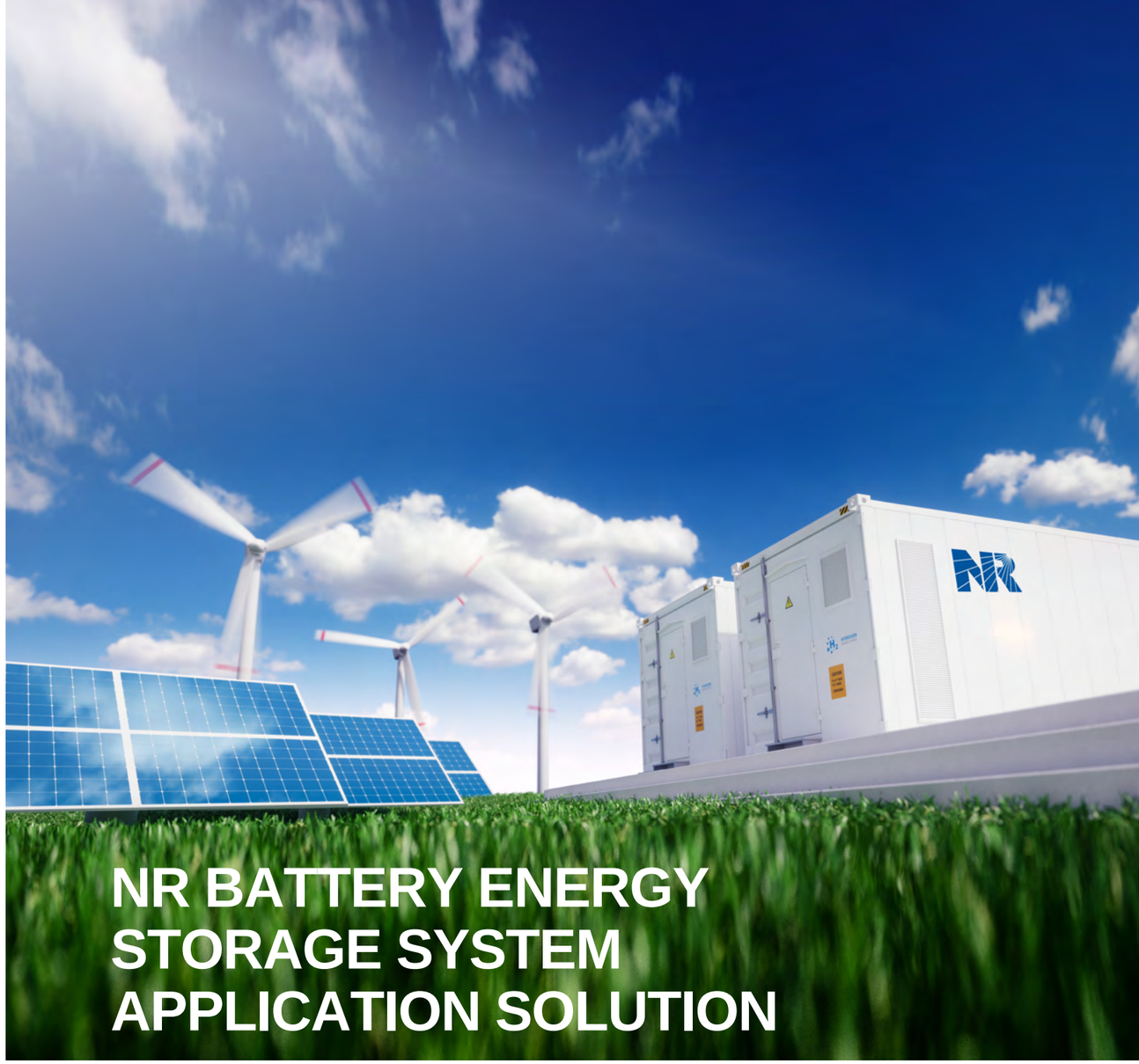

NR BATTERY ENERGY STORAGE SYSTEM APPLICATION SOLUTION

For Better Energy Flexibility and Availability

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NR Electric Co., Ltd.

The Leader of Green Energy Revolution for A Better World .

BESS solution with high flexibility, reliability, safety and availability.

