



SOLUTION CATALOGUE

Power Stability Expert



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NR Electric (NR), as a power stability expert, is dedicated to provide smart, reliable and environmental friendly solutions for power generations, power grid and industries. The products and solutions cover Protection, Automation & Control (PAC), HVDC & FACTS, Renewable & Micro-grid, engineering, consultation & services.

Based on more than 20 years of professional experience of high-tech innovations, NR provides a wide spectrum of electrical and power electronics solutions to enable its worldwide customers to meet the growing challenges of quality and safety. These solutions play vital roles from power generations, HVAC and HVDC transmissions, distributions, industry, to eco-friendly renewable wind and solar farms.

NR focuses on the research & development of innovative products and solutions with unique patents and knowhow. We combine products, systems and services to provide comprehensive solutions in the following fields:



Protection, Automation & Control

Full spectrum of smart, flexible and reliable solutions for power system protection, automation and management.



HVDC & FACTS

Proven and cost-effective solutions to achieve a Flexible AC Transmission System (FACTS) & HVDC transmission system to improve the safety, reliability, efficiency, transfer capacity and to ensure quality of your next generation smart grid.



Renewable & Microgrid

NR has specialized in renewable energy and micro-grid energy technology offering customers a solution for the major solar farm inverter, Power Conversion System (PCS), SCADA, protection & control system and reactive power compensation, etc., to make your renewable energy and microgrid system as effective as possible.



Engineering, Consulting & Service

NR offers engineering, consulting and services solutions to implement a project to customers' exact specifications and efficient production processes. As an experienced and reliable partner, NR ensures smooth project delivery and guarantees successful turnkey





Protection, Automation & Control (PAC)

Built upon decades of research and development excellence with field proven application experience in power system, leveraging numerous operational experiences in power secondary system, NR provides integrated PAC solution comprising a full spectrum of hardware & software products to safeguard reliability and safety of power system.

The unified and integrative solution covers from station level to grid level. At a station level, the PAC solution integrates protection, control, monitoring, metering, recording and communication in each substation.

At a grid level, it provides the following:

- Energy Management System (EMS)
- Distribution Management System (DMS)
- Dispatcher Training Simulator (DTS)
- Power Stability Control System (PSCS)
- Wide Area Measurement System (WAMS)
- Disturbance & Fault Management System (DFMS)
- Protection Management System (PMS)

The Local Area Network (LAN) is used for the internal communication within substations or control centres. The Wide Area Network (WAN) such as Synchronous Optical Networking (SONET)/Synchronous Digital Hierarchy (SDH) networks can be adopted for the inter-station communication according to the specific application requirements.

With the PAC solution, utility operators can unify the management system of control centres and substations. Based on the IEC 61850, IEC 61970 standards, and other international communication protocols, data is classified and can be shared by several applications within the Integrated Secondary System. The unified data format allows for easy extension of new applications. The cyber security is fully considered and deployed in the overall application.

Protection & Control Solution

NR is dedicated to providing diverse protection and control products with well-proven technologies that have been widely employed to thousands of projects worldwide. The protection and control solution covers all primary assets including: generator, transformer, transmission line, bus-bar, circuit breaker, reactor, capacitor, feeder and motor etc.

As for hardware architecture, NR's innovative two-out-of-two logic is implemented to eliminate mal-operations due to the component failure.

The blend of the two-out-of-two logic and the implementation of a redundant scheme ensure the dependability and security of our protection & control solution systems. NR invented the Deviation of Power Frequency Component (DPFC), a protection principle, which can assist, identify & confirm the fault in milliseconds and clear the fault fast & accurately.



Protection & Control for Transmission and Distribution

NR's fast & reliable, protection & control devices provide accurate protection of substations with voltage levels up to 1000kV. The distance & current differential protections provide protection and control solutions for transmission lines with high-speed sub-cycle distance element. They are compatible for the application on overhead lines and underground cables including series compensated, double-circuit, heavily loaded, weak in feed (WI), short and long transmission lines. The centralized & distributed bus-bar protections provide scalable bus-bar and breaker failure protection for various bus-bar configurations. The patented weighted anti-saturation algorithm in the current differential protection quickly clears internal fault during CT saturation while keeps security to external fault. Transformer protection provides full-scheme protection & control for various transformer applications, including two-winding transformers, three-winding transformers and auto-transformers. It adopts adaptive-blocking and cross-blocking methods for inrush current to enhance the performance.

All the protections are fully complied with IEC 61850, offer interfaces for station bus and process bus and supports IEC 61850-8-1 MMS, GOOSE, IEC 61850-9-2 sampling value.

Protection & Control for Generation

NR provides the all-around solutions for generations, including generator, step-up substation and auxiliary electrical system. NR's protection and control solution has been widely used in high capacity steam-turbine, gas-turbine and nuclear power generators. The unique generator transformer unit protection provides the complete main and backup protection of generator-transformer units which comprises generator, main transformer, auxiliary transformer and exciter or excitation transformer. Variable slope percentage characteristic is adopted for current differential protection. High sensitivity can be gained during internal fault, while transient unbalance current can be avoided during external fault. DPFC percentage differential protection can detect slight fault within the transformer and generator. NR's distribution protection and control devices addresses the solution for the auxiliary electrical system to achieve high operation reliability. The directional over-current protection provides protection, control, monitoring and measurement of distribution feeders, transformers and distribution lines. It can also be applied as interlocking overcurrent (ILOOC) protection for distribution bus-bar. The motor protection solution covers the motor management and the motor protection & control of PCC and MCC system. The automatic transfer device continuously monitors the power supply lines of load and provides automatic transfer logic from a main source to backup source. The high speed transfer device is utilized in power plants to ensure the continuous and reliable power supply for bus-bars.

Protection & Control for Industrial

NR provides comprehensive protection and control solutions for large industrial enterprises including petrochemicals, coal, iron and steel, metallurgy and electrified railway. Uninterrupted power supply is always critical to industrial enterprises and thus highly reliable protection and control is necessary. NR provides the reliable protection and control products for severe environmental conditions in industrial operating environment. The protection and control solution ranges from the auxiliary electrical system of industrial factories to the self-owned power plants and the interconnection substations. The full series of protection and control devices enables reliable protection and control of primary equipment, offering security for operation personnel and primary assets. As well, NR provides the arc protection solution for the distribution bus-bar and switch cabinet applications, used to prevent short circuit by arc light. The integrated unique sensor technology can help to fast locate arc short circuit and the device can quickly trip the fault circuit to minimize harms.

Solution Features

- Full-range protection and control solutions covering transmission line, transformer, bus-bar, circuit breaker, generator, reactor, feeder, motor and capacitor.
- Successfully applied to the world highest voltage level - 1000kV HVAC substations.
- High speed fault clearance capability and well immunity to power swing and load fluctuation
- System security and dependability enhanced by two-out-two logic in hardware design
- Unique power swing blocking releasing logic to prevent mal-operation of distance protection for internal faults during power swing
- Improved system security during CT saturation and sensitive to internal faults.
- Rapid and reliable bus-bar protection during CT saturation based on patented adaptive-weight anti-saturation algorithm and harmonic restrain algorithm
- Both $\Delta \rightarrow Y$ and $Y \rightarrow \Delta$ phase angle compensation to realize phase segregated inrush blocking.
- Customized system scheme such as flexible hardware design, scalable function library, programmable logics, configurable I/Os and definable LEDs
- Fully compatible with IEC 61850 application
- Powerful disturbance recording function supporting post-fault analysis

Main Related Products

Transmission Line Protection

- PCS-902 Line Distance Relay
- PCS-902S Line Distance Relay
- PCS-931 Line Differential Relay
- PCS-931S Line Differential Relay
- PCS-924 Stub Differential Relay
- PCS-924S Stub Differential Relay

Bus-bar Protection

- PCS-915IC Centralized Bus-bar Relay
- PCS-915SC Centralized Bus-bar Relay
- PCS-915ID Distributed Bus-bar Relay
- PCS-915SD Distributed Bus-bar Relay

Transformer Protection

- PCS-978 Transformer Relay (HV/MV)
- PCS-978S Transformer Relay
- PCS-974 Mechanical Relay
- PCS-9671 Transformer Relay (MV/LV)
- PCS-9671S Transformer Relay

Circuit Breaker Protection

- PCS-921 Circuit Breaker Relay
- PCS-921S Circuit Breaker Relay
- PCS-9830 Switching Controller

Generator Protection

- PCS-985B/AW Generator-Transformer Unit Relay
- PCS-985GI Generator Relay
- PCS-985G/GW/BG/RS Generator Relay
- PCS-985TI Transformer Relay
- PCS-985BT/TW/TS/T Transformer Relay
- RCS-985U Voltage Injector
- PCS-985RE Rotor Earth-Fault Relay

Feeder Protection

- PCS-9611 Feeder Relay
- PCS-9611S Feeder Relay
- PCS-9613 Differential Relay
- PCS-9613S Differential Relay
- PCS-9691 Management Relay

Capacitor Protection

- PCS-9631 Capacitor Relay
- PCS-9631S Capacitor Relay

Motor Protection

- PCS-9641 Motor Relay
- PCS-9641S Motor Relay

Arc Flash Protection

- PCS-9656 Arc Flash Relay

Transfer Device

- PCS-9651 Automatic Transfer Switch
- PCS-9655 Fast Transfer Device
- PCS-9659 Synchronizer

Automation Solution

NR's automation systems enable real time monitoring and control of system operating data, including power system status monitoring, remote/local control, fault analysis and evaluation, operators' authorization, asset management, history data statistical analysis and communication for control centres. It manages utility assets, monitors operation states and measures load profiles. Operators can execute remote control via the workstation.



