WH-TIANWU- AIO- L Technical Introduction (Volume 1.0)

Overseas Pre-Sales Technical Support Department

Jiangsu Weiheng Intelligent Technology Co., Ltd.

Content

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1

Model Description

Model Description

TIANWU AIO-L-100-233-A/B

A: PCS & Battery Liquid Cooling
B: PCS air Cooling
& Battery Liquid Cooling

Energy Level

Power Level

Series Name

Side View of TIANWU

For Overseas Market Air Cooling PCS is Only Available at this time.

2

Functions and Features

Functions and Features

Functions:

- On-grid mode
- Off-grid mode
- On/Off-grid mode

Features:

- Power supply and distribution system
- Monitoring system
- Environmental control system
- Fire suppression system
- Features high safety and reliability
- Rapid deployment
- Low cost of ownership
- High energy efficiency
- Intelligent management.
- Standard modules can be spliced as needed for easy maintenance and scaling up.
- Liquid cooling, high energy density, low footprint, and highly consistent cell temperature

Applications of TIANWU BESS

- Environmental (Reduces Carbon Emission)
- Peak Shaving/Load Management/Reduce Grid Dependency
- Arbitrage/Energy Time Shifting/Reduce Energy Cost
- “Always On” Supply/ Enhanced Resilience (Back up Power)
- Co-Location of Assets(VRE)
- Frequency Control

Advantages of WEIHENG's TIANWU

- **Economical**

Highly Integrated ESS for easy transportation and O&M.

The integrated design allows the site to be quickly set up and used.

- **Liquid Cooling**

The temperature deviance of battery cells in the whole system is within 3°C, due to intelligent liquid cooling system. It can expand the life time of the battery cells up to 20%.

- **Safe**

The system has four levels management structure which can accurately provide short circuit protection, over current protection, over voltage protection, under voltage protection, over temperature protection, etc.

Advantages of WEIHENG's TIANWU

- CATL Battery pack World's Top ranking Manufacturer
- LV Operated machine (0.4kV, User Friendly)
- Easy Maintenance for each single unit without interrupting whole BESS System
- Dual warranty by CATL & WEIHENG
- Guaranteed 24/7 after sale service
- Easy to upgrade whole BESS system
- Especially design for Commercial and Industrial applications

TIANWU-AIO-L

All-In-One Design,
Easy for Installation and O&M

› 86.5 %	15 Years	5 years
RTE	Design Life	Warranty
‹ 3 ℃	IP 55	‹ 1 day
Difference between battery cells	Protection Level	Installation Time

Real Installation View of TIANWU

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3

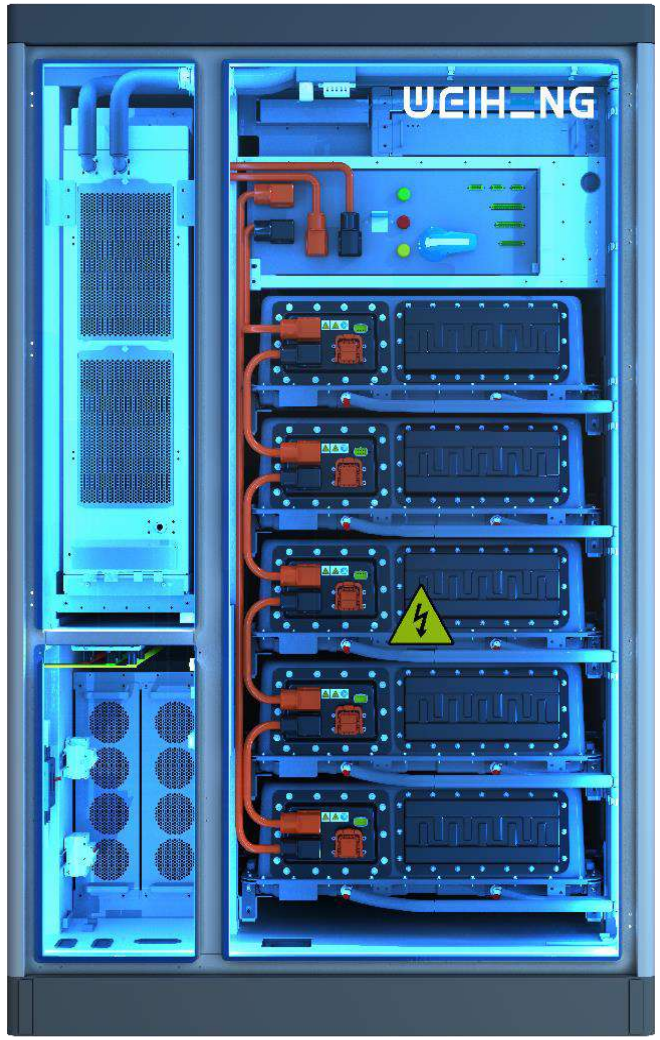
TIANWU BESS Cabinet

TIANWU-AIO-L BESS Cabinet

A liquid cooling all-in-one commercial and industrial ESS, is integrated with

- CATL Battery Packs
- WEIHENG's BMS
- WEIHENG's EMS
- WEIHENG's PCS

  & DC/DC Converter, STS, Transformer etc. (Control Cabinet)
- Thermal management System
- Fire protection System
- Environment Control System



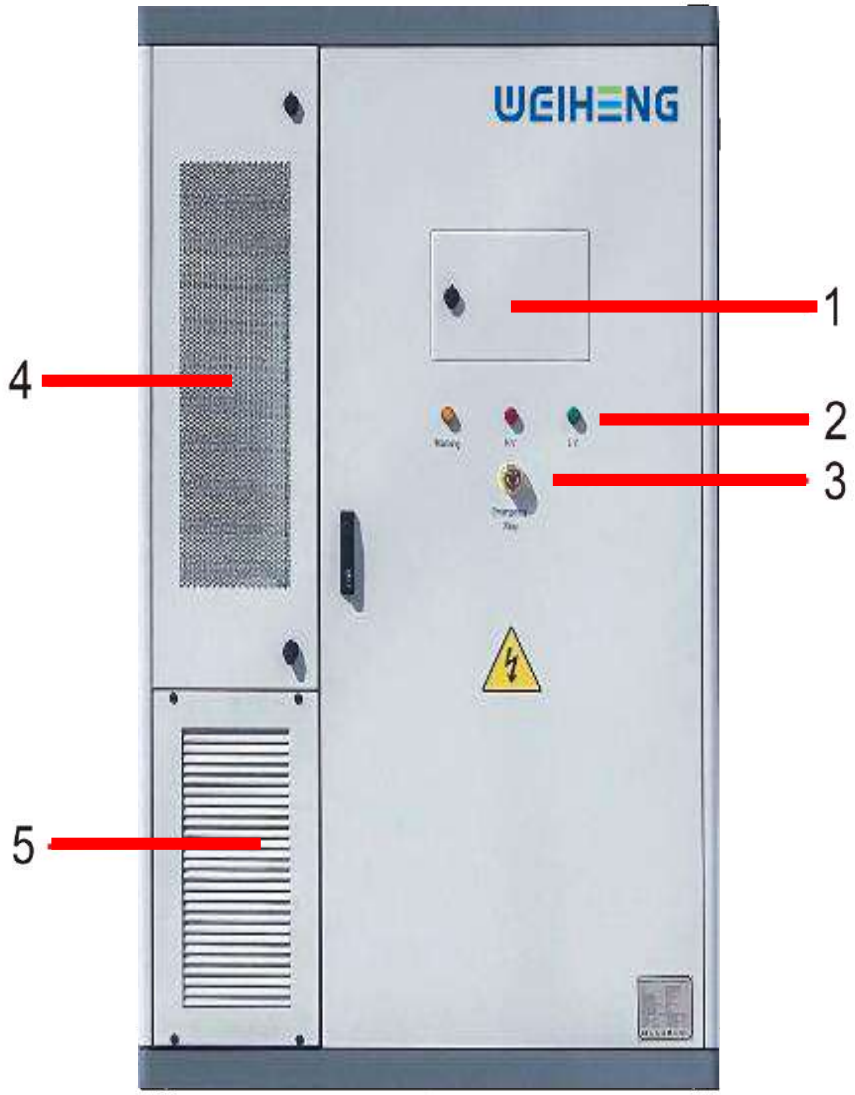
3D Interior View of TIANWU

TIANWU BESS Specification

System Information	
Rated Capacity	233kWh
Rated DC Voltage	832V
Battery Type	LFP from CATL
Cell Specification	3.2V, 280Ah
System Battery Configuration	1P*52S*5S
Protection Level	IP55
Inverter Topology	Non Isolated
Operating Temp. Range	-20~55°C (derating @>45°C)
Altitude	2000m
Dimensions (W*D*H)	1400*1350*2100mm
Cooling Method	Liquid Cooling Battery
Thermal Management System	Envicool Chiller (Smart Refrigeration & Electric Heating),Operating ambient temperature range, -30°C ~ +55°C
Environment Control System	Travel Switch, Water Leak Sensor & Transducer
Fire Control System	Detector, Aerosol, Fire Alarm Control Panel & Emergency Start/ Stop
Communication Protocol	Modbus, TCP/IP
Weight	~2700 kg

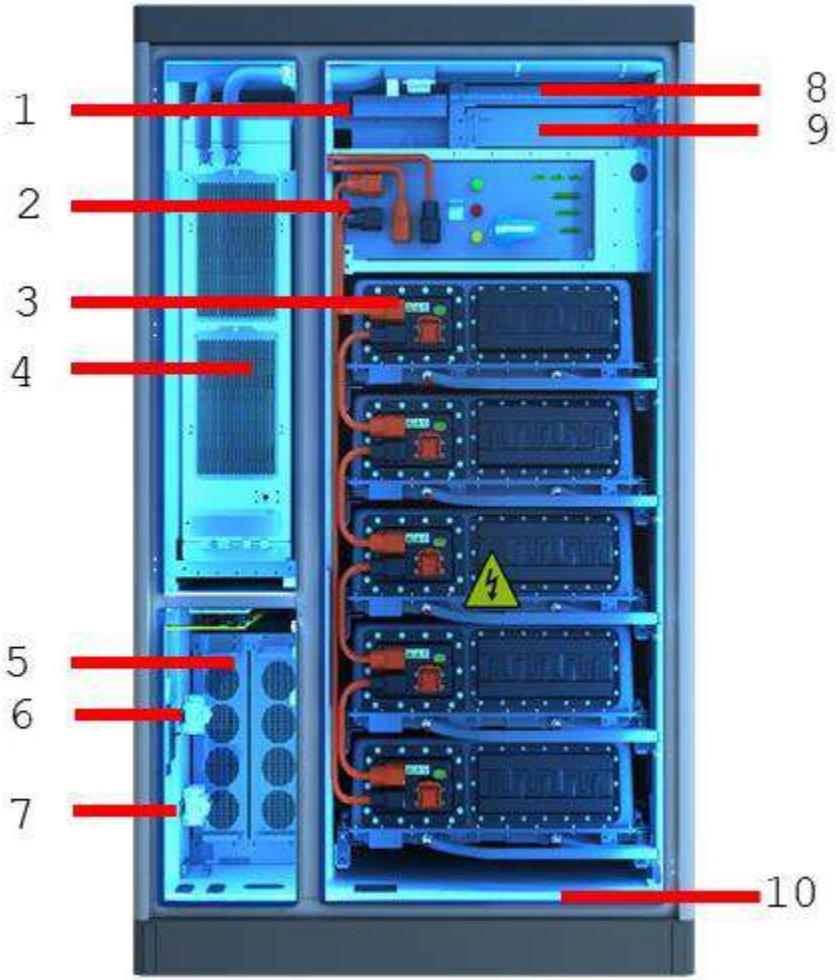
Part configuration (with cabinet door closed)

SN	Name	Quantity
1	Display screen	1
2	Indicators	3
3	Emergency stop button	1
4	Chiller unit	1
5	Air inlet	1



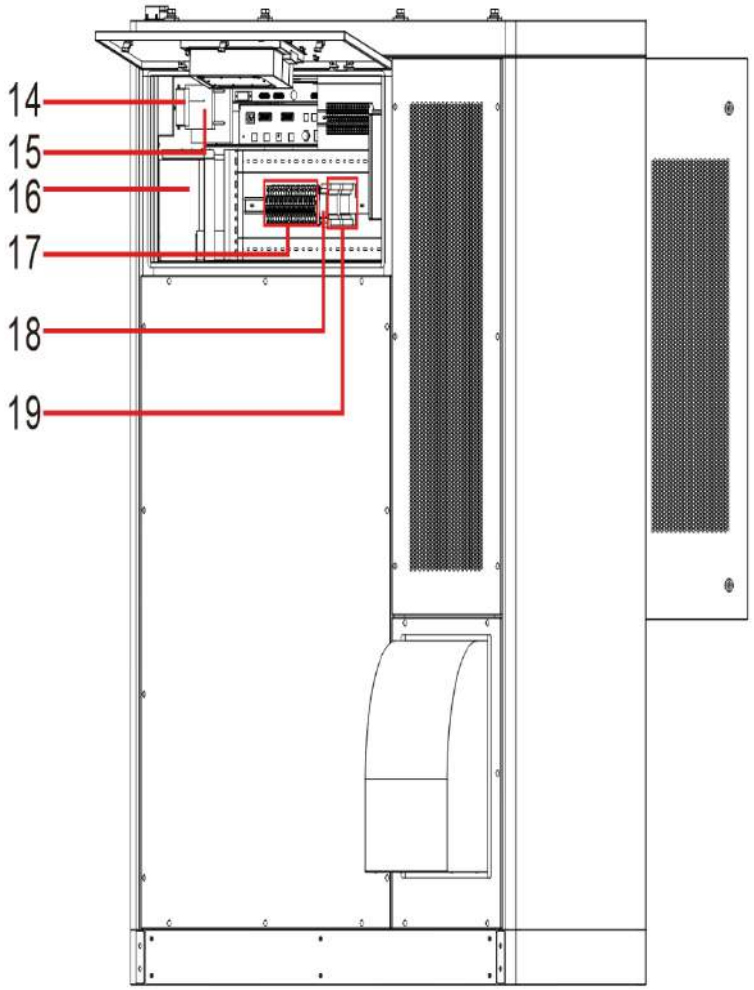
Front sides of parts (with cabinet door opened)

