Shenzhen MicroGrid EMS Engineering Laboratory

Yi Qin

UniversityTown Inovation Park 1507# Nanshan Shenzhen China +008613316525500

Introduction

The Shenzhen Microgrid Energy Management System Engineering Laboratory, established in 2011 as a key project under Shenzhen's New Energy Development Plan, focuses on four core objectives:

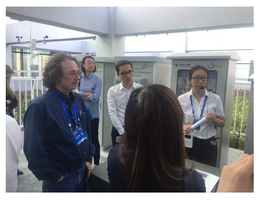
(1) Developing core technologies for microgrids (distributed power generation and energy storage systems) by building experimental systems integrating distributed power sources, energy storage facilities, and microgrid infrastructure;

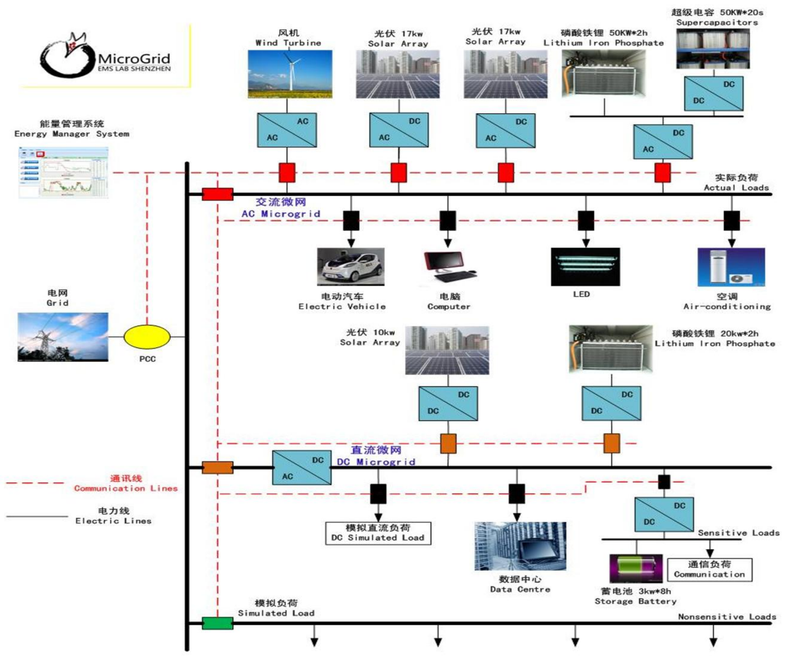
(2) Creating integrated microgrid management systems through optimized operations **and** establishing a comprehensive data platform with AI-driven analytics;

(3) Establishing a holistic evaluation framework for microgrid performance, along with industry- standard protocols to drive sustainable development in the renewable energy ;

(4) Cultivating technical experts and providing system commissioning services to support innovation in the new energy industry ‘