Substation Automation

NR provides the integrated automation solution for new substations and/or retrofit substations. The solution complies with IEC 61850 standards over star LAN or ring LAN. The system is composed of Bay Control Unit, Protective Relay, Fault Recorder, PMU, Protocol Converter, Gateway, GPS Receiver, Gigabit Switch and HMI Software. NR can also integrate metering and CCTV devices into the automation system.

Power Plant Automation

NR's power plant automation system addresses economical control and monitoring of electrical system in a power plant, covering auxiliary power system and sub-station in power plants with unit capacity up to 1000MW. Advanced automatic, such as safety monitoring of primary devices and real time monitoring of electric parameters, are provided to operation personnel for the management of entire power plant.

Hydro Power Plant Automation

PCS-9150 is the Local Control Unit (LCU) product, which represents advanced level of open LCU system. It features powerful predominance of dual power supplies for I/O modules, dual 100 Mbps communication rate and high real-time capability. The PCS-9150 system focuses on advanced technologies and modern control theories, so as to achieve comprehensive advantages compared to ordinary distributed control system.

Industrial Automation

NR's innovative automation solutions for industrial needs consist of a system automation that is applicable to industrial power systems, and the industrial-class devices. Automation provides fast & real-time control and monitoring of electrical power systems in different industrial fields.

Solution Features

NR's automation solution is designed based on Ethernet communication and the whole system is hierarchical and distributed. The system adopts functional diversification and object-oriented design to improve availability for different applications.

• Flexible and open system architecture

- Redundant System configuration and redundant communication
- System compatibility and extensibility
- SQL standard access interface
- XML-based database import/export
- SVG-based graph import/export

• Friendly human machine interface

- Custom operating environment and interface style
- Custom information display
- Layered, graded, classified alarm processing

• System offline maintenance and online update

- Database/graph offline maintenance
- Database/graph verification
- Database/graph online publish
- System online update

• Cyber security

- Boundary security
- IED security
- Behaviour security

• Fully support the IEC61850 standard (Ed1 and Ed2)

- Multiple communication channels supported
- ICD, SCD file import
- Report, GOOSE and SV configuration
- IEC61850-6 standard CID, GOOSE and SMV configuration file export and download

• Advanced IGML modelling

- Visualized substation primary equipment modelling
- Custom graph templates
- Complete calibration

Main Related Products

- PCS-9700 Substation Automation System
- PCS-9700 HMI Software
- PCS-9150 Hydropower Plant Automation System
- PCS-9705 Bay Control Unit
- PCS-9710 Remote Terminal Unit
- PCS-9799 Station Manager
- PCS-9794 Protocol Converter
- PCS-9785 Satellite-Synchronized Clock (Source/Extension)
- PCS-9882 Ethernet Switch

Digital Substation Solution

Through the development of protection, control, automation and communication technology, NR' s digital substation technologies offer a complete digitalized solution that connects the control room to the switchyard with optical fiber links. This proven solution reduces your capital investment, operational and maintenance costs. It also offers peerless information integration, and provides better reliability and security for substations.

Solution Features

• IEC 61850 Based Communication Network

The baseline communication topology of NR' s Digital substation solution consists of a process bus and a station bus.

The process bus employs IEC 61850-9-2 Sampling Value, IEC 61850- 8-1 GOOSE for time-critical message and IEEE 1588 protocols. The station bus employs IEC 61850-8-1 MMS, GOOSE message and SNTP protocols. All of devices are fully compatible with IEC61850 ed1&ed2.

• True Optical Links

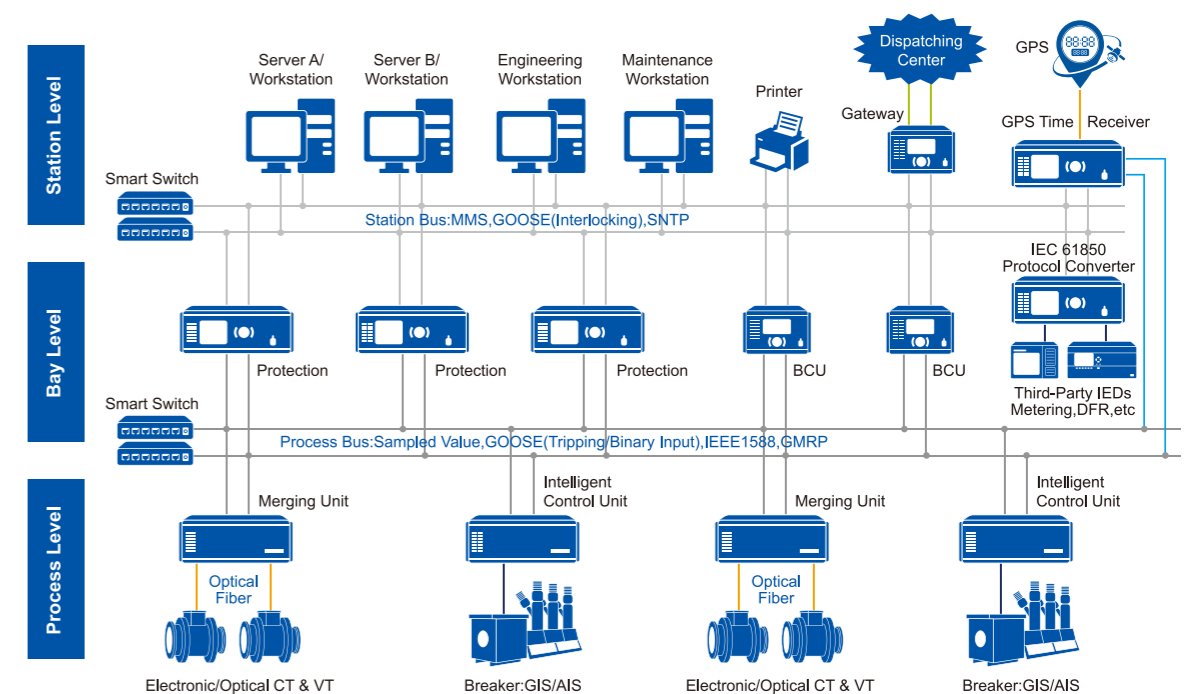
Communications between equipment can be realized by fiber links in the entire substation. This unique and smart solution is suitable for newly constructed and refurbished substations. The merging units not only support connections to electronic CT/VT and optical CT, but also conventional CT/VT.

• Reliable Electronic CTs/VTs

NR has pursued advanced research on electronic CTs and VTs to ensure maximum reliability and availability in the applications of metering and protection relays. It has the advantages of no magnetic saturation, none ferromagnetic resonance, giant dynamic measuring scope, wide frequency band and compact structure.

Main Related Products and Systems

- PCS-900/9000 series Protection & Control Devices
- PCS-221 Merging Unit
- PCS-221S Merging Unit
- PCS-222 Circuit Breaker Controller
- PCS-223 CB Online Monitoring Unit
- PCS-9250 AC Electronic CT/VT and OCT
- PCS-9705 Bay Control Unit
- PCS-9705S Bay Control Unit
- PCS-9794 Protocol Converter
- PCS-9799 Station Manager
- PCS-9700 HMI Software
- PCS-9785 Satellite-Synchronized Clock
- PCS-9882 Gigabit Ethernet Switch



Disturbance Recording Solution

NR' s disturbance recording solution is a multifunctional data acquisition system designed to deal with the data recording requirements of transmission or distribution power substations. It is implemented by Disturbance Fault Management & Recording (DFMR) System and disturbance fault recorders (DFRs).

The DFMR system collects disturbance data of a whole power network and provides real-time monitoring & waveform analysis based on the information collected. Operators in local substations are capable of modifying settings, inspecting alarm information and analysing waveforms. Brief data is available for retrieving upon request. The DFMR system adopts SDH/SONET or WAN in order to comply with IEC 61850, FTP and IEC 60870-5-103 standards. The DFR captures the curves of monitored quantities and aligns the values of different supervised objects to build disturbance records.

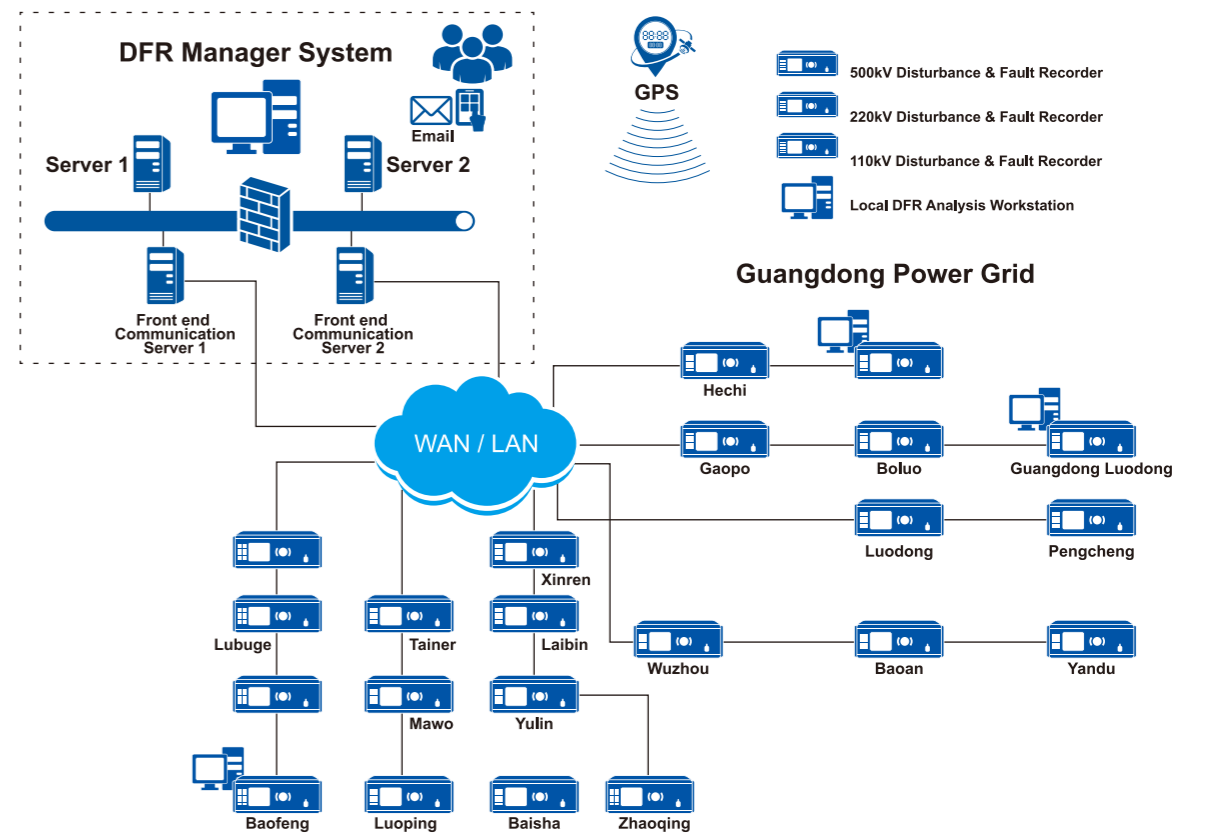
NR' s disturbance recording solution helps users to clarify disturbance analysis by combining the discrete records in different protective relays.