NR Electric (NR) is a leading solution-provider to improve the stability, reliability, efficiency and environmental friendliness of power system. NR Electric, as a power stability expert, is dedicated to all around solutions for electric power generation, transmission and distribution. With more than twenty years of experience and high-tech innovations, NR Electric provides continuous innovation and dedicated power system solutions, including BESS solution, with world class products & services to global customers.

As the leader of green energy revolution for a better world, NR Electric offers a sophisticated solution for flexible Battery Energy Storage System (BESS), which includes advanced converter/inverter technology and comprehensive control, protection and energy management system to ensure the safety, reliability and flexibility of BESS. With years of experience in energy storage system application, NR has acquired comprehensive know-how on storage media and built good relationships with various kinds of battery manufacturers. So NR can help to procure the battery and supply a turnkey solution according to customers' requirements.

- NR's well-proven PCS, certified by UL, G59 and TUV, is able to connect any battery type or energy medium, such as Lithium-ion, Lead-acid, Sodium Sulfur (NAS), Vanadium redox and Zinc-bromine, etc.
- Proprietary control algorithms with utility grade BESS controller and energy management software help to enable a variety of energy storage applications and optimize system efficiency and performance.
- NR offers integrated turnkey BESS service package with qualified third-party products to satisfy clients' needs, especially based on reliable and good cooperative relationship with a variety of battery manufacturers.
- NR's solution makes your ESS as effective as possible based on precise system control and operation, maximizes the use of energy storage system and deliver exceptional recovery on investment.

NR BESS
Application Solution

- Solution for PV or Wind Power Plant
- Solution for Large Scale BESS Station
- Solution for Distributed BESS Project
- Solution for Flexible Distribution Power Grid
- Solution for Microgrid System

Configuration of BESS Solution

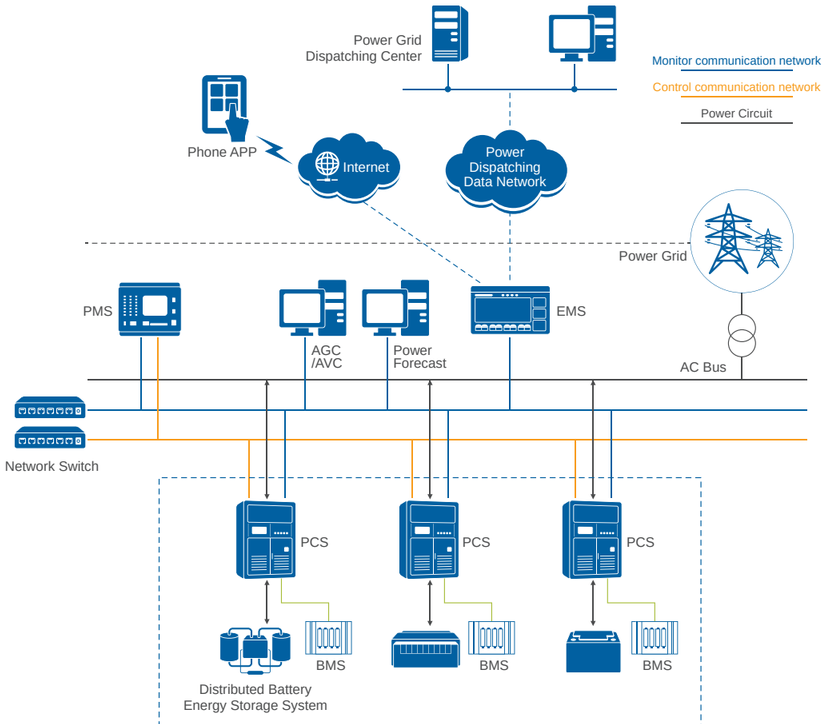
The Battery Energy Storage System supplied by NR Electric mainly consists of the Energy Management System (EMS), Power Management System (PMS), Power Conversion System (PCS), Battery and Battery Management System (BMS). EMS is usually deployed to supervise and manage the entire energy storage system to achieve the stable & economical operation, ensuring the flexibility, safety and reliability of the system. PMS can achieve the transient control function. It can coordinate the operation of multiple PCSs reasonably by developing appropriate control strategies according to different application scenarios. As the interface between battery and grid, PCS is used for realizing Bi-direction flow of energy.