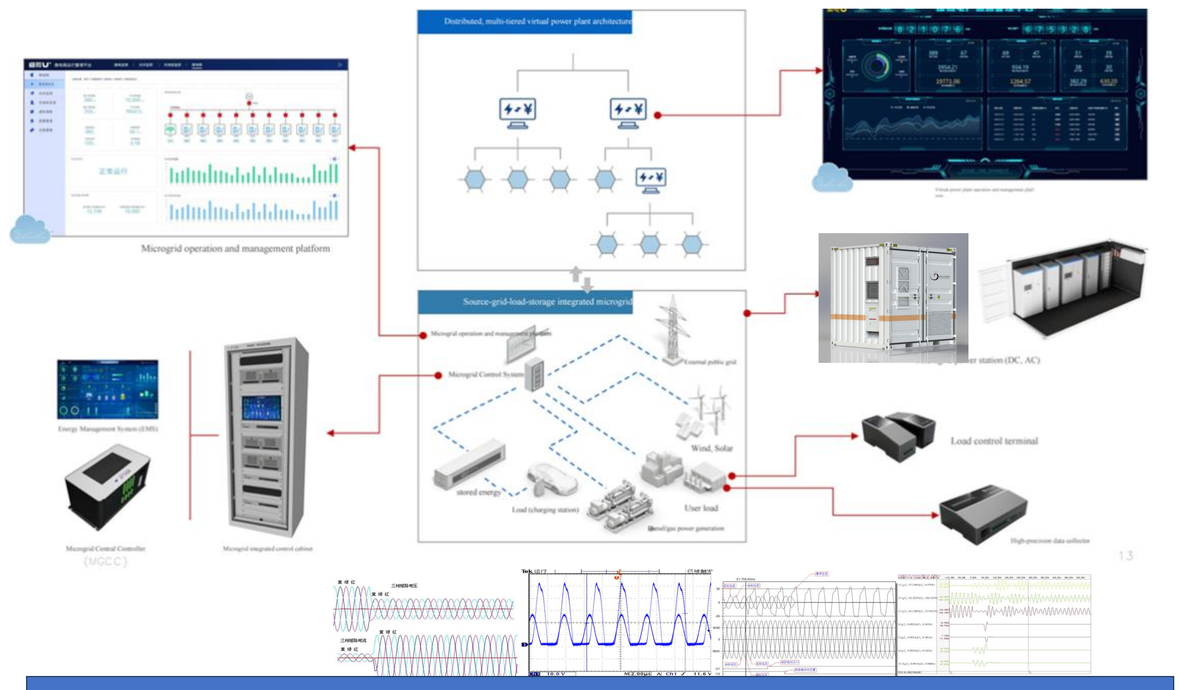
Laboratory





PV, Power Storage, DC Power Supply, Flexiable Usage Intergrad

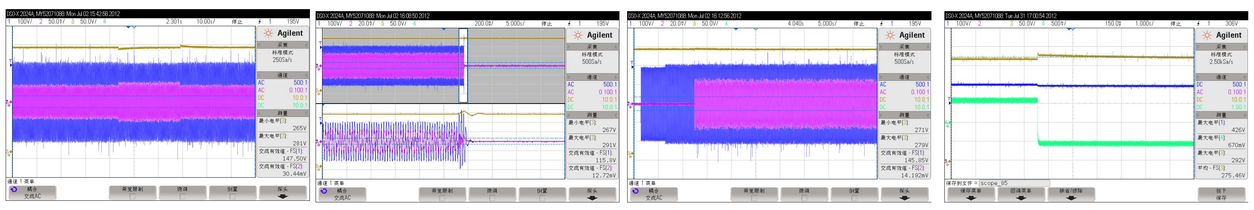
The photovoltaic-Powerstorage-direct-flexible power station integrates microgrid energy control systems, photovoltaic inverters, energy storage PCS, AC/DC distribution cabinets, and grid-connected switchgear. It enables rapid standardized integration of photovoltaic systems, energy storage batteries, charging piles, and other equipment, creating a microgrid system that combines power supply access, energy storage, AC/DC conversion, power dispatching, optimized control, and grid interaction capabilities.



Cost&Benifit

	Intergraded	Traditional
Commissioning period	The factory adopts prefabricated design, production, and commissioning, completing the installation of equipment and communication debugging in the power station in advance. The standard externalpower access interface enables plug-and-play installation on-siteThe factory adopts prefabricated design, production, and commissioning, completing the installation of equipment and communication debugging in the power station in advance. The standard external power access interface enables plug-and-play installation on-site	On-site installation of multiple elements and devices including lighting, energy storage, and charging stations Long commissioning and construction commissioning cycle
Construction difficulty and impact range	Low coupling design for AC distribution networks, standard power access interface, low construction difficulty; outdoor rapid deployment,maximum reduction Construction volume in the building	Photovoltaic systems, energy storage devices, and charging stations are all remotely connected to the building's electrical infrastructure. Large amount of work and difficult construction
Secure and stable	The internal structure is designed with comprehensive planning, featuring high integration and prefabricated installation and commissioning to ensure the system operates safely and stably	On-site integration and joint debugging of equipment from multiple manufacturers, including photovoltaic and energy storage systems, may pose risks to system stability
Construction and O&M costs	High integration of key equipment reduces construction and construction costs by 10% It reduces on-site debugging time by over 20% and enables one-stop operation and maintenance. Routine inspection reduces operation and maintenance costs by more than 10%	Multiple devices need to be installed and integrated on-site, with extensive construction work. Devices are scattered, and the construction and operation and maintenance costs are high
Demonstration project requirement	The walk-in design with a pull-out cabin door meets construction requirements. Debugging, equipment inspection and maintenance, display of internal box structure, and other functions Features and Requirements	The equipment is scattered in various distribution rooms, without a sense of overall design. The display effect is poor.

