LUNA2000-(107-215) Series Smart String Energy Storage System Solution Maintenance Handbook

Issue	03
Date	2025-05-26

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Contents

1 Purpose

1.1 Application Scenario

- This document is applicable to the deployment of the LUNA2000-(107-215) Series Smart String ESS.
- This document is applicable to the routine maintenance of the LUNA2000-(107-215) Series Smart String ESS.

1.2 Intended Audience

This document is intended for maintenance engineers.

1.3 Change History

Issue 02 (2025-05-09)

Updated **2 Key ESS Devices and Their Functions**.

Updated **3 ESS Power-On and Deployment Commissioning**.

Updated **7 Troubleshooting**.

Issue 01 (2025-01-22)

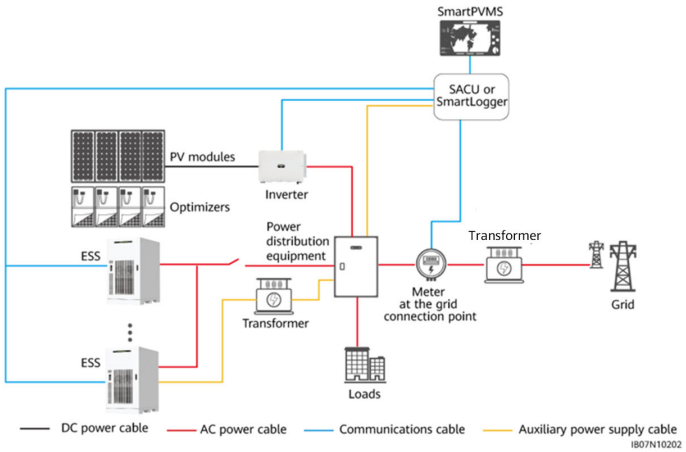
This issue is the initial release.

2 Key ESS Devices and Their Functions

2.1 C&I PV+ESS On-Grid Scenario

The PV+ESS system is mainly used for maximum PV self-consumption as well as peak staggering and peak shaving at the grid connection point. **Figure 2-1** shows the networking architecture of the PV+ESS system.

Figure 2-1 Networking architecture of the PV+ESS system



2.1.1 C&I On-Grid PV+ESS System and Key Devices

For details about the solution in which the C&I liquid-cooled ESS is used in on-grid scenarios, see the **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

2.1.2 Key Devices in the C&I Liquid-Cooled ESS

The C&I Smart String ESS supports pack-level active balancing, intelligent liquid cooling, independent smoke duct, top-mounted explosion vent, and centralized fire suppression (optional). The ESS supports three-sided cabinet layout. The battery packs and power modules are installed in different cabins. The Liquid

Thermal Management System (LTMS) is mounted on the door. The ESS has an all-in-one architecture. Only AC output power cables and communications cables need to be installed onsite.

Figure 2-2 Components (interior view, with DCDC)

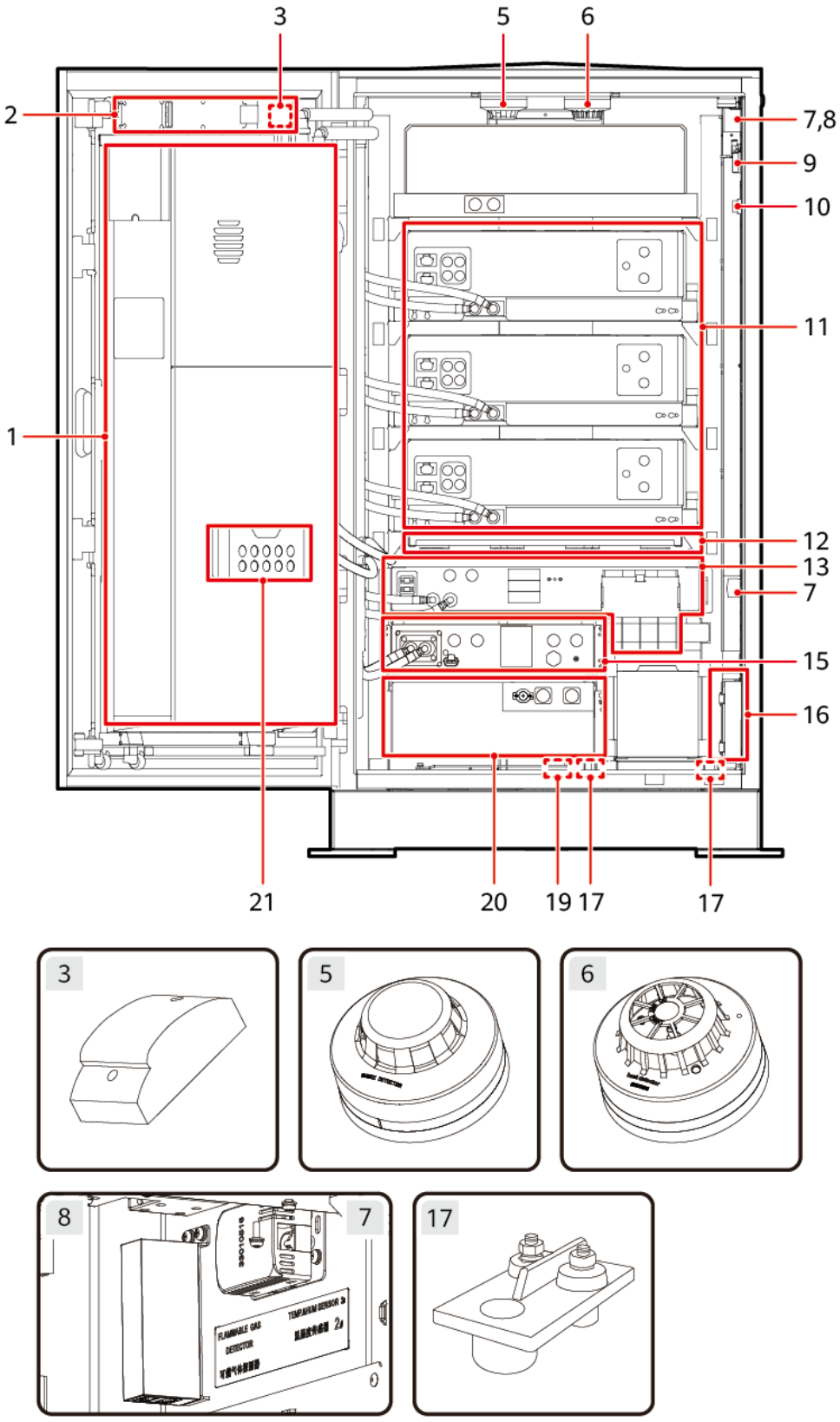


Table 2-1 Component description

No.	Item	Maximum Quantity per ESS	Description
1	LTMS	1	The Liquid Cooling Controller (LCC) controls the temperature in the ESS with the cooling, heating, and dehumidification functions.
2	Display module	1	Provides an independent fire alarm indicator, SOC indicator, and status indicator for the ESS.
3	Fire alarm horn/strobe	1	Generates alarms for internal devices when abnormal temperature or smoke occurs.
4	Exhaust fan	2	Exhausts combustible gases from the cabinet. Only some models support this function.
5	Smoke detector	1	Photoelectric smoke detector that detects smoke.
6	Heat detector	1	Monitors temperature to prevent fire.
7	T/H sensor	2	Measures the real-time ambient temperature and humidity in the cabinet.
8	CO sensor	1	Checks the concentration of CO in combustible gases.
9	Door status sensor	1	Monitors the opening or closing status of the ESS door.
10	Door limit switch	1	Works with the door status sensor to monitor the opening or closing status of the ESS door.
11	PACK	2/3/4	A battery pack is a combination of battery cells that are connected in series and supply or receive power through a pair of positive and negative terminals. Each battery pack is equipped with a battery management module, balancing DCDC module, and liquid cooling plate.
12	Aerosol fire suppression device	3	When the aerosol fire suppression device senses the high temperature, it automatically starts and releases extinguishant.

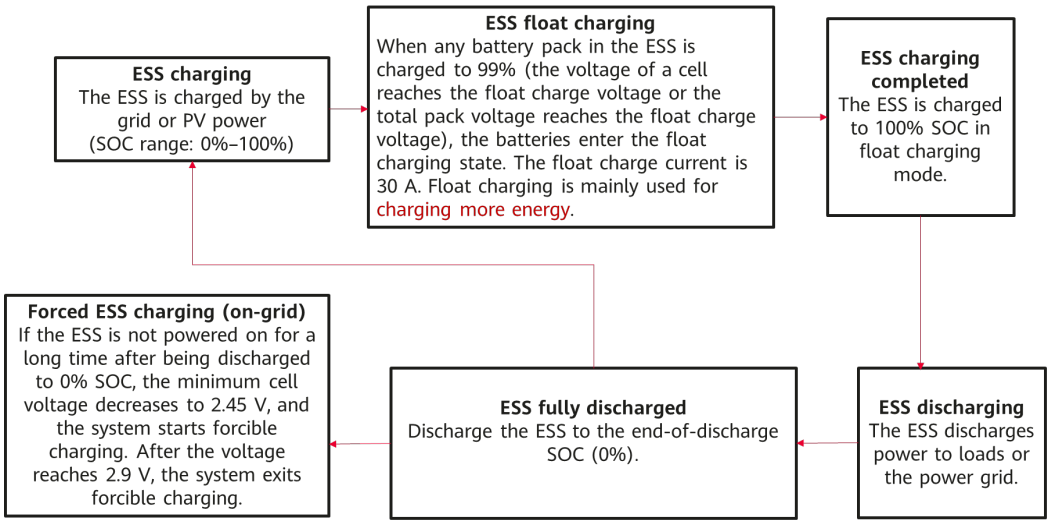
No.	Item	Maximum Quantity per ESS	Description
13	PCS	1	The PCS converts the battery DC voltage discharged from the ESS into specified AC voltage and converts AC voltage into DC voltage to charge the ESS. It supports 100% unbalanced loads.
14	Lead-acid battery box	-	The lead-acid battery box is optional. It works with the thermal runaway suppression system to supply power to the TRSD. Only some models support this function.
15	DCDC	1	DC-DC converter that converts the DC voltage of a battery rack into stable DC voltage. Only some models support this function.
16	SmartLogger installation position	-	The SmartLogger can be installed inside the ESS in the single-cabinet scenario. The SmartLogger manages the voltage, current, temperature, and energy of each ESS in an array.
17	Water sensor	2	Detects water based on the resistance change between both electrodes.
18	TRSD host	1	When a thermal runaway alarm is generated for any PACK, the TRSD host communicates with the BMS to respond to the fire alarm and start automatic fire suppression control. Only some models support this function.
19	Desiccant	4	Desiccants are used for dehumidification inside the ESS. **NOTE** Do not remove the desiccants before the ESS is powered on. If the ESS has been delivered for more than six months, replace the desiccants with those of the same specifications and amount (Montmorillonite desiccant, 500 g/bag).

No.	Item	Maximum Quantity per ESS	Description
20	RCM	1	The RCM consists of the BCU, rack power control board, fuse, contactor, disconnector, etc. It is used for ESS control, short-circuit fault detection, insulation detection, leakage current detection, high-precision current sampling, auxiliary power supply, and connecting to the ESS on the mobile app.
21	Document holder	1	Stores documents related to the ESS, such as the quick guide.

The following describes the battery pack, DCDC (optional), PCS, RCM, power distribution, LTMS, sensor, and TRSD.

1. RCM: consists of the battery control unit (BCU), rack power control board (RPCB), contactor, fuse, power copper bar, and heat dissipation fan. The RPCB contains the low-voltage auxiliary power supply for the ESS and provides two 12 V DC power supplies, one for the LTMS and the other for low-voltage electrical devices. The BCU is the main control unit of the ESS. It communicates with external devices in the northbound direction and controls and manages internal devices in the southbound direction. The RCM also provides an independent 220 V AC power supply for air conditioners, which is controlled by a circuit breaker.
2. PCS: converts 648–864 V DC voltage into 380–480 V AC voltage, supports 3-phase 4-wire and 100% unbalanced loads, uses CAN for communication, and supports hardware rapid shutdown.
3. DCDC: converts the DC voltage of the battery racks into stable 760 V DC voltage (adjusted as required) to match the PCS, uses CAN for communication, and supports hardware rapid shutdown.
4. Battery pack: composed of cells connected in series and parallel (1P60S in this solution). It is the minimum energy storage unit that stores or provides energy. Data such as the battery voltage, battery current, and battery temperature is reported.
5. LTMS: includes a highly integrated thermal management module developed by Huawei. It ensures the optimal operating temperature for each module of the ESS and optimal temperature and humidity inside the cabinet through adaptive adjustment and control.
6. Main power distribution: 1000 V DC high-voltage DC design for fault isolation or power-off maintenance

Figure 2-3 ESS charge and discharge logic



2.2 C&I PV+ESS On/Off-Grid Scenario

For details about the solution in which the C&I liquid-cooled ESS is used in on/off-grid scenarios, see the **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

Table 2-2 Application scenarios of the C&I on/off-grid solution

Solution Source	Scenario	Scenario Description	Solution Overview	
C&I solution (SmartLogger as the controller and PV+ESS)	Seamed on/off-grid switching	**Application scenario**: disaster recovery. The utility power grid is relatively stable. The PV+ESS system operates in on-grid mode for a long time, which poses high requirements on the on-grid dispatching precision. The on-grid economical operation policy is adopted. When a power outage occurs due to force majeure, the PV+ESS system is able to operate in off-grid mode and provides emergency power supply to critical loads. During on-grid operation, the backup power SOC can be set to reserve power for off-grid emergency power supply. In this scenario, the PV+ESS solution is not coupled with gensets.	PV+ESS (no genset)	SmartLogger+PV+ESS: The SmartLogger works with the utility power grid detection relay to control the on-grid operation, off-grid operation, and on/off-grid switching of the PV+ESS system.

Solution Source	Scenario	Scenario Description	Solution Overview	
	Seamless on/off-grid switching (all-time VSG)	**Application scenario**: The utility power grid often encounters power outages. The requirements for on-grid power dispatching and control are not high, and power fluctuations are acceptable. When the system runs in on-grid mode, the economical operation policy is implemented. When the power grid experiences a power outage or major disturbance, the PV+ESS system automatically disconnects the switch at the grid connection point and switches to off-grid mode to ensure continuous power supply to critical loads. When the utility power grid recovers to a stable range, the PV+ESS system seamlessly connects to the power grid and restores the on-grid operation policy. During on-grid operation, the backup power SOC can be set to reserve power for off-grid emergency power supply. If there is a genset, the loads automatically switch to the genset branch by using the ATS and the genset starts to supply power to the loads. The PV+ESS system is decoupled from the genset through the ATS.	PV +ESS (no genset)	The SmartLogger works with the whitelisted third-party protective relay to implement seamless on/off-grid switching (all-time VSG).
			PV +ESS (loads switching to the genset through the ATS)	The loads automatically switch to the genset branch by using the ATS. The genset serves as the backup power for the PV+ESS system.

Solution Source	Scenario	Scenario Description	Solution Overview	
	Off-grid only	**Application scenarios**: This solution is mainly used to ensure power supply availability, such as remote areas and rural areas where short-term power supply interruption is acceptable. The PV+ESS system forms an independent microgrid to supply power to loads. In the daytime, PV modules supply power to loads and charge the ESS. At night, the ESS supplies power to loads and shuts down after the ESS discharges energy to a low SOC level. In the morning of the next day, the PV+ESS system automatically starts and supplies power to loads. If there is a genset, the loads automatically switch to the genset branch by using the ATS and the genset starts to supply power to the loads. The PV+ESS system is decoupled from the genset through the ATS.	Genset replaced by the PV+ESS system	The PV+ESS system runs in off-grid mode without other power supplies. The SmartLogger serves as a controller to automatically control off-grid operation.
			PV+ESS (loads switching to the genset through the ATS)	The SmartLogger serves as a controller to automatically control off-grid operation. The loads automatically switch to the genset branch by using the ATS. The genset serves as the backup power for the PV+ESS system.

2.2.1 C&I On/Off-Grid PV+ESS System and Key Devices

Figure 2-4 Networking architecture of the on/off-grid PV+ESS (PQ/VSG) system

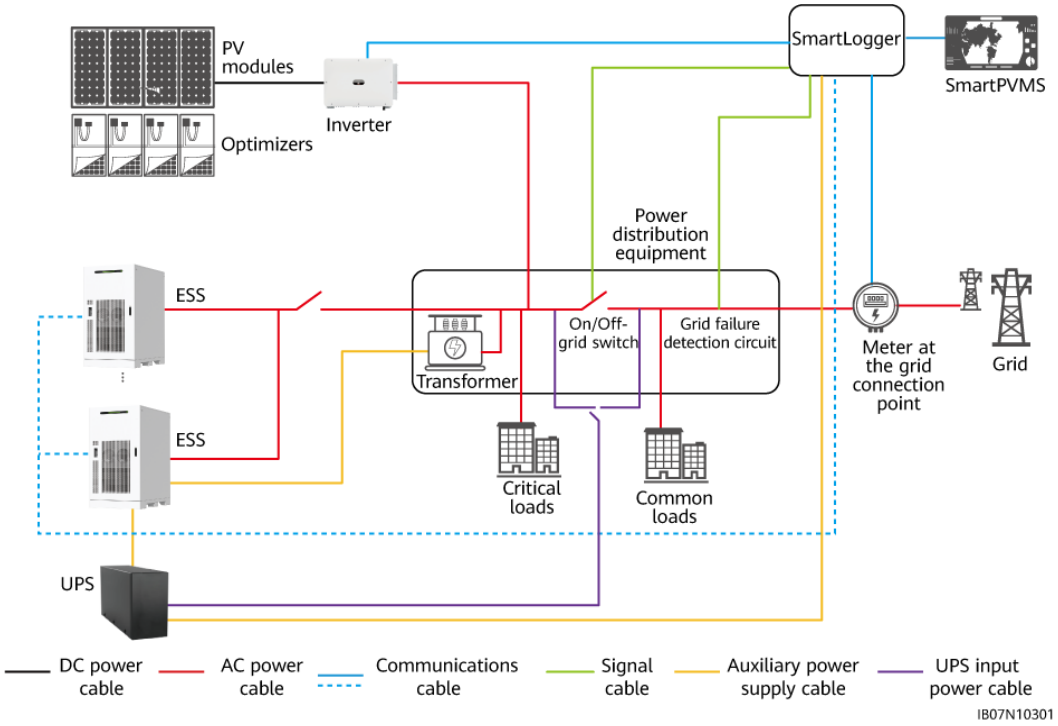


Figure 2-5 Networking architecture of the on/off-grid PV+ESS (VSG) system (with genset controlled by ATS)

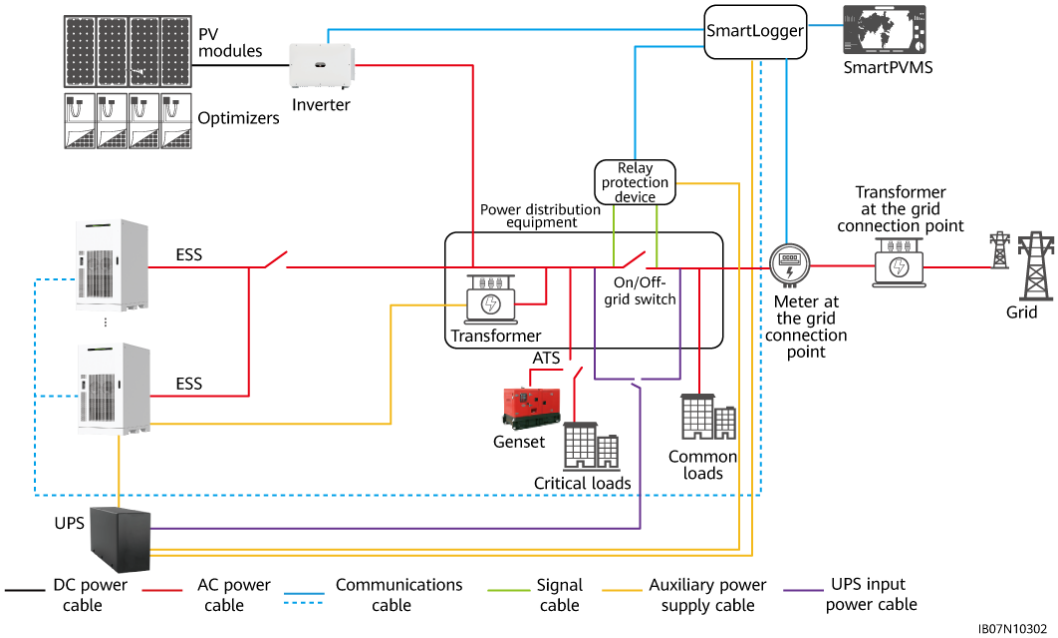
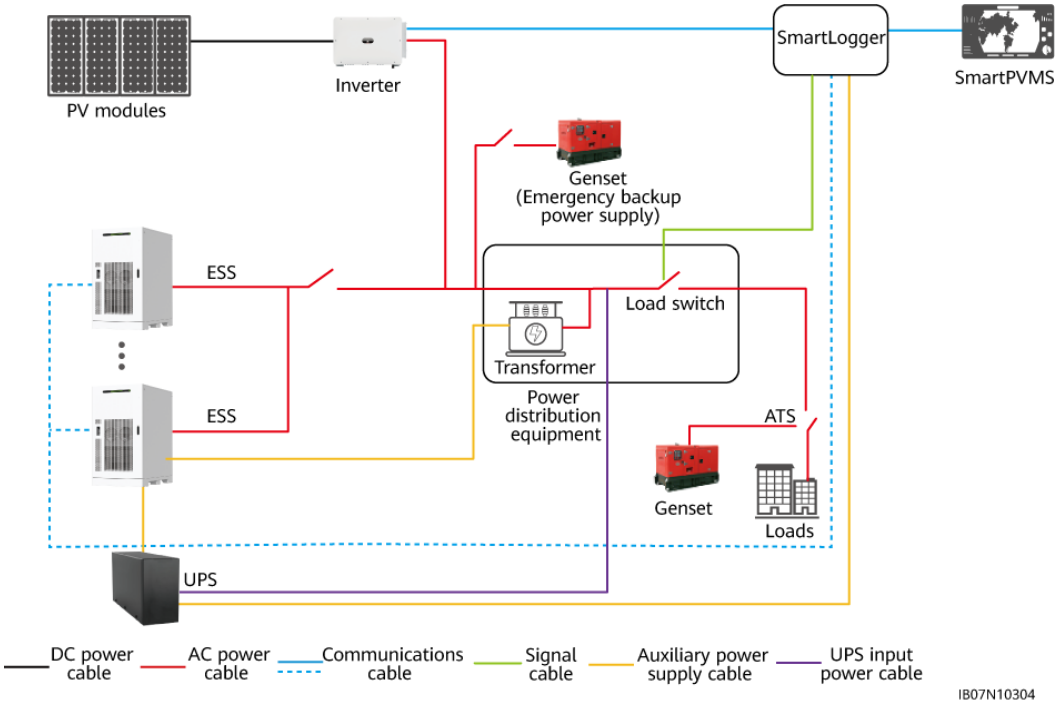


Figure 2-6 Networking architecture of the off-grid PV+ESS system



2.2.2 Introduction to Key Devices

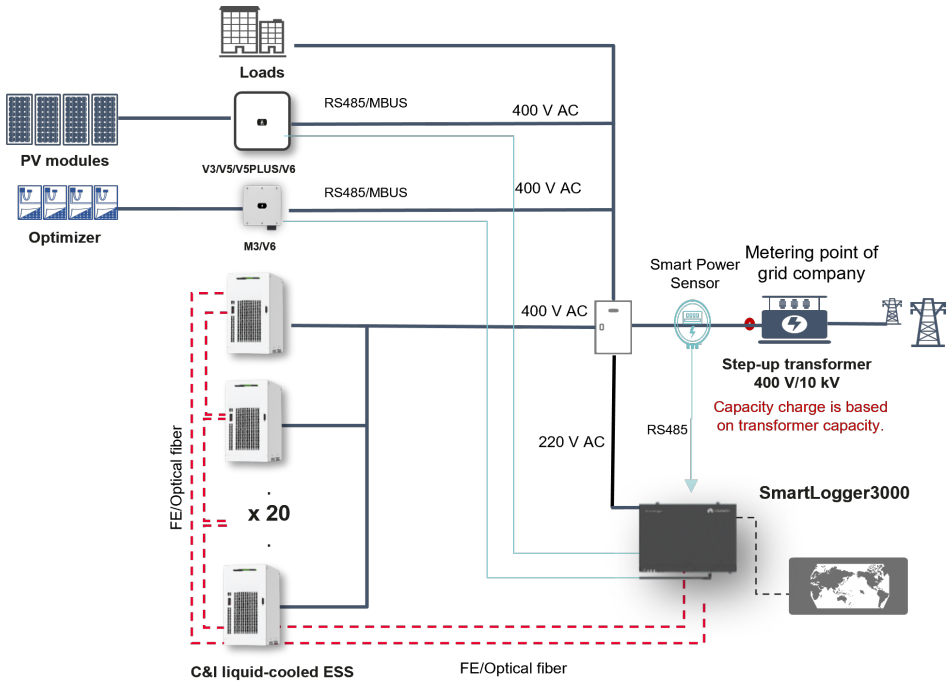
For details about the solution in which the C&I liquid-cooled ESS is used in on/off-grid scenarios, see the **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

3 ESS Power-On and Deployment Commissioning

3.1 C&I PV+ESS On-Grid Scenario

The working mode of an on-grid C&I ESS can be set to maximum self-consumption, time of use (TOU), TOU at fixed power (without meter), charge/discharge based on grid dispatch, peak shaving, or power boost limit.

Figure 3-1 C&I PV+ESS on-grid scenario

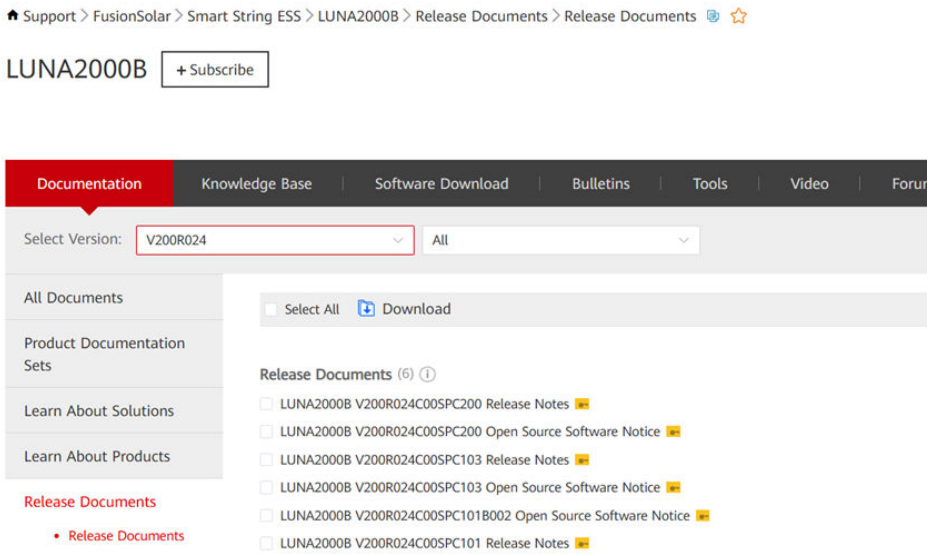


3.1.1 Software Version

Download the required software version before the deployment.

Software version obtaining path: For LUNA2000B, download the latest SPC software version corresponding to V200R024C00. Download the matching version of the SmartLogger and the inverter version.

Download link: **https://support.huawei.com/enterprise/en/fusionsolar/luna2000b-pid-255740921?category=release-documents&subcategory=release-documents**



3.1.2 Power-On and Deployment Commissioning

Power-on and deployment commissioning process

No.	Step	Description
1	Powering on the equipment	Power on the ESS in on-grid mode.
2	Logging in to the system	Log in to the SmartLogger.
3	Obtaining startup authorization	Log in to Power-Partner to obtain the startup authorization code. For details, see the service startup authorization guide.
4	Upgrading the SmartLogger software	Upgrade the SmartLogger to the latest version, as some earlier versions cannot detect the ESS.
5	Upgrading the ESS software	Upgrade the software, as there may be version mismatch between the ESS and DCDC.
6	Upgrading the inverter software	Upgrade the inverter software.
7	Performing wizard-based deployment	Set basic device parameters, search for devices, and set device parameters.
8	Setting ESS parameters	/

No.	Step	Description
10	Detecting wire sequence	Wire sequence detection is required only in the zero feed-in scenario with three-phase imbalance phase-level power control.
11	Starting the ESS and connecting it to the grid	/
12	Checking inverter parameters and starting the inverter	/
13	(Optional) Connecting to a meter	/
14	Connecting to a third-party EMS/Huawei management system	/

3.1.2.1 Powering On the ESS

Step 1 Power on the auxiliary loop and main loop of the ESS:

1. Before the ESS is powered on and runs stably, remove the blue protective film from the ESS to avoid compromising the ESS heat dissipation performance.
2. (Optional) Press the red button on the lead-acid battery box to start the lead-acid battery.
3. Remove the RCM cover.
4. Remove the protective cover from the mains AC input wiring terminal (MAINS). If a UPS is configured, remove the protective cover from the UPS AC input wiring terminal (UPS).
5. Turn on the auxiliary power supply switch of the customer's power distribution cabinet.
6. (Optional) Turn on the ESS power switch on the UPS side. This operation is required when a UPS is configured.
7. Check that the AC voltage of the mains input terminals (MAINS) is within the normal range using a multimeter.
8. (Optional) Check that the AC voltage of the UPS input terminals (UPS) is within the normal range using a multimeter.
9. Turn off the auxiliary power supply switch of the customer's power distribution cabinet.
10. (Optional) Turn off the ESS power switch on the UPS side. This operation is required when a UPS is configured.
11. Install the protective cover to the mains AC input wiring terminal (MAINS). If a UPS is configured, install the protective cover to the UPS AC input wiring terminal (UPS).
12. Turn on the auxiliary power supply switch of the customer's power distribution cabinet.

13. (Optional) Turn on the ESS power switch on the UPS side. This operation is required when a UPS is configured.
14. Turn on the RCCB on the RCM.
15. Turn on the mains AC input switch QF1 on the RCM.
16. (Optional) Turn on the UPS AC input switch QF2 on the RCM. This operation is required when a UPS is configured.
17. Turn off the auxiliary power supply switch of the customer's power distribution cabinet.
18. (Optional) Turn off the ESS power switch on the UPS side. This operation is required when a UPS is configured.
19. Install the RCM cover.
20. (Optional) Turn on the RCM disconnector. This operation is required when a disconnector is configured.
21. Turn on the general power distribution switch of the customer's power distribution cabinet.
22. Check that the AC voltage of the PCS input terminals is within the normal range using a multimeter.
23. Turn on the auxiliary power supply switch of the customer's power distribution cabinet.
24. (Optional) Turn on the ESS power switch on the UPS side. This operation is required when a UPS is configured.

Step 2 Power on the system.

1. Power on the SACU.
2. Power on the SmartLogger.
3. Turn on the SmartLogger power switch.
4. Turn on the switch of the SmartModule or network switch.

Step 3 Power on the inverter.

Select a power-on method based on the inverter model.

Method 1:

1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on.
2. Check that the indicators are not steady red.

Method 2:

1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on.
2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON.
3. Check that other indicators are not steady red.

----End

3.1.2.2 Obtaining Startup Authorization

Step 1 Set **Startup authorization code** of the ESS. Otherwise, the ESS cannot be started. This parameter needs to be set only for the LUNA2000-215-2S12.

1. Use **Startup authorization verification code** to apply for **Startup authorization code**.

   NOTE

   Contact the device vendor or its authorized supervision service provider to apply for a startup authorization code through the Power-Partner app.

   - Method 1: Choose **Monitoring** > **ESS** > **Running Info.** > **Basic Information** to view **Startup authorization verification code**.
   - Method 2: Choose **Deployment Wizard** > **Connect Device** to view **Startup authorization verification code**.

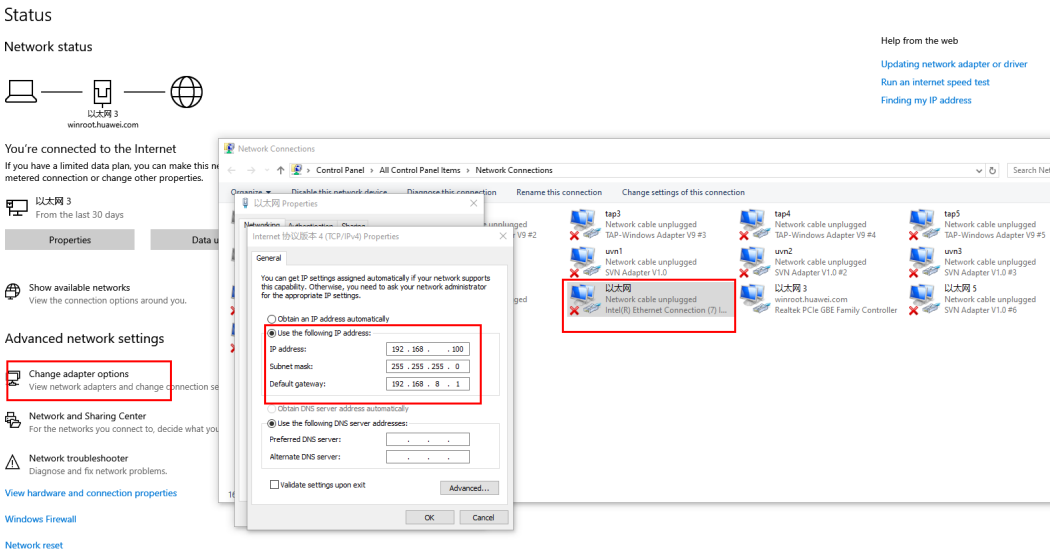
2. Set **Startup authorization code** of the ESS.
   - Method 1: Choose **Deployment Wizard** > **Connect Device**, and set **Startup authorization code**.
   - Method 2: Choose **Monitoring** > **ESS** > **Running Param** > **Basic Parameters**, and set **Startup authorization code**.

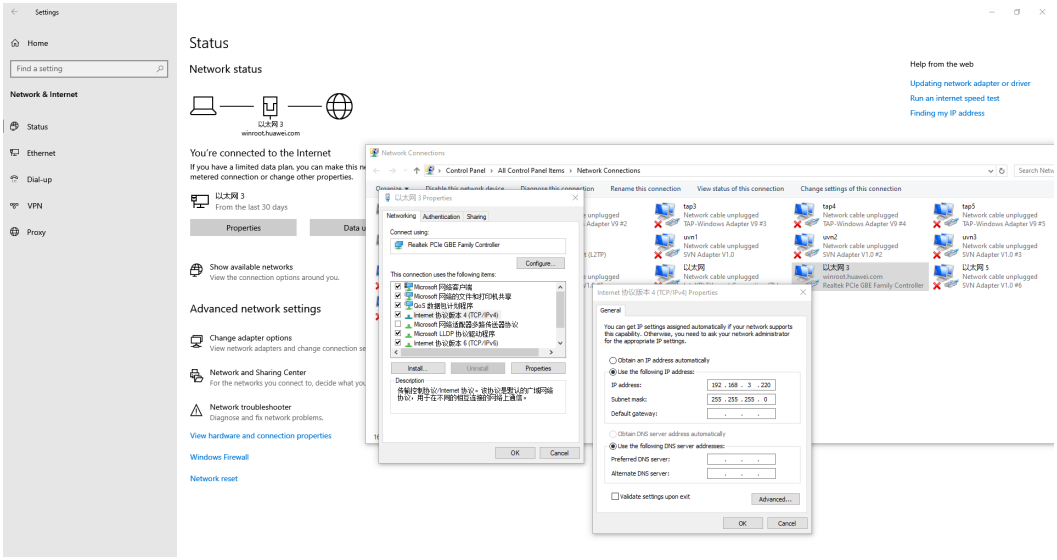
----End

3.1.2.3 Logging In to the SmartLogger and Upgrading the Software

Step 1 Set the IP address of the PC.

Recommended IP address: 192.168.0.100





Step 2 Log in to the SmartLogger.

Connect the network port on the PC to the WAN or LAN port on the SmartLogger using a network cable.

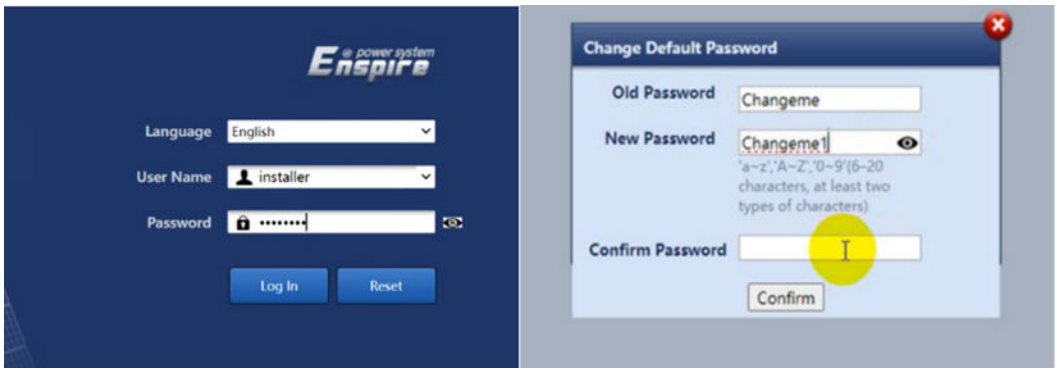
The default IP addresses are as follows.

Port	Item	Default Value on SmartLogger	PC Setting Example
SmartLogger WAN port	IP address	192.168.0.10	192.168.0.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.0.1	192.168.0.1
SmartLogger LAN port	IP address	192.168.8.10	192.168.8.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.8.1	192.168.8.1

In the address bar of a browser, enter **https://***XX.XX.XX.XX* (*XX.XX.XX.XX* is the IP address of the SmartLogger) and press **Enter**. The login page is displayed. If you are logging in to the WebUI for the first time, a security warning is displayed. Click **Continue to this website** to log in to the WebUI.

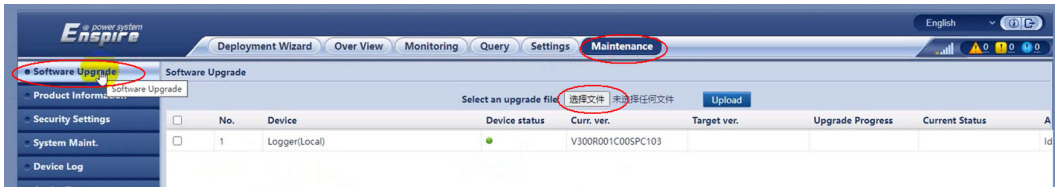
For the first login, the user name is **admin**, and the initial login password is **Changeme**.

Use the initial password upon the first power-on. After login, change the initial password and log in again. The login password contains at least eight characters.



Step 3 Upgrade the software.

Choose **Maintenance** > **Software Upgrade**.



Note: The SmartLogger software and BSP file shall be upgraded together.

If an error message is displayed during file upload, decompress the SmartLogger software package, upload the SmartLogger3000-BSP and upgrade the BSP file. Then upload the SmartLogger3000 software package and upgrade the SmartLogger software.

----End

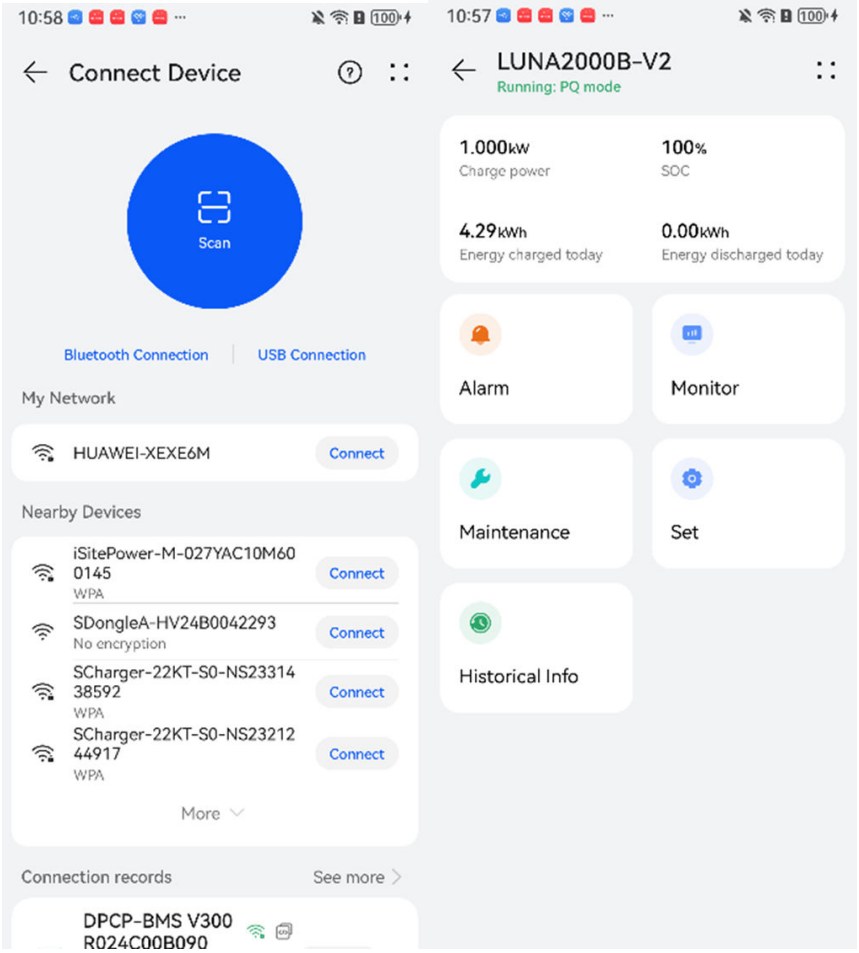
Note: If the SACU-D-D08 is used, ensure that the SmartLogger is upgraded to the latest C&I version SmartLogger V300R024C00SPC*XXX* before deployment.

3.1.2.4 Upgrading the ESS Software

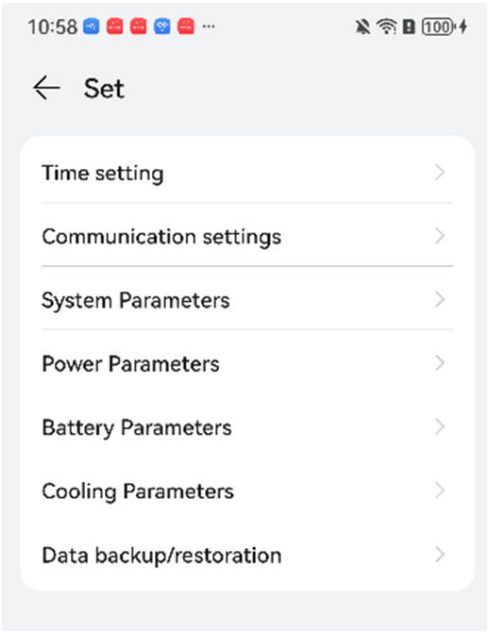
Before the upgrade, ensure that the reserved SOC is greater than 15%. If the SOC is lower than 15%, charge the ESS first.

If the ESS cannot be charged onsite and the SOC is lower than 15%, perform the following operations before upgrading the software. Otherwise, the upgrade will fail.

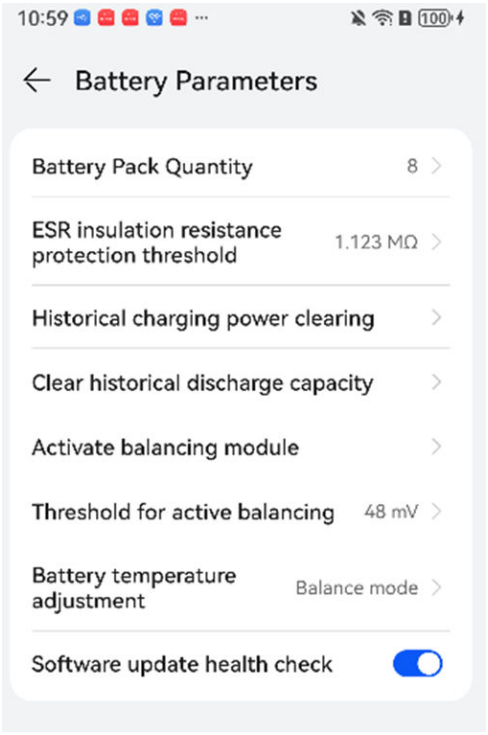
Step 1 Log in to the FusionSolar app, scan the QR code, and connect to the equipment.



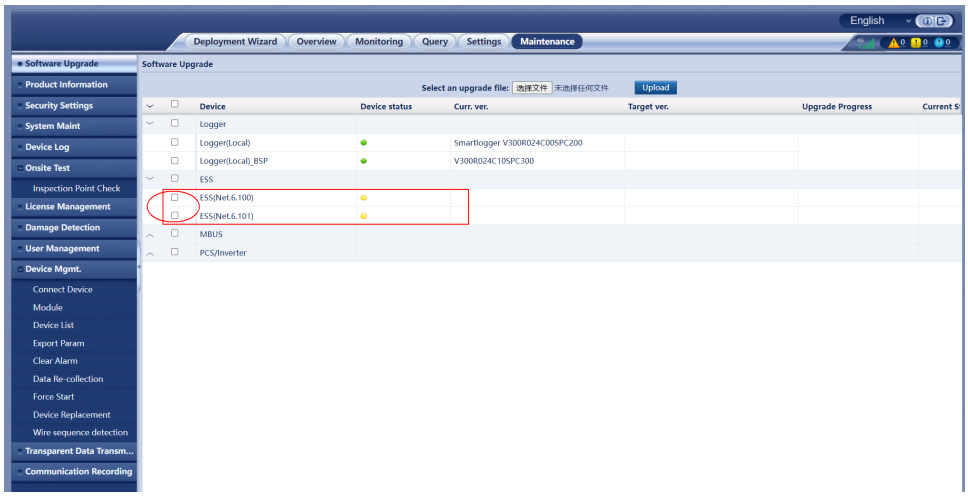
Step 2 Choose **Set** > **Battery Parameters**.



Step 3 Disable **Software update health check** on the **Battery Parameters** screen.



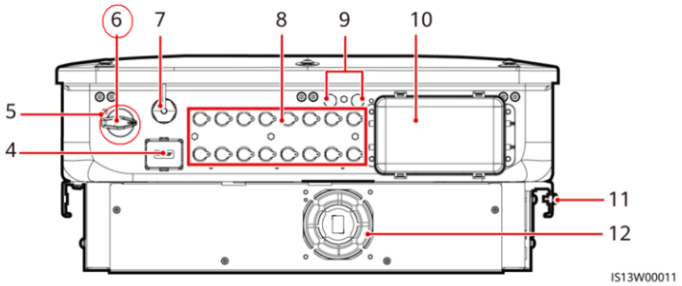
Step 4 Choose **Maintenance** > **Software Upgrade** to upgrade the ESS software.

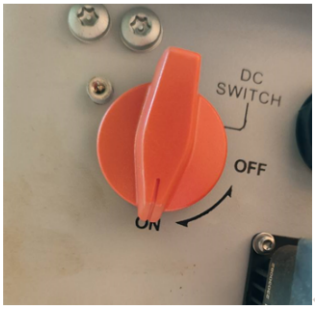


----End

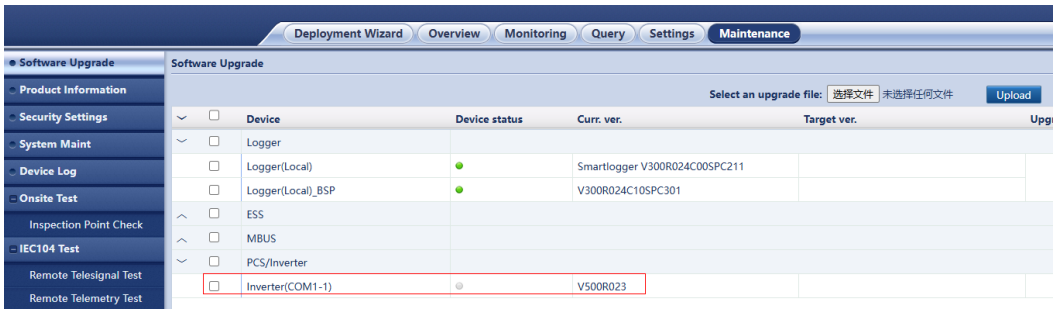
3.1.2.5 Upgrading the Inverter Software

Step 1 Start the inverter and turn on the DC switch of the inverter.

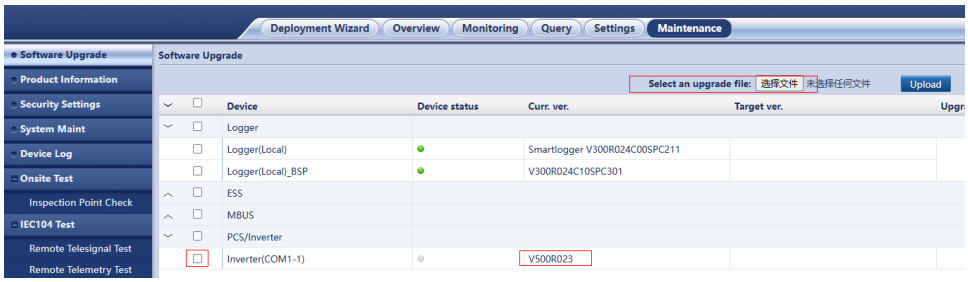




Step 2 Check the inverter connection status on the SmartLogger.



Step 3 Upgrade the inverter software.



----End

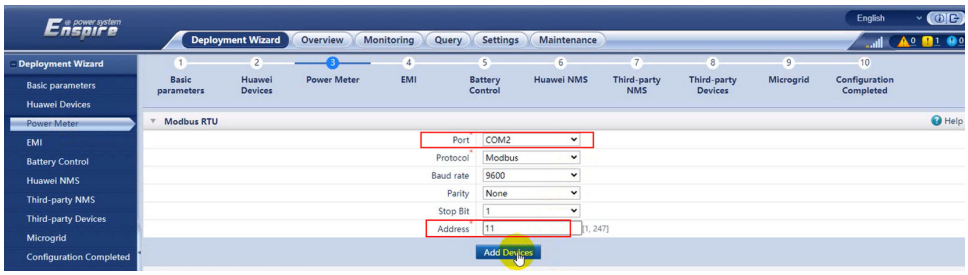
3.1.2.6 Performing Wizard-based Deployment

For details about wizard-based deployment, see **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

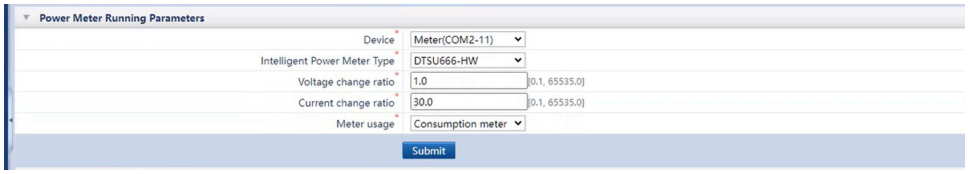
3.1.2.7 (Optional) Connecting to a Meter

Step 1 Power on the meter, turn on the voltage switch on the AC side of the meter, and check the voltage, current, and power readings on the meter. The power is positive when power is supplied from the grid.

