TPStorage
Solution Technical Proposal

Issue 01

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Solution design reference only and detailed solution subject to the actual engineering

HUAWEI TECHNOLOGIES CO., LTD.

HUAWEI

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Acronyms and Abbreviations

Terms and Abbreviations	Full Spelling
BMS	Battery Management System
BMU	Battery Monitoring Unit
BCU	Battery Control Unit
CMU	Central Monitoring Unit
PCS	Power Conversion System
SOC	State of Charge
SOH	State of Health

1 Advantages of the Solution

Key Performance	Huawei Smart String Energy Storage Solution	Traditional Energy Storage Solution
Discharge capacity	An optimizer is configured for each battery pack to prevent capacity loss caused by mismatch of packs connected in series in a battery rack. A smart controller is configured for each battery rack to prevent capacity loss caused by cross current. As a result, the lifetime discharge throughput is increased.	There is no battery pack balancing design and no optimization between battery packs in a rack. The battery racks cannot be fully charged or discharged due to mismatch between battery packs. The capacity of the battery racks cannot be fully utilized. The battery racks are directly connected in parallel without rack-level voltage adjustment. The voltage difference between racks reduces the available capacity and power.
Investment	The high-density factory pre-installation solution reduces the onsite delivery cost. Old and new batteries can be mixed, allowing phased battery installation.	The initial investment and total investment are high. New batteries cannot be mixed with old batteries. As a result, 30% more batteries must be installed during the initial deployment to meet future capacity needs.
Smart cooling	Smart distributed temperature control design, prolonging battery life.	Only one or two air conditioners are deployed in a container. The temperature difference can reach 10°C, which shortens the battery module lifespan.
Simplified O&M	During battery replacement, the SOC does not need to be manually adjusted, and periodic SOC calibration is not required. Onsite O&M personnel can directly replace battery packs, reducing O&M costs by more than 90%.	Experts need to manually adjust the SOC of replacement batteries and periodically calibrate the SOC.
AI-powered internal short circuit detection	Internal short circuit prediction accurately detects and protects against unexpected internal short circuits to improve the safety of the energy	Internal short circuits cannot be identified, which may cause a fire.

Key Performance	Huawei Smart String Energy Storage Solution	Traditional Energy Storage Solution
	storage system (ESS).	
Modular system design	The cooling system, battery system, and PCS adopt a modular design. This improves the system availability	No modular design is used. A faulty PCS affects the entire container. The system availability is only 97% to 98%.
Simplified commissioning	The operating system, database, and management system software are preinstalled on the server. This eliminates software and hardware compatibility risks and reduces onsite commissioning time by more than 90%.	Software is installed separately from hardware.
Security and trustworthiness	Huawei's operating system and database with proprietary intellectual property rights meet the IEC 62443 Maturity Level 3 (ML3) certification requirements.	Third-party OS and database without cyber security certification are used.
Automatic identification of cable connection topologies	The AC and DC cable connection topologies are automatically generated without manual configuration. The cable connection status and error messages are intuitively displayed. No physical check is required, reducing the impact of incorrect cable connections. The device fault, offline, and standby status are clearly displayed.	Not supported. The wiring diagram needs to be manually configured.
3D visualization and refined management	Battery rack-level and battery pack-level data is displayed in 3D graphics. The SOC and charge/discharge power of all battery packs in a rack and the SOH/SOC, temperature, and voltage of electrochemical cells are monitored.	Information about battery packs in a rack is not displayed intuitively. Only the highest and lowest SOCs are displayed, and the SOCs of other battery packs are unknown. The management granularity is coarse. Faulty packs cannot be quickly located.

2 Energy Storage Plant Solution Design Strategy

2.1 Design Basis

This technical proposal mainly references the following standards:

IEC 62477-1:2012 Safety requirements for power electronic converter systems and equipment - Part 1: General

IEC 61000-6-2:2016 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments

IEC/EN 61000-6-4: Emission standard for industrial environments

EN 55011 Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

UL 9540A

ISO 9227:2017 Corrosion tests in artificial atmospheres — Salt spray tests

IEC 60068-2-11:2021 Environmental testing - Part 2-11: Tests - Test Ka: Salt mist

IEC 62933-5-1:2017 Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems - General specification

IEC 62933-5-2:2020 Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems

IEC 61508-1:2010 Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements

IEC 62116:2014 Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures

IEC 61727:2004 Photovoltaic (PV) systems - Characteristics of the utility interface

IEC 60068-1:2013 Environmental testing - Part 1: General and guidance

2.2 Design Principles

Safety and optimal Levelized Cost of Storage (LCOS) are prioritized in the development and design of the products and features in Huawei Smart String Energy Storage Solution.

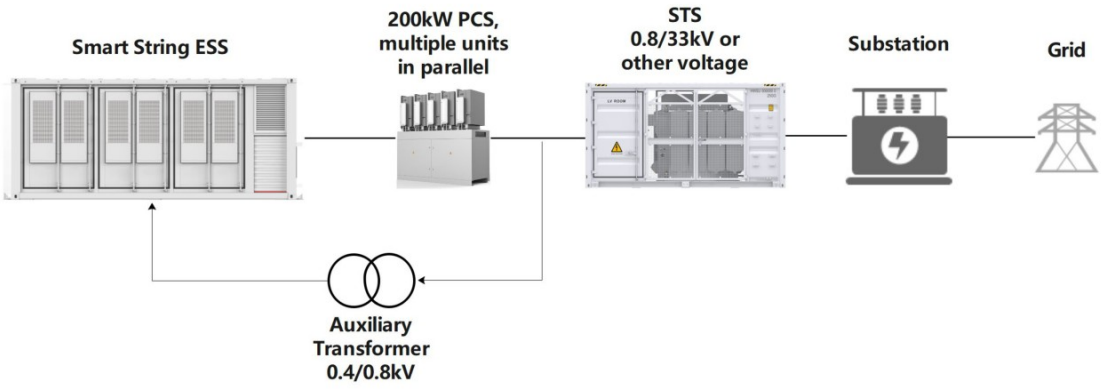
3 Energy Storage Solution Design

3.1 Energy Storage Subarray Design

3.1.1 System Architecture of Smart Energy Storage Plant

The smart energy storage plant system consists of the Smart String ESS, DC LV Panel, Smart Power Conversion System (PCS), Smart Array Controller (SACU), and step-up transformer. Figure 3-1 shows the architecture of the smart energy storage plant system.

