5MWh 20ft liquid cooled container energy storage system specification

Name：5MWh 20ft liquid cooled container energy storage system

Model：CL1P416S05MC1

Energy：5MWh

Prepared	Checked	Approved

Revision History

Rev	Revised content description	Date of issue	Revised by	Checked by	Approved by
A/1	First edition	20240926			
A/2	Second edition, technical term, inset	20250225			

CONTENT

REVISION HISTORY 2
1.TERMS DEFINITION 4
2. PRODUCT INTRODUCTION 5
2.1 ELECTRICAL DIAGRAM OF CONTAINER TOPOLOGY 5
2.2 BMS 6
2.3 PARAMETERS OF CONTAINER 6
2.4 CONTAINER KEY COMPONENTS LIST 7
3. KEY COMPONENT PARAMETERS 8
3.1 CELL 8
3.1.1 Parameters of cell 8
3.1.2 Dimensions of cell 9
3.2 BATTERY MODULE 10
3.2.1 Parameters of battery module 10
3.2.2 Dimensions of battery module 10
3.3 BATTERY CLUSTER 11
3.3.1 Battery cluster parameters 11
3.3.2 HV Box 11
3.4 PDB 12
3.4.1 Appearance of power distribution box 12
3.4.2 List of key components 12
3.5 DCCB 13
3.5.1 Appearance of DC combiner box 13
3.5.2 List of key components 13
3.6 THERMAL MANAGEMENT SYSTEM 13
3.6.1 Thermal management system layout 13
3.6.2 HVAC 15
3.7 FIRE PROTECTION SYSTEM 15
3.7.1 Fire protection system composition 15
3.7.2 Fire system logic 17
3.8 CONTAINER DESIGN 18
3.8.1 Container structure 18
3.8.2 Container thermal management 19
3.8.3 Container grounding 20
3.8.4 Container wiring 20
4. SPECIFICATION FOR CONTAINER TRANSPORTATION AND INSTALLATION 20
4.1 PREPARATION AND INSPECTION BEFORE UNLOADING 20
4.2 DISCHARGING PRECAUTIONS 20
4.3 LIFTING OF ENERGY STORAGE CONTAINER 20
4.4 FIXATION OF CONTAINER 21

1.Terms definition

Table 1: Terms definition

RJETech	SB-BW Design:13
LFP	Lithium Iron Phosphate
AC	Alternating Current
DC	Direct Current
BMS	Battery Management System
BMU	Battery Management Unit
BCMU	Battery Cluster Management Unit
BSMU	Battery System Management Unit
BOL	Begin Of Life
EOL	End Of Life
HV Box	High Voltage Control Box
MSD	Manual Service Disconnect
PCS	Power Conversion System
SOC	State Of Charge
SOH	State Of Health
SOE	State Of Energy
SOP	State Of Power
UPS	Uninterruptible Power Supply
CCS	Cell Connection System
CAN	Controller Area Network
ETH	Ethernet Module
PDB	Power Distribution Box
DCCB	DC Combiner Box
HVAC	Heating Ventilation Air Conditioning
MCCB	Molded Case Circuit Breaker

2. Product introduction

The 5MWh 20ft liquid cooled container energy storage system consists of 12 clusters of 1331.2V/314 Ah battery cluster, PDB, DCCB, fire protection system, battery management system, and thermal management system. The system outline diagram is shown in figure 1.

Adopting standard non-walk-in 20ft container, the modular design enhances the utilization of space in the container. The advanced liquid cooling cycle design concept enables the battery system to perform optimally; the three-level intelligent battery management system minimizes the risk of thermal runaway of the system, which effectively improves the all-round safety of the energy storage system and the life cycle of the storage battery, and provides a safer technical guarantee for the operation of the energy storage system.

Front Rear

Figure 1: Container appearance diagram

2.1 Electrical diagram of container topology

The container system adopts an integrated solution.

PCS adopts a centralized solution, with 12 clusters of batteries passing through a high voltage control box and a DCCB, connected to one PCS module input terminal, as shown in figure 2.