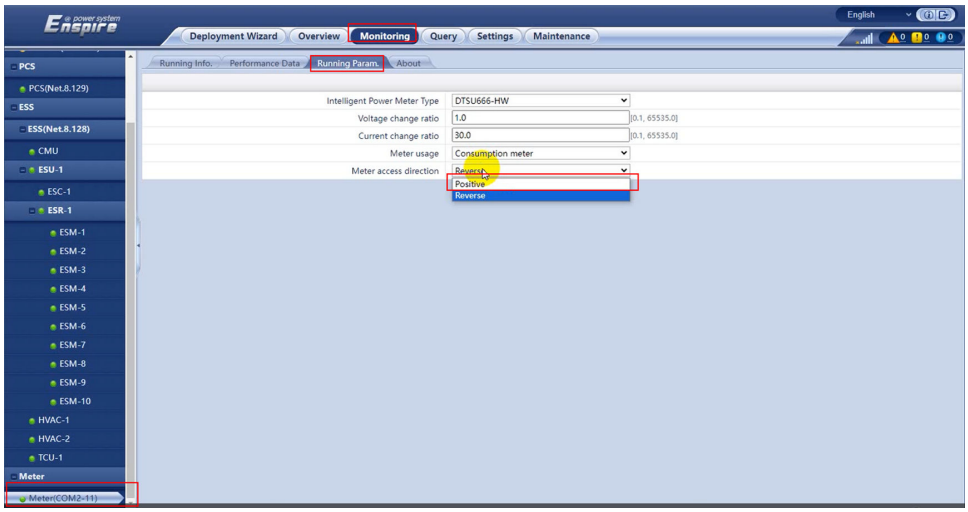
Step 2 Choose **Deployment Wizard** > **Power Meter** to set communication parameters for the meter. Set **Port** to **COM2** and set **Address** to **11**. Click **Add Devices** to connect to the meter.



Step 3 Set **Intelligent Power Meter Type** to **DTSU666-HW** or YADA-YDS60-80(for example), **Voltage change ratio** to **1**, and **Current change ratio** based on the onsite CT ratio. If there is one ESS, the CT ratio is 150/5. In this case, set **Current change ratio** to **30**. Set **Meter usage** to **Consumption meter**.



Step 4 After the meter is connected, choose **Monitoring** > **Meter** > **Running Param.** to set the meter running parameters. Set **Meter access direction** to **Positive**.

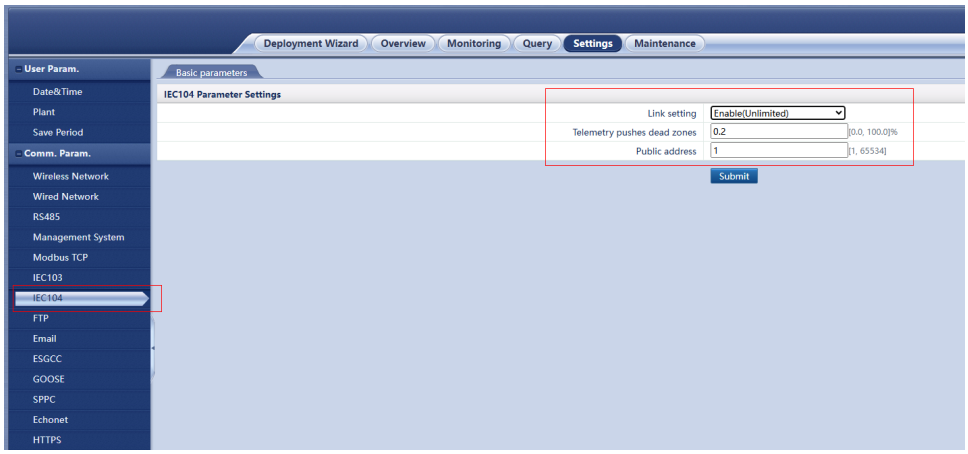


----End

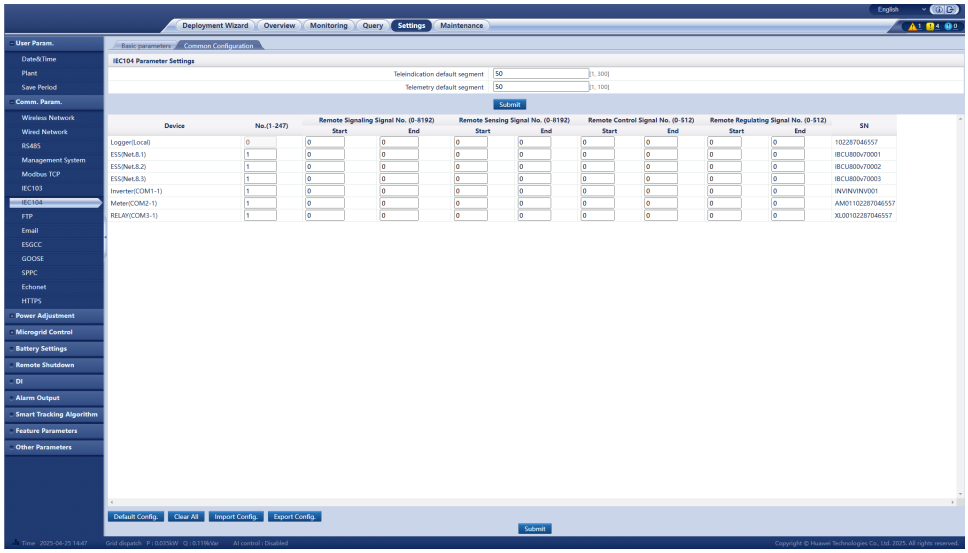
3.1.2.8 Connecting to a Third-Party EMS (IEC 104)

Currently, third-party EMSs can be connected only in on-grid scenarios.

Step 1 Set IEC 104 parameters.

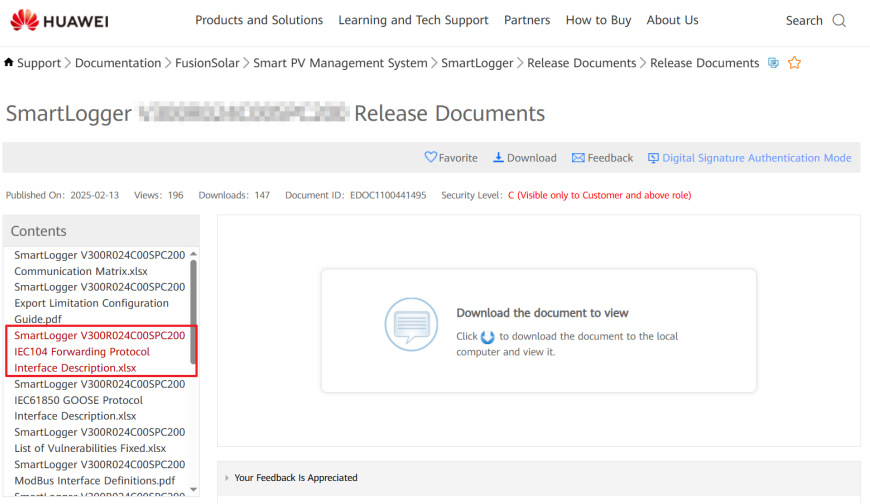


Step 2 Set **Common Configuration**.



Step 3 After the configuration is complete, send the overall signal point list to the EMS vendor for communication signal interconnection.

Example link for obtaining the IEC 104 protocol forwarding table on Support-E:

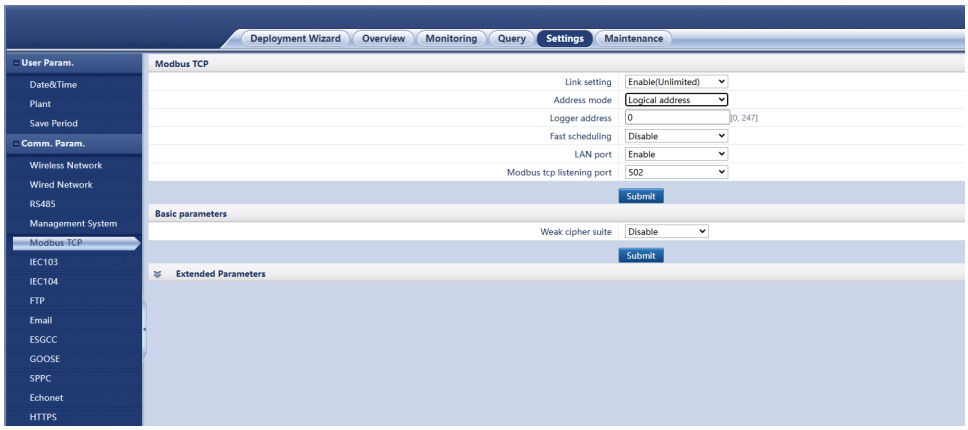


----End

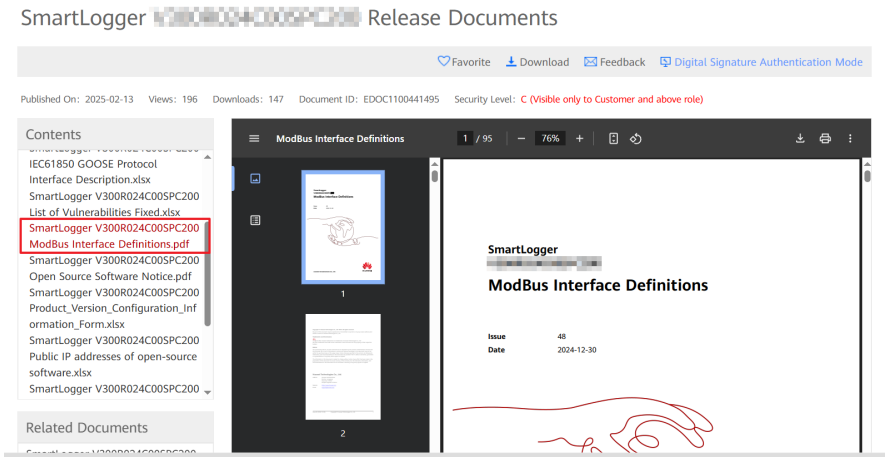
3.1.2.9 Connecting to a Third-Party EMS (Modbus)

Currently, third-party EMSs can be connected only in on-grid scenarios.

Step 1 Set Modbus TCP.



Step 2 Download the Modbus point list from the Support-E website and send it to a third-party EMS for communication signal interconnection (**example link**).



----End

3.1.3 Parameter Setting Reference

3.1.3.1 SOC Reference Value

Huawei device SOC parameter settings

No.	Parameter	Reference	Remarks
1	SOC upper threshold	100%	The battery pack stops charging when the SOC reaches this value.
2	SOC lower threshold	5%	The battery pack stops discharging when the SOC reaches this value.

3.1.3.2 EMS Control Reference

No.	Parameter	Reference	Remarks
1	SOC upper threshold	100%	When the EMS receives the signal that the array SOC reaches 100%, the SOC of some battery packs may not reach 100% due to rounding. Therefore, the EMS shall maintain the charge command until the ESS is fully charged.
2	SOC lower threshold	5%	When the EMS receives the signal that the array SOC reaches 5%, the SOC of some battery packs may not reach 5% due to rounding. Therefore, the EMS shall maintain the discharge command until the ESS is fully discharged.

3.1.4 Basic Function Tests

3.1.4.1 Charge/Discharge Based on Grid Dispatch

The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS.

The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the ESS charge power is insufficient or the Smart PCS limits the power, the grid charges the ESS with the maximum capability. If the ESS is not fully charged when the dispatch target value is met, the PV energy is used to charge the ESS.

In addition, the EMS can control the PV power and ESS power separately.

3.1.4.1.1 Working Mode Description

Scenario

This mode applies to scenarios where a third-party controller controls the SmartLogger and delivers active power dispatch commands.

Function description

The purpose of discharge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. PV energy is preferred. If the generated PV energy is insufficient, the ESS discharges energy and the energy is fed to the grid based on the active power dispatch target value. If the generated

PV energy is sufficient, the energy is fed to the grid based on the active power dispatch target value, and the surplus PV energy is used to charge the ESS.

The purpose of charge based on grid dispatch is to meet the active power dispatch target value at the grid connection point. If the ESS charge power is insufficient or the Smart PCS limits the power, the grid charges the ESS with the maximum capability. If the ESS is not fully charged when the dispatch target value is met, the PV energy is used to charge the ESS.

In the scenario where a third-party EMS is used for dispatch, you need to set **Active power control mode** to **Remote communication scheduling** and set **Shutdown upon communication exceptions** (this parameter is disabled by default). If the communication is abnormal or disconnected, the SmartLogger executes the latest dispatch command delivered by the third-party EMS.

Working mode

The SmartLogger allocates charge and discharge power according to the power commands from northbound controllers, such as a third-party EMS/PPC and AGC/AVC devices, based on the balancing principle, if the power requirements at the grid connection point are met.

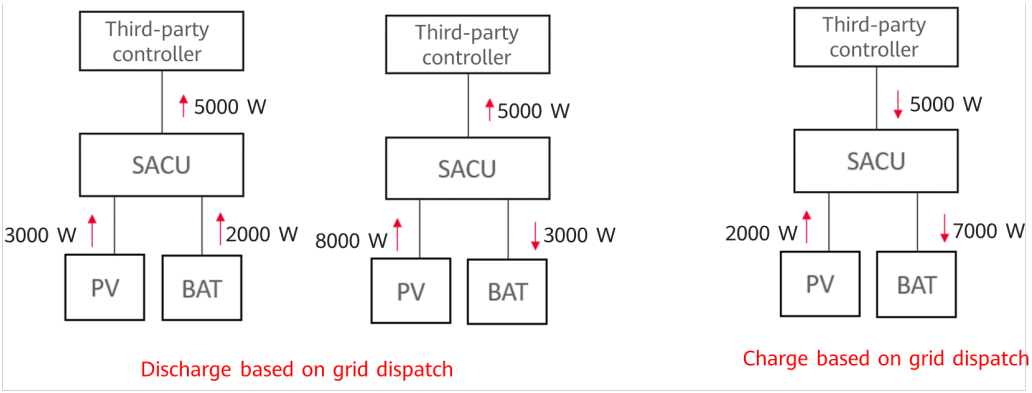
Discharge based on grid dispatch: To meet power requirements at the grid connection point, the PV energy is preferentially used. If PV energy is insufficient, the ESS discharges energy to loads. If PV energy is sufficient, the surplus PV energy is used to charge the ESS.

Charge based on grid dispatch: To meet power requirements at the grid connection point, the grid charges the ESS first. If the ESS is not fully charged and PV energy is sufficient, the surplus PV energy is used to charge the ESS.

The following uses array control as an example:

Discharge based on grid dispatch: To meet power requirements at the grid connection point, the PV energy is preferentially used. If PV energy is insufficient, the ESS discharges energy to loads. If PV energy is sufficient, the surplus PV energy is used to charge the ESS.

Charge based on grid dispatch: To meet power requirements at the grid connection point, the grid charges the ESS first. If the ESS is not fully charged and PV energy is sufficient, the surplus PV energy is used to charge the ESS.



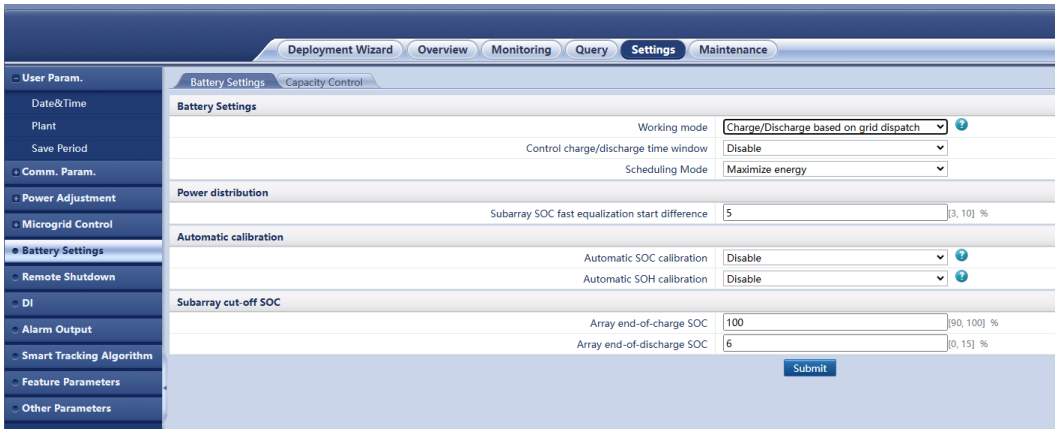
Discharge based on grid dispatch

Charge based on grid dispatch

3.1.4.1.2 Parameter Definition

Parameter settings

Step 1 Choose **Settings** > **Battery Settings**, and set **Working mode** to **Charge/Discharge based on grid dispatch**.



Working Mode	Parameter	Description
Charge/Discharge based on grid dispatch	Adaptive adjustment parameters	Set the adjustment period and step parameters for raising the inverter power. **Enable**: The adjustment period and step set in the SmartLogger are used. Generally, the adjustment period and step are calculated based on the number of devices connected to the port and device specifications. **Disable**: Use this value based on site requirements.
	Adjustment period	If **Adaptive adjustment parameters** is disabled, the customer can set the period for increasing the inverter power based on the site requirements.
	PV power adjustment step	If **Adaptive adjustment parameters** is disabled, the customer can set the step for increasing the inverter power based on the site requirements.
	Control charge/discharge time window	/
	Difference threshold for starting array SOC rapid equilibrium	/

Step 2 Choose **Settings** > **Active Power Control**, and set the mode to **Remote communication scheduling**. You can set **Shutdown upon communication**

exceptions or **Limit solar inverter power upon active power scheduling timeout** as required. The function is disabled by default. If the communication is abnormal or disconnected, the SmartLogger executes the latest dispatch command delivered by the third-party EMS.

----End

3.1.4.1.3 ESS and EMS Interconnection Test

After telemetry, teleindication, telecontrol, and teleadjust signals are tested, it can be determined that the EMS signals are consistent with those specified in the point list provided by Huawei.

Step 1 Test the ESS telemetry signal.

No.	Signal Name	Unit	Remarks
1	Array steady-state SOC	%	The SOC values displayed on the SmartLogger and the EMS are the same.

Step 2 Test the ESS teleindication signal.

No.	Signal Name	Unit	Remarks
1	ESS PCSs operation in array	0: Not in operation; 1: In operation	If all PCSs are powered off, the uploaded signal is **0**. If at least one PCS is powered on, the uploaded signal is **1**.

Step 3 Test the ESS telecontrol signals.

No.	Signal Name	Command	Remarks
1	ESSs shutdown in array	0: Shutdown; 1: Invalid	Shuts down all ESS devices in the array if the value is 0.
2	ESSs startup in array	0: Startup; 1: Invalid	Starts up all ESS devices in the array if the value is 0.
3	ESS PCS shutdown in array	0: Shutdown; 1: Invalid	Shuts down all PCSs in the array if the value is 0.

No.	Signal Name	Command	Remarks
4	ESS PCS startup in array	0: Startup; 1: Invalid	Starts up all PCSs in the array if the value is 0.

Step 4 Test the ESS teleadjust signal.

No.	Signal Name	Command	Remarks
1	Active ESS PCS power adjustment of array in fixed value	+20 kW/–20 kW	A positive value indicates discharging, and a negative value indicates charging. In the on-grid mode, the PCS operating power is consistent with that specified by the EMS command and is not affected by the frequency.

----End

3.1.4.1.4 Test Procedure

Step 1 Set **Active power control mode** to **Export Limitation(kW)** and **Working mode** of the ESS to **Charge/Discharge based on grid dispatch**.

Step 2 Start the ESS.

Step 3 Deliver a charge command from the EMS. Check the PCS power and array power. The array power shall be the same as the power specified by the command delivered by the EMS.

Step 4 Deliver a discharge command from the EMS. Check the PCS power and array power. The array power shall be the same as the power specified by the command delivered by the EMS.

NOTE

Check the command delivered by the EMS in the lower right corner of the WebUI.

----End

3.1.4.2 Maximum Self-consumption Mode (with Meter at Grid Connection Point)

PV energy is preferentially supplied to loads, and then the surplus PV energy is charged to the ESS. If the ESS is fully charged or is being charged at full power, the surplus PV energy is fed to the power grid. When PV energy is insufficient or no PV energy can be generated at night, the ESS discharges energy to loads. This improves the self-consumption rate and energy self-sufficiency rate, and reduces electricity costs. The ESS cannot discharge to or be charged from the grid.

CAUTION

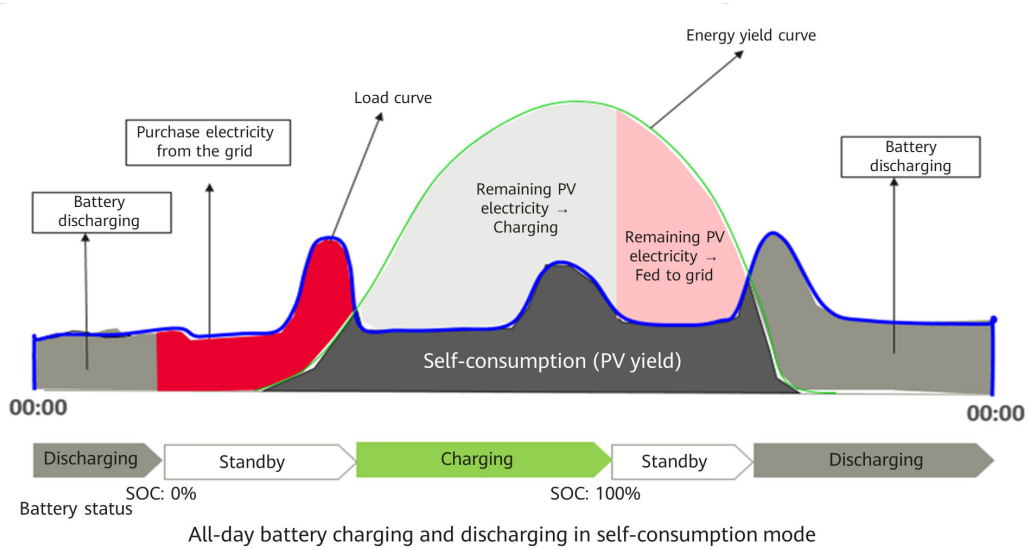
Before testing this mode, check whether the direction and transformation ratio of the meter at the grid connection point are correct. For details, see **7.2.3.1 Meter at the Grid Connection Point**.

3.1.4.2.1 Working Mode Description

PV power is preferentially used by loads, and surplus power is used to charge the ESS. If the ESS is fully charged or is being charged at full power, there is still surplus power, and feed-in conditions are met, surplus PV power is fed to the grid. The ESS cannot be charged from the grid and cannot discharge to the grid.

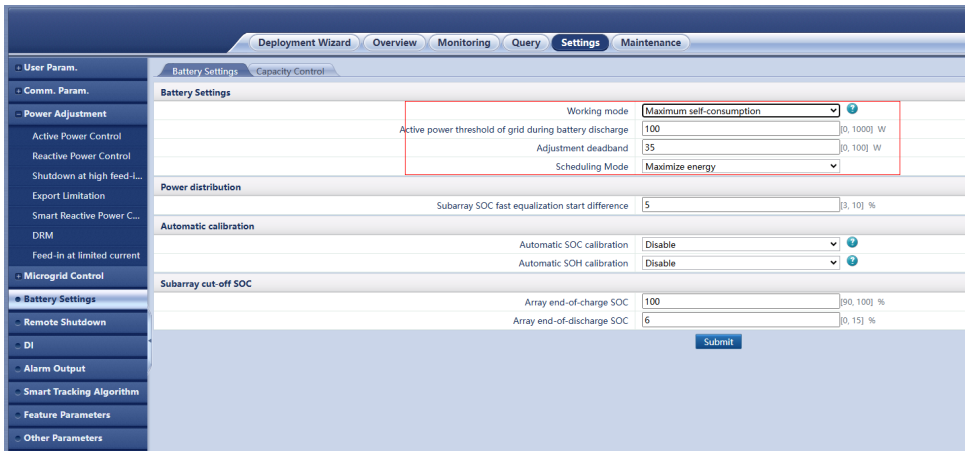
PV energy supply priority: load > ESS > power grid

Load power consumption priority: PV > ESS > power grid



All-day battery charging and discharging in self-consumption mode

3.1.4.2.2 Parameter Definition



Working Mode	Parameter	Description
Maximum self-consumption	Active power threshold of grid during battery discharge	Set the maximum target grid power when the grid connection point has zero power. A larger value indicates a lower probability that the ESS discharges to the power grid.
	Adjustment deadband	Set the allowed fluctuation of the target grid power for the grid connection point.
	Adaptive adjustment parameters	Set the adjustment period and step parameters for raising the inverter power. **Enable**: The adjustment period and step set in the SmartLogger are used. Generally, the adjustment period and step are calculated based on the number of devices connected to the port and device specifications. **Disable**: Use this value based on site requirements.

3.1.4.2.3 Test Procedure

Step 1 Set **Active power control mode** to **Export Limitation(kW)** and **Working mode** of the ESS to **Maximum self-consumption**.

Step 2 Shut down the ESS and inverter, and check the data on the meter at the grid connection point. The load obtains power from the grid. The power reading on the meter shall be a positive value and shall be equal to the load power.

Step 3 Start the ESS.

Step 4 Start the inverter.

Step 5 Check the power of the ESS and inverter.

Step 6 Check the reading on the meter.

Power	Power Reading on the Meter
$P_{PV} > P_{load} + P_{max\ ESS\ charge\ capability}$	Energy is supplied to the grid, and the power is negative.
$P_{load} + P_{max\ ESS\ charge\ capability} > P_{PV} > P_{load}$	The power is 0.
$P_{PV} + P_{max\ ESS\ discharge\ capability} > P_{load} > P_{PV}$	The power is 0.
$P_{PV} + P_{ESS\ discharge\ capability} < P_{load}$	Energy is obtained from the grid, and the power is positive.

----End

3.1.4.3 TOU Mode (with Meter at Grid Connection Point)

You can manually set the charge and discharge time segments. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the maximum power during the charge period. If you set the high electricity price period as the discharge period, the ESS can discharge only during the discharge period based on the actual load power, reducing electricity costs.

The charge/discharge period can be set. A maximum of 14 time segments can be set. During the charge period, the grid and PV modules charge the ESS. During the discharge period, the ESS supplies power to loads but not to the grid, and the surplus PV power can be charged to the ESS. During other periods without settings, the ESS does not discharge, and PV modules and the grid supply power to loads, and the surplus PV power can be charged to the ESS.

CAUTION

Before testing this mode, check whether the direction and transformation ratio of the meter at the grid connection point are correct. For details, see **7.2.3.1 Meter at the Grid Connection Point**.

3.1.4.3.1 Working Mode Description — TOU (Charge)

(1) Discharge period (**Charge**): PV power is preferentially used by loads, and surplus power is used to charge the ESS. If the ESS is fully charged or is being charged at full power, there is still surplus power, and feed-in conditions are met, surplus PV power is fed to the grid.

PV power priority: Load (P_{load}) > ESS (P_{bat}) > Grid (P_{grid})

Load power consumption priority: PV (P_{PV}) > ESS (P_{bat}) > Grid (P_{grid})

(2) Non-charge/discharge period (**Charge**): The ESS cannot discharge to or be charged from the grid.

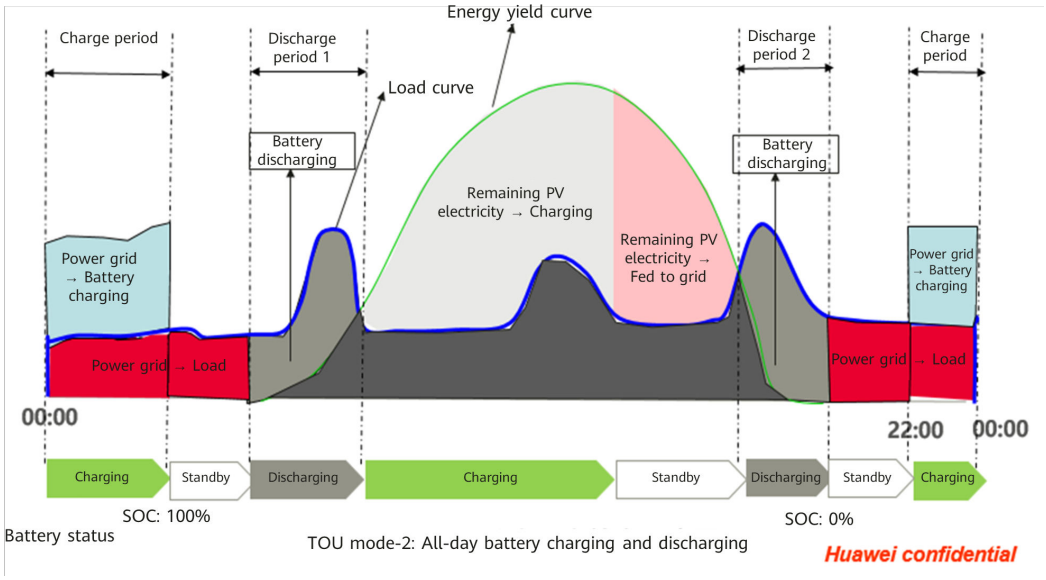
PV power priority: Load (P_{load}) > ESS (P_{bat}) > Grid (P_{grid})

Load power consumption priority: PV (P_{PV}) > Grid (P_{grid})

(3) Charge period: The ESS is charged but does not discharge energy, and the loads are not tracked.

PV power priority: ESS (P_{bat}) > Load (P_{load}) > Grid (P_{grid})

ESS charge priority: PV (P_{PV}) > Grid (P_{grid})



3.1.4.3.2 Working Mode Description — TOU (Fed to Grid)

(1) Discharge period (**Fed to grid**): PV energy is preferentially supplied to loads and fed to the grid. When the feed-in power limit is reached, surplus PV power is used to charge the ESS.

PV power priority: Load (P_{load}) > Grid (P_{grid}) > ESS (P_{bat})

Load power consumption priority: PV (P_{PV}) > ESS (P_{bat}) > Grid (P_{grid})

(2) Non-charge/discharge period (**Fed to grid**): The ESS cannot discharge to or be charged from the grid.

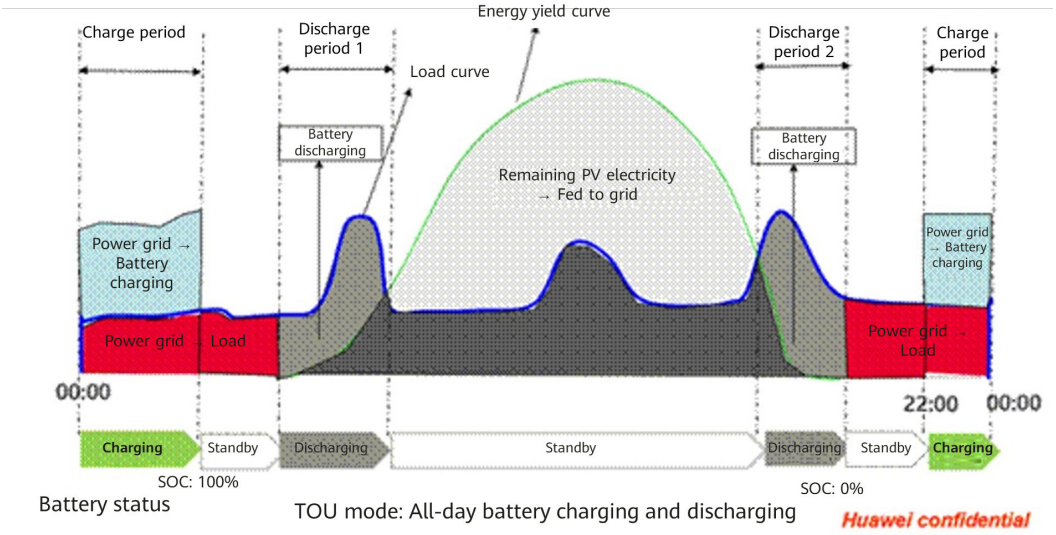
PV power priority: Load (P_{load}) > Grid (P_{grid}) > ESS (P_{bat})

Load power consumption priority: PV (P_{PV}) > Grid (P_{grid})

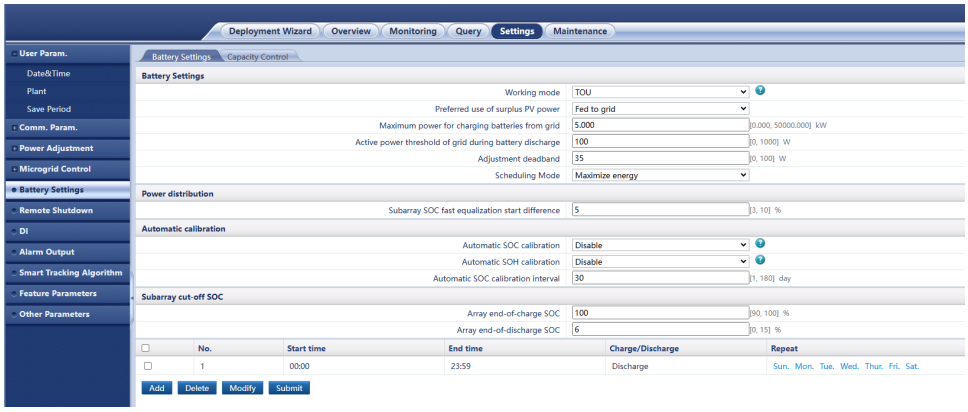
(3) Charge period: The ESS is charged but does not discharge energy, and the loads are not tracked.

PV power priority: ESS (P_{bat}) > Load (P_{load}) > Grid (P_{grid})

ESS charge priority: PV (P_{PV}) > Grid (P_{grid})



3.1.4.3.3 Parameter Definition



Parameter	Description
Preferred use of surplus PV power	**Charge**: When the PV power is greater than the load power, the surplus PV energy is used to charge the batteries. After the maximum charge power is reached or the batteries are fully charged, the surplus PV energy is fed to the grid. **Fed to grid**: When the PV power is greater than the load power, the surplus PV energy is preferentially fed to the grid. When the maximum output power of the device is reached, the surplus energy is used to charge the batteries. This setting is applicable to the scenario where the FIT is higher than the electricity purchase price and the grid cannot charge the ESS.
Maximum power for charging batteries from grid	Set the maximum power at which the grid charges the batteries.

Parameter	Description
Active power threshold of grid during battery discharge	Set the maximum target grid power when the grid connection point has zero power. A larger value indicates a lower probability that the ESS discharges to the power grid.
Adjustment deadband	Set the allowed fluctuation of the target grid power for the grid connection point.
Adaptive adjustment parameters	Set the adjustment period and step parameters for raising the inverter power. **Enable**: The adjustment period and step set in the SmartLogger are used. Generally, the adjustment period and step are calculated based on the number of devices connected to the port and device specifications. **Disable**: Use this value based on site requirements.
Start Time	Set the start time and end time of charge and discharge. A maximum of 14 time segments can be set. You can set a weekly cycle by clicking the buttons corresponding to **Mon.** through **Sun.** in the **Repeat** box. The buttons are blue by default, indicating being selected. After you click it, the button turns gray.
End Time	
Charge/ Discharge	
Repeat	

3.1.4.3.4 Test Procedure

Step 1 Set **Active power control mode** to **Export Limitation(kW)** and **Working mode** of the ESS to **TOU**.

Step 2 Shut down the ESS and inverter, and check the data on the meter at the grid connection point. The load obtains power from the grid. The power reading on the meter shall be a positive value and shall be equal to the load power.

Step 3 Start the ESS.

Step 4 Set the current time to the charge period. The ESS starts to be charged, and the power reading on the meter increases. The increased reading is equal to the ESS power.

Step 5 Set the current time to the discharge period. The ESS starts to discharge, and the power reading on the meter decreases. The decreased reading is equal to the ESS power.

Step 6 Set the charge period and discharge period based on the customer scenario.

Step 7 Start the inverter and check whether the mapping between the inverter power, ESS power, and meter power is correct.

----End

3.1.4.4 TOU at Fixed Power (Without Meter at Grid Connection Point)

Scenario

- This mode applies to ESS-only systems in scenarios where the electricity prices are significantly different between peak and off-peak hours and no power meters are used. During off-peak hours, the grid supplies power to charge the ESS. During peak hours, the ESS discharges to supply power to loads.
- In this mode, at least one charge or discharge time segment for the ESS needs to be set. For example, if you set the low electricity price period at night as the charge period, the system charges the ESS at the fixed power during this period. If you set the high electricity price period as the discharge period, the ESS can discharge energy only during the discharge period at the fixed power, reducing electricity costs.

CAUTION

TOU at fixed power applies only to the ESS-only system. If TOU at fixed power is set in the PV+ESS scenario, the output power of the PV inverter is 0.

In some countries, the ESS is not allowed to discharge to the power grid. In this case, this mode cannot be used.

3.1.4.4.1 Working Mode Description — TOU at Fixed Power

Function description

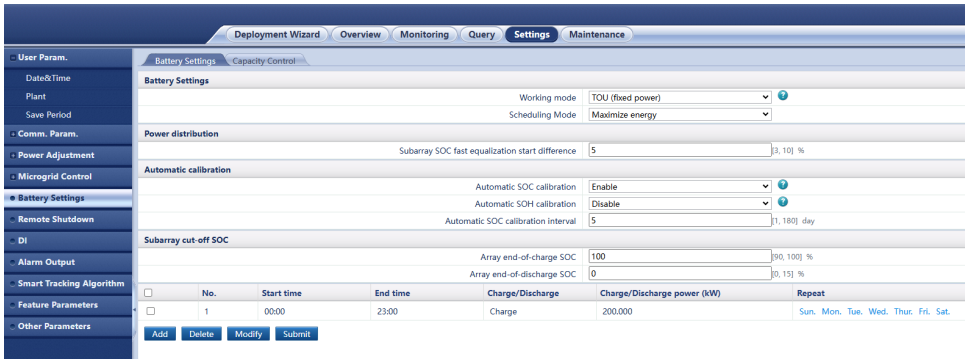
You can manually set the charge and discharge time segments and the fixed charge and discharge power in the corresponding time segments.

The SmartLogger instructs the ESS to charge or discharge at a fixed power in the corresponding time segments. This mode can work when no meter is available.

Scenario constraints

In this scenario, there is no meter control. The ESS is charged and discharges based on the preset fixed power. Ensure that the transformer has a sufficient remaining capacity to charge the ESS. Otherwise, the transformer may be overloaded. The load power is high enough to discharge the ESS. Otherwise, when the load power is less than the ESS discharge power, the ESS feeds power to the power grid.

3.1.4.4.2 Parameter Definition



Parameter	Description
Working mode	Set this parameter to **TOU (fixed power)**.
Difference threshold for starting array SOC rapid equilibrium	When the SOC difference between racks in the array is greater than the value of **Difference threshold for starting array SOC rapid equilibrium**, the rapid equilibrium algorithm is enabled. The default value is 5%.
Start time	Set the start time and end time of charge and discharge. A maximum of 14 time segments can be set. You can set a weekly cycle by clicking the buttons corresponding to **Mon.** through **Sun.** in the **Repeat** box. The buttons are blue by default, indicating being selected. After you click it, the button turns gray. • Discharge time window: The ESS is discharged at the fixed power. • Charge time window: The ESS is charged at the fixed power. • Non-charge/discharge time window: The ESS cannot be charged or discharge power.
End time	
Charge/Discharge	
Repeat	

3.1.4.4.3 Test Procedure

Step 1 Set the ESS working mode to **TOU (fixed power)**.

Step 2 Start the ESS.

Step 3 Set the current time to the charge period. The ESS starts to be charged. The ESS power displayed on the SmartLogger is the same as the configured charge power.

Step 4 Set the current time to the discharge period. The ESS starts to be discharged. The ESS power displayed on the SmartLogger is the same as the configured discharge power.

Step 5 Set the charge period and discharge period based on the customer scenario.

----End

3.1.4.5 Capacity Control Mode (with Meter at Grid Connection Point)

This mode applies to the PV+ESS and ESS-only systems where demand charge is involved and power meters are available.

Peak shaving limits the maximum peak power at the grid connection point. In some areas, electricity fees consist of both volumetric charge and demand charge. The **Peak shaving** function allows you to lower the peak demand purchased from the grid during peak hours, reducing electricity fees. **Peak shaving** applies to areas where demand charges are collected. The peak shaving function allows you to lower the peak power purchased from the grid in **Maximum self-consumption** or **TOU** mode during peak hours, reducing electricity fees.

Power boost limit is designed to limit the maximum peak current at the grid connection point. By doing so, it ensures that the electric current purchased from

or sold to the grid does not exceed the maximum peak current at the grid connection point, which may trigger the system's overcurrent protection mechanism, potentially causing the transformer to trip.

CAUTION

Before testing this mode, check whether the direction and transformation ratio of the meter at the grid connection point are correct. For details, see **7.2.3.1 Meter at the Grid Connection Point**.

The **Power boost limit** function is unavailable during the SmartLogger and ESS upgrade. After the upgrade is complete, this function will be automatically restored.

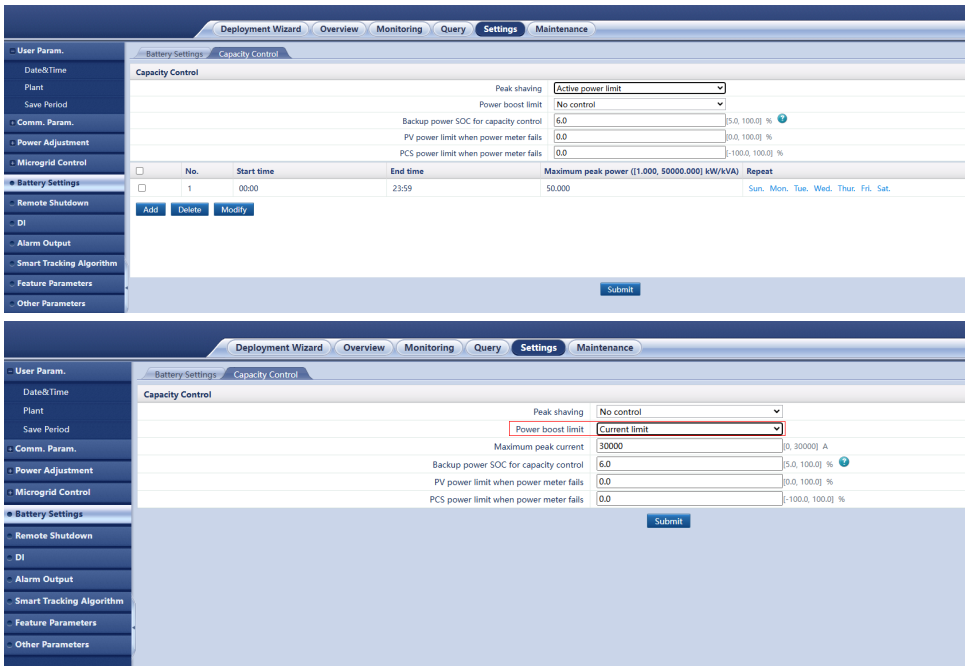
3.1.4.5.1 Working Mode Description

In SmartLogger V300R023C10SPC550 and later versions, **Capacity Control** is displayed and can be set only in energy storage scenarios. Choose **Settings** > **Battery Settings** > **Capacity Control** and set related parameters.

You can manually set the peak shaving time segments (a maximum of 14 peak shaving time segments can be set) and the maximum peak shaving power. The ESS is charged or discharges energy at the maximum peak shaving power during this period. The ESS is charged or discharges energy based on the actual load power to implement peak shaving and minimize the demand charge.

The maximum peak current can be set for power boost limit. Current at the grid connection point can be controlled by controlling the battery charge and discharge to prevent the transformer from tripping within a limited period of time.

3.1.4.5.2 Parameter Definition



Parameter	Description
Peak shaving	**No control**: The peak shaving function is disabled. **Active power limit**: The active power purchased from the grid cannot exceed the preset capacity limit. **Apparent power limit**: The apparent power purchased from the grid cannot exceed the preset capacity limit.
Power boost limit	**No control**: The power boost limit function is disabled. **Current limit**: The current of electricity purchased from or sold to the grid cannot exceed the preset current limit.
Maximum Peak Current	This parameter is displayed when **Power boost limit** is set to **Current limit**. Set the maximum peak current at the grid connection point. The default value is 30000 A. Set this parameter based on the maximum peak current for power purchase or sales at the grid connection point.
Backup power SOC for capacity control	Specifies the backup power SOC for capacity control. The value of this parameter affects the peak shaving capability. A larger value indicates stronger peak shaving capability.
PV power limit when power meter fails	Specifies the active power limit of the inverter when the export+import meter communication is abnormal. You can manually change the active power percentage of the inverter as required.
PCS power limit when power meter fails	Specifies the active power limit of the PCS when the export+import meter communication is abnormal. You can manually change the active power percentage of the PCS as required.
Start time	Set the peak power range based on the start time and end time. The peak power is configured based on electricity prices in different time segments. You are advised to set the peak power to a low value when the electricity price is high. A maximum of 14 time segments can be set.

3.1.4.5.3 Test Procedure

Step 1 Set the ESS mode to **Capacity Control**.

Step 2 Shut down the ESS and inverter, and check the data on the meter at the grid connection point. The load obtains power from the grid. The power reading on the meter shall be a positive value and shall be equal to the load power.

Step 3 Start the ESS and inverter.

Step 4 **Peak shaving**: Set the current time to the charge period. Set the maximum peak power and backup power SOC for capacity control. If the load exceeds the maximum peak power, the ESS starts to discharge. The meter indicates a decrease in the power at the grid connection point, with the reduced power being equal to the ESS power.

Step 5 **Power boost limit**: Set the maximum peak current and backup power SOC for capacity control. If the current at the grid connection point in the power purchase direction exceeds the maximum peak current, the ESS starts to discharge. The meter indicates a decrease in the current at the grid connection point, with the reduced current being equal to the ESS current. If the current at the grid connection point in the feed-in direction exceeds the maximum peak current, the ESS starts to charge. The meter indicates a decrease in the current at the grid connection point, with the reduced current being equal to the ESS current.

Step 6 Set the charge period and discharge period based on the customer scenario.

----End

3.1.4.6 Multi-mode Overlay (with Meter at Grid Connection Point)

Overlay of multiple dispatch modes is applicable to the scenario where different business modes are used at the same plant to meet customers' requirements. Multiple flexible overlay control policies are provided to improve the overall benefits of the project.

CAUTION

Before testing this mode, check whether the direction and transformation ratio of the meter at the grid connection point are correct. For details, see **7.2.3.1 Meter at the Grid Connection Point**.

3.1.4.6.1 Working Mode Description

In the energy dispatch function configuration, multiple on-grid dispatch functions can be enabled at the same time and take effect together. In the current SmartLogger configuration, there are multiple ESS SOC settings. Note that after demand control is enabled, there are multiple SOC settings in the SmartLogger configuration. The priorities of different dispatch policies vary with the ESS SOC. The details are as follows.

ESS SOC	Description
End-of-charge SOC	When the end-of-charge SOC is reached, the ESS charge stops.
Backup power SOC for capacity control	Reserved power for capacity control, which is valid only when capacity control is enabled.

ESS SOC	Description
Force-charge SOC for capacity control (internal control logic, not displayed on the UI)	Force-charge SOC for implementing capacity control. It is controlled internally and cannot be configured. The calculation formula is as follows: Force-charge SOC for capacity control = (Backup power SOC for capacity control + End-of-discharge SOC)/2
End-of-discharge SOC	When the end-of-discharge SOC is reached, the ESS discharge stops.

ESS SOC < Force-Charge SOC for Capacity Control

ESS charge is the core requirement and has a higher priority than other dispatch policies. In this case, the dispatch policy of the SmartLogger is as follows:

- PV output power + Upper limit of power from grid > Load power: The surplus power is used to charge the ESS.
- PV output power + Upper limit of power from grid < Load power: The ESS discharges to supplement the power.

ESS SOC Between the Backup Power SOC for Capacity Control and the Force-Charge SOC for Capacity Control

The ESS does not discharge except for demand control. This priority is higher than that of all other dispatch policies. In this case, the dispatch policy of the SmartLogger is as follows:

- PV output power > Load power: The surplus PV power is preferentially charged to the ESS, and then fed to the grid if permitted. Otherwise, the PV power is limited.
- PV output power < Load power: Preferentially purchase power from the grid for loads. When the purchased power exceeds the demand control requirement, the ESS discharges to supplement the power.

ESS SOC > Backup Power SOC for Capacity Control

In this case, the power control policies in different overlay and power scenarios are as follows.

Energy Scheduling		PV Output Power > Load	PV Output Power < Load
Charge/ Discharge based on grid dispatch	Charge based on grid dispatch	Surplus PV power is preferentially used for charging the ESS, and is then limited.	Surplus grid power is preferentially used for charging the ESS, and is then limited.

Energy Scheduling		PV Output Power > Load	PV Output Power < Load
	Discharge based on grid dispatch	Surplus PV power is preferentially used for charging the ESS, and is then limited.	PV output power is insufficient, and the ESS discharges to supplement the power.
Maximum self-consumption		Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	The PV output power is insufficient and the ESS discharges to supplement the power. If it is still inadequate for the load, grid power is purchased.
TOU	Discharge period (**Charge**)	Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	
	Discharge period **(Fed to grid)**	Surplus PV power is preferentially fed to the grid. When the feed-in limit is reached and there is still surplus power, the power is used to charge the ESS.	
	Charge period	The PV power and grid power are preferentially supplied to loads, and surplus power is used to charge the ESS.	Preferentially use the grid power. The ESS discharges to ensure that the purchase power at the grid connection point does not exceed the threshold.
	Non-charge/ discharge period (**Charge**)	Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	PV power and grid power are supplied to loads. If the purchase power at the grid connection point exceeds the upper threshold, the ESS discharges to supply power.
	Non-charge/ discharge period **(Fed to grid)**	Surplus PV power is preferentially fed to the grid. When the feed-in limit is reached and there is still surplus power, the power is used to charge the ESS.	

Zero feed-in + other dispatch features

In this case, the power control policies in different overlay and power scenarios are as follows.

Energy Scheduling		PV Output Power > Load	PV Output Power < Load
Charge/ Discharge based on grid dispatch	Charge based on grid dispatch	Surplus PV power is preferentially used for charging the ESS, and is then limited.	Surplus grid power is preferentially used for charging the ESS, and is then limited.
	Discharge based on grid dispatch	Surplus PV power is preferentially used for charging the ESS, and is then limited.	PV output power is insufficient, and the ESS discharges to supplement the power.
Maximum self-consumption		Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	The PV output power is insufficient and the ESS discharges to supplement the power. If it is still inadequate for the load, grid power is purchased.
TOU	Discharge period (**Charge**)	Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	
	Discharge period **(Fed to grid)**	Surplus PV power is preferentially fed to the grid. When the feed-in limit is reached and there is still surplus power, the power is used to charge the ESS.	
	Charge period	The PV power and grid power are preferentially supplied to loads, and surplus power is used to charge the ESS.	Preferentially use the grid power. The ESS discharges to ensure that the purchase power at the grid connection point does not exceed the threshold.
	Non-charge/ discharge period (**Charge**)	Surplus PV power is preferentially used for charging the ESS and is then fed to the grid. When the feed-in limit is reached, the PV power is limited.	PV power and grid power are supplied to loads. If the purchase power at the grid connection point exceeds the upper threshold, the ESS discharges to supply power.

3.1.4.6.2 Multi-mode Overlay Settings

Multi-mode overlay is a combination of multiple on-grid scheduling policies.

Combination 1: Maximum Self-Consumption + Capacity Control

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings** and set **Working mode** to **Maximum self-consumption**. For details, see the setting of **Maximum self-consumption** in section "Working Mode" in **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

Step 2 Choose **Settings** > **Battery Settings** > **Capacity Control**. For details, see section "Capacity Control" in **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

----End

Combination 2: TOU + Maximum Self-Consumption

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings** and set **Working mode** to **TOU**.

Step 2 Set **Preferred use of surplus PV power** to **Charge**. For details, see section "Working Mode" in the **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

----End

Combination 3: TOU + Maximum Self-Consumption + Capacity Control

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings** and set **Working mode** to **TOU**.

