Power Stability Expert

PCS-9617MG Microgrid Controller

Making microgrid under perfect control

Microgrid is an electricity distribution system containing loads and distributed energy resources, (such as distributed generators (DG), storage devices, or controllable loads) that can be operated in a controlled, coordinated way either while connected to the main power network or while islanded. With its autonomous control, protection and management, it provides multiple advantages including higher energy utilization rate, higher power supply safety & reliability, less power transmission loss, low environmental impact.

PCS-9617MG is a coordination control equipment specifically designed for microgrid (both grid-connected and islanded). It has the function of control, protection, measuring, monitoring, communication, etc. and carries out the coordinative control of DG, energy storage, controllable load to realize the safe, stable and economic operation of microgrid. This helps to increase the economic benefit for customers and enhance the penetration and utilization of DG and renewable energy.

PCS-9617MG in Microgrid

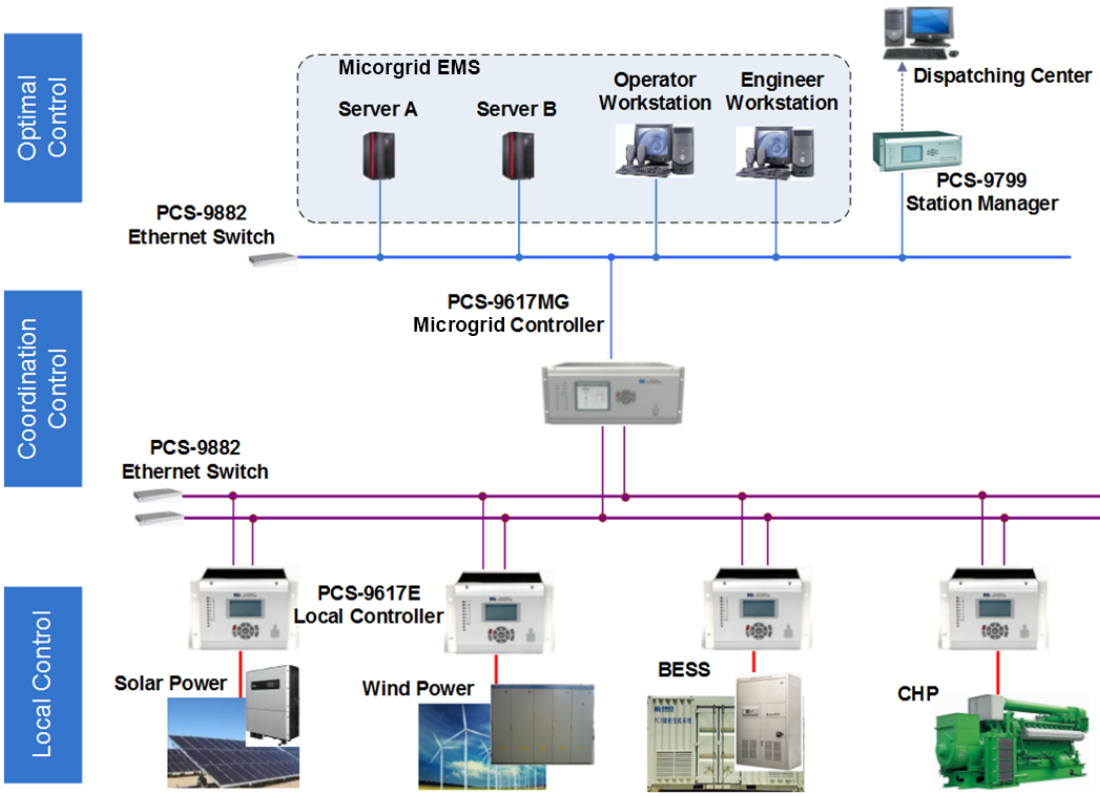
NR's microgrid control and protection system adopts the layered and distributed design, which is divided into optimal control level, coordinative control level and local control level.