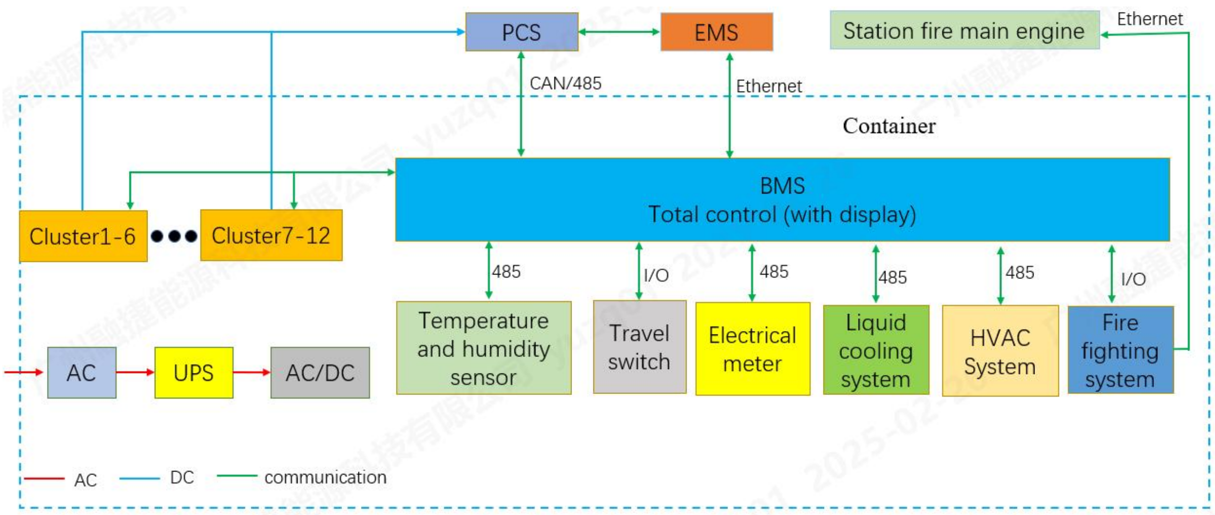


Figure 2： Electrical diagram of container topology

2.2 BMS

The whole battery management system includes three levels of architecture, which are first level slave controller, second level master controller and third level system controller, and the functions at all levels are shown in figure 3. The main protection parameters are detailed in the "BMS technical protocol".