Step 2 Set **Preferred use of surplus PV power** to **Charge**. For details, see section "Working Mode" in the **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

Step 3 Choose **Settings** > **Battery Settings** > **Capacity Control**. For details, see section "Capacity Control" in **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

----End

Combination 4: TOU + Capacity Control

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings** and set **Working mode** to **TOU**.

Step 2 Set **Preferred use of surplus PV power** to **Fed to grid**. For details, see section "Working Mode" in the **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

Step 3 Choose **Settings** > **Battery Settings** > **Capacity Control**. For details, see section "Capacity Control" in **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

----End

3.1.4.6.3 Test Procedure

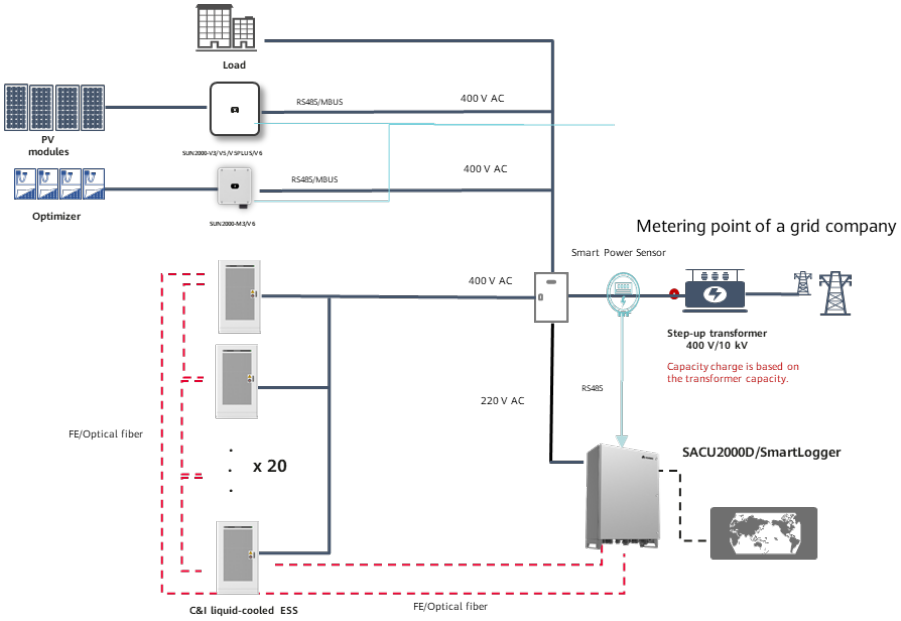
Refer to the test procedure in single mode.

3.1.5 Typical Cases

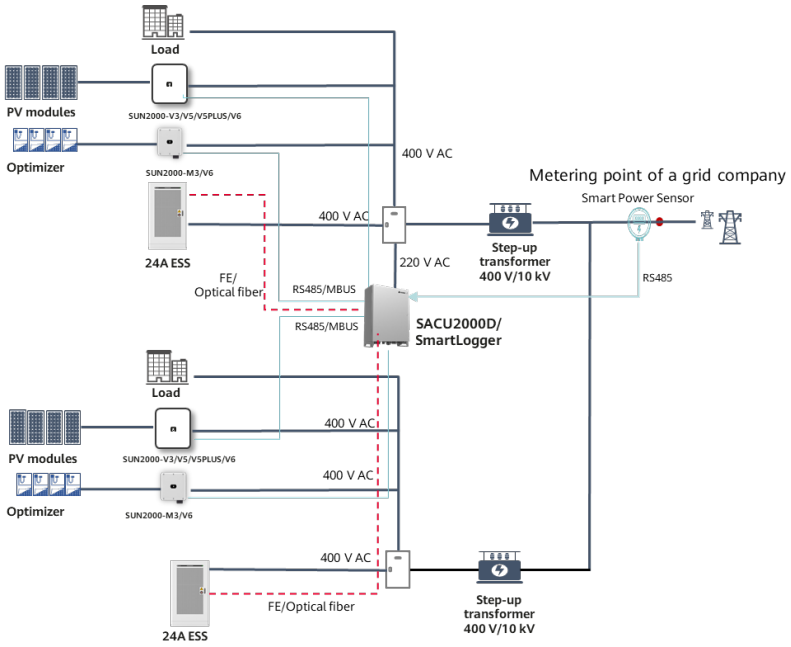
3.1.5.1 Standard Delivery Scenario

Typical delivery scenarios

Currently, only one SmartLogger and one grid connection point are supported in typical delivery scenarios.



The typical multi-transformer scenario is as follows. The following constraints must be met:



Constraints:

The power of the PV system, ESSs, and loads does not exceed the transformer limit.

Case description:

The meter is connected to the high-voltage 10 kV side of the transformer and connected to the secondary current of the 10 kV PT and CT. The PT and CT ratios must be set according to the meter quick guide and consistent with those on the customer side.

3.1.5.2 Typical Cases in Standard Delivery Scenarios

1. TOU+Transformer Overload Prevention

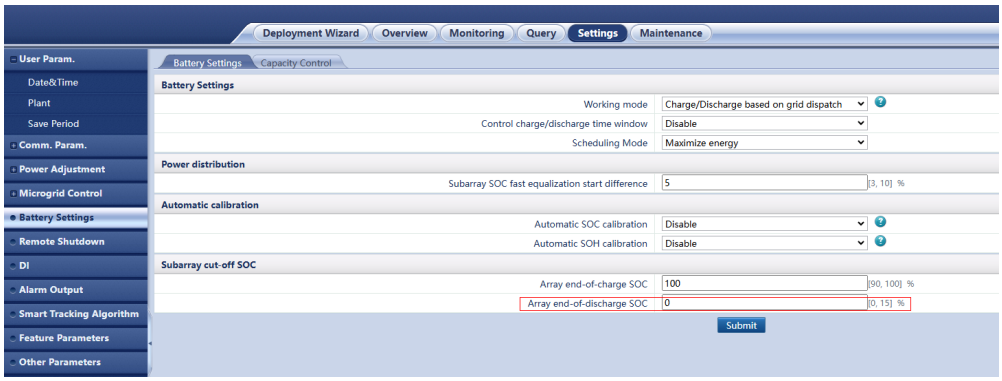
Case: The customer's load is 400 kW, the transformer capacity is 500 kW, and the ESS capacity is 200 kW. Overload may occur during charging.

ESS control settings:

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings**, set **Working mode** to **TOU**, and set charge and discharge periods based on peak and off-peak electricity prices.

Step 2 Set **Preferred use of surplus PV power** to **Fed to grid** or **Charge**. For details, see the TOU parameter settings in section "Working Mode" in the **LUNA2000-(107-215) Series Commercial and Industrial On-Grid Energy Storage Solution User Manual**.

Step 3 Choose **Settings** > **Battery Settings** > **Capacity Control**, set **Peak shaving** to **Active power limit**, and set end-of-discharge SOC to 0 (based on customer requirements), SOC for capacity control to 0 (consistent with the end-of-discharge SOC), peak shaving period to 00:00–23:59, and maximum peak power to the transformer capacity (for example, 500 kW). Then overload can be prevented during the TOU charge period.



----End

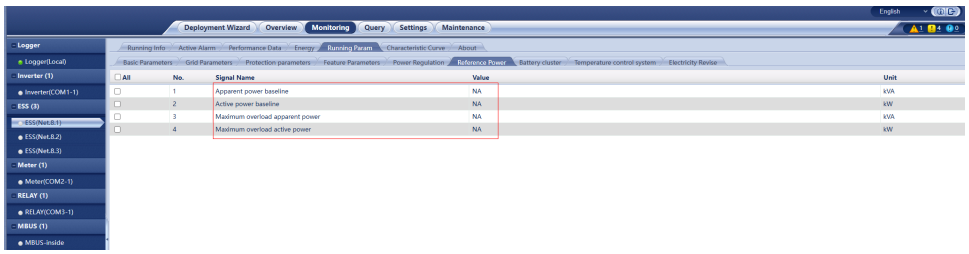
2. Using a Third-Party EMS to Implement 1.1x Charge and Discharge Power

Case: The customer load is 400 kW, the ESS configuration is 108 kW, and a third-party EMS is used. 1.1x overload charge and discharge need to be implemented in a certain period.

ESS control settings:

Step 1 Choose **Settings** > **Battery Settings** > **Battery Settings**, set **Working mode** to **Charge/Discharge based on grid dispatch**, and set other parameters by referring to section "Charge/Discharge Based on Grid Dispatch."

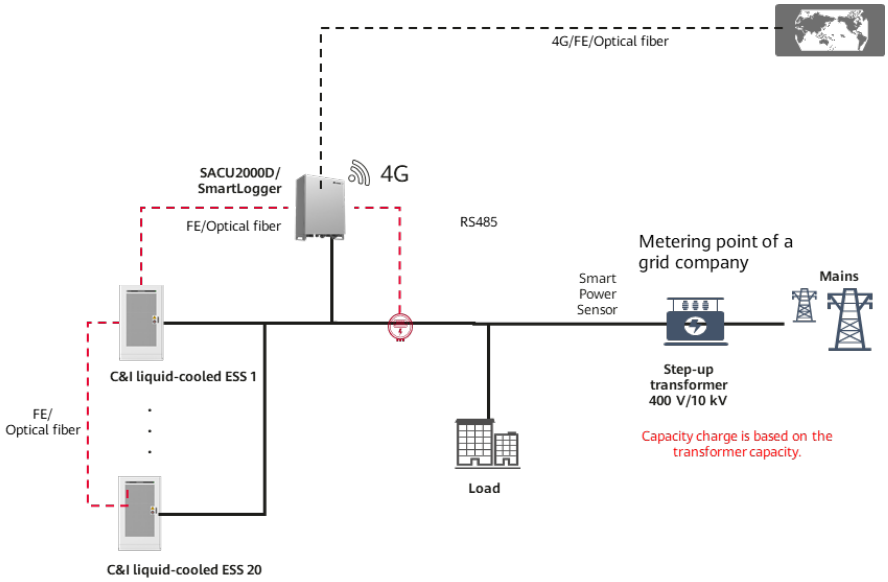
Step 2 Choose **Monitoring** > **Running Param** for the ESS, click the **Reference Power** tab, and set **Apparent power baseline** and **Active power baseline** to 118.8 kW respectively. If the third-party EMS delivers 118.8 kW charge and discharge power, the ESS can perform 1.1x overload. Similarly, if the ESS capacity is too large and the ESS power needs to be limited, set reference power on this page. After the configuration is complete, the power delivered from the SmartLogger or third-party EMS is not greater than this reference power.



----End

3.1.5.3 Typical Cases in Non-standard Delivery Scenarios

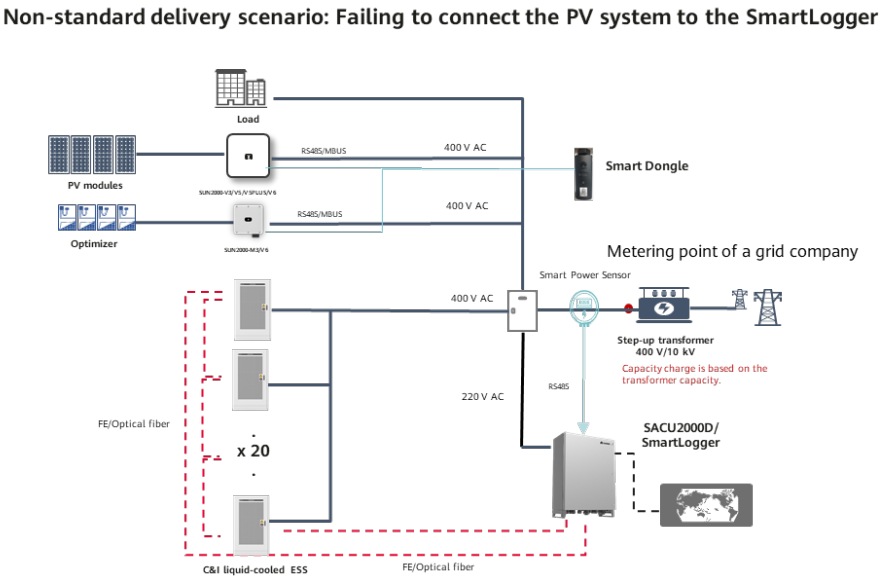
1. Incorrect Meter Connection



Case description:

The meter should be connected to the transformer 400 V side. The meter can calculate the total power balance of the ESS, PV system, and load only after the load, ESS, and PV system are connected downstream of the meter.

2. Failing to Connect the PV System to the SmartLogger



Case description:

PV+ESS collaborative control is not supported in the following scenarios:

The PV inverter adopts Smart Dongle networking and does not connect to the SmartLogger.

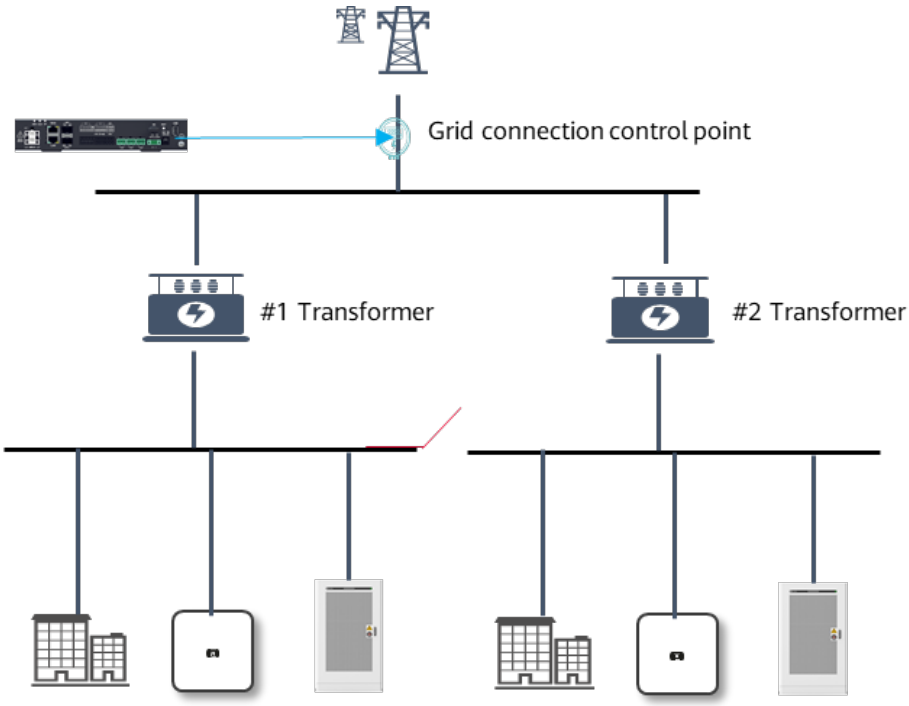
The third-party PV inverter is networked independently and cannot connect to the SmartLogger.

Solution description:

Connect Huawei's PV inverter to the SmartLogger.

If a third-party PV inverter is used, deploy a third-party controller to control the third-party PV system and Huawei's ESS.

3. Transformer Overload in Multi-transformer Scenario



Case description:

Transformers #1 and #2 are overloaded during battery charge and discharge.

The PV power of transformer #1 is large. If the SmartLogger controls the grid connection point only on the high voltage side, transformer #2 is overloaded because the PV power of transformer #1 is used to charge the ESS of transformer #2.

The bus tie switches of transformers #1 and #2 back up each other.

Solution description:

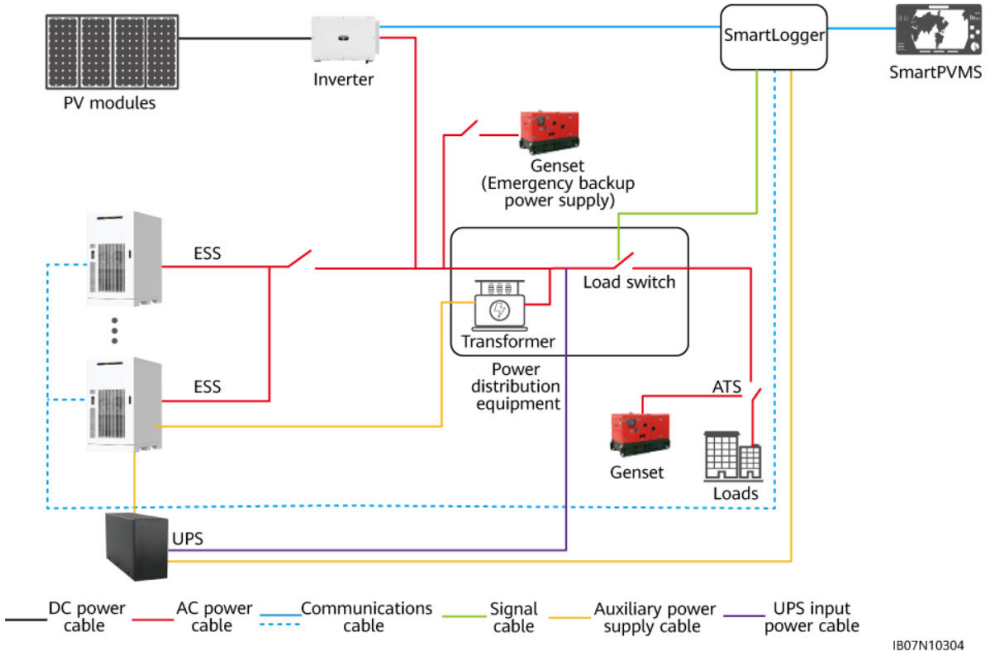
Huawei's solution supports only one SmartLogger and one grid connection point. If the transformer is overloaded, reduce the PCS reference power (charge and discharge are dispatched based on this power). After the PCS reference power is reduced, the charge and discharge time will become too long, and risk 2 specified in case description cannot be avoided.

In the multi-transformer layered control scenario, a third-party EMS is required to control the grid connection point and the ESS connection points of transformers #1 and #2.

3.2 C&I PV+ESS Off-Grid Scenario

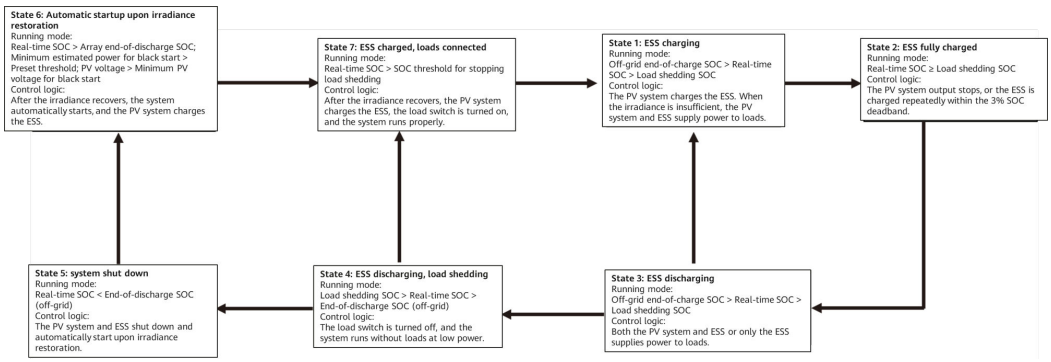
The C&I off-grid PV+ESS system mainly runs in scenarios without grids. The PV system and ESS work together to establish a microgrid to supply power to loads.

The genset is used to temporarily charge ESSs only when the ESSs are fully discharged. During normal operation, the genset is not connected.



3.2.1 System Running Logic

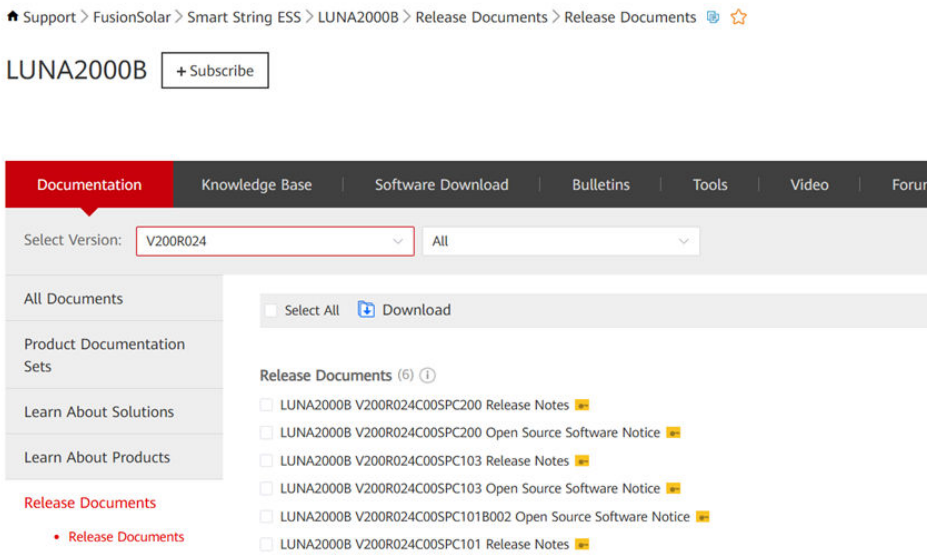
The system running logic of the case with the default settings is as follows:



3.2.2 Software Version

Download the required software version before the deployment.

Software version obtaining path: For LUNA2000B (**download link**), download the latest SPC software version corresponding to V200R024C00. Download the matching version of the SmartLogger and the inverter version.



3.2.3 Power-On and Deployment Commissioning

Power-on and deployment commissioning process

No.	Step	Description
1	Powering on the equipment	Use the UPS to supply power to the SmartLogger and ESS monitoring auxiliary power supply. 1. Turn on the power supply switch on the UPS output side. 2. For the C&I liquid-cooled ESS, see **Power-On Operations**.
2	Obtaining startup authorization	Log in to Power-Partner to obtain the startup authorization code. For details, see the service startup authorization guide.
3	Logging in to the system	Log in to the SmartLogger.
4	Upgrading the SmartLogger software	Upgrade the SmartLogger to the latest version, as some earlier versions cannot detect the ESS.
5	Upgrading the ESS software	Upgrade the software, as there may be version mismatch between the ESS and DCDC.
6	Upgrading the inverter software	Upgrade the inverter software.
7	Performing wizard-based deployment	Set basic device parameters, search for devices, set device parameters, and set microgrid parameters.

No.	Step	Description
8	(Optional) Detecting wire sequence	Applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs. In the off-grid scenario, ensure that the load has been disconnected.
10	Setting the inverter and ESS to three-phase four-wire mode	/
11	Checking the grid code and working mode of the ESS	/
12	Starting the system in off-grid mode	/
13	Checking inverter parameters and starting the inverter	/
14	Connecting to the meter	Not involved in off-grid mode.
15	Connecting to the management system	/

3.2.3.1 Powering On the Equipment

Power-on process description of the off-grid PV+ESS system

No.	Task	Power-On Operation
1	Starting the UPS	For details, see the documents provided by the manufacturer.
2	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-ESS auxiliary power supply (for black start)	For details, see **Power-On Operations**.

No.	Task	Power-On Operation
3	Powering on the ESS auxiliary power supply (for LTMS and other devices)	
4	Powering on the ESS AC side	
5	Powering on the inverter	**Select a power-on method based on the inverter model.** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

3.2.3.2 Obtaining Startup Authorization

Step 1 Set **Startup authorization code** of the ESS. Otherwise, the ESS cannot be started.

1. Use **Startup authorization verification code** to apply for **Startup authorization code**.

   NOTE

   Contact the device vendor or its authorized supervision service provider to apply for a startup authorization code through the Power Partner app.

   - Method 1: Choose **Monitoring** > **ESS** > **Running Info.** > **Basic Information** to view **Startup authorization verification code**.
   - Method 2: Choose **Deployment Wizard** > **Connect Device** to view **Startup authorization verification code**.
2. Set **Startup authorization code** of the ESS.
   - Method 1: Choose **Deployment Wizard** > **Connect Device**, and set **Startup authorization code**.

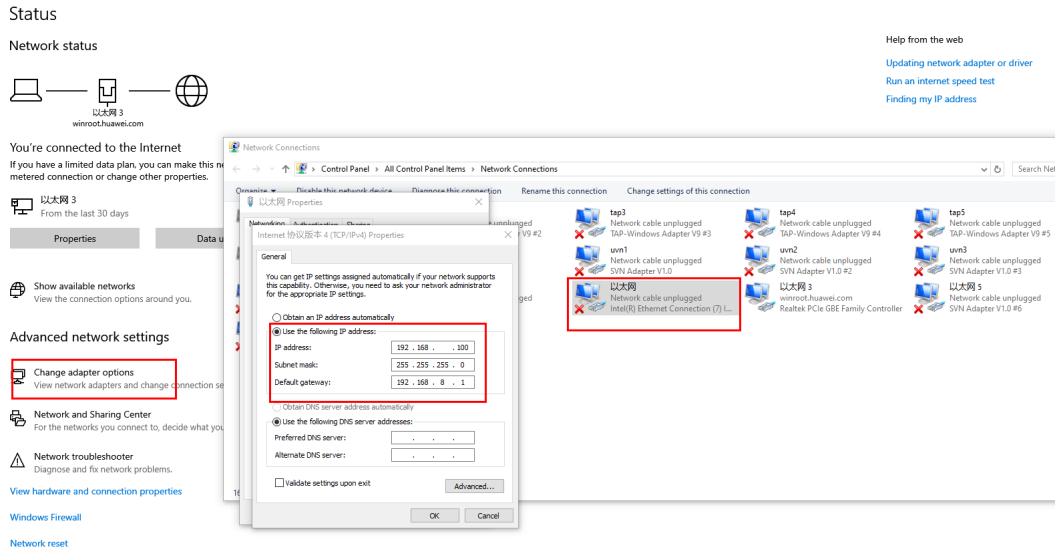
- Method 2: Choose **Monitoring** > **ESS** > **Running Param.** > **Basic Parameters**, and set **Startup authorization code**.

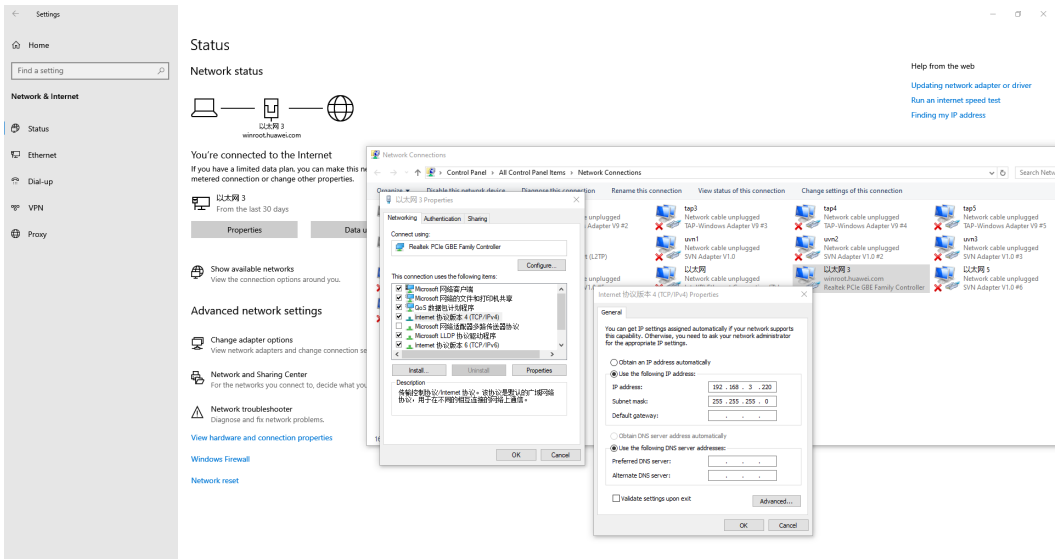
----End

3.2.3.3 Logging In to the SmartLogger and Upgrading the Software

Step 1 Set the IP address of the PC.

Recommended IP address: 192.168.0.100





Step 2 Log in to the SmartLogger.

Connect the network port on the PC to the WAN or LAN port on the SmartLogger using a network cable.

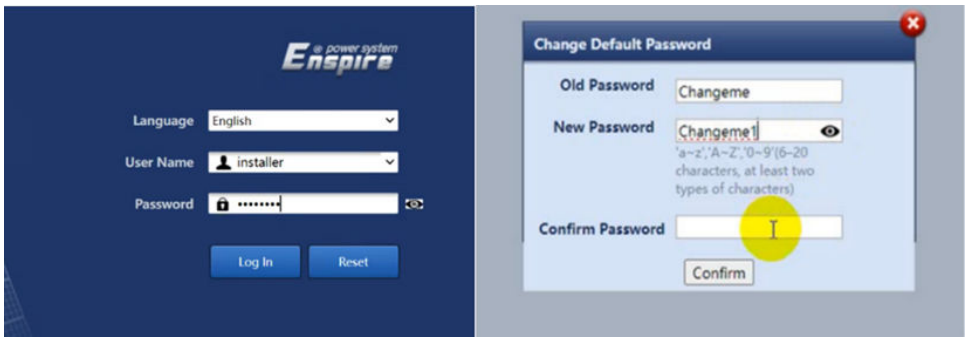
The default IP addresses are as follows.

Port	Item	Default Value on SmartLogger	PC Setting Example
SmartLogger WAN port	IP address	192.168.0.10	192.168.0.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.0.1	192.168.0.1
SmartLogger LAN port	IP address	192.168.8.10	192.168.8.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.8.1	192.168.8.1

In the address bar of a browser, enter **https://***XX.XX.XX.XX* (*XX.XX.XX.XX* is the IP address of the SmartLogger) and press **Enter**. The login page is displayed. If you are logging in to the WebUI for the first time, a security warning is displayed. Click **Continue to this website** to log in to the WebUI.

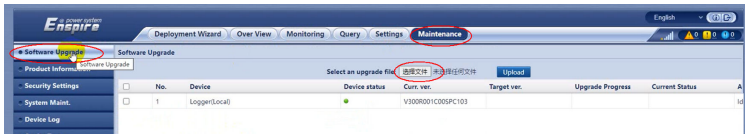
For the first login, the user name is **admin**, and the initial login password is **Changeme**.

Use the initial password upon the first power-on. After login, change the initial password and log in again. The login password contains at least eight characters.



Step 3 Upgrade the software.

Choose **Maintenance** > **Software Upgrade**.



Note: The SmartLogger software and BSP file shall be upgraded together.

If an error message is displayed during file upload, decompress the SmartLogger software package, upload the SmartLogger3000-BSP and upgrade the BSP file.

Then upload the SmartLogger3000 software package and upgrade the SmartLogger software.

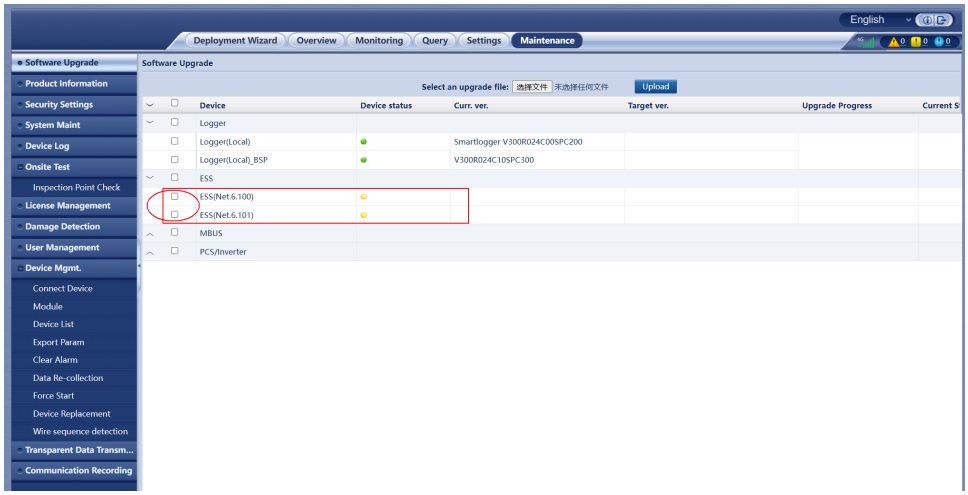
----End

3.2.3.4 Upgrading the ESS Software

Before the upgrade, ensure that the reserved SOC is greater than 15%. If the SOC is lower than 15%, charge the ESS first.

If the ESS cannot be charged onsite and the SOC is lower than 15%, perform the following operations before upgrading the software. Otherwise, the upgrade will fail. For details, see **3.1.2.4 Upgrading the ESS Software**.

Step 1 Choose **Maintenance** > **Software Upgrade** to upgrade the ESS software.



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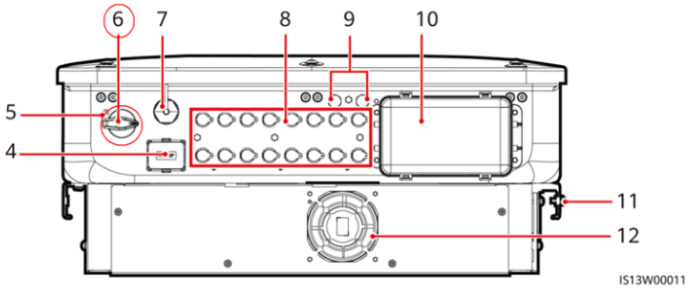
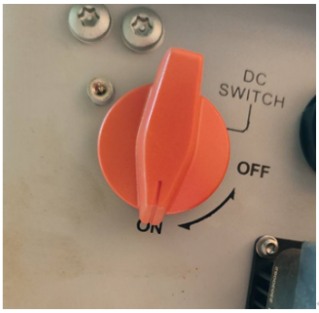
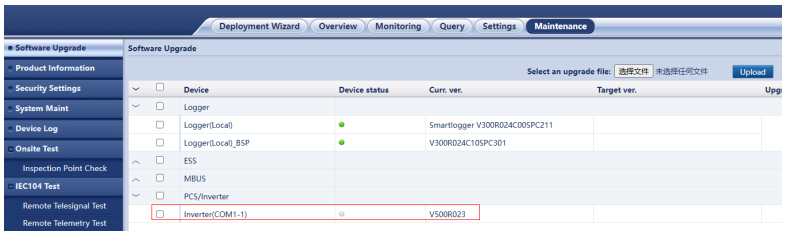
3.2.3.5 Upgrading the Inverter Software

Step 1 Start the inverter and turn on the DC switch of the inverter.

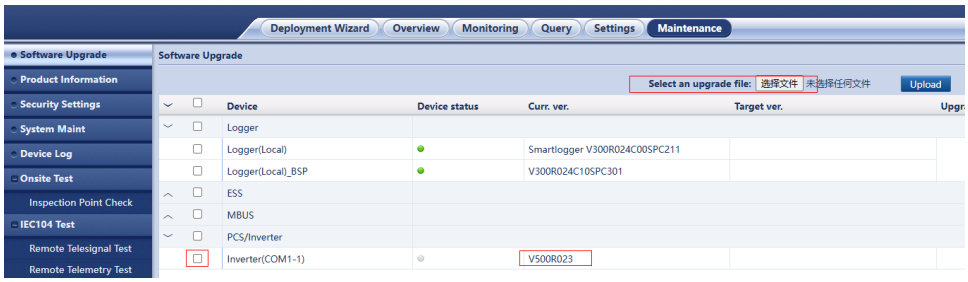




Step 2 Check the inverter connection status on the SmartLogger.



Step 3 Upgrade the inverter software.



----End

3.2.3.6 Performing Wizard-based Deployment

For details about wizard-based deployment, see **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

3.2.3.7 (Optional) Detecting Wire Sequence

This function applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs.

- In the off-grid scenario, ensure that the loads have been disconnected and then click **Starting up**.
- In the on/off-grid scenario, click **Starting up**.

Parameter	Description
Wire sequence detection status	Check the status of wire sequence detection. ● Not detected ● Testing ● Detection failed: The wire sequence detection has failed. In this case, check the **Abnormal Wire Sequence** alarm and rectify the fault based on the handling suggestions. ● If the wire sequence is consistent, no action is required. ● If the wire sequence is inconsistent, rectify the cable connection. 1. Check the phase sequence detection result. The phase sequences of multiple ESSs shall be **Positive**. If not, rectify the cable connection. 2. If the phase sequences of multiple ESSs are **Positive**, check the phase again. If the phase difference between ESSs is greater than 60°, rectify the cable connection.
Wire sequence detection time	Check the time when the wire sequence detection is complete.
Wire sequence check progress	Check the wire sequence detection progress.
Phase Sequence	Check the phase sequence detection result. The detection result can be **Positive** or **Negative**.
Phase	Check the phase detection result. The detection result range is [0, 360]°.

3.2.3.8 Setting the Inverter and ESS to Three-Phase Four-Wire Mode

Step 1 Set **Output mode** for the inverter and ESS.

- For the inverter: Choose **Monitoring** > **Inverter** > **Running Param** > **Grid Parameters**, and set **Output mode** for the inverter to **Three-phase four-wire**.
- For the ESS:
  - In the **On-grid/Off-grid (VSG)** or **On-grid/Off-grid (PQ/VSG)** scenario, choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.
  - In the **Off-grid** scenario, disconnect loads and perform black start. Then choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.

----End

3.2.3.9 Checking the Grid Code and Working Mode of the ESS

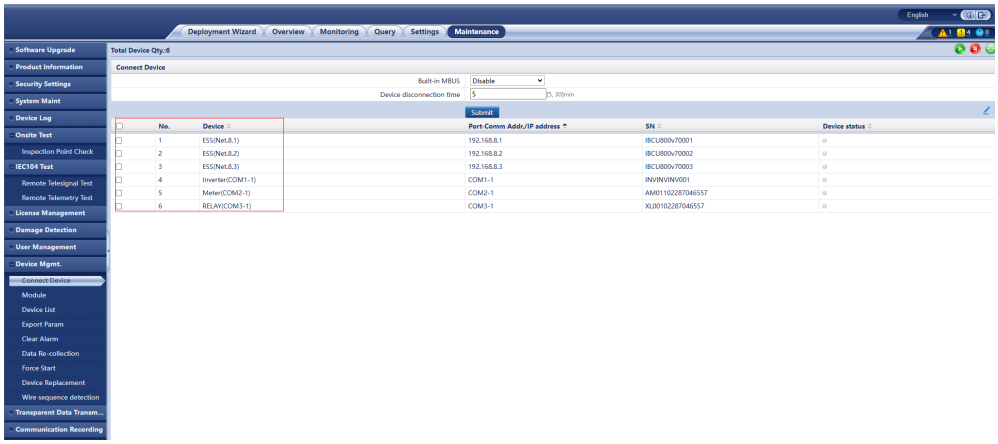
Step 1 Check whether **Grid code** and **Working mode** of the ESS are correctly set. If not, correct the settings.

- Choose **Monitoring** > **ESS** > **Running Param** > **Grid Parameters**, and check the setting of **Grid code**.
- Choose **Monitoring** > **ESS** > **Running Param** > **Feature Parameters**, and check the setting of **Working mode**.

----End

3.2.3.10 Starting the System in Off-Grid Mode

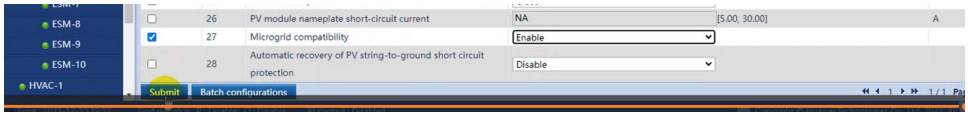
Step 1 To start the C&I ESS in off-grid mode, choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click the start icon.



----End

3.2.3.11 Checking Inverter Parameters

Step 1 Check that **Microgrid compatibility** is set to **Enable** for the inverter.



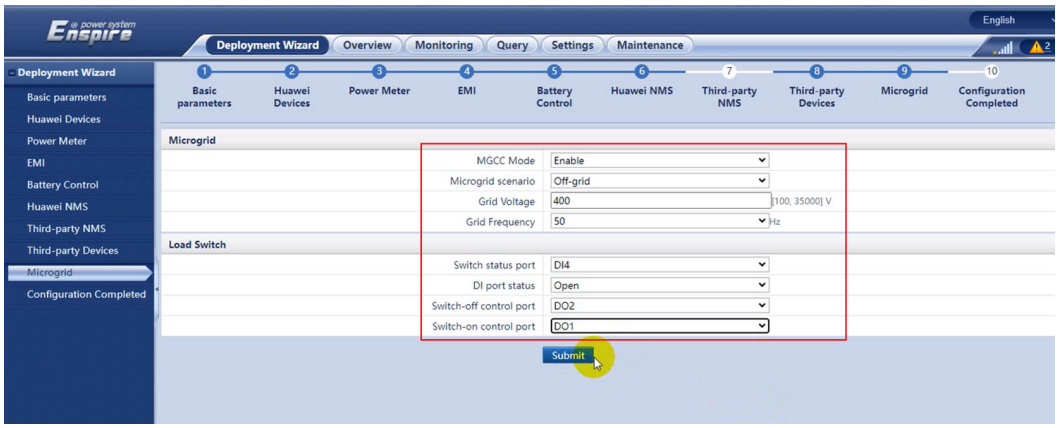
----End

3.2.3.12 Connecting to the Meter (Not Involved in Off-Grid Mode)

3.2.4 Parameter Setting Reference

3.2.4.1 Reference for Off-Grid Parameter Settings

Check the grid voltage and frequency after wizard-based deployment.



3.2.4.2 Reference Values of the SOC and Black Start Voltage

Table 3-1 Off-grid control parameters

Tab	Parameter	Reference	Description
Control Policy	Automatic load connection/ shedding	Enable	• Enable: The automatic load connection/shedding function is enabled. • Disable: The automatic load connection/shedding function is disabled.
	Automatic black start after irradiance restoration	Enable	Specifies whether to enable automatic black start after irradiance restoration. • Enable: During off-grid operation, automatic black start is performed after the irradiance restores. • Disable: Automatic black start is not performed after the irradiance restores.
	Automatic PCS recovery	Enable	Specifies whether to enable the function of automatic recovery in case of abnormal PCS shutdown. • Enable: During off-grid operation, when the SmartLogger detects that the PCS shuts down abnormally and causes power failure, the SmartLogger automatically attempts to black start to restore the power supply. • Disable: When the PCS shuts down abnormally, the SmartLogger does not perform automatic black start.

Tab	Parameter	Reference	Description
Control Policy	End-of-charge SOC (off-grid)	90%	Set the maximum SOC for charge in off-grid mode. The default value is 90%. Set the parameter based on the actual situation. To ensure reliable operations of the microgrid, the recommended value range is [85, 95] and this parameter must be ≤ (**Array end-of-charge SOC** – 5%).
	SOC threshold for stopping load shedding	30%	This parameter is displayed when **Automatic load connection/ shedding** is set to **Enable**. The default value is 30%. The value range is [26, 40]. If the current ESS SOC is greater than or equal to **SOC threshold for stopping load shedding**, the load switch is automatically turned on to supply power to loads. If you manually turn on or off the load switch, the automatic control function of the load switch will be automatically disabled. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario.
	SOC threshold for starting load shedding	20%	This parameter is displayed when **Automatic load connection/ shedding** is set to **Enable**. The default value is 20%. The value range is [10, 25]. If the SOC is less than or equal to **SOC threshold for starting load shedding**, the load switch is automatically turned off to reduce the ESS discharge power. If you manually turn on or off the load switch, the automatic control function of the load switch will be automatically disabled. This function can be restored only after the SmartLogger is restarted or the black start is successful in the off-grid scenario.

Tab	Parameter	Reference	Description
	End-of-discharge SOC (off-grid)	10%	Set the minimum SOC for discharge in off-grid mode. The default value is 10%. Set the parameter based on the actual situation. To ensure reliable operations of the microgrid, the recommended value range is [10, 15] and this parameter must be ≥ (**Array end-of-discharge SOC** + 5%).
	Min PV voltage for black start	600 V	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. After the solar irradiance recovers, the inverter PV voltage increases. If the PV1 voltage of an inverter is greater than or equal to **Min PV voltage for black start**, the black start function may be enabled.
	Minimum estimated power for black start	10%	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. Set this parameter to a percentage of the ESS rated power. The default value is 10% of the ESS rated power. When the irradiance is restored, if the estimated PV output power of the inverter is greater than the minimum estimated power for the black start, the black start is automatically performed.
Off-grid charging control	Real-time SOC (%)	/	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	/	

Tab	Parameter	Reference	Description
Load control	Manual Load Control	/	This function is used only for load switch status detection. • **Close**: Loads are connected. • **Open**: Loads are disconnected. **NOTE** • In the off-grid scenario, the **Close** and **Open** buttons are available only when the DO ports of **Switch-off control port** and **Switch-on control port** under **Load Switch** are configured. • When the load switch is off, the **Close** button is available, and the **Open** button is grayed out. • When the load switch is on, the **Close** button is grayed out, and the **Open** button is available. • When the load switch is in invalid state, the **Close** and **Open** buttons are grayed out.

NOTE

Array end-of-charge SOC > **End-of-charge SOC (off-grid)** ≥ **SOC threshold for stopping load shedding** > **SOC threshold for starting load shedding** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

3.2.5 Basic Function Tests

3.2.5.1 Testing Load Switch Functions

CAUTION

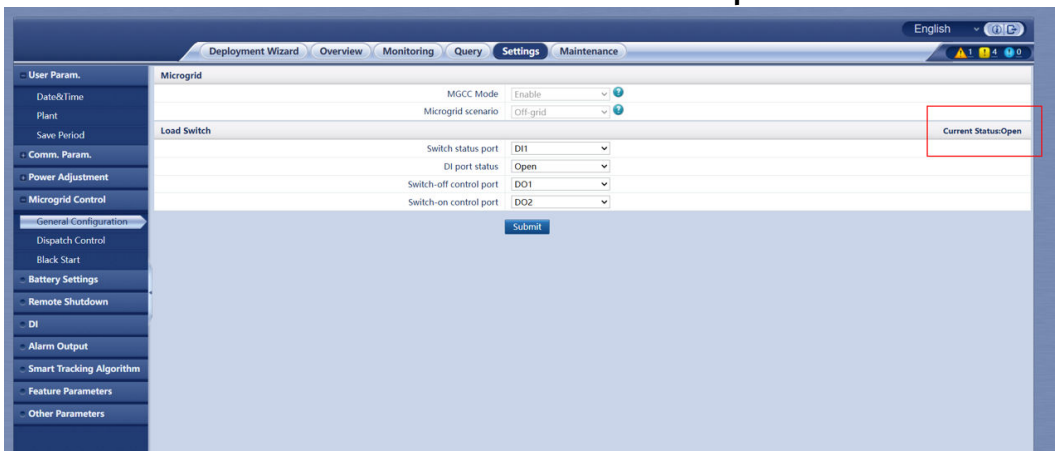
Manually turn on and off the load switch to check whether the switch configuration is correct.

- Ensure that the equipment is not damaged before you operate the on/off-grid switch or load switch. Otherwise, electric shocks or fire may occur.
- When operating the on/off-grid switch or load switch, wear insulated gloves and use insulated tools to prevent electric shocks or short circuits.

Step 1 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 2 Manually turn on or off the load switch onsite. Then, on the SmartLogger WebUI, choose **Settings** > **Microgrid Control** > **General Configuration** > **Load Switch** and check whether **Status** changes. If yes, the DI cable connection is normal. If no,

check whether the DI cable connection to **Switch status port** is normal.



Step 3 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load Switch** and check whether **Status** is consistent with the actual load switch status. If no, change **DI port status** to ensure that the status is consistent.

Step 4 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load control** and check whether the **Open** button is available. If so, click **Open** and then check onsite whether the actual status of the load switch is off. If no, check whether the DO cable connection to **Switch-off control port** is normal.

Step 5 Choose **Settings** > **Microgrid Control** > **General Configuration** > **Load control** and check whether the **Close** button is available. If so, click **Close** and then check onsite whether the actual status of the load switch is on. If no, check whether the DO cable connection to **Switch-on control port** is normal.

Step 6 After the load switch inspection is complete, choose **Settings** > **Microgrid Control** > **Black Start** and click **Starting**.

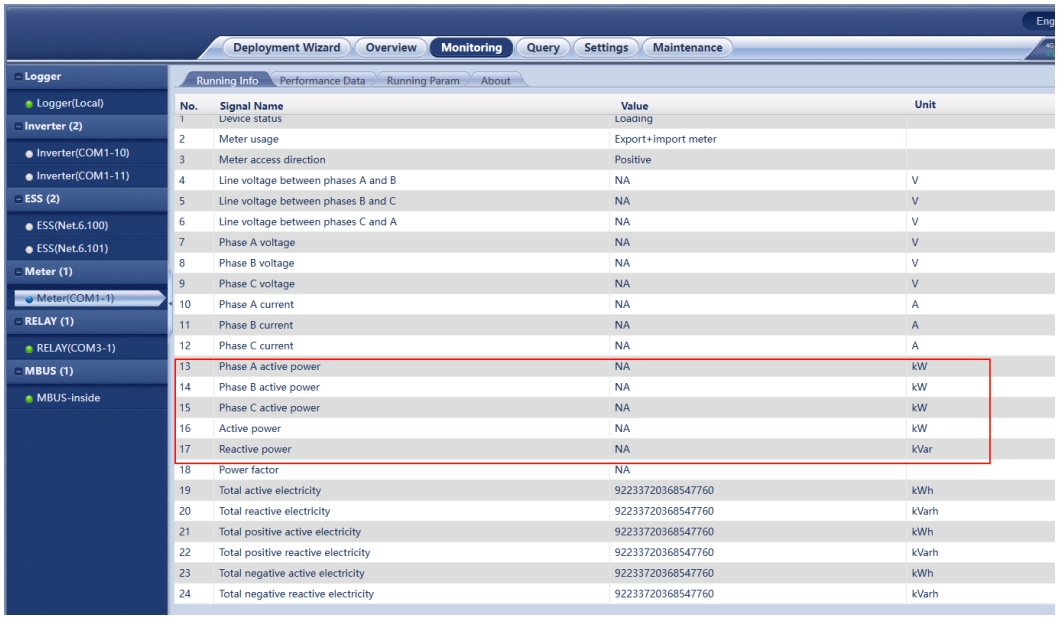
CAUTION

If any exception occurs, check the cable connection between the SmartLogger and the switch.

----End

3.2.5.2 Testing Charge/Discharge

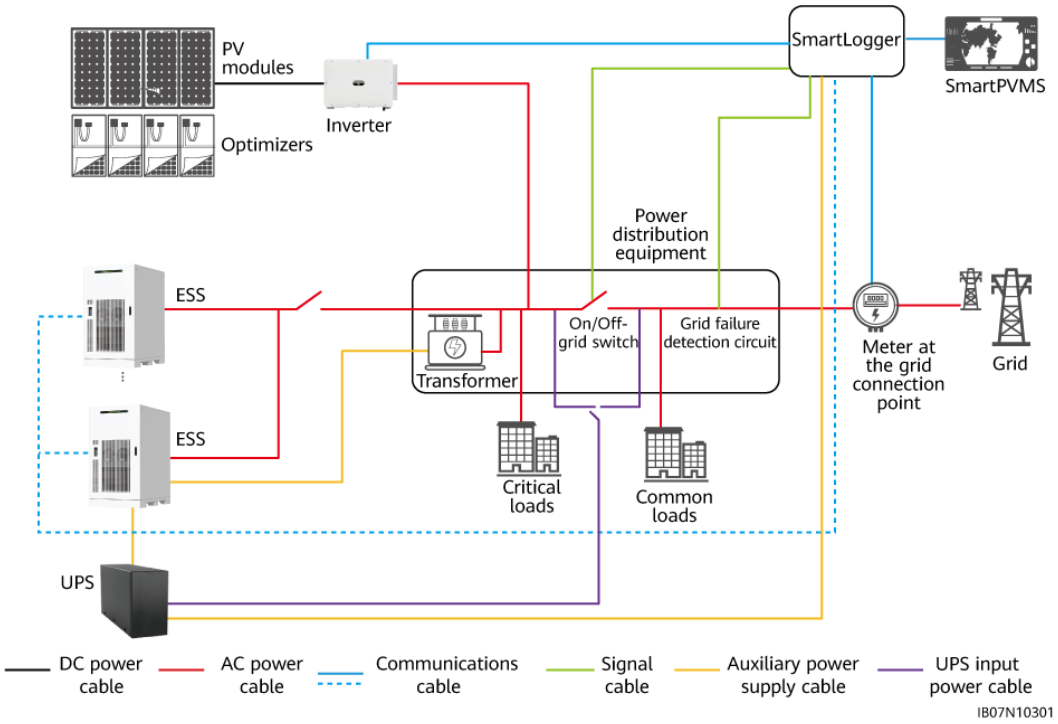
Turn on the load shedding switch, connect the load, and check the PV power, ESS power, and load power. The PV power and ESS power are approximately equal to the load power.



