Specification of container energy storage system

1MW/4.1MWh

Product Name:　　Container-type lithium-ion battery energy storage system

Product Model #:　　NV-ESSI4.1MWh

Part Description:　　1MW/4.1MWh

File Version NO.:　　V1.0

Effective Date:　　2023-12-7

Company confirmation

Prepared by	Checked by	APPROVED

Customer confirmation

Confirmation Opinions ：

Seal (signature):

Date ：

Safety precautions

Hazards and warnings!

The system can only be installed by professionals.

Nova Energy will not be liable for faults caused by failure to comply with the instructions in this specification.

Note tips!

After removing the overall package of the system, before setting or using, please read all of this manual.

To ensure the good functionality of the energy storage system, please install, set up, use and maintain the system in the manner described in this manual.

This specification is not intended to include all details or changes to the unit or to provide all possible accidents related to installation, operation, maintenance. Contact Nova Energy for further information or special questions not fully stated in this specification.

Catalogue

Chapter 1: Systematic introduction

1.1 Design description

Nova Energy storage container energy storage system is the lithium iron phosphate battery, battery management system, energy storage bidirectional converter, gas fire extinguishing system, environmental control system, scheduling control terminal, and other subsystems organic configuration in standard container, integrated combination of energy storage system, can be widely used in distributed energy storage power station park micro grid system, electric car storage station, urban energy storage power station, industrial and commercial energy storage power station, etc.

Nova energy storage container energy storage system can be directly connected with EMS cloud platform, and carry out power load response and peak-valley arbitrage based on the regional power grid electricity price policy, so as to obtain the best economic benefits and shorten the recovery life of equipment investment cost. In addition, the reliability of the system is reflected in the battery fault, the imbalance of battery DC parallel, energy storage converter fault, abnormal environment and human operation fault, to ensure the long-term operation safety of the system.

This document is used to describe the container storage specifications of 1MW/4.1MWh

1.2 System characteristics

◆ Modular design, linear expansion battery cell and energy storage two-way inverter unit;

◆ Customized battery management system to provide perfect measurement and protection functions;

◆ Fault classification processing mechanism to respond to the preset fault scenarios;

◆ Adopt private cloud scheduling, combined with local curing strategy operation, remote update operation strategy and firmware upgrade;

◆ DC parallel logic lock control to ensure the safe operation of multiple batteries in parallel;

◆ Fast engineering installation, low operation and maintenance cost;

◆ Suitable for regulating the power load and reducing the enterprise electricity charges;

◆ Suitable for response to power grid load control, reduce power grid peak load;

1.3 System composition

System configuration 11 clusters of energy storage battery (composed of 143 custom battery pack), 11 sets of battery management system, 2 sets of energy storage bidirectional converter, 1 set of energy dispatching system, 1 set of gas fire control system, 1 set of environmental monitoring system, 2 air conditioning system, a custom container hardware equipment and a set of cloud dispatching platform application system.

The container is designed to have an escape door, and the back door should be opened and locked before entering the container, and a prominent position on the door. In this project, the PCS outlet side is three-phase outgoing line. The user should configure the circuit breaker switch and connect to mains, and the control loop power supply comes from mains.

Chapter 2: Technical Parameters

2.1 System Definition

1MW/4.1MWh Energy storage container

Model	Converter power (kilowatt)	battery capacity (kilowatt-hour)	Dispatcher's control	Space (length * width * height)	weight
Nova1MW/4.1 MWh	500*2	4100	EMS Cloud	12192*2438*2896(mm)	<35 Tons

More combined configurations need to be appropriately customized according to the specific project requirements

2.2 Allocation of the energy storage system

The whole energy storage system adopts lithium iron phosphate battery as the physical carrier of energy storage, and takes 372.736KWh energy battery cluster as the unit, through 11 battery clusters to form 4100 KWh battery container energy storage system.

The 4.1MWh energy storage system configuration table is as follows:

No.	Project description	Burst mode	Rated voltage （V）	Rated capacity （Ah）	Storage of electricity （kWh）	Implementation method
1	The cell		3.2	280	0.896	A single cell
2	battery pack	2P16S	51.2	560	28.672	Module series
3	Battery cluster	2P208S	665.6	560	372.736	13 series of the battery pack
4	battery cupboard	22P208S	665.6	6160	4100.096	11 Parallel of Battery cluster

## 2.3 Arrangement of battery and high voltage breaking box for energy storage system

The energy storage battery is installed in the battery prefabricated cabin, which has 11 battery racks, 13 battery packs installed and 1 cluster control box, 11 battery racks installed 143 battery packs and 11 cluster control boxes to form the 665.6V 6160Ah energy storage system.