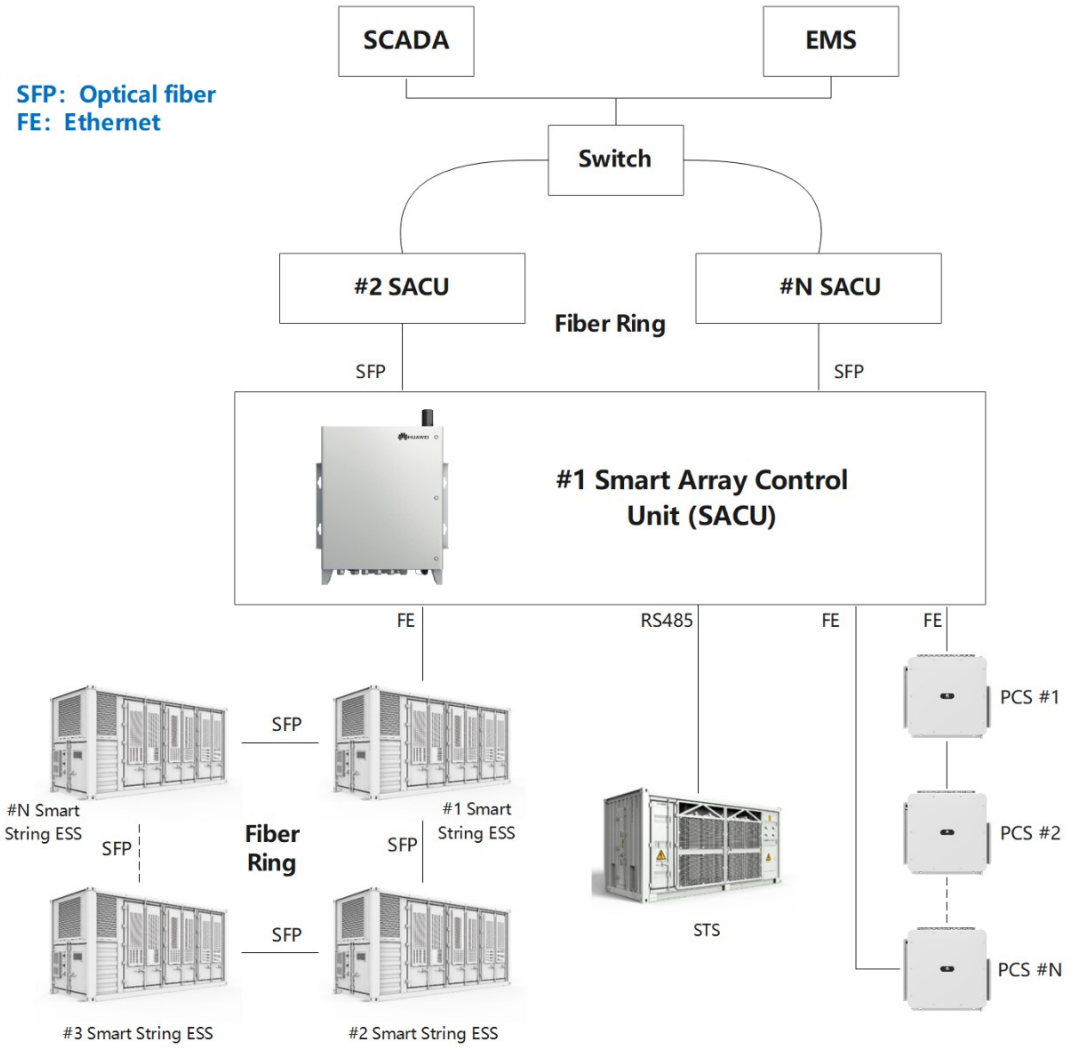
Figure 3-1 System architecture of an energy storage plant



The two-level architecture of Huawei smart string energy storage solution allows flexible sub-array deployment based on AC power and DC power backup duration requirements.

3.2 System Monitoring&Communication Design Scheme

Figure 3-2 Monitoring network architecture of an energy storage plant



4 Device Specifications of an ESS

4.1 Smart String ESS

4.1.1 LUNA2000-2.0MWH-1/2H1

Huawei Smart String ESS adopts a modular design and consists of the battery cabin, Smart Rack Controller Cabin, and control unit cabin. It integrates the lithium iron phosphate batteries and battery racks, a battery management system (BMS), heating, ventilation and air conditioning system (HVAC), lighting system, fire detection and automatic fire extinguishing system, security system, and emergency system, surge protection devices (SPDs), grounding protection devices, and grounding fault detection devices.

Huawei Smart String ESS 280 Ah cells (1P18S pack, 57.6 V/280 Ah, 16.128 kWh). Each battery rack contains 21 battery packs connected in series. The battery rack specifications are 1209.6 V/280 Ah/338.699 kWh. A 20-feet container houses six battery racks. The nominal capacity of a container is 2.032 MWh. Each battery rack is connected to a Smart Rack Controller for independent management. The rated voltage at the high-voltage DC side of the ESS is 1250 V.