3.3 C&I PV+ESS Seamed On/Off-Grid (PQ/VSG) Switching

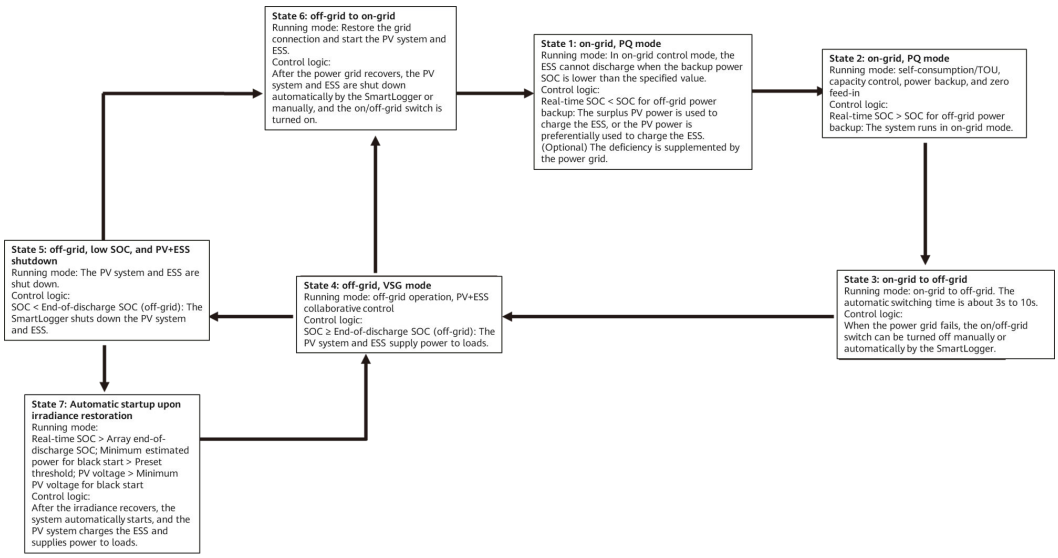
This mode is applicable to scenarios where the grid is relatively stable and power outage occurs occasionally. After a grid outage occurs, the ESS performs a black start after receiving a black start command from the SmartLogger.

In this system, the microgrid implements on-grid and off-grid operations through an on/off-grid switch. When the system is off-grid, the ESS functions as the primary power supply to supply power to critical loads together with the PV system.



3.3.1 System Running Logic

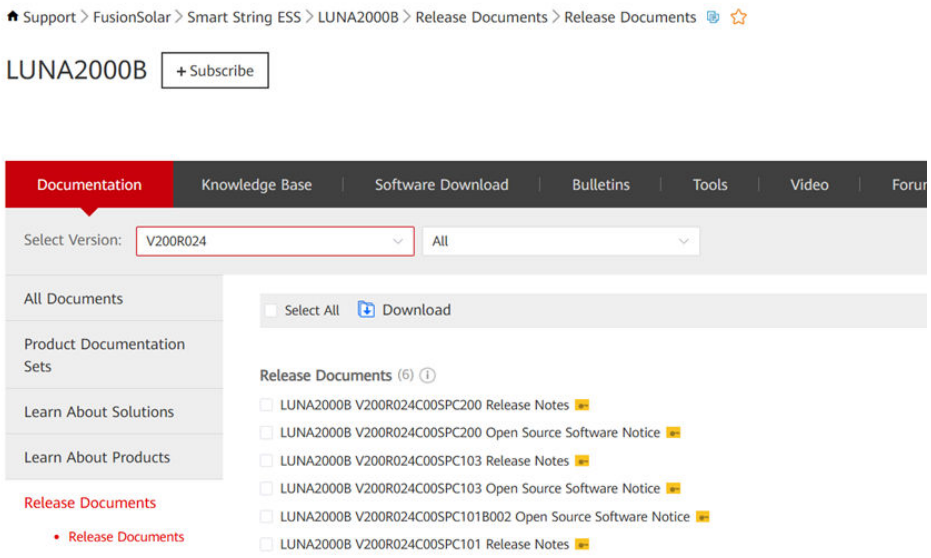
Note: After the system runs in off-grid mode, the system automatically starts after the irradiance is restored. If no controllable load switch is connected to the SmartLogger, the estimated power threshold shall be greater than the load power.



3.3.2 Software Version

Download the required software version before the deployment.

Software version obtaining path: For LUNA2000B, download the latest SPC software version corresponding to V200R024C00. Download the matching version of the SmartLogger and the inverter version. (**Link**)



3.3.3 Power-On and Deployment Commissioning

Power-on and deployment commissioning process

No.	Step	Description
1	Powering on the equipment	Perform deployment in on-grid mode (turn on the on/off-grid switch in the power distribution equipment). Use the UPS to supply power to the SmartLogger and ESS monitoring auxiliary power supply. 1. Turn on the power supply switch on the UPS output side. 2. For the C&I liquid-cooled ESS, see **Power-On Operations**.
2	Obtaining startup authorization	Log in to Power-Partner to obtain the startup authorization code. For details, see the service startup authorization guide.
3	Logging in to the system	Log in to the SmartLogger.
4	Upgrading the SmartLogger software	Upgrade the SmartLogger to the latest version, as some earlier versions cannot detect the ESS.
5	Upgrading the ESS software	Upgrade the software, as there may be version mismatch between the ESS and DCDC.
6	Upgrading the inverter software	Upgrade the inverter software.

No.	Step	Description
7	Performing wizard-based deployment	Set basic device parameters, search for devices, set device parameters, and set microgrid parameters.
8	(Optional) Detecting wire sequence	Applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs. In the off-grid scenario, ensure that the load has been disconnected.
10	Setting the inverter and ESS to three-phase four-wire mode	/
11	Checking the grid code and working mode of the ESS	/
12	Starting the system in on-grid mode	/
13	Checking inverter parameters and starting the inverter	/
14	Connecting to the meter	/
15	Connecting to the management system	/

3.3.3.1 Powering On the Equipment

Power on the on/off-grid PV+ESS (PQ/VSG) system when an external power supply is available.

Figure 3-2 Power-on process of the on/off-grid PV+ESS (PQ/VSG) system

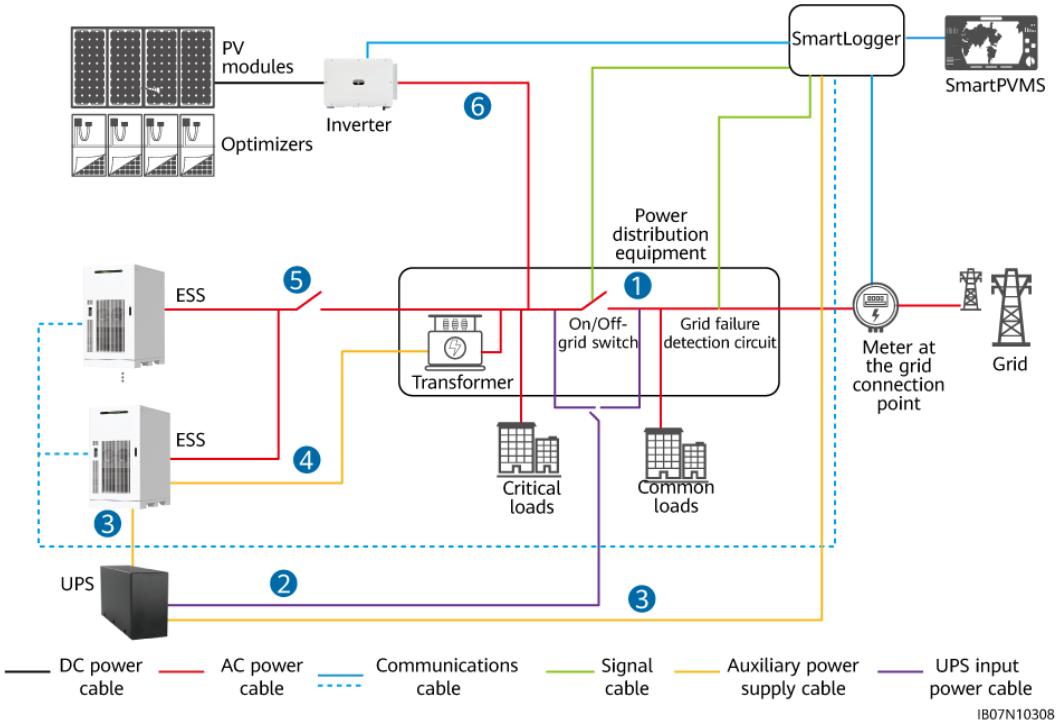


Table 3-2 Power-on process description of the on/off-grid PV+ESS (PQ/VSG) system

No.	Task	Power-On Operation
1	Powering on the power distribution equipment	1. Turn on the on/off-grid switch in the power distribution equipment. 2. Turn on the switch of the grid failure detection circuit in the power distribution equipment.
2	Powering on the UPS	1. Turn on the UPS power switch on the power distribution equipment side. 2. Start the UPS.
3	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-ESS auxiliary power supply (for black start)	For details, see **Power-On Operations**.

No.	Task	Power-On Operation
4	Powering on the ESS auxiliary power supply (for LTMS and other devices)	
5	Powering on the ESS AC side	
6	Powering on the inverter	**Select a power-on method based on the inverter model.** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

3.3.3.2 Obtaining Startup Authorization

Step 1 Set **Startup authorization code** of the ESS. Otherwise, the ESS cannot be started.

1. Use **Startup authorization verification code** to apply for **Startup authorization code**.

   NOTE

   Contact the device vendor or its authorized supervision service provider to apply for a startup authorization code through the Power Partner app.

   – Method 1: Choose **Monitoring** > **ESS** > **Running Info.** > **Basic Information** to view **Startup authorization verification code**.
   – Method 2: Choose **Deployment Wizard** > **Connect Device** to view **Startup authorization verification code**.
2. Set **Startup authorization code** of the ESS.
   – Method 1: Choose **Deployment Wizard** > **Connect Device**, and set **Startup authorization code**.

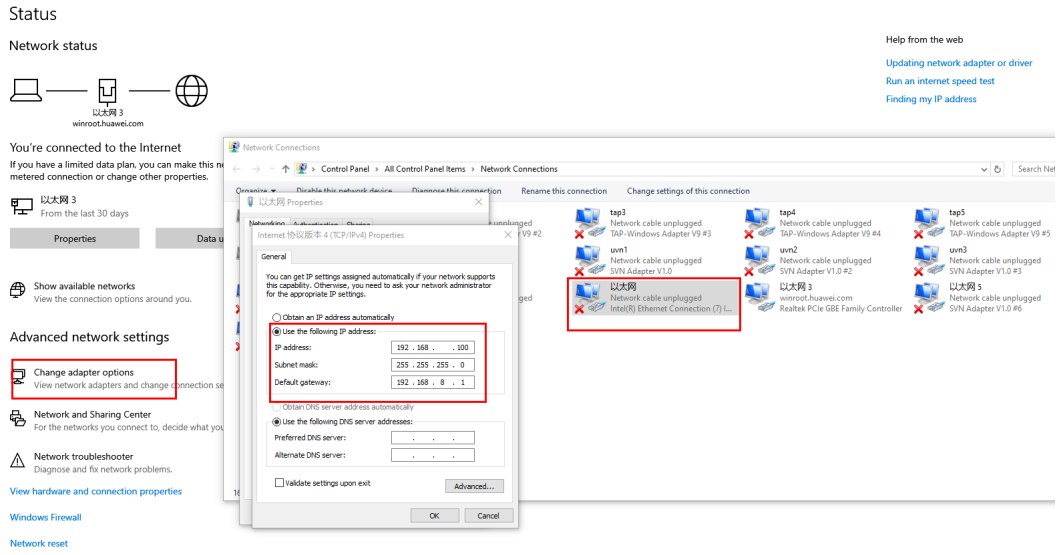
- Method 2: Choose **Monitoring** > **ESS** > **Running Param.** > **Basic Parameters**, and set **Startup authorization code**.

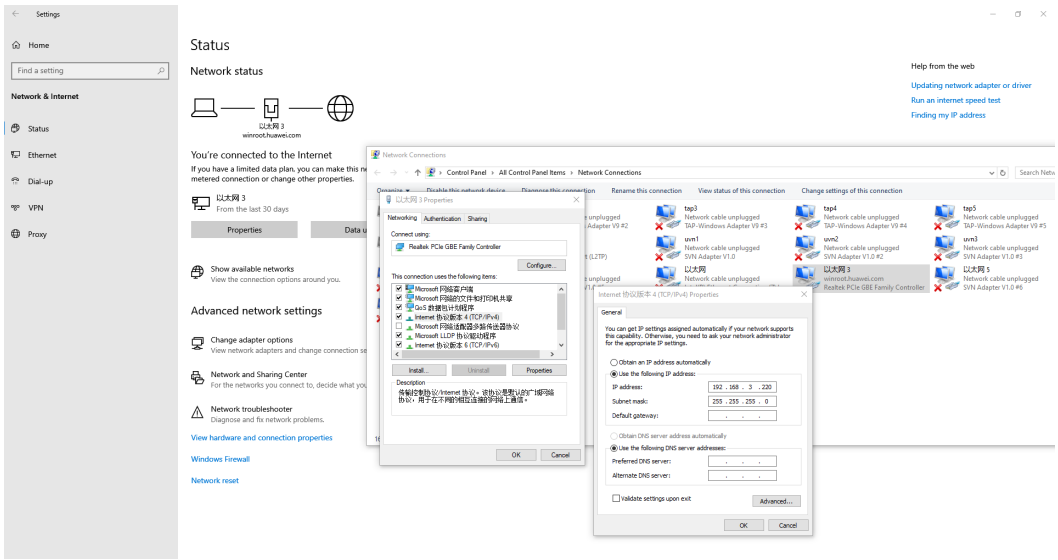
----End

3.3.3.3 Logging In to the SmartLogger and Upgrading the Software

Step 1 Set the IP address of the PC.

Recommended IP address: 192.168.0.100





Step 2 Log in to the SmartLogger.

Connect the network port on the PC to the WAN or LAN port on the SmartLogger using a network cable.

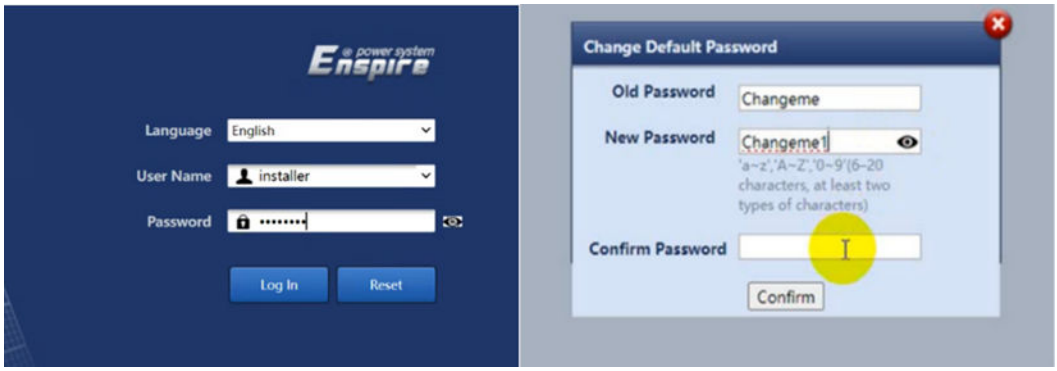
The default IP addresses are as follows.

Port	Item	Default Value on SmartLogger	PC Setting Example
SmartLogger WAN port	IP address	192.168.0.10	192.168.0.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.0.1	192.168.0.1
SmartLogger LAN port	IP address	192.168.8.10	192.168.8.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.8.1	192.168.8.1

In the address bar of a browser, enter **https://***XX.XX.XX.XX* (*XX.XX.XX.XX* is the IP address of the SmartLogger) and press **Enter**. The login page is displayed. If you are logging in to the WebUI for the first time, a security warning is displayed. Click **Continue to this website** to log in to the WebUI.

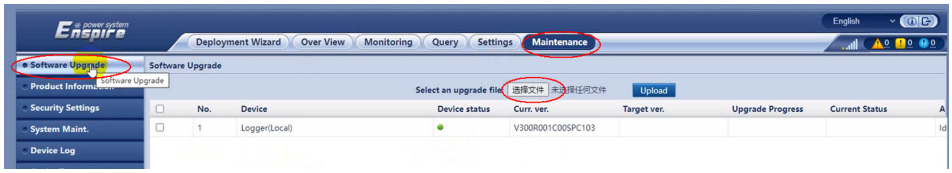
For the first login, the user name is **admin**, and the initial login password is **Changeme**.

Use the initial password upon the first power-on. After login, change the initial password and log in again. The login password contains at least eight characters.



Step 3 Upgrade the software.

Choose **Maintenance** > **Software Upgrade**.



Note: The SmartLogger software and BSP file shall be upgraded together.

If an error message is displayed during file upload, decompress the SmartLogger software package, upload the SmartLogger3000-BSP and upgrade the BSP file.

Then upload the SmartLogger3000 software package and upgrade the SmartLogger software.

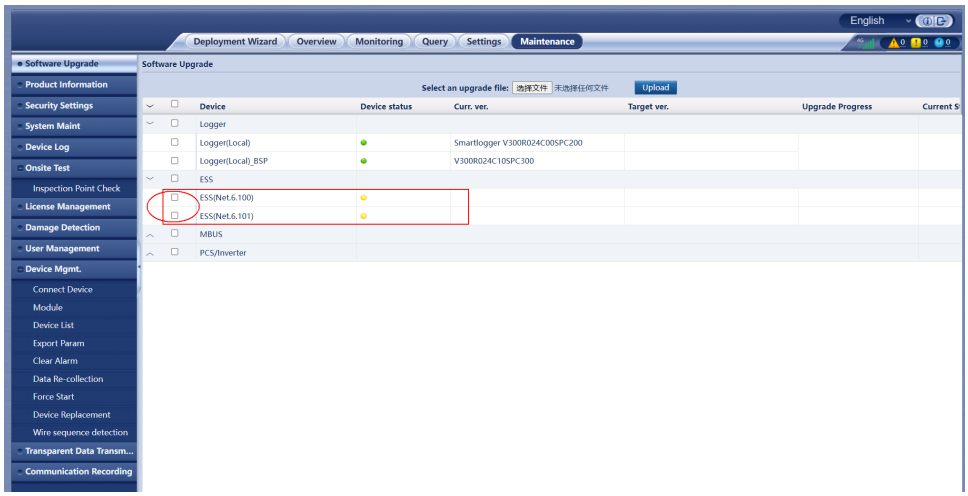
----End

3.3.3.4 Upgrading the ESS Software

Before the upgrade, ensure that the reserved SOC is greater than 15%. If the SOC is lower than 15%, charge the ESS first.

If the ESS cannot be charged onsite and the SOC is lower than 15%, perform the following operations before upgrading the software. Otherwise, the upgrade will fail. For details, see section 3.1.2.4.

Step 1 Choose **Maintenance** > **Software Upgrade** to upgrade the ESS software.

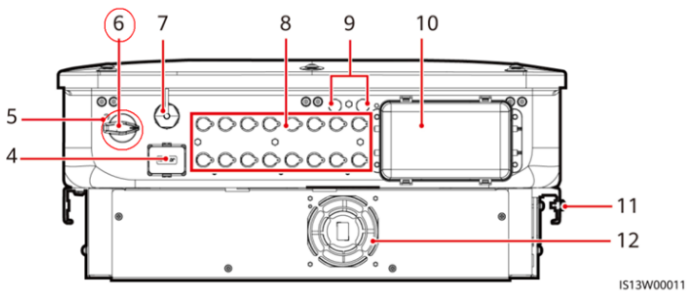


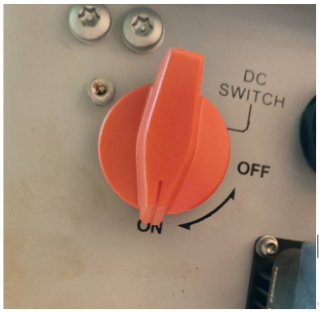
Step 2 After the upgrade is complete, check that all battery packs are connected and sorted on the **Monitoring** page. Check that the software version inconsistency alarm is cleared.

----End

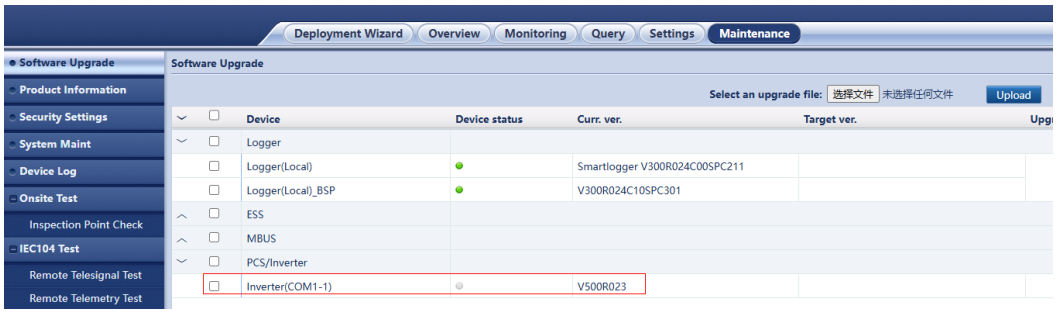
3.3.3.5 Upgrading the Inverter Software

Step 1 Start the inverter and turn on the DC switch of the inverter.

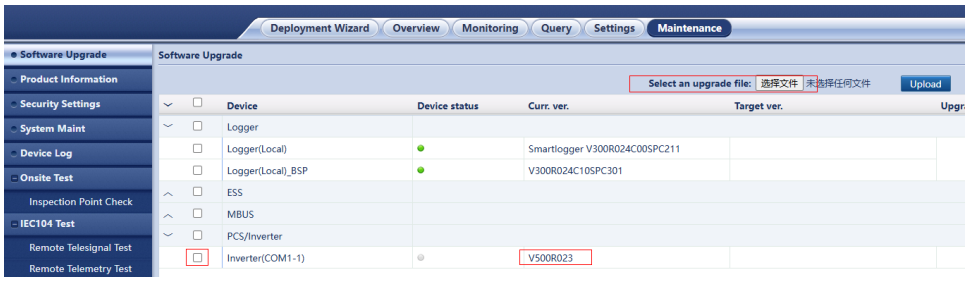




Step 2 Check the inverter connection status on the SmartLogger.



Step 3 Upgrade the inverter software.



----End

3.3.3.6 Performing Wizard-based Deployment

For details about wizard-based deployment, see **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

3.3.3.7 (Optional) Detecting Wire Sequence

This function applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs.

- In the off-grid scenario, ensure that the loads have been disconnected and then click **Starting up**.
- In the on/off-grid scenario, click **Starting up**.

Parameter	Description
Wire sequence detection status	Check the status of wire sequence detection. ● Not detected ● Testing ● Detection failed: The wire sequence detection has failed. In this case, check the **Abnormal Wire Sequence** alarm and rectify the fault based on the handling suggestions. ● If the wire sequence is consistent, no action is required. ● If the wire sequence is inconsistent, rectify the cable connection. 1. Check the phase sequence detection result. The phase sequences of multiple ESSs shall be **Positive**. If not, rectify the cable connection. 2. If the phase sequences of multiple ESSs are **Positive**, check the phase again. If the phase difference between ESSs is greater than 60°, rectify the cable connection.
Wire sequence detection time	Check the time when the wire sequence detection is complete.
Wire sequence check progress	Check the wire sequence detection progress.
Phase Sequence	Check the phase sequence detection result. The detection result can be **Positive** or **Negative**.
Phase	Check the phase detection result. The detection result range is [0, 360]°.

3.3.3.8 Setting the Inverter and ESS to Three-Phase Four-Wire Mode

Step 1 Set **Output mode** for the inverter and ESS.

- For the inverter: Choose **Monitoring** > **Inverter** > **Running Param** > **Grid Parameters**, and set **Output mode** for the inverter to **Three-phase four-wire**.
- For the ESS:
  - In the **On-grid/Off-grid (VSG)** or **On-grid/Off-grid (PQ/VSG)** scenario, choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.
  - In the **Off-grid** scenario, disconnect loads and perform black start. Then choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.

----End

3.3.3.9 Checking the Grid Code and Working Mode of the ESS

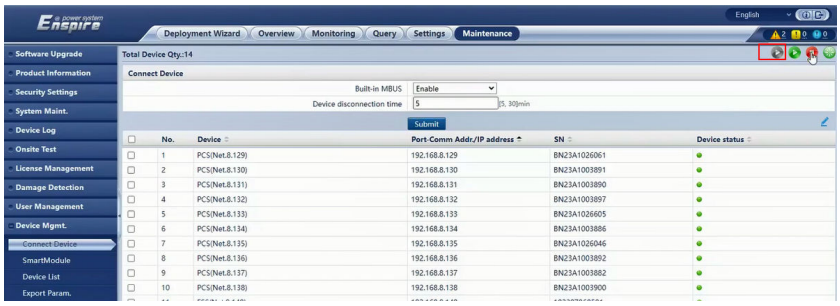
Step 1 Check whether **Grid code** and **Working mode** of the ESS are correctly set. If not, correct the settings.

- Choose **Monitoring** > **ESS** > **Running Param** > **Grid Parameters**, and check the setting of **Grid code**.
- Choose **Monitoring** > **ESS** > **Running Param** > **Feature Parameters**, and check the setting of **Working mode**.

----End

3.3.3.10 Starting the System

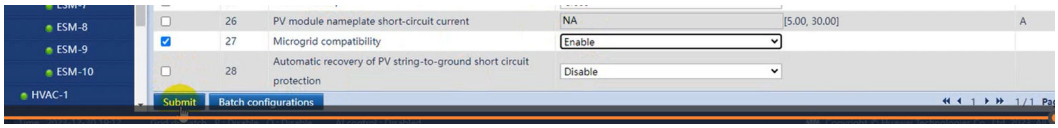
Step 1 To start the C&I ESS in off-grid mode, choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click the start icon.



----End

3.3.3.11 Checking Inverter Parameters

Step 1 Check that **Microgrid compatibility** is correctly set for the inverter (automatically set on the SmartLogger; disabled in on-grid mode and enabled in off-grid mode).

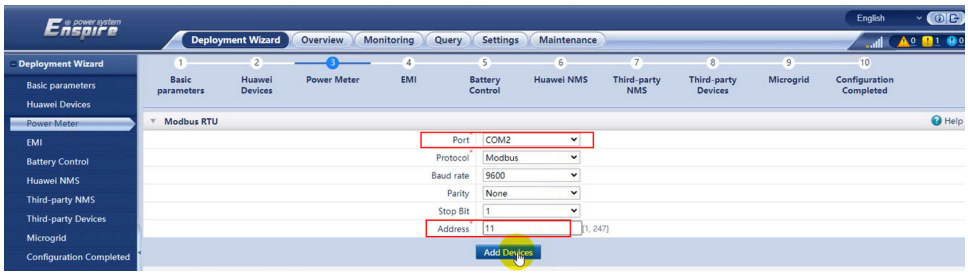


----End

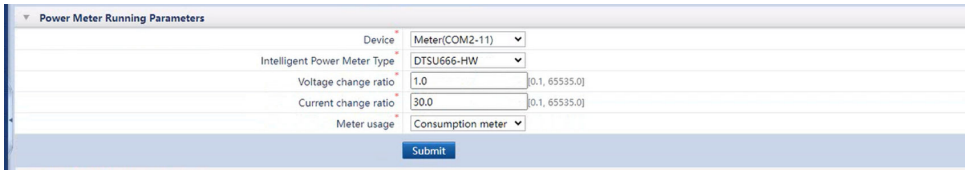
3.3.3.12 Connecting to the Meter

Step 1 Power on the meter, turn on the voltage switch on the AC side of the meter, and check the voltage, current, and power readings on the meter. The power is positive when power is supplied from the grid.

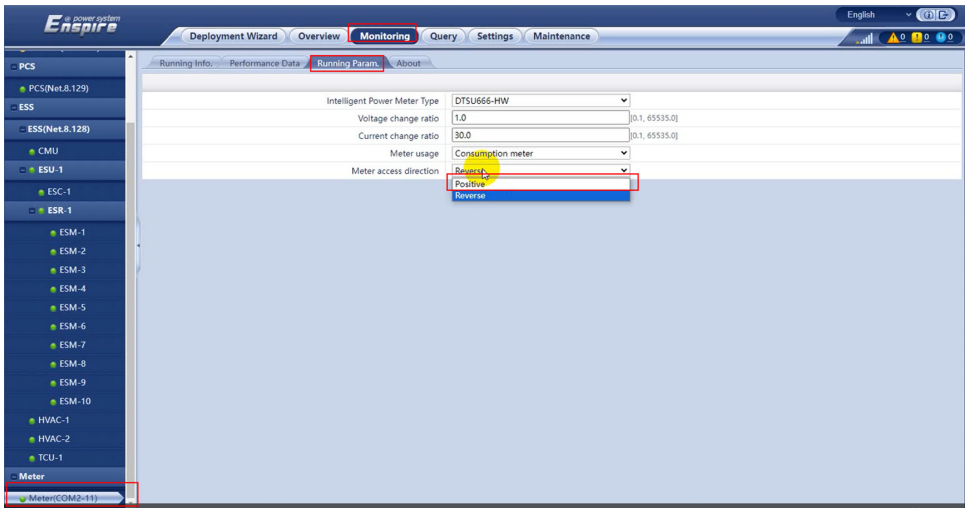
Step 2 Choose **Deployment Wizard** > **Power Meter** to set communication parameters for the meter. Set **Port** to **COM2** and set **Address** to **11**. Click **Add Devices** to connect to the meter.



Step 3 Set **Intelligent Power Meter Type** to **DTSU666-HW** or YADA-YDS60-80 (for example), **Voltage change ratio** to **1**, and **Current change ratio** based on the onsite CT ratio. If there is one ESS, the CT ratio is 150/5. In this case, set **Current change ratio** to **30**. Set **Meter usage** to **Consumption meter**.



Step 4 After the meter is connected, choose **Monitoring** > **Meter** > **Running Param.** to set the meter running parameters. Set **Meter access direction** to **Positive**.



----End

3.3.4 Parameter Setting Reference

3.3.4.1 Microgrid Control Mode

In this solution, the SmartLogger is used as the MGCC. The SmartLogger control function needs to be configured.

Step 1 Set **MGCC Mode** to **Enable**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 2 Set **Microgrid scenario** to **On-grid/Off-grid (PQ/VSG)**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**. **Scenario** under **Arrays Operation Scenario** shall be set to **On/Off-grid**.

----End

3.3.4.2 SOC Reference Value

No.	Parameter	Reference	Remarks
1	SOC upper threshold	100%	The battery pack will be bypassed when the SOC reaches this value.
2	SOC lower threshold	5%	The battery pack will be bypassed when the SOC reaches this value.

3.3.4.3 Setting Dispatch Control Parameters for the SmartLogger

Table 3-3 Dispatch control parameters

Tab	Parameter	Reference	Description
Control Policy	Automatic black start after irradiance restoration	Enable	Specifies whether to enable automatic black start after irradiance restoration. • **Enable**: Automatic black start is performed after the irradiance restores. • **Disable**: Automatic black start is not performed after the irradiance restores.
	Automatic PCS recovery	Enable	Specifies whether to enable the function of automatic recovery in case of abnormal PCS shutdown. • **Enable**: When the SmartLogger detects that the system is powered off due to abnormal PCS shutdown, it automatically attempts to restore the power supply by black start. • **Disable**: When the PCS shuts down abnormally, the SmartLogger does not perform automatic black start.
Control Policy	End-of-charge SOC (off-grid)	90%	Set the maximum SOC for charge in off-grid mode. The default value is 90%. Set this parameter as required. To ensure reliable operations of the microgrid, the recommended value range is [85, 95] and this parameter must be ≥ (**Array end-of-charge SOC** – 5%).

Tab	Parameter	Reference	Description
	End-of-discharge SOC (off-grid)	10%	Set the minimum SOC for discharge in off-grid mode. The default value is 10%. Set this parameter as required. To ensure reliable operations of the microgrid, the recommended value range is [10, 15] and this parameter must be ≥ (**Array end-of-discharge SOC** + 5%).
	Min PV voltage for black start	600 V	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. After the solar irradiance recovers, the inverter PV voltage increases. If the PV1 voltage of an inverter is greater than or equal to **Min PV voltage for black start**, the black start function may be enabled.
	Minimum estimated power for black start	70%	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. Set this parameter to a percentage of the ESS rated power. The default value is 70% of the ESS rated power. When the irradiance is restored, if the estimated PV output power of the inverter is greater than the minimum estimated power for the black start, the black start is automatically performed.
Off-grid charging control	Real-time SOC (%)	/	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	/	
Power Backup	Off-grid power backup	Enable	Set this parameter to **Enable**. The off-grid power backup function is enabled. When the SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging to maintain sufficient power for off-grid operation.
	Min. SOC for off-grid power backup (%)	40%	In on-grid mode, set **Min. SOC for off-grid power backup**. The default value is 40%. The value range is [20, 90]. The precision of the off-grid backup power SOC is 1%. This parameter is displayed when **Off-grid power backup** is set to **Enable**.

Tab	Parameter	Reference	Description
	Prioritize off-grid power backup	/	When this function is enabled, if the current ESS SOC is ≤ (Min. SOC for off-grid power backup – 3%), the ESS will be charged preferentially by the PV system or the grid.
	Draw power from grid for off-grid power backup	/	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**. • **Disable**: The ESS is not allowed to obtain power from the grid for off-grid power backup. • **Allow**: The ESS is allowed to obtain power from the grid for off-grid power backup.
	Charge power for off-grid power backup (kW)	/	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Allow**. Set the power for charging by the grid for off-grid power backup. The default value is 100 kW, and the value range is [0.0, 50000.0].

NOTE

Array end-of-charge SOC > **End-of-charge SOC (off-grid)** ≥ **Backup power SOC for peak shaving** ≥ **Min. SOC for off-grid power backup** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

3.3.5 Basic Function Tests

3.3.5.1 Testing the Wiring of the On/Off-Grid Switch

Step 1 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **General Configuration**, and set **On/Off-grid switching mode** to **No control**.

Step 2 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 3 Manually turn on or off the on/off-grid switch onsite. Then, on the SmartLogger WebUI, choose **Settings** > **Microgrid Control** > **General Configuration** > **On/Off-grid switch** and check whether **Status** changes. If yes, the DI cable connection is normal. If no, check whether the DI cable to **Switch status port** of the on/off-grid switch is properly connected.

Step 4 Choose **Settings** > **Microgrid Control** > **General Configuration** > **On/Off-grid switch** and check whether **Status** is consistent with the actual on/off-grid switch status. If no, change the setting of **DI port status** to ensure that the status is consistent.

Step 5 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Open**. Then check onsite whether the actual status of the on/off-grid switch is off. If the actual status of the on/off-grid switch is not off, check whether **Switch-off control port** is configured. If yes, check the DO cable connection to **Switch-off control port**.

Step 6 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Close**. Then check onsite whether the actual status of the on/off-grid switch is on. If the actual status of the on/off-grid switch is not on, check whether **Switch-on control port** is configured. If yes, check the DO cable connection to **Switch-on control port**.

Step 7 After the on/off grid switch inspection is complete, choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **General Configuration**, and set **On/Off-grid switching mode** to **Auto**.

----End

3.3.5.2 Testing the ESS On/Off-Grid Switching

On-Grid to Off-Grid

Step 1 Check that the ESS runs in the on-grid mode, and the PCS runs in the PQ mode.

Step 2 Turn off the upstream switch to simulate a power grid outage and trigger PV+ESS AC shutdown protection.

Step 3 Check that the SmartLogger turns off the on/off-grid switch after receiving the power failure status feedback signal.

Step 4 After the on/off-grid switch is turned off, check that the SmartLogger controls the ESS to perform black start in VSG mode and transfer to off-grid mode.

Step 5 Check that the PCS AC frequency is stable at 50 Hz or 60 Hz.

----End

Off-Grid to On-Grid

Step 1 Check that the PV+ESS system is off-grid (the on/off-grid switch is turned off or the mains fails).

Step 2 Recover the mains.

Step 3 Check that the SmartLogger receives the power failure status feedback signal (mains recovered).

Step 4 Check that the SmartLogger controls PV+ESS AC shutdown.

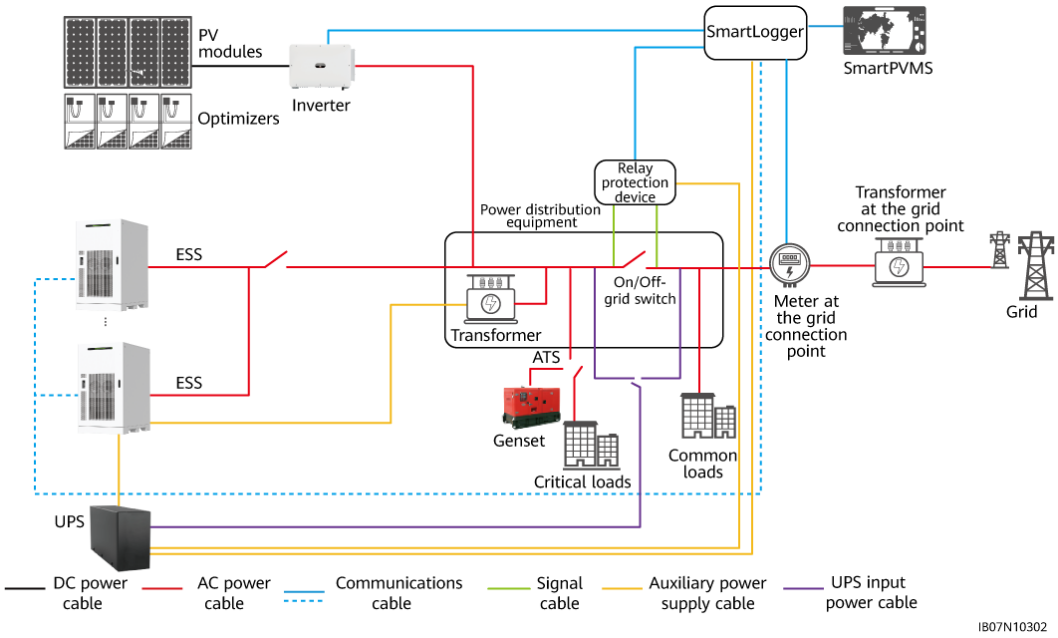
Step 5 Check that the SmartLogger turns on the on/off-grid switch.

Step 6 Check that the SmartLogger controls the PV system to start and operate in on-grid PQ mode.

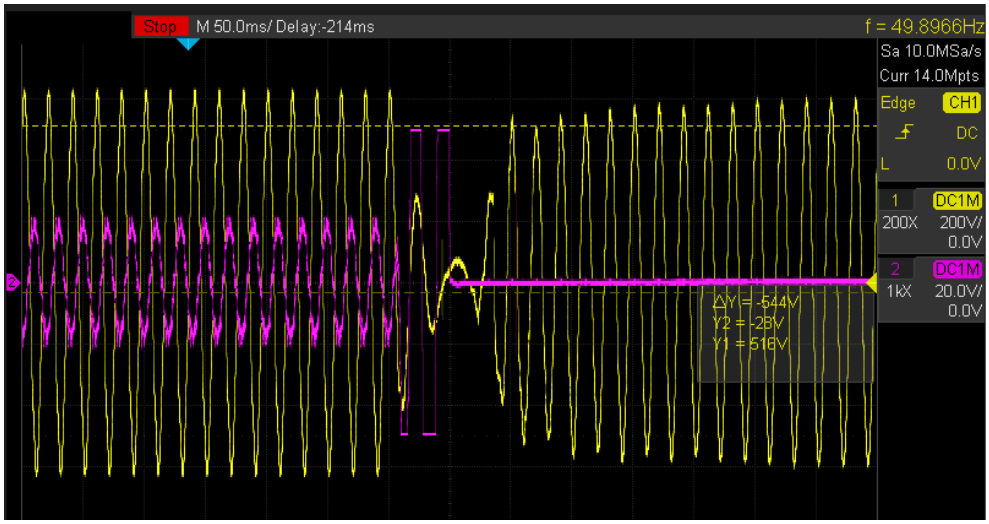
----End

3.4 C&I PV+ESS Seamless On/Off-Grid (All-Time VSG) Switching

This mode is applicable to scenarios where the grid is not stable and power outage occurs frequently. The ESS immediately switches to the off-grid mode after a grid outage occurs. The system implements on/off-grid switching through an on/off-grid switch controlled by a protective relay.



The following figure shows the voltage and current waveforms during on/off-grid switching.



CAUTION

There is a power threshold during on/off-grid switching of ESSs. If critical loads include loads such as large motors, overcurrent protection may be triggered during on/off-grid switching. As a result, the PCS fails to establish a grid. For details, see chapter 8 "Troubleshooting."

Application Constraints on Seamless On/Off-Grid Switching (All-Time VSG)

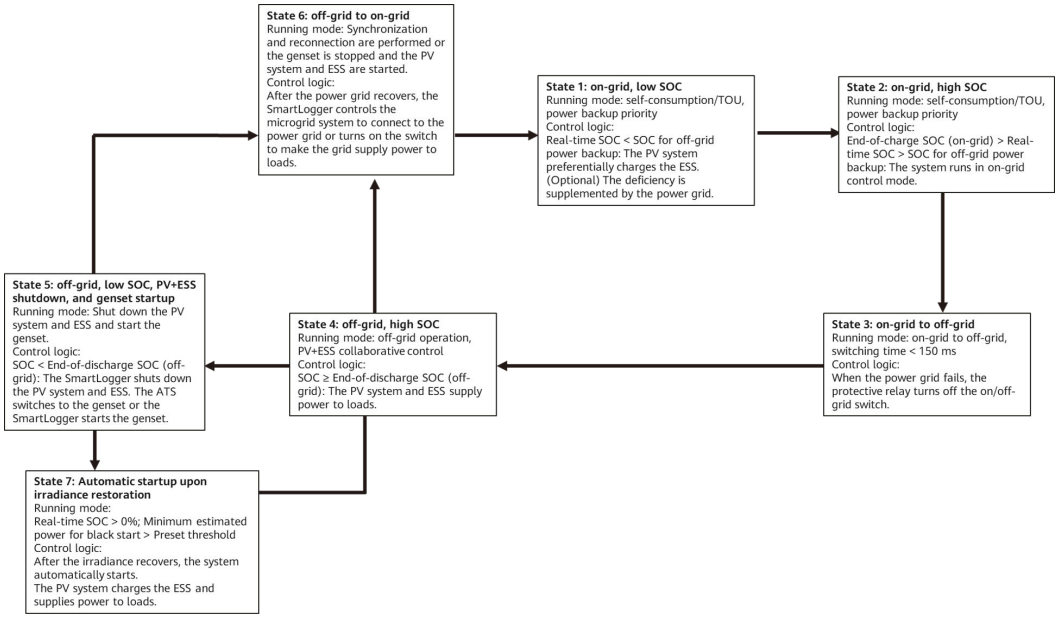
Application scenarios: Scenarios where backup power and continuous power supply are the main requirements, power supply continuity is required, and economic dispatch is not required.		
Not applicable in any of the following scenarios		
Scenario 1	Strict grid code requirements	Note: The HVRT, LVRT, islanding protection, overfrequency/ underfrequency protection, and underfrequency-caused power raising are designed to adapt to the on/off-grid switching and do not meet the grid code requirements.
Scenario 2	Zero feed-in requirement/ Feed-in energy requirement	Note: When the system runs in VSG mode, it proactively responds to the power grid frequency and voltage changes. The PCS transient power is not controlled by dispatching commands, and the maximum response power is the PCS rated power. Therefore, the VSG mode cannot be used in scenarios where dispatching is required to control the active and reactive power of the grid connection point.
Scenario 3	Demand control requirements at the grid connection point	
Scenario 4	Power factor/Reactive power control requirements for the grid connection point	
Scenario 5	When energy is fed to the utility power grid, the PCS responds to frequency and voltage changes. This will cause electricity fee/electricity loss, which is not accepted.	
Scenario 6	Scenarios with requirements on the THDi of on-grid ESSs	Note: During on-grid operation in VSG mode, the current harmonics of some loads in the power grid are absorbed due to the voltage source feature. The current THDi may exceed the threshold.
The onsite configuration shall meet the following requirements.		
DOD	It is recommended that the SOC range be 10% to 90%.	/

Power distribution capacity	Both transformer capacity and power distribution switch capacity shall be greater than 1.2 times the larger value between: Total rated capacity of the PCS + Peak load; Total rated power of the PCS + Total rated capacity of the PV inverter.	/
Mapping relationship	Refer to the standard solution mapping table. Product portfolios beyond the mapping table are unavailable.	/
Load	The load must meet the solution constraints.	The device may shut down due to overload protection if the load exceeds the limit and the power grid or load fluctuates.
During application, the performance of the following indicators may deteriorate if the power grid constraints are exceeded.		
Indicator 1	Charging duration	For example, the charging duration for reaching the target value shall be 2 hours if the pre-charged energy is 100 kWh, the charge power is set to 50 kW, and the efficiency loss is ignored. However, in VSG mode, the actual charge power fluctuates around 50 kW because the system proactively responds to the power grid frequency and voltage changes. As a result, the charging duration may be longer or shorter than 2 hours. The deterioration degree depends on the stability of the power grid.
Indicator 2	Battery life	Note: When the scheduled power of the ESS is 0, charging or discharging still occurs due to the fluctuation of the power grid frequency and voltage. As a result, the battery charge and discharge cycle occurs, which affects the battery lifespan. The impact depends on the stability of the power grid.

Power grid constraint conditions	Steady-state frequency range: fn±0.8 Hz	Note: Under the standard working conditions of the power grid, the active power dispatching precision can be stabilized to 2% within 1s, and the reactive power dispatching precision can be stabilized to 2% within 10s.
	Frequency change rate: < 1 mHz/s	
	Voltage range: Un±2% Un	

3.4.1 System Running Logic

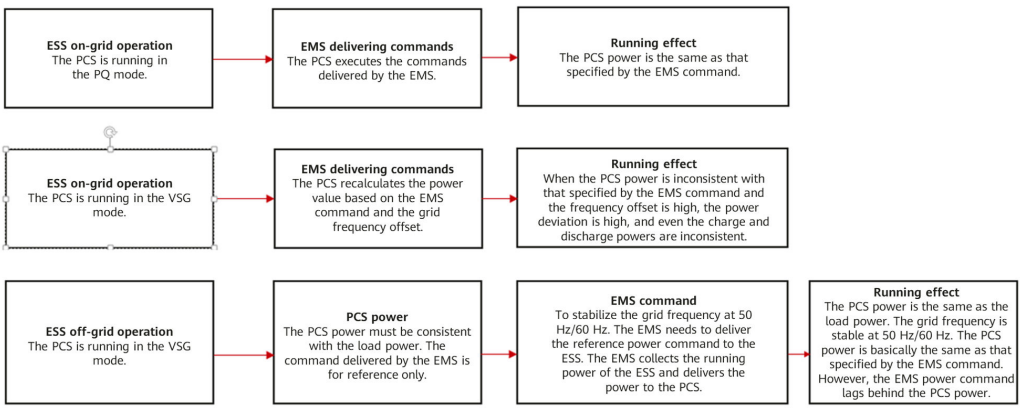
1. System running logic of the seamless on/off-grid switching solution



NOTE

After the system runs in off-grid mode, the system automatically starts after the irradiance is restored. If no controllable load switch is connected to the SmartLogger, the estimated power threshold shall be greater than the load power.

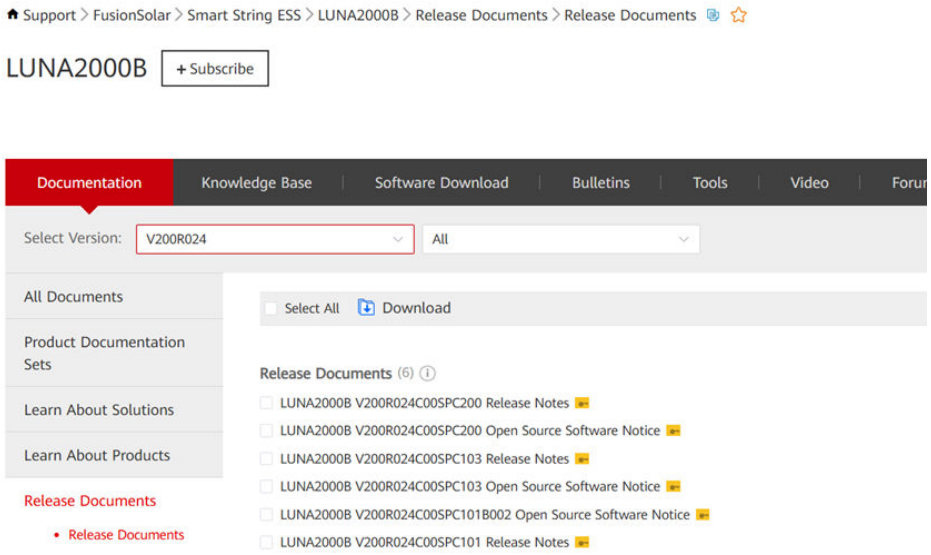
2. Control logic of dispatch control (SmartLogger as the EMS)



3.4.2 Software Version

Download the required software version before the deployment.

Software version obtaining path: For LUNA2000B, download the latest SPC software version corresponding to V200R024C00. Download the matching version of the SmartLogger and the inverter version. (**Link**)



3.4.3 Power-On and Deployment Commissioning

Power-on and deployment commissioning process

No.	Step	Description
1	Powering on the equipment	Perform deployment in on-grid mode (turn on the on/off-grid switch in the power distribution equipment). Use the UPS to supply power to the SmartLogger and ESS monitoring auxiliary power supply. 1. Turn on the power supply switch on the UPS output side. 2. For the C&I liquid-cooled ESS, see **Power-On Operations**.
2	Obtaining startup authorization	Log in to Power-Partner to obtain the startup authorization code. For details, see the service startup authorization guide.
3	Logging in to the system	Log in to the SmartLogger.
4	Upgrading the SmartLogger software	Upgrade the SmartLogger to the latest version, as some earlier versions cannot detect the ESS.

No.	Step	Description
5	Upgrading the ESS software	Upgrade the software, as there may be version mismatch between the ESS and DCDC.
6	Upgrading the inverter software	Upgrade the inverter software.
7	Performing wizard-based deployment	Set basic device parameters, search for devices, set device parameters, and set microgrid parameters.
8	(Optional) Detecting wire sequence	Applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs. In the off-grid scenario, ensure that the load has been disconnected.
10	Setting the inverter and ESS to three-phase four-wire mode	/
11	Checking the grid code and working mode of the ESS	/
12	Starting the system in on-grid mode	/
13	Checking inverter parameters and starting the inverter	/
14	Connecting to the meter	/
15	Connecting to the management system	/

3.4.3.1 Powering On the Equipment

Power on the on/off-grid PV+ESS (VSG) system when an external power supply is available.