Solution Features

- Scalable distributed or centralized architecture, up to 48 analogue channels and 64 digital channels.
- 3 speeds full view of records
- Dynamic recording of power system in multiple time scale, 10000Hz-10s,1000Hz-7days, 1Hz-3 months+ for 50Hz system, 12000Hz- 10s,1200Hz-7days, 1Hz-3 months+ for 60Hz system
- Web HMI. Provide an easy way configure the DFR locally and remotely.

Main Related Products and Systems

- PCS-9013 Disturbance Fault Management & Recording System
- PCS-996 Disturbance Fault Recorder
- PCS-996S Disturbance Fault Recorder for Digital Substation
- PCS-986 Disturbance Fault Recorder for Power Plant



Typical Structure of DFR Management System

Phasor Measurement Unit (PMU) Solution

In order to enhance the dynamic stability monitoring and analysis abilities, Phasor Measurement Units (PMUs) are installed in the corresponding substations and power plants. Furthermore, the wide area measurement system (WAMS) could be used for monitoring the system's state and action accordingly.

NR's Phasor Measurement Unit (PMU) system is mainly implemented to measure synchronized phasor and to record dynamic process of the power system. The system consists of Phasor Measurement Units (PMU) and phasor Data concentrators (PDC). The core phasor measurement unit characteristics include synchronized phasor measurement, based on standard clock signals and timekeeping capacity without the standard clock signal. In addition, the system is designed to achieve high-speed communication capacities between the localized PMUs and the central WAMS. The standard communication protocol is IEEE C37.118. A PDC is used to collect data from several PMUs, and then the PDC sends the data to the WAMS control center.

Integration to WAMS

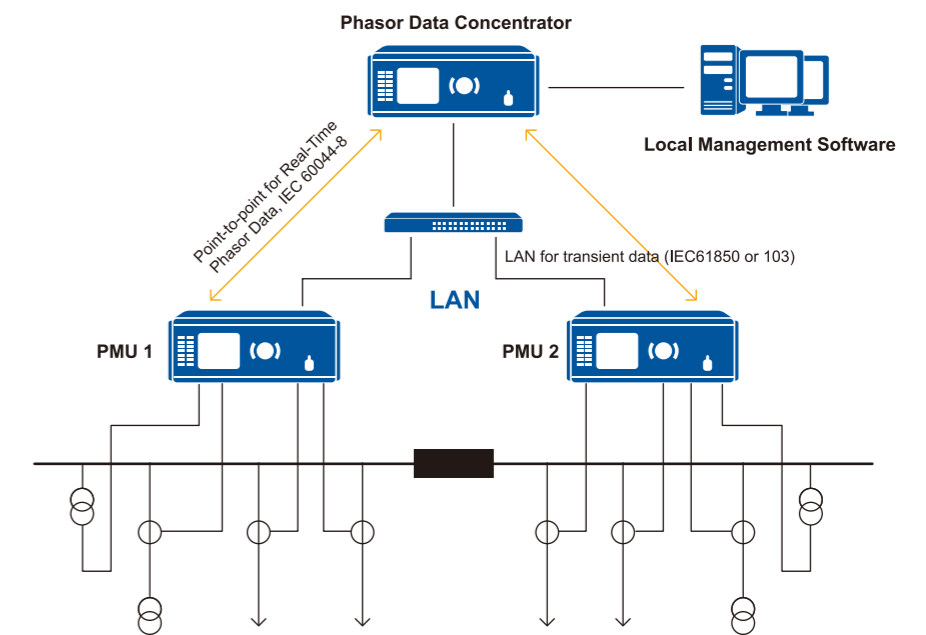
The PCS-996 fully supports communications to the Wide Area Measurement System (WAMS) based on international protocols (IEEE Std C37.118-2005, IEC 60870-5-103 and IEC 61850). The measured phasors are transmitted from PCS-996 to WAMS via a communication network and assembled for advanced supervision and analysis. This allows direct phasor comparison from various locations in the power system.

Solution Features

- The robust hardware platform for PMU and PDC is the same one as in NR's protection and control system, which has been well proven in field
- PCS-996 PDC can be connected to 1-8 PMUs and four control centers. Furthermore, a 128G storage disk can be integrated to the PDC.
- The high-precision IRIG-B code is adopted for GPS clock synchronization through optical fiber or RS-485 ports.
- The PCS-996 supports the communication standards of IEEE C37.118 and IEC60870-5-103.

Main Related Products

- PCS-996A Phasor Measurement Unit
- PCS-996D Phasor Data Concentrator



Schematic Diagram of PDC and PMU

Energy Management Solution

The Energy Management System (EMS) monitors, manages & optimizes energy generation, transmission, distribution and consumption in order to help utility or industrial customers to maximize efficiency and minimize cost. It supervises the whole power network and produces the accurate control strategies to accomplish energy optimization. The EMS helps the utilities or industrial customers to improve economic efficiency and lower operation cost.

With more than three decades of experience in supplying EMS to the electric utilities, NR has a wealth of experience to provide electric enterprise a wide area of system solutions. NR's system solutions range included Supervisory Control and Data Acquisition (SCADA) System, Automatic Generation Control (AGC), Energy Management System (EMS), Wide Area Measurement System (WAMS), Dispatcher Training Simulator (DTS) and etc.

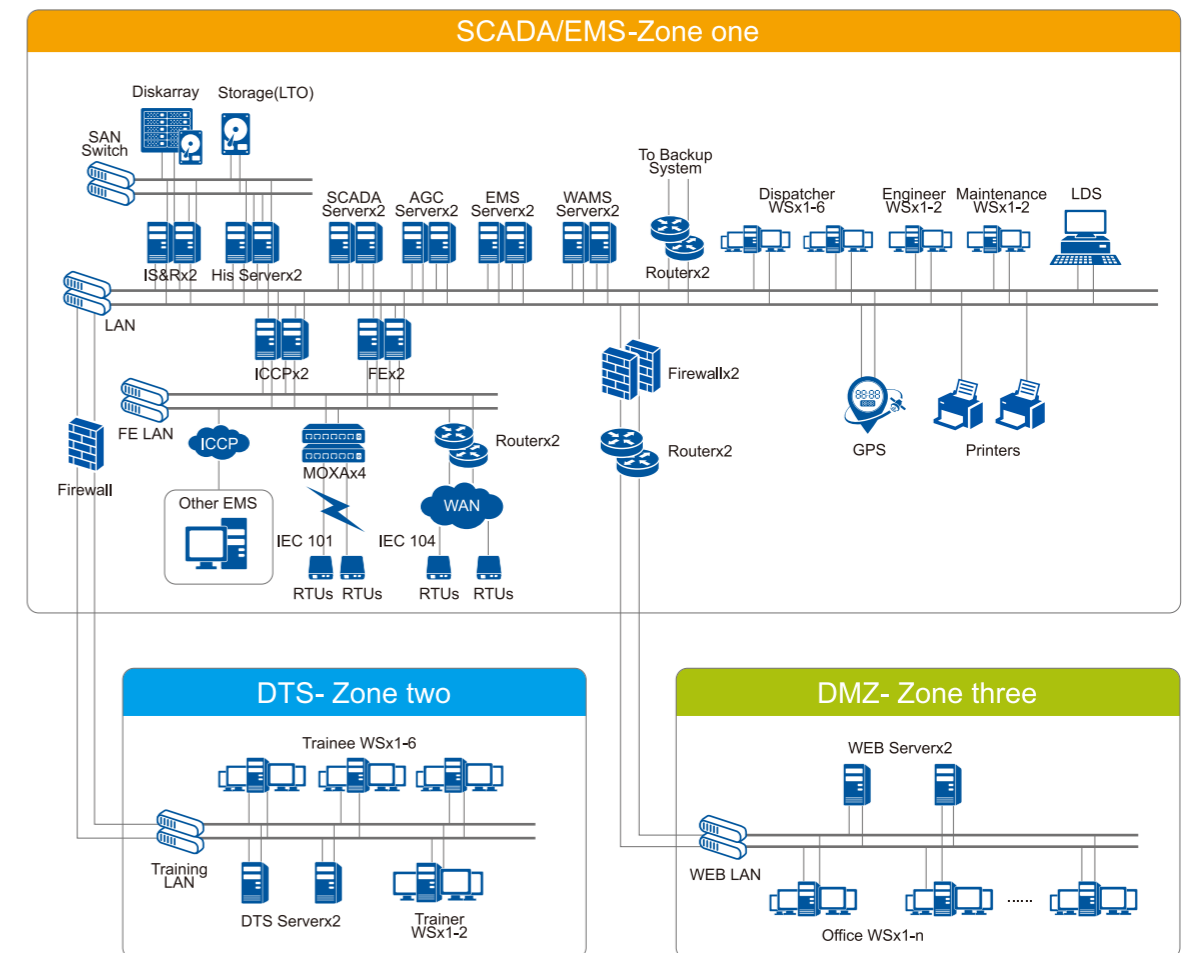
NR's PCS-9000 EMS is the right control centre solution to manage your complex power system, while ensuring the required level of cyber security. It is also an energy information system that provides reliable process information to all levels of decision makers in the organization. The philosophy behind PCS-9000 EMS functionality is to meet the high availability and efficiency, optimize the power system operation and provide customization system. With the best services and hundreds of licenses deployed all over the world from power plants, renewable generations, substations to the National control centres, PCS-9000 EMS is a versatile system to facilitate an efficient, secure and reliable grid operation, not only for managing today's power network but also for tomorrow's Smart Grid.