Currently, Huawei provides two types of Smart String ESSs: LUNA2000-2.0MWH-1H1 (one-hour power backup, as shown in Figure 4-1) and LUNA2000-2.0MWH-2H1 (two-hour power backup). Both are standard 20-foot containers.

Figure 4-1 Appearance of LUNA2000-2.0MWH-1/2H1



Table 4-1 Huawei Smart String ESS specifications

Technical Specifications	LUNA2000-2.0MWH-1H1	LUNA2000-2.0MWH-2H1
Rated voltage at the DCDC bus side	1250 V	1250 V
Maximum voltage at the DCDC bus side	1500 V	1500 V
DCDC quantities	One DCDC for one battery rack	One DCDC for two battery racks
Rated voltage of a single rack (V)	1209.6 V	1209.6 V
Voltage range of a single rack (V)	1021–1380 V	1021–1380 V
Battery pack model	ESM57280AS1	ESM57280AS1
Battery pack quantities per rack	21 battery packs connected in series	21 battery packs connected in series
Nominal capacity of a single rack (kWh)	338.7 kWh (280 Ah cells)	338.7 kWh (280 Ah cells)
Nominal power (kW)	6 x 338 kW (280 Ah cells)	3 x 338 kW (280 Ah cells)
Rated charge and discharge current (A)	6 x 275.2 A	3 x 275.2 A
Charge and discharge rate	≤ 1C@40℃	≤ .5C@40℃
Intra-rack equalization mode	Pack-level proactive equalization	Pack-level proactive equalization
Rack quantities per container	6	6
Battery capacity per container (kWh)	2032 kWh	2032 kWh
Container dimensions (H x W x D)	20 ft: 2896 mm x 6058 mm x 2438 mm	20 ft: 2896 mm x 6058 mm x 2438 mm
Weight	≤ 30T	≤ 30T
IP rating	IP55	IP55
Operating temperature range	–30°C to +55°C	–30°C to +55°C
Storage temperature range	–40°C to +60°C	–40°C to +60°C
Operating humidity range	0–100% (non-condensing)	0–100% (non-condensing)

Technical Specifications	LUNA2000-2.0MWH-1H1	LUNA2000-2.0MWH-2H1
DC surge protection	Type II	Type II
Maximum operating altitude	4000 m	4000 m
Battery cooling mode	Industrial air conditioning	Industrial air conditioning
Auxiliary power supply	380/220 V AC	380/220 V AC
Fire suppression system	FM-200/ Novec™ 1230	FM-200/ Novec™ 1230
System communications port	Ethernet/Optical port (standard configuration)	Ethernet/Optical port (standard configuration)
System communications protocol	Modbus TCP	Modbus TCP
Environmental protection requirements	RoHS 6	RoHS 6
Standards compliance	IEC62477-1, IEC62040-1, IEC61000-6-2, EN55011, UL9540A, UN38.3, etc	IEC62477-1, IEC62040-1, IEC61000-6-2, EN55011, UL9540A, UN38.3, etc

NOTE

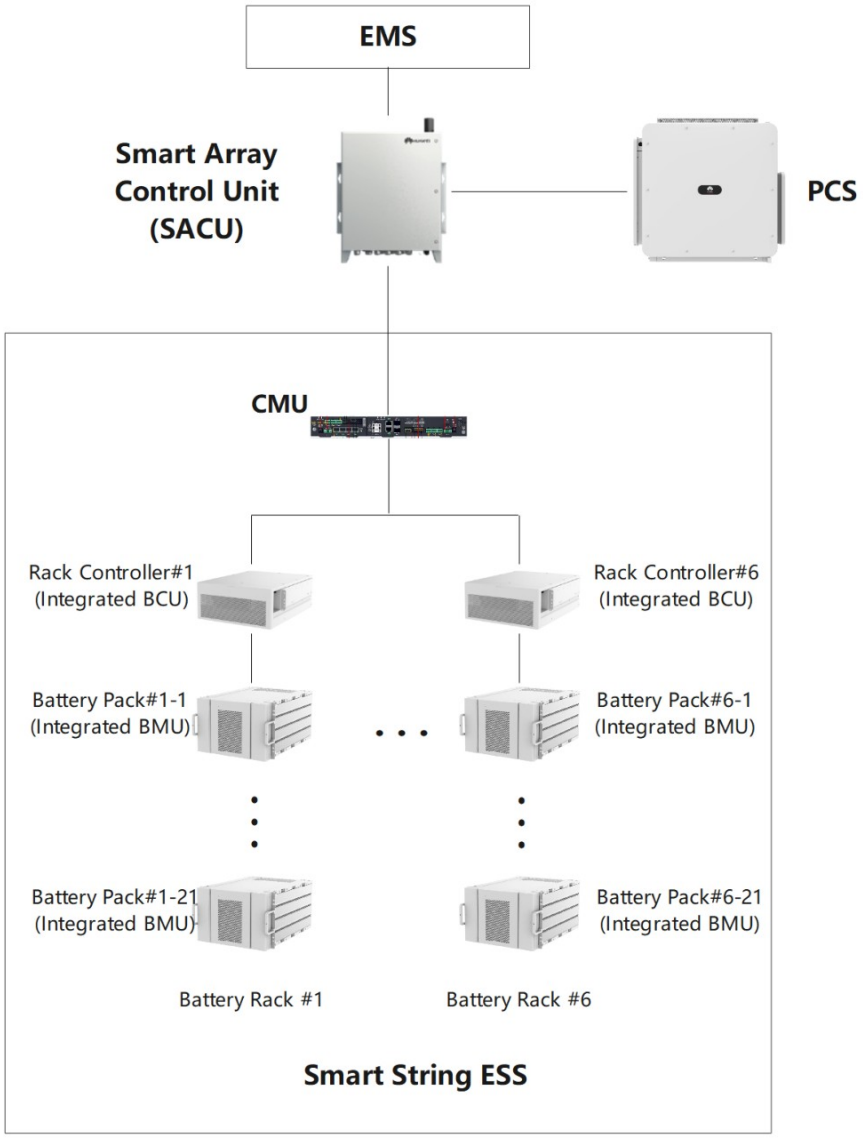
Lithium batteries are important components of a Smart String ESS, and the self-discharge of lithium batteries is inevitable. The time from the manufacture date to the power-on of the Smart String ESS must be shorter than eight months. Otherwise, maintenance charge must be performed. If maintenance charge is not performed as required, the performance and service life of lithium batteries in the Smart String ESS may be adversely affected.