Figure 3-3 Power-on process of the on/off-grid PV+ESS (VSG) system

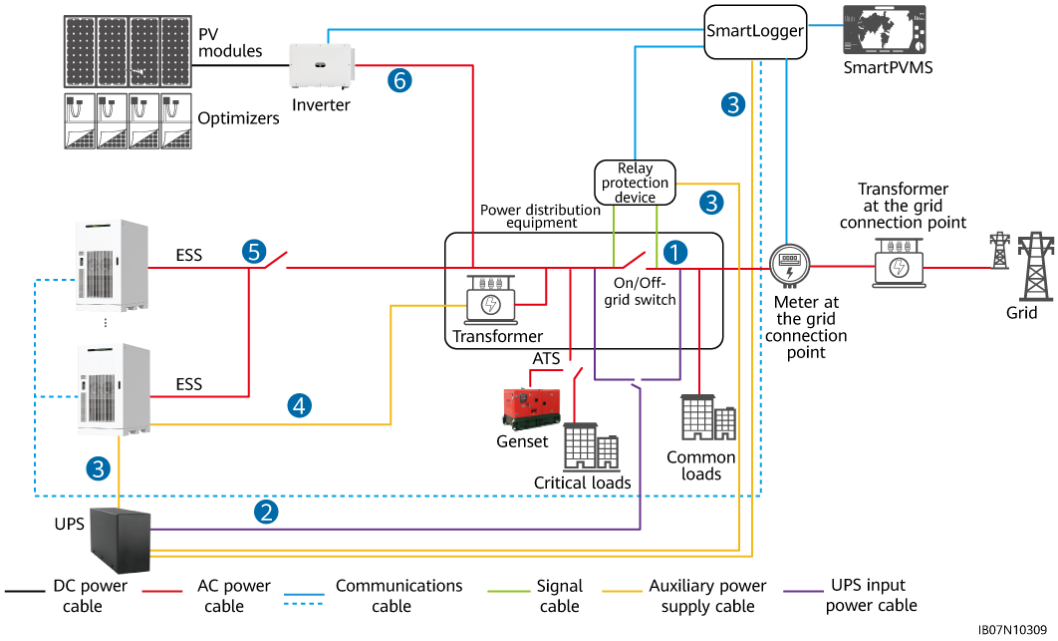


Table 3-4 Power-on process description of the on/off-grid PV+ESS (VSG) system

No.	Task	Power-On Operation
1	Powering on the power distribution equipment	Turn on the on/off-grid switch in the power distribution equipment.
2	Powering on the UPS	1. Turn on the UPS power switch on the power distribution equipment side. 2. Start the UPS.
3	Powering on the UPS-SmartLogger auxiliary power supply	1. Turn on the SmartLogger power switch on the UPS side. 2. Turn on the switch on the SmartLogger side: Turn on the power switch (if any) between the SmartLogger and the UPS based on site requirements.
	Powering on the UPS-relay protection device auxiliary power supply	Turn on the power switch of the relay protection device on the UPS side.
	Powering on the UPS-ESS auxiliary power supply (for RCM and other devices)	For details, see **Power-On Operations**.

No.	Task	Power-On Operation
4	Powering on the ESS auxiliary power supply (for LTMS and other devices)	
5	Powering on the ESS AC side	
6	Powering on the inverter	**Select a power-on method based on the inverter model.** **Method 1:** 1. Set the DC SWITCH to ON. When you hear a click, the switch is completely turned on. 2. Check that the indicators are not steady red. **Method 2:** 1. Set the DC SWITCH 1 (MAIN SWITCH) to ON. When you hear a click, the switch is completely turned on. 2. Check the status of the PV connection indicator. If it is steady green, set DC SWITCH 2 and DC SWITCH 3 to ON. 3. Check that other indicators are not steady red.
Note: For details about the switch layout and operations of the devices prepared by the customer, see the documents provided by the vendors.		

3.4.3.2 Obtaining Startup Authorization

Step 1 Set **Startup authorization code** of the ESS. Otherwise, the ESS cannot be started.

1. Use **Startup authorization verification code** to apply for **Startup authorization code**.

   NOTE

   Contact the device vendor or its authorized supervision service provider to apply for a startup authorization code through the Power Partner app.

   - Method 1: Choose **Monitoring** > **ESS** > **Running Info.** > **Basic Information** to view **Startup authorization verification code**.
   - Method 2: Choose **Deployment Wizard** > **Connect Device** to view **Startup authorization verification code**.
2. Set **Startup authorization code** of the ESS.
   - Method 1: Choose **Deployment Wizard** > **Connect Device**, and set **Startup authorization code**.

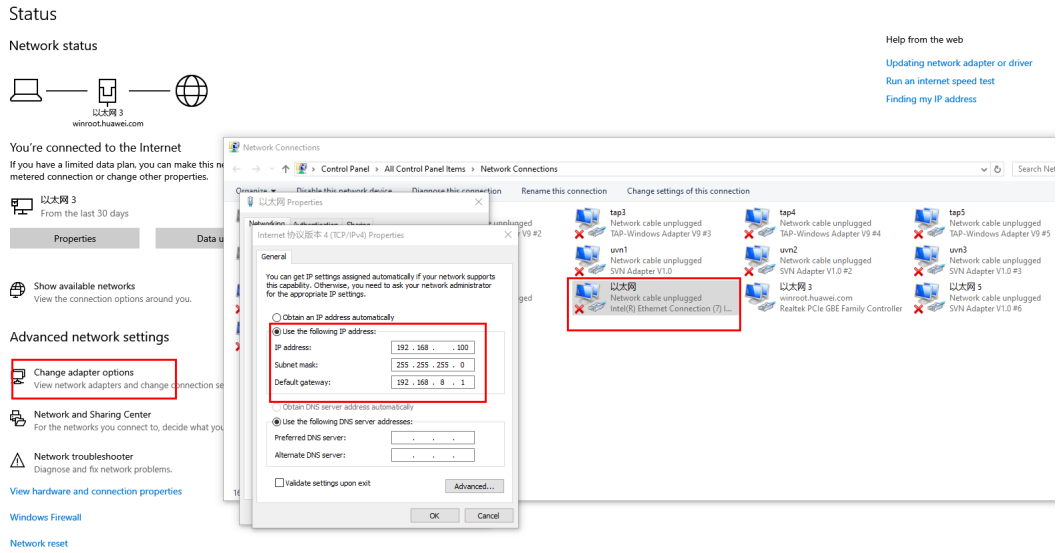
- Method 2: Choose **Monitoring** > **ESS** > **Running Param.** > **Basic Parameters**, and set **Startup authorization code**.

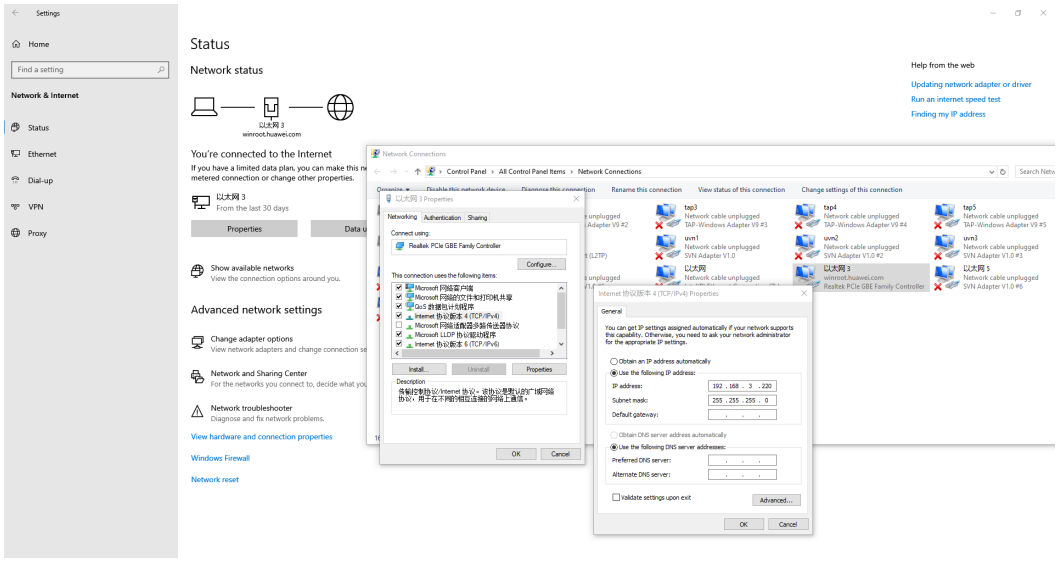
----End

3.4.3.3 Logging In to the SmartLogger and Upgrading the Software

Step 1 Set the IP address of the PC.

Recommended IP address: 192.168.0.100





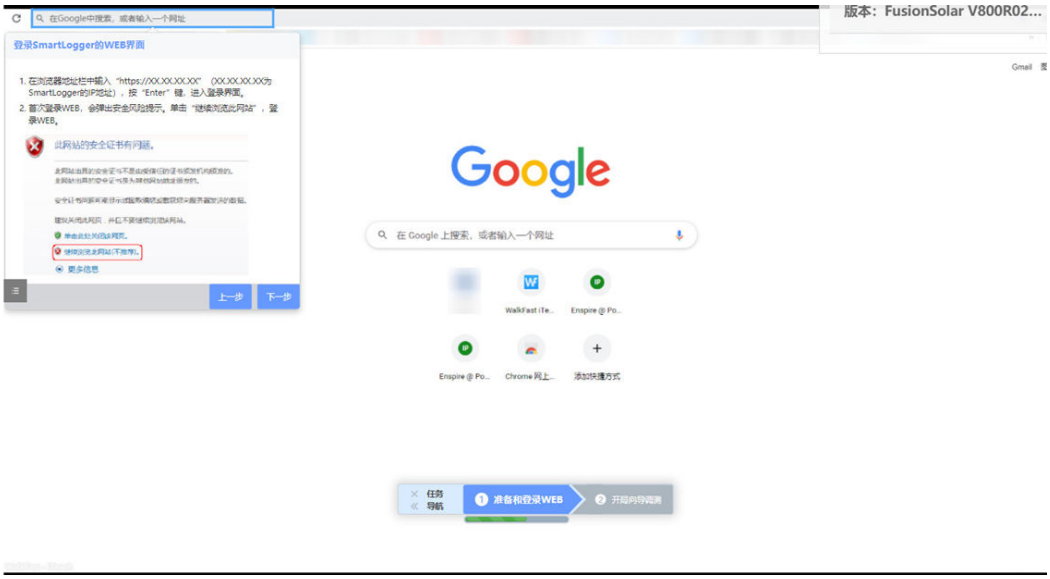
Step 2 Log in to the SmartLogger.

Connect the network port on the PC to the WAN or LAN port on the SmartLogger using a network cable.

The default IP addresses are as follows.

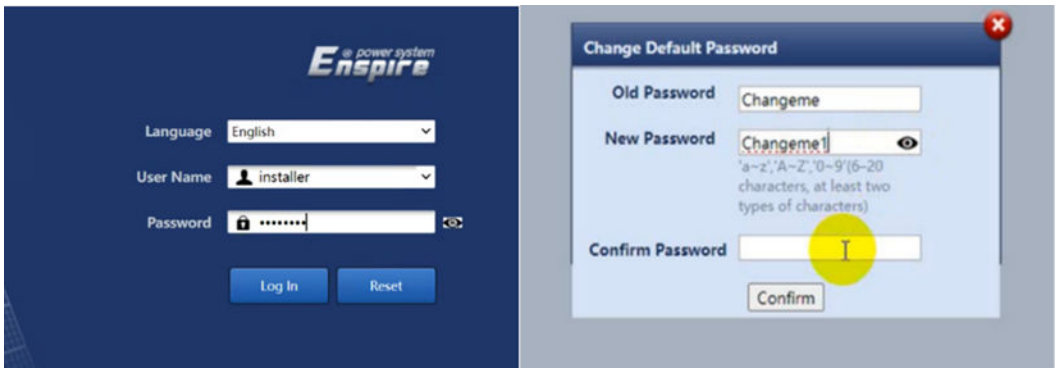
Port	Item	Default Value on SmartLogger	PC Setting Example
SmartLogger WAN port	IP address	192.168.0.10	192.168.0.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.0.1	192.168.0.1
SmartLogger LAN port	IP address	192.168.8.10	192.168.8.100
	Subnet mask	255.255.255.0	255.255.255.0
	Default gateway	192.168.8.1	192.168.8.1

In the address bar of a browser, enter **https://***XX.XX.XX.XX* (*XX.XX.XX.XX* is the IP address of the SmartLogger) and press **Enter**. The login page is displayed. If you are logging in to the WebUI for the first time, a security warning is displayed. Click **Continue to this website** to log in to the WebUI.



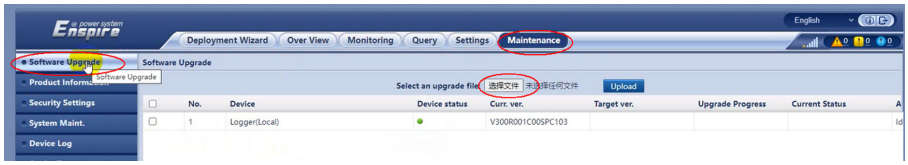
For the first login, the user name is **admin**, and the initial login password is **Changeme**.

Use the initial password upon the first power-on. After login, change the initial password and log in again. The login password contains at least eight characters.



Step 3 Upgrade the software.

Choose **Maintenance** > **Software Upgrade**.



Note: The SmartLogger software and BSP file shall be upgraded together.

If an error message is displayed during file upload, decompress the SmartLogger software package, upload the SmartLogger3000-BSP and upgrade the BSP file. Then upload the SmartLogger3000 software package and upgrade the SmartLogger software.

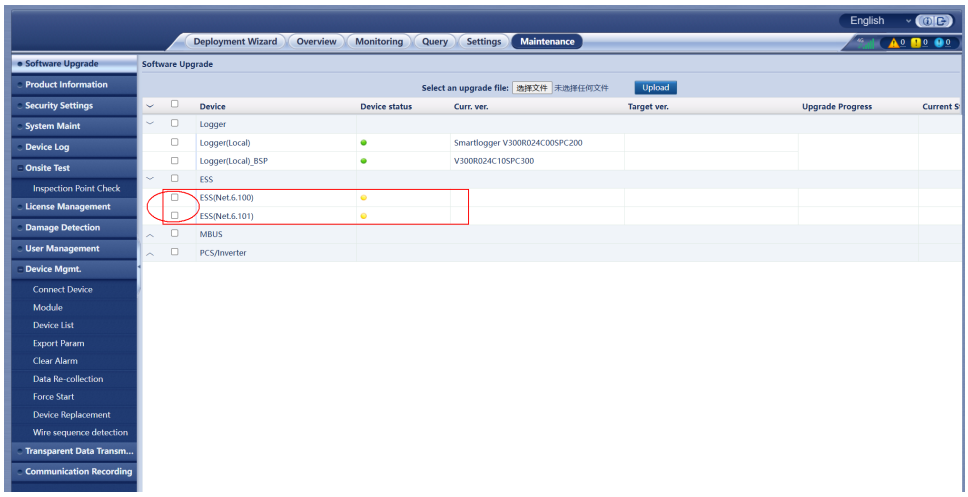
----End

3.4.3.4 Upgrading the ESS Software

Before the upgrade, ensure that the reserved SOC is greater than 15%. If the SOC is lower than 15%, charge the ESS first.

If the ESS cannot be charged onsite and the SOC is lower than 15%, perform the following operations before upgrading the software. Otherwise, the upgrade will fail. For details, see section 3.1.2.4.

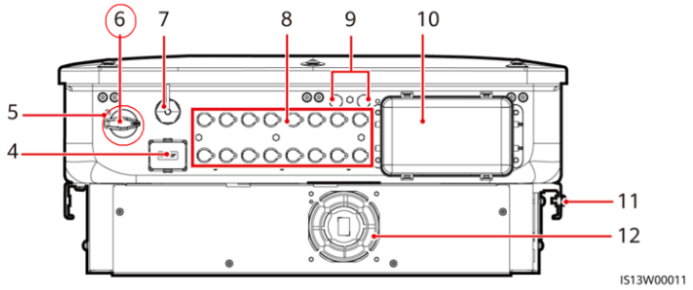
Step 1 Choose **Maintenance** > **Software Upgrade** to upgrade the ESS software.

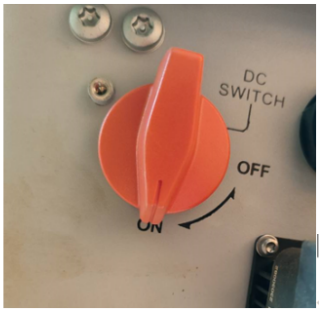


----End

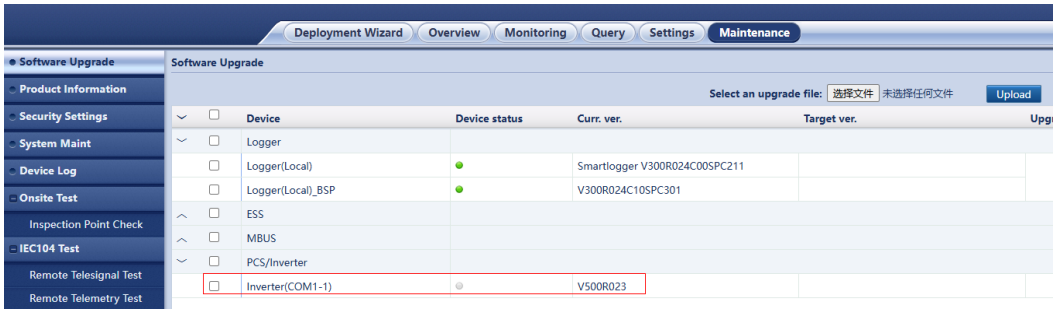
3.4.3.5 Upgrading the Inverter Software

Step 1 Start the inverter and turn on the DC switch of the inverter.

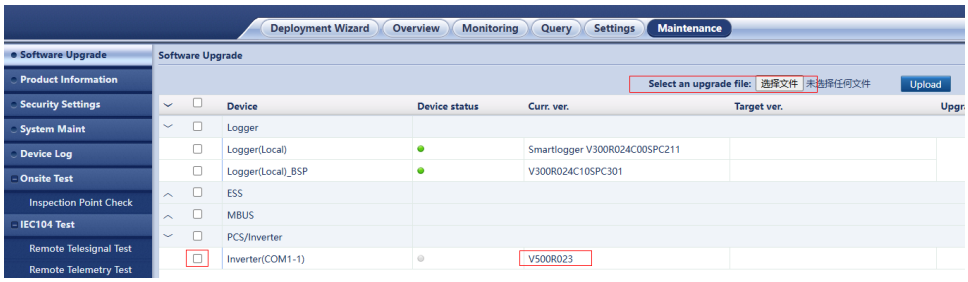




Step 2 Check the inverter connection status on the SmartLogger.



Step 3 Upgrade the inverter software.



----End

3.4.3.6 Performing Wizard-based Deployment

For details about wizard-based deployment, see **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

3.4.3.7 (Optional) Detecting Wire Sequence

This function applies only to the C&I liquid-cooled ESS in the scenario with multiple ESSs.

- In the off-grid scenario, ensure that the loads have been disconnected and then click **Starting up**.
- In the on/off-grid scenario, click **Starting up**.

Parameter	Description
Wire sequence detection status	Check the status of wire sequence detection. • Not detected • Testing • Detection failed: The wire sequence detection has failed. In this case, check the **Abnormal Wire Sequence** alarm and rectify the fault based on the handling suggestions. • If the wire sequence is consistent, no action is required. • If the wire sequence is inconsistent, rectify the cable connection. 1. Check the phase sequence detection result. The phase sequences of multiple ESSs shall be **Positive**. If not, rectify the cable connection. 2. If the phase sequences of multiple ESSs are **Positive**, check the phase again. If the phase difference between ESSs is greater than 60°, rectify the cable connection.
Wire sequence detection time	Check the time when the wire sequence detection is complete.
Wire sequence check progress	Check the wire sequence detection progress.

Parameter	Description
Phase Sequence	Check the phase sequence detection result. The detection result can be **Positive** or **Negative**.
Phase	Check the phase detection result. The detection result range is [0, 360]°.

3.4.3.8 Setting the Inverter and ESS to Three-Phase Four-Wire Mode

Step 1 Set **Output mode** for the inverter and ESS.

- For the inverter: Choose **Monitoring** > **Inverter** > **Running Param** > **Grid Parameters**, and set **Output mode** for the inverter to **Three-phase four-wire**.
- For the ESS:
  - In the **On-grid/Off-grid (VSG)** or **On-grid/Off-grid (PQ/VSG)** scenario, choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.
  - In the **Off-grid** scenario, disconnect loads and perform black start. Then choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and set **Output mode** for the ESS to **Three-phase four-wire**.

----End

3.4.3.9 Checking the Grid Code and Working Mode of the ESS

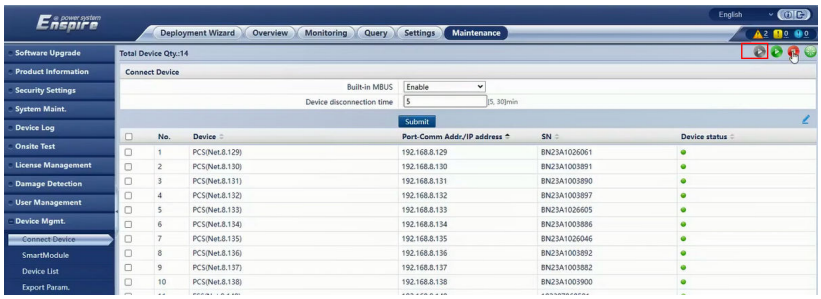
Step 1 Check whether **Grid code** and **Working mode** of the ESS are correctly set. If not, correct the settings.

- Choose **Monitoring** > **ESS > Running Param** > **Grid Parameters**, and check the setting of **Grid code**.
- Choose **Monitoring** > **ESS > Running Param** > **Feature Parameters**, and check the setting of **Working mode**.

----End

3.4.3.10 Starting the ESS

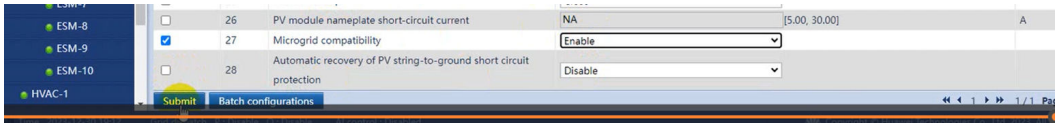
Step 1 To start the C&I ESS in off-grid mode, choose **Maintenance** > **Device Mgmt.** > **Connect Device**.



----End

3.4.3.11 Checking Inverter Parameters and Starting the Inverter

Step 1 Check that **Microgrid compatibility** is set to **Enable** for the inverter (enabled throughout the entire process).

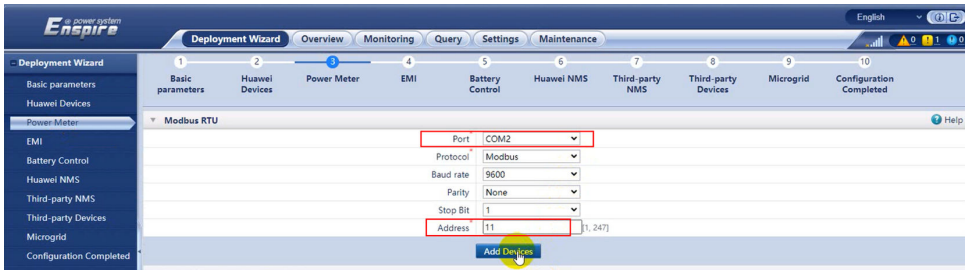


----End

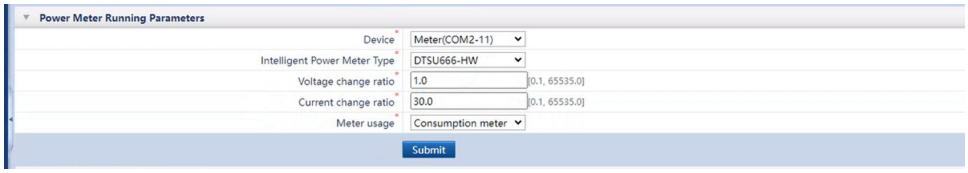
3.4.3.12 Connecting to the Meter

Step 1 Power on the meter, turn on the voltage switch on the AC side of the meter, and check the voltage, current, and power readings on the meter. The power is positive when power is supplied from the grid.

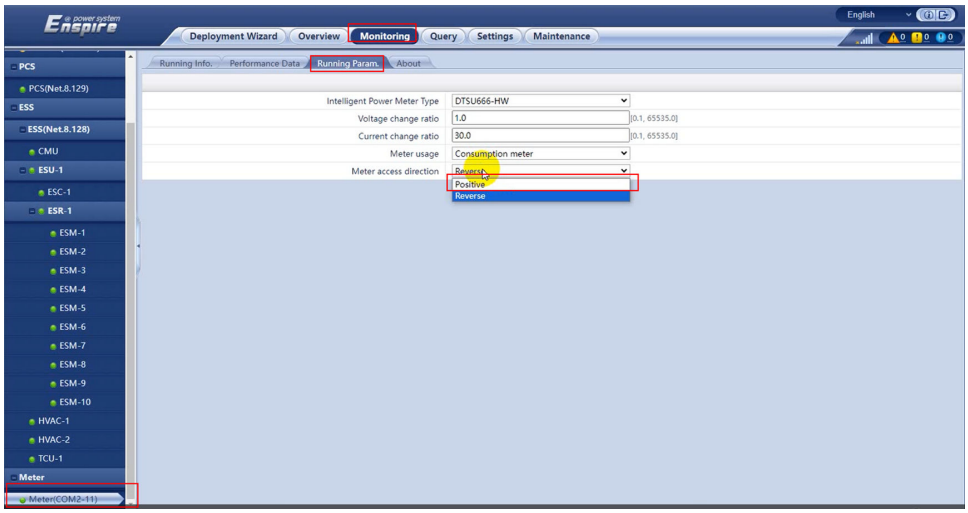
Step 2 Choose **Deployment Wizard** > **Power Meter** to set communication parameters for the meter. Set **Port** to **COM2** and set **Address** to **11**. Click **Add Devices** to connect to the meter.



Step 3 Set **Intelligent Power Meter Type** to **DTSU666-HW** or YADA-YDS60-80 (for example), **Voltage change ratio** to **1**, and **Current change ratio** based on the onsite CT ratio. If there is one ESS, the CT ratio is 150/5. In this case, set **Current change ratio** to **30**. Set **Meter usage** to **Consumption meter**.



Step 4 After the meter is connected, choose **Monitoring** > **Meter** > **Running Param.** to set the meter running parameters. Set **Meter access direction** to **Positive**.



----End

3.4.4 Parameter Setting Reference

3.4.4.1 ESS Control Mode

Step 1 Set **MGCC Mode** to **Enable**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**.

Step 2 Set **Microgrid scenario** to **On-grid/Off-grid (VSG)**. This parameter can be modified only under **Deployment Wizard** > **Microgrid** > **Microgrid**. **Scenario** under **Arrays Operation Scenario** shall be set to **On/Off-grid**

----End

3.4.4.2 SOC Reference Value

Huawei device SOC parameter settings

No.	Parameter	Reference	Remarks
1	SOC upper threshold	100%	The battery pack will be bypassed when the SOC reaches this value.
2	SOC lower threshold	5%	The battery pack will be bypassed when the SOC reaches this value.

EMS SOC parameter settings

No.	Parameter	Reference	Remarks
1	Upper SOC charge threshold	90%	Prevent the battery pack from being bypassed after it is fully charged.
2	Genset startup SOC	20%	In the off-grid mode, the genset starts when the array SOC decreases to this value.

3.4.4.3 Setting Dispatch Control Parameters for the SmartLogger

Table 3-5 Dispatch control parameters

Tab	Parameter	Reference	Description
Control Policy	Automatic black start after irradiance restoration	Enable	Specifies whether to enable automatic black start after irradiance restoration. • Enable: During off-grid operation, automatic black start is performed after the irradiance restores. • Disable: Automatic black start is not performed after the irradiance restores.
	Automatic PCS recovery	Enable	Specifies whether to enable the function of automatic recovery in case of abnormal PCS shutdown. • Enable: During off-grid operation, when the SmartLogger detects that the PCS shuts down abnormally and causes power failure, the SmartLogger automatically attempts to black start to restore the power supply. • Disable: When the PCS shuts down abnormally, the SmartLogger does not perform automatic black start.
Control Policy	End-of-charge SOC (on-grid)	90%	Set the maximum SOC for charge in on-grid mode. The default value is 90%.

Tab	Parameter	Reference	Description
	End-of-charge SOC (off-grid)	90%	Set the maximum SOC for charge in off-grid mode. The default value is 90%. Set the parameter based on the actual situation. To ensure reliable operations of the microgrid, the recommended value range is [85, 95] and this parameter must be ≤ (**Array end-of-charge SOC** – 5%).
	End-of-discharge SOC (off-grid)	10%	Set the minimum SOC for discharge in off-grid mode. The default value is 10%. Set the parameter based on the actual situation. To ensure reliable operations of the microgrid, the recommended value range is [10, 15] and this parameter must be ≥ (**Array end-of-discharge SOC** + 5%).
	Min PV voltage for black start	600 V	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. After the solar irradiance recovers, the inverter PV voltage increases. If the PV1 voltage of an inverter is greater than or equal to **Min PV voltage for black start**, the black start function may be enabled.
	Minimum estimated power for black start	70%	This parameter is displayed when **Automatic black start after irradiance restoration** is set to **Enable**. Set this parameter to a percentage of the ESS rated power. The default value is 70% of the ESS rated power. The default value is recommended. When the irradiance is restored, if the estimated PV output power of the inverter is greater than the minimum estimated power for the black start, the black start is automatically performed. To ensure stable operation after the black start is successful, the minimum estimated power for black start must be greater than the actual load power.

Tab	Parameter	Reference	Description
Off-grid charging control	Real-time SOC (%)	/	The output power of the inverter is controlled based on the current battery SOC to meet the battery charge power adjustment target. The value of **Allowed Charge Power (%)** ranges from 0 to 70. The value of SOC ranges from **End-of-discharge SOC (off-grid)** to **End-of-charge SOC (off-grid)**.
	Allowed Charge Power (%)	/	
Genset Control	Genset Auto Control	Disable	Set this parameter to **Disable** to disable the automatic control of genset startup and shutdown.
Power Backup	Off-grid power backup	Enable	Set this parameter to **Enable**. The off-grid power backup function is enabled. When the SOC is less than or equal to **Min. SOC for off-grid power backup**, the ESS stops discharging to maintain sufficient power for off-grid operation.
	Min. SOC for off-grid power backup (%)	40%	In on-grid mode, set **Min. SOC for off-grid power backup**. The default value is 40%. The value range is [20, 90]. The precision of the off-grid backup power SOC is 1%. This parameter is displayed when **Off-grid power backup** is set to **Enable**.
	Prioritize off-grid power backup	/	When this function is enabled, if the current ESS SOC is ≤ (Min. SOC for off-grid power backup – 3%), the ESS will be charged preferentially by the PV system or the grid.
	Draw power from grid for off-grid power backup	/	This parameter is displayed when **Prioritize off-grid power backup** is set to **Enable**. • **Disable**: The ESS is not allowed to obtain power from the grid for off-grid power backup. • **Allow**: The ESS is allowed to obtain power from the grid for off-grid power backup.

Tab	Parameter	Reference	Description
	Charge power for off-grid power backup (kW)	/	This parameter is displayed when **Draw power from grid for off-grid power backup** is set to **Allow**. Set the power for charging the ESS by the grid for off-grid power backup. The default value is 100 kW, and the value range is [0.0, 50000.0].

NOTE

Array end-of-charge SOC > **End-of-charge SOC (on-grid)** or **End-of-charge SOC (off-grid)** ≥ **Backup power SOC for peak shaving** ≥ **Min. SOC for off-grid power backup** > **End-of-discharge SOC (off-grid)** > **Array end-of-discharge SOC**

3.4.5 Basic Function Tests

3.4.5.1 Testing the Wiring of the On/Off-Grid Switch and Protective Relay

Step 1 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**. On the **On-grid to Off-grid** tab page, set **Switch to Off-grid** to **Disable**. On the **Off-grid to On-grid** tab page, set **Off-grid to on-grid** to **Disable**.

Step 2 Choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 3 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Open**. Then check whether **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If not, check whether the configuration or cable connection of the relay protection device is correct.

Step 4 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching** > **On/Off-grid switch control** and click **Close**. Then check whether **Status of switch at grid connection point** is consistent with the actual status of the on/off-grid switch. If not, check whether the configuration or cable connection of the relay protection device is correct.

Step 5 After the on/off grid switch inspection is complete, choose **Maintenance** > **Device Mgmt.** > **Connect Device** and click  .

Step 6 Choose **Settings** > **Microgrid Control** > **On/Off-grid switching**. On the **On-grid to Off-grid** tab page, set **Switch to Off-grid** to **Enable**. On the **Off-grid to On-grid** tab page, set **Off-grid to on-grid** to **Enable**.

Step 7 Choose **Monitoring** > **RELAY** > **Telemetering**, and check whether the cable connection for the potential transformer of the relay protection device is normal based on the analog parameters on the grid side and microgrid side.

1. Check whether the values of **UA of Grid**, **UB of Grid**, and **UC of Grid** are consistent with the rated voltages of the local power grid. If they are inconsistent, check whether the cable connection for the potential transformer is normal.
2. Check whether the values of **UAB of Grid**, **UBC of Grid**, and **UAC of Grid** are consistent with the rated voltages of the local power grid. If they are inconsistent, check whether the cable connection for the potential transformer is normal.
3. Check whether the value of **UAB of Microgrid** is consistent with that of **UAB of Grid** for the ESS. If they are inconsistent, check whether the cable connection for the potential transformer is normal.
4. Check whether the value of **Frequency of Microgrid** is consistent with that of **Frequency of Grid** for the ESS. If they are inconsistent, check whether the cable connection for the potential transformer is normal.

----End

3.4.5.2 Setting Protection Parameters

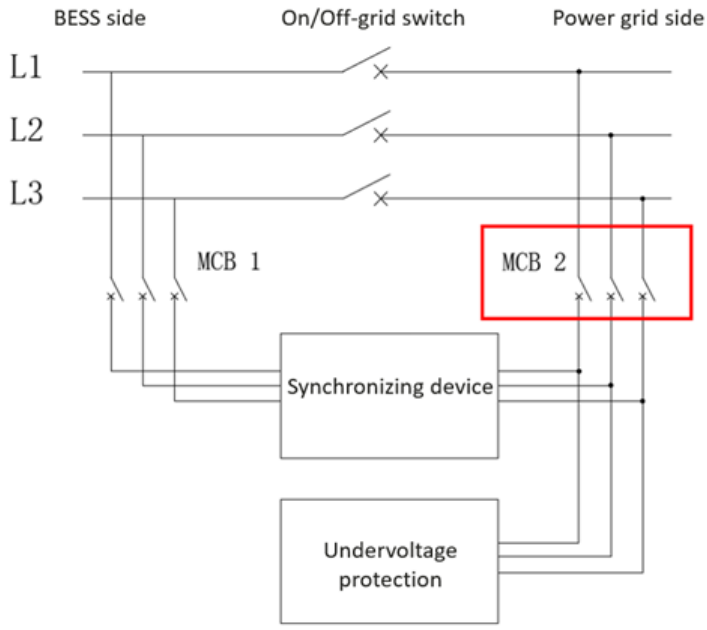
Ensure that the protection function of the protective relay is correctly configured and meets the solution configuration requirements. For details, see the **LUNA2000-(107-215) Series Commercial and Industrial Microgrid Energy Storage Solution User Manual**.

3.4.5.3 Testing the ESS On/Off-Grid Switching (Simulating a Grid Outage)

On-Grid to Off-Grid

Step 1 Check that the ESS runs in the on-grid mode, and the PCS runs in the VSG mode. Check that the grid connection point switch is turned on through the SmartLogger.

Step 2 Simulate a grid outage. In the on/off-grid switch cabinet, manually turn off the voltage sampling switch on the grid side (MCB 2 in the following figure). The moment the switch is turned off, undervoltage protection is triggered and the on/off-grid switch is turned off. The off-grid power supply is restored immediately (the indicator blinks once).



Step 3 Check the PCS voltage and frequency on the SmartLogger. The line voltage is about 400 V, and the frequency is stable at 50 Hz/60 Hz.

Step 4 Check the dispatch command delivered by the EMS on the SmartLogger. The EMS delivers the power value to the ESS to ensure that the ESS obtains power reference and stabilizes the frequency at 50 Hz/60 Hz.

Step 5 Check the status of the on/off-grid switch on the SmartLogger. The switch shall be turned off.

----End

Off-Grid to On-Grid

Step 1 Simulate the grid restoration. In the on/off-grid switch cabinet, manually turn on the voltage sampling switch on the grid side (MCB 2 in the following figure).

Step 2 The EMS delivers a synchronization command to the synchronizing device. After a while, the synchronizing device delivers a command and the on/off-grid switch automatically turns on.

Step 3 Check the dispatch command delivered by the EMS on the SmartLogger and check that the ESS completely executes the command.

Step 4 Check the status of the on/off-grid switch on the SmartLogger. The switch shall be turned on.

----End

4 ESS Performance Tests

Generally, the performance of an ESS is tested and verified by a third party.

Communicate with customers in advance and make a test plan to avoid the customers' self-testing, which may cause serious deviation of test results.

Some tests require special instruments, such as oscilloscopes. Communicate the requirements with customers in advance.

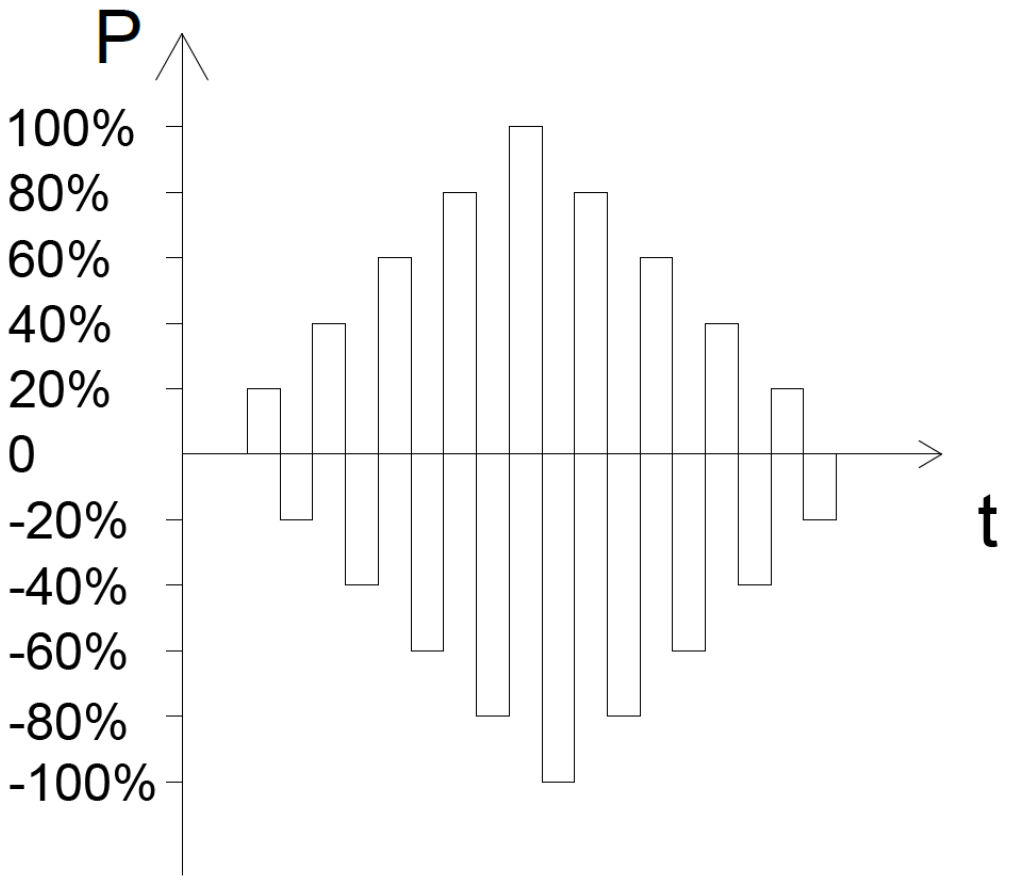
4.1 Charge/Discharge Switching Test

Test the charge and discharge capabilities of an ESS.

4.1.1 Test Content

Periodically deliver charge or discharge commands at different powers to verify the charge and discharge capabilities of the ESS at different powers.

The following figure shows the power waveform.



4.1.2 Test Device

You can use the EMS to perform the test and view the power diagram on the EMS.

4.1.3 Test Method

Step 1 Set **Working mode** in the **Battery Control** area to **Charge/Discharge based on grid dispatch**.

Step 2 Deliver a discharge command on the EMS to discharge batteries to 50% SOC. Check that the SOC of each battery rack is about 50%.

Step 3 Set the charge and discharge process on the EMS (processed by the EMS supplier). After the EMS delivers a command, the ESS automatically charges and discharges batteries based on the charge/discharge command.

Step 4 Check charge/discharge curves. If the curves are normal, the test is completed.

----End

4.1.4 Precautions

1. One day before the test, charge the ESS to 100% to complete the SOC calibration.

2. Before the test, disable the frequency response function of the PCS, and disable functions such as overfrequency-caused power derating and underfrequency-caused power raising. Restore the functions after the test is completed.

3. Disable the SOC and SOH calibration functions to avoid power tilt caused by automatic calibration.

4.2 Constant-Power Charge/Discharge Test

Test the constant-power charge and discharge capabilities of an ESS for a period of time. A single test usually takes 10 minutes. This test is frequently performed in frequency regulation scenarios.

4.2.1 Test Content

When the SOC is 50%, charge the batteries at full power for 10 minutes.

When the SOC is 50%, discharge the batteries at full power for 10 minutes.

4.2.2 Test Device

You can use the EMS to perform the test and view the power diagram on the EMS.

4.2.3 Test Method

Step 1 Set **Working mode** in the **Battery Control** area to **Charge/Discharge based on grid dispatch**.

Step 2 Deliver a discharge command on the EMS to discharge batteries to 50% SOC. Check that the SOC of each battery rack is about 50%.

Step 3 The EMS delivers a command to charge the ESS at the rated power. The charge stops after 10 minutes. Check the power curve. The power curve should remain unchanged within 10 minutes.

Step 4 Deliver a discharge command on the EMS to discharge batteries to 50% SOC. Check that the SOC of each battery rack is about 50%.

Step 5 The EMS delivers a command to discharge the ESS at the rated power. The discharge stops after 10 minutes. Check the power curve. The power curve should remain unchanged within 10 minutes. The test is completed.

----End

4.2.4 Precautions

1. One day before the test, charge the ESS to 100% to complete the SOC calibration.

2. Before the test, disable the frequency response function of the PCS, and disable functions such as overfrequency-caused power derating and underfrequency-caused power raising. Restore the functions after the test is completed.

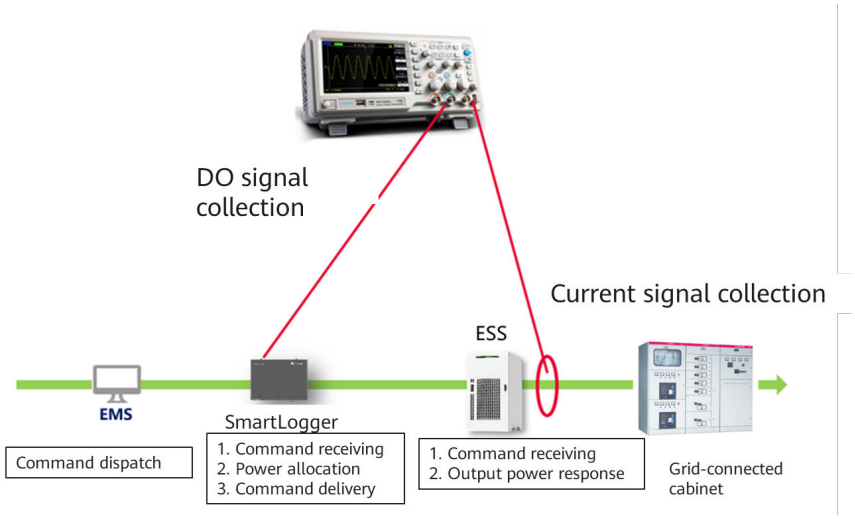
3. Disable the SOC and SOH calibration functions to avoid power tilt caused by automatic calibration.

4.3 Power Response Speed Test

Test the duration from the time when the ESS receives a power command to the time when the power reaches 90% of the power specified by the command.

4.3.1 Test Content

Deliver a command to charge/discharge the ESS at rated power. Use an oscilloscope to test the duration from the time when the SmartLogger receives the command to the time when the power meets the requirement.

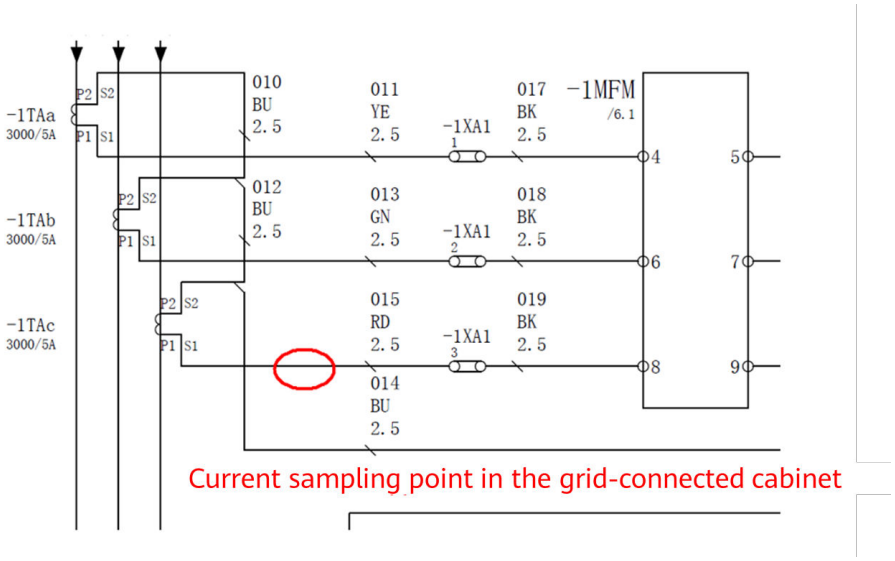


4.3.2 Test Device

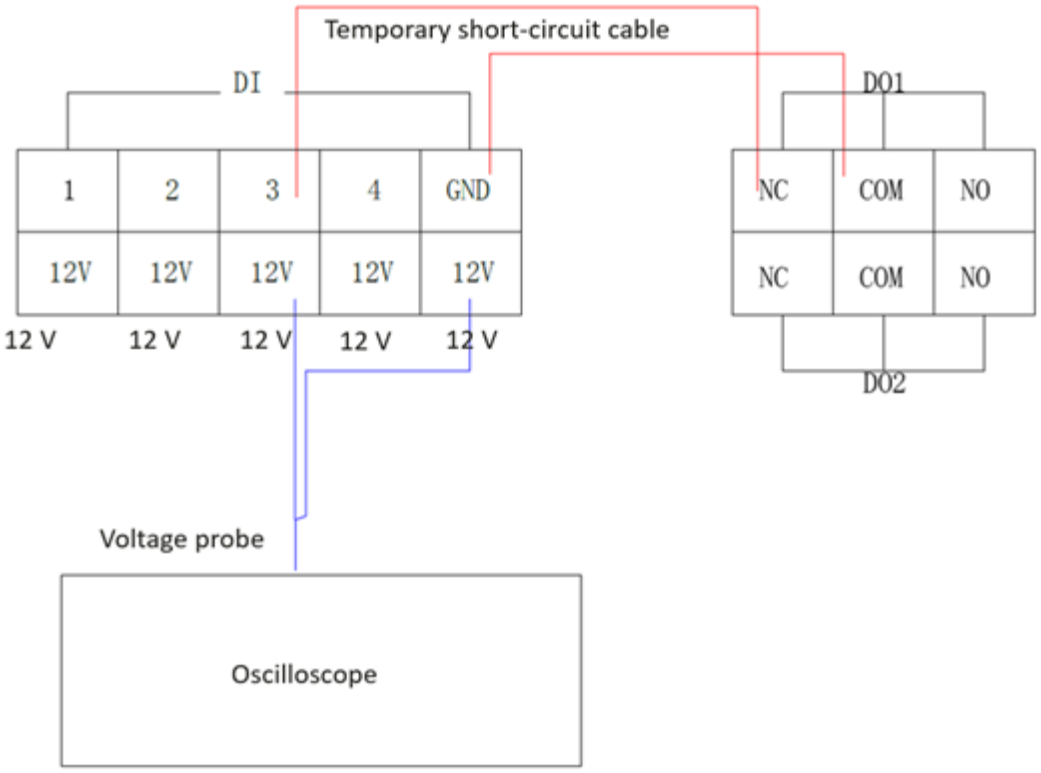
Oscilloscope, including the voltage probe and current probe.

4.3.3 Test Method

Step 1 Connect the current probe of the oscilloscope to the secondary side of the CT in the low-voltage grid-connected cabinet to measure the current.



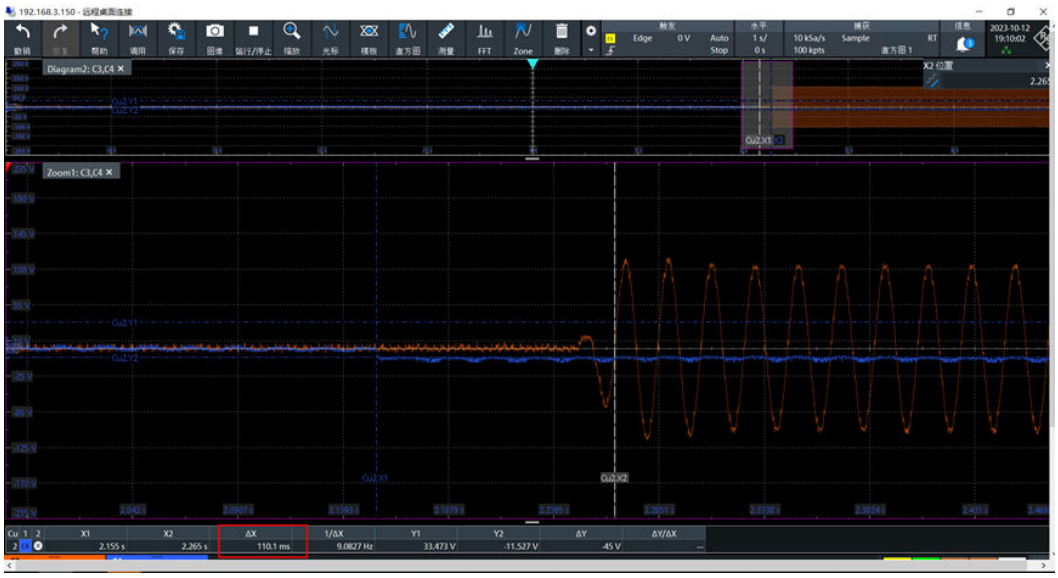
Step 2 Connect the voltage probe of the oscilloscope to the DO2 port (only this port is supported) of the SmartLogger. After the SmartLogger receives a dispatch command, the signal of the DO port of the SmartLogger is inverted. Use the oscilloscope to measure the power inversion time.