SN	Modules	Quantity
1	Fire control system	1
2	HV box	1
3	Lithium battery pack	5
4	Chiller unit	1
5	PCS	2
6	SPD	1
7	Auxiliary power switch	1
8	BMS	1
9	EMS100	1
10	Water leak sensor	1



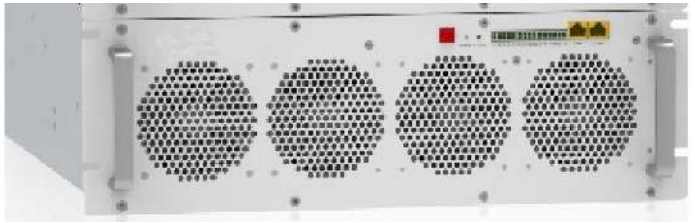
Back sides of parts (with cabinet door opened)

SN	Modules	Quantity
14	GPS	1
15	Router	2
16	UPS	1
17	QF1~QF5 (Circuit Breakers)	5
18	SJ1 (Signaling interface of water leak sensor.)	1
19	Switching power supply	1

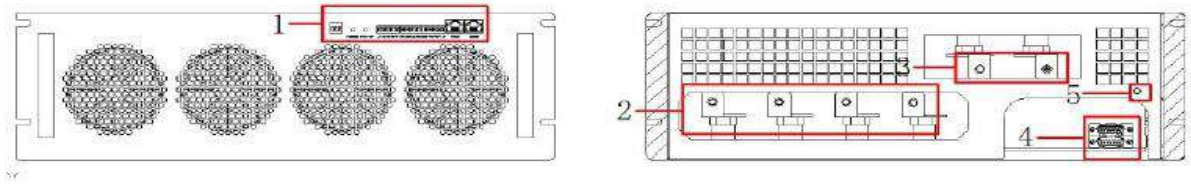


TIANWU Power Conversion System (PCS)

Technical Specification of AC side	
Rated Power/ Maximum Power	50kW/55kW
DC operating/ Full load voltage Range	500V ~ 950V
Max. DC Current	110A
Rated Ac voltage	400Vac, 3W+PE
Rated Frequency	50/60 Hz (±5Hz)
Rated Alternating Current	72A
Power factor adjusting range	-1 lead to +1 lag
Overload Capacity	110%, Normal Operation;120%, 1 Minute
Rated Voltage	400Vac
THD	<3% (Linear Load)
Maximum Conversion Efficiency	98.5%
General DATA	
Battery Voltage Range	728V dc ~ 936V dc
Inverter Topology	Non Isolation
Operating Humidity Range	0-95% (non-condensing)
Noise Level	<70 dB
Operating Temperature Range	-25 °C~60 °C (Derating at >45°C)
Cooling Method	Air Cooling
Altitude	2000m
Communication Protocol	RS485/CAN/Ethernet
Weight	35kg



Front View of PCS (Only for Reference)



Front & Back View of PCS with Interfaces and Ports

CATL LFP Cell/Battery Benefits

- High Level of Safety

- CATL's LFP material with high thermal stability
- High-safety electrolyte technology
- High-safety separator technology
- Prismatic sealing with more high-safety than pouch

- Long Service Life

- CATL's advanced slow-degradation technology brings cycle-life up to 8,000 cycles.
- First-year degradation less than 5% and as long as 15 to 20 year reliability when collocating with CATL liquid-cooling system.

- Advanced features of cells are

- Lower fire risk, no explosion risk, higher safety;
- Advanced thermal design;
- Self-discharge rate: Total ≤5.0%, First 3 months, Per month ≤1.0%, After 3 months.

TIANWU CATL Cell Specifications

Item	Unit	Specification	Reference
Battery Chemistry	-	LFP	
Life Cycle	-	8000 (25°C, @60% SOH)	
Dimension (W×D×H)	mm	173.9×71.7×207.2	
Weight	kg	5.5±0.3	
Nominal Capacity	Ah	280	
Nominal Energy	Wh	896	
Nominal Voltage	Vdc	3.2	
Operating Voltage	Vdc	2.5~3.65	
Operating Temperature Range	°C	Charge: 0 - 60	
		Discharge: -20 - 60	
Storage Humidity	%	≤85	
Certification	-	IEC 62619, UL 1973, UL 9540A, UN 38.3	

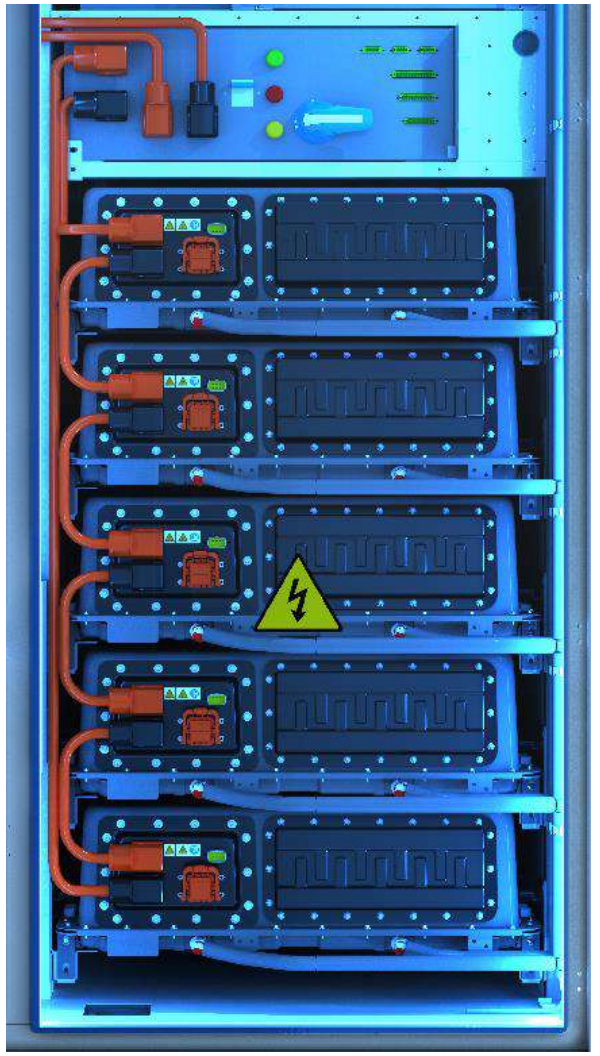
TIANWU CATL Battery Module Specifications

Item	Unit	Specification	Reference
Configuration	-	1P*52S	
Key Component	-	52 cells, 1 module	
Cell self-discharge Rate/Month	≤3.5%	25°C, 30%SOC 3 Months after new battery produced	
Nominal Capacity	Ah	280	
Nominal Energy	kWh	46.59	
Nominal Voltage	Vdc	166.4	
Operating Voltage	Vdc	145.6~187.5	
Charge/Discharge Rate	P	0.5	
Charge/Discharge Temperature (°C)		Charging: 0~55°C Discharging: -20~55°C	
Storage Temperature	°C	-30~60	
Storage Humidity	%	≤95	
Weight	kg	330±10kg	
IP Code		IP66	
Recommended Operating temperature		21±3°C, Average 21°C	
Cooling Mode		Liquid cooling	
Communication		CAN	
Certification		UL 9540A (V3), UN 38.3	

TIANWU Rack Specifications

Item	Unit	Specification
Configuration	-	1P*5S
Number of Modules		5
Key Component	-	5 modules, 1 HV box
Cooling System	-	Liquid cooled
Nominal Capacity	Ah	280
Nominal Energy	kWh	232.96
Nominal Voltage	V	832
Operating Voltage	V	500 ~ 950V
Operating Temperature Range	°C	-25~55
Recommended Operating Temp.	°C	25±3
Storage Temperature	°C	-30~60
Storage Humidity	%	≤95

Reference



TIANWU BMS SYSTEM

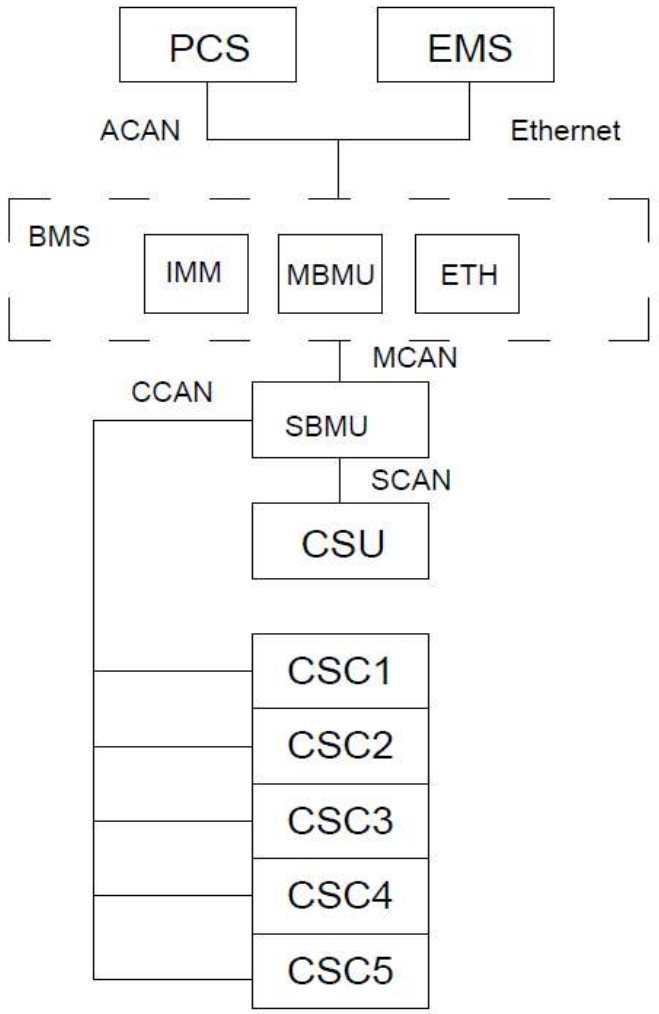
System BMS

BMS is used in energy storage system to monitor the

- Battery voltage
- Current
- Temperature
- Managing energy absorption and release,
- Thermal management
- Low voltage power supply
- High voltage security monitoring
- Fault diagnosis and management
- External communication with the EMS

to ensure the stable operation of the energy storage system.

Scheme of BMS System



BMS Architecture

BMS includes 3-level structure, composed of

- 1 unit of MBMU,
- 1 unit of IMM,
- 1 unit of ETH,

And 1 units of SBMUs, 5units of CSCs. This is the architecture of the PCS connected to Battery Rack. Each module communicates with each other through CAN. The BMS control unit in this part mainly consists of a main battery management unit (MBMU), an isolation monitor module (IMM), and an Ethernet conversion module (ETH).

TMS System (Liquid Cooling System)

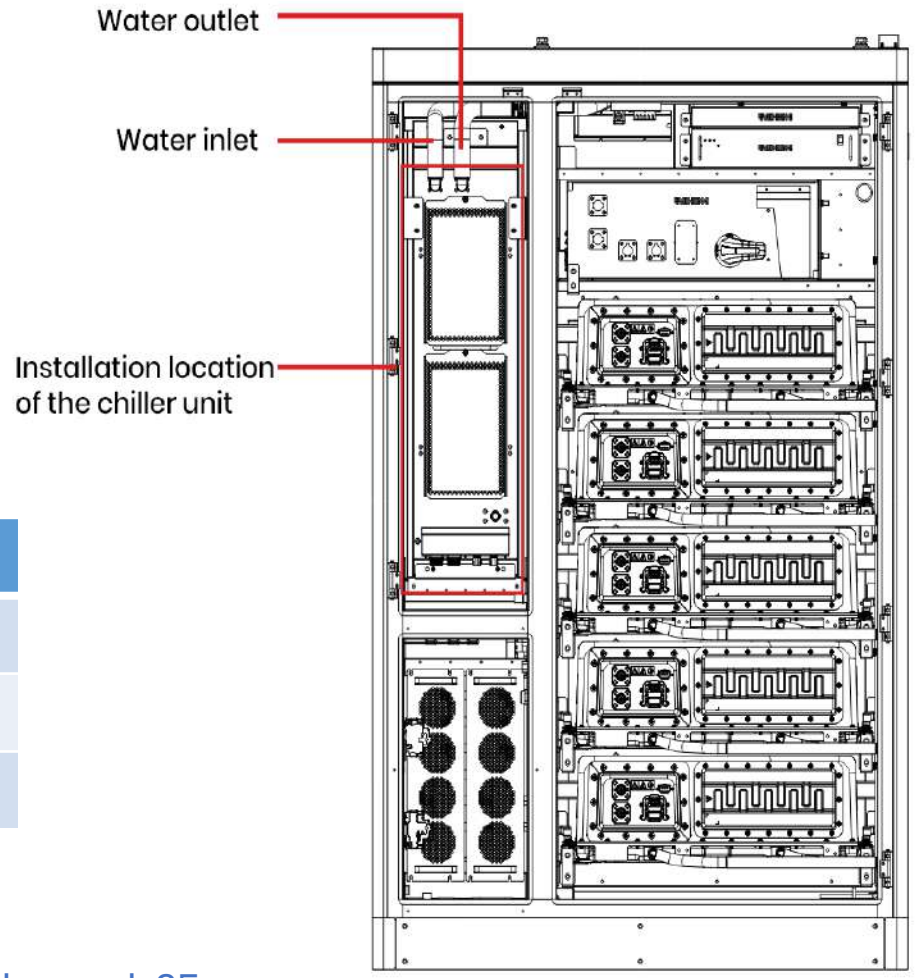
Chiller

The chiller unit is used to adjust the temperature of the battery pack in the energy storage system to ensure that the battery pack always work within the appropriate temperature range to maintain the best working condition of the system

- Smart Refrigeration
- Electric Heating
- Remote Monitoring
- Replenishment

No.	Specification	Details
1	Cooling Capacity of Chiller	5kW
2	Cooling Power Consumption	2.6kW
3	Heating Power Consumption	2.0kW

Capacity and Consumption of TMS



Overview of TMS System

The coolant shall be BASF GLYSANTIN G30 and Sinopec OEVC electric vehicle thermal-35 recommended by WEIHENG. Once every five years.