2.4 Technical indicators of energy storage battery

List of main technical indicators of Nova-1MW-2 MWh:

No.	Project		Metric
1	System nominal	power rating	500*2KW
		nominal capacity	4100KWh
2	Communication side	rated voltage	400V
		voltage range	320～460V
		rated current	722*2A
		rated frequency	50/60Hz
		power factor	> 0.975
3	direct current side	rated voltage	665.6V
		Lower limit voltage	520 V
		Upper limit voltage	759.2V
		rated current	1025*2A
		Cell specifications	280Ah
		Number of cells	4576 Of the
		actual capacity	4100KWh
4	Battery management	Cluster battery	Group 11
		Cluster unit	143 The
		voltage accuracy	0.2%
		Temperature accuracy	1%
		SOC accuracy	5%
		Power precision	1%
5	air-conditioning	way to install	flushbonading
		Cold power	10KW
6	extinguishing and protection	Fire media	Seven fluoride propane
		The way of ejecting	Pipe type
7	System cycle life		> 3,500 times (25℃)
8	Capacity availability		>80%
9	weight		<35 Tons
10	structure size		12192*2438*2896(m m)

2.5 Technical requirements of PCS inverter system
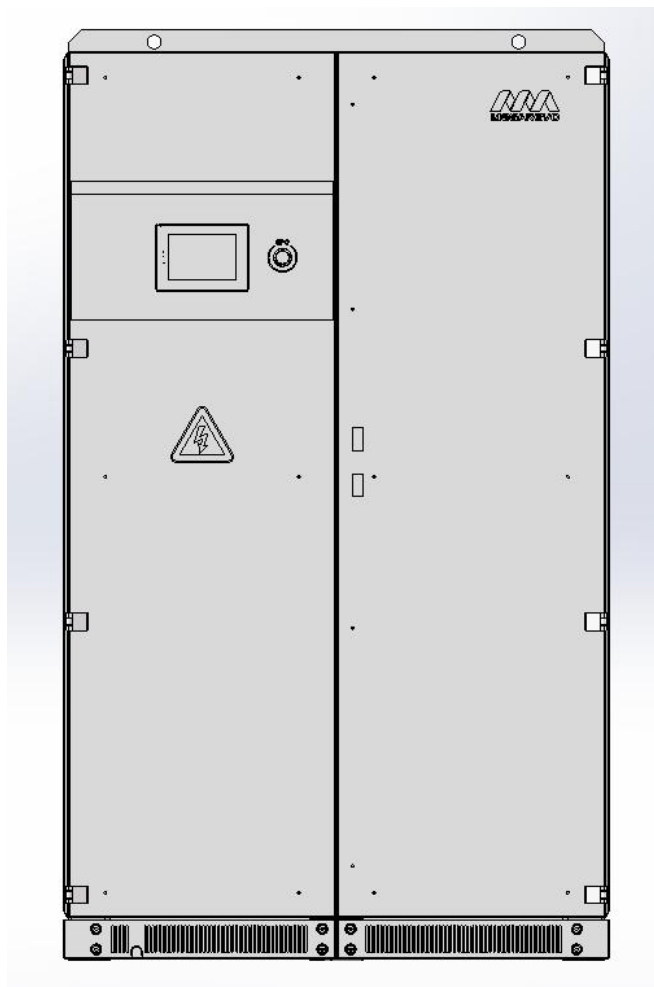
2.5.1 Specific parameters of PCS inverter:

order number	project	parameter	explain
1	output rating	500KW	
2	Operating voltage range	500Vdc ～850Vdc	
3	Maximum AC current	794A	
4	AC output voltage	400Vac	
5	voltage range	320～460	
6	rated current	722A	
7	Rated output frequency	50Hz/60Hz	Can set
8	Communication connection	3W+N+PE	

9	Output voltage accuracy	1%	Linear load
10	overload capacity	110%	
11	productiveness	97.1%	
12	isolation transformer	possess	
13	levels of protection	IP21	
14	operating ambient temperature	-30℃~55℃	
15	relative humidity	0~95%	No condensation
16	cooling-down method	Temperature control intelligent air cooling	Intelligent speed regulation of fan
17	Dimension W * D * H (mm)	1600*1050*2050	
18	Weight (kg)	2665	
19	BMS communication	RS485、CAN	
20	EMS communication	RS485、TCP/IP	

