It is an active electronic transformer (including the electronic current transformer ECT, electronic voltage transformer EVT and electronic current/voltage integrated transformer (ECVT) that is used with the gas insulated switch(GIS) or air insulated switch (AIS)as a complete set. Its voltage level covers from 10kV to 1100kV(including 10kV,66kV,110kV, 220kV ,330kV ,500kV ,750kV,800kV,1000kV and 1100kV).

The devices complies with standards, such as: IEC61869-9,IEC60044-8 etc.

Figure 3: PCS-9250 series ECT/EVT for GIS application

Figure 3: PCS-9250 series ECT/EVT for AIS application

Figure 4: Outdoor MU & ICU

PCS-221S Merging Unit (MU)

PCS-221S Merging Unit (MU) is used to receive AC analog values and transmit the Sampled Values (SVs) to protection devices, Bay Control Units (BCUs) or electricity meters through optical communication channels based on the IEC 61850-9-2 protocol and IEC61869-9 protocol. PCS-221S provides 2 methods to receive AC analog values: to sample AC analog values directly as a Stand-Alone Merging Unit (SAMU), or to receive digital sampling data from Low-Power Instrument Transformer (LPIT) via optical fiber.

The PCS-221S can also be used to control primary switching equipment, i.e.: Circuit Breaker (CB), Disconnector Switch (DS), Earthing Switch (ES) in digital substations of all voltage levels. It supports real-time GOOSE communication, and can realize tripping and closing of CB/DS/ES via protection devices and BCUs. It can acquire binary input signals of primary equipment (CB/DS/ES) at the same time. It can meet the requirements of GOOSE tripping by point-to-point mode or network mode.

PCS-S series protection and control devices

PCS-S series protection and control devices are fully compliant with IEC61850 Ed2/Ed2.1, Cyber Security function and PRP/HSR communication protocol. Special algorithm and patented technology can increase the reliability, stability of the substation.

PCS-S series products are the highly modular and flexible generation of smart devices with the functions of protection, automation and control designed for innovative solutions. With its modular structure, flexibility and the powerful PCS-Studio configuration tool, PCS-S series products offer future-oriented system solutions with high investment security and low operating costs.

PCS-9886 Network Analyzer

PCS-9886 network analyzer is a network message recording and analyze device which is suitable for the integrated automation systems of intelligent substations and conventional substations with different voltage levels.

The PCS-9886 faces the station process layer network, station control layer network and power dispatching communication network. It records all kinds of communication messages including SV, GOOSE, MMS, IEC 60870-5-104, PRP/HSR, SNTP, PTPv2 in substation communication network, monitors the working status and health status of substation communication network system and gives early warning through real-time analysis of messages.

Configuration Tools of Digital Substation

Two configuration tools are designed to realize the configurable functions of IEDs.

PCS-Studio is a software tool designed for PCS-S series devices based on UAPC platform. The software has integrated offline visual programming configuration, device drive file generation, device drive file upgrading and importing, online debugging and download, and GOOSE/SV configuration function.

SCL Configurator

The SCL configurator is developed for the engineering implementation of IEC61850. It provides the visual configuration platform/tool especially used for SCL files. It can be used to create, edit and view SCL files, which conform to IEC61850-6 regulations, and then construct the substation configuration, structures, models, etc. to meet different requirements.

Both PCS-Studio and SCL Configurator provide interlock configuration function within a bay, whereas only SCL Configurator provides inter-bay interlock configuration function.

Figure: Flow chart of substation engineering configuration

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Solutions for Digital Substation

Experienced Digital Substation Pioneer

NR ELECTRIC CO., LTD.

Introduction

Now-a-days Traditional substations are being boycotted due to its duplication investment over equipment, less reliability, accuracy and time constraint. Traditional substations are those old designs, which use traditional CT/VT and analog communication system. Data sharing across process level is not possible due to analog communication.

Based on traditional substation, digital substation extends communication technology from indoor to outdoor through onsite installation of Intelligent Electronic Device (IED) and IEC61850-based communication network on primary switchyard. The digitized signals and information sharing keeps the digital substation in an efficient, economical, reliable, safe and stable operation.

The digital technology enables the traditional copper cables replaced by a few optical fibers, and the analog signal transmission replaced by digital transmission, to achieve the self-describing via the MMS protocol in the substation control layer (SCL). This maximizes the IEDs' interoperability and makes the commissioning easier. In additional, it reduces not only the overall the construction costs by more than 20% and reduce the maintenance costs by more than 40%, but also the design and commissioning workload by 40% or so.

Moreover, the introduction of electronic transformer and optical transformer applications in digital substation eliminates the problem caused by traditional transformer, such as saturation inclination, secondary circuit opening, poor anti-interference and accuracy. These smart transducers are highly reliable for the digital substation sampling data.