FSS Fire Suppression System

- Detector

The detector integrates a variety of detection sensors such as temperature, smoke, CO and electrolyte volatile gas and can detect various conditions of thermal runaway of batteries

- Aerosol

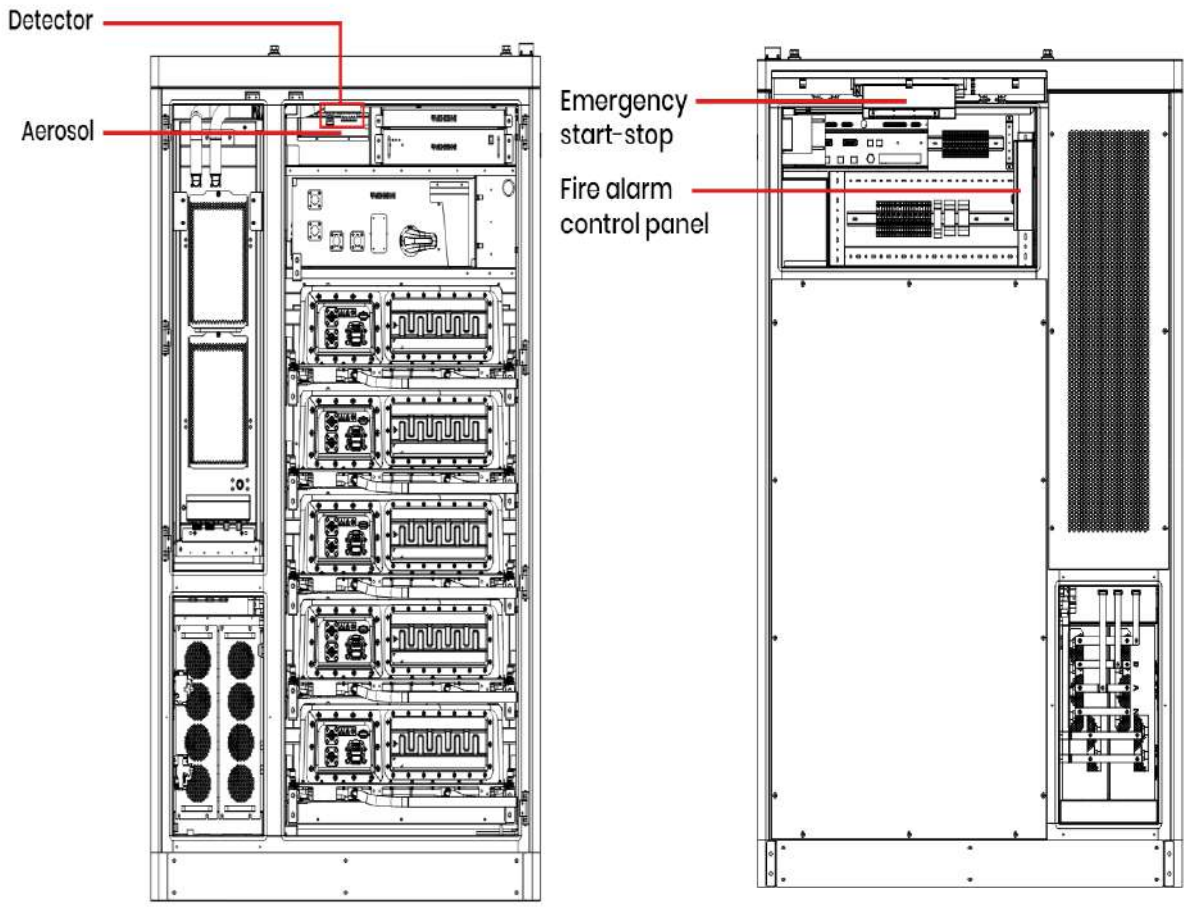
When this condensed aerosol fire suppression device receives the start signal, the aerosol generator in the cartridge will be activated to decompose the chemical coolant on the upper layer, so that the aerosol generator and the coolant work together to suppress a fire.

- Fire Alarm control panel

the fire alarm control panel features detector data acquisition, fire extinguisher start up, audible and visual alarm control, and in-section control system linkage communication

- Emergency start-stop Switch

This emergency start-stop switch integrates auto and manual control, forced start, emergency stop, and fire alarm indicators,



Overview of FSS System

Environment Control System

- Travel Switch

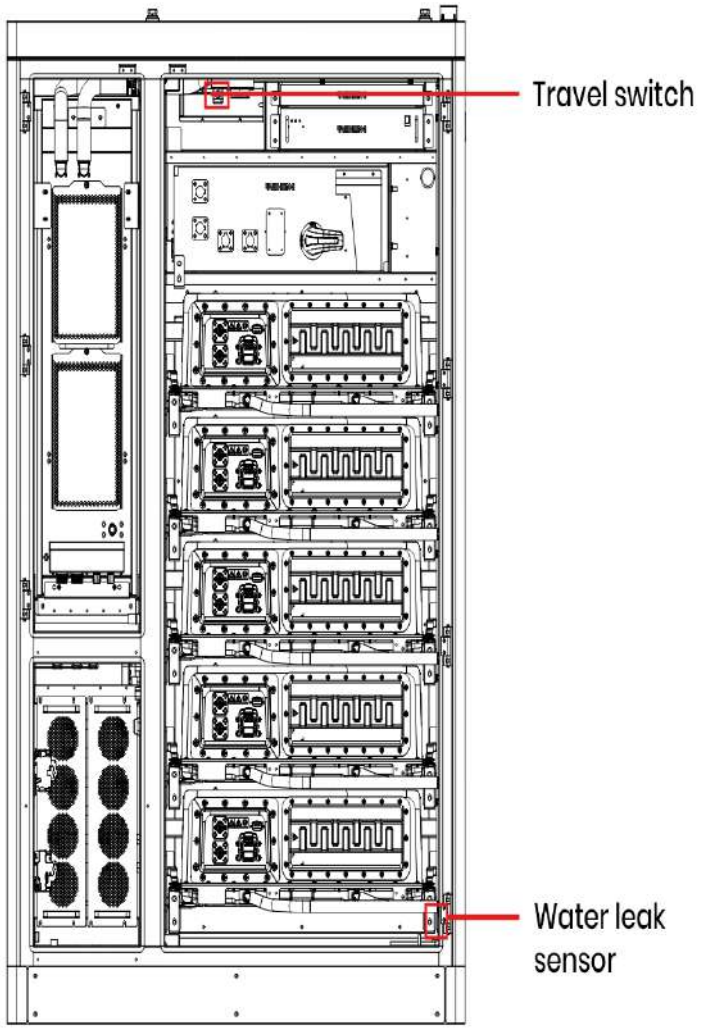
Travel Switch is used for safety and security of the machine, it ensures that door of the machine is closed

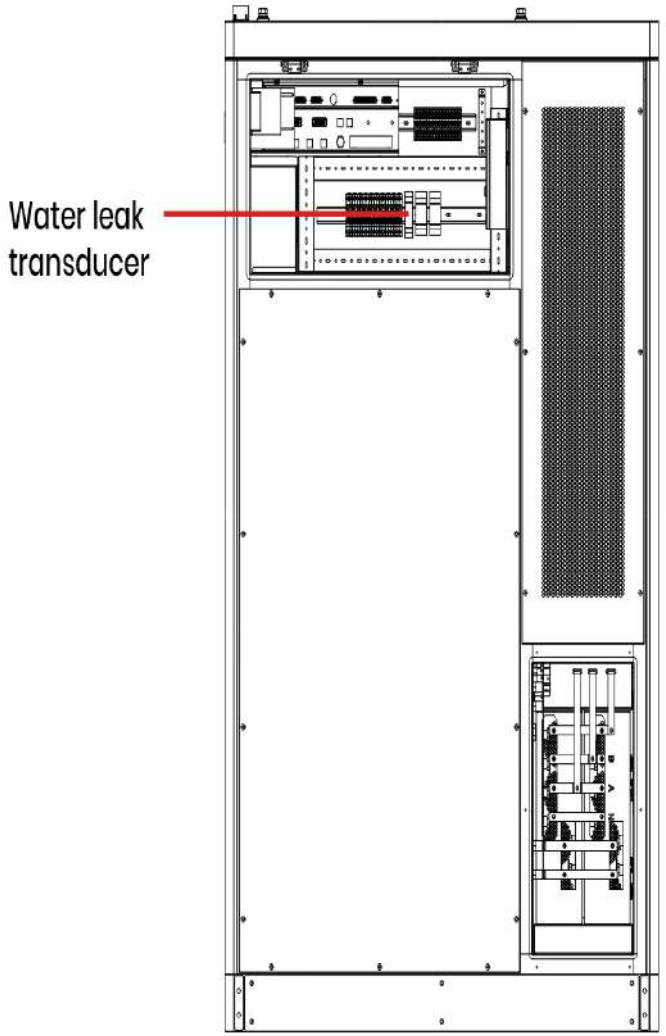
- Water Leak Sensor

The sensor needs to be used with a transducer. The impedance changes when the water leak sensor is wetted between two stages.

- Water Leak Transducer

The transducer needs to be used with a water leak sensor to give a wetting alarm at the point where the sensor is located. This part is reverse polarity protected. The power supply, input, and output are isolated from each other. In addition, there are four sensitivity gears, enabling users to adjust sensitivity gears of the transducer as needed.





Overview of Environment Control System

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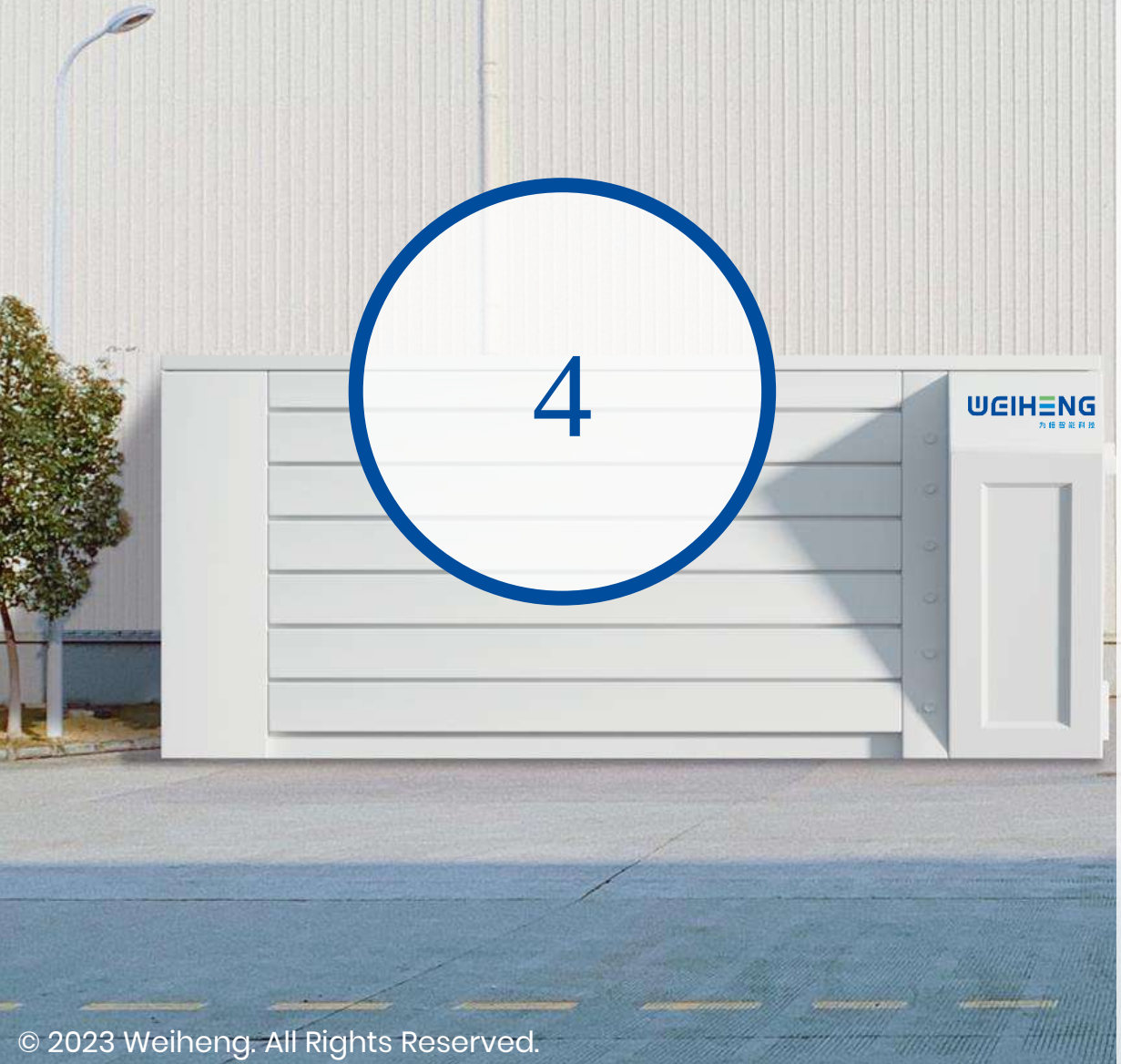