The self-developed key devices of the Energy Storage System by NR Electric include:

- PCS-9700 EMS/SCADA for Energy Storage System
- PCS-9567C Power Management System(PMS)
- PCS-9567 Power Conversion System (PCS)
- PCS-9600 Series protection and control devices

NR's Energy Storage System solution can support or integrate multiple kinds of batteries such as Lithium-ion, Lead-acid or Lead-carbon, Sodium Sulfur (NAS), Vanadium redox and Zinc-bromine, etc. With rich experiences, NR's ESS solution has been widely applied in renewables power plants, large scale BESS station, distributed BESS projects, urban flexible distribution power grid, and microgrid system, etc.

Typical configuration of BESS Application



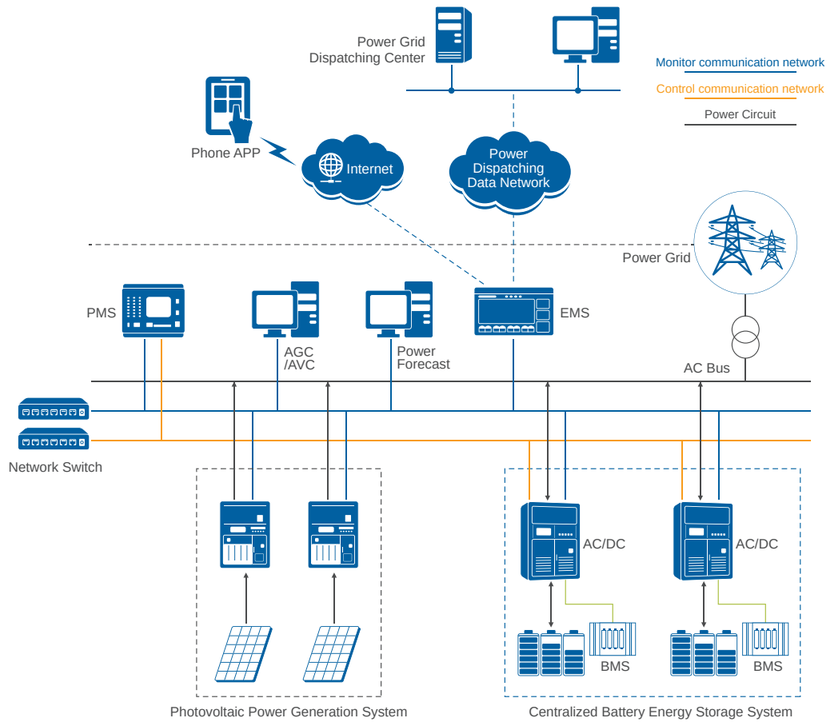
Solution for PV or Wind Power Plant

The ESS plays a vital role in assisting the renewable power penetration and its reliable operation. NR BESS solution for renewable power plant can not only absorb fluctuating renewable energy during off-peak times, but also improve system efficiency, reduce power fluctuation and improve renewable power quality. NR Electric can provide tailored centralized and distributed BESS solution for solar and wind power plants based on the actual requirements.

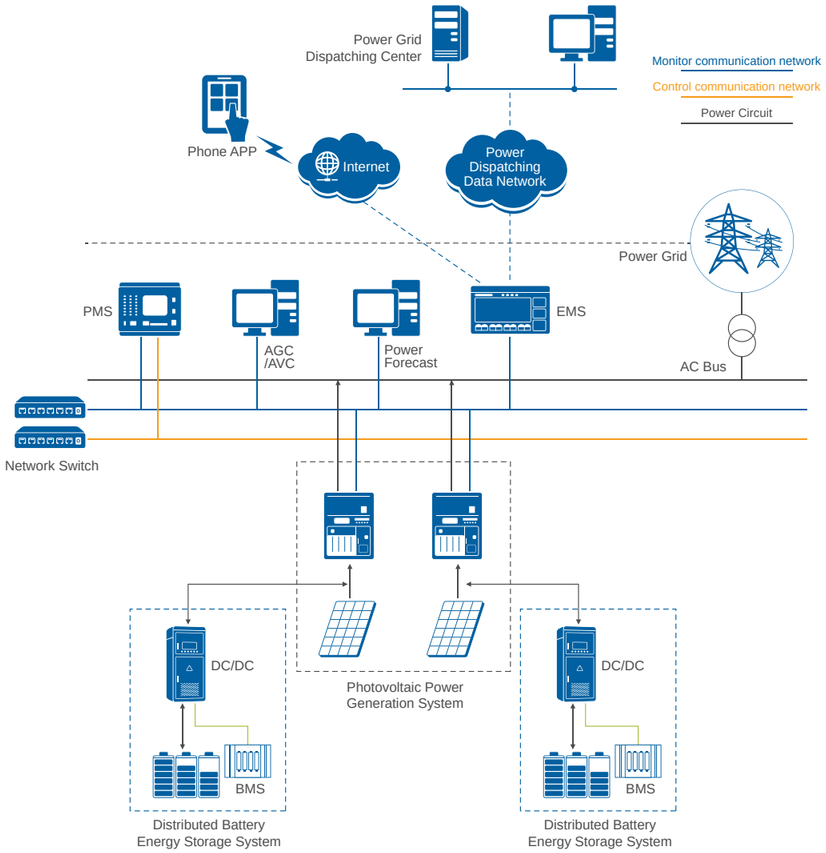
Feature:

- Stabilize renewable energy integration, enhance power quality and friendliness of renewable power.
- Smooth the power fluctuation of renewable power, increase the income of plants.
- Improve controllability, accurately tracking the command curve given by dispatching center.
- Effectively participate in the auxiliary services such as frequency regulation, voltage regulation and peak shaving.
- Excess renewable power management.

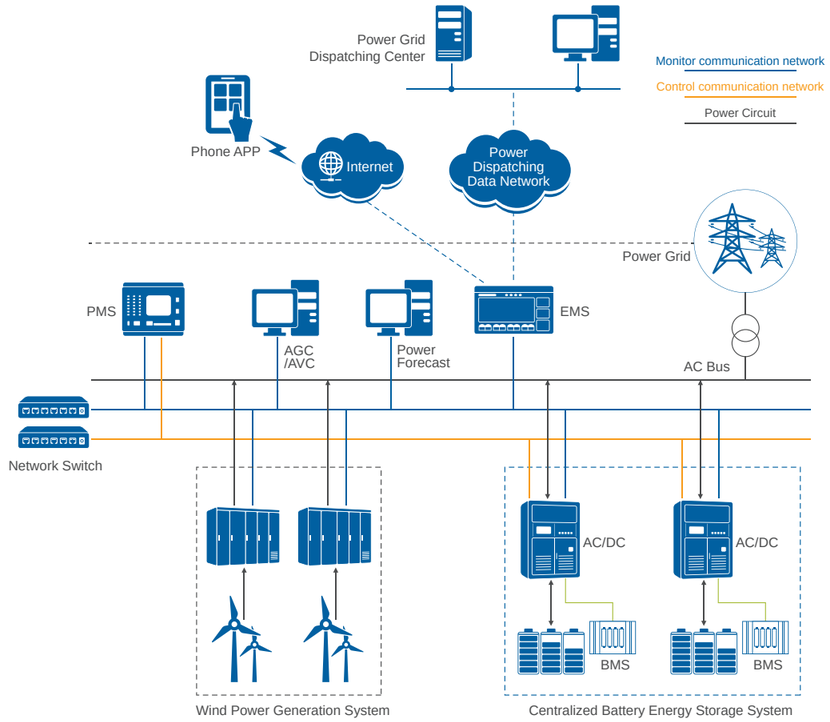
Centralized Configuration of BESS Application in Solar Power Plant