2.6 Technical requirements of EMS electric power management system
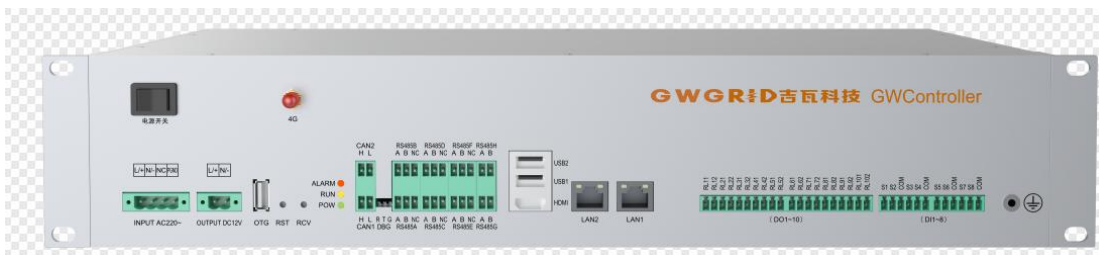
2.6.1 EMS technical parameters

No.	project	parameter	explain
1	Enter the power supply	AC220V	
2	power dissipation	<10W	
3	CPU	4 Nuclear 2.0G	The ARM architecture, the 64-bit one
4	operating system	flushbonading linux	
5	MTBF	>50000H	

6	storage facilities	>100GB	
7	certainty of measurement	Voltage <0.1%; current <0.5%; temperature <0.5℃; time resolution <0.1s	
8	Monitor the number of PCS performed	<6	
9	Topological circuit	Unipolar, bipolar, and chain type	
10	Ethernet 100M	2 Independent url	
11	operating system OS	Linux、SylixOS	
12	protocol	DL/T101、DL/T103、CAN、MODBUS	
13	time lock	IRIGB、NTP	
14	communication interface	RS485 8 A, and CAN 2	
15	IO mouth	8DO,10DI	
16	Number of access air conditioners	<4	
17	Number of electricity meters connected	<8	
18	Number of PV connected to the photovoltaic inverter	<4	
19	4G interface	One	

2.6.2 Features of the EMS system

function	explain
The SCADA system is monitoring	Data display of the key equipment of the whole system, including the topology map, status, alarm information, etc.
EMS control model	Through this interface, the control mode of energy storage (micro grid) system can be set, including simple and intelligent modes.

BMS supervisory control	Through this interface, you can view the battery attributes, status, information, alarm, SOC, SOH and other data.
Testing Control of the test	This function is mainly used in debugging, you can configure system level test, single equipment test, such as PCS test, DCDC test, BMS test, air conditioning, heater test, etc.
The BAS moving ring monitoring	This page can see the power environment data of the energy storage system, and the test control and parameters can also be adjusted on this page.
Tech Indicators Technical indicators	It mainly includes SOH, energy efficiency, PCS efficiency, availability, charge and discharge response and regulation time, battery attenuation rate, etc
Gateway Data upload	When the energy storage system is connected to other third-party systems, this page can configure the protocol type of the connection, the communication status of the connection, and the command record, etc
Configure Parameter configuration	Including: the maximum power of the connection point of the energy storage system, whether it supports the reverse power or not, and the working mode configuration of various equipment
LogMgr Alarm and log	Alarm includes alarm judgment, current real-time alarm, and historical alarm

2.7 Use environment

A) Operating temperature: -10~ + 45℃:

Bb) Storage temperature: -20~ + 55℃;

C) Relative humidity: not more than 95%;

D) The medium with explosion risk is not allowed at the use place;

E) The place of use shall have facilities to guard against rain, snow, wind, sand and ash;

F) Choose a site with hardened foundation, not directly exposed in summer, not low-lying.