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TIANWU Control Cabinet

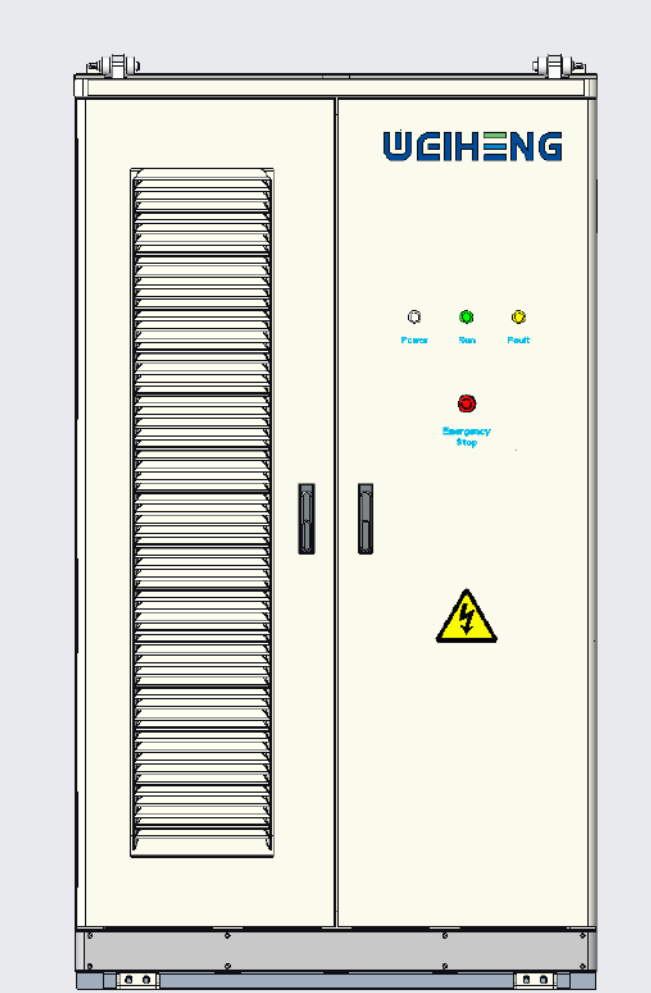
TIANWU 100kW Control Cabinet

Technical Specification of 100kW Control Cabinet

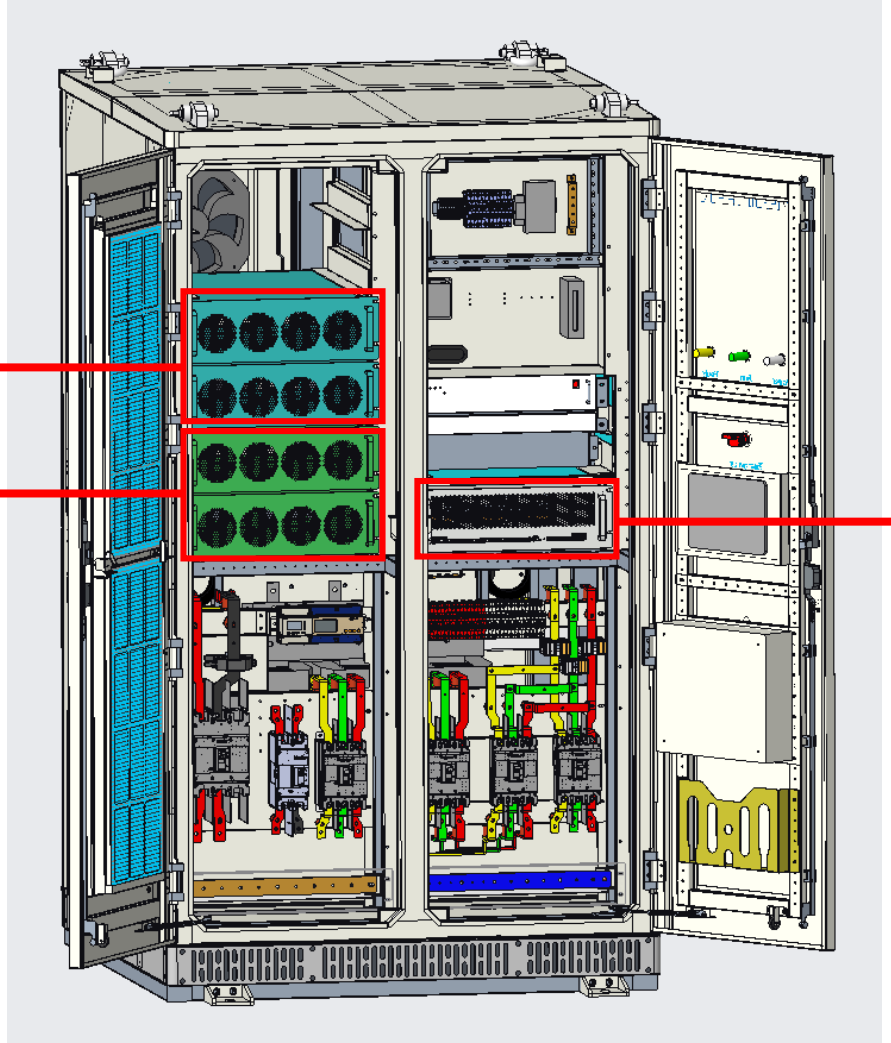
Technical Specification of AC side	
Rated Power/ Maximum Power	100kW/110kW
DC operating/ Full load voltage Range	500V ~ 950V
Max. DC Current	220A
Rated Ac voltage	400Vac, 3W+PE
Rated Frequency	50/60 Hz (±5Hz)
Rated Alternating Current	144A
Isolation mode	Non-isolation
Power factor adjusting range	-1 lead to +1 lag
Technical Specifications of DC/DC Converter/ PV Parameters	
Rated Power	100kW
Max. Output Power	110kW
DC Voltage Operating Range	250V~545V
Full Load Operating Range	315V~545V
Maximum Current on the Low voltage side	320A

Load Parameters	
Rated Power	100kW
Rated Voltage	400Vac
AC Voltage THD	<2% (Linear Load)
General DATA	
Battery Voltage Range	728V dc ~ 936V dc
Protection Level	IP54
Inverter Topology	Transformer Isolation
Operating Humidity Range	0-95% (non-condensing)
Noise Level	<70 dB
Operating Temperature Range	-25 ºC~55 ºC
Cooling Method	Air Cooling
Altitude	2000m
Communication Protocol	RS485/CAN/Ethernet
Dimensions (W*H*D)	1000*1350*2100
Weight	~1t

TIANWU 100kW Control Cabinet



WH-TIANWU-100TS(DC100)-A (Door Closed)



WH-TIANWU-100TS(DC100)-A (Door Opened)

TIANWU 300kW Control Cabinet

Technical Specification of 300kW Control Cabinet

Technical Specification of AC side	
Rated Power/ Maximum Power	300kW/330kW
DC operating/ Full load voltage Range	500V ~ 950V
Max. DC Current	660A
Rated Ac voltage	400Vac, 3W+PE
Rated Frequency	50/60 Hz (±5Hz)
Rated Alternating Current	432A
Isolation mode	Non-isolation
Power factor adjusting range	-1 lead to +1 lag
Technical Specifications of DC/DC Converter/ PV Parameters	
Rated Power	300kW
Max. Output Power	330kW
DC Voltage Operating Range	250V~545V
Full Load Operating Range	315V~545V
Maximum Current on the Low voltage side	640A

Load Parameters	
Rated Power	300kW
Rated Voltage	400Vac
AC Voltage THD	<2% (Linear Load)
General DATA	
Battery Voltage Range	728V dc ~ 936V dc
Protection Level	IP54
Inverter Topology	Transformer Isolation
Operating Humidity Range	0-95% (non-condensing)
Noise Level	<75 dB
Operating Temperature Range	-25 ºC~55 ºC
Cooling Method	Air Cooling
Altitude	2000m
Communication Protocol	RS485/CAN/Ethernet
Dimensions (W*H*D)	1750*1350*2300
Weight	~3T

Parallel Integration

Use on grid Multiple machines in parallel

Photovoltaic access
DC/DC coupling

1C system expansion,
multi-system adaptation

Off-grid power backup

Support diesel engine access

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5

Energy Management System

Energy Management System (EMS SAAS)

In the Cabinet, PCS, BMS, fire protection, liquid Cooling system, electricity meters and other equipment directly communicate with the core controller through TCP protocol to maintain core communication instructions. Completed inside the electrical cabinet to maximize communication quality and control effects. EMS communicates with the core controller in the cabinet using MODBUS TCP protocol, only relevant power command adjustments, data monitoring, and calculations are performed to provide operation and maintenance personnel with a friendly operation interface. When the EMS Cloud system causes network failure for some reason, the local controller EMS-100 in the container can maintain the normal operation of the control system in the cabinet.

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PANGU OS (EMS)

TIANWU EMS system

- Supports source, network, load, storage, etc.; the monitoring interface is simple and intuitive, supports intelligent analysis of power stations, and provides analysis reports
- Seamless access to smart terminals and management at any time
- Safe and reliable, 7*24 hours uninterrupted monitoring

PANGUOS

Root-level data analysis, comprehensive front-end, middle-end and back-end services; covering all scenarios of distribution, transmission and use

Support communication interfaces adapting to various power communications and smart grids

Active safety measures by PANGU OS (EMS)

- Communication disconnection:

When sub system communication is disconnected, system load reduction or protection can be automatically performed according to the situation.

- Fire protection:

When the fire protection system reports an abnormality, it will shut down;

- Air conditioning:

Works according to ambient Temperature

- PCS:

Bi-directional Power conversion system

- BMS:

battery Management system to optimize battery cell, voltage, current and temperature

- Power outage:

Power outage with UPS support; two-way communication.

- EMS operation:

Real-time charge and discharge power, Temperature scene interface

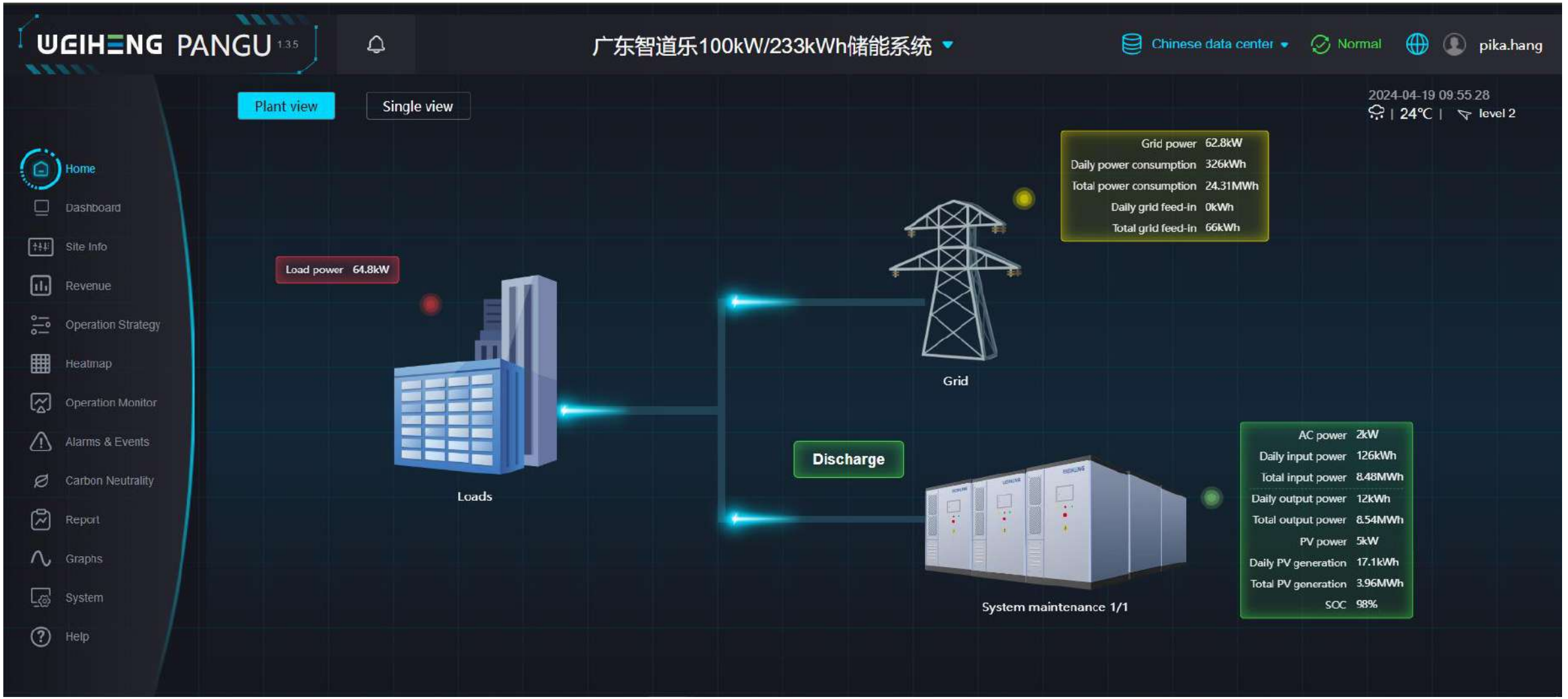
Flexible control strategy, Multiple guarantees Operation Safety.