Step 3 The EMS delivers a 0 power command to the SmartLogger. Check the dispatch command in the lower right corner of the SmartLogger WebUI and the value should be 0.

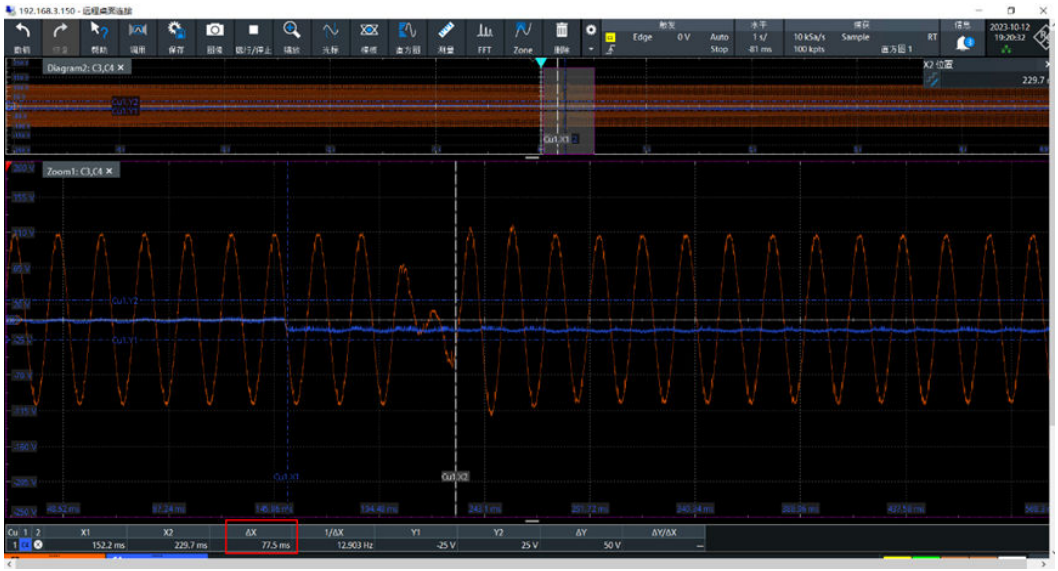
Step 4 Start the oscilloscope.

Step 5 The EMS delivers a command to charge the ESS at rated power (from 0 power to charging). Check the waveform on the oscilloscope. Measure the duration from the time when the DO starts to change to the time when the waveform reaches 90% of the current, that is, the power response time of the ESS.



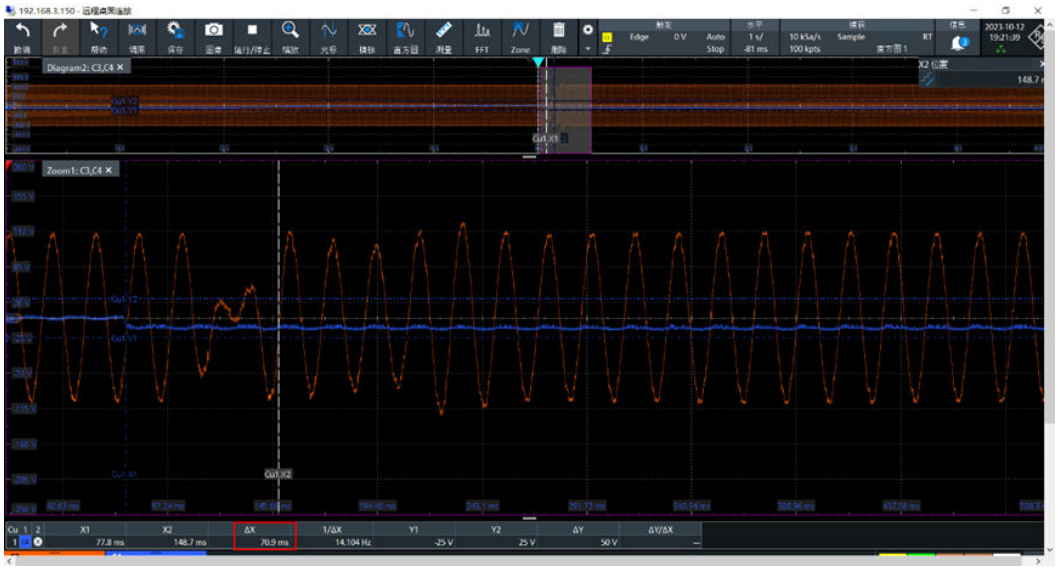
In this waveform, the duration from the time when the power is reversed to the time when the charge power increases to 90% rated power is 110 ms.

Step 6 The EMS delivers a command to discharge the ESS at rated power (from charging to discharging). Check the waveform on the oscilloscope.



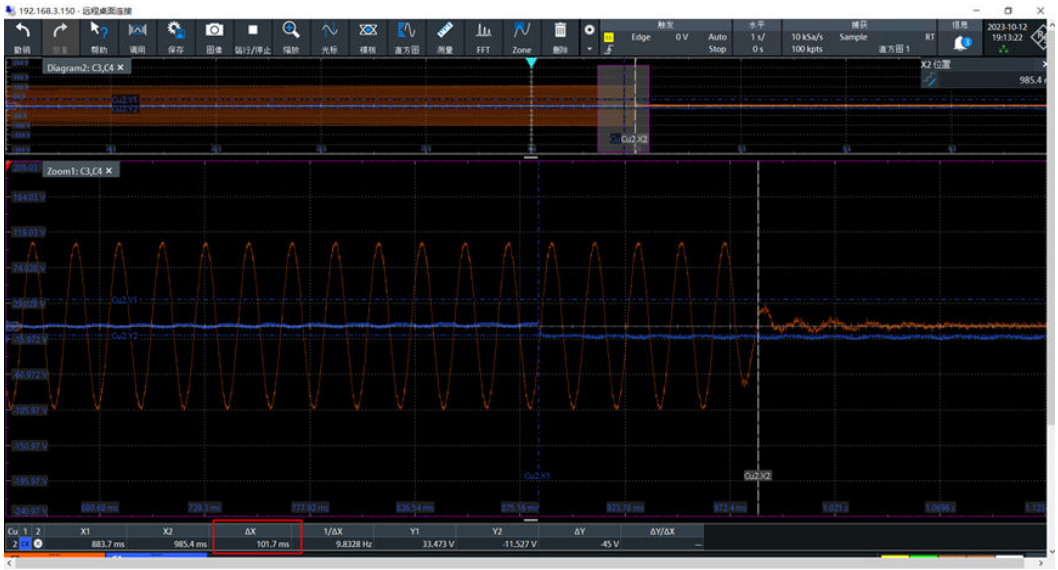
In this waveform, the duration from the time when the power is reversed to the time when the discharge power increases to 90% rated power is 77 ms.

Step 7 The EMS delivers a command to charge the ESS at rated power (from discharging to charging). Check the waveform on the oscilloscope.



In this waveform, the duration from the time when the power is reversed to the time when the charge power increases to 90% rated power is 71 ms.

Step 8 The EMS delivers a 0 power command (from charging to 0 power). Check the waveform on the oscilloscope.



In this waveform, the duration from the time when the power is reversed to the time when the power becomes 0 is 101 ms.

----End

4.3.4 Precautions

1. During the test, adjust the SOC to the middle area to prevent charge derating or optimizer bypass after full charge due to high SOC.

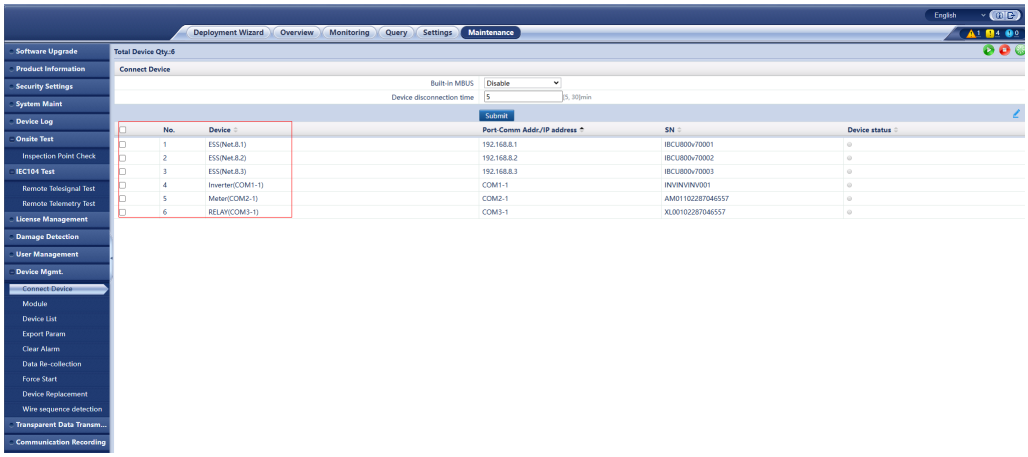
2. Before the test, disable the frequency response function of the PCS, and disable functions such as overfrequency-caused power derating and underfrequency-caused power raising. Restore the functions after the test is completed.

3. Disable the SOC and SOH calibration functions to avoid power tilt caused by automatic calibration.

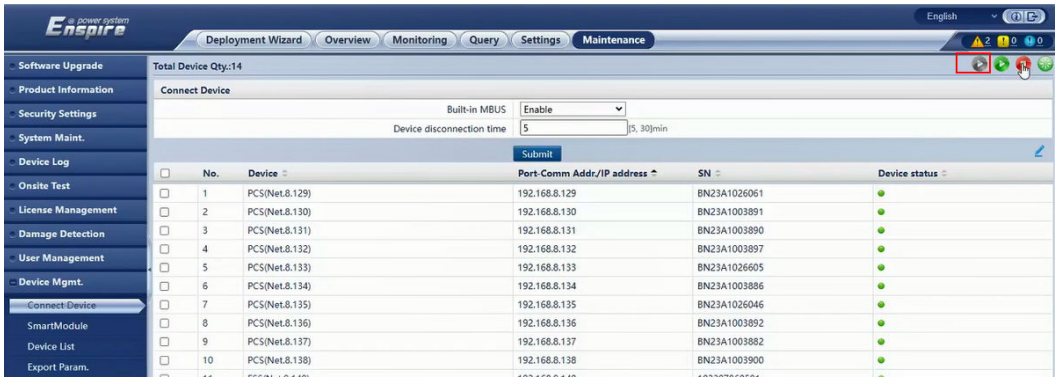
5 Routine O&M

5.1 ESS Startup and Shutdown

Array startup/shutdown: All inverters and ESSs in the array are started or shut down, regardless of the devices selected in the device list.



Black start: The array-level black start can be performed in off-grid scenarios.



5.2 Spare Parts Replacement

For details about how to replace C&I ESS spare parts, see **LUNA2000-(107-215) Series Smart String ESS Maintenance Manual**.

5.3 Guide for Handling Long-Time ESS Power Failure

Batteries in an ESS discharge slowly during storage. Long-term storage may cause battery overdischarge and damage.

After an ESS is powered off, the fire suppression system (optional for some models) is powered by its lead-acid batteries for about two days. If the power failure lasts for more than two days, the batteries may be overdischarged and scrapped.

5.3.1 Short-Time Power Failure Within 2 Days

No further action is required. If the power failure lasts for more than two days, disconnect the batteries of the fire suppression system on the second day. Otherwise, the batteries will continue to discharge and be scrapped.

5.3.2 Long-Time Power Failure for Two Days to 1 Month

Charge the batteries to 30% SOC and disconnect the batteries of the fire suppression system after the power failure.

5.3.3 Long-Time Power Failure for More than 1 Month

Charge the batteries to more than 50% SOC. Disconnect the batteries of the fire suppression system after the power failure. Place more than 2 kg desiccant in each ESS and replace the desiccant every three months.

6 Information Collection and Quick Streamlining

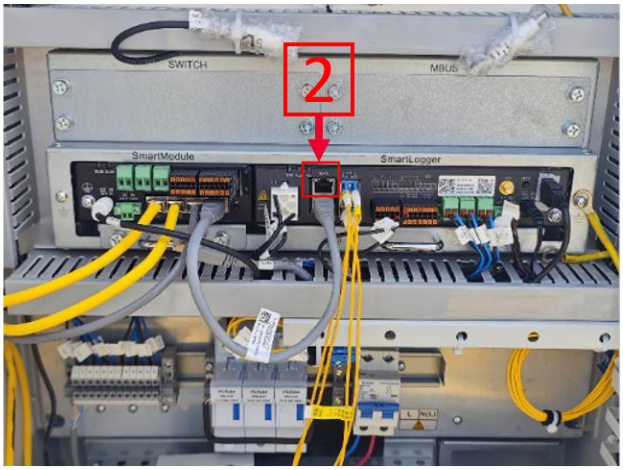
If an exception occurs in the ESS, perform the following operations to export data or contact the HQ to remotely locate the fault.

6.1 Log and Data Export

This section describes how to export logs and data from the SmartLogger.

Preparations and System Login

Step 1 Locate the SmartLogger at the site and open it using a T30 hex torx screwdriver.



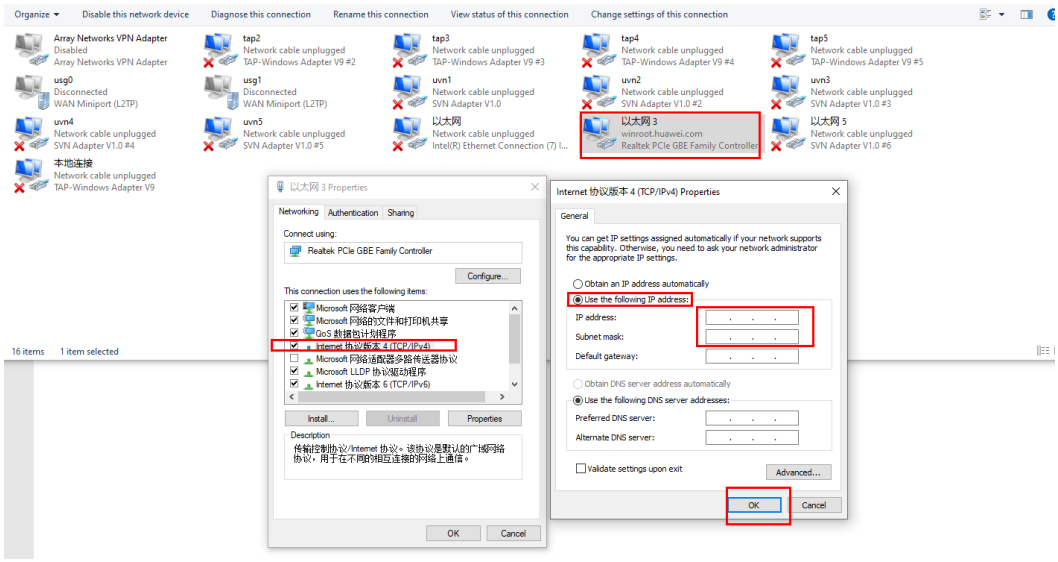
Step 2 Connect one end of a network cable to the WAN port of the SmartLogger and the other end to a PC.

Step 3 Click the **Network** icon in the lower right corner of the desktop.

Step 4 In the navigation pane, click **Network & Internet**.

Step 5 Click **Ethernet**.

Step 6 Click **Change adapter options**.



Step 7 Click **Ethernet 2**. (The displayed name may vary according to the PC. Select **Ethernet** or **Local Connection** with a network cable.)

Step 8 Double-click **Attributes**.

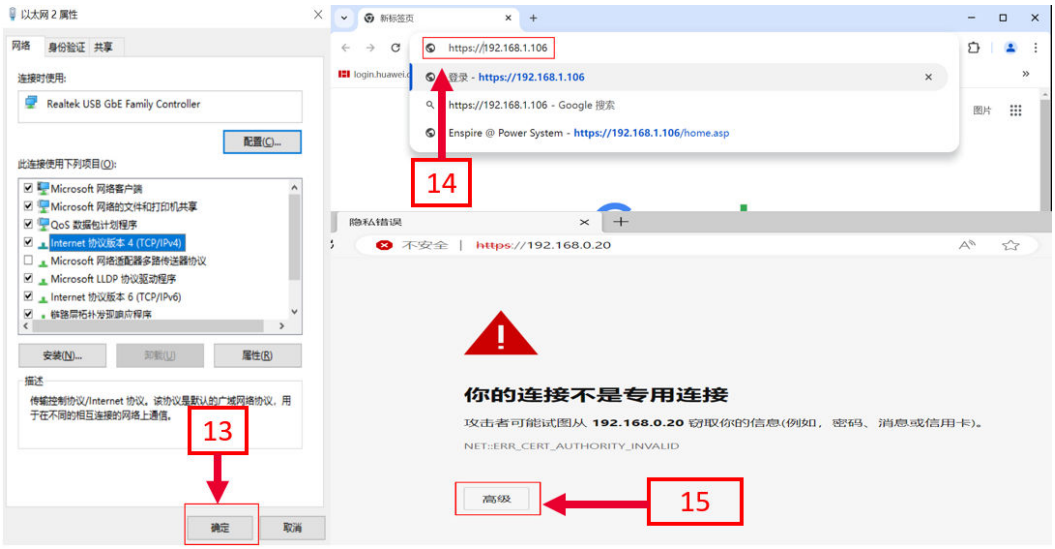
Step 9 Double-click **Protocol Version 4**.

Step 10 Select the **Use the following IP address** option box.

Step 11 Enter the IP network segment of the SmartLogger. For example, if the IP address of the SmartLogger is 192.168.0.20, you can enter **192.168.0.210**. (You are advised to change the last digits to 200–230 to avoid IP address conflicts.)

Step 12 The value is automatically generated when you click the box. Use the default value.

Step 13 Click **OK**.



Step 14 Click **OK**.

Step 15 Open a browser (Google Chrome is recommended) and enter the SmartLogger IP address. (Note that the IP address must be prefixed with **https://**.)

Step 16 Click **Advanced**.

Step 17 Click **Continue**.

Step 18 Select a language (**English** by default).

Step 19 Select or enter a username in the **Username** area.

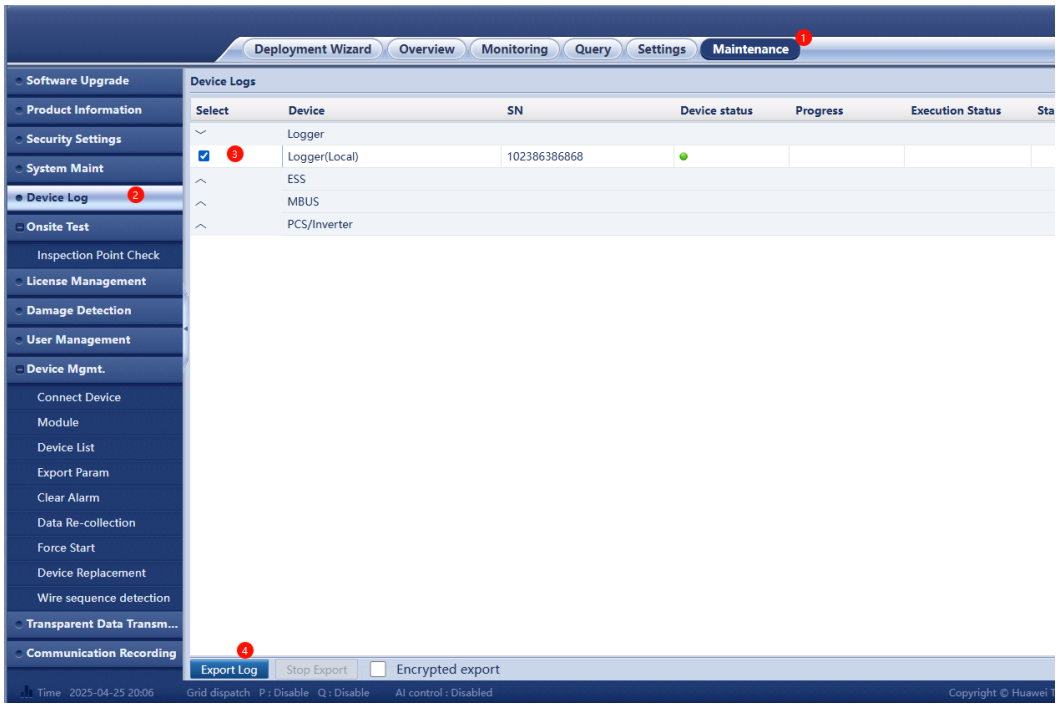
Step 20 Enter the password.

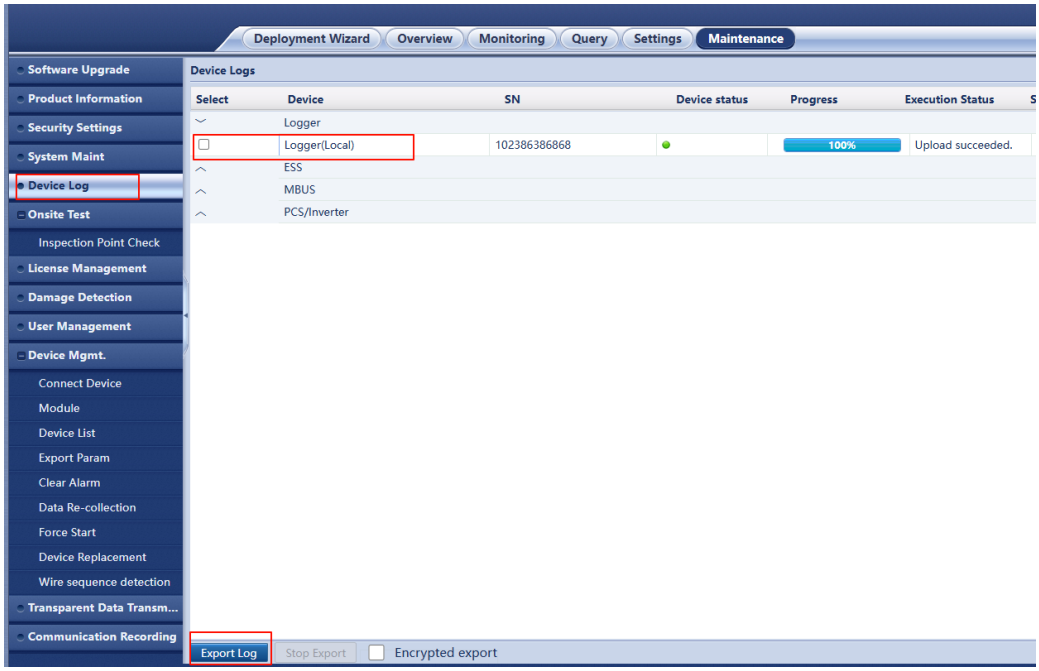
Step 21 Click **Log In** to access the WebUI to complete preparations and login. You can export logs.

----End

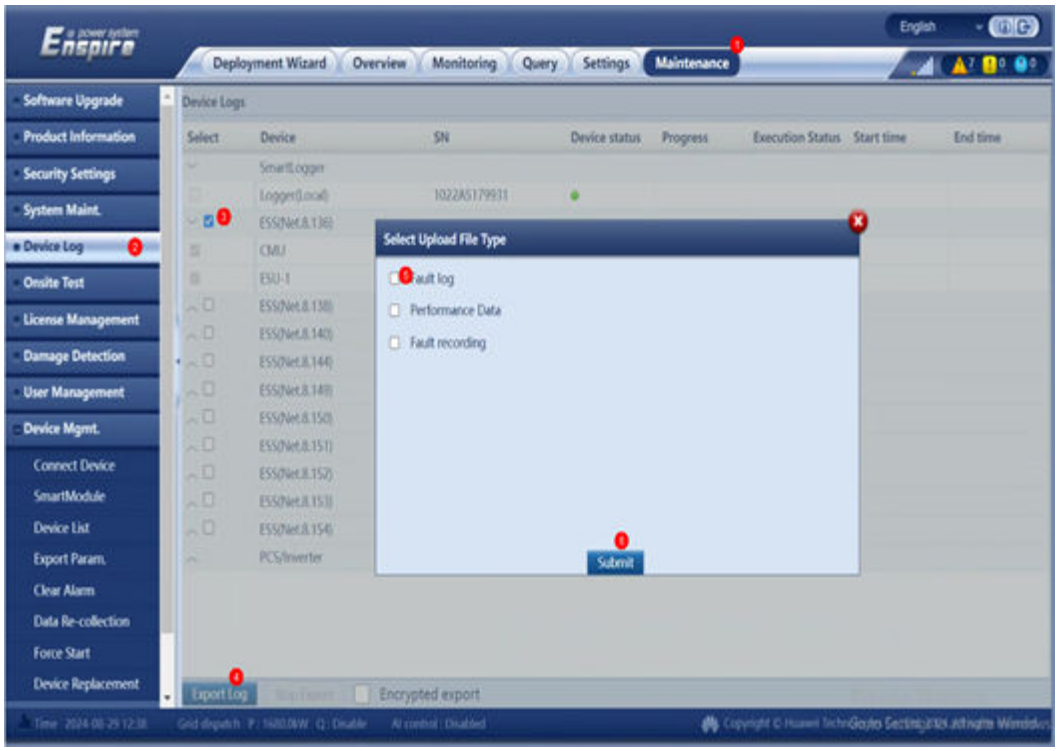
Exporting SmartLogger Logs

Export SmartLogger logs by referring to the following figures.


Deployment Wizard
Overview
Monitoring
Query
Settings
Maintenance
1
Software Upgrade
Product Information
Security Settings
System Maint
Device Log
2
Onsite Test
Inspection Point Check
License Management
Damage Detection
User Management
Device Mgmt.
Connect Device
Module
Device List
Export Param
Clear Alarm
Data Re-collection
Force Start
Device Replacement
Wire sequence detection
Transparent Data Transm...
Communication Recording
Device Logs
Select
Device
SN
Device status
Progress
Execution Status
Logger
3
Logger(Local)
102386386868
ESS
MBUS
PCS/Inverter
4
Export Log
Stop Export
Encrypted export
Time 2025-04-25 20:06
Grid dispatch P : Disable Q : Disable
AI control : Disabled

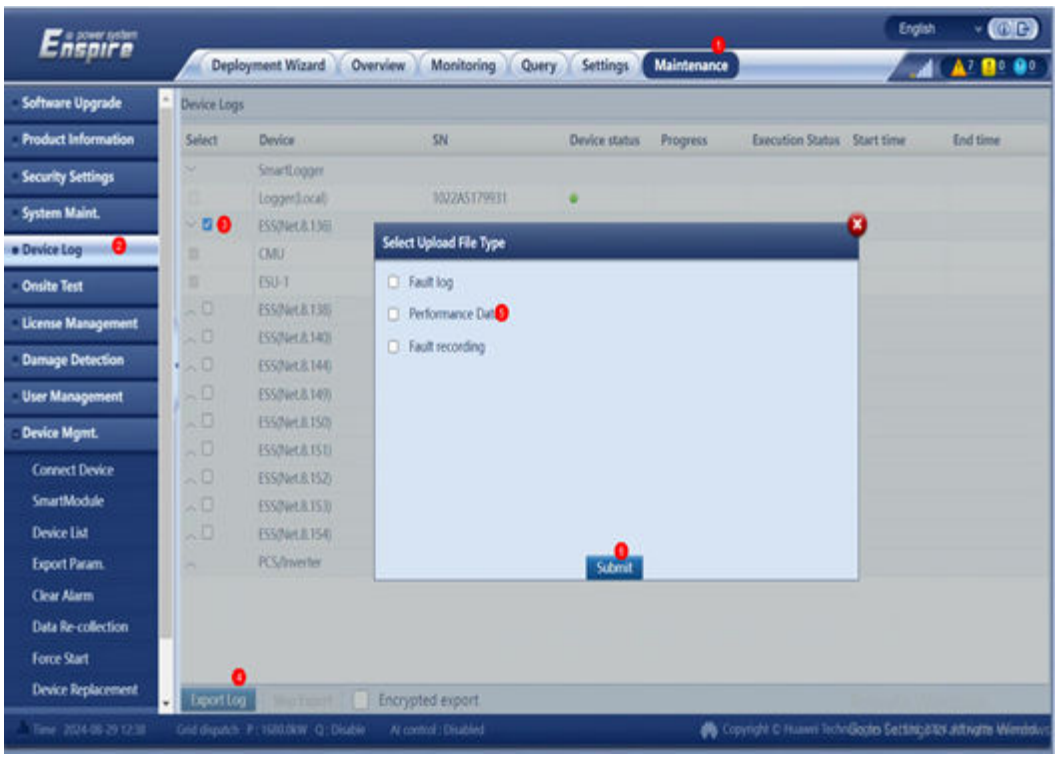

Deployment Wizard
Overview
Monitoring
Query
Settings
Maintenance
Software Upgrade
Product Information
Security Settings
System Maint
Device Log
Onsite Test
Inspection Point Check
License Management
Damage Detection
User Management
Device Mgmt.
Connect Device
Module
Device List
Export Param
Clear Alarm
Data Re-collection
Force Start
Device Replacement
Wire sequence detection
Transparent Data Transm...
Communication Recording
Device Logs
Select
Device
SN
Device status
Progress
Execution Status
Logger
Logger(Local)
102386386868
100%
Upload succeeded.
ESS
MBUS
PCS/Inverter
Export Log
Stop Export
Encrypted export

Exporting All ESS Logs



Exporting ESS Performance Data

Export performance data by referring to the following figure.



7 Troubleshooting

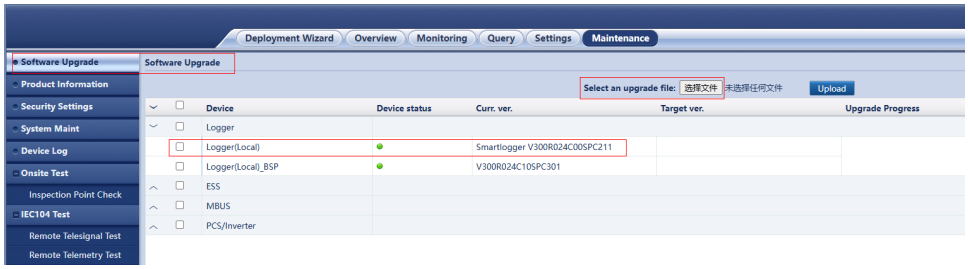
7.1 Troubleshooting for Deployment

7.1.1 SACU-D08 Software Version Mapping

Symptom: The SACU-D08 cannot be identified when it is connected to the C&I liquid-cooled ESS.

Cause: The SACU-D08 is a utility-scale product. The utility-scale software version is delivered by default before June 30, 2025. You need to upgrade the software to the latest C&I software version before deployment.

Solution: Log in to the SmartLogger WebUI, choose **Maintenance**, upload the latest C&I version file, and confirm the upgrade.



7.1.2 V2 C&I Liquid-Cooled ESS Cannot Be Identified by V3 SmartLogger Without a New Root Certificate

Symptom: In the capacity expansion scenario, V3 SmartLogger of an earlier version cannot identify the C&I liquid-cooled ESS.

Cause: V3 SmartLogger of an earlier version does not have a new root certificate that can match the C&I liquid-cooled ESS before delivery, and the software cannot be upgraded onsite.

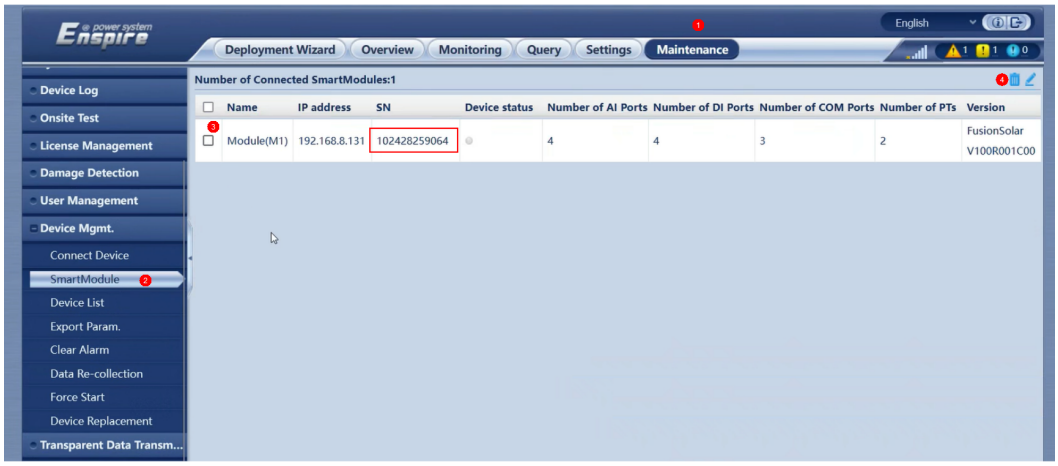
Solution: Use the V3 SmartLogger with a new root certificate. For details about the SmartLogger code, see **C&I ESS 215kWh Series Configuration List**.

7.1.3 SmartModule Communication Fault

Symptom: The CMU of the C&I ESS reports a SmartModule communication fault alarm (alarm ID: 3845-1).

Cause: The CMU of the C&I ESS does not connect to a SmartModule, but the CMU onsite displays an offline SmartModule. This is because the SmartModule was connected during factory commissioning and is not deleted. The CMU records the SmartModule and attempts to communicate with the SmartModule. The communication failed, triggering the alarm.

Solution: Log in to the CMU WebUI, choose **Maintenance** > **SmartModule**. Select **Module(M1)**, and click **Delete** in the upper right corner.



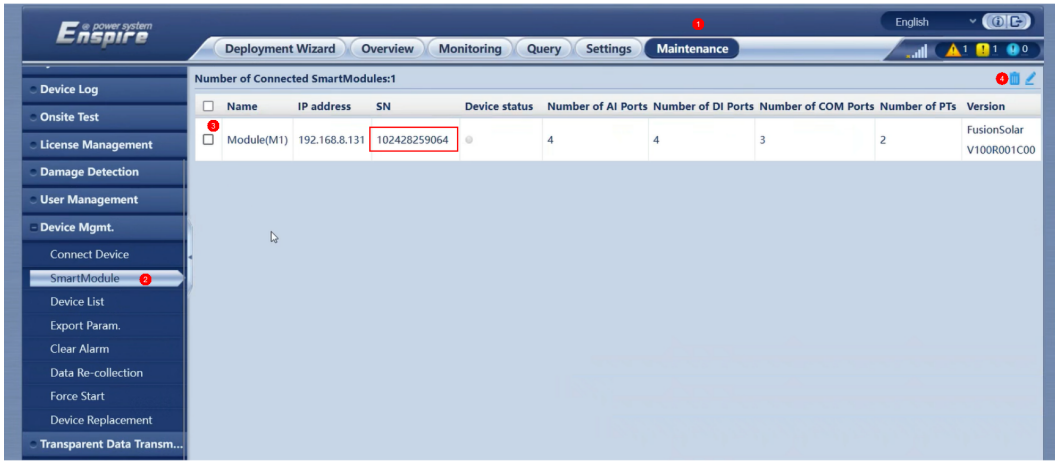
7.1.4 Abnormal Communication Between the SmartLogger and the SmartModule

Symptom: The communication between the SmartLogger and the SmartModule is abnormal.

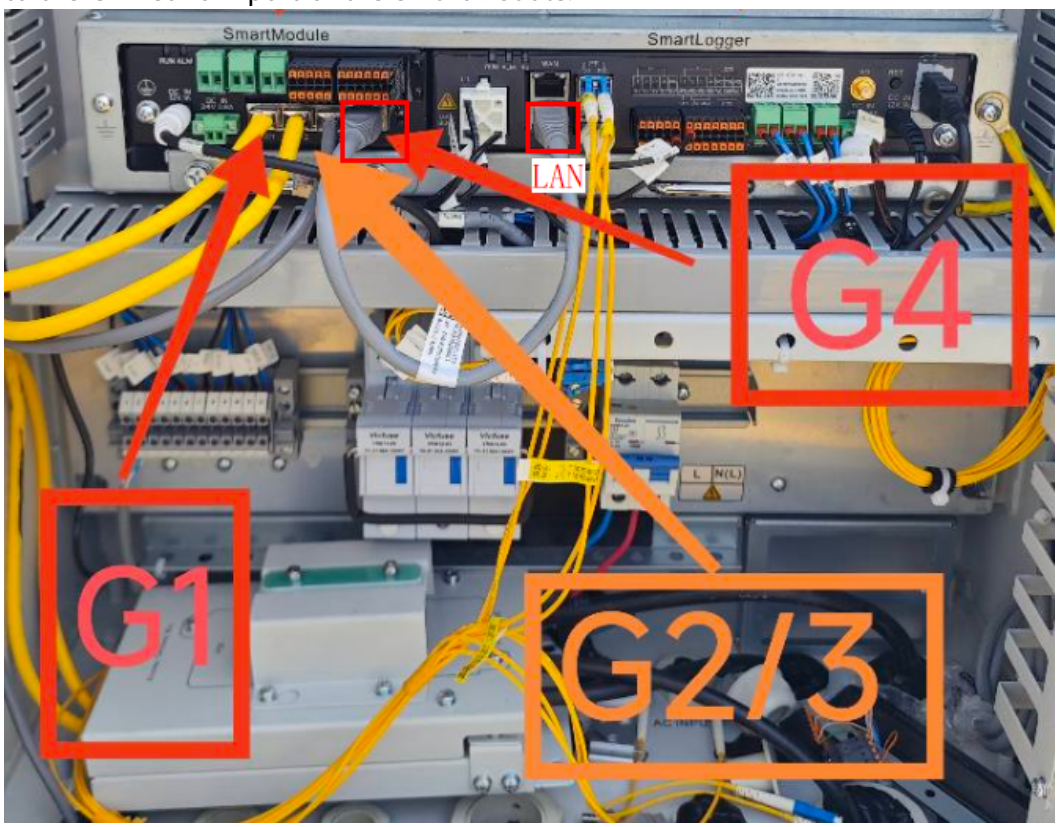
Cause: During factory commissioning, a SmartModule was connected to the SmartLogger and not deleted. During onsite use, the actual SmartModule is inconsistent with the historical one and the onsite cable connection is not standard. The SmartLogger is not connected to the G4 network port of the SmartModule. Therefore, the onsite SmartLogger fails to communicate with the SmartModule or the communication is abnormal.

Solution:

Step 1 On the SmartLogger WebUI, delete the SmartModule used for factory commissioning: Choose **Maintenance** > **SmartModule** > **Module(M1)** and click the delete icon in the upper right corner.



Step 2 Change the onsite cable connection and connect the LAN port of the SmartLogger to the G4 network port of the SmartModule.



----End

7.2 Troubleshooting for Routine Operation

7.2.1 ESS Faults

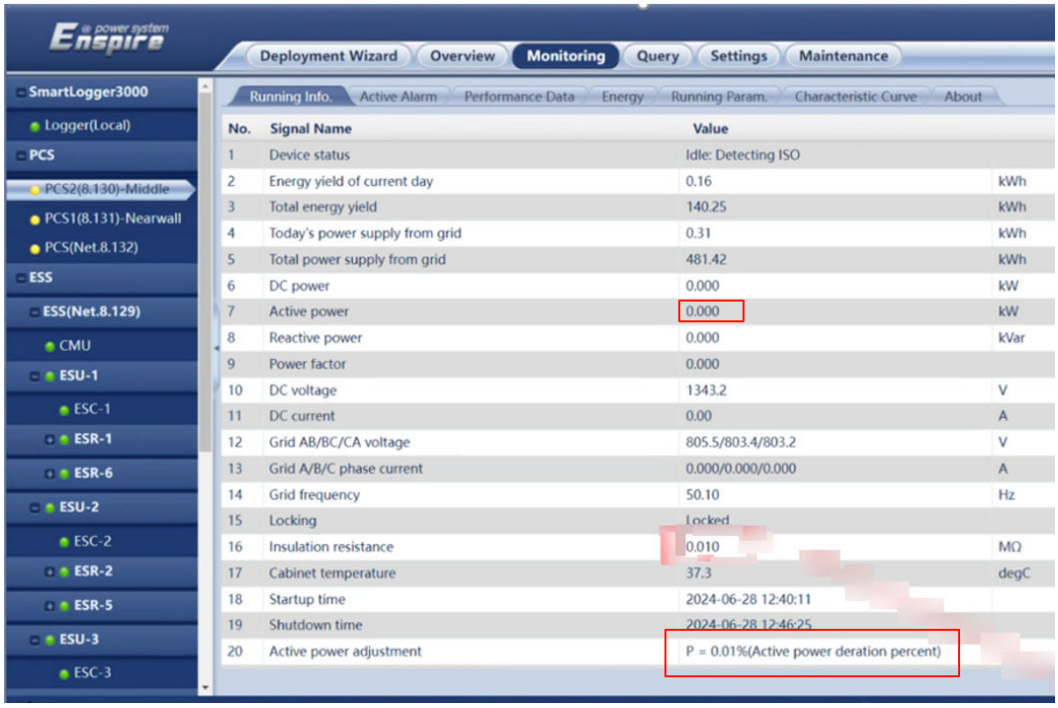
7.2.1.1 PCS Power Inconsistent with Dispatched Power

Symptom: The PCS output power is inconsistent with that specified in the dispatch command.

Cause 1: The PCS is running in the VSG mode.

Cause 2: The frequency response function is enabled, and the frequency is greatly different from the rated frequency. Therefore, the frequency response function is triggered.

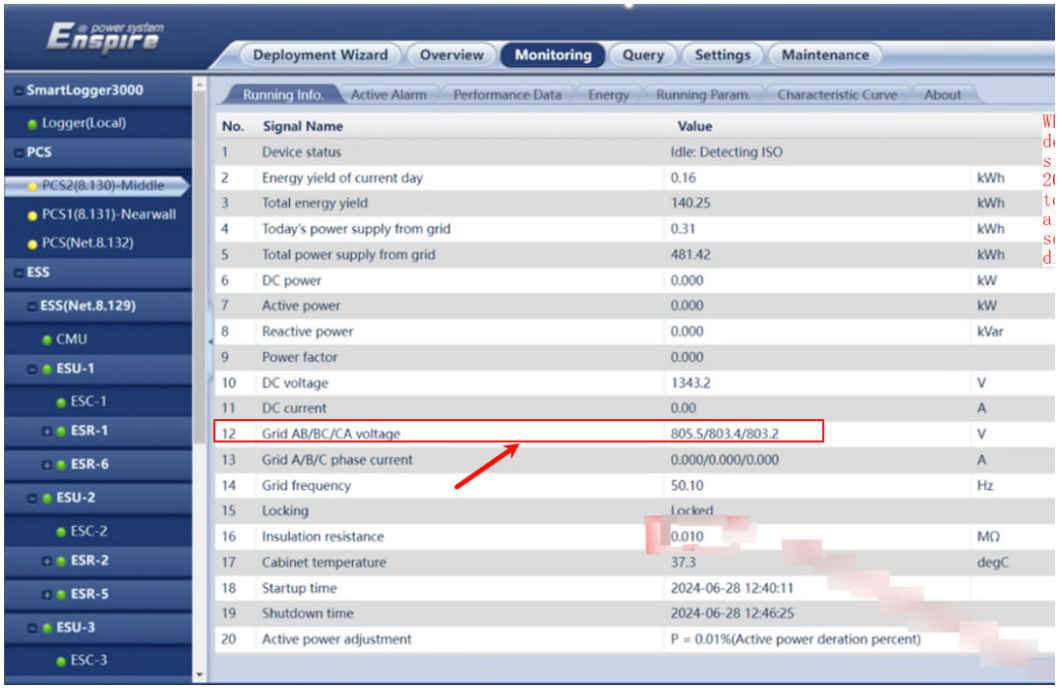
Cause 3: Microgrid compatibility is enabled.



7.2.1.2 PCS Shutdown Due to Overvoltage

Symptom: In the XX project with two C&I ESSs in China, the ESSs run properly when the power is less than 50 kW. When the power is greater than 50 kW, the PCS shuts down unexpectedly and reports an overvoltage alarm for a short period of time. Then the alarm disappears suddenly.

Cause: The grid voltage is high (414 V), and the level-1 protection voltage threshold of the PCS is 418 V. On the **Monitoring** page of the SmartLogger WebUI, check the value of **Grid AB/BC/CA voltage** in the **Running Info.** area of the ESS or PCS.



Solution: Reduce the grid voltage or increase the level-1 protection voltage threshold of the PCS.

On the SmartLogger WebUI, choose **Monitoring** > **ESS** or **PCS** > **Running Param.** > **Protection Parameters** > **Level-1 overvoltage protection threshold**.

Modify the threshold after confirming with Huawei engineers and the local power grid company.

7.2.1.3 Inconsistent ESS Running Power and Command Power, and Power Fluctuation

Symptom 1: In the PQ mode, the discharge power is low after the discharge command is delivered.

Possible cause 1: The frequency response function is enabled. When the grid frequency is high, overfrequency-caused power derating is triggered.

Symptom 2: In the PQ mode, the charge power is high after the charge command is delivered.

Possible cause 2: The frequency response function is enabled. When the grid frequency is high, overfrequency-caused power derating is triggered.

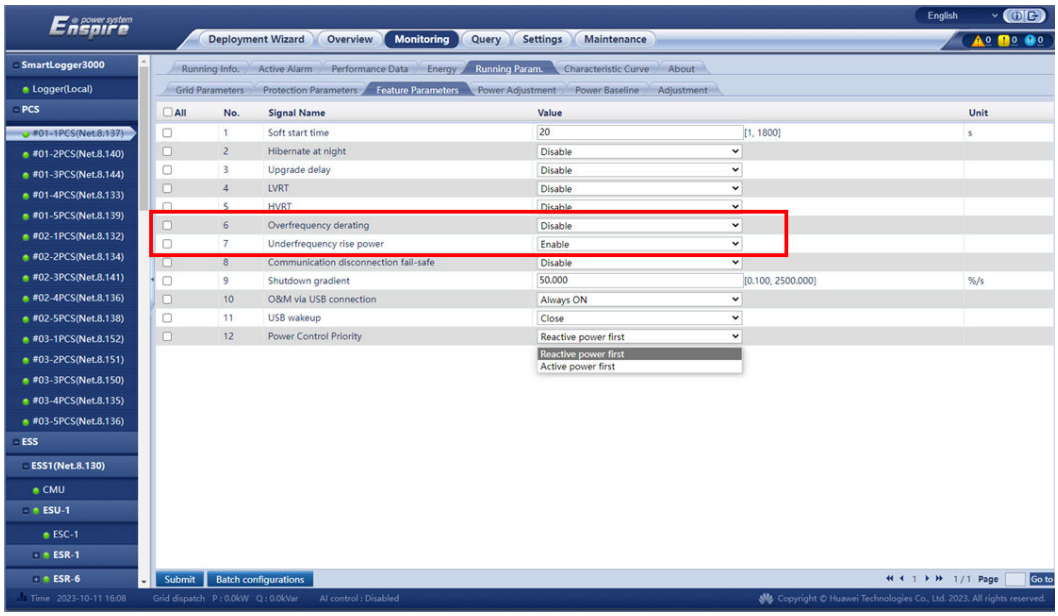
Symptom 3: In the PQ mode, the discharge power is high after the discharge command is delivered.

Possible cause 3: The frequency response function is enabled. When the grid frequency is low, underfrequency-caused power raising is triggered.

Symptom 4: In the PQ mode, the charge power is low after the charge command is delivered.

Cause 4: The frequency response function is enabled. When the grid frequency is high, overfrequency-caused power derating is triggered.

Solution: Disable the frequency response function.

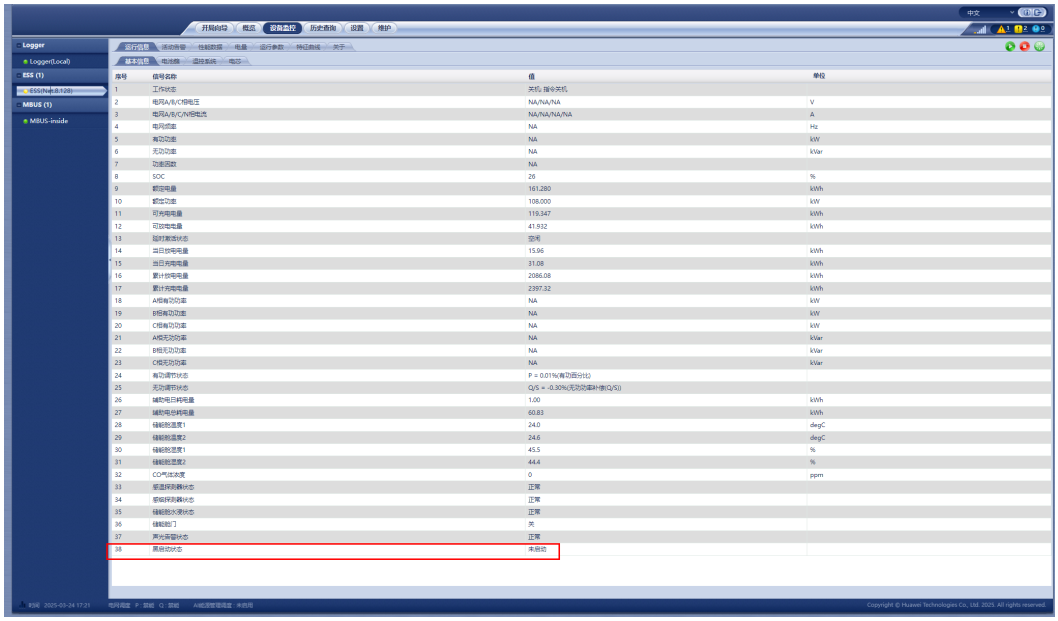


7.2.1.4 Remote Black Start Failure or Timeout

Symptom: In the remote black start scenario, a critical alarm is generated, causing black start failure. After the alarm is cleared, black start still fails. The black start status is displayed as not started or timeout.

Possible cause: This is a known issue in earlier versions. The activation signal fails to be correctly delivered to the PCS.

Solution: Reset the IBCU software (by clicking the reset button on the SmartLogger or app or powering off and then powering on the IBCU).



7.2.2 SmartLogger Faults

7.2.2.1 ESS Unidentifiable Due to an Early SmartLogger Software Version

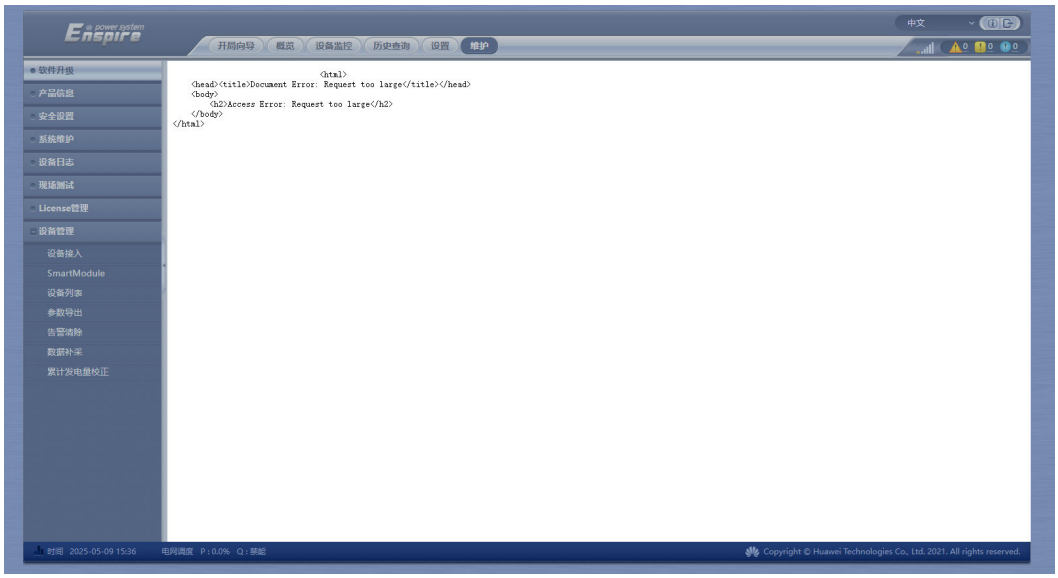
Symptom: After the SmartLogger is powered on, the PCS can be identified, but the ESS cannot be identified.

