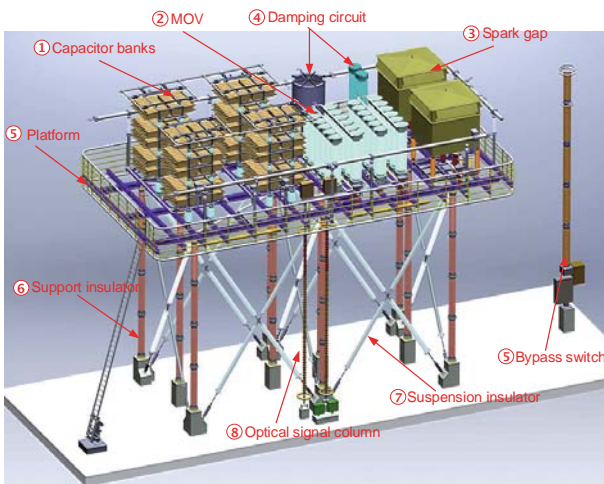


Figure 3 750kV FSC Three-dimensional Layout Diagram

System Configuration

FSC mainly consists of the following components:

- Capacitor Bank
Capacitor banks are used to achieve the compensation for transmission line inductance so as to reduce the electrical distance between two substations and improve the system transient stability.

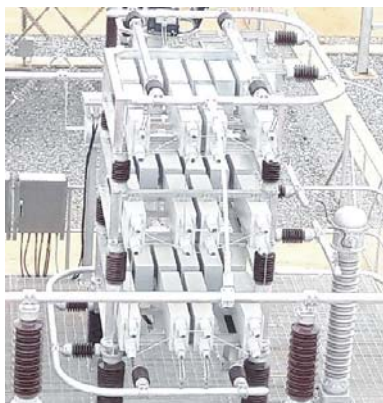


Figure 4 Capacitor Bank

- MOV
MOV has good non-linear characteristic. It provides overvoltage protection for capacitor banks to limit the overvoltage across capacitor bank at the protection level 2.0pu ~ 2.5pu (typically) or less, to ensure the safe operation of capacitor bank.
- Spark Gap
The duration from turn-on command issuing to completely spark gap conduction is less than 1ms. It prevents the MOV against damage due to the excessive absorption of energy.
- Damping Circuit
The damping device comprises damping reactors and linear resistor string gap (or non-linear resistance). When the series compensation device is in bypass state, the damping circuit can facilitate and speed up the energy storage in capacitor.
- Bypass Switch
The closing time of bypass switch is longer than the conduction time of spark gap, but it can cause the spark gap interrupted. In addition, it provides normal operation and maintenance functions for series compensation devices.
- FSC Control and Protection System
The typical configuration of series compensation is shown as below. Protection devices and trigger gap control are in redundant design. The switching control device integrates conventional circuit breaker monitoring and control functions in one rack. The protocol converter and the remote device can be configured according to the actual situation. The remote control unit provides distant sequence control of series compensation to realize free-maintenance station.



Figure 5 MOV



Figure 6 Spark Gap

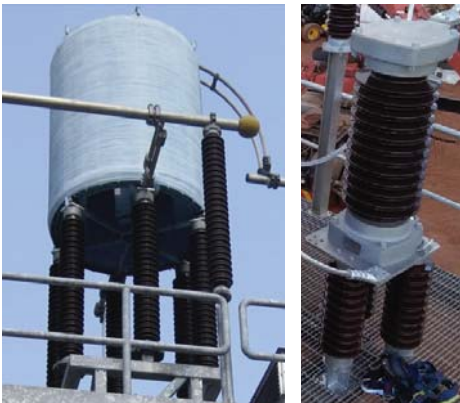


Figure 7 Damping Circuit

Functions

- Support manual enable/disable capacitor banks and sequence enable/disable capacitor banks, support five-maloperation system for switch operation.
- Provides complete protections, including: capacitor protection, MOV protection, gap protection, etc.
- Support the linkage interface with line protection and SSR (Sub Synchronous Resonance) devices.
- Equip with HMI monitoring, clock synchronization, fault recording and other functions.

Features

The PCS-9570 series products are developed based on NR's solid AC high voltage protection principles and years' of

experience. It provides protection and control solutions for AC transmission line capacitors in series compensation system. It features:

- Professional design of safe and reliable equipment
The PCS-9570 system adopts safe and reliable primary equipment such as capacitors, MOV, spark gap, damping device, electronic transformer and protection & control system.
- Unified UAPC platform
The self-developed UAPC platform has visual programming software and hardware modular configuration. It is flexible for expansion. Communications between hardware modules are fulfilled by internal high-speed bus.
- The operation of duplicated protections are fully independent. The starting components are combined with protection output to increase operation reliability.
- The use of electronic transformer greatly improves its anti-interference capability.
- Interposing relay sets are developed for the closing of bypass switches.
- The control and protection module can facilitate the realization of sequence characteristics of series compensation equipments.
- Measurement and control devices are fully complied with IEC61850. Operators can enable or disable dispatching of series compensation devices through the remote one-touch control function.
- Easy-to-use testing device
The conventional relay tester can ease the on-site inspection of series compensation system.

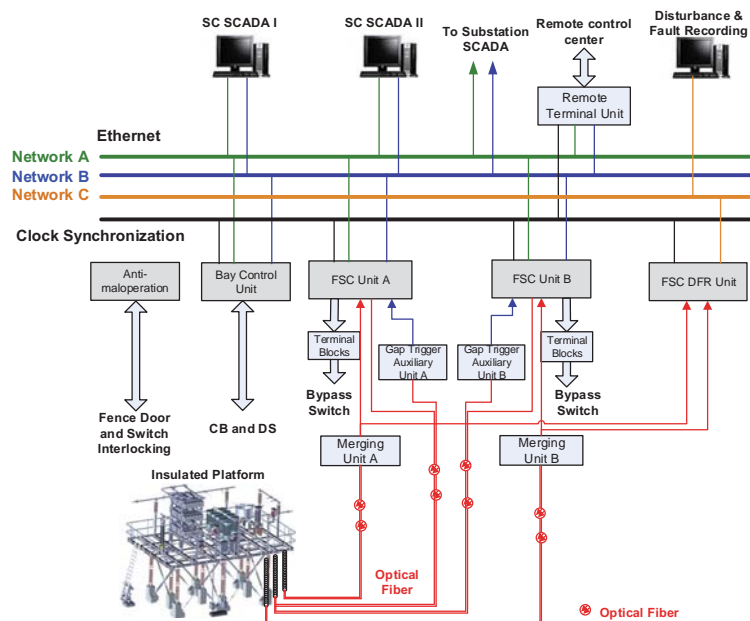


Figure 8 Fixed Series Compensation Network Structure