Chapter 3: Structural Dimensions

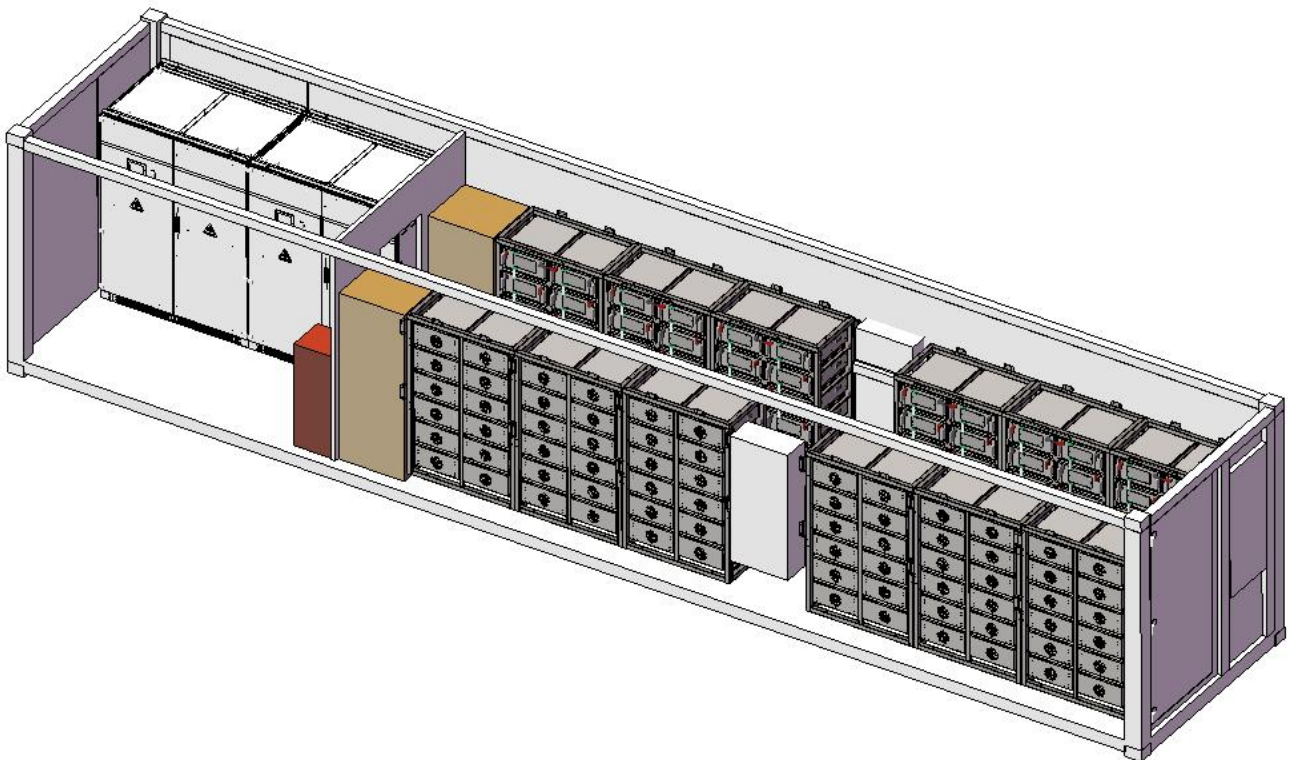The structural dimensions of energy storage system is as follows:

Figure 3-1 Internal layout diagram

Energy storage container The energy storage system adopts a 40-foot container with a structure size of 12.192 (length) * 2.438 (width) * 2.896 (height) meters.

Chapter 4: Description of the module functions

4.1 Dispatch and control terminal

Dispatching control terminal is a device to realize the system operation state control, DC grid-connected control, protection and data exchange, and is the core center of energy storage system operation.

The main features of the device are:

Real-time data collection, including AC side power parameters, DC side power parameters PCS operating parameters, BMS operating parameters, environmental parameters, etc.;

Historical data storage, including PCS start and stop, battery string connected to and off the grid, PCS fault information, battery string fault information, smoke sense / fire trigger information, precision air conditioning start and stop information, minute-level real-time data storage, etc.;

Cluster battery DC grid-connected logic control; backup protection;

Receive control instructions from EMS cloud or other dispatching systems and upload data;

4.2 Energy storage bidirectional converter

Energy storage bidirectional converter is a device to realize the two-way energy conversion between the battery and the AC power grid. Its core part is the converter composed of power electronic devices and the corresponding embedded control software.