Solution Features

- Distributed architecture with open-standard system to ease users' operations
- Unified supporting platform with increased reliability and simplified system integration
- Extendable communication front-end to save your future investment
- Real-time monitoring and control function with advanced visualization capabilities and user configurable dashboard
- Precise regional Automatic Generation Control (AGC) function
- Network analysis software with indispensable operation direction and practical algorithm
- Dispatcher training simulator offering easy learning with a mirroring training system
- Paperless dispatching management function

Main Related Products

- PCS-9000 SCADA/EMS (Supervisory Control and Data Acquisition/Energy Management System)
- PCS-9000 DTS (Dispatcher Training Simulator)
- PCS-9000 WAMS (Wide Area Measurement System)



PCS-9000 SCADA/EMS typical configuration

Distribution Management Solution

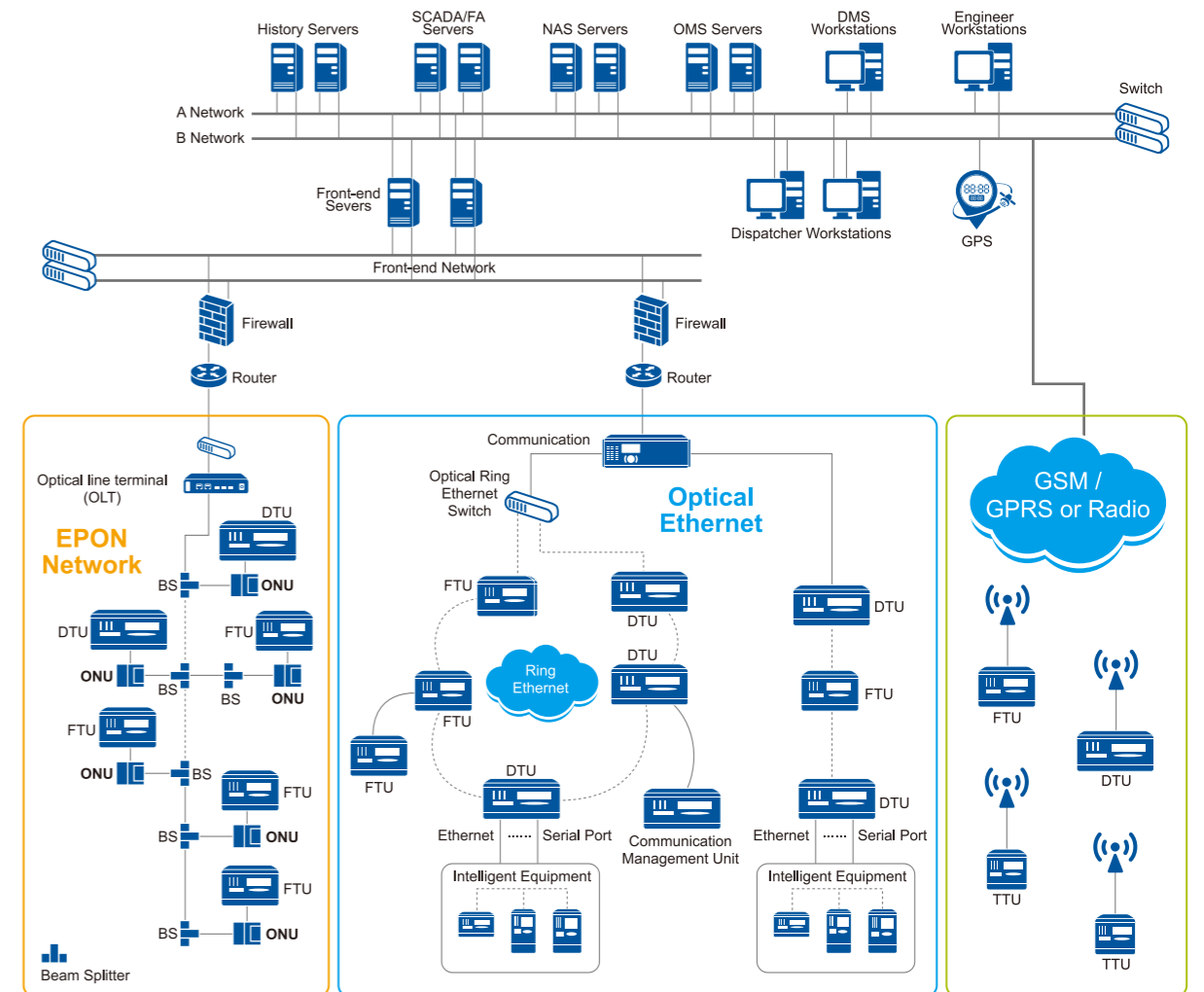
Keeping the path of Smart Grid moving forward, NR has developed innovative distribution management solution for electric distribution network based on state-of-the-art software and hardware technologies. It provides integrated functions & advanced applications for control, management, analysis and optimization of day-to-day operations.

Solution Features

- Fully complies with IEC 61970 and IEC 61968 international standards
- SCADA/DMS/GIS/OMS/MWFM are fully integrated and operated on a unified platform
- Friendly GUI and easy to use
- Rich and extensive baseline functionality such as unbalanced load flow, restoration switching analysis and fault location
- Customizable functionality
- Intellectualized Fault Location, Isolation and System Restoration (FLISR) function
- Seamless integration design with the GIS display platform
- Hardware independent
- Provides visual tools for day-to-day management operation
- Has capability to control and manage renewable energy resources

Main Related Products

- PCS-9000 SCADA/DMS (Supervisory Control and Data Acquisition/Distribution Management System)
- PCS-9721A/B Series DTU (Distribution Terminal Unit)
- PCS-9721C Series FTU (Feeder Terminal Unit)



Power Stability Control Solution

Blackouts severely impact the modern society communities in many various ways, from economic repercussions to life setbacks. It can be particularly damaging to enterprises such as hospitals, underground mining operations, gas stations and sewage treatment plants, etc. To solve the above problems, NR provides the unique stability control solution to keep power system stability and significantly reduce possible blackouts.

NR's stability control solution comprises power stability control system, out-of-step controller, and frequency & voltage controller. The Power Stability Control System (PSCS) is used to prevent and reduce the possibility of system oscillations. Out-of-step controllers and frequency/voltage controllers detect the system's parameters and take actions to avoid the expansion of instability.

Solution Features

- Pre-Determined Based Power Stability Control System**

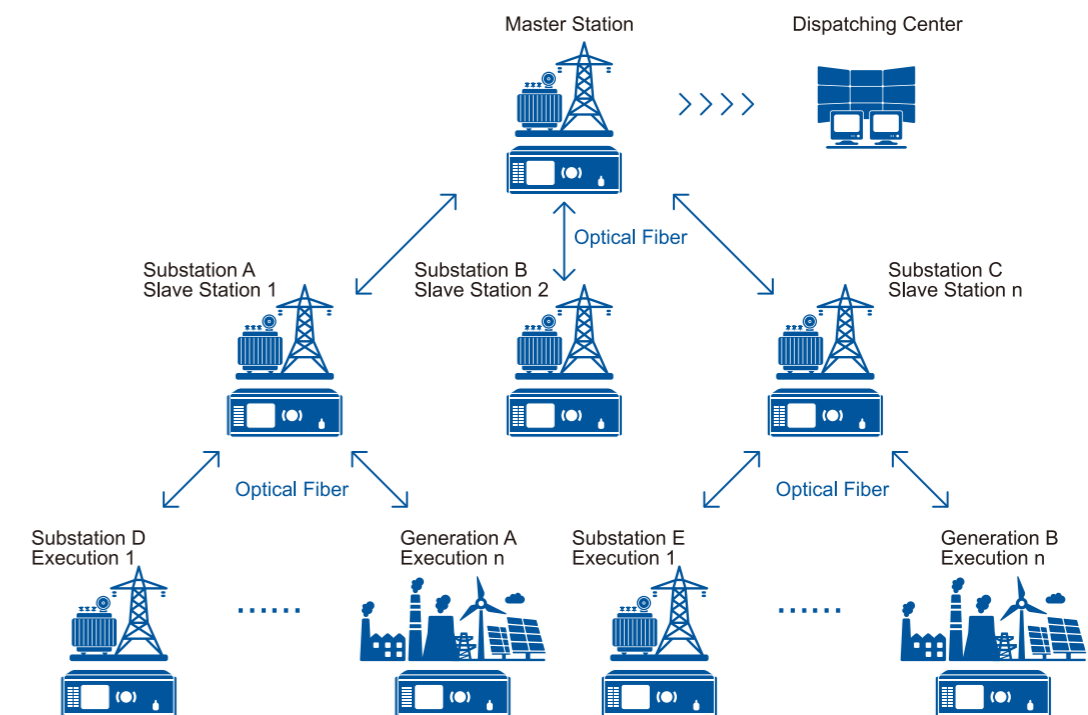
Imbalance between loads and power generations can result effects in system frequency and voltage changes variations that could ultimately lead to system collapse. Power stability control can quickly restore a system's balance by load shedding or generator shut down based on the preset control tactic. Ultimately, bringing voltage and frequency back to an acceptable value, so as to minimize the affected area and avoid cascading instability.