To obtain the manufacture date of the Smart String ESS, you can check for the SN of the ESS in the delivery records or consult the service engineers of the company.

4.1.2 Battery Management System (BMS)

The BMS is the core component of the ESS. Huawei smart BMS system adopts a four-level architecture, as shown in Figure 4-2. It consists of the pack-level BMU, battery rack-level BCU, system-level CMU, and array-level SACU to monitor, protect, and manage the battery system smartly.

Figure 4-2 Huawei BMS architecture



BMU: Battery monitoring unit that monitors and collects battery running information, manages passive electrochemical cell balancing, diagnoses faults, and bypasses a battery pack by using the battery pack optimizer.

BCU: Battery control unit, which collects information about all battery packs as well as the voltage and current of the entire rack through the BMU, and generates alarms and protects the battery rack during charge and discharge. In addition, it also delivers commands to the BMU to balance the SOC between battery packs in a rack and bypass each battery pack independently, implementing pack-level optimization.

CMU: Central Monitoring Unit, which manages the BMU and BCU, analyzes and calculates the uploaded data, processes alarms, records and stores data, balances loads among racks, and manages the state of charge (SOC) and state of health (SOH). It also collects information about the environment monitoring system (such as the fire suppression system, cooling system, temperature and humidity sensor, and water sensor) of the Smart String ESS to create appropriate cooling policies, improve

battery temperature consistency, and warn about and respond to fire to protect the safety of the ESS.

The BMS is also integrated with a direct PCS. Once the BMS detects a critical alarm such as overcurrent or short circuit, it directly sends a dry contact control signal to emergency stop the DCDC and protect the system from deteriorating or affecting other devices.

To improve system reliability and performance, Huawei BMS uses a Smart Array Controller (SACU) to coordinate and control the battery systems of the entire array. The CMU and PCS are connected to the SACU to coordinate the time sequence and logic for the three levels of battery system protection and PCS protection. The hierarchical protection actions are designed based on the time sequence, delay, and probability of partial fault protection failure of protection units. The SACU connects to the EMS through the northbound interface to receive power grid scheduling commands and deliver them to the PCS and CMU.

The BMS provides the following functions:

1. The BMS collects parameters such as the cell temperature, cell voltage, battery pack voltage, and battery rack voltage and current in real time with high precision to control and optimize the operation of batteries, battery packs, and battery racks, ensuring long-term efficient operation of batteries.
2. The BMS can estimate and calibrate the SOC and SOH of batteries. It calculates, displays, and reports the number of cycles, DOD, SOC, and SOH in real time.
3. It controls the charge and discharge of batteries based on the SOC control plan, diagnoses battery faults, and troubleshoots them based on fault conditions. Table 4-2 lists the supported protection levels.

Table 4-2 Functions of BMS components

Level	Configuration	Function
Level 1	BMU x 1/battery pack	Monitors battery cell voltage and temperature, and aggregates and reports the collected data. Balances the battery voltage and SOC and bypasses battery cells as instructed by the upper-level unit. Controls the heat dissipation fan based on the temperature. Performs real-time self-test on the sampling circuit and equalization circuit, and reports the self-test result in real time. Communicates with the upper-level BCU through the CAN bus.
Level 2	BCU x 1/battery rack	Monitors the total voltage and current of a battery rack, and collects the temperature, voltage, battery current, and SOC information reported by battery packs in the battery rack. Calculates the SOH of the battery rack based on the calibration operations. Manages the running and alarm information of batteries in

Level	Configuration	Function
		the battery rack, and controls the charge and discharge currents of the battery rack based on control requirements. Delivers equalization commands based on the voltage state of batteries in the rack. Delivers insulation detection commands to the BMU based on the commands from the host. Uploads battery rack parameters and switch status to the CMU through the FE port, and receives control commands from the CMU.
Level 3	CMU x 1 + SACU x 1	1. The CMU collects and manages level-2 BCU information, centrally manages the voltage, current, temperature, SOC, and bus insulation detection of the lower level, and uploads the information to the SACU through optical fibers. 2. The SACU connects to the CMU, PCS management system, and third-party environment monitoring system through the southbound interfaces, and connects to the EMS and SCADA through the northbound interfaces to manage the energy flow of the ESS. 3. The SACU calculates and collects parameters such as the voltage, current, and SOC of each rack reported by the BCU, and determines whether to enable the inter-rack balancing function of the BCU. 4. The CMU collects statistics on the overall alarm status and protection status and determines whether to turn off the main circuit breaker for protection. 5. The CMU calculates the SOC of the connected batteries and the battery capacity based on the cycle count. 6. The CMU transmits data to the local management app and delivers local control commands.