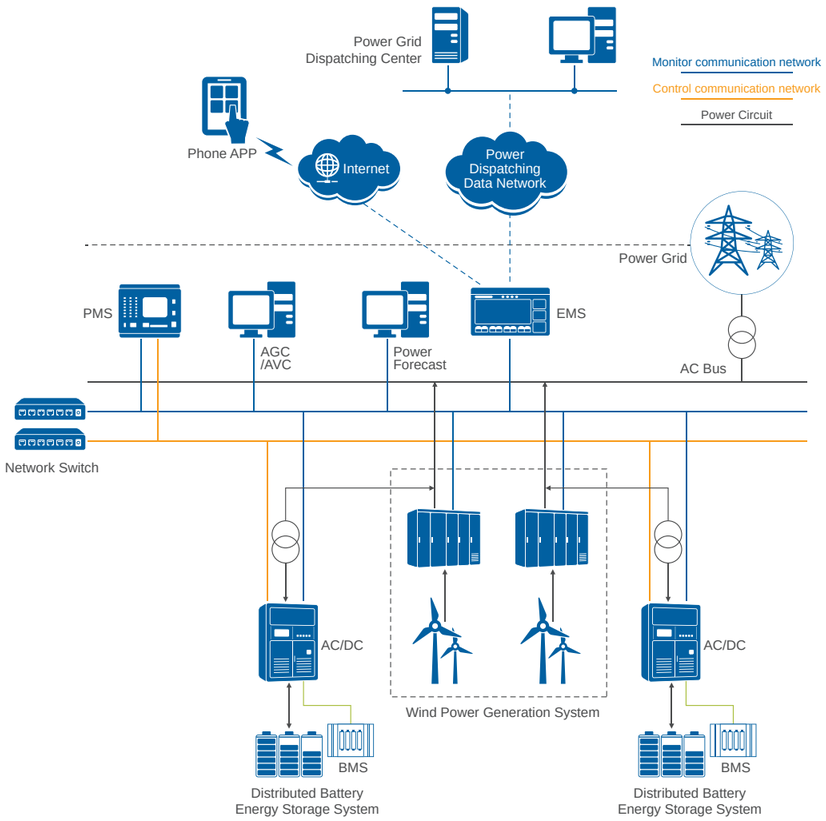
Distributed Configuration of BESS Application in Solar Power Plant



Centralized Configuration of BESS Application in Wind Power Plant



Distributed Configuration of BESS Application in Wind Power Plant



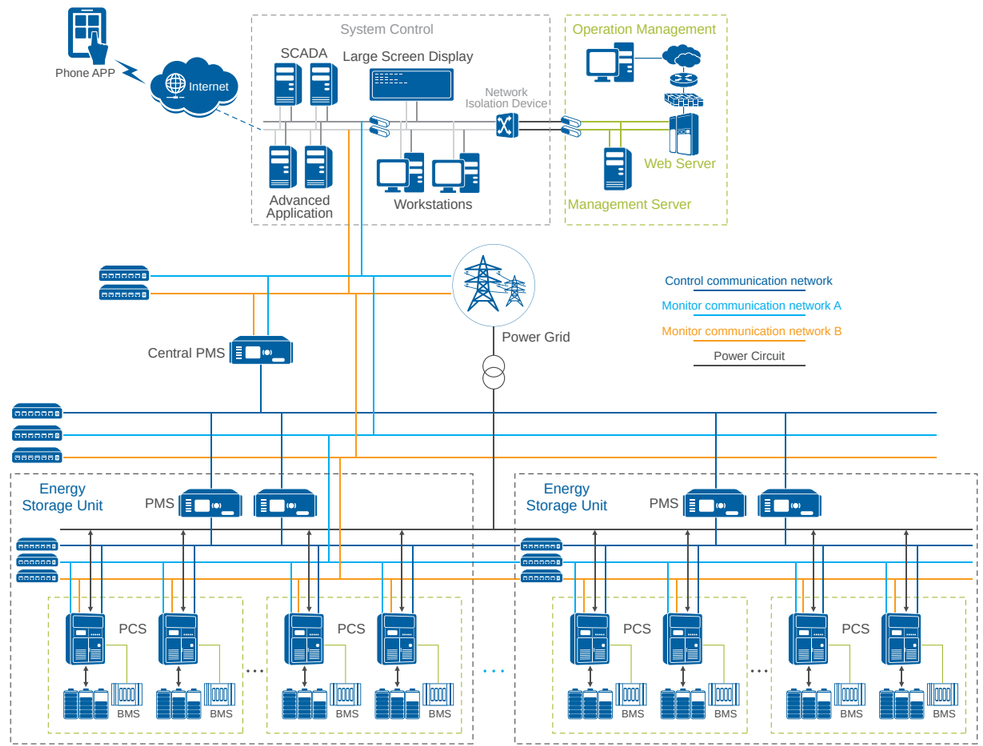
Application Solution for Large Scale BESS Station

The large scale energy storage system is generally applied for peak shaving, backup power, transmission investment deferral and frequency or voltage regulation in power grid. Furthermore, it has the black start and islanding function to provide continuous power to critical loads in the event of grid outage.

