Power Stability Expert

| Case Study |

# Beijing Future City 220KV Digital Substation

## Enhanced Reliability of China's First Indoor Digital Substation

Beijing 220kV Future City Substation is a typical digital substation invested by State Grid Corporation of China(SGCC) in 2013. It is a vital load-center substation in Beijing using underground installation. In the year 2013, NR Electric (NR) won the order from SGCC to provide its innovative digital substation solution to this Substation. In the end of December 2013, after one month's site test and commissioning, the substation was put into service.

## Overview

The Future City Substation locates in Changping District of Beijing. It is an important hub substation of north China power grid and a key component of the smart grid of SGCC. Also it is the first indoor digital substation in China. The Future City Substation adopts 220/110/10kV three-level half underground structure, in which the 220kV side and the 110kV side using direct earthing system while the 10kV side using small resistance earthing system.

## NR Solution

Considering the reliability issues of Beijing power grid and speed up the development of smart grid, the Future City Substation adopts a classical digital substation structure. As the solution provider, NR offers its field-proven network solution. Double-star topology is used to fulfil data exchanges and communications between process layer and station layer in the whole station.

The communications between station level and process level in the whole station are based on IEC61850 standard. Secondary equipment including electronic transformers, MUs(Merging Units), IBCs(Intelligent Breaker Controllers), protection devices, monitor system and fault recording devices, etc., are all supplied, integrated and installed by NR.

Station level network: the station level network uses double star topological structure to transmit MMS message and share GOOSE message to realize the communication between bay level and station level.

Process level network: in the process bus, 220kV and 110kV devices adopt double star network while 10kV devices uses single star network configuration. All three networks are physically independent. IEC61850-9-2 SV and GOOSE messages are shared via transmission network to realize functions such as networking tripping via GOOSE, monitoring, control and fault recording etc.

Station level equipment includes monitoring host, data server, synthetic application server, data traffic gateway, printer, network analyzer and other smart interface devices, etc. The man-machine interface is fulfilled by station level equipment for operators to realize management and control functions at bay level and process level. It also supports communications with remote control center to adapt to unattended substation's requirements.

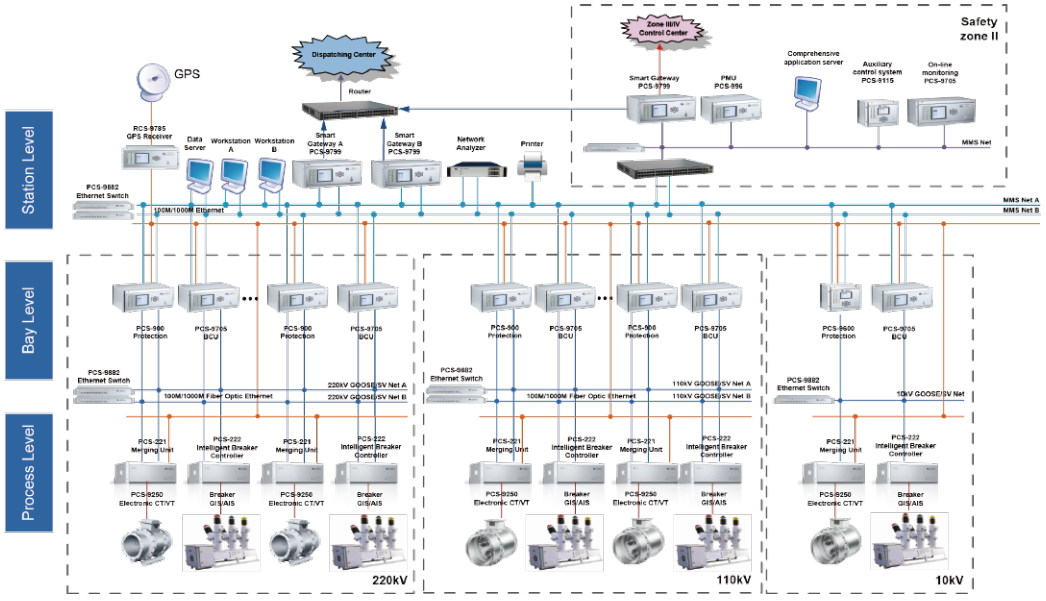


Figure 1. Schematic Diagram of Future City Digital Substation

In this substation, considering data volume and reliability, the 220kV process level equipment uses MU(PCS-221) and IBC(PCS-222) independent configuration, while 110kV process level uses integrated IED of MU and IBC (PCS-222EB) to maximally enhance the integration of device and save spaces.

NR's digital substation solution features,

- All-in-one monitoring system composed of monitoring host, data server and comprehensive application server.
- Advance functions such as event logging with alarm status display and inquiry, equipment status and parameters inquiry, in-station VQC, sequence control and data identification, etc.
- General data query and accesses to station level equipment are enabled by consolidated storage of digital substation's panoramic data.
- Powerful PCS-9799 smart gateway with telecontrol, protection and fault information management functions
- Multi-function Bay Control Units integrating monitoring, control, PMU and measurement functions in one unit. Digital interfaces are adopted to realize interlocking, control and measurement of primary equipment, and to realize PMU and electrical measurement statistics functions.
- Data transformation and sharing between primary equipment and the secondary system are fulfilled in process level
- Stable data sharing via IEC61850-9-2 is guaranteed by synchronous interpolation algorithm of merging unit.

## Customer Benefits

So far, Beijing Future City Substation has been smoothly operating for three years. After put into service, the security and reliability of electricity transmission in Changping District and the southeast area of Beijing City has been significantly improved. The stability of power supplies to important and critical consumers are guaranteed.

The completion of Beijing Future City Substation has created a good example for SGCC to implement smart grid upgrade in the future. Meanwhile, as an important hub station, the Future City Substation uses full digitalized configuration to reduce the total construction work, such as,

- Traditional cables are replaced by optical fibers to limit the occupation area
- Secondary system communication reliability is enhanced through using optic links
- Non-conventional instrument transformers substitute for conventional transformers to reduce the influence of electromagnetic interference and dangerous of secondary open circuit and to enhance the accuracy and reliability of sampling
- Manual maintenance works and labor costs are greatly reduced, which thanks to the application of IEC61850 communication model

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