- Instability prediction instead of instability measurement.**

The tactic table is pre-determined and simulated according to the complex stability studies and strategy analysis before installation. After installation, the power stability control system collects related real-time data from substations or power plants and seeks appropriate remedy actions in the tactic table to pull the power system back to a stable state before it goes into a state of instability.

Main Related Products

- PCS-992 Power Stability Control System (PSCS)
- PCS-993 Out-of-Step Controller
- PCS-994 Frequency & Voltage Controller
- PCS-994S Frequency & Voltage Controller



Structure of Power Stability Control System

HVDC & FACTS

With rapid development of modern society, power security and quality become critical issues for power grids. Greenfield networks, long distances transmission and special purpose applications bring challenges to power utilities worldwide. Relying on in-depth acknowledge of power grids, NR introduces the state-of-the-art HVDC and FACTS (Flexible AC Transmission Systems) turnkey solutions to bring a better power connection.

NR's HVDC & FACTS turnkey solutions are the combinations of feasibility study, system study & design, manufacturing, procurement, installation, commissioning, operation, maintenance, troubleshooting and training. We value extensive services, warranty and long-lasting spare part supply for our customers. So far, NR has gained abundant experience from undertaking hundreds of projects, including the world first $\pm 500\text{kV}$ 4-terminal VSC-HVDC grid, $\pm 800\text{kV}$ 3-terminal hybrid HVDC project, $\pm 200\text{kV}$ 5-terminal VSC-HVDC transmission project, ± 1100 Changji LCC-UHVDC transmission project etc., and 900MVar Ethiopia SVC project, 120MVar STATCOM project, 500/750kV series compensation, CSR in 750kV substation and so on.

HVDC Transmission

NR field proven High Voltage Direct Current (HVDC) systems is highly effective alternative for transmitting bulk power over long distance, asynchronous grids interconnection, renewable power access to grid, city center in-feed and power from shore. An HVDC transmission system may be economical and suffer lower electrical losses for long-distance transmission. In addition, HVDC avoids the heavy currents required by the cable capacitance for submarine power cables. HVDC also enables power transmission between asynchronous AC power grids, and can supply power to urban heavy load center.

NR's complete HVDC transmission solutions are built upon the latest LCC-HVDC (Line Current Commutated HVDC) and VSC-HVDC (Voltage-Sourced Converter HVDC) technologies. Base on know-how capability and vast experience, NR offers "All-In-One" HVDC Transmission solutions to clients globally.

LCC-HVDC Transmission Solution

Base on vast experience and strong technical background, NR offers LCC-HVDC solution package to both new and retrofit projects. The "All-In-One" LCC-HVDC solution package is composed of in-depth system study & design, high quality manufacturing, well system integration, FAT, commissioning, training and maintenance.

LCC-HVDC Converter Valve

- Guaranteed performance by multi physical field analysis platform
- Easy Maintenance with built-in platform
- High reliability due to separate design of hydraulic and electrical circuit
- Enhanced safety with fire resistance materials up to UL94-V0

Valve Control Unit

NR's Valve Control Unit builds connections between converter valves and HVDC protection & control systems. It controls the converter valves upon the signals received from protection & control system and meanwhile sends indicative signals (IPs) from TCU to provide feedback signal back to protection & control system.

NR's LCC-HVDC Valve Control Unit Features

- High reliability due to redundant configurations
- Strong EMC capability through fully-enclosed racks
- Powerful communication by fiber optics
- High reliability of valves through variable-PWM technology of TCU
- Quick fault location by high speed fault record function
- Comprehensive valve monitoring and protection function
- Convenient for operation and maintenance through user friendly HMI
- Enhanced visual programming and setting configurations



Water Cooling System

NR's patented Water Cooling System (WCS) is exclusively designed for valve cooling of power electronics equipment. It is widely applied in many different solutions for seamless cooling of valves and to increase the efficiency of valve technology. NR's water cooling system provides

- Automatic water refill function
- Maintenance without shutdown
- All-inclusive monitoring

DC Yard Electronic CT/VT

NR provides PCS-9250 DC Yard Electronic CT/VT, including DC electronic CT, electronic VT and DC filter electronic CT for both LCC-HVDC and VSC-HVDC transmission projects. The DC electronic transformers have advantages of small size, light weight and no ferromagnetic resonance dilemmas.

HVDC Control & Protection System

Relying on decades' research on protection and control of power system, NR provides the LCC-HVDC protection & control system to guarantee the safe and reliable operation of the whole HVDC system.

The PCS-9550 LCC-HVDC Protection & Control System adopts a hierarchical & distributed structure that each cell is responsible for the monitoring and control of the equipment in one physical or logical area. The design of each cell aims at mutual independency to achieve minimum information exchange between different cells and to eliminate the influence of fault in one cell on the normal operation of others. The communication between distributed cells are based on standard Field bus or Ethernet via fiber cable, featuring excellent real-time availability, strong interference immunity, high stability and reliability.

Main Related Products and Systems

- PCS-8600 LCC-HVDC Valve
- PCS-9586 Valve Control Unit
- PCS-9510 Water Cooling System
- PCS-9550 HVDC Protection & Control System
- PCS-9250 DC Yard Electronic CT/VT

LCC-HVDC Turnkey Service Package

NR provides complete HVDC turnkey solution to global users for new built HVDC and obsolete HVDC upgrade projects. The services package covers,

Phase-I: Conceptual Phase

- Conceptual design
- Systems studies
- Equipment specifications
- Selection of vendors

Phase-II: Design & Installation Phase

- Approval of design drawings
- Permits and approvals
- Installation Management
- System start-up
- Testing / commissioning

Phase-III: Operation Phase

- Operator training
- System operation & maintenance



VSC-HVDC Transmission Solution

Compared to LCC-HVDC transmission, VSC-HVDC transmission has no limitation in minimum short circuit capacity, and thus it can be used in interconnection or directly connected to weak grids, such as power supply to island, city centre in feed and decoupling to urban grid.

Based on its strong technical background and vast experience over HVDC transmission project, NR offers advanced VSC-HVDC solution to accomplish special purpose applications for our clients.

VSC-HVDC Converter Valve

The PCS-8100 VSC-HVDC Converter Valve is fully-controlled electronic equipment used to achieve mutual conversions/transitions between DC and AC circuits. The valve adopts MMC topology that it is comprised of sub modules, converter valve tower and valve control units. By setting the quantity of sub-modules, the converter's output voltage and power levels are flexible to control. Thus, it is easy to extend the output levels with low harmonic distortion and low switching frequency, so as to reduce operational losses and improve system efficiency.

NR has passed the witness type test of $\pm 535\text{kV}/3000\text{MW}$ converter valve.

DC Breaker

Nowadays, multi-terminal VSC-HVDC or VSC-HVDC grid becomes more and more popular and the key barrier is fast & selective fault clearance. The puzzle is how to quickly break large DC current at high DC voltage and it has bothered power system experts for a long time. The DC breaker is the answer to this puzzle and NR has developed its own 535kV DC breaker that has the capability of breaking 25kA current within 3ms.

The main parameter of DC breaker

| Items | Values |
|------------------|--------|
| Rated Voltage | 535kV |
| Rated Current | 3kA |
| Breaking Current | 25kA |
| Breaking Time | ≤3ms |

NR also got verification of type tests of 535kV DC circuit breaker by DNV.GL.

DC Yard Electronic CT/VT

NR provides PCS-9250 DC Yard Electronic CT/VT, including DC electronic CT, electronic VT & DC filter electronic CT for both LCC-HVDC and VSC-HVDC transmission projects. The DC electronic transformers have advantages of small size, light weight, and no ferromagnetic resonance problems.

Valve Base Control

Converter valve is composed of extensive amount of sub-modules, all these sub-modules are controlled by Valve Base Control (VBC). Each VBC can control up to 224 sub-modules, consequently less VBC units are required for whole project. Furthermore, VBC is integrated with disturbance recording function, bringing convenience to trouble shooting.

Water Cooling System

NR's patented Water Cooling System (WCS) is exclusively designed for valve cooling of power electronics equipment. It is widely applied in many different solutions for seamless cooling of valves and to increase the efficiency of valve technology.

VSC-HVDC Protection & Control System

Relying on decades' research on protection & control of power system, NR provides the VSC-HVDC protection & control system to monitor, control and protect all AC and DC system in a VSC-HVDC transmission system. Each VSC-HVDC system has two independent protection & control systems for redundancy to ensure high reliability. Multiple transient fault recording (TFR) functions are used for fault tracing. The recording settings are flexible to accommodate the consumer's requirements.

Solution Features

- In-house system study and system design capability base on experienced team and state of the art facility
- High quality products compatible with international standard certified by DNV GL
- Comprehensive factory acceptance test to ensure performance before delivery base on world-class test lab
- Sophisticated service team and qualified project managers to accomplish construction management, site commissioning, maintenance and training
- Mature quality control and HSE management system through whole life cycle

Main Related Products and Systems

- PCS-8100 VSC-HVDC Valve
- PCS-9586 Valve Control Unit
- PCS-9510 Water Cooling System
- PCS-9520 HVDC Protection & Control System
- PCS-9250 DC Yard Electronic CT/VT

VSC-HVDC Turnkey Service Package

NR provides VSC-HVDC turnkey package to global users, covering system study, system design, system integration, factory acceptance tests, site commissioning, maintenance and training. We believe that all these professional engineering services will ultimately lead to the success to each individual project.