Feature:

- EMS has the integrative functions including electrical monitoring, energy management and auxiliary monitoring.
- Superior functions include peak shaving, frequency regulation, voltage regulation, black start and oscillation damping.
- With synchronous coordination control ability of hundreds of PCSs.
- The coordination control system adopts the hierarchical control structure and high-speed fiber communication to achieve the ms-level communication delay.
- Support IEC 61850 protocol to easily realize the digitization and intelligence.
- The monitoring network and the coordinated control network are independent, realizing the group control and regulation of PCSs reliably.

Typical Configuration of Large-scale BESS Application



Solution for Distributed BESS Project

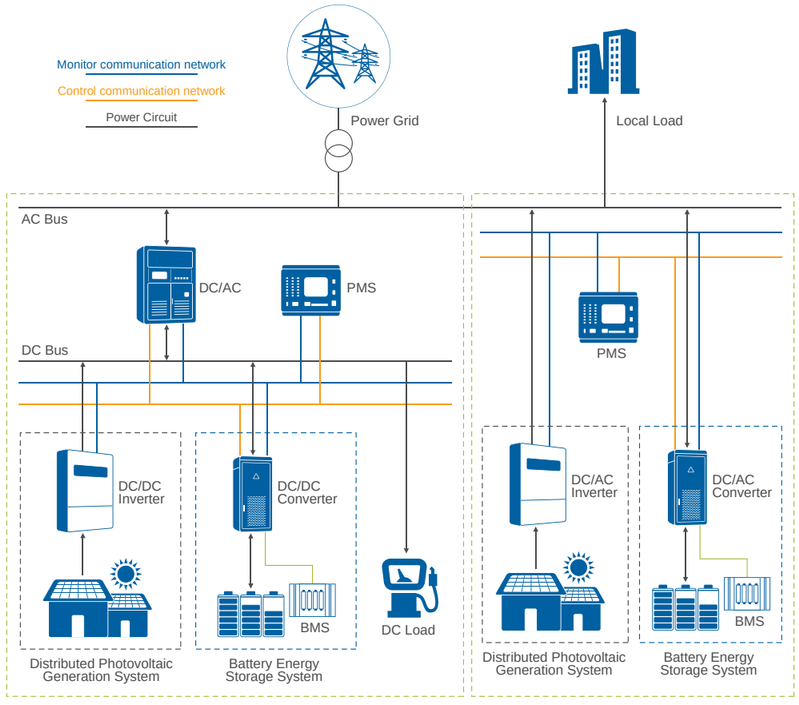
With the massive promotion of distributed resources, energy storage system has been widely used in distributed networks. In factories, hospitals, airports, rural areas and other places, the energy storage system can be reasonably adopted and be connected to the distribution system. It ensures maximizing the penetration of renewable power, up to 100%. Consumers can also schedule the charge and discharge power of energy storage system based on the local multistep electricity for more revenue. Energy storage system can be charged when the electricity price is low and discharged when the electricity price is high. In addition, the energy storage system can be used to balance peak load and realize peak shaving, defer the upgrading of power distribution facilities, improve power quality and reliability of power supply.

The distributed energy storage system can be configured to be coupled to DC bus or AC bus independently or simultaneously.

Feature:

- PV power, energy storage system and DC loads are all connected to a common DC bus for higher efficiency.
- Also suitable for enforcement without DC load.
- Flexible and reliable control strategy.
- High suitability for various kinds of batteries with large range of DC voltage.

Typical Configuration of Distributed BESS Application



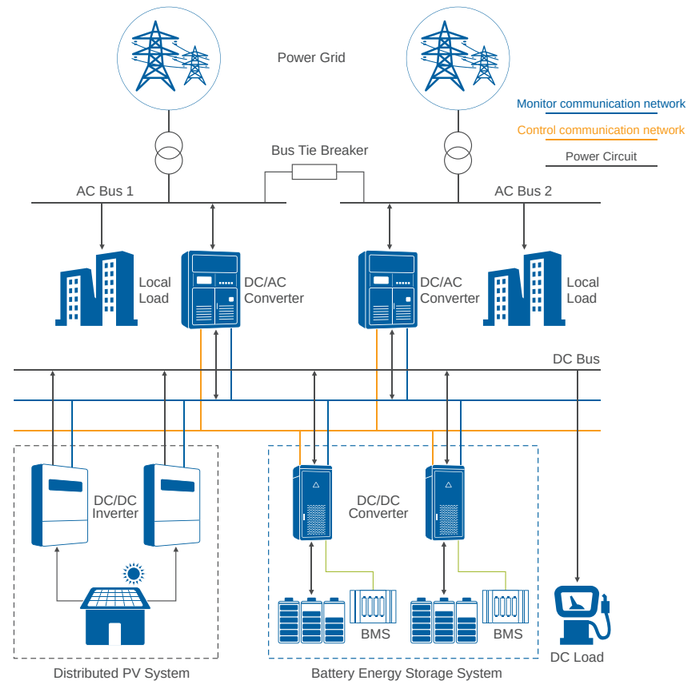
Solution for Flexible Distribution Power Grid