DC Microgrid Control Strategy

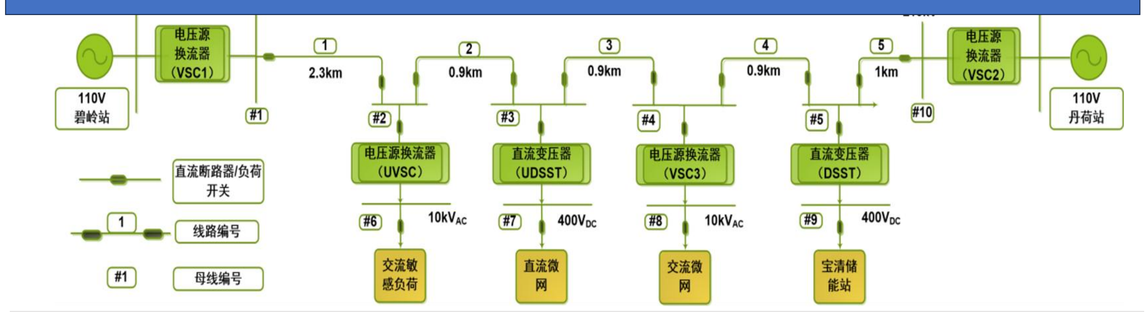


Grid connected mode DC/DC — Grid connected to island — Island mode to grid connected — Bidirectional

DC microgrid operation mode in different DC bus voltage

Mode	Micro-grid state	Grid AC/DC	Battery DC/DC	PV DC/DC	Load
I	Grid connected	Inverting	Charging	MPPT	Normal
II	Grid connected	Rectifying	Discharging	MPPT	Normal
III	Islanding	Shutdown	Charging	MPPT	Normal
IV	Islanding	Shutdown	Shutdown	Constant Voltage	Normal
V	Islanding	Shutdown	Discharging	MPPT	Normal
VI	Islanding	Shutdown	Discharging	MPPT	Load shedding

DC Power Supply System



The “hand in hand” dual-end power supply topology is adopted to meet the requirements of high-quality powerupply access to four typical services:

1) High-capacity AC loads (unidirectional), such as those requiring high power

2) supply reliability and high power quality, variable frequency drives

2) DC loads (unidirectional), including EV charging equipment and DC loads

3) A bidirectional AC microgrid system integrating renewable energy generation, energy storage, and AC loads

4) A bidirectional DC microgrid system integrating renewable energy generation, energy storage, and DC loads

UserCase

Shenzhen Longgang International Low-carbon City Future Building DC energy micro-grid system project

Background

Application scenario: Commercial building | Construction time: 2019~2022 | Project location: Shenzhen

20 On May 3, 2012, Shenzhen and the Netherlands jointly initiated the development of the Shenzhen International Low-Carbon City, establishing a flagship project for China-Europe sustainable urbanization cooperation. The urban area spans 53.14 square kilometers, with 19 square kilometers designated for construction, while 63% of the land is protected under ecological conservation zones. The city's transportation network integrates regional connectivity with low-carbon mobility solutions, green building designs emphasize harmonious integration of production, living, and ecological systems, and its energy infrastructure features a “photovoltaic-storage-direct-charging” DC power distribution system, enabling coordinated control and optimized energy management across the entire ecosystem.