Phase-I: Conceptual Phase

- Conceptual design
- Systems studies
- Equipment specifications
- Bid documents
- Selection of vendors

Phase-II: Design & Installation Phase

- Review of design drawings
- Permits and approvals
- Construction Management
- Equipment installation
- System start-up
- Testing / commissioning

Phase-III: Operation Phase

- Operator training
- System operation & maintenance

Flexible AC Transmission System (FACTS)

NR engineered innovative Flexible AC transmission system (FACTS) that contribute to enhanced grid stability and power quality. Flexible AC Transmission System (FACTS) is a power electronics-based system that can enhance controllability, capacity and flexibility of the AC power network. NR's FACTS solutions are built upon in-depth knowledge of existing transmission systems, providing utility companies with fast voltage regulation, effective load flow control to improve the reliability and quality of power supply.

Static VAR Compensator (SVC) Solution

A power grid usually suffers from the voltage drop due to heavy loads. Many industry loads, like mining machine and electric furnace, always generate large amount of harmonic currents, heavy voltage flickers and drops. These problems can easily interrupt power supplies, lower product quality and even reduce productivity.

To help utility and industry customers' enhance power quality, NR offers SVC solution to regulate reactive power and voltage so as to improve power quality. The SVC system employs innovative valve technology and reliable thyristor triggering method, comprising compact valve banks, efficient cooling system and advanced protection and control system. It has gained extensive market value for its fast response time and low-cost maintenance schemes.

Solution Features

- Well-proven practical tool for dynamic reactive power compensation
- Compact thyristor valve in press stack for easy maintenance
- Power transmission and distribution capacity increase at lower cost
- Effective application of power factor correction, voltage support, flicker reduction
- Open interface based on advanced platform
- Flexible coordination control with other reactive power regulator

Main Related System

- PCS-9580 Static Var Compensator

SVC Turnkey Service Package

With strong power system analysis and design capabilities, NR provides turnkey service package for the total solution.

The SVC turnkey service package covers the entire life cycle of the project, including,

- Project Management
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Testing & Commissioning
- Operation and maintenance services



Static Synchronous Compensator (STATCOM) Solution

High-power rapid changing loads and swift growth of asymmetrical loads can lead to considerable reactive disturbances in power systems. Ultimately, affecting power stability, power quality and the economic operation of power grids. Additionally, the overcurrent and overvoltage caused by these disruptions may damage the associated electrical apparatuses.

Maintaining voltage stability by dynamic reactive power compensation is crucial. The most advanced solution is using high performance Insulated Gate Bipolar Transistor (IGBT) to provide quick and variable reactive power to the grid. NR's STATCOM solution relies on the latest fully-controlled IGBT technology. It helps both utility and industrial customers gain economic benefits through solving voltage unbalance and distortion problems, restraining system overvoltage and improving power factor.

Solution Features

- Easy maintainability with detachable capacitors
- Less footprints, compact structure and less overall cost.
- Integrated control and protection system to realize quick fault clearance to ensure system operation security
- Standardized Workstation offers easy access
- Operator Workstation (OWS) fully compatible with IEC60870-5-103, IEC61850 and other international standards.
- Perfect performance of flicker reduction due to fast response speed
- Strong voltage support capability even at depressed system voltage
- Fast dynamic regulation to improve power quality

Main Related System

- PCS-9583 Static Synchronous Compensator (STATCOM)

STATCOM Turnkey Service Package

Based on undertaking hundreds of STATCOM projects worldwide, NR offers its STATCOM turnkey service package to meet clients' needs. The STATCOM turnkey service package covers the entire life cycle of the project, including,

- Project Management
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Testing & Commissioning
- Operation and maintenance services



De-Icer Solution

Severe weather conditions, such as frozen rain, can create ice coating on transmission lines and steel towers. More harsh icing of conductors on steel transmission lines can cause the towers to buckle and the structure to fail, leading to interruption of power supply and threatening the safe operation of the whole power system. NR provides the innovative and versatile DC De-Icer solution to help customers solve the dangerous icing problems.

The De-Icing solution adopts thyristor-based rectifier to convert AC current into DC current and DC current flows through the line resistance producing heat for de-icing. In severe climate situations, the De-Icer serves to melt the ice cover and reduce the risk of tower collapse. In other situations, the De-Icer could be used as SVC to compensate the reactive power in the power grid. NR can provide both fixed and re-locatable De-Icer solutions depending on requirement from customer.

Solution Features

- Compact and customized valve bank to save land space
- Phase switching device with balance function of ice-melting
- Small impact to system during de-icing
- Fast system response with less interruption time
- High precision (0.01°) of control firing angle
- Flexible operation with rich on-site monitoring function

Main Related System

- PCS-9590 Fixed DC De-Icer
- PCS-9591 Re-locatable DC De-Icer

De-Icing Turnkey Service Package

- Project Management
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Onsite Testing & Commissioning
- Operation and maintenance services

Series Compensation Solution

The main purpose of using series compensation in a power system is virtual reduction of line reactance in order to enhance power system stability and boost the transmission capacity of existing & new transmission lines. Due to the deregulation of power market the existing transmission assets are to be utilized to the maximum extent to ensure efficient investment return. Simultaneously strong environmental awareness impedes construction of additional overhead transmission lines. Cost effective series compensation from NR can assist system operator boost the transmission capacity of existing transmission system and also reduce the number of lines needed for green field power transmission projects so as to limit the impact to the environment.

NR series compensation solution consists of control and protection system, capacitor bank, MOV, spark gap, damping circuit, bypass breaker and insulation platform. NR provides the 'all-in-one' Turnkey solution for series compensation covering planning, design, supply, installation, commissioning, training and maintenance.

Solution Features

- Standardized, modular control and protection platform
- Independent and redundant control and protection system
- Electronic CT with improved anti-interference capability
- Seismic design of platform according to IEEE 693
- Reliable and field-proven primary equipment
- Remote online monitoring and supervision upon request
- Professional configuration and protection parameter optimization
- Stable and accurate firing performance for spark gap component

Main Related System

- PCS-9570 Series Compensation

Series Compensation Turnkey Service Package

Combined with vast experience of project management and profound expertise of engineering know-how, NR is able to provide turnkey solution of series compensation to customer.

- Project Management
- Consulting and System Planning
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Onsite Testing & Commissioning
- Operation and maintenance services

Unified Power Flow Controller (UPFC) Solution

Unified Power Flow Controller (UPFC) is the most advanced FACTS solution which provides independent active and reactive power control of the transmission system. The UPFC is a combination of static synchronous compensator (STATCOM) and a static synchronous series compensator (SSSC) coupled via a common DC voltage link.

Due to the dynamic and flexible control in both active and reactive power UPFC can bring a bunch of benefits to power transmission system:

- Flexible power flow control integrated with reactive power compensation
- Dynamic voltage regulation
- Improved system stability
- Power oscillation damping
- Regulation of loop current in meshed network to achieve optimal load flow
- Increase of transmission capacity of existing network and avoid installation of new lines

UPFC solution from NR is based on state-of-art MMC converter. Through connection of sub-modules in series, power regulation at various high voltage levels is achieved according to system requirement.

Solution Features

- MMC converter with high flexibility
- Redundant sub-modules to ensure high availability
- Low converter losses
- No filters required
- Easy scalability

Main Related System

- PCS-8200 Unified Power Flow Controller (UPFC)

UPFC Turnkey Service Package

The first MMC based UPFC in the world was successfully put into service in 220 kV grid of Nanjing city on Dec.11th, 2015 by NR. NR is responsible for the total solution covering system study, basic design & detailed design, manufacturing and procurement, installation and commissioning. The successful operation of UPFC marks that NR has completely owned the capability of designing, supplying, manufacturing and commissioning of UPFC as a turnkey solution provider.

- Consulting and System Planning
- Project Management
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Onsite Testing & Commissioning
- Operation and maintenance services

Controllable Shunt Reactor (CSR) Solution

A Controllable Shunt Reactor (CSR) system can be employed to absorb inductive reactive power in a rapid response. NR's CSR solution can adjust the reactive power to smooth the line voltage profile and achieve a reasonable power flow distribution. Furthermore, when applied to transmission lines, CSR can also restrain the secondary arc current to increase reclosing success rate at recovery process.

Solution Features

- Reactive power solution to smooth voltage
- Transmission capacity increase for renewable generation access corridor
- Fast and no-overshoot operating due to compact thyristor valves
- Well coordination control with other regional regulators
- Stepwise output in tailored design to enable voltage into acceptable range

Main Related System

- PCS-9578 Controllable Shunt Reactor (CSR)

CSR Turnkey Service Package

Depending on deep application experience and strong design capability, NR is able to provide a total CSR turnkey service package to meet customers' demands.

- Project Management
- Conceptual & Detailed Design
- Grid analysis for feasibility
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Testing & Commissioning
- Operation and maintenance services

Renewable & Microgrid

NR renewable energy solutions intelligently harnesses the vital energy resources of earth to deliver eco-friendly energy generation and storage solutions. The strength of NR's renewable energy generation solutions is based on our deep professional knowledge of electrical grids and over decades of experience as a key power system solutions provider.

The integrated renewable energy and Microgrid solutions cover power conversion system, PV inverter, renewable energy management, power forecast, AGC/AVC, Static Frequency Converter (SFC) and generator excitation system. The advanced control and management system assist to improve the efficiency, availability & reliability of the renewable and Energy Storage System. NR fully protects your renewable energy station and makes your renewable energy system as effective as possible.

PV Grid-Connection Solution

In recent years, renewable energy generation has become popular since it is clean, economical and has low installation costs, especially where grid power is inconvenient or unreasonable expensive to connect. However, due to the intermittent and unstable characteristics of renewable energy, its grid connection may have an influence on the stability of grid operation.