Energy Management System

EMS- PANGU OS Functions

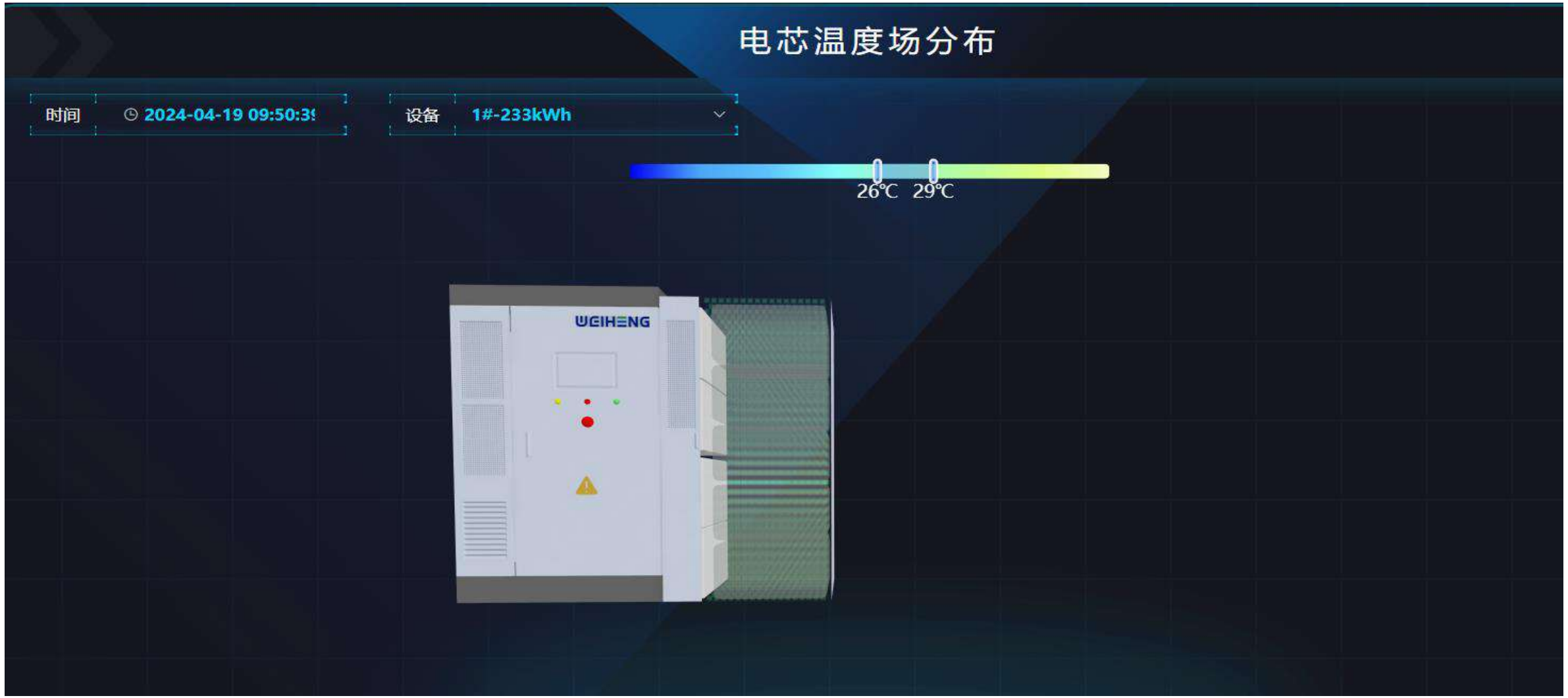
Flexible control strategies	Peak Shaving	Backup operation
	Maximum demand control	PV+ BESS+ EV Charger
	Load consumption tracking, forecasting	Electrical ancillary services
Multiple protection Operational safety	Cloud data integration	Edge AI Module
	2000 battery cell detection points	3000 module measuring points
	Automotive grade chip testing	Proactive warning 24 hours in advance

PANGU Home screen

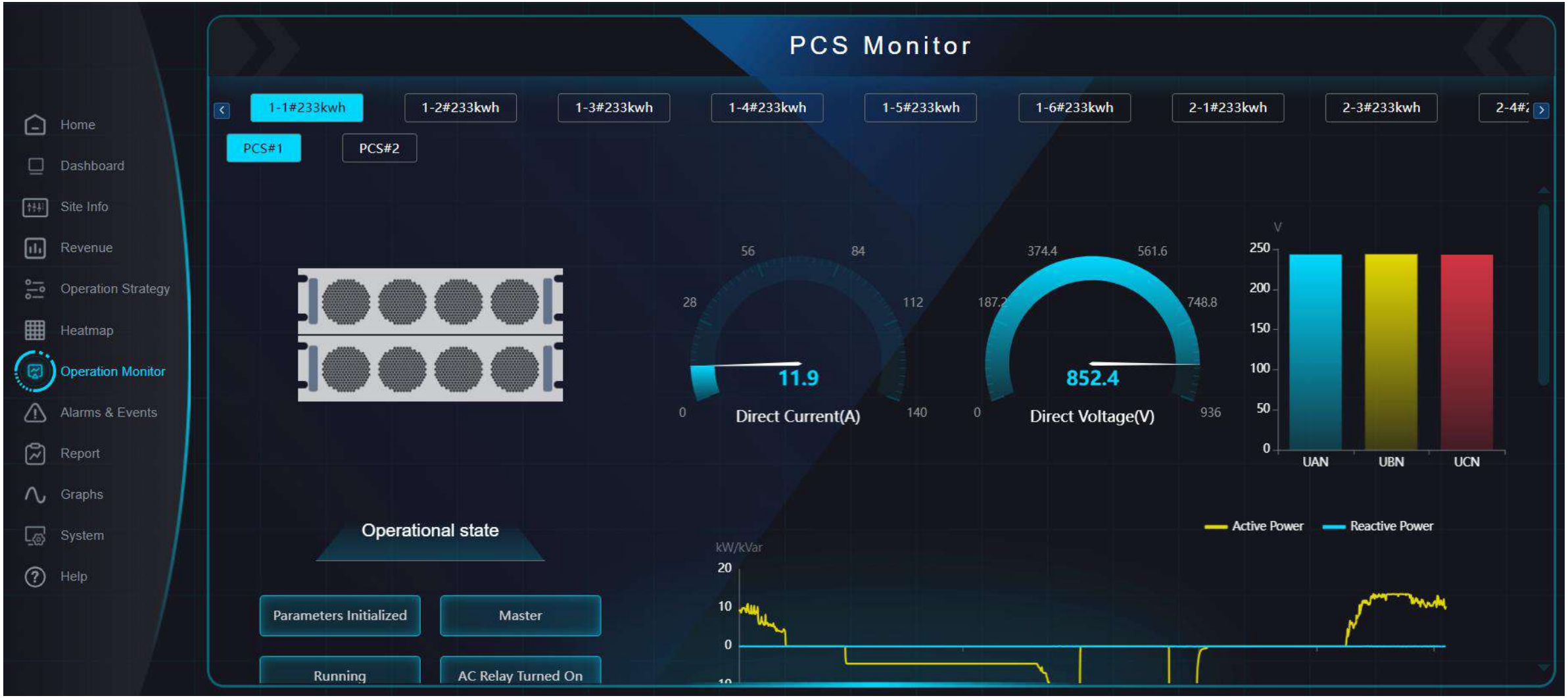


PANGU OS Dashboard

Thermal Field Heat Power



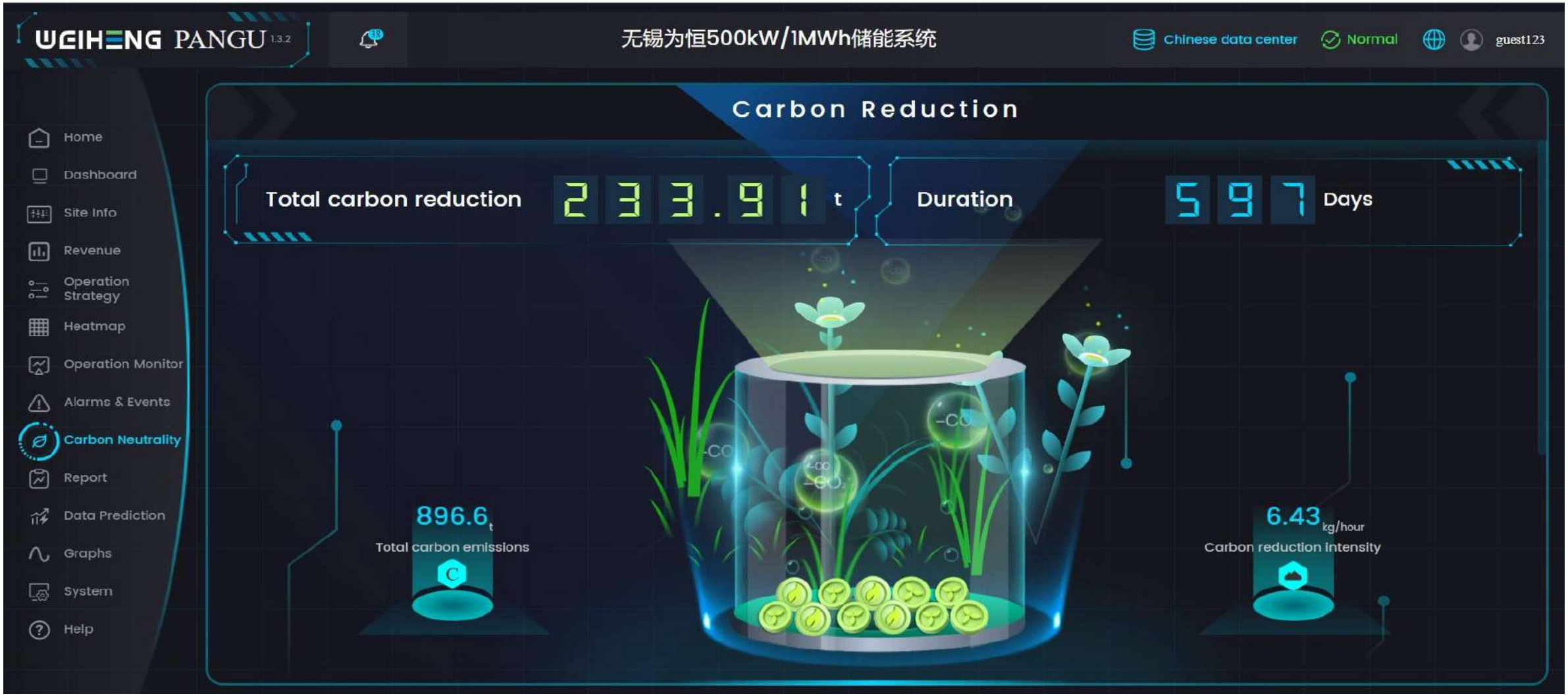
PCS Operation Monitoring



BMS Monitoring

Cooling & Fire Control Monitoring

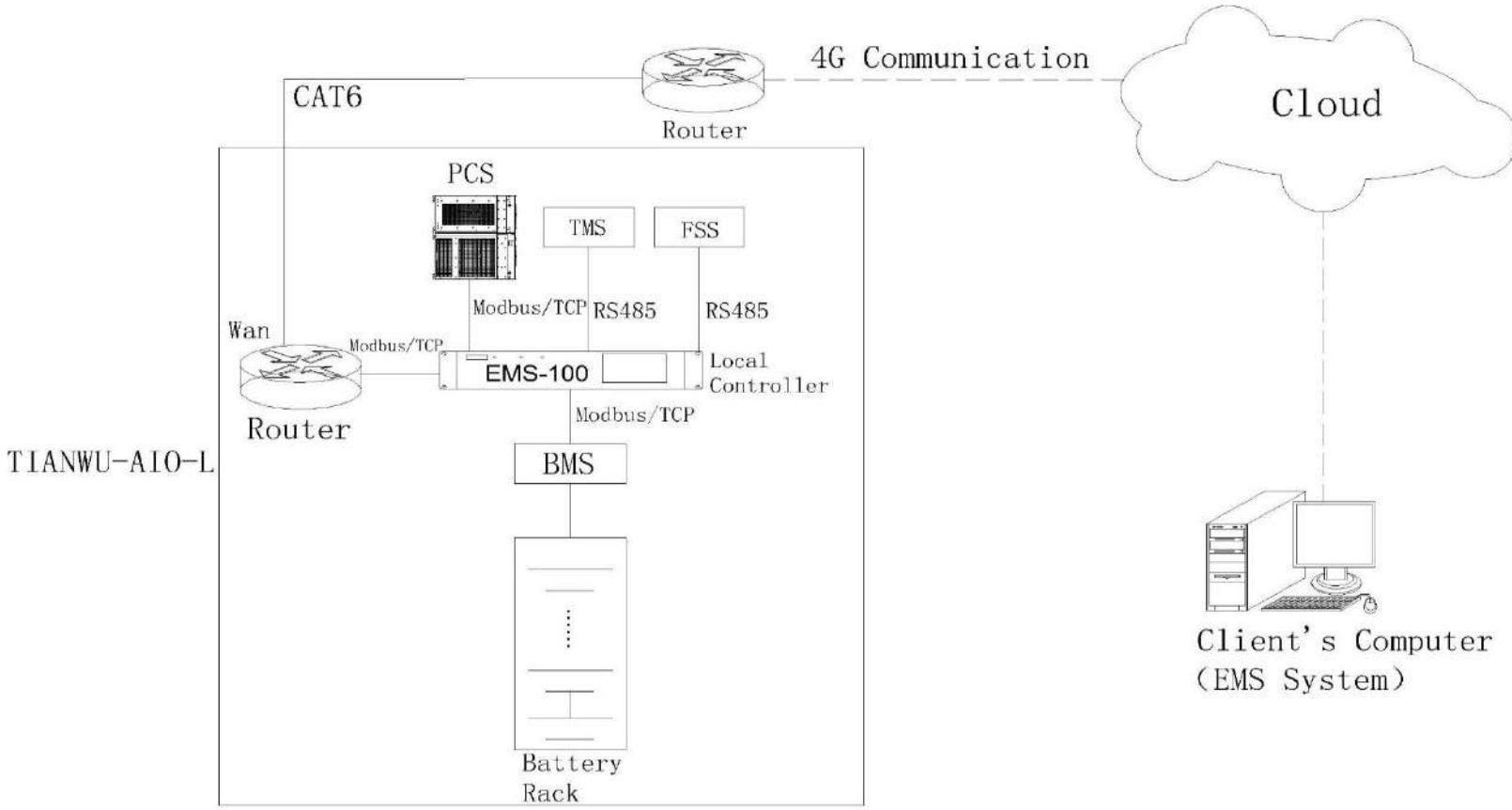
Carbon Reduction Monitoring



Different Power Curves

System Operation Control

Energy Management System (EMS SAAS)