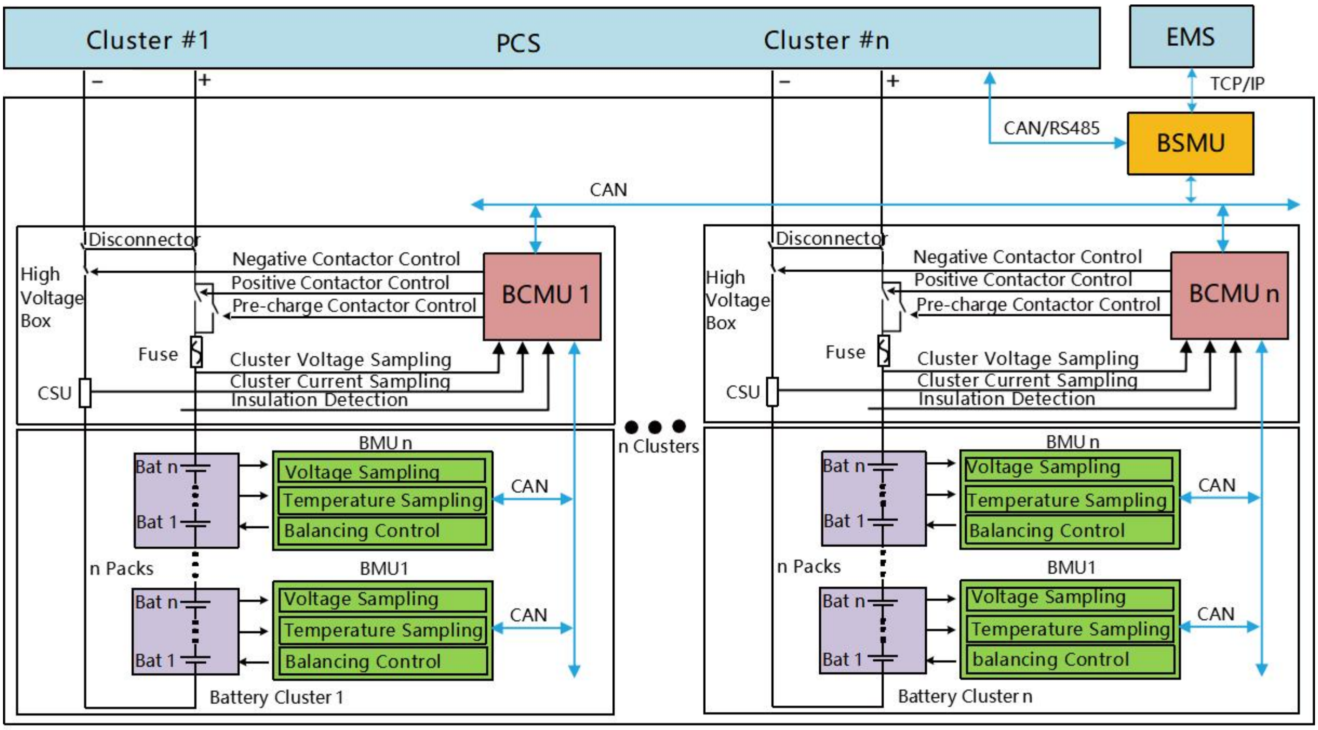


Figure 3: BMS level 3 architecture schematic

2.3 Parameters of container

The technical parameters of this product are based on the measurement results of new modules or batteries at room temperature of 25±2℃.

Table 2: Parameters of container

No.	Item	Parameter	Remark
1	Configuration	1P416S×12	12-clusters para
2	Rated voltage	1331.2V	Standard charge and discharge
3	Rated energy	5.015MWh	Standard charge and discharge
4	Voltage range	1164.8-1497.6VDC	
5	Rated charge/discharge power	0.5P	Charge：15~35℃ Discharge：0~45℃
6	Operating temperature range	-30~55℃（discharge） -30~55℃（charge）	Heating first before charging when below 0℃
7	SOC（%）	30%	(25±2) ℃

8	Adaptive PCS		Centralized type PCS	
	Storage condition	Storage temperature	0~45℃	
		Storage humidity	5%≤RH≤90%	
		Altitude	≤2500m	>2500m Derated operation
10	General parameters	Dimension	6058×2438×2896mm	W×L×H
		Weight	42.5t	
		IP level	IP55	
		Thermal management	Liquid cooled	
		Communication interface	CAN\RS485\Ethernet	
		Communication protocol	Modbus\IEC 61850	
11	Certification	Container	IEC 62619/ EN 61000-6-2/4 EN 62477-1 /UN 38.3/NFPA 68/ IEEE 693/UL 9540A/UL 1973/IEC 62933/ANSI C63.4 & 47 CFR PART 15B	

2.4 Container key components list

Table 3: Container key components list

Component	Quantit	Unit	Remark
Battery rack	6	set	Two clusters in one rack, totally 12 clusters
Battery module	48	pcs	1P104S in one module
HV Box	6	pcs	Including isolation switch, Fuse, Relay, Switching power supply, Pre-charge resistance
Thermal management system	1	set	Including chiller host, liquid cooling plate， cooling pipe and HVAC
Fire protection system	1	set	Aerosol fire protection system, including detector, fire protection control host and pipe Water fire protection system, including pipe and sprinkler
PDB	1	set	Auxiliary power supply
DCCB	1	set	Container level DC busbar
BMS	1	set	BSMU (including display), BCMU, BMU