Cause: The SmartLogger software version is too early.

Solution: Upgrade the SmartLogger software version by referring to section "Power-On and Deployment Commissioning."

7.2.2.2 Failure to Upload an Upgrade Software Package

Symptom 1: An error message is displayed, indicating that the software package is too large.



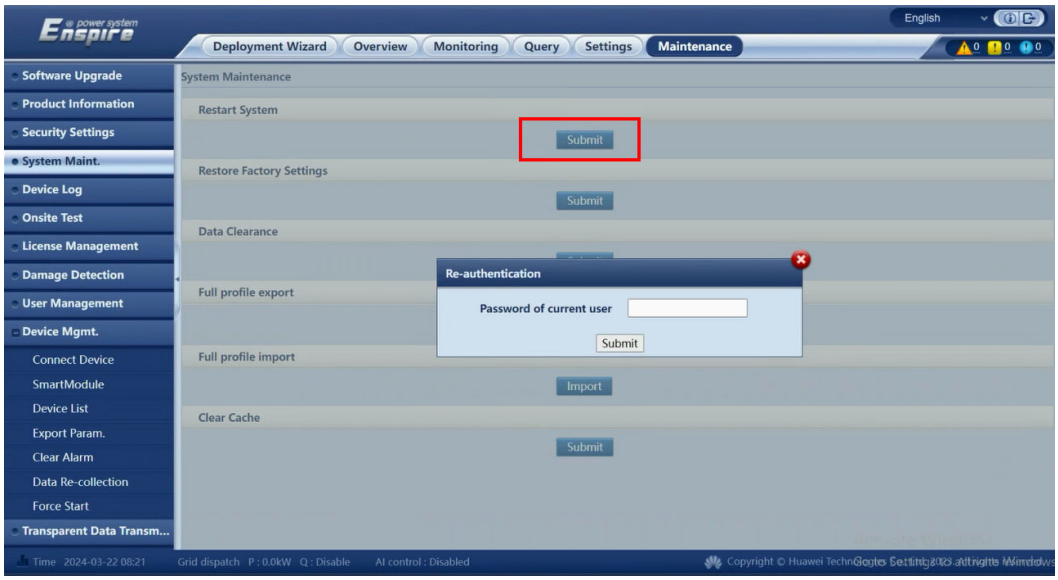
Cause: Some earlier SmartLogger software versions support the upload of a software package of up to 20 MB.

Solution: The SmartLogger software package contains two upgrade packages: SmartLogger and BSP. Decompress the SmartLogger software package. Upload and upgrade the BSP file separately. Then upload and upgrade the SmartLogger software separately.

Symptom 2: A white screen or error message is displayed after the upgrade.

Cause 1: The SmartLogger memory is insufficient.

Solution 1: Restart the SmartLogger.

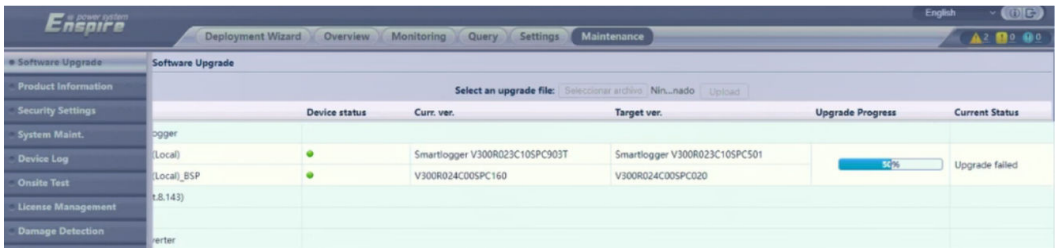


Cause 2: The PC is connected to the SmartLogger through a third-party network switch, and the network switch intercepts the software package transmission of the SmartLogger.

Solution 2: Directly connect the PC to the SmartLogger for upgrade.

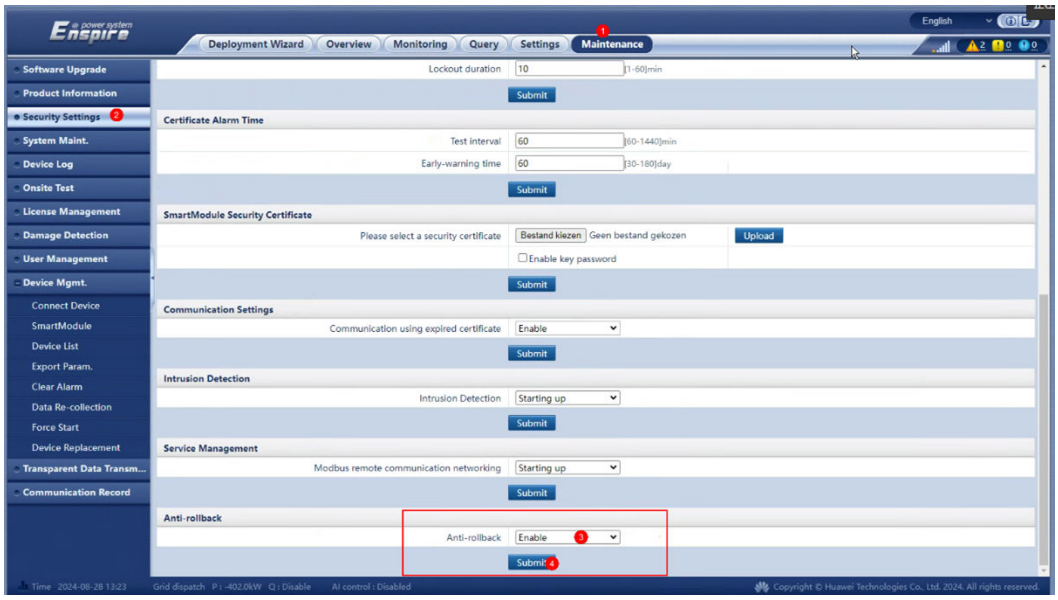
7.2.2.3 SmartLogger Software Upgrade Progress Stuck at 50%

Symptom: The SmartLogger software upgrade progress is stuck at 50% and the upgrade fails.



Cause: The SmartLogger software version later than 903t has the anti-rollback function.

Solution: Set **Anti-rollback** to **Disable**.



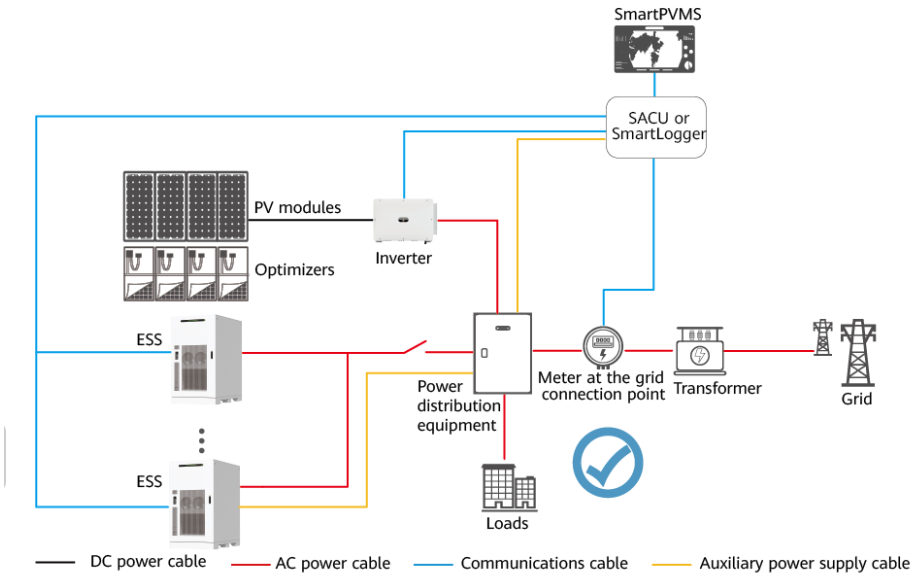
7.2.3 TOU Faults

7.2.3.1 Meter at the Grid Connection Point

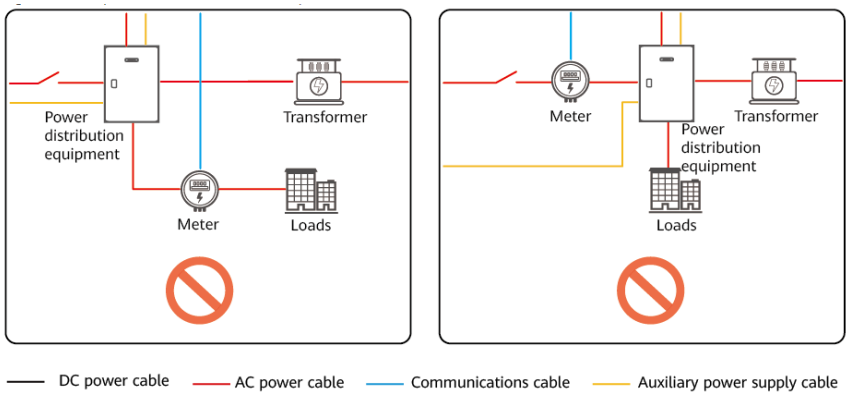
CAUTION

If the meter at the grid connection point is incorrectly connected or set, the maximum self-consumption mode and TOU mode will be abnormal. In addition, the power flow diagram on the management system may be abnormal.

Install a meter at the grid connection point. The following figure shows the installation position.

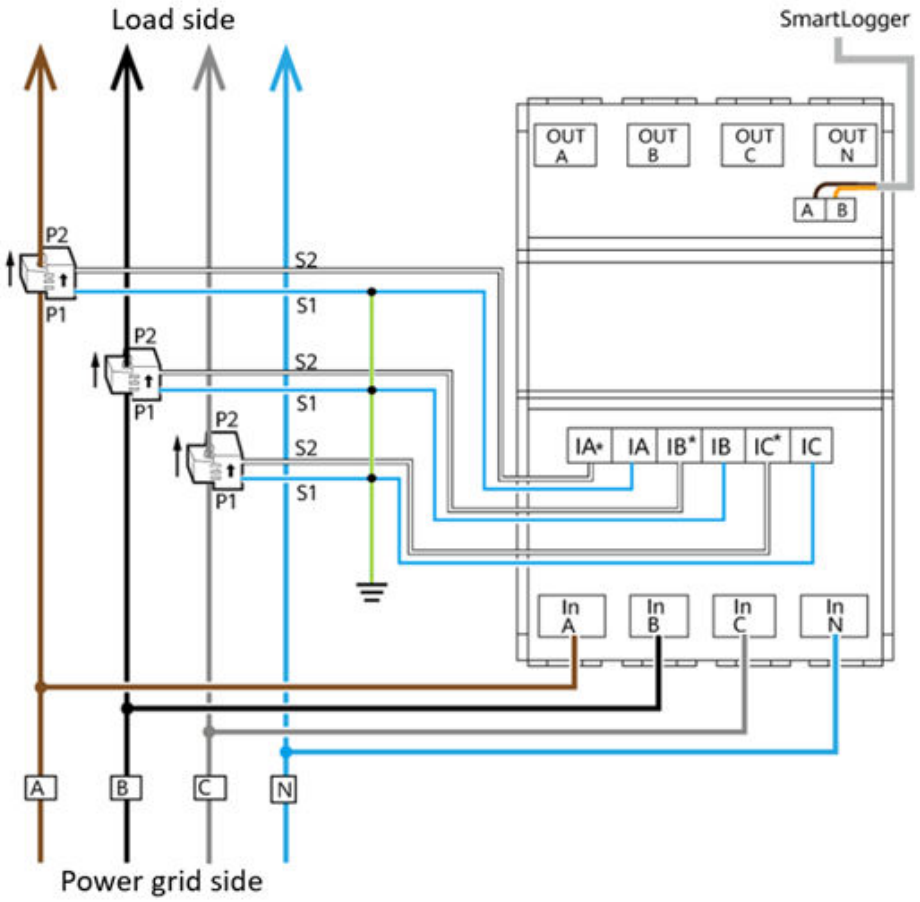


Incorrect meter installation position

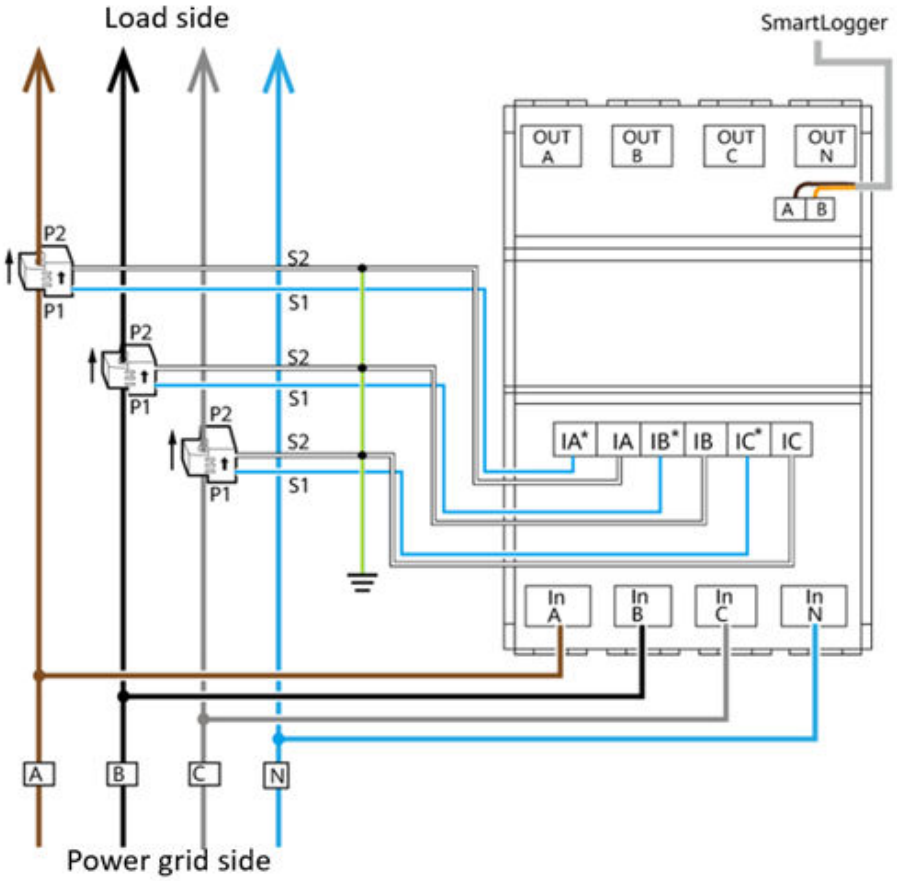


Due to some historical reasons, the connection modes of meters in China and outside China are different. The current directions of meters in China and those outside China are different. Otherwise, data on the management system will be abnormal.

Connection mode of meters in China

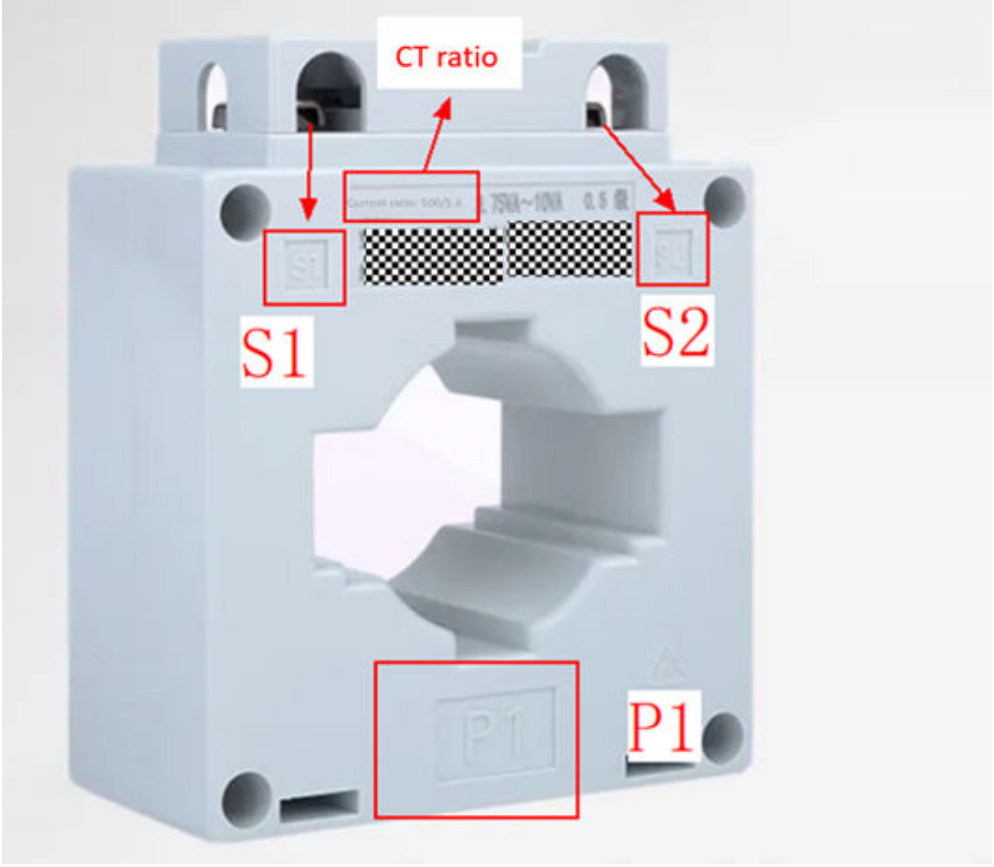


Connection mode of meters outside China

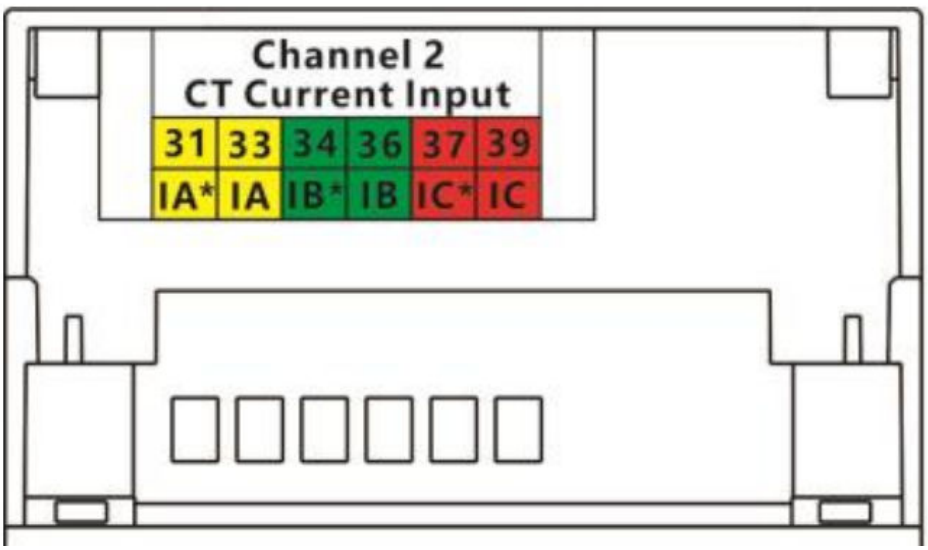


Meter connection direction verification: Perform this operation when the ESS is started. On the SmartLogger WebUI, choose **Settings** > **Power Adjustment** > **Reactive Power Control**, and click **Detect** next to **Electric meter power direction**.

Check the P1, P2, S1, and S2 of the CT and the CT ratio.

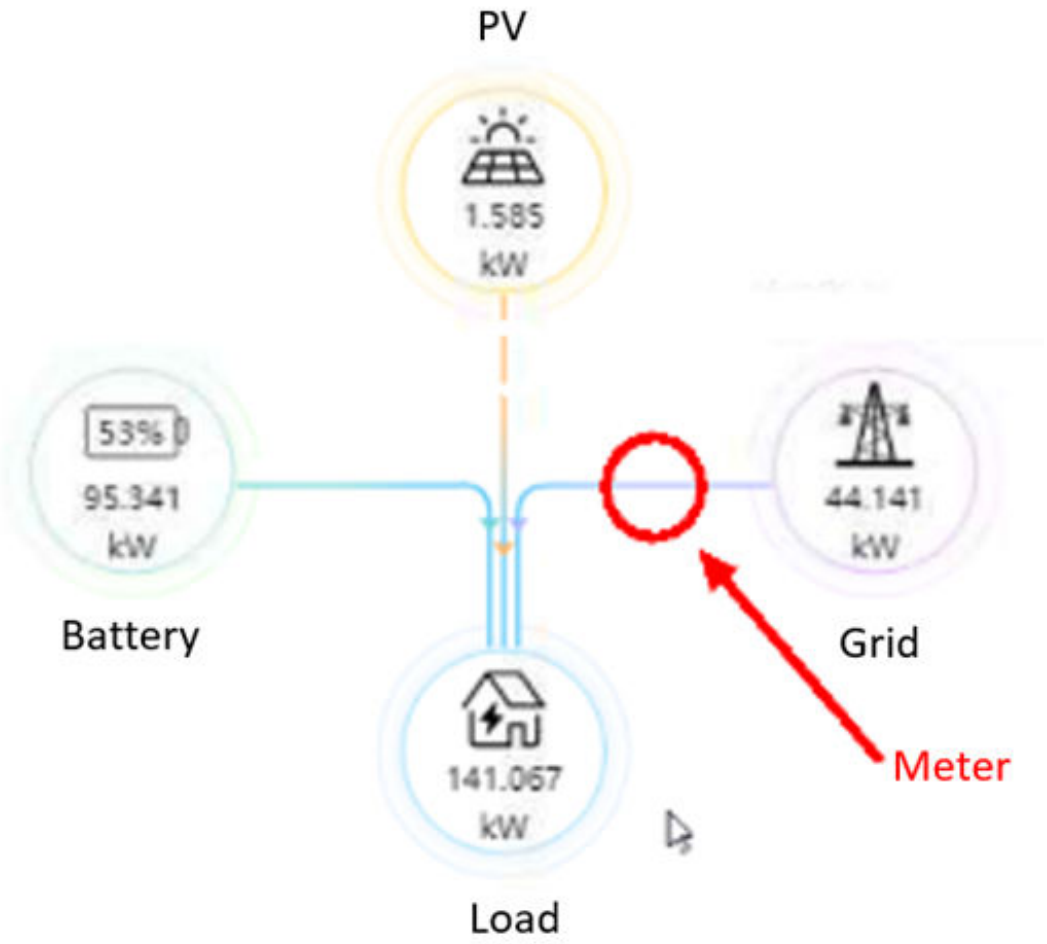


If the meter connection direction does not meet the requirements of the region, exchange the current sampling cables of each phase on the meter side. For example, exchange the I_{A*} and I_A cables, I_{B*} and I_B cables, and I_{C*} and I_C cables on the meter side, as shown in the following figure. Ensure that the switch at the grid connection point is turned off during the exchange. Otherwise, high voltage may be generated when the current sampling cable is removed, which may cause electric shocks.



7.2.3.1.1 Incorrect Meter Installation Position

Correct meter installation position



Incorrect position 1: The meter is installed on the PV side.

Symptom: The meter reading is the same as the PV power. In the maximum self-consumption or TOU mode, the ESS is charged or discharges at the maximum power.

Incorrect position 2: The meter is installed on the ESS side.

Symptom: The meter reading is the same as the ESS power. In the maximum self-consumption or TOU mode, the ESS power is 0.

Incorrect position 3: The meter is installed on the load side.

Symptom: The meter reading is the same as the load power. In the maximum self-consumption or TOU mode, the ESS is charged or discharges at the maximum power.

Solution: Connect the meter to the grid connection cable according to the standard solution.

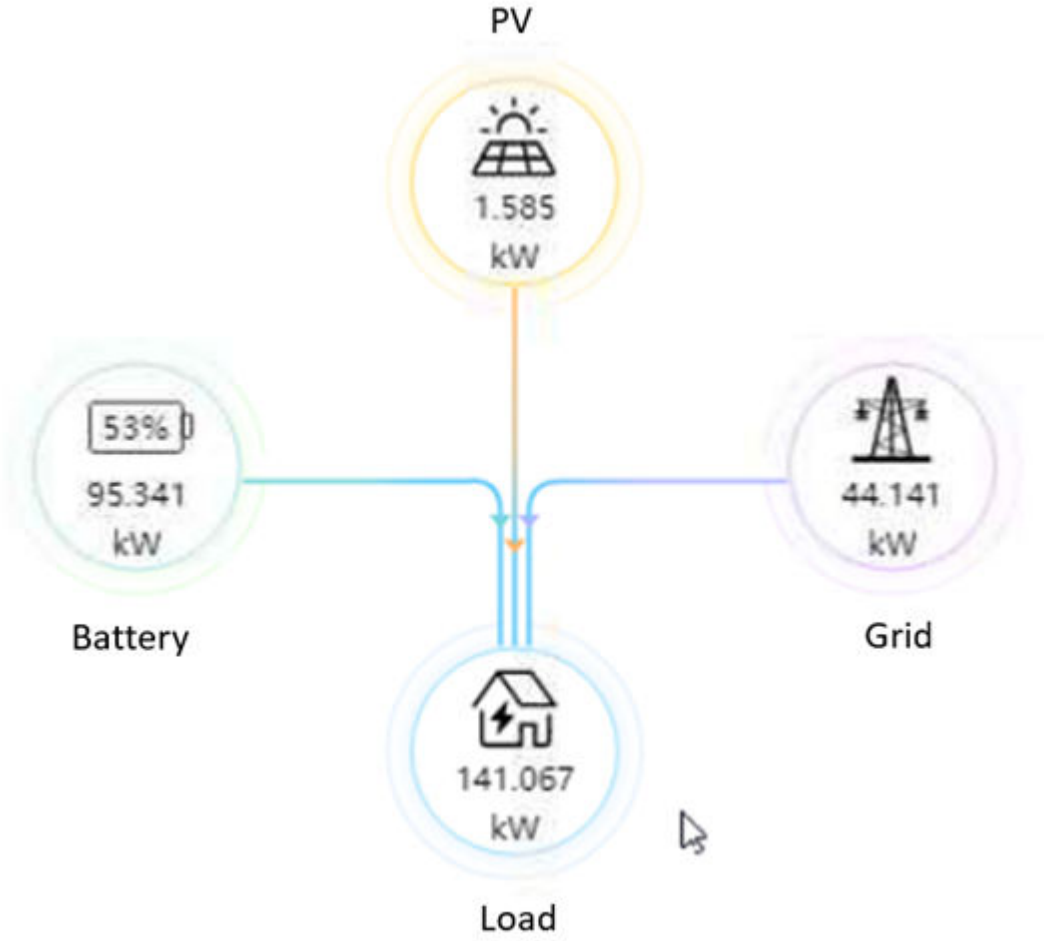
7.2.3.1.2 Incorrect Meter Installation Direction

Symptom: As shown in the following figure, the actual load is basically 0, and the management system displays 141 kW load. After the PV system and ESS are shut down, the load power changes to 0 and the power on the grid side also changes to 0.

Cause: When there is no load, the ESS discharges to the grid. However, the meter installation direction at the grid connection point is incorrect. As a result, the meter indicates that the grid discharges to the ESS.

Check method: When the load power is fixed, if the ESS power decreases, the grid power shall increase. Therefore, if the grid power decreases, the meter installation direction is incorrect.

Solution: Change the meter installation direction.



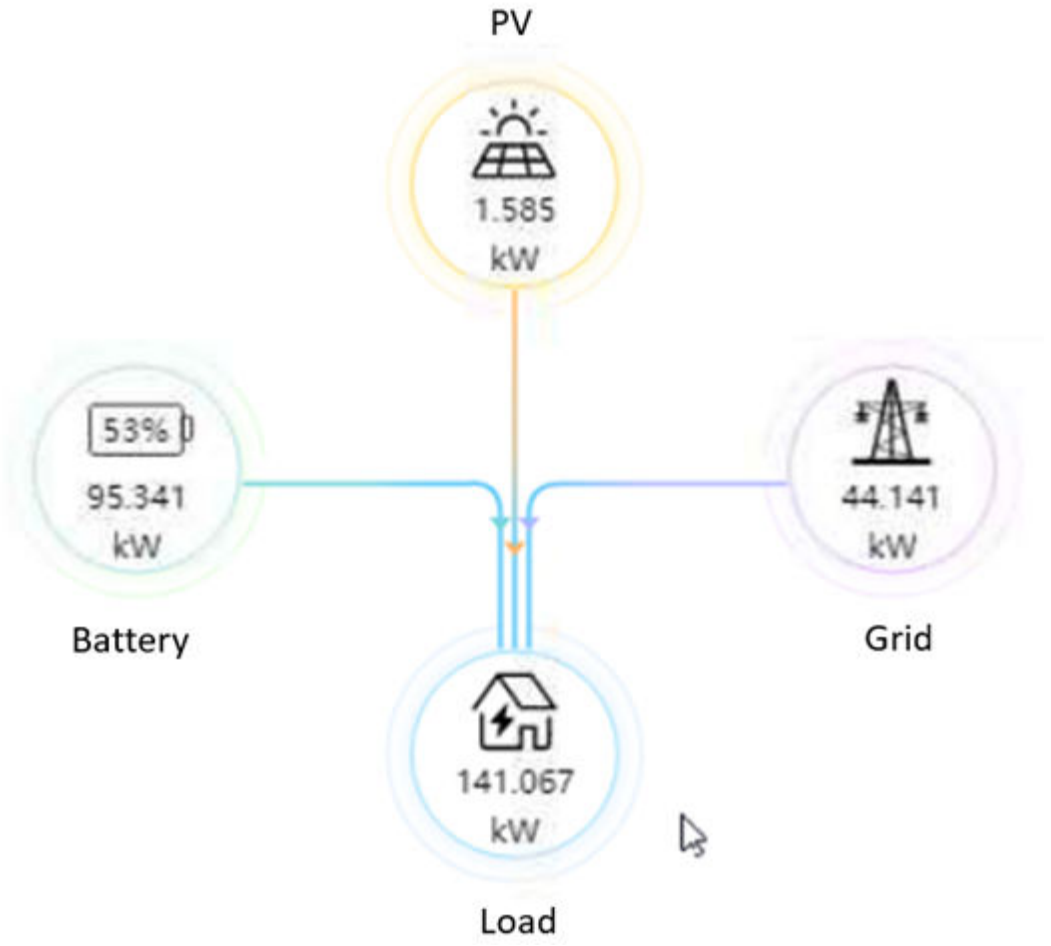
7.2.3.1.3 Meter CT Ratio Incorrectly Set

Symptom: As shown in the following figure, the actual load is basically 0, and the management system displays 141 kW load (95 kW from the ESS and 44 kW from the grid). After the PV system and ESS are shut down, the load power changes to 0 and the power on the grid side also changes to 0.

Cause: When there is no load, the power of the ESS should be the same as that of the grid even if the meter installation direction is incorrect. Therefore, the meter CT ratio is incorrectly set.

Check method: Change the ESS power to 50 kW. If the grid power changes to 20 kW, the load power changes to 70 kW, and all power readings decrease by half, the CT ratio is incorrectly set.

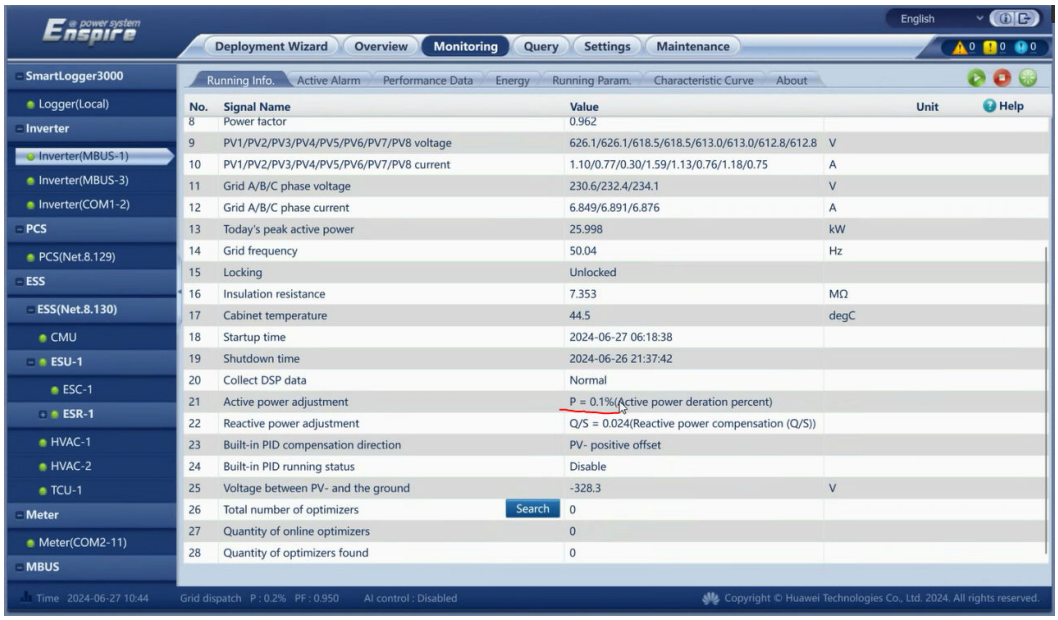
Solution: Check the CT ratio and change the meter CT ratio setting.



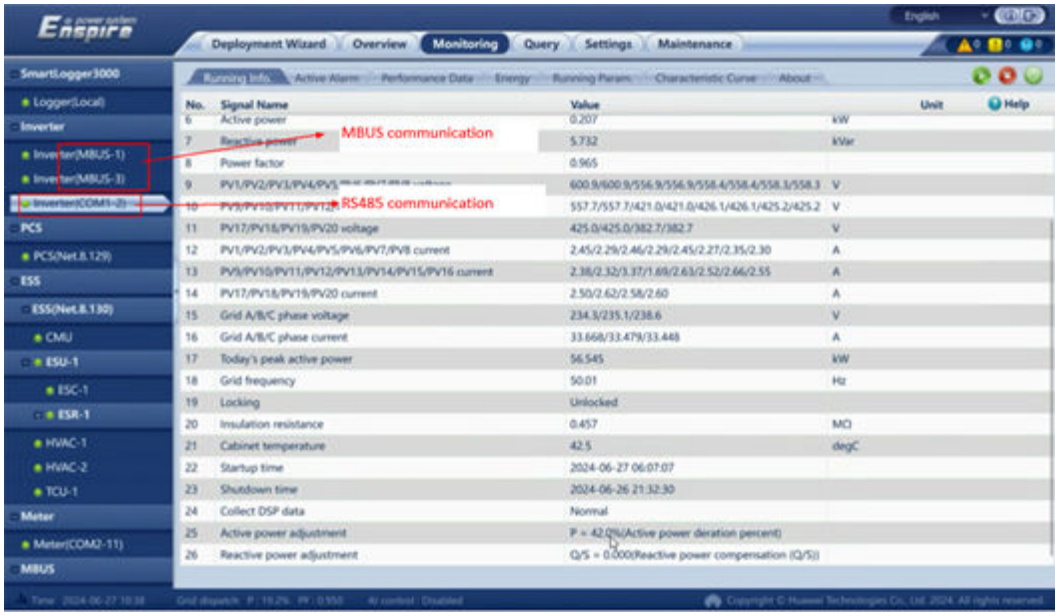
7.2.3.2 Inverter Power Limiting

7.2.3.2.1 Inverter Power Change or Limiting in the TOU/Maximum Self-consumption Mode

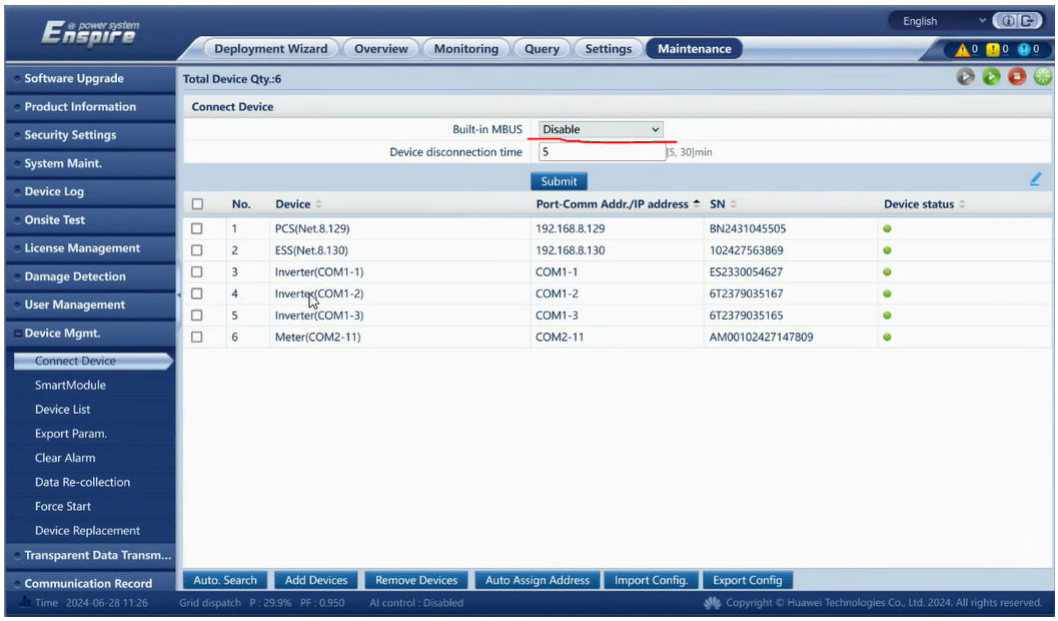
Symptom: The inverter power changes or is limited in the TOU/maximum self-consumption mode.

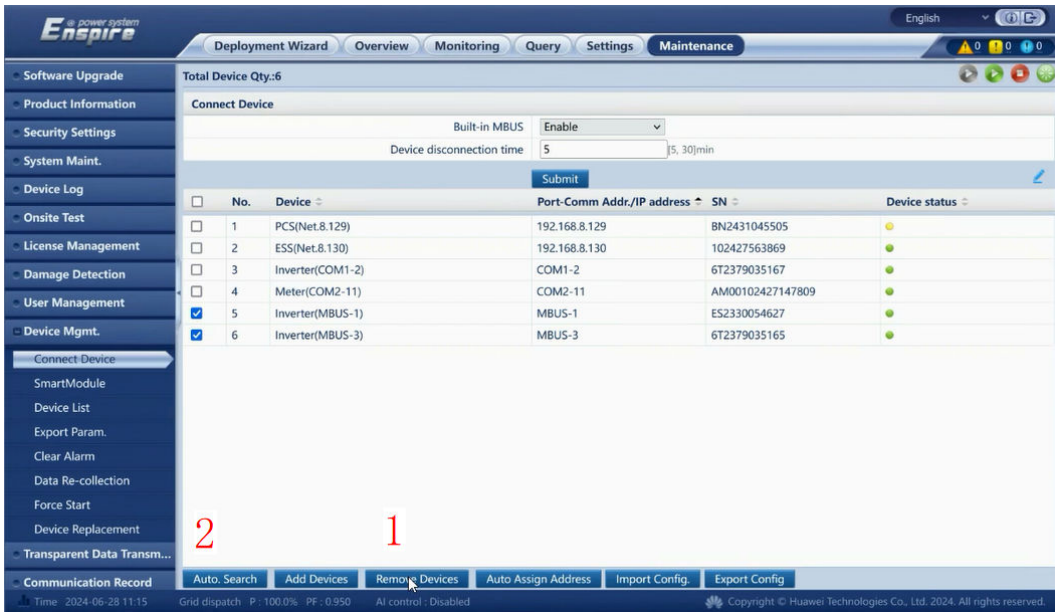


Cause: There are three inverters onsite. Two of them communicate with the SmartLogger over MBUS, and one of them communicates with the SmartLogger over RS485. Therefore, the SmartLogger communicates with the inverter over two protocols at the same time, causing abnormal communication and control.



Solution: Disable the MBUS function on the SmartLogger for the medium-power three-phase inverter. Delete the inverter of the sampling MBUS and identify it.

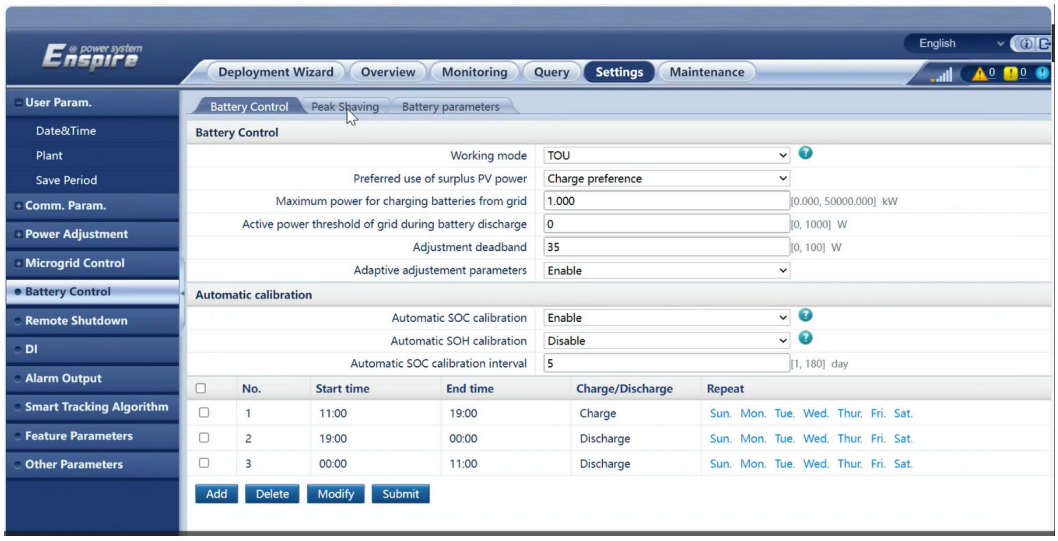




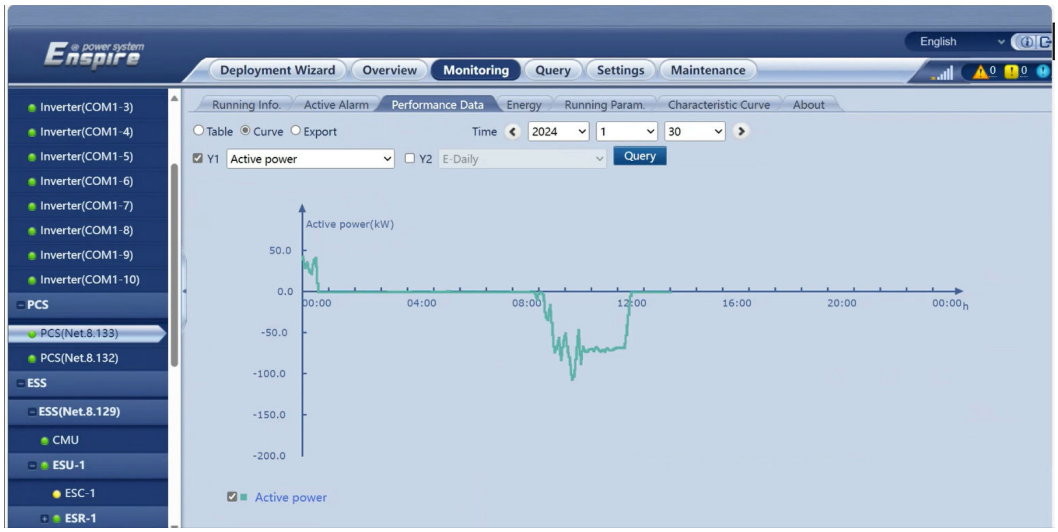
7.2.3.2.2 Charged by the Grid at High Power with the Charge Power Displayed as 0 in TOU Mode

Symptom: In a hospital project outside China, in TOU mode, when the ESS is charged by the grid at high power, the grid charge power displayed on the management system is 0. In addition, during the discharge period, the discharge mode automatically switches to the charge mode. The power of the inverter and ESS increases slowly. **Preferred use of surplus PV power** cannot be enabled for the ESS charge period.

TOU mode settings



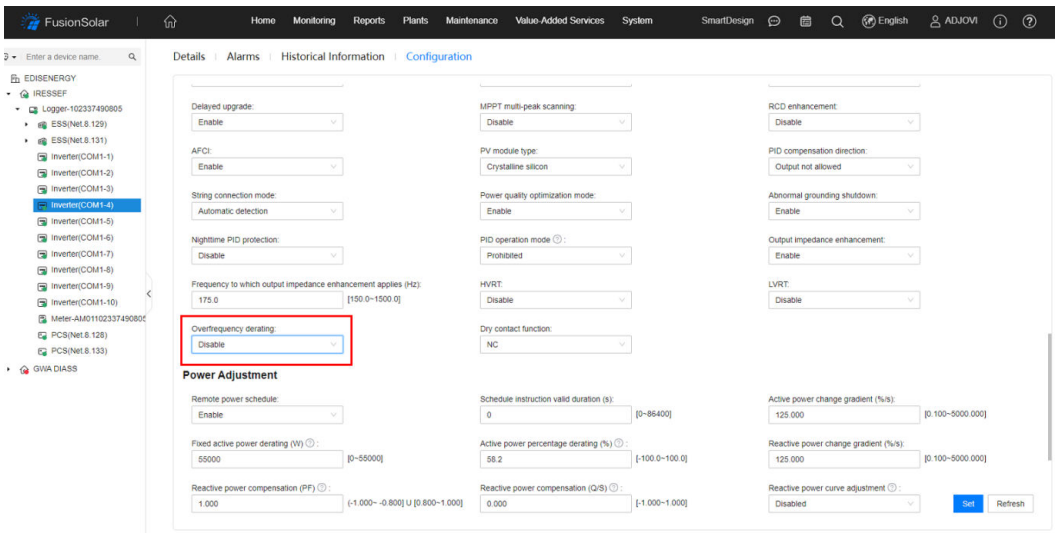
PCS charge/discharge at high power in the daytime

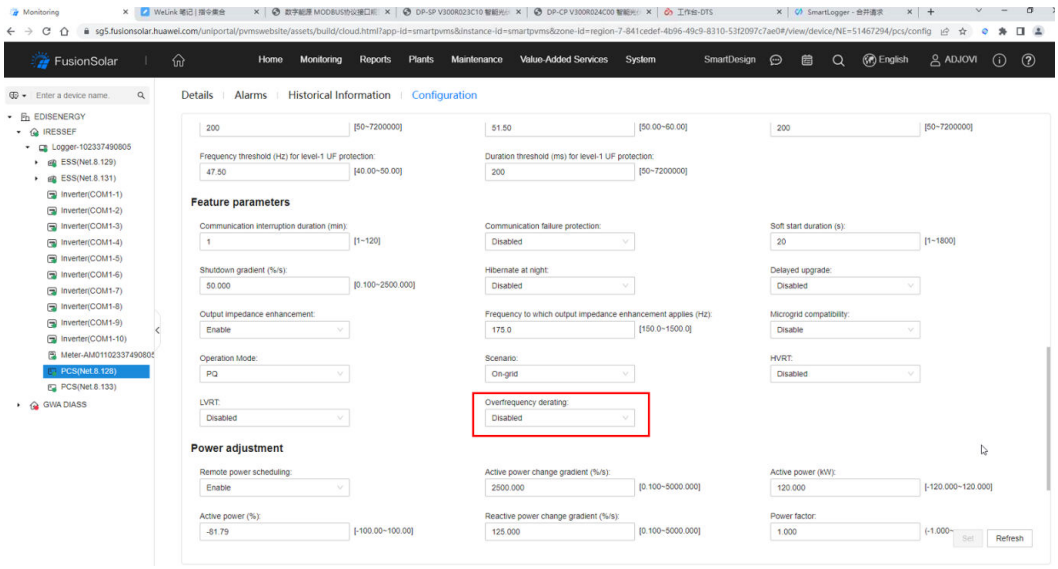


After **Working mode** is changed from TOU to **Discharge**, the ESS is occasionally charged and discharged.

Cause: 1. The zero feed-in function is enabled, and the deadband is set to 1 kW, which is low. The power may change frequently. It is advised to set the power rise threshold as follows: P_N x 1%–2% = 7–14 kW. After feed-in occurs, reduce the array output power to reduce energy consumption. In this case, to meet the load requirements, power is obtained from the grid connection point. 2. The charge power from the grid indicates that the maximum power for the grid to charge the array is 0 kW, but the PV system can charge the ESS at more than 0 kW. In TOU mode, the surplus PV is set to charge first. When the PV output power exceeds the load power, the ESS is charged first.

Solution: The problem is caused by the overfrequency derating function. The onsite grid frequency is high. Disable **Overfrequency derating** to solve the problem.





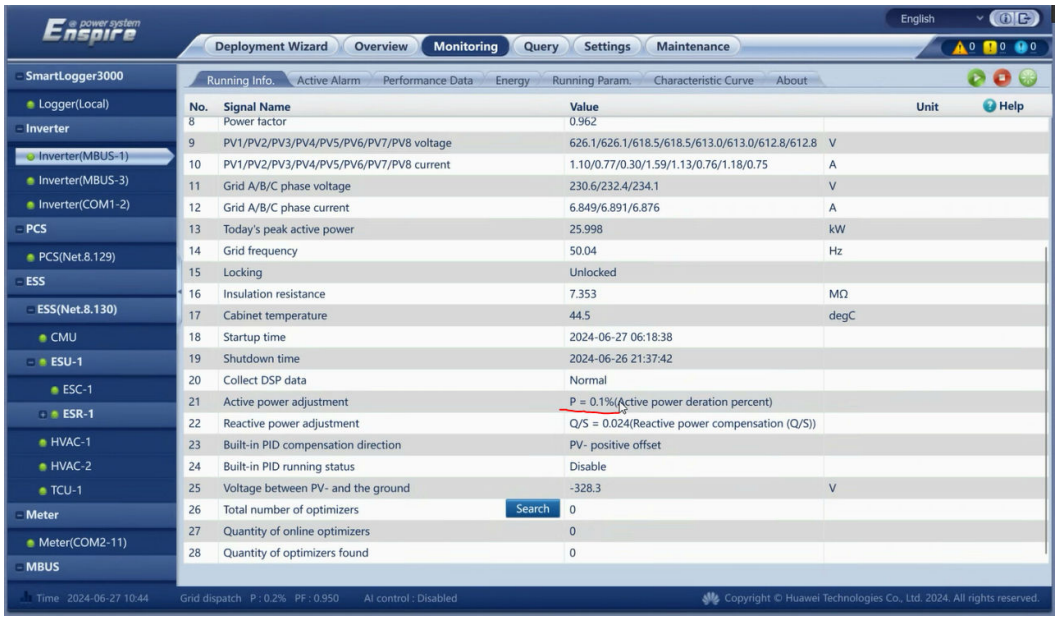
7.2.3.2.3 Inverter Power Limiting in the PV+ESS Scenario

Symptom 1: The inverter power is limited to a low value.

Symptom 2: The inverter power is limited to 0, and only one 0.1% protection dispatch command is delivered.

Cause: The inverter software version is SPC109. The MPPT capability is not uploaded to the SmartLogger.