Communication architecture of TIANWU

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7

System Efficiency

System Efficiency

Battery DC side

DC side conversion rate > 94.5%

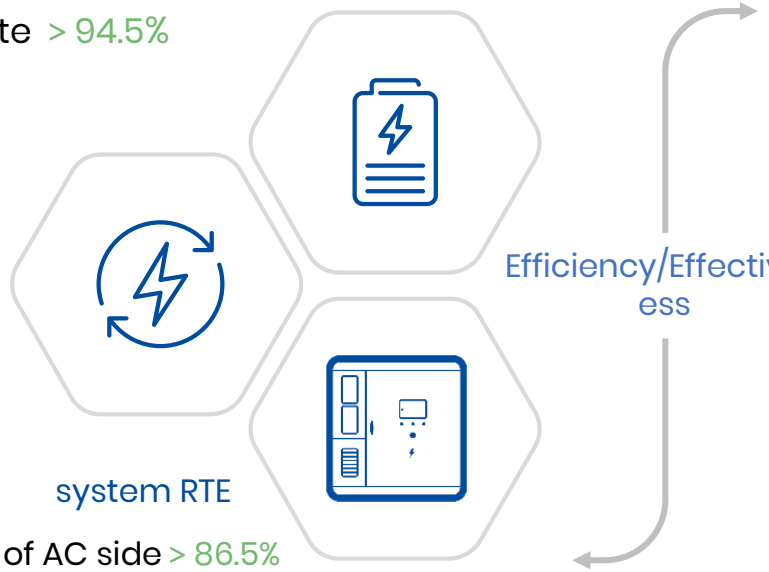
Energy storage converter PCS

Independently developed PCS;

highest efficiency ≥98.5%

system RTE

Annual average efficiency of AC side > 86.5%



Efficiency/Effectiveness

EMS management system

Maximize benefit tracking technology

MPT service– Max Profit Tracking

Transportation and installation

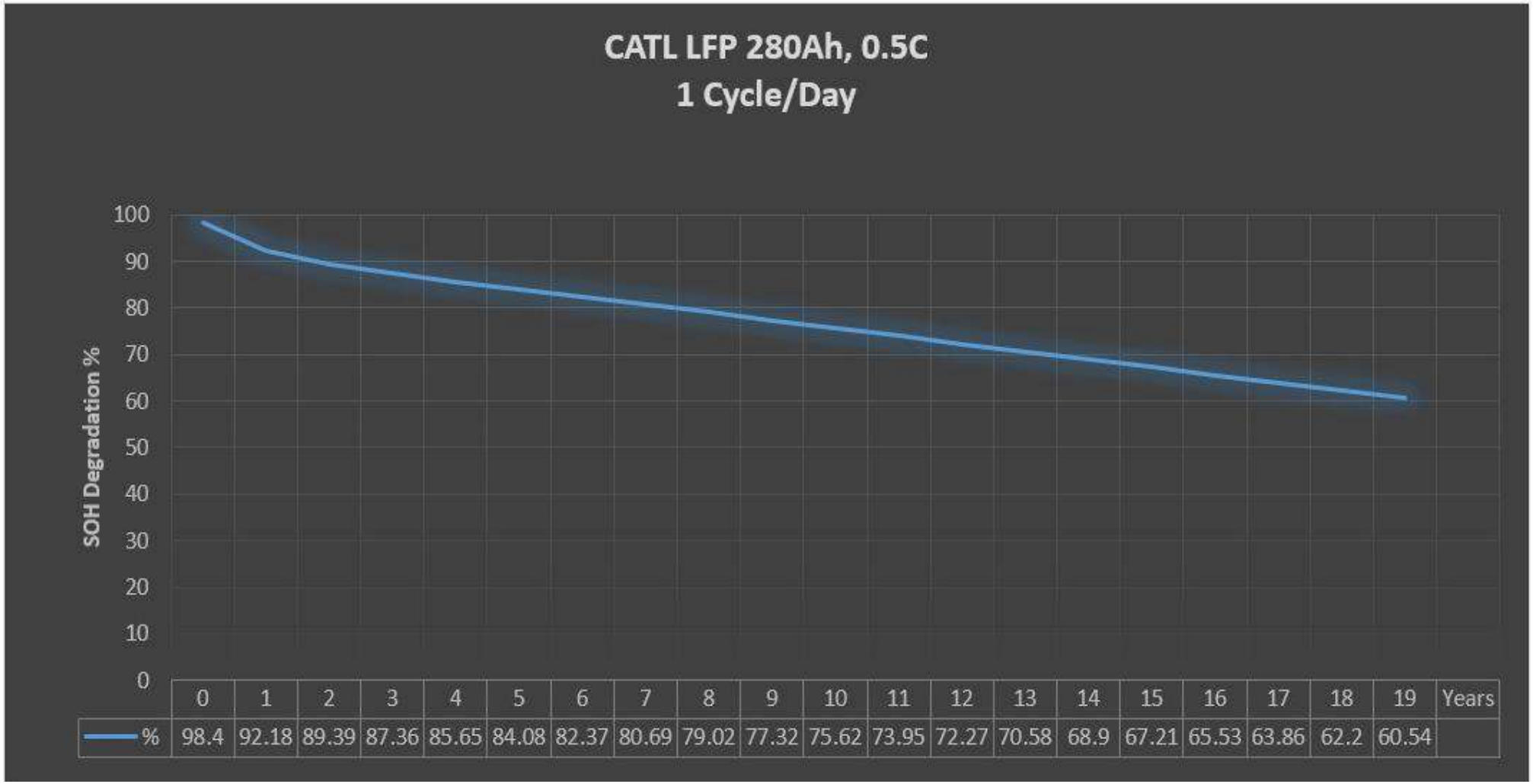
The entire container has passed UN38.3 and freight appraisal certification; Reduce overseas transportation and installation costs

Installation

The entire cabinet is pre-installed at the factory, requiring only network configuration and wiring on site.

Customer on-site Installation and commissioning hours <4 hours

Capacity Degradation Curve of System



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Years
%	98.4	92.18	89.39	87.36	85.65	84.08	82.37	80.69	79.02	77.32	75.62	73.95	72.27	70.58	68.9	67.21	65.53	63.86	62.2	60.54	

8

Standards & Certification

TIANWU Standards & Certification

TIANWU Standards & Certification	
UN 38.3	UN Transportation Testing for Lithium Batteries
UL9540A (V3)	Energy Storage Systems and Equipment
EN50549-1	Requirements for generating plants to be connected in parallel with distribution networks - Connection to a LV distribution network.
IEC62477	Safety requirements for power electronic converter systems and equipment –Part 1: General
IEC 62619	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries for use in industrial applications
IEC 61000-6-2	Generic standards – Emission standards for industrial environments
IEC 61000-6-2/4	Electromagnetic compatibility (EMC) –Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances induced by radio-frequency fields
IEC 63056	Safety requirements for Secondary cells and batteries containing alkaline or other non-acid electrolytes (Lithium cells and batteries) for use in electrical energy storage system
VDE4105	In Germany network-supporting functionality to guarantee safe and reliable network operation for maximum integration of generating capacity in the low voltage distribution network
CEI-021	In Italy, CEI 0-21 regulation defines the technical rules for active and passive users connected to low voltage electrical networks.

More Certificates & approvals are available upon request

WEIHENG Certificates

WEIHENG Certificates	
ISO 9001:2015	Quality Management System complies with standard requirement
ISO 45001:2018	Occupational health and safety management system certification
ISO 14001:2015	Environmental Management system complies with standard requirement
ISO/IEC 27001:2013	Information security management system compiles with standard requirement
ISO/IEC 20000-1:2018	Information technology service management system complies with standard requirement

WEIHENG is one of the world's leading and fastest growing suppliers of integrated energy storage systems We design, manufacture, deploy, and service battery power storage systems for the full range of customer segments.

- Utilities (traditional power generation, Wind, Wave, solar/PV, etc.)
- Commercial and Industrial
- Residential and Distributed

TIANWU Production Lines

Cabinet storage area
The cabinet arrives and is stored

1

Spray area
Test the cabinet for water resistance and return to the cabinet storage area after completing the test

2

Assembly line
Cabinet assembly line

3

packaging area
Product ready to be packaged and shipped

6

Test area
Factory testing

5

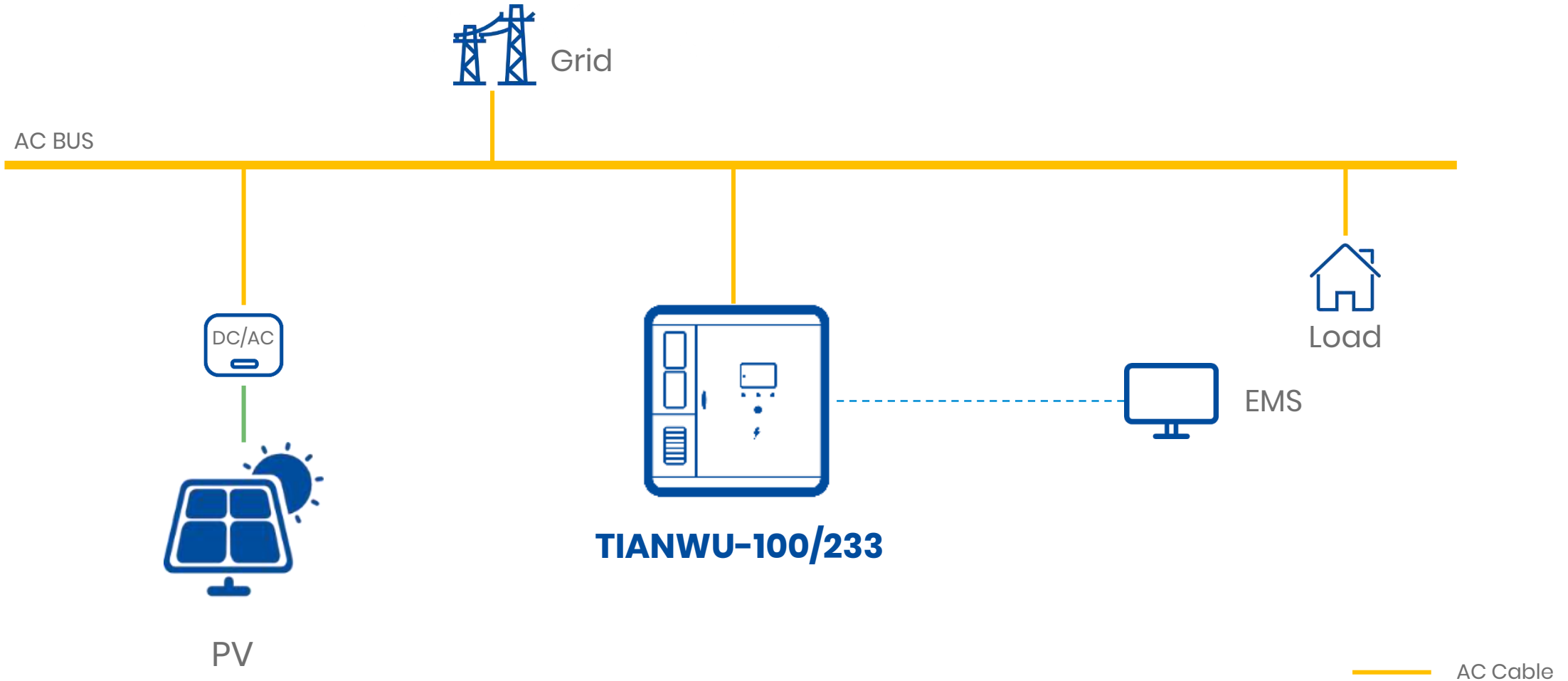
Assembly line
Internal modules are pre-installed at the factory