3. Key component parameters

3.1 Cell

3.1.1 Parameters of cell

Table 4: Parameters of cell

No.	Item	Parameter	Remark
1	Cell type	LFP	
2	Cell model	RBA4F1	
3	Cell weight	5.7±0.3kg	Wrapped in blue film
4	Internal resistance of BOL	0.18±0.05mΩ	30% SOC，1kHz
5	Nominal capacity	314Ah	(25±2)℃，Standard charge and discharge
6	Nominal voltage	3.2V	(25±2)℃，
7	Rated energy	1004.8Wh	(25±2)℃，
8	Operating voltage	2.50～3.65V 2.00～3.65V	T＞0℃ T≤0℃
9	Energy density	≥177.8Wh/kg	(25±2)℃，Standard charge and discharge
10	SOC recommended	5%～95%	
11	Monthly self-discharge	≤3.0%	New cells of EOL, 25±2℃，30% SOC, storage for 3 months
12	Maximum continuous charging power	0.5P	Charge：15~35℃
13	Maximum continuous discharge power	0.5P	Discharge：0~45℃
14	Discharge temperature range	-20~55℃	
15	Charge temperature range	0~55℃	Heating first before charging when below 0℃

Note: The thickness is measured at a surface pressure of 5000±200N.

Cell detailed parameters can be referenced in “314Ah Cell Product Specification”.

3.1.2 Dimensions of cell

Table 5: Dimensions of cell

No.	Item	Parameter	Tolerance
1	Height (excluding pole)	204.4 mm (including insulation film, including outer gasket)	±0.6mm
2	Height (including pole)	206.8 mm (including insulation film)	±0.5mm
3	Thickness	71.55 mm (including insulation film)	±0.5mm
4	Width	174.26 mm (The bottom hem of the cell, including insulation film)	±0.05mm
		174.04mm（The middle part of the battery cell contains an insulating film）	±0.05mm
5	Welding area of pole	Ø16mm（Excluding plastic outside the pole）	±0.2mm
6	Center distance between positive pole and negative pole	123mm	±0.3mm