After over more than 10 years of advanced research and over 1500+ projects around the world, NR Electric's digital substation delivers the great potential of this technology: such as:

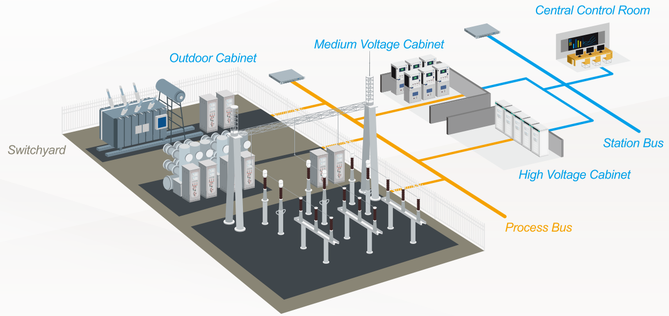
- Interoperability and configuration
- Maximized reliability and availability
- Real-time performance
- Smart Grid communication capabilities
- Reduced cost of ownership along with various outcomes and rewards

In addition, solution continuity from traditional system to the newest digital substation is ensured through proper planning and designing.

NR Solution of Digital Substation

NR Electric has the capability to provide all products in process level, bay level and station level.

	IEC61850 Ed2 adopted at station level	IEC61850 Ed2 adopted at process bus	Electronic CT/VT are used
Scheme 1	√	√	
Scheme 2	√	√	√



Recommended Networking Scheme

The operation of a digital substation relies on a reasonable communication frame, where the communication between process bus, bay level and station level is accomplished by high-speed Ethernet networks.

The entire communication network includes:

- Station bus communication network between bay level and station level
- Process bus communication network between bay level and process level

The communication protocols of station level network, the process bus GOOSE network and analog sampling SV network are independent and assigned with different tasks. It also supports PRP/HSR communication protocol.

Features of MMS network data in station level

- Strong abruptness
- Massive volumes of data
- Low requirements on real-time transmission

MMS network is the communication bridge between SCADA, dispatching centers and IEDs in bay level with interlocking GOOSE application. The full use of Ethernet switch to process the message priority can bring the realization of GOOSE scheme between relays.

Features of GOOSE network data in process bus

- Small volumes
- High requirements on transmission reliability and real-time performance

GOOSE network in process bus can be configured with SV network or independently.

Features of SV network

- High reliable massive volumes of data
- Real-time, stable and reliable data transmission
- Data sharing

NR Electric's PCS-S series protection and control devices are fully compliant with IEC61850 protocol and can be directly connected to SCADA, Gateway and Protection Management Units. The advanced IEC61850 engineering configuration tools can generate SCL files, which can be used for data and information exchange with other engineering tools from third party manufacturers.

According to the features of network structures, NR Electric frames a digital substation-networking scheme, where MMS network is configured independently along with combined GOOSE and SV mode. The advantages of this scheme are excellent communication quality and simple network structure. The reason to configure SV and GOOSE network together in the process bus is the featured data flow. SV has large but stable data flow, while GOOSE has small but burst data flow.

GOOSE and SV can form different networks according to the voltage levels. For example, PCS-978 transformer protection can provide optional modules to support independent process bus networks with different voltage levels. This configuration scheme can simplify network designs, ease commissioning and optimize network reports.

Each MMS, GOOSE and SV boards of PCS-S series devices are equipped with four 10/100MB fiber optical Ethernet ports to support double network structure of process bus and station bus. Also, all of the products from NR Electric can support the PRP/HSR communication protocol.

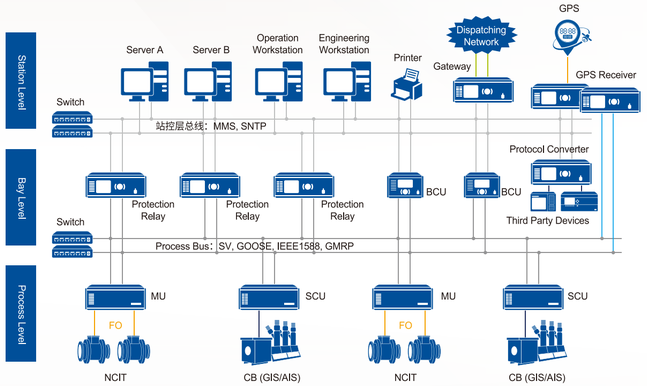


Figure 1. Scheme of independent MMS network and GOOSE+SV combined network

Protection & Control Devices for Digital Substation

NR Electric's protection & control devices are based on the patented UAPC hardware platform, designed by NR Electric and can be widely used in digital substations.

PCS-9250 Series Electronic CT/VT (Optional)

PCS-9250 series is a substitute product of conventional electromagnetic current and voltage transformers. It has advantages of simple insulation design, small size, wide dynamic range, and no magnetic saturation and resonance, etc.