4. The BMS collects the temperature of each battery in real time and adjusts the heat dissipation policy of the distributed air conditioners in real time to prevent battery over-temperature. Huawei smart string energy storage solution adopts the distributed heat dissipation design. Each battery rack is independently cooled by a door-mounted air conditioner. Each battery pack is equipped with an adjustable fan to improve the battery operating temperature consistency and reduce the temperature difference between battery packs in the container to less than 3° C (at 0.5C). In addition, the heat management function strictly monitors the operating temperature of the battery pack. If the temperature is higher or lower than the protection value, a heat management start signal is generated to adjust the temperature by adjusting the fan speed and air conditioner power. If the temperature reaches the preset hazard threshold, the BMS automatically triggers the system protection mechanism to disconnect the battery loop to ensure system safety.

5. Both the BMS and the PCS connect to the SACU to exchange information. The BMS supports the Ethernet, optical fiber, and RS485 communication ports for northbound data exchange.
6. The BMS provides three-level balance management to balance electrochemical cells, battery packs, and battery racks to prevent capacity loss and cross current risks caused by inconsistency.
7. The operating parameters of the BMS can be set on the local management app or touchscreen, or remotely modified on the BMS platform (password authentication supported). The operating status, such as the system status, analog parameter information, alarm information, and protection information, can be displayed on the local management app or touchscreen after password authentication.
8. The BMS can store events and historical data of the battery energy storage system. It meets the IEC62619, EN ISO13849, IEC 61508 requirements and can store at least 5000 events, which is adequate for storing events in 30 days. The following figure shows the progress of the BMS IEC62619, EN ISO13849, IEC 61508 certifications issued by a third-party testing organization.

4.1.3 Smart Cooling System

The Smart String ESS adopts constant temperature and humidity design. The built-in industrial air conditioner cooling and heating system adopts the distributed temperature control design. Door-mounted air conditioners, not traditional centralized air conditioners, are used to maintain consistent temperature in the container.

Cool air is blown from the top and recirculated in the container to prevent dust from coming into the container. The cool air blown from the air conditioner flows along the top board to the back of the battery racks on two sides and then sucked in by the fans in battery packs. The hot air goes to the intake of the air conditioner over the top of the door. This keeps the temperature in the container at 23±5° C to ensure best operating conditions for the batteries. The air outlet temperature is low. To prevent condensation, PEF thermal insulation foam is attached on the top of the container.

In addition, through professional thermal simulation, Huawei comprehensively analyzes and optimizes the thermal design based on the test results in different high and low temperature scenarios to ensure that the heat dissipation design meets the requirements.

Figure 4-3 shows the thermal simulation and air flow diagram in the 0.5C scenario. The highest temperature in the container is 24.86° C, the lowest temperature is 22.31° C, and the temperature difference is only 2.5° C.

Figure 4-3 Internal thermal simulation diagram of Huawei Smart String ESS

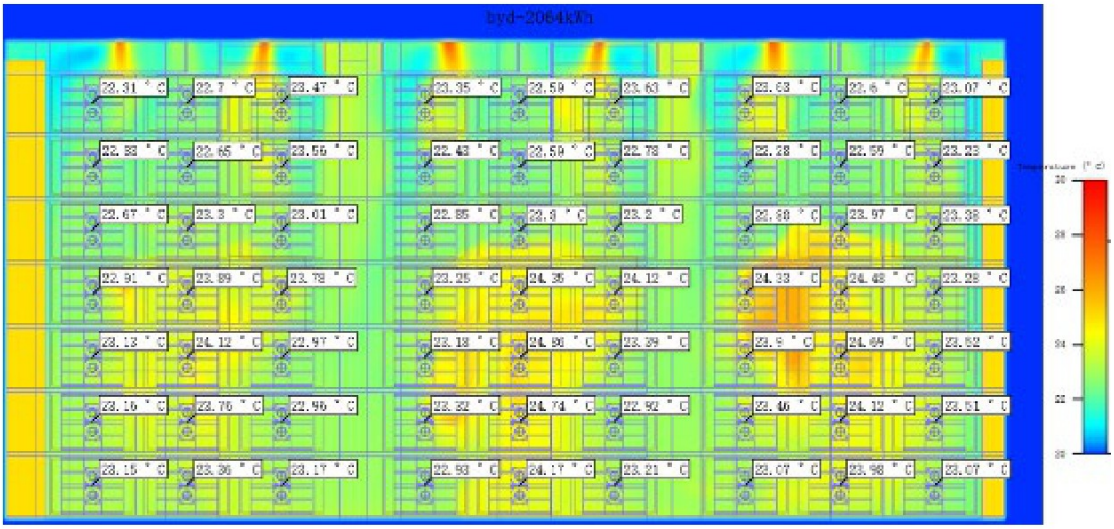
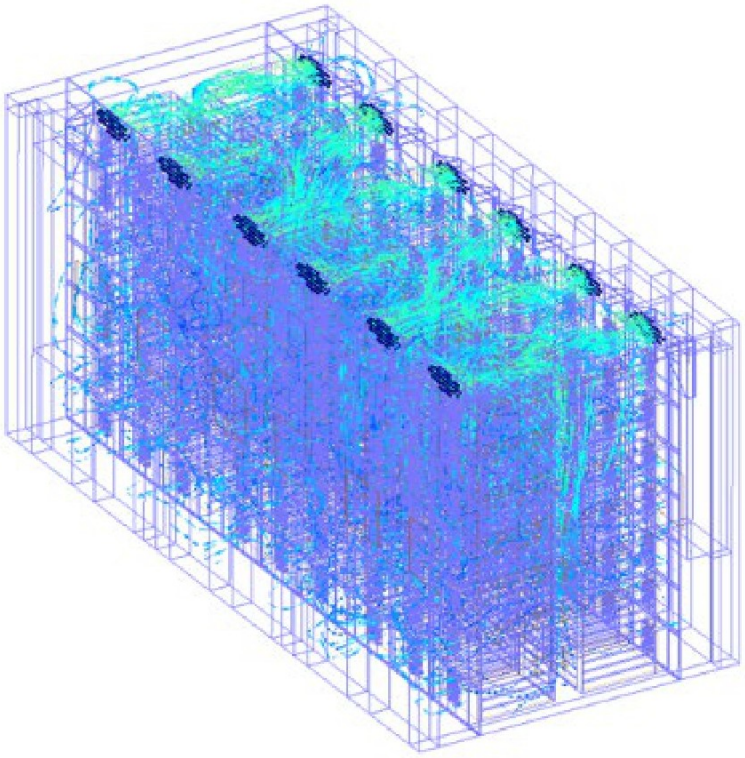