Based on the deep knowledge of electrical grids, NR introduces the integrated renewable grid-connection solution to address efficient AC/DC conversion, high power quality and smooth grid interconnection.

PV Inverter

The PV inverter is a critical component in a PV system that it converts solar power to electric power which can be fed into the grid. NR' s PCS-9563 series PV grid-connected inverters, including central inverter & string inverter, consist of advanced IGBT controlled inverter, protection & control equipment and I/O switchgear etc. The system power capacity portion is designed in modularized structure featuring easy extension, convenient installation & maintenance, optimal layout, and less land occupation. The system control portion is based on the professional protection & control platform featuring abundant hardware resources, complete software functions & flexible configuration of control/operation parameters, to maximally meet the extension demand of on system flexibility and extensibility.

Centralized Supervision & Control System

More and more distributed renewable energy power plants have been constructed and put into service. Hence, the Centralized Supervision & Control of renewable power stations is necessary. NR's centralized control centre solution offers real-time monitoring and control of primary equipment in solar power plant & wind farms and provides centralized data processing for operation personnel. The system also helps to realize renewable power management and analysis for more reap of generation.

Power Forecast System

PV power is an intermittent generation source. The higher the penetration of PV the more important is the precise knowledge of the past and future solar resource. The solar power forecast system is used to predict the output power of solar power plant in an upcoming period. NR' s PCS-9700F power forecast system forecasts the output power of PV power station based on highly accurate Numerical Weather Prediction (NWP). The system computes reliable forecast based on high accurate numerical weather prediction (NWP), with acquired site monitoring data, environment data & history statistical data through the process of physical model and artificial neural network (ANN) model.

The solar power forecast system is recommended to install separately from solar power station SCADA system. It will communicate with the SCADA of solar power plant via a firewall to acquire measured data. It will communicate with the weather processor server on the internet via reverse isolation equipment to acquire the NWP data. It will communicate with the forecast master station via the dispatching data network to send out the short term or extra-short term PV power prediction.



Automatic Generation Control & Automatic Voltage Control

NR supplies optional Automatic Generation Control (AGC) & Automatic Voltage Control (AVC) functions for power regulation and voltage maintenance of renewable energy stations.

NR's AGC/AVC function features

- Effective optimizing the operation status of solar energy stations following regulation plan and strategies in real-time
- Reducing system power losses and extending the service life of PV generation units based on smart and optimal regulation processes
- Real-time information transfer to control centre or solar power control centre including control block signals and standby power capacities
- Realizing the monitoring and control of solar power generation automatically and improve the utilization of the solar energy.

Solution Features

- All-around Protection & Control (P&C) products portfolio to safeguard PV Generation
- Comprehensive power system application experience
- Utility grade hardware & software modules and SCADA system with powerful user-definable functions
- Advanced PV power management functions to achieve high operation efficiency and reap more solar power
- Strong flexibility to fit diversified customer needs

Main Related Products and Systems

- PCS-9563 series PV Inverter (Central inverter & String inverter)
- PCS-9700 Renewable Generation SCADA
- PCS-9700F Power Forecast System
- PCS-9700R AGC/AVC

PV Grid-Connection Turnkey Service Package

NR offers grid-connection all-in-one service package with qualified third party products to meet clients' needs.

Engineering Services

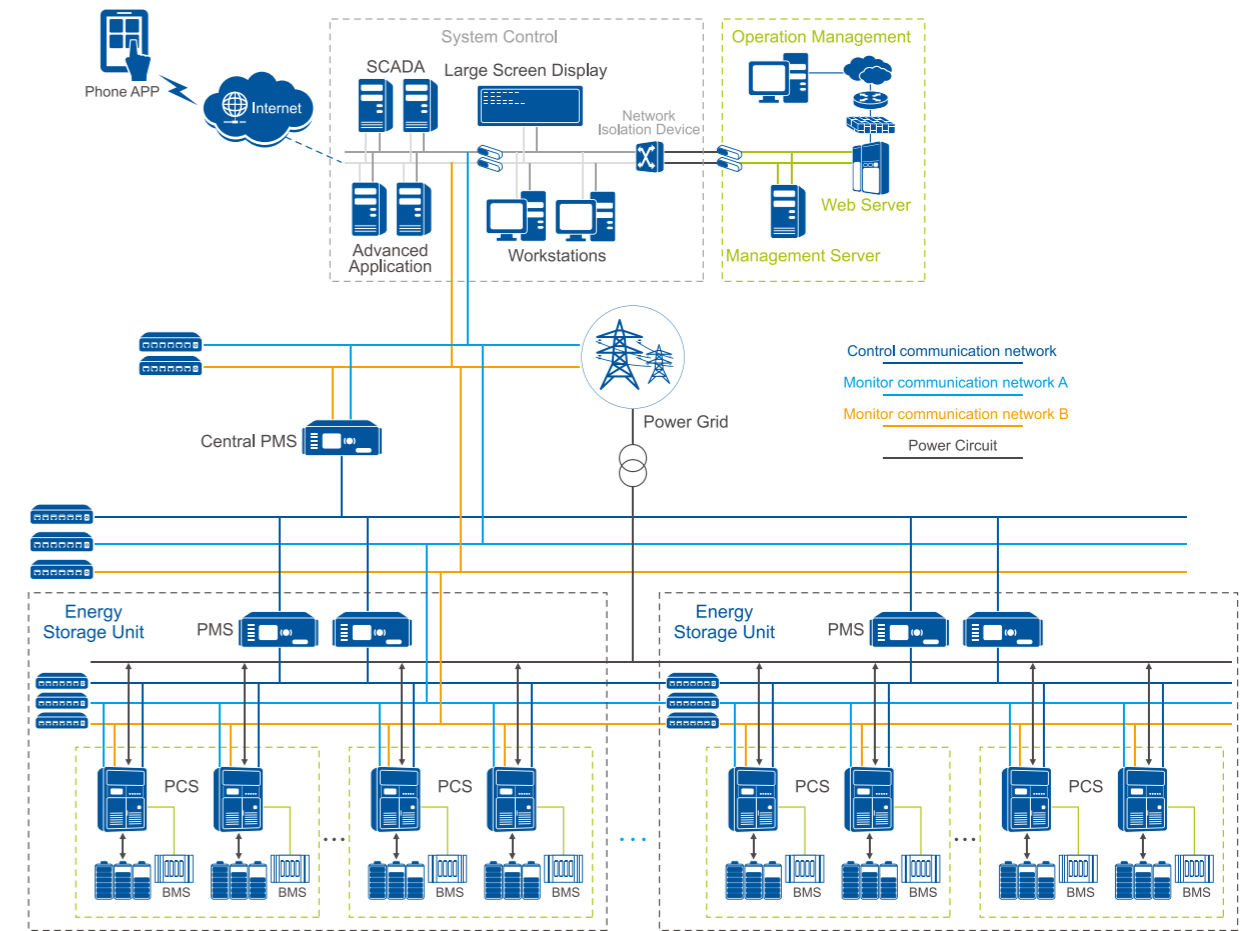
- Site Assessment & Planning
- Complete Design of Solar System
- Specification Development

Site System Maintenance

- Preventive Maintenance
- Emergency Response
- Extended Warranty
- Operational & Safety Training

Project Management

- Project Construction
- Procurement
- On-site Installation Supervision
- Start-up & Commissioning Services



Typical Configuration of Large-scale BESS Application

Battery Energy Storage System (BESS) Solution

The energy storage technology allows stored energy to be accessed exactly when it is required. Leveraging our extensive experience and solutions, NR offers a sophisticated power conversion solution for grid-scale Battery Energy Storage System (BESS). Our Power Conversion System (PCS) solution includes advanced converter/inverter technology and all-inclusive control, protection & management system to ensure the safety, reliability and flexibility of your BESS. It can reduce power supply cost, improve power system stability, regulate grid frequency and compensate load fluctuation, etc. NR's PCS, with various battery technologies, is flexible to provide a wide range of functionalities asked by the smart grid.

A utility grade Supervisory Control and Data Acquisition (SCADA) system is the foundation of NR's BESS solution. The SCADA platform provides reliable data acquisition, supervisory & remote control, real-time and historical database, reporting, energy accounting, user definable Human Machine Interfaces (HMIs). SCADA system monitors the important operational data and generates alarms when the BESS system is beyond the normal status.

PCS-9567 series PCS supports diverse operating modes to meet the requirements of different micro-grid application scenarios for peak shaving, frequency & voltage regulation, etc. Through mode selection, it can operate in either grid-connected mode or islanded mode. The advanced virtual synchronous generator (VSG) control strategy is applied to realize the fast and seamless switchover between grid connected mode and islanded mode to avoid the impact of voltage and current sudden change due to the operation mode switchover.

- PQ decoupling mode: Decoupled control of active and reactive power under grid-connection condition is suitable for peak shaving and frequency & voltage regulation.
- VF control mode: Frequency & voltage control is suitable for the reliable operation under islanded mode.
- Droop control mode: Active power-frequency and reactive power voltage droop controls is suitable for frequency & voltage regulation.
- VSG mode: Simulating the external characteristics of synchronous generator that it is suitable for the seamless switchover between grid connected mode and islanded mode.
- Black start mode: To establish and stabilize the grid voltage and frequency. It is suitable for the black-start application under the islanded condition

Solution Features

- Higher efficiency, Max up to 98.75%
- UL & TUV certified
- Less Modular design, easy for maintenance
- Compact footprint
- Built-in advanced ESS control system
- High and low voltage ride-through (LVRT) capability & better frequency adaptability enable frequency and voltage supports to ensure the stable operation of micro-grid.