In the modern urban distribution system, load becomes to be more and more complicated. When the transformer is operating with low load or no-load, its efficiency is very low. But in case of peak time, such as EV charger is put into operation suddenly, the transformer tends to be over-loaded. In order to solve this problem, NR Electric proposes the urban flexible distribution system solution, which adopts flexible DC transmission technology and combines with the energy storage system to promote the intelligent development of urban distribution system effectively.

Feature:

- Solve short-time overload of transformers by controlling the power flowing from one AC bus to another.
- The energy storage system can discharge to output power when system fault or overload occur, which is a better way to improve power supply capacity
- Photovoltaic power generation, energy storage system and DC load such as electric car charging piles can connect to a common DC bus.
- Improve the reliability of the distribution system and achieve uninterrupted power supply.
- The community can be interlinked to reduce the construction cost of Mid-Voltage dual power supply

Typical Configuration of BESS Application in Flexible Distribution Power Grid



Solution for Microgrid System

Microgrids are electricity generation and distribution systems containing loads and distributed energy resources, and energy storage system, etc. Microgrid can be operated in a controlled, coordinated way either while connected to the main power network or while islanded.

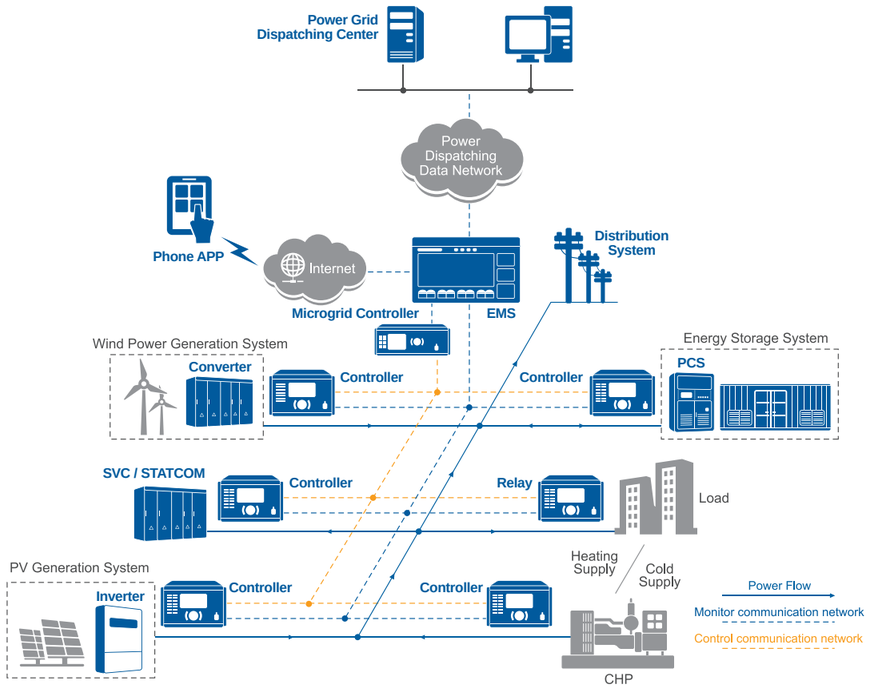
The microgrid (MG) consists of two types, namely grid-connected microgrid and permanently islanded microgrid. The grid-connected microgrid is synchronized with the external power grid and generally applied in industrial parks and enterprises, communities, hospitals, schools, etc. It operates in parallel with the distribution network to realize the bidirectional energy exchange. During the external grid outage, it operates in the islanded mode to enhance the power supply reliability. The permanently islanded microgrid is a stand-alone network, normally applied in the remote districts not covered by the large power grids, such as countryside, island, etc. It generally operates independently to meet the load demand by the distributed generator or Energy Storage System (ESS) within microgrid.