Figure 4-4 Internal air flow diagram of Huawei Smart String ESS



In addition, the temperature sensor collects temperature signals and sends them to the CMU. The CMU calculates related parameters to adjust the operating status of the air conditioner.

4.1.4 Fire Suppression System

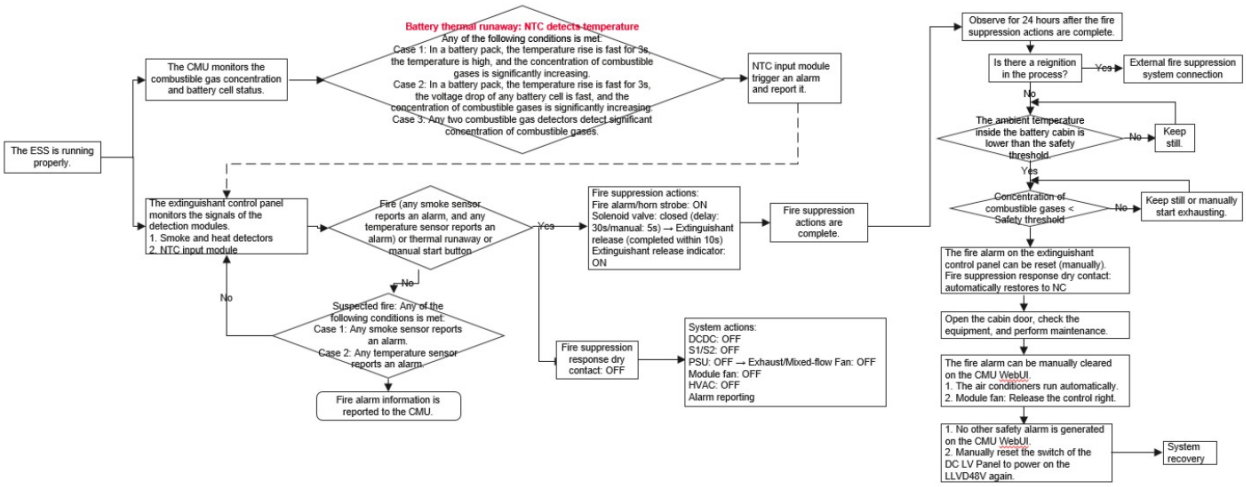
Huawei Smart String ESS integrates a centralized fire suppression system, which consists of a gas extinguishing agent cylinder, pipes, nozzles, signal feedback components, fire detectors and extinguishant control panel, emergency start/abort button, horn strobe, and gas release indicator. Table 4-3 describes the components of the centralized fire suppression system.

Table 4-3 Fire suppression system configuration of Huawei Smart String ESS

Item	Quantity	Remarks
Novec1230 Gas Agent, Cylinder, Piping, Nozzle	1	33-34kg, 9.7% design concentration, reserved residual 1 kg, 38L&40L cylinders, 3 nozzles
Fire Suppression Control Panel	1	Outside the power cabin door
Smoke detector	2	In the battery cabin of the container
Heat detector	2	In the battery cabin of the container
Horn strobe	1	Outer side of the container
Fire alarm bell	1	Outer side of the container
Extinguishant release button	1	Outer side of the container
Extinguishant abort button	1	Outer side of the container
Extinguishant release indicator	1	Outside of the container
Solenoid valve	1	Works with the fire suppression cylinder
Combustible gas exhaust system	1	In the battery cabin

The CMU monitors the combustible gas concentration, cell temperature and cell voltage drop. If the CMU detects the battery thermal runaway, the alarm will be reported. If both the smoke sensor and the temperature sensor detect the fire signal, or the cell thermal runaway signal is detected, or the emergency start button is pressed, the fire extinguishing action will be triggered. After the fire extinguishing actions are complete, observe for 24 hours and ensure that the ambient temperature and combustible gas concentration in the battery cabin are lower than the safety thresholds.

Figure 4-5 Interworking between the fire suppression system and the ESS



4.2 Smart PCS

The Smart PCS is one of the core components that converts AC to DC and vice versa. Huawei string PCS adopts a modular design and is installed outdoors. The cabinet surface is spray-painted with RAL9003 and RAL7035 with the same color. The enclosure is made of 5052 aluminum alloy and is IP66 and C5M rated, with a designed service life of 25 years. It does not need to be installed in a container. This simplifies onsite installation and O&M.