The optimal control level includes the microgrid energy management system (EMS) and communication devices, realizing the functions of data analysis, energy prediction, load management, optimal operation, economic dispatching, etc. And the Local control level includes DGs, energy storage, local controller and protection IEDs, providing fast response speed during disturbances or short-circuit faults, and stabilizing power-supply by the self-regulation of converter or the fast action of protection equipment.

As the interface between optimal control level and local control level, the coordinative control level includes the microgrid controller, which acquires the information of DGs, energy storage, and important load via the control communication network. When microgrid operates

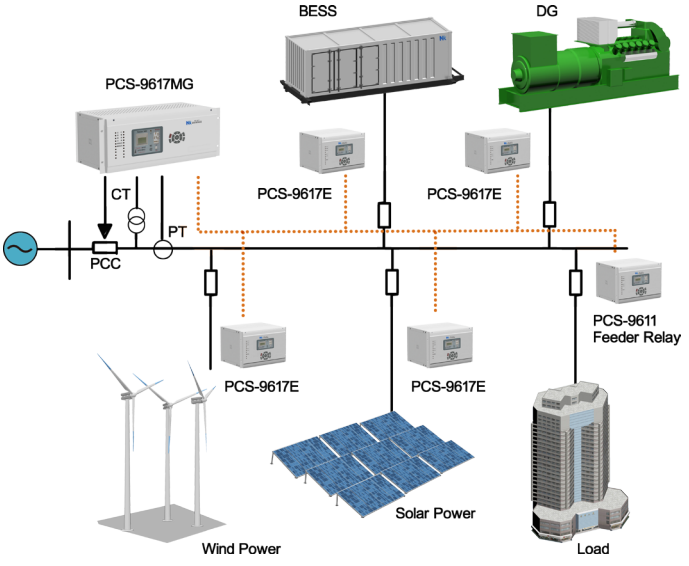
in the islanded mode and large disturbance occurs (such as non-scheduled grid outage, large-capacity DG tripping, etc.), the microgrid controller coordinates the operating modes of energy storage and diesel generator as well as the output power of DGs to maintain the voltage and frequency within the allowable ranges and guarantee the stable and safe operation of microgrid system.

PCS-9617MG microgrid controller is the key controller in coordination level and is specially designed for the coordination and integration of the various devices in local control level. The high-performance and ms-level response speed of the microgrid controller enables the seamless switch between different microgrid operation modes.



Function

PCS-9617MG is developed based on high-performance Unified Advanced Platform for Protection and Control (UAPC) independently developed by NR Electric with high speed control response and thousands of applications. This guarantees the stable and safe operation of microgrid with seamless operation. In addition, it adopts the advanced optimal control algorithm to ensure the highly efficient and economic operation of various energy sources within microgrid, such as DG, CHP, solar generation, wind generation. Its control logic can be flexibly configured according to the various microgrid application scenarios. Besides of the advanced control functions, it also integrates the functions of microgrid interface protection.



PCS-9617MG includes the following functions:

Control

a) Control Strategy for Grid-connected Mode

- Tie-line power control

In order to avoid the impact of large tie-line power variation and power flow of distribution network, microgrid controller controls the output of energy storage devices and DGs and regulates the power flow of Point of Common Coupling (PCC) within the predefined range. This makes the microgrid as a controllable source/load for a friendly grid-connected distributed microgrid system.

- Ancillary Services

Control the power of energy storage and DGs based on the dispatch center command or local voltage/frequency to supply the grid with the frequency & voltage regulation service.

- Energy storage management

Fluctuation suppression: The randomicity and volatility of wind generation and solar generation impact the power quality and stability of microgrid. However, the energy storage device has the capability to dynamically absorb or release the power depending upon grid needs. Special strategy is set in the controller to suppress the power output fluctuation of wind generation and solar generation and realize the smooth power output of wind generation and solar generation.