4

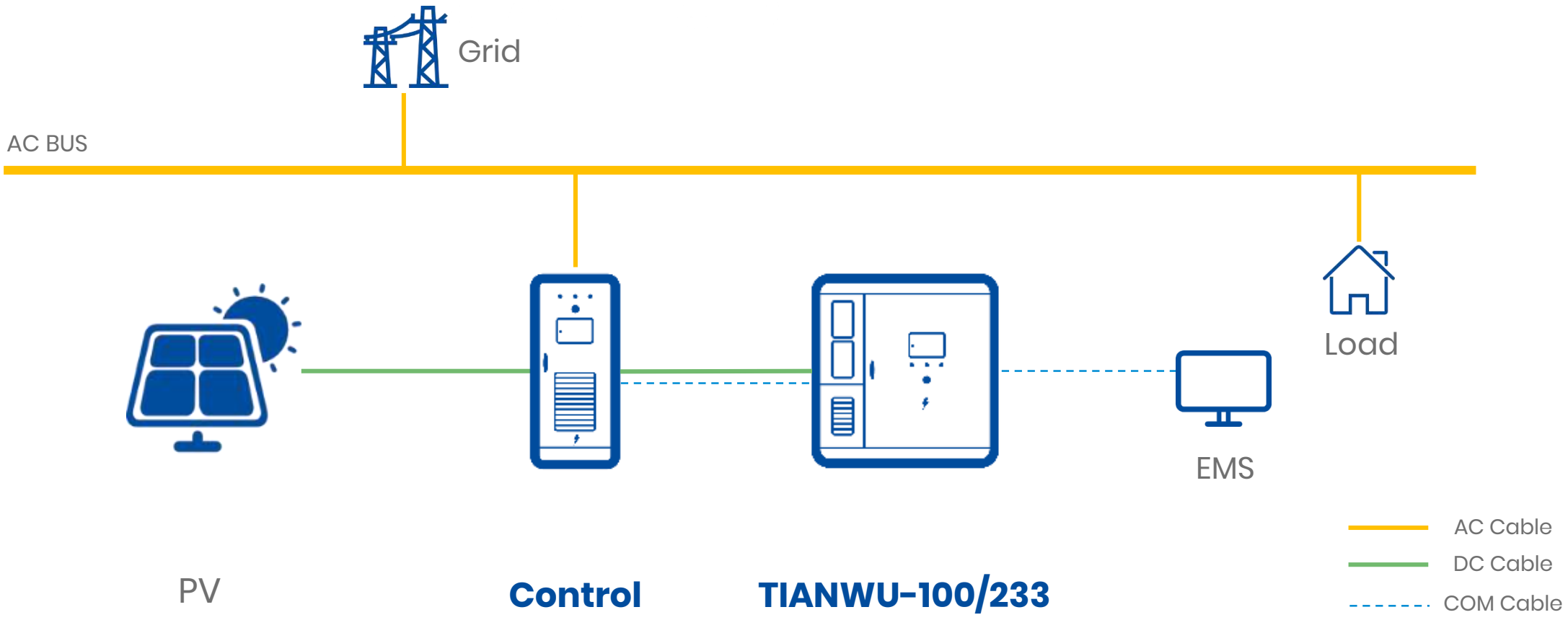
9

Standard Application of TIANWU

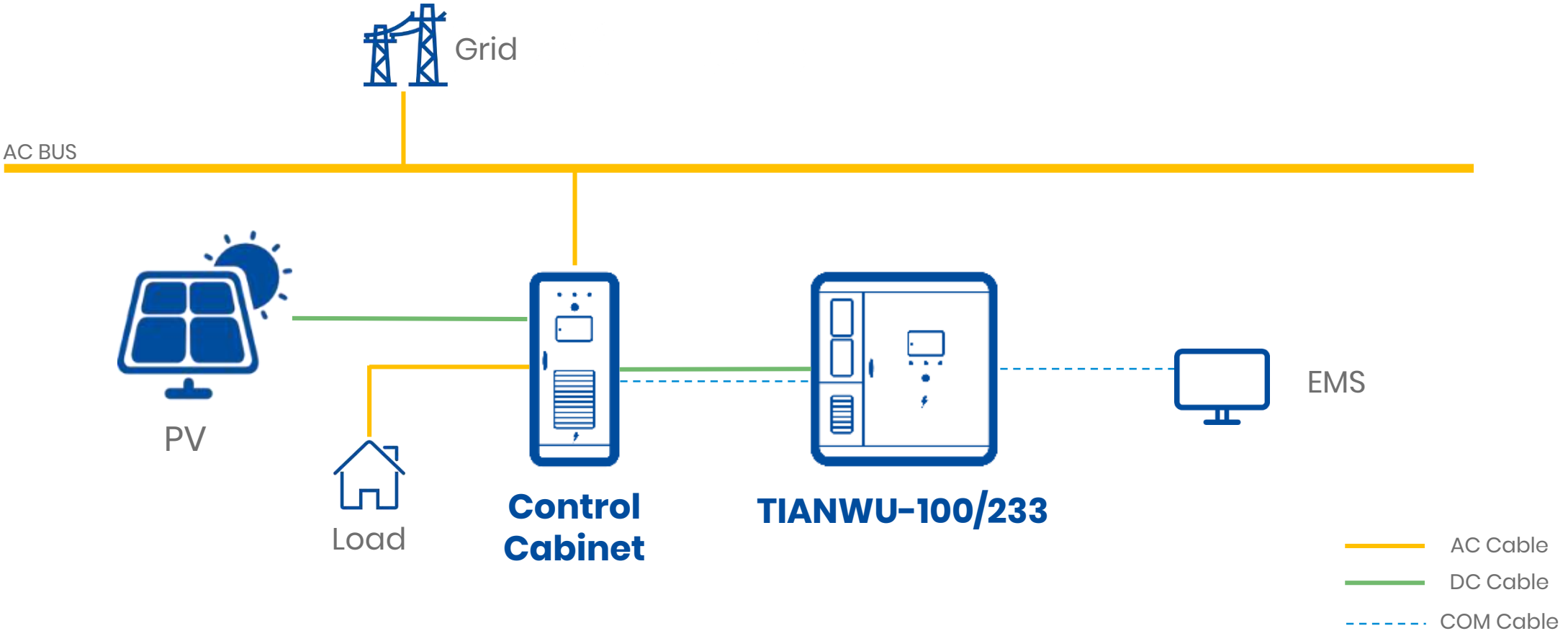
On Grid (AC Coupled)



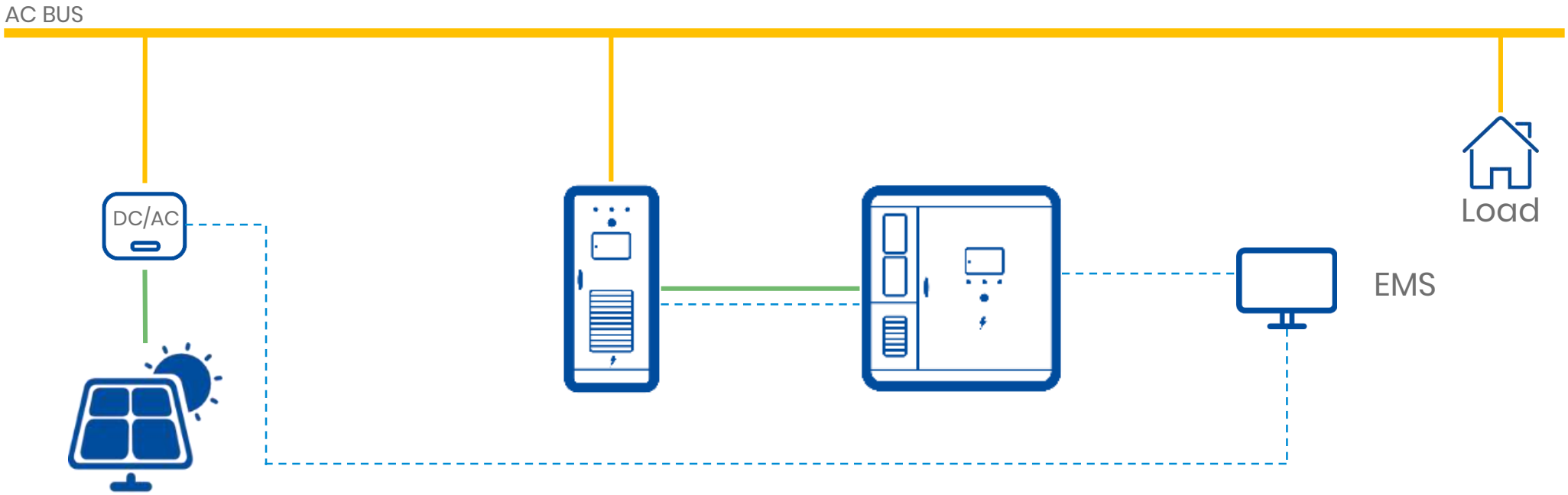
On Grid (DC Coupled)



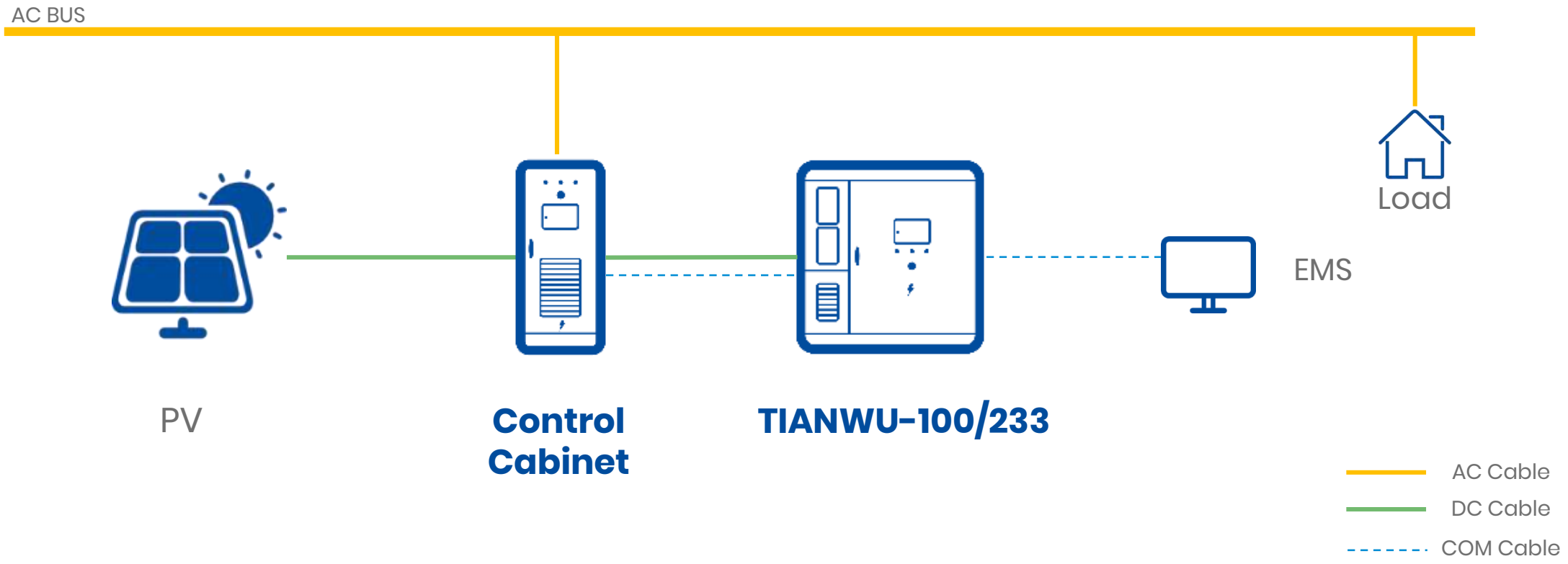
On Grid Power Backup (DC Coupled)



Off Grid Power Backup (AC Coupled)

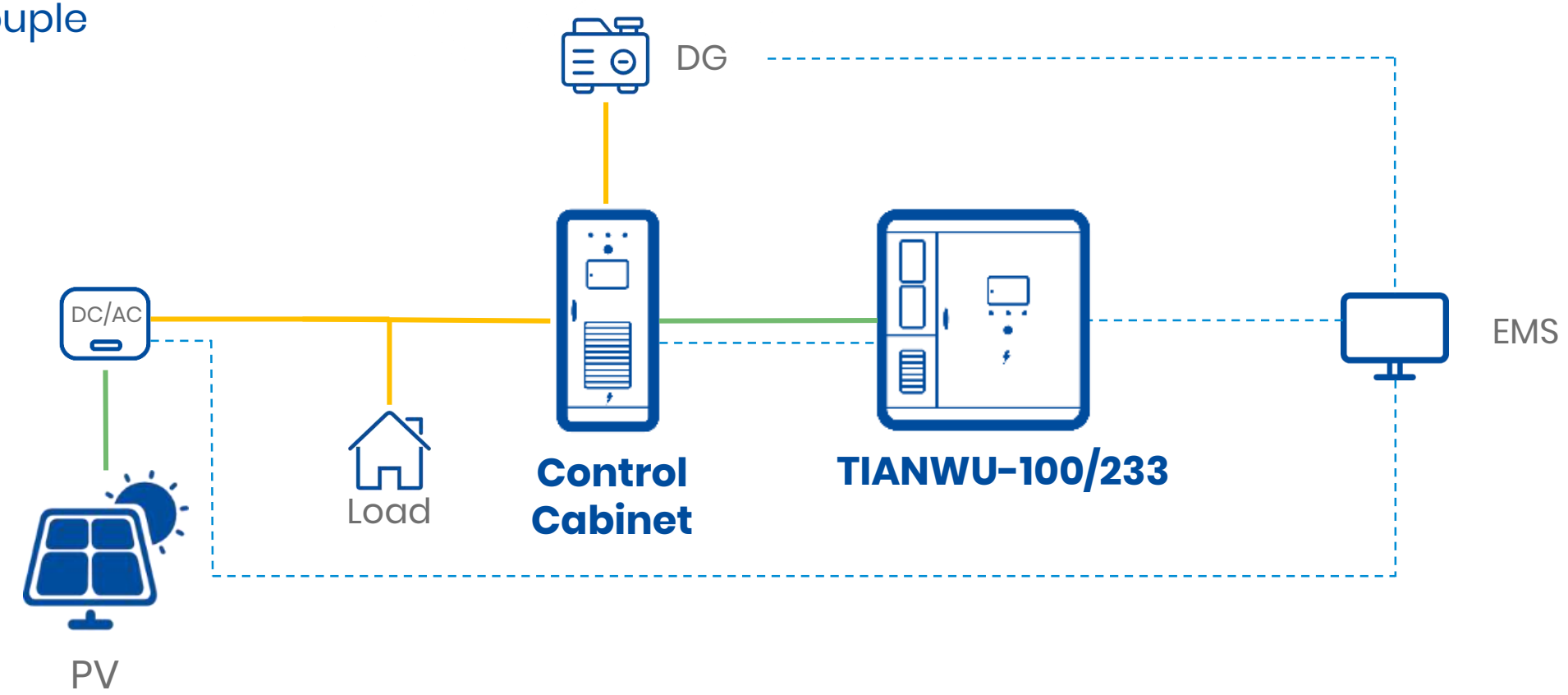


Off Grid Power Backup (DC Coupled)