The model of Huawei string PCS is LUNA2000-200KTL-H1, and the capacity of each device is 200 kW. Figure 4-6 shows a Huawei string PCS.

Figure 4-6 Picture of Huawei string PCS



Table 4-4 lists the specifications of Huawei LUNA2000-200KTL-H1 200 kW PCS.

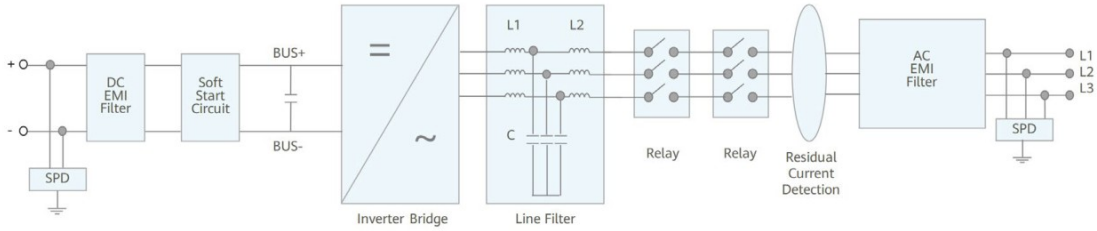
Table 4-4 Technical specifications of Huawei LUNA2000-200KTL-H1

Category	Technical Specifications	LUNA2000-200KTL-H1
Efficiency	Maximum efficiency	99.01%
DC side	Number of DC inputs	1
	Maximum DC voltage	1500 V
	Maximum DC power	245 kW
	Maximum DC current	207.6 A
	Minimum startup voltage	540 V
	Full-load voltage range	1180–1350 V (rectification mode) 1180–1280 V (inverter mode)
	Operating DC voltage range	1180 V to 1500 V
	Rated DC voltage	1180 V
On-Grid Parameters	Rated AC voltage	800 V
	Rated AC power	200 kW
	Maximum apparent power	240 kVA
	Maximum active power	240 kW
	Rated AC current	144.3 A
	Maximum AC current	173.2 A
	Rated AC frequency	50 Hz/60 Hz
	Power factor	1 leading and 1 lagging
	Maximum total harmonic distortion (rated power)	< 3%
Off-Grid Parameters	Rated AC voltage	800 V
	DC components in output voltage	± 0.1% (with a transformer)
	Output frequency	50 Hz/60 Hz
	Phase difference (three-phase voltage)	120±1° (balanced load)
	Rated output power	200 kW
	Voltage THD (linear load)	< 1.5% (0.8 leading and 0.8 lagging)

Category	Technical Specifications	LUNA2000-200KTL-H1
	Unbalanced load	100% unbalanced (with a transformer)
Protection	Anti-islanding protection	Supported
	AC overcurrent protection	Supported
	DC reverse polarity protection	Supported
	DC surge protection	Type II
	AC surge protection	Type II
	Insulation resistance detection	Supported
	Residual current monitoring unit (RCMU)	Supported
	Overvoltage category	DC II/AC III
Display and communication	Display	LED indicators and WLAN module+app
	Ethernet	Supported
	USB	Supported
General specifications	Dimensions (H x W x D)	875 mm × 820 mm × 365 mm
	Net weight	< 99 kg
	Operating temperature	–25°C to +60°C (derated at +40°C or higher)
	Cooling mode	Smart air cooling
	Maximum operating altitude	4000 m (derated when the altitude is greater than 2000 m)
	Relative humidity	0%–100% RH
	Input and output terminals	OT/DT terminal
	Ingress protection rating	IP66
	Topology	Transformerless

The following figure shows the electrical diagram of Huawei LUNA2000-200KTL-H1 PCS.

Figure 4-7 Electrical diagram of Huawei LUNA2000-200KTL-H1



4.3 Smart Transformer Station

Huawei provides three types of typical energy storage subarrays with the power of 9 MW, 6 MW or 3 MW. A 9 MW subarray is connected to the medium-voltage (MV) power grid through the 9.0 MVA JUPITER-9000K-H0 Smart Transformer Station (STS); a 6 MW is connected to the medium-voltage power grid through the 6.8 MVA STS-6000K-H1 STS; and a 3 MW subarray is connected to the medium-voltage power grid through the 3.4 MVA STS-3000KTL-H1 STS.