Main Related System

- PCS-9567 Power Conversion System

BESS Turnkey Service Package

NR offers integrated BESS service package with qualified third-party products to meet clients' needs. These services include,

- Project Management
- Conceptual & Detailed Design
- Manufacturing & Testing
- Engineering & Procurement
- Site construction, installation
- Testing & Commissioning
- Maintenance services



Generator Excitation System Solution

The PCS-9400 generator excitation system is an important part of generator that is used to inject the exciting current into rotor to establish the magnetic field. The excitation system should maintain the generator voltage level and is required to act on power system static & transient conditions.

NR provides microprocessor-based excitation system to enhance generator performance and reduce maintenance costs. It offers inclusive control strategies for different applications, such as power system stabilizer, optimum control or adaptive control, etc. It also can be customized to meet the numerous specifications of specific project. The current rating is available from 100A up to 7000A and the voltage rating is available from 100V up to 700V.

NR's excitation system consists of numerical excitation regulation system, thyristor rectifier, diode valve rectifier, de-excitation equipment and auxiliary cabinets. According to the different requirements of each excitation mode, the above equipment can be flexibly tailored to combine the compatible solution.

Solution Features

- Module design with interchangeability, easy extension and maintenance.
- This device can detect the real-time status of all the important aspects of this device, it also can do a redundant process to the abnormality or error link in the system at once and block the abnormal channel to avoid the generator condition fluctuation due to the hardware fault.
- Maintaining the normal operation of the excitation system by fault tolerant control
- Double sets or multiply sets configuration to improve reliability of the whole control system
- This device provides complete protection function generator excitation limitation by selecting any combination and putting into operation.

And it can choose whether to switch to the standby channel when the protection is operated.

- According to the real-time adjustment curve of the generator operation condition, this device can make the operation curve and the excitation loss protection of the generator cooperate "seamlessly".
- The IEEE standard excitation adjustment control mathematical model and power system stabilizer (PSS) mathematical model are adopted in this device. And this device provides several internal measuring points for model identification.
- Supporting communication with SAS or RTU via Ethernet network ports and serial ports
- Complete event recording function is provided
- Powerful fault and disturbance recording function is provided
- Powerful PC tool software can fulfil function configuration, modify setting and commissioning.

Main Related System

- PCS-9400 Generator Excitation System



Static Frequency Converter Solution

Large capacity synchronous machines need speed control during startup to improve efficiency and minimize cost. To solve these problems, NR brings its Static Frequency Converter (SFC) solution to realize smooth startup of generators for pumped storage power plant, gas turbine power plant and some industrial enterprises.

NR's SFC system can effectively adjust motor speed by injecting the variable-frequency current into the stator winding of synchronous machine to produce a varying magnetic flux. It can detect the initial position of rotor without any external sensor.

Solution Features

- Cutting-edge rising speed control tactics to guarantee successful and smooth startup process.
- Series-parallel hybrid air flue design for more efficient cooling effect and high-voltage valve bridge.
- Redundant and reliable protection scheme with one separate protection and another embedded in SFC controller.
- Innovative various frequency differential protection for Converter Bridge and transformer to guarantee reliability, selectivity and rapidity of protection.
- Automatic, seamless and smart interface switch design for easy realizing redundant SFC scheme, especially for refurbishment or upgrade of existing SFC project.

Main Related System

- PCS-9575 Static Frequency Converter

Engineering, Consulting & Service

NR offers engineering, consulting and services solutions to utilities, renewable generation and industry customers worldwide. From simple loose relay supply, to power system electrical design and turnkey service, NR always implements a project to meet customers' exact specifications. As an experienced and reliable partner, NR is your outstanding choice to ensure smooth project delivery and guarantees successful turnkey.



Turnkey Service

As a reliable partner, NR is always ready to offer turnkey services to our global clients, assisting them to resolve power system technical problems and to maximize project benefits. Hand over your project to NR from initial evaluation stage, we will offer a customized system solution combining with strict project management, experienced site commissioning and well-performance products. Through the professional project life cycle management and executions, NR's turnkey service is a value added choice for your investment.

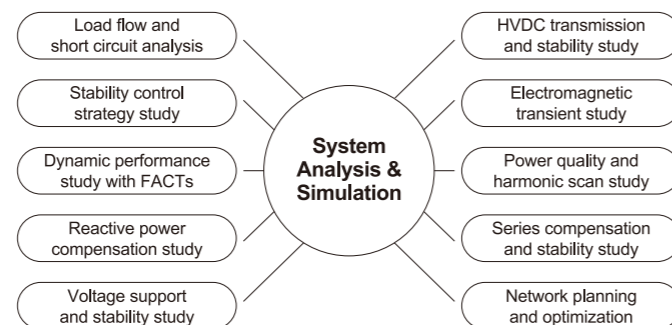
- System Studies & Consulting
- Basic & Detailed Design
- Project Management
- Procurement & Manufacturing
- Site Construction & Installation
- Testing & Commissioning
- Maintenance Services

System Analysis

NR owns a strong system analysis team, who can provide system analysis and technical consultation for both planned and operating power grids, helping to realize the economic and reliable operation of grids. NR's system studies and technical consultation cover following areas:

Besides system study, NR also offers feasibility study to help clients objectively evaluate the project's potential for success. Our feasibility study covers,

- Definition of project requirements
- Optimization of single line scheme
- Voltage level and feeder arrangement
- Main equipment specification and layout
- Load flow & dynamic stability
- System protection coordination
- Integrated & distributed resources planning
- Cost Minimized



System Design

In the past decades' of serving power utility and industry clients, NR always insists that a detailed and precise engineering design work from the early stage of a project is the foundation for well construction and safe operation of a power grid. For this reason, we keep striving to improve our engineering design capabilities to maximize clients' benefits from the beginning of a project. Based upon professional experiences gained from thousands of projects of different voltage levels, NR offers complete engineering design works including.

Basic Design

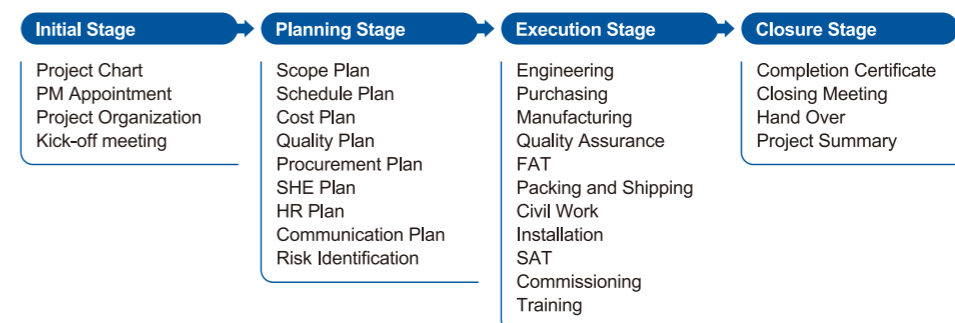
- Equipment and conductor selection calculation
- Single line diagram
- System layout
- Architectural Design of Building
- Protection & Control Configuration
- Auxiliary supply Configuration
- Communication system proposal
- Communication Configuration
- Bill of Material

Detailed Design

- Layout & installation design
- Lightning and grounding design
- Protection & Control design
- Auxiliary supply design
- Auxiliary control system design
- Steel Structure Design
- Civil Design
- Hydraulic Design
- Ventilation Design
- Communication system installation design

Project Management

From undertaking thousands of projects in the past decades, NR believes the key factor to achieve the project success is professional project management. From the initial state to project closure, NR offers life cycle project management and assigns qualified project managers to ensure the project can be implemented efficiently and economically.



Procurement & Manufacturing

Reliable and safe power system operation relies on advanced system solutions and high-quality products. As a professional system solution provider, NR manufactures high quality products and procures qualified third-party devices to ensure the project completed on time and on budget.

NR IEDs and power electronic equipment factories situated over 500,000 square-meters (5,400,000 square feet) of area with annual manufacturing capability of 250,000 IEDs, 50,000 panels, 2,500 pieces of power electronics equipment and 2,500 electronic CTs/VTs. Before delivery to site, all OEM products have to pass Factory Acceptance Tests (FATs) to assure mechanical quality and electrical performance.

NR's FATs including,

- High Voltage Test
- Dynamic Model Test
- Digital Simulation Test
- VSC-HVDC Synthetic Test
- LCC-HVDC Synthetic Test

NR also purchases qualified third-party devices, materials and services to achieve the best overall value for clients' investment. Our procurement system has established a supplier database that each supplier has been selected and investigated carefully. NR's procurement professionals understand the importance of selecting appropriate suppliers and will give their strict adherence to safety and quality of your project.

Site Construction & Installation

For each single project, no matter the location, or conditions, NR always appoints experienced project managers and engineers to site to manage & implement construction and installation work. Per your specific requirements, NR carefully chooses subcontractors to complete the project on schedule. NR's construction and installation management services covers

- Greenfield or brownfield projects
- International civil works, site works, erection and installation
- Evaluates the site to achieve a safe and cost effective on-time delivery
- Partnering with local qualified contractors



Testing & Commissioning

NR's regional engineering teams are always working in close cooperation with end users to reduce site testing & commissioning time and cost. This service enables NR well trained technical engineers to provide hands-on trouble shooting for operation personnel. NR's site test and commissioning services feature

- Primary equipment testing and AC withstand testing in substations of voltage level up to 500kV
- Protection, automation and control devices testing in substations of voltage level up to 1000kV
- Comprehensive commissioning quality plan
- Familiarity with the equipment
- Pre-prepared standard test record schemes
- Review results with Chief engineer & scheme designer

Maintenance Services

After the completion of each project, NR provides flexible maintenance package to ensure long time safe and economical operation of your power system. Our full-service maintenance package includes equipment & device testing & commissioning, trouble shooting, repair & replace, spare parts supply and engineering training. Find NR contact information on our website or directly contact our local technical support/service centre, our experienced service engineers will response to you at the first time.