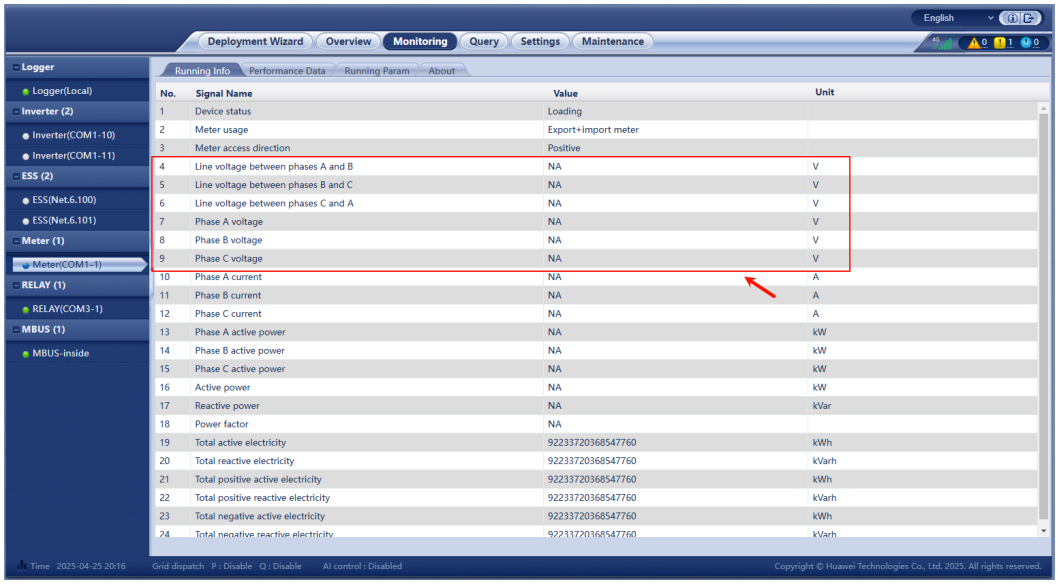
Solution: Upgrade the software to SPC113 or later and the SmartLogger to SPC530 or later.



7.2.3.2.4 Inverter Power Limiting in the TOU Mode Due to Incorrect Meter CT Ratio

Symptom: In the TOU **Fed to grid** mode, the inverter power is limited.

Cause: The meter CT ratio is incorrect.



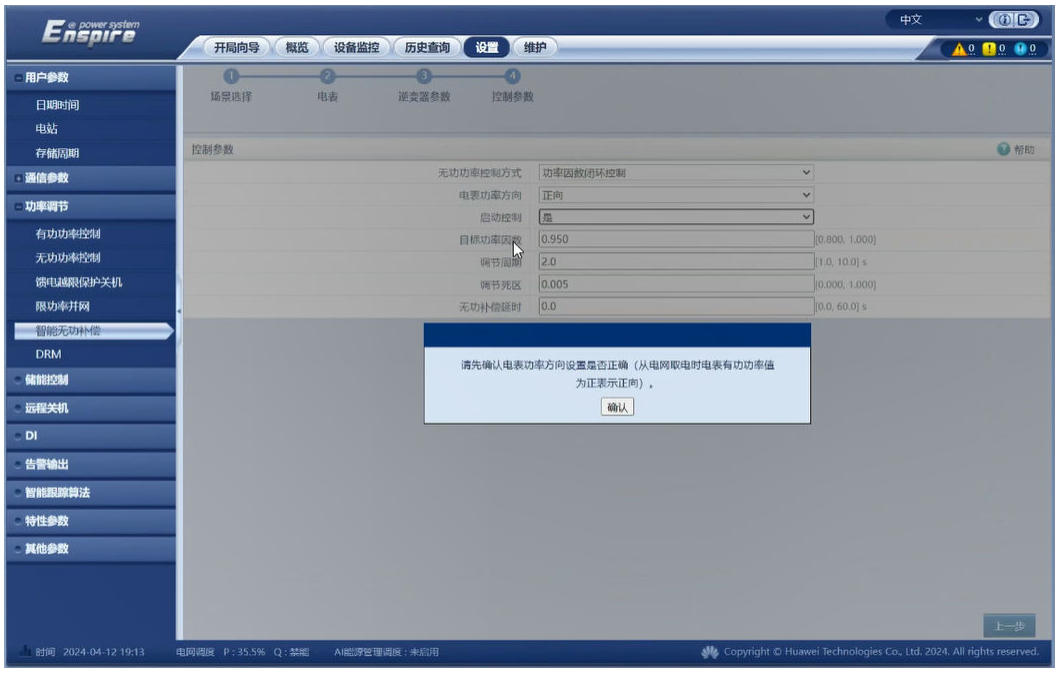
Solution: If the CT ratio is correctly set for the SmartLogger, change the CT ratio for the meter.

7.2.3.3 Supplying a Small Amount of Power to the Grid in TOU Mode (Three-Phase Power Imbalance)

Symptom: The load is unbalanced, and the meter indicates that a single phase at the grid connection point discharges to the grid.

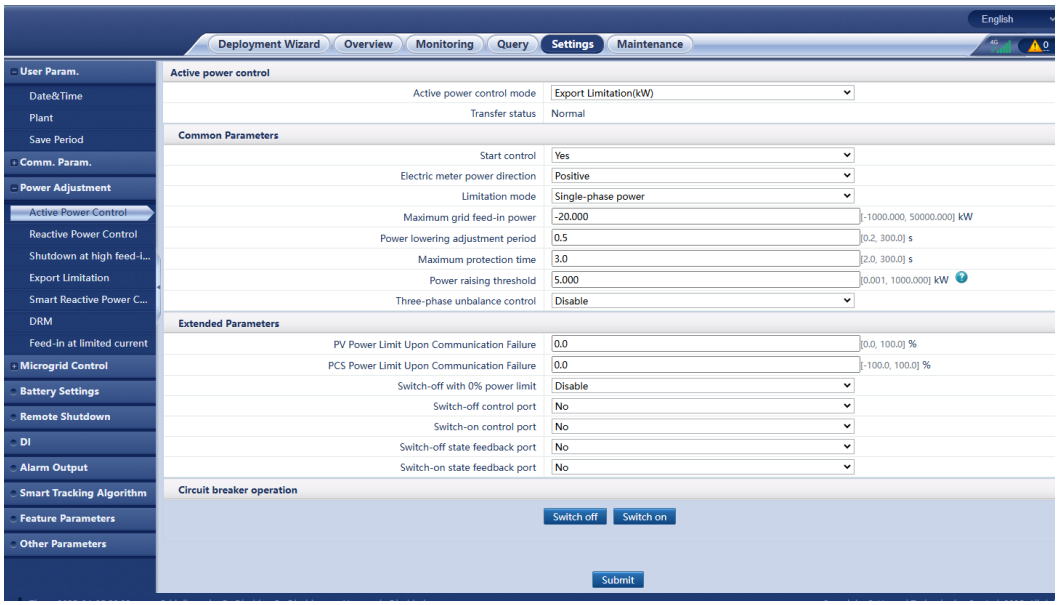
Cause 1: The power factor of the grid connection point is low, and the measurement is inaccurate.

Solution: Use intelligent reactive power compensation for ESSs to increase the power factor at the grid connection point and improve the meter measurement accuracy at the grid connection point.



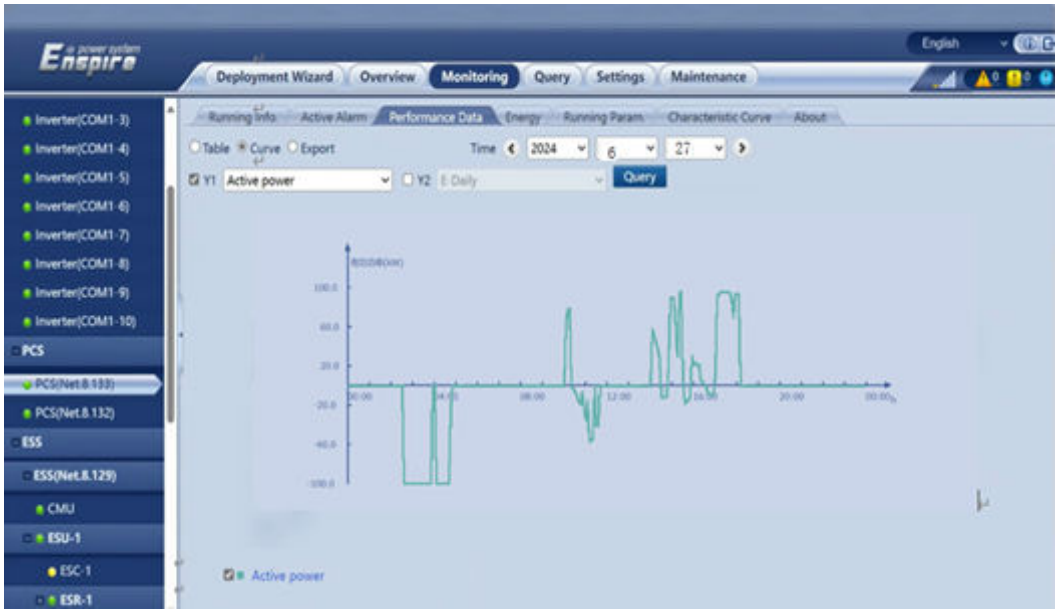
Cause 2: The power response speed is insufficient.

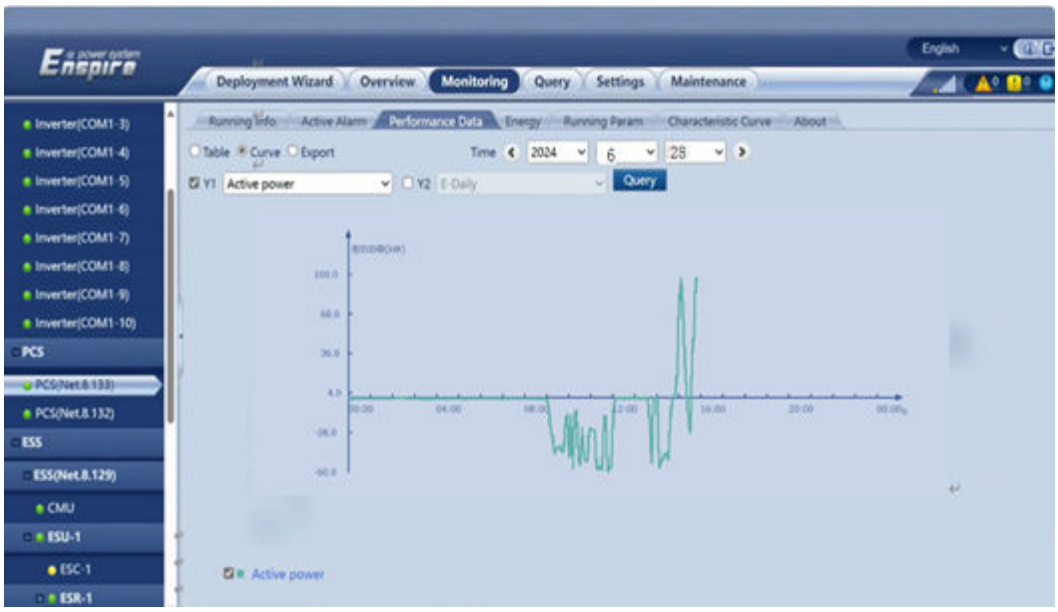
Solution: Change the maximum grid feed-in power (negative power): On the SmartLogger WebUI, choose **Settings** > **Power Adjustment** > **Active Power Control** > **Common Parameters** to change the value of **Maximum grid feed-in power**.



7.2.3.4 Charge Not Started During the Charge Period in TOU Mode

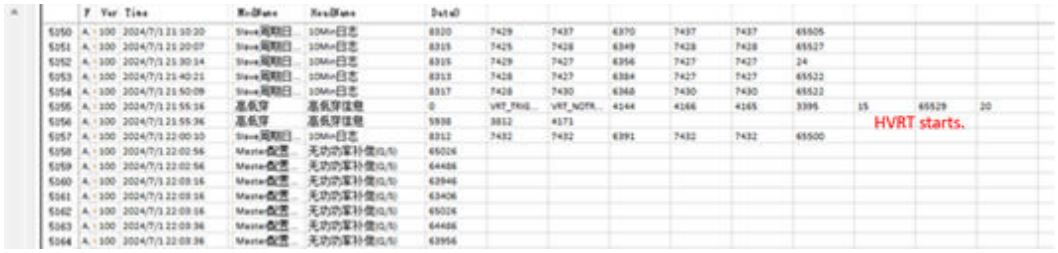
Symptom: In the TOU mode, charge occasionally fails during the charge period.



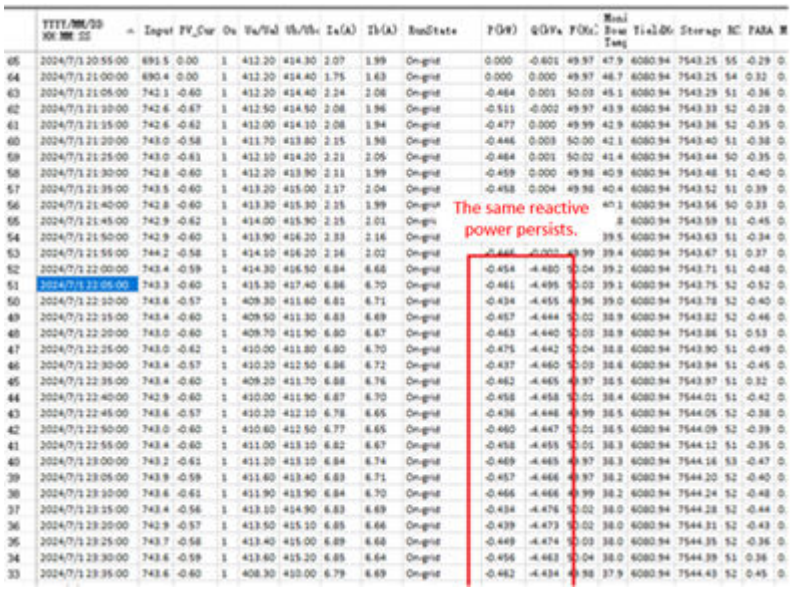


Log analysis:

Entered high voltage ride-through (HVRT) at 21:55.



Did not exit HVRT until 24:00.



Cause: The rated voltage of the grid code is 380 V. The actual running voltage exceeds 410 V in the early morning, which is easy to trigger HVRT.

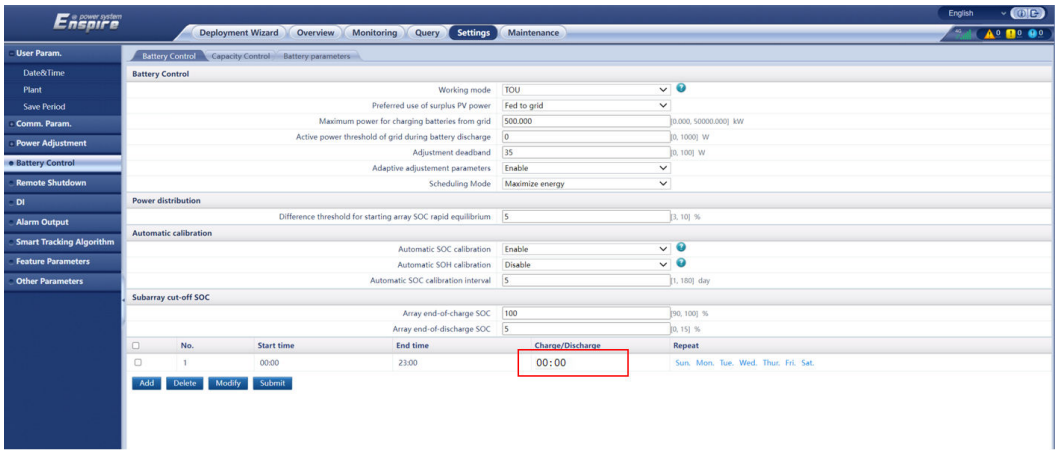
2024/07/01 23:25:00	743.7	-0.58	三相三线制	413.4	415	6.888	6.676	并网
2024/07/01 23:20:00	742.9	-0.57	三相三线制	413.5	415.1	6.851	6.657	并网
2024/07/01 23:15:00	743.4	-0.56	三相三线制	413.1	414.9	6.831	6.689	并网
2024/07/01 23:10:00	743.6	-0.61	三相三线制	411.9	413.9	6.844	6.703	并网
2024/07/01 23:05:00	743.9	-0.59	三相三线制	411.6	413.4	6.83	6.708	并网
2024/07/01 23:00:00	743.2	-0.61	三相三线制	411.2	413.1	6.836	6.742	并网
2024/07/01 22:55:00	743.4	-0.6	三相三线制	411	413.1	6.821	6.667	并网
2024/07/01 22:50:00	743	-0.6	三相三线制	410.6	412.5	6.766	6.651	并网
2024/07/01 22:45:00	743.6	-0.57	三相三线制	410.2	412.1	6.781	6.649	并网
2024/07/01 22:40:00	742.9	-0.6	三相三线制	410	411.9	6.87	6.703	并网
2024/07/01 22:35:00	743.4	-0.6	三相三线制	409.2	411.7	6.881	6.757	并网
2024/07/01 22:30:00	743.4	-0.57	三相三线制	410.2	412.5	6.857	6.722	并网
2024/07/01 22:25:00	743	-0.62	三相三线制	410	411.8	6.802	6.696	并网
2024/07/01 22:20:00	743	-0.6	三相三线制	409.7	411.9	6.799	6.672	并网
2024/07/01 22:15:00	743.4	-0.6	三相三线制	409.5	411.3	6.831	6.694	并网
2024/07/01 22:10:00	743.6	-0.57	三相三线制	409.3	411.6	6.808	6.709	并网
2024/07/01 22:05:00	743.3	-0.6	三相三线制	415.3	417.4	6.856	6.701	并网
2024/07/01 22:00:00	743.4	-0.59	三相三线制	414.3	416.5	6.839	6.678	并网
2024/07/01 21:55:00	744.2	-0.58	三相三线制	414.1	416.2	2.16	2.017	并网
2024/07/01 21:50:00	742.9	-0.6	三相三线制	413.9	416.2	2.326	2.156	并网
2024/07/01 21:45:00	742.9	-0.62	三相三线制	414	415.9	2.149	2.013	并网
2024/07/01 21:40:00	742.8	-0.6	三相三线制	413.3	415.3	2.145	1.991	并网
2024/07/01 21:35:00	743.5	-0.6	三相三线制	413.2	415	2.167	2.037	并网
2024/07/01 21:30:00	742.8	-0.6	三相三线制	412.2	413.9	2.107	1.989	并网
2024/07/01 21:25:00	743	-0.61	三相三线制	412.1	414.2	2.214	2.05	并网
2024/07/01 21:20:00	743	-0.58	三相三线制	411.7	413.8	2.148	1.977	并网
2024/07/01 21:15:00	742.6	-0.62	三相三线制	412	414.1	2.075	1.938	并网

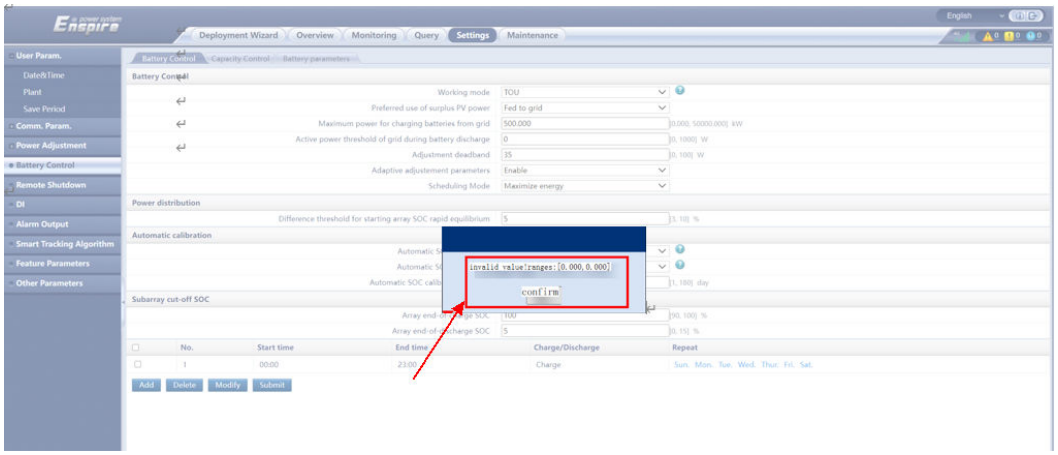
Solution: Change the HVRT trigger threshold to avoid frequent HVRT. In addition, change the HVRT exit threshold to ensure that the system can exit HVRT in a timely manner after the voltage decreases. Change the HVRT trigger threshold to 440 V, and the VRT exit hysteresis threshold to 10 V.

全选	序号	信号名称	值		单位
	1	开机故启动时间	20	[1, 1800]	s
	2	夜间休眠	禁能		
	3	延迟升级	禁能		
	4	LVRT	使能		
	5	LVRT模式	无功优先模式		
	6	LVRT触发阈值	323.0	[190.0, 380.0]	V
	7	LVRT正序无功补偿因子	2.0	[0.0, 10.0]	
	8	LVRT负序无功补偿因子	0.0	[0.0, 10.0]	
	9	LVRT无功电流限幅百分比	106	[0, 120]	%
	10	LVRT零电流模式阈值	266.0	[0.0, 380.0]	V
	11	LVRT有功电流维持系数	100.00	[0.00, 100.00]	
	12	HVRT	使能		
	13	HVRT触发阈值	418.0	[380.0, 516.8]	V
	14	HVRT正序无功补偿因子	1.5	[0.0, 10.0]	
	15	HVRT负序无功补偿因子	0.0	[0.0, 10.0]	
	16	VRT退出滞环阈值	19.0	[7.6, 38.0]	V
	17	VRT时电网电压保护屏蔽	使能		
	18	VRT有功电流限幅百分比	100	[10, 120]	%
	19	VRT有功功率恢复梯度	50	[1, 10000]	%/s
	20	电网故障零电流模式	禁能		
	21	过频降额	使能		
	22	过频降额截止功率	-100	[-100, 100]	%
	23	欠频升功率	使能		
	24	欠频升功率截止功率	100	[-100, 100]	%
	25	通信断链失效保护	禁能		
	26	关机梯度	50.000	[0.100, 2500.000]	%/s

7.2.3.5 TOU Power (Fixed Power) Setting Failure

Symptom: When the TOU (fixed power) is set for the C&I ESS and the displayed charge/discharge power range is [0, 0.00], the power setting fails and an invalid value is displayed.





Cause: The topology identification is not successful. The battery capability can be collected and is used as the upper limit of the range only after the topology identification is successful.

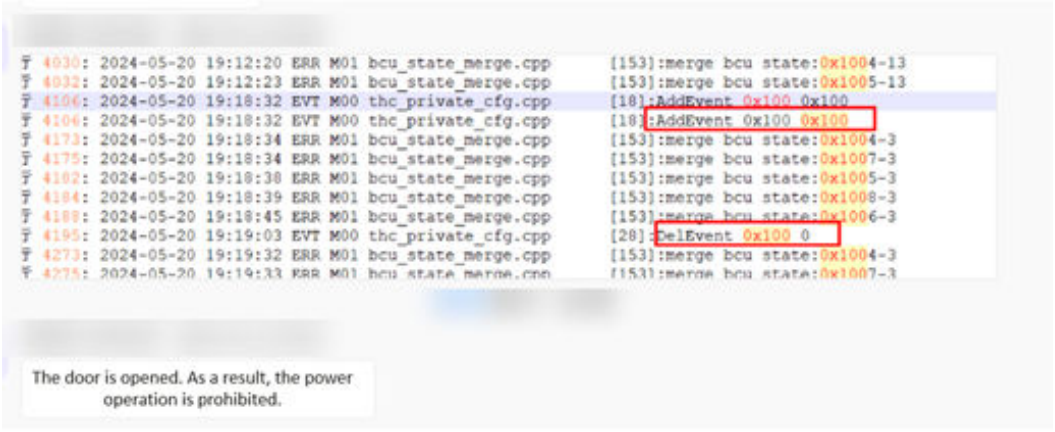
Solution: Identify the topology and set the parameters.

7.2.4 Faults Related to On-Grid/Off-Grid Modes

7.2.4.1 Abnormal Shutdown After Switching to the Off-Grid Mode

Symptom: In a project in Tanzania, the ESS shuts down abnormally several minutes after switching to the off-grid mode.

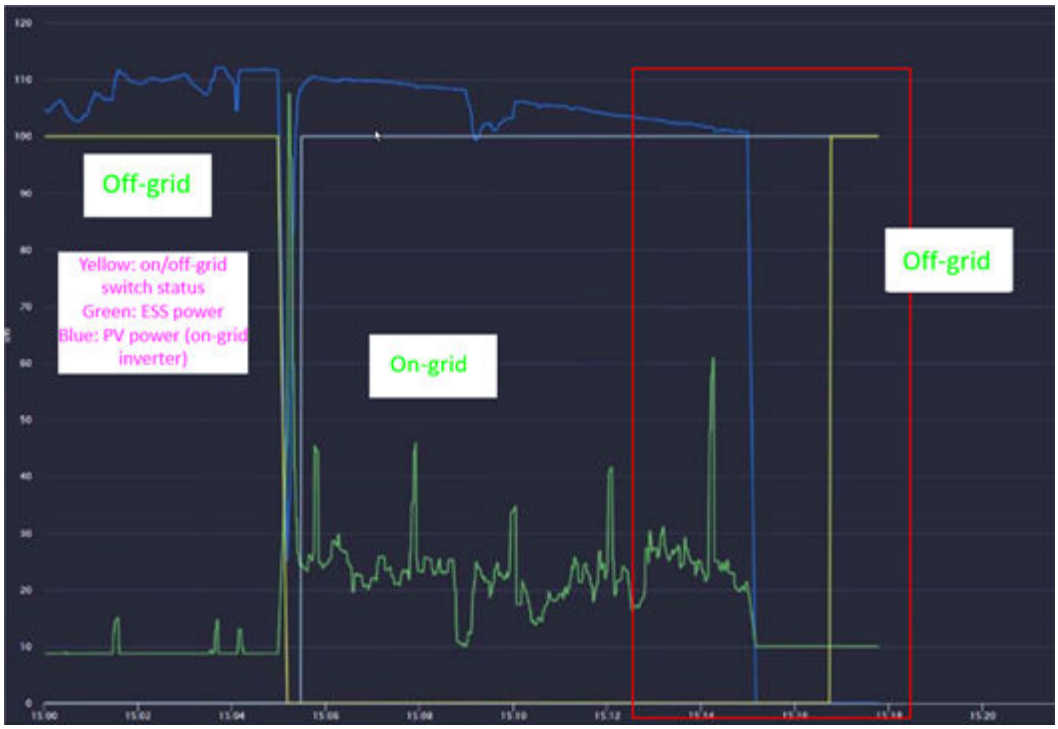
Cause: The battery cabin door of the ESS is opened during operation.



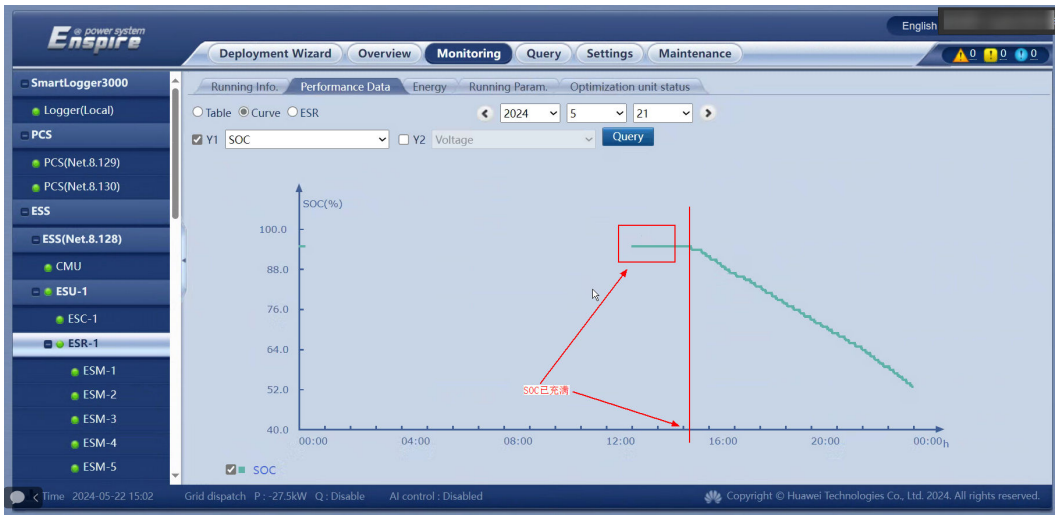
Solution: Close the battery cabin door, log in to the SmartLogger, and start the ESS.

7.2.4.2 Abnormal Shutdown After Several Minutes of Off-Grid Running

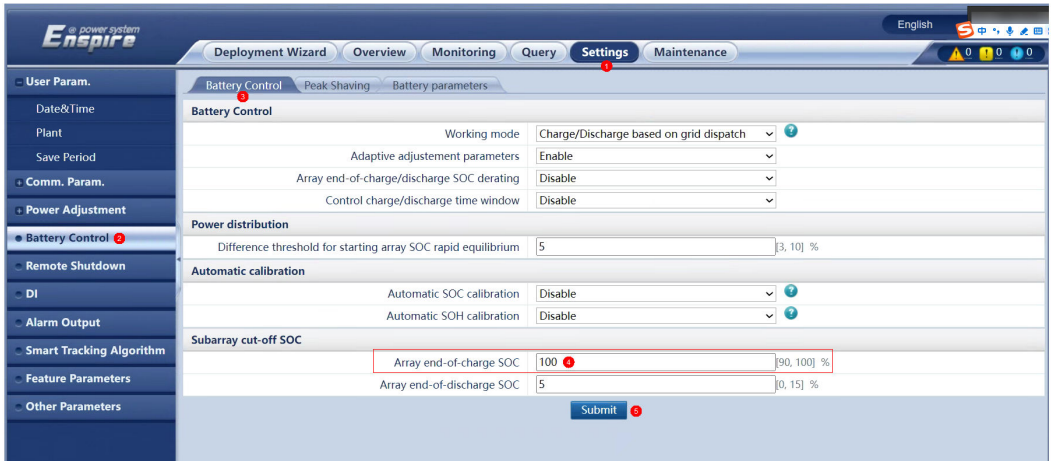
Symptom: After the ESS runs in the off-grid mode for several minutes, it stops running for 2 minutes and then recovers.



Cause: The ESS has been charged to the end-of-charge SOC. If the grid fluctuates slightly, the ESS will be bypassed and stops running.

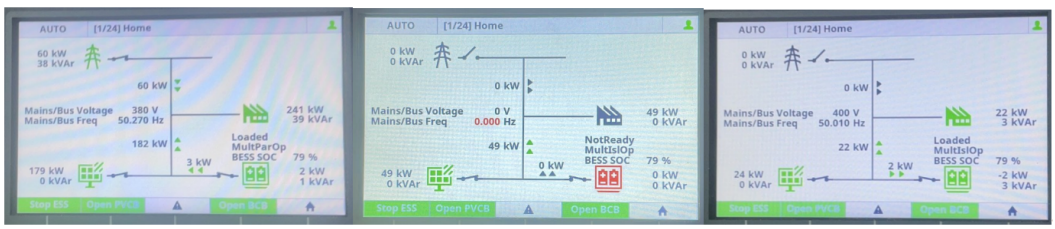


Solution: Set the end-of-charge SOC of the ESS to 100% on the SmartLogger and to 90% on the EMS. (It is recommended to charge the ESS to 100% SOC when the grid is available, calibrate the SOC, and then set the end-of-charge SOC to 90% on the EMS.)



7.2.4.3 On/Off-Grid Switching Failure Due to High Loads

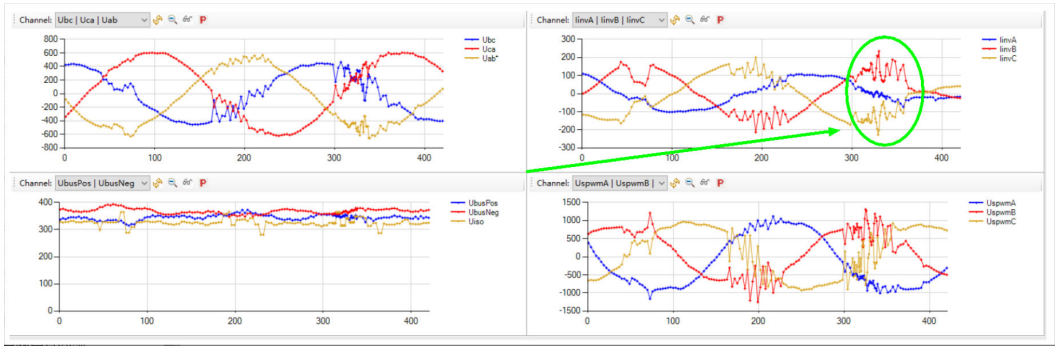
Symptom: In a microgrid project with two C&I ESSs in Nigeria (total rated power: 200 kW), when the load power reaches 250 kW, microgrid power reaches 63 kW, PV power reaches 182 kW, and ESS power reaches 5 kW, the microgrid suddenly powers off, and the ESS fails to switch to the off-grid mode and shuts down. Perform three on/off-grid switching tests. After the first and second black starts are complete, the load switch is turned on and the ESS shuts down. After the third black start is performed, the loads are reduced and the ESS starts successfully.



Cause: The microgrid is powered off and the load is 250 kW. After the power failure, the PV system is the current source. The ESS is the only power supply for load. The load exceeds the maximum output capability of the ESS, causing ESS shutdown.

First and second power outages: After the black start of the ESS is complete, the load switch is turned on. A large number of loads are connected to the ESS, including a large number of air conditioners. The air conditioners start at the same time, and the inrush current is far greater than the rated current and exceeds the ESS capability. As a result, a power outage occurs.

After the third black start, the loads are reduced, and the ESS starts successfully.



Solution:

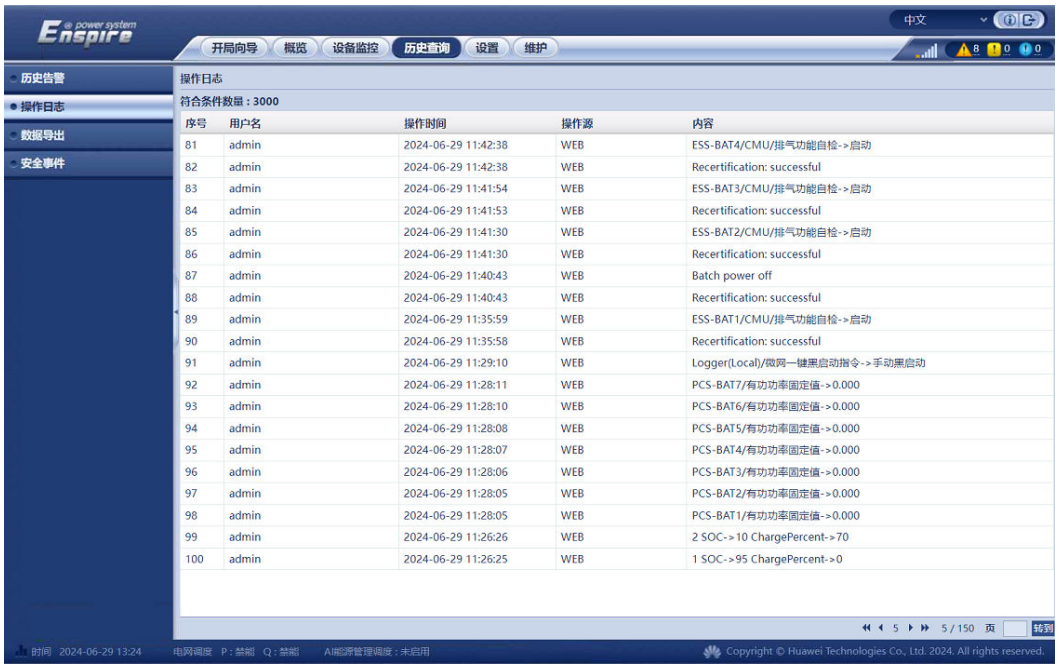
1. Add a delay relay for the loads so that they start gradually to avoid strong inrush current. The running load power cannot exceed 70% of the rated load power.

2. If there is no delay relay, shut down all loads during the grid failure. After the ESS starts, start the loads one by one at an interval of 30 seconds.

7.2.5 Faults Related to SOX

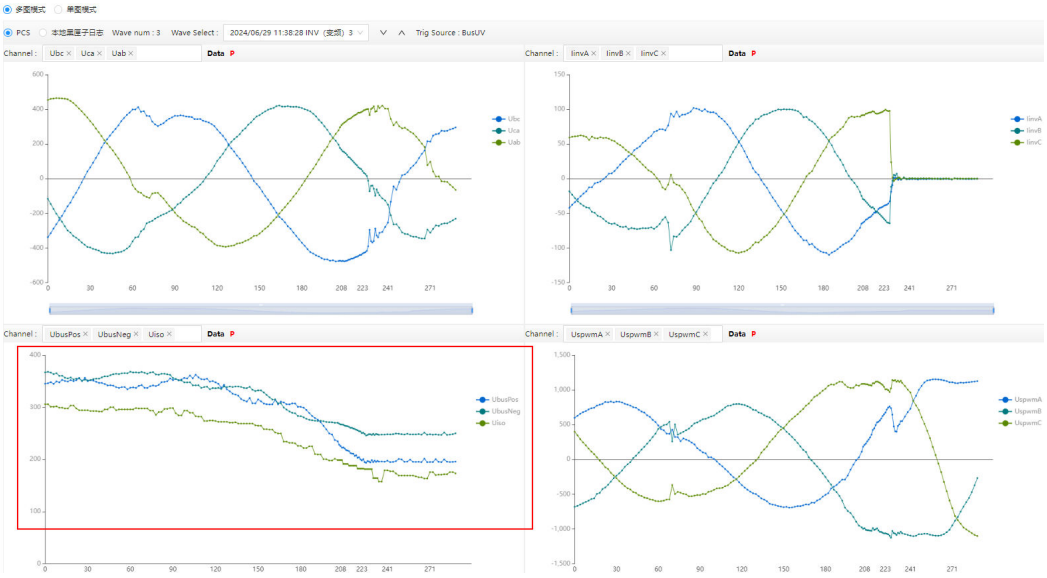
7.2.5.1 Microgrid Failure Several Minutes After Black Start

Symptom: For a microgrid C&I ESS project, the genset is used to fully charge the ESS in the PQ mode. After the ESS is fully charged, the genset exits and the VSG mode is used for black start. During the black start, an exhaust fan alarm is generated. After a small amount of load is connected, the microgrid fails.



Analysis: The voltage on the DC bus side of the PCS decreases rapidly, and the waveform on the AC side is distorted.

The DCDC enters the standby mode when a fault occurs.



Cause: After the ESSs are fully charged, the DCDC enters the standby mode. During the black start, the DCDC is still in the standby mode. At the end of the black start, the exhaust fan self-check is implemented. The power output of the DCDC in the standby mode is insufficient to start the fan. As a result, the fan self-check fails.

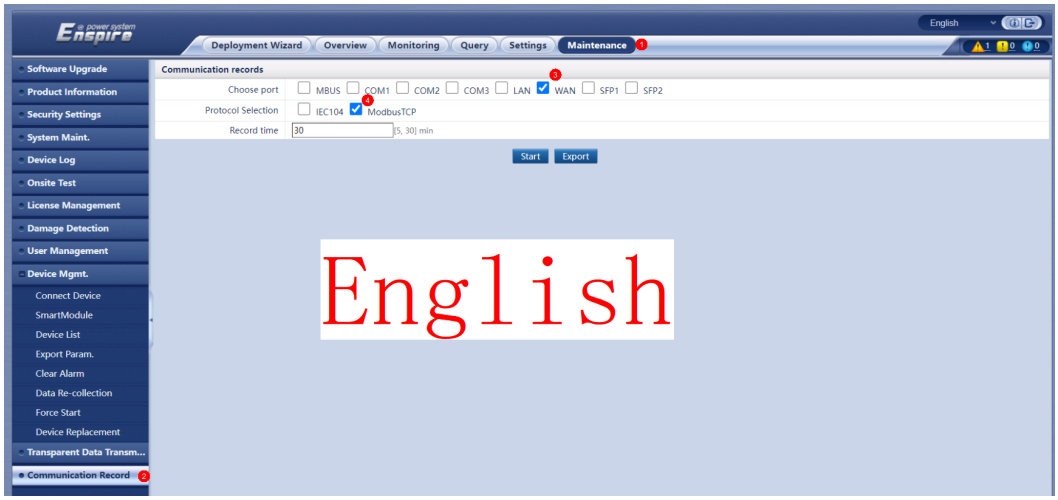
Solution 1: Turn off the PV switch, and start the genset and load. Discharge the ESS in the PQ mode. After the ESS SOC reaches 95%, power off the genset, perform black start, and connect the PV system.

Solution 2: Turn off the PV switch, perform black start, and power on the loads (the loads may cause microgrid failure). After microgrid failure, perform black start again. After the ESS is discharged to 95% SOC, connect the PV system.

8 Maintenance Guide

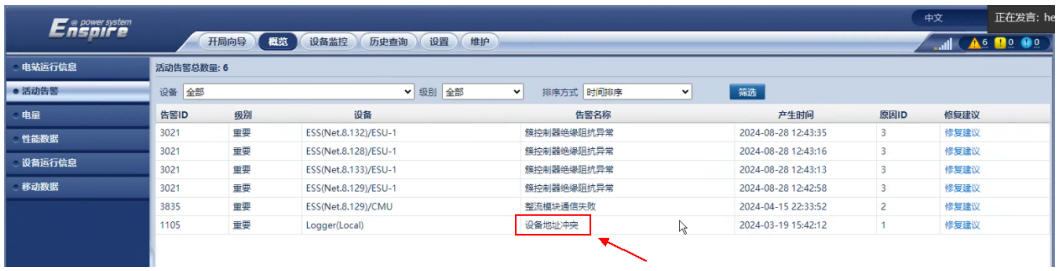
8.1 SmartLogger Packet Capture

Note: The packets captured by the SmartLogger refer to the packets between the SmartLogger and the northbound device (EMS). To capture packets locally, you can log in to the SmartLogger WebUI through the LAN port on the computer and then capture packets. See the following figure.



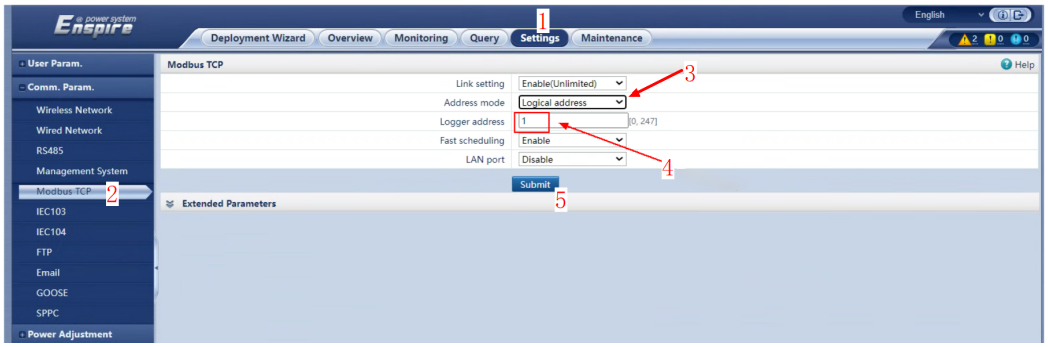
8.2 Clearing the Device Address Conflict Alarm (1105-1)

Symptom: The device reports the 1105-1 device address conflict alarm.



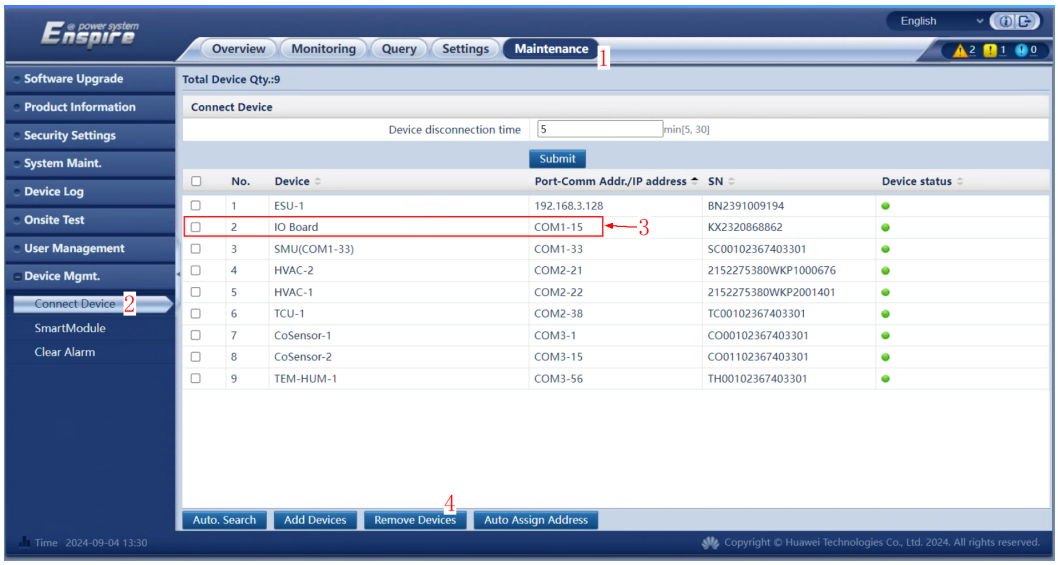
Solution:

1. Log in to the SmartLogger and go to the page shown in the following figure. Set **Address mode** to **Logical address** and **Logger address** to **10**. Click **Submit** and wait for 1 minute. Check whether the device reports the 1105-1 device address conflict alarm.

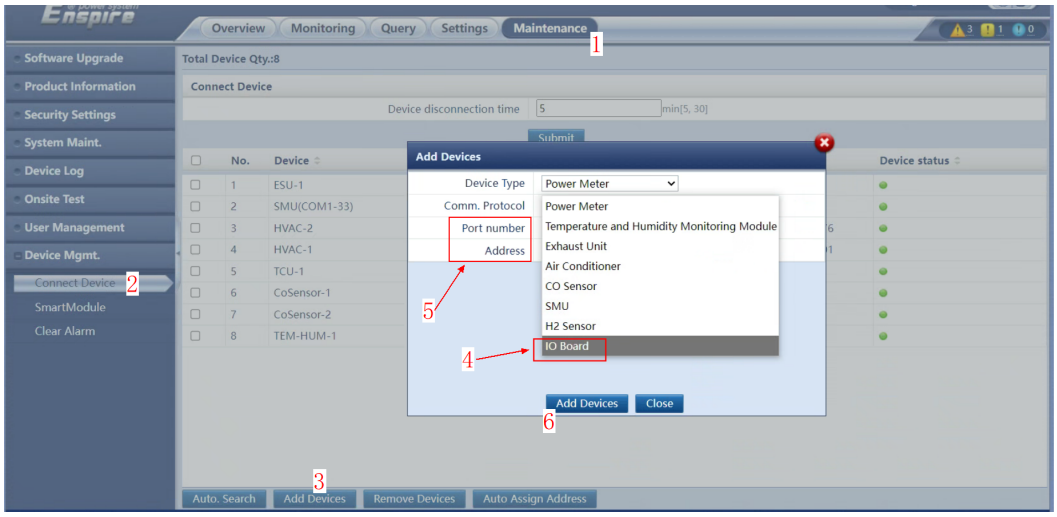


2. If the device still reports the 1105-1 device address conflict alarm, connect the PC to the CMU.

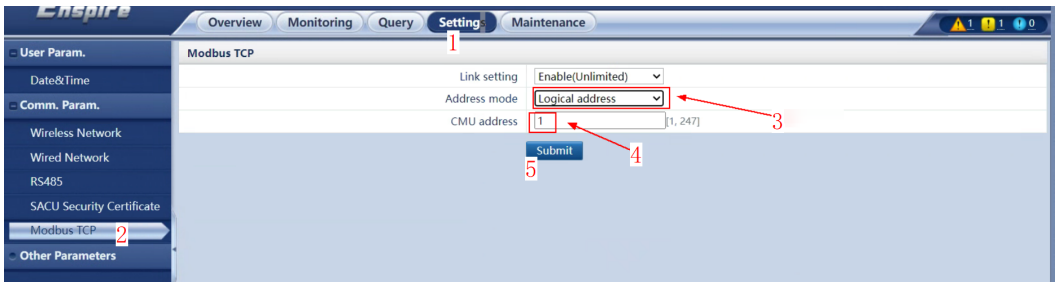
a. Delete **IO Board** from the device list. (Record the port and address of **IO board** before deleting it.)



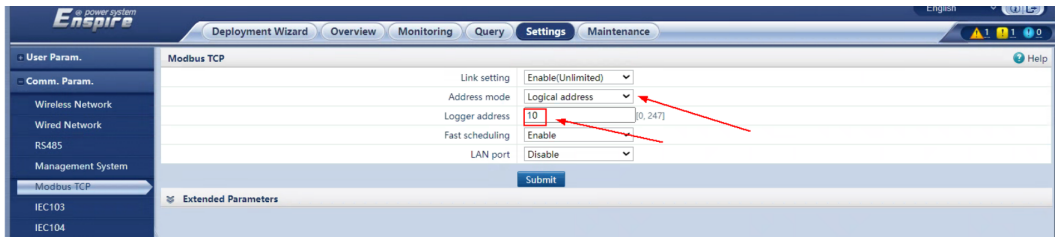
b. Select **IO Board** and enter the recorded port number and address to add the IO board.

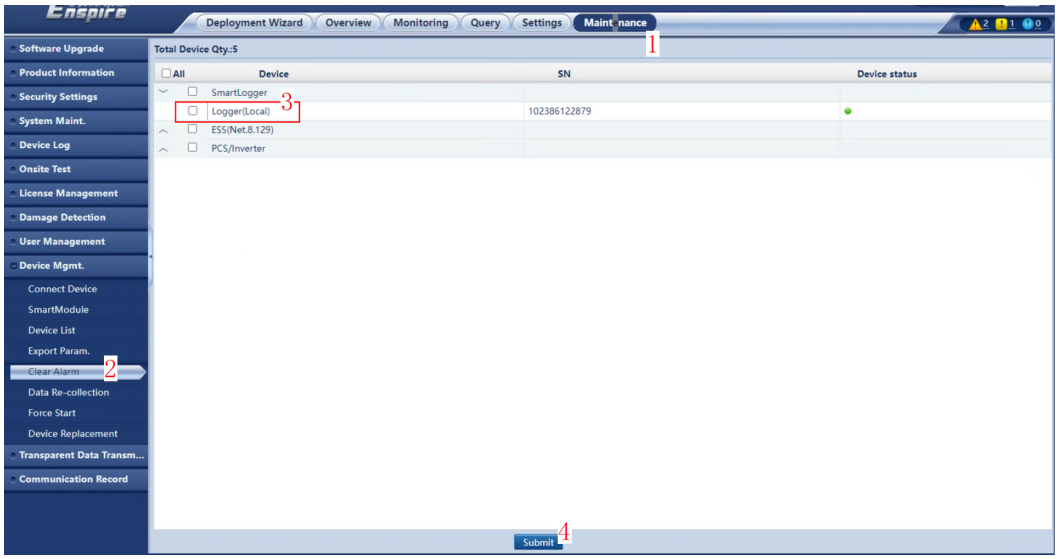


c. Set **Address Mode** to **Logical Address** and **CMU Address** to **1**, and click **Submit**.



d. Connect to the SmartLogger and check whether the 105-1 device address conflict alarm persists. If the alarm persists, check whether the Modbus TCP settings are correct. If the settings are correct, clear the alarm on the SmartLogger and check again.




Deployment Wizard
Overview
Monitoring
Query
Settings
Maintenance
1
Software Upgrade
Product Information
Security Settings
System Maint.
Device Log
Onsite Test
License Management
Damage Detection
User Management
Device Mgmt.
Connect Device
SmartModule
Device List
Export Param.
Clear Alarm
2
Data Re-collection
Force Start
Device Replacement
Transparent Data Transm...
Communication Record
Total Device Qty.:5
All
Device
SN
Device status
SmartLogger
Logger(Local)
3
102386122879
ESS(Net.8.129)
PCS/Inverter
Submit
4