Main features of energy storage bidirectional converter:

Automatic synchronous grid connection, no impact on the power grid; modular design, convenient installation and maintenance;

Perfect protection measures: power grid undervoltage / overvoltage / reverse phase sequence protection, frequency abnormal protection, anti-island protection short circuit protection, over temperature protection, DC side overvoltage / reverse polarity protection, insulation protection, etc.;

Low current harmonics: THDi harmonics <3%; large screen human-machine interface;

Powerful communication expansion: CANRS485LAN; multiple communication protocols: MODBUSTCP / IP, etc.; can accept power grid or monitoring system dispatching;

4.3 Battery management system

Battery management system BMS is composed of battery pack management unit BMU and battery pack string management system SBMS. The BMS system has the functions of high-precision detection and reporting of analog signals, uploading and storing fault alarm,

battery protection, parameter setting, passive balancing, battery pack SOC calibration and information interaction with other devices

Main features of the battery management system:

Implement a comprehensive detection of the running state of the battery, including voltage, current, temperature, etc.;

High voltage detection accuracy of single battery: + 2 mV, to ensure the credibility of system data analysis multi-point temperature monitoring, to avoid battery thermal runaway, to ensure the safety of the system;

Passive balance mode, effectively delay battery life; modular design, strong scalability; complete and reliable battery protection function;

4.4 Lithium iron phosphate battery

The system adopts aluminum shell base acid lithium iron capacity battery, the nominal capacity is 280 AH, and the technical specifications are as follows:

No.	project		parameter	remarks
1	nominal capacity		280Ah	25℃ 30A constant current discharge with a 2.0V cutoff
2	minimum capacity		280Ah	
3	nominal voltage		3.2V	0.5C constant current discharge average voltage
4	internal resistance		<0.6mΩ	At the 30%SOCAC1kHz condition
5	Charging (constant current and constant voltage)	Maximum continuous charging current	0.5CA	From 0 to 45℃ conditions
		Maximum pulse charging current	1CA (within 30s)	
		Charging cut-off voltage	3.65V	
6	discharge	Maximum	2CA	

		discharge current		
		Discharge cut-off voltage	2.0V	
7	charging interval	Standard charging	2.5h	reference value
		quick charge	2h	
8	Recommended SOC window		10%～90%	
9	Operating temperature under charging conditions		0～45℃	During the battery charging process, the battery and the ambient temperature shall not exceed 45℃
10	Operating temperature under discharge conditions		-20～55℃	The battery works normally within the specified temperature range
11	Storage temperature	Short-term (1-month)	-20～45℃	
		Long term (1 year)	0～35℃	
12	Store humidity		<70%	
13	Battery weight		5600±30g	

4.5 Gas fire extinguishing system

The sevafluoropropane fire extinguishing system is designed according to the size of the container, which transfers the fire extinguishing agent from the extinguishing agent cylinder group through the main pipe and the branch pipe to the nozzle for spraying. The system includes fire detector, sound and light alarm box, emergency start and stop button, vent indicator light, gas fire extinguishing controller, etc., following the national mandatory standards.

Main characteristics of the gas fire-extinguishing system:

Use extinguishing electrical fire, liquid surface fire and molten solid fire with automatic, manual and mechanical emergency start mode to effectively prevent system misinjection and perfect anti-misstart measures caused by chronic leakage

Chapter 5: Energy storage control

5.1 Operating status

Nova energy storage system can run into four states: charging state, discharge state, ready standing state and fault state.

Charging state: the power grid injects the current into the battery through the PCS, and the battery stores the energy: in this state, the system accepts the background power dispatching;

Discharge state: the battery injects current into the power grid through PCS, and the battery releases energy; in this state, the system accepts the background power dispatching;

Ready standing state: there is no energy exchange between the grid and the battery, the battery DC is in grid connection condition, and the PCS is in standby condition; in this state, the system accepts background power dispatching;

Fault state: the energy cannot be exchanged between the power grid and the battery. After a serious fault occurs, it must be restored by manual operation, and the system does not accept the background power dispatching;

5.2 Charge and discharge

Nova energy storage system receives the scheduling strategy of EMS cloud, and solidifies the strategy in the scheduling control terminal. When no new dispatching strategy is received, it starts the charging state or discharge state according to the current strategy.

Usually, the battery charge and discharge interval is between 10% and 100% capacity, the system will default the charge and discharge lock parameter, in order to avoid the battery heating problem caused by overcharge and the battery life decline caused by overdischarge

5.3 Standby

When the energy storage system enters the ready standing state, the energy storage two-way converter and battery management system can be set to the standby state to reduce the power consumption.

The standby protection feature remains effective, and the connection to the EMS cloud platform remains effective.

5.4 Battery string and DC grid connection

The energy storage system can be expanded to support 12 battery packs. Due to the small internal resistance of the battery strings, when the energy storage system is put for a long time or a battery string after maintenance, the voltage difference between the battery strings will lead to the formation of circulation between the battery banks when the grid is connected. Nova energy storage system has a customized control strategy, which can control this circulation within the affordable range of the system.