NR Electric, taking the advantage of multi-professional techniques, adopts hierarchical distributed control system architecture which inherits the smart substation technology. Through coordination and optimal control of different levels, NR microgrid solution can achieve the stable and economic operation of microgrid, and can greatly improve penetration of the distributed clean energy.

Feature:

- Hierarchical and distributed microgrid control system architecture
- Redundant design of control network to guarantee control reliability
- Advanced microgrid coordination controller with ms-level response speed to achieve the flexible switchover of different operation modes
- Self-adaptive protection setting design for on-grid and off-grid operation modes.

Typical Configuration of BESS Application in Microgrid System



Typical Application Cases

Hybrid microgrid of PV and NAS BESS in Nanjing city, China

2.58MW roof-top PV system and 1.4MWh/200kW NAS BESS

Need »

Peak Shaving

Microgrid Regulation

Load Shifting

Project Details »

2.58MW roof-top PV system and 200kW/1400kWh NAS BESS.

Installed in 2015

India's first Li-ion & Lead Acid Pilot BESS projects of India Power Grid

500kW/250kWh lead-acid battery and 500kW/250kWh lithium battery

Need »

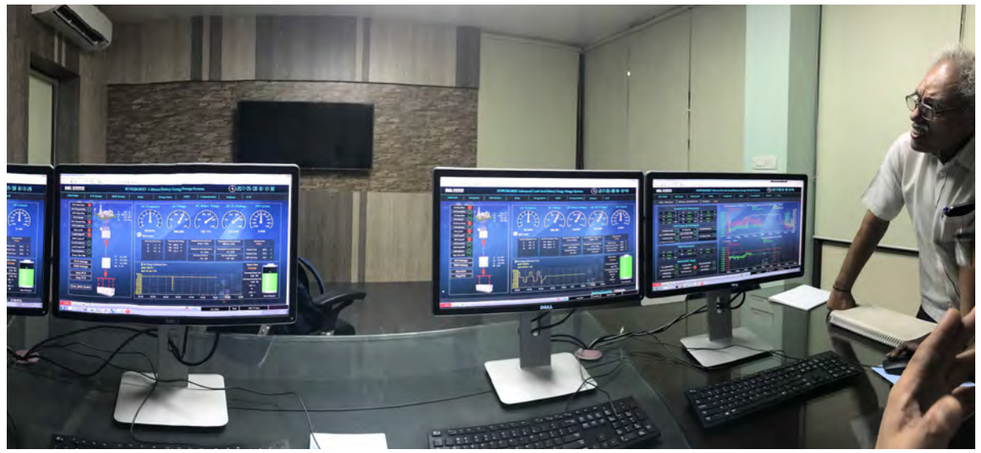
Frequency Regulation

Energy Time Shift

Project Details »

500kW/250kWh lead-acid battery and 500kW/250kWh lithium battery

Installed in 2017



China's first flexible DC distribution system including BESS for Xuzhou utility of China

300kW/340kWh lithium BESS

Need »

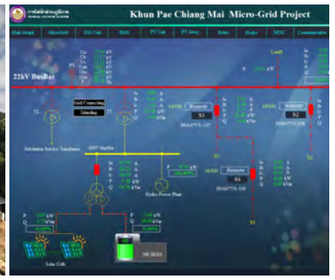
Frequency & Voltage Regulation

Flexible DC Distribution Regulation

Project Details »

300kW/340kWh lithium BESS

Installed in 2017



Lithium Battery Energy Storage System for PEA's First Microgrid in Chiang Mai, Thailand

100kW/100kWh Lithium BESS

Need »

Frequency & Voltage Regulation

Microgrid Regulation

Project Details »

100kW/100kWh lithium BESS

NR supplied turnkey solution, including BESS, PV system

Installed in 2017

Redox Flow Battery Energy Storage System in Osaka, Japan

1000kW/4MWh Redox Flow BESS

Need »

Frequency & Voltage Regulation

Peak Shaving

Project Details »

1000kW/4000kWh Redox Flow BESS

Installed in 2017

NAS Battery Energy Storage System in Nagoya, Japan

600kW/3.6MWh NAS BESS

Need »

Frequency & Voltage Regulation

Peak Shaving

Project Details »

600kW/3600kWh NAS BESS

Installed in 2016