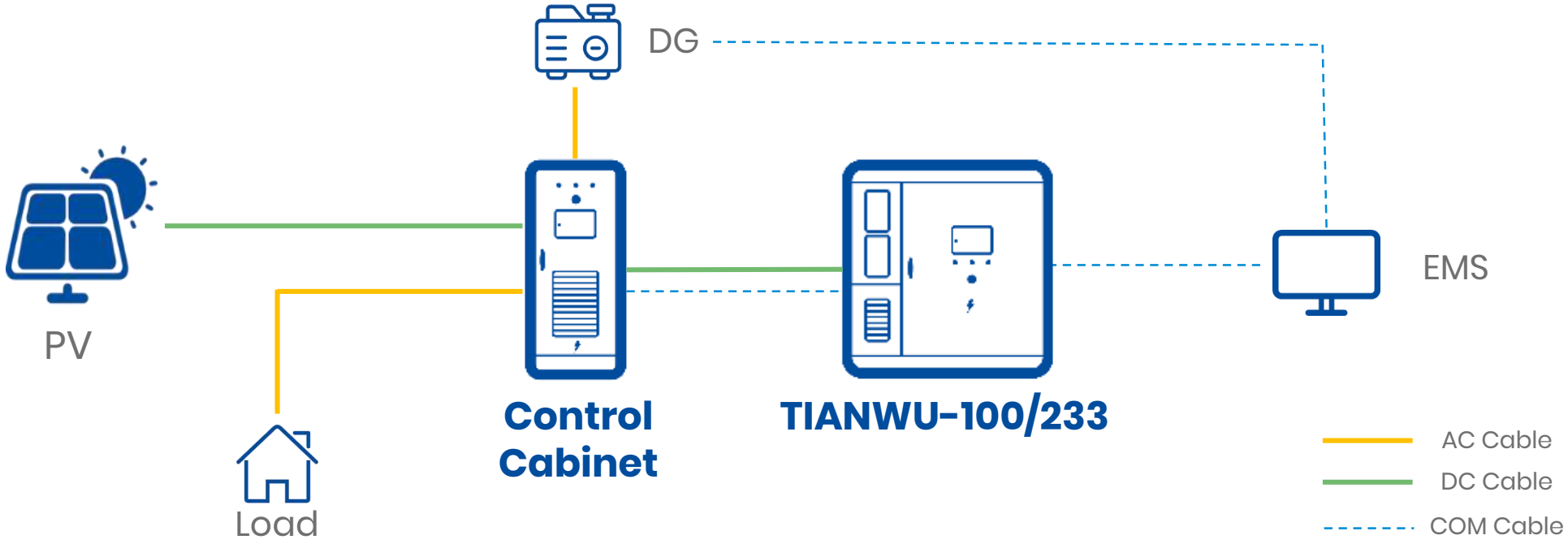
Off Grid with DG

- AC-couple



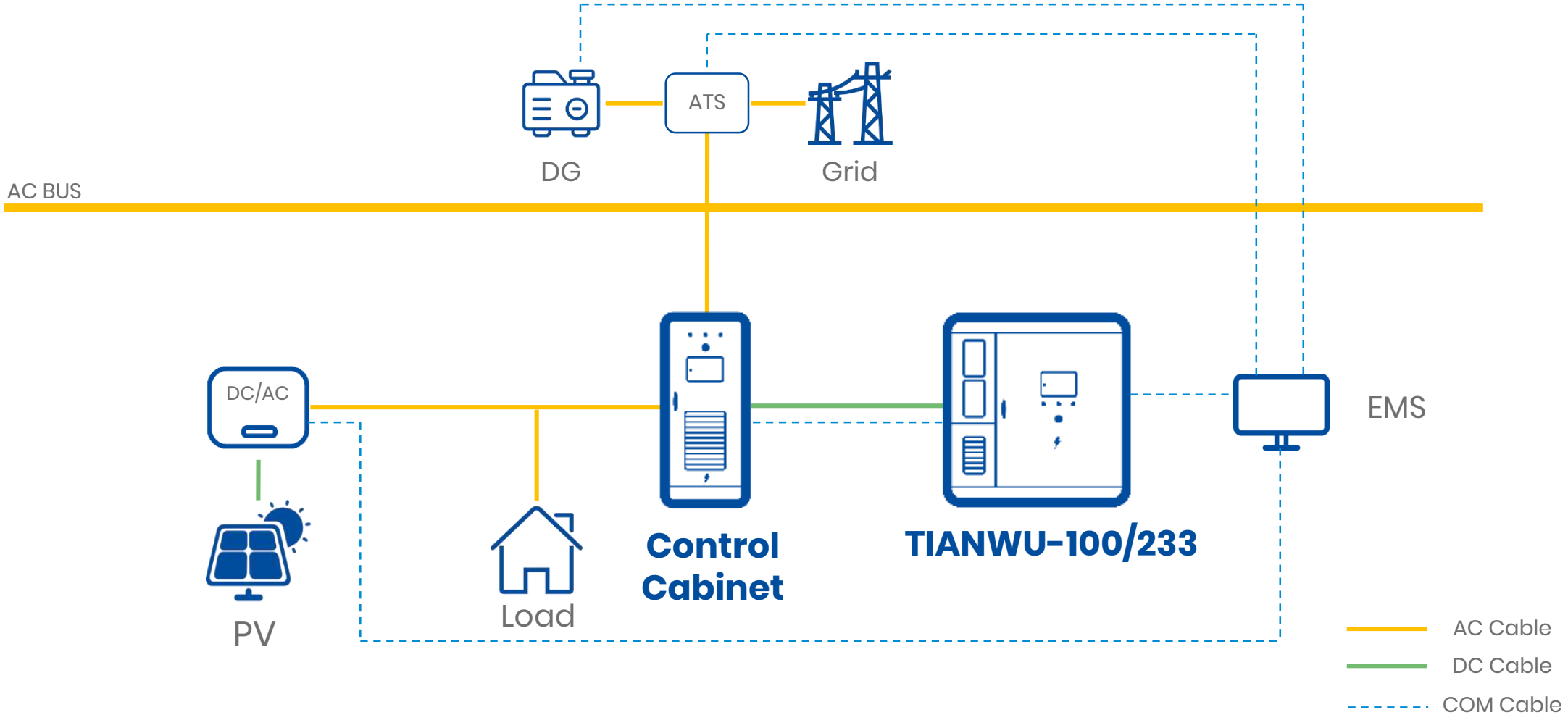
Off Grid with DG

- DC-couple



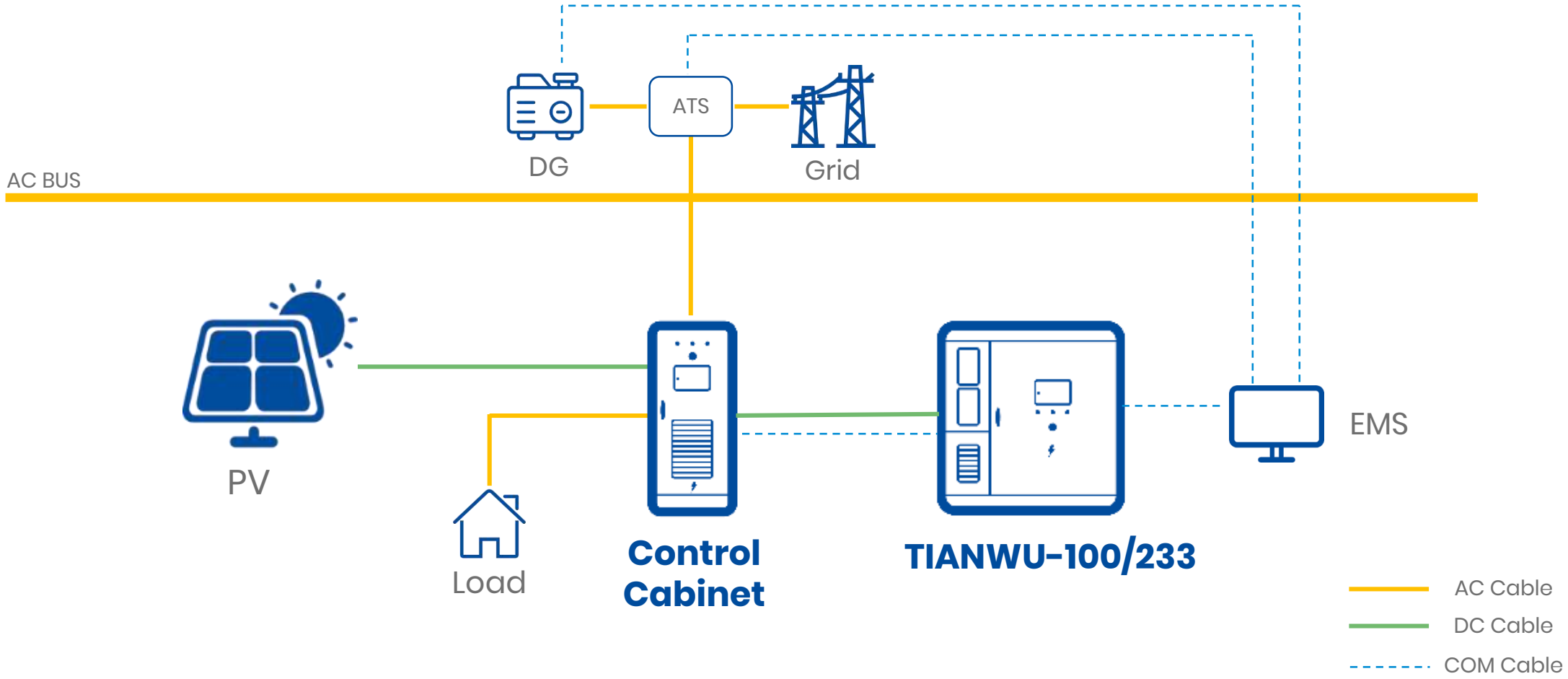
On/Off Grid with DG

- AC-couple

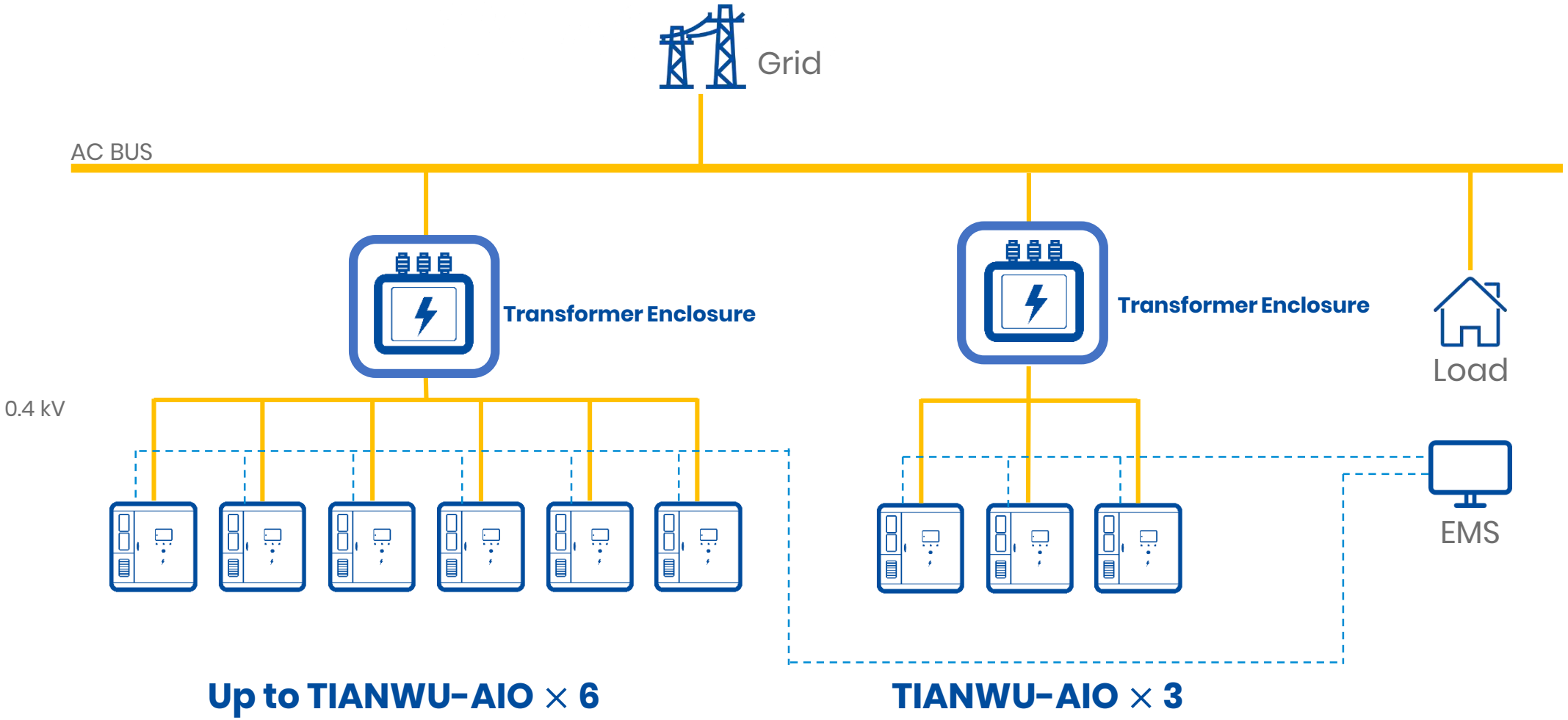


On/Off Grid with DG

- DC-couple



Scale Up TIANWU



Note: Isolation transformer is required when more than 6 TIANWU need to install on single access point.

AC Cable
COM Cable

TIANWU AIO Battery Highlight- Easy Installation

WEIHENG TIANWU

vs.

A Well-known Player

WEIHENG:

- Everything in the cabinet pre-Assembled
- Whole system shipping
- Plug & play installation

A Well-known Player:

- Components installed on site
- Separate shipping of batteries and PCS
- **20 labor * 8 hours** installation just for batteries

TIANWU AIO with EV Charger

TIANWU AIO Case in Netherlands

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