The dispatching and control terminal of the energy storage system provides a perfect dc grid-connected logic control function. When the above situation occurs, the cluster battery pack with excessive pressure difference will be prevented from being directly connected to the grid through the locking related contactor. Users can enter the DC automatic network connection state by startup, and the system can automatically complete the grid connection of all effective cluster battery packs without manual intervention.

5.5 Emergency shutdown

The energy storage system supports manual emergency shutdown operation, and forcibly triggers the shutdown signal.

5.6 Overflow trip

When the energy storage system detects a serious fault, it will automatically disconnect the circuit breaker in the PCS and isolate the power grid. If the circuit breaker refuses, the system will output the overflow jump signal, allowing the upper circuit breaker to buckle and isolate the fault.

5.7 Gas fire extinguishing

The energy storage system will start the fire extinguishing system when the temperature exceeds the warning value or the smoke signal action. The fire extinguishing agent is released into the container through the high pressure channel, and the fire extinguishing agent absorbs a lot of heat from the liquid to the gas, reduces the oxygen concentration, and separates the flame propagation. At the same time, the system triggers the sound and light alarm, and conducts remote alarm through the EMS cloud platform. When the fire alarm signal is triggered, the system will have an emergency shutdown, disconnect the connection with the power grid, and disconnect the cluster battery.

Chapter 6 System main list

No	device name	model	quantity	unit
one	Lithium battery unit			
1	Lithium iron phosphate cell	3.2V / 280 AH, square	4576	pcs
2	Battery cluster	665.6V/560A h, 2 and 208 string, including voltage and temperature acquisition wire beam, laser welding	11	suite
two	Battery management system			
1	BMU cell	16 circuit voltage 10 circuit temperature, passive equilibrium	143	pcs
2	SBMS main engine	Each string of voltage, temperature, total voltage, current, S OC SOH Battery overtemperature,	12	pcs

		overpressure, pressure loss, temperature rise protection		
		Battery over temperature, over pressure, under pressure, temperature rise alarm lock		
		Module body fault monitoring		
		Upink MODBUS-TCP downside CANBUS		
three	Bi-directional rectifier flow converter			
1	PCS	Dynamic load balancing control, support multi-channel communication, support remote scheduling control. Rated power is 500KW.	2	pcs
four	battery elevator			
1	battery box	Two battery modules can be arranged, including battery connected to aluminum row, battery, and extreme column connected to copper row	143	suite
2	Battery drawer connects to machine columns and cables	Positive and negative pole column and high-voltage connection cables	11	suite
3	Battery extraction and communication connection and cable	BMS communication transfer board and connecting cable	11	suite
4	Battery cluster control cabinet	Built-in 250A DC circuit breaker, 250A DC contactor, 100A DC contactor, 400A DC fuse,	11	suite

		pre-charging resistance and auxiliary materials, etc		
5	battery elevator	627 * 1130 * 1692 cabinet, including PACK drawer cabinet, high voltage drawer cabinet, connecting cable auxiliary materials, etc	11	suite
five		control cabinet		
1	control cabinet	505 * 700 * 1792 cabinet, including 1 set of EMS power management system, Schneider circuit breaker, terminal row, 24V starting power supply (backup power supply) and auxiliary materials, etc	1	suite
six		Converter cabinet		
1	Converter cabinet	505 * 700 * 1792 cabinet, including 1 Schneider circuit breaker and confluence copper bar, etc	1	suite
seven		Container and auxiliary systems		
1	Sevofluoropropane gas fire extinguishing system	Including 140L gas extinguishing bottle, smoke sense, temperature sense, gas extinguishing controller extinguishing agent conveying pipeline and installation accessories, etc	1	suite
2	Outdoor cabinet air conditioning	5kW cooling power, dehumidification, IP65 support self-start and remote control, protective cover	2	suite

3	40 ft custom standard container	40 feet, inside 20 mm insulation layer, including reinforced steel bar, facade spray LOGO	1	suite
eight	Energy scheduling system			
1	G WC200 Energy scheduling system	Energy storage charge and discharge strategy local control, over charge and over discharge protection	1	suite
		DC bus grid connection logic control, string battery disconnection control		

Statement:

The information provided in this manual is modified without prior notice

Shenzhen Nova Energy Co.,Ltd.. reserves the right to interpret the said information

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