Figure 4-8 Picture of STS-6000KTL-H1

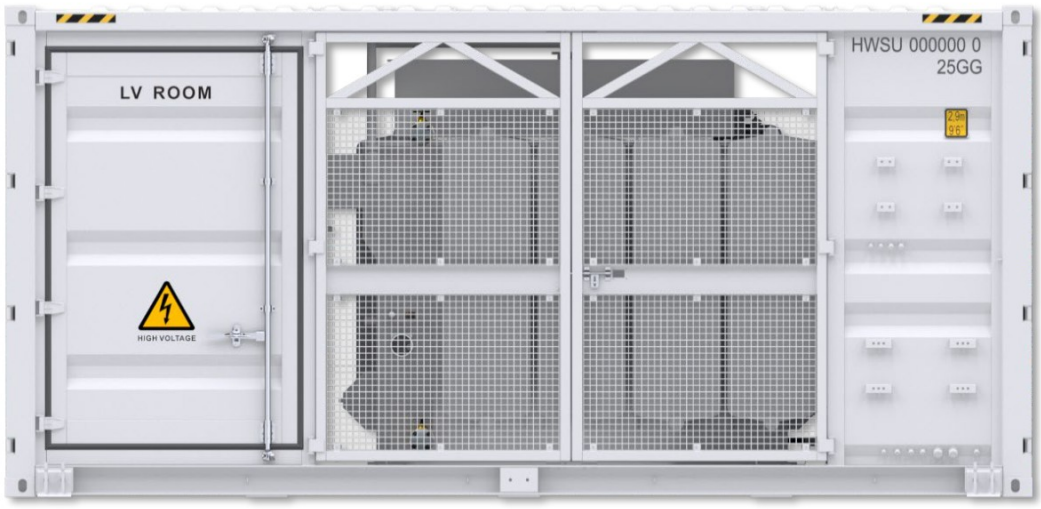


Table 4-5 STS technical specifications

STS model	JUPITER-9000K-H0	STS-6000KTL-H1	STS-3000KTL-H1
Input			
Available PCS	LUNA2000-200KTL		
Maximum LV AC Inputs	44	34	17
AC capacity	9000 kVA @ 40°C	6800 kVA @ 40°C	3400 kVA @ 40°C
Rated input voltage	800 V AC		

STS model	**JUPITER-9000K-H0**	**STS-6000KTL-H1**	**STS-3000KTL-H1**
Maximum input current at nominal voltage	2 x 3247.7 A	2 x 2637.8 A	2637.8 A
Output			
Rated output voltage	10 / 11 / 15 / 20 / 22 / 30 / 33 / 34.5 / 35 kV		
Frequency	50 Hz		
Transformer type	Oil-immersed, Conservator Type		
Transformer cooling type	ONAN		
Tappings	±2 x 2.5%		
Transformer oil type	Mineral oil (PCB-free)		
Transformer vector group	Dy11-y11	Dy11-y11	Dy11
Transformer Minimum PEI Efficiency	Designed according to EN 50588-1		
Transformer impedance (HV-LV1 or HV- LV2)	19% (0 ~ +10%) Semi-crossing	14.6% (0 ~ +10%) Semi-crossing	7.3% (0 ~ +10%)
M-voltage ring main unit	SF_6 gas insulated ring main unit		
Auxiliary transformer	5 kVA, Ii0, 800 V/230 V	5 kVA, Dyn11	
2.0 kVA UPS	Optional		
MV Surge Arrester for MV VCB	Optional		
Protection			
Transformer monitoring and protection	Oil level, oil temperature, oil pressure and buchholz		
Protection Degree of MV & LV Room	IP54		
Internal Arcing Fault of STS	IAC A 20 kA 1S		
MV relay protection	50/51, 50 N/51 N		
LV overvoltage protection	Type I+II		
General specifications			
Dimensions (H x W x D)	6058 mm x 2438 mm x 2896 mm		
Weight	< 28 t	<22 t	< 15 t
Operating temperature range	–25°C to +60°C		
Maximum operating altitude	2000 m	1000 m	

STS model	JUPITER-9000K-H0	STS-6000KTL-H1	STS-3000KTL-H1
LV & MV Room Cooling	Hermetically-Sealed Smart Cooling for Higher Availability		
Communications	Modbus TCP	Modbus RTU	
Standards compliance	IEC 60076, IEC 62271-200, IEC 62271-202, EN 50588-1, IEC 61439-1		

4.4 Smart Array Controller

The Smart Array Controller (SACU2000D) is the communication part in an energy storage subarray. It collects data from devices (including the PCSs, Smart String ESSs, and STSs), and reports the data to the plant monitoring backend over a fiber ring network, LTE network, or another type of network.

The SACU can be equipped with the SmartLogger, PLC communications module, fiber ring network switch, access terminal box (ATB), PoE source, communication management unit, and appropriate wiring terminals and power distribution switches.

The SACU can be installed on a support, pole, or wall. Cables are routed in and out from the bottom. The front door can be opened for installation, cable connection, and maintenance.

Table 4-6 Specifications of the SACU

Technical Specifications	SmartACU 2000D-D-06	SmartACU 2000D-D-00	SmartACU 2000D-D-01	SmartACU 2000D-D-03
Configurations				
Smart Logger	SmartLogger3000B x 1			
SmartModule1000A	Optional			Standard with 1
Ethernet	14	1 or 3 (with a SmartModule1000A) or 6 (with a SmartModule1000A and a five-port switch)		
RS485	COM x 6, 1,200 / 2,400 / 4,800 / 9,600 / 19,200 / 115,200 bps			
Optical Ethernet	SFP x 10, 100 / 1,000 Mbps	SFP x 2, 100 / 1,000 Mbps		

Technical Specifications	SmartACU 2000D-D-06	SmartACU 2000D-D-00	SmartACU 2000D-D-01	SmartACU 2000D-D-03
Number of MBUS Module [1]	0	1	1	2
Number of SmartPID2000 Module	0	0	1	2
Environment				
Operating Temperature Range	-40°C ~ 60°C			
Relative Humidity	4% ~ 100%(Non-condensing)			
Max. Operating Altitude	4,000 m			
Electrical				
AC Input Voltage for Cabinet	100 V～240 V, L / N (L)+ PE			
AC Input Voltage for MBUS	380 V ~ 800 V, 3Ph			
AC Input Voltage for PID	380 V ~ 800 V, 3Ph + FE (Functional Earth)			
AC Input Frequency	50 Hz / 60 Hz			
Power Supply	Standard: 12 V DC, Optional: 24 V DC2			
Mechanical				
Cable Entries	Bottom in & out			
Maintenance	Front			
Dimensions (W x H x D)	640 x 770 x 315 mm		880 x 770 x 369 mm	
Weight	32 kg	29 kg	49 kg	61 kg
Protection Degree	IP 65			
Installation Options	Wall Mounting, Rack Mounting, Pole Mounting			

Figure 4-10 shows the appearance and dimensions of an SACU2000D.

Figure 4-9 SACU picture