Peak shaving: When microgrid operates in the grid-connected mode, the grid injects power into the distribution system during the peak-load period and absorbs power from the distribution system during the valley-load period. The peak-valley schedule curve function is set in the controller, which receives the schedule curve issued by the dispatching center and controls the power output according to make the microgrid an excellent solution for the distribution system. A peak-valley power output curve can also be set locally to generate power during the peak-price period and absorbs power during the valley-price period to obtain the benefit of peak-valley price difference which ultimately enhance the economic efficiency of the Microgrid.

b) Control Strategy for Islanded mode

- Frequency & voltage emergency control

In islanded mode, the power deficiency or excess may lead to the sharp variation of frequency and voltage. This severely impacts the normal operation of loads within microgrid and causes the system breakdown. The frequency & voltage emergency control is set to balance the power demand within microgrid and to recover the voltage and frequency within the allowable operating ranges by the energy storage output control, fast load shedding and DG disconnection.

- PV power limit control

In order to avoid the automatic shutdown or damage of generator (diesel generator, gas engine) due to its too low power output, the PV power output is limited by the automatic control to raise the power output of generator up to an allowable range.

c) Transient process control

- Switching between grid-connected and islanded

Switchover from grid-connected mode to islanded mode: When the grid is de-energized due to fault, overhaul, etc., the controller quickly detects the islanded condition, trips the circuit-breaker of PCC and sends the islanded signal to the energy storage and DGs for the switching between microgrid two operating modes.

- Synchronous grid-connection

Switchover from islanded mode to grid-connected mode: The controller provides automatic synchronous switching-on function for a safe and reliable grid inter-connection of microgrid.

Protection

All the major protection functions according to grid codes needed including over-current protection, under/over voltage protection and under/over frequency protection are all inbuilt in the controller.

Monitoring and Measuring

a) Voltage, current, frequency, active power, reactive power, power factor and kilowatt-hour at PCC

b) Monitoring of circuit-breaker position, CT broken, PT broken, etc.

c) Up to 64 fault & action logs, 64 fault wave records, 1024 self-check reports and 1024 COS logs

d) The time synch interface supports several GPS synchronization modes, including IRIG-B, SNTP, as well as IEEE1588 V2 high-precision net synchronization mode

Communication

- Up to 6 10/100Mbps Ethernet ports, one 1000Mbps Ethernet port and 6 RS-485/RS-232 serial ports are equipped for communicating with DGs and SCADA system. Additionally, it supports IEC60870-5-103, IEC60870-5-104, DNP3.0 and MODBUS (Master and Slave).
- Up to 8 100Base-FX optical Ethernet ports are equipped for the fast communication with PCSs and supportsIEC`61850-8-1 GOOSE.
- Hundreds of communication protocols library is available for communicating with DGs and other intelligent devices. The configuration mode is convenient and the protocol module configuration is flexible and expandable.

Features of PCS-9617MG

- It is developed based on the unified control & protection platform (UAPC), with relay-level response speed and utility-grade reliability, capable of seamless switchover between different microgrid operating modes.
- The control logic can be flexibly configured, for the specified logic development by user.
- Sufficient communication ports and protocols to realize the communication access of converters with different equipment and different manufacturers.
- The communication card and I/O module can be flexibly and optionally configured to meet the requirements of different microgrid capacities.

Microgrid References

- The microgrid protection and control system of Yunnan science park
- The microgrid protection and monitoring system of Island Dawanshan
- The microgrid protection and monitoring system of Island Guishan
- The microgrid protection and monitoring system of Island Dong’ao
- The microgrid protection and monitoring system of Gonghe, CGNPC
- The protection and control system of Dynamic simulation microgrid, Zhejiang EPRI
- The protection and control system of the Changchun Institute of Technology
- The microgrid protection system of Yanqing, Beijing
- The microgrid project of Jiaze, Ningxia
- The PV-storage microgrid of Jiangning intelligent industrial park in Nanjing city
- The India's first 500kW Li-ion and 500kW Lead Acid Battery Energy Storage System of Power Grid Corporation of India
- The AC/DC hybrid-type microgrd turnkey project of State Power Economic Research Institute, Beijing city of China

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