Construction Content

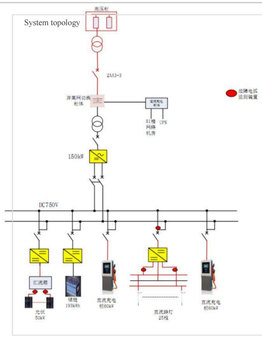
- 750VDC low-voltage DC busbar power distribution system
- 260kW DC charging piles
- 33kWp photovoltaic power generation system
- 193kWh storage
- 5kW DC street light
- 150kW AC/DC (Alternating Current to Direct Current) Converter
- Energy microgrid energy management system

Our company participates

Energy management system

- Project feasibility study
- Microgrid primary and secondary system design
- Microgrid system modeling and simulation
- Microgrid Energy Management System (EMS)

System topology



Effectiveness

- Realize the local consumption and effective utilization of photovoltaic power generation
- Establish flexible connectivity and energy exchange between DC construction and distribution networks,
- Ensure safe, reliable, low-carbon, and economical operation of DC power supply in buildings
- Integrate emergency response, safety, stable operation, cost-efficient dispatch, and carbon optimization
- Compared with the AC system, the building operation efficiency is improved by about 10%
- The annual energy saving is about 79 tons of standard coal

DC Microgrid Project for a Power Supply Bureau's Building HenQin Zhuhai

Background

Application scenario: Commercial building | Construction time: 2021~2023 | Project location: Zhuhai

In June 2021, the State Grid Corporation of China released the "Action Plan for Accelerating the Construction of a New Power System to Serve Carbon Peaking and Carbon Neutrality," which outlined the establishment of a demonstration site for a new power system in Hengqin Cooperation Zone. This initiative focuses on developing green electricity-based power systems and carbon neutrality demonstration zones, while expanding building energy efficiency and tapping into the potential for energy conservation in the construction sector. The following July, the "Work Plan for State Grid's Integration and Service to the Guangdong-Macao Deep Cooperation Zone" was issued, emphasizing the comprehensive adoption of clean energy. It aims to create three demonstration zones: high-reliability power supply, digital grid, and carbon neutrality. The plan also includes research on DC distribution technologies like flexible grid interconnection, development of intelligent, high-efficiency, and high-power-density equipment, and promotion of the DC distribution industry chain. This pilot project advances "new electrification and DC adoption" in construction, explores flexible loads such as non-production air conditioning loads, charging facilities, and user-side energy storage for demand response, guides research on advanced electrical equipment for new power systems, focuses on core equipment development like DC distribution devices, and explores zero-carbon energy solutions for buildings to achieve high green energy utilization.

Construction Content

Develop a digital platform for energy management in DC buildings to enable precise monitoring of energy consumption loads. By applying data analysis and mining technologies, the system identifies energy consumption patterns and potential energy-saving opportunities. Through energy optimization management techniques, the platform enhances building performance and energy efficiency.

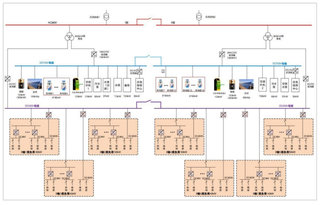
Top-tier photovoltaic systems, energy storage solutions, V2G charging stations, air conditioning systems, and controllable loads

Optimize management to achieve low-carbon, green and economic operation of DC buildings.

The zero-carbon building's power distribution system integrates bidirectional AC/DC converters, energy storage, rooftop photovoltaic panels, V2G DC charging stations, air conditioning systems, and controllable loads.

Our Company Participates

- Microgrid primary and secondary system design
- Microgrid system modeling and simulation
- Microgrid Energy Management System (EMS)
- Microgrid integrated control cabinet
- Project system integration and debugging



Effectiveness

- Provide real-time monitoring of light, storage, charging, and load, and provide daily, weekly, and monthly statistical analysis services
- Use data analysis technology to analyze energy use behavior and energy saving space, statistics of building carbon emissions and analysis of carbon footprint, to achieve low-carbon building certification
- The system performs optimized analysis on multi-source energy consumption data to adjust the output curves of photovoltaic (PV), energy storage, charging, vehicle-to-grid (V2G), and adjustable loads. This enables energy management optimization, ensuring peak-to-valley load difference does not exceed 30% and energy consumption is at least 50% lower than the
- Build an online alert system with "pre-event warning, in-process alert, and post-event traceability" to enable proactive digital operations management, with operations response completed within 1 hour.