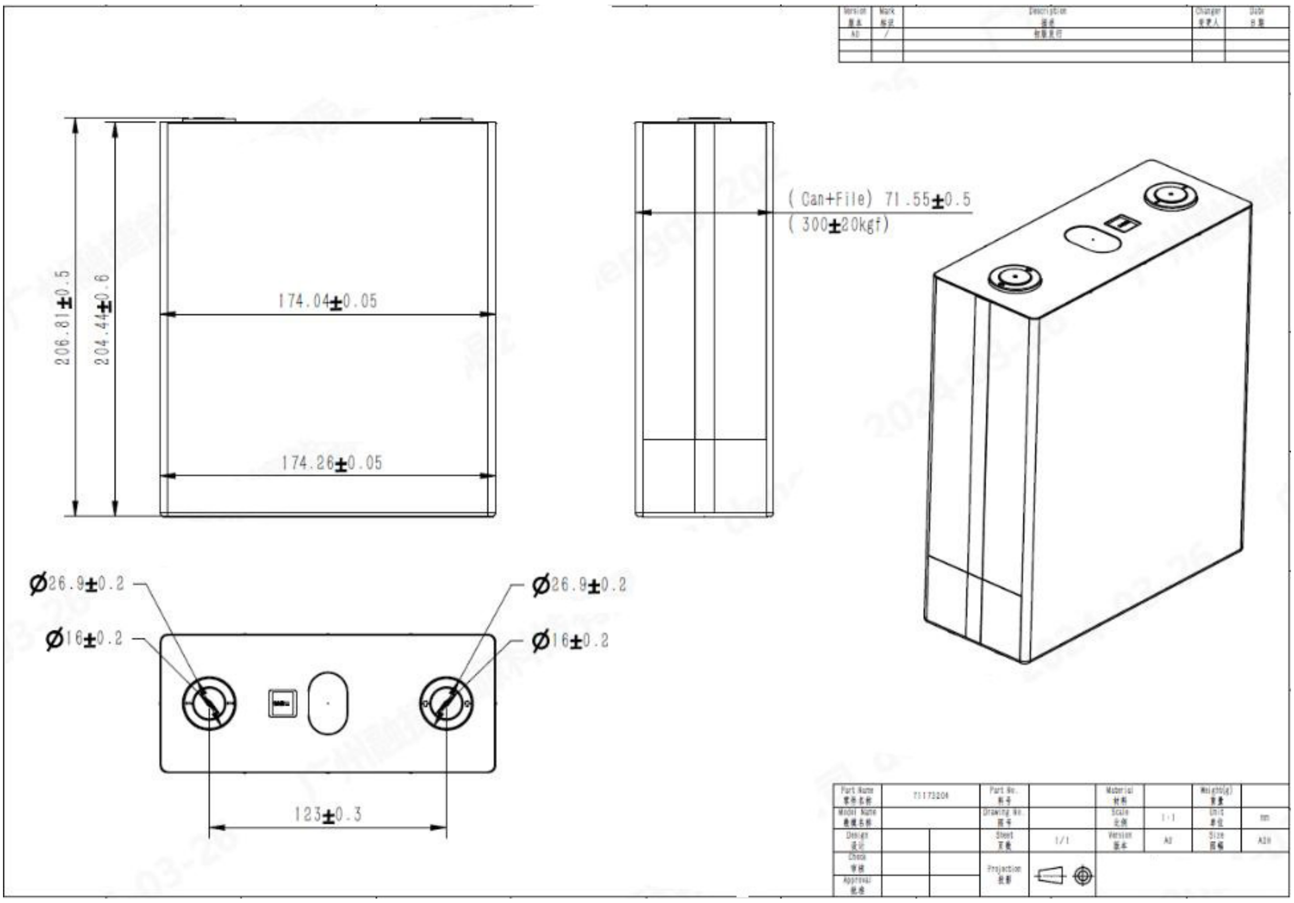


Figure 4: Cell dimension diagram

3.2 Battery module

3.2.1 Parameters of battery module

Table 6: Parameters of battery module

No.	Item	Parameter	Remark
1	Configuration	1P104S	104 cells in serries
2	Nominal voltage	332.8V	Standard charge and discharge
3	Nominal capacity	104.5kWh	Standard charge and discharge
4	Discharge cut-off voltage	260 V or any cell voltage reaches 2.5V	T＞0℃
		208 V or any cell voltage reaches 2.0V	T≤0℃
5	Charge cut-off voltage	379.6 V or any cell voltage reaches 3.65V	
6	Maximum charge/discharge current	314A (1 min)	Maximum charge/discharge current
7	Rated charge/discharge current	157A	Rated charge/discharge current
8	Operating temperature range	-30~55℃ (Discharge) -30~55℃ (Charge)	Heating first before charging when below 0°C
9	Storage temperature range	0~45℃	Over six months, complete charge and discharge maintenance is required
10	Power connection	Fast plug	
11	Communication interface	CAN	
12	Shipment SOC（%）	30%	(25±2)℃
13	Weight	685±5kg	

3.2.2 Dimensions of battery module

Figure 5: Appearance diagram of battery module

Table 7: Dimensions of battery module

W	H	L
（800±2）mm	（245±1.5）mm	（2200±3）mm

3.3 Battery cluster

The battery cluster consists of 4 332.8V/314Ah lithium iron phosphate battery modules connected in series, and the high voltage control box is placed at the bottom of the rack.

3.3.1 Battery cluster parameters

Table 8: Battery cluster parameters

No.	Item	Parameter	Remark
1	Configuration	1P104S×4	4-Modules in series
2	Rated voltage	1331.2V	Standard charge and discharge
3	Battery cluster capacity	418kWh	Standard charge and discharge
4	Voltage range	1164.8-1497.6Vdc	
5	Rated charge/discharge power	0.5P/0.5P	Charge：15~35℃ Discharge：0~45℃

3.3.2 HV Box

The two-in-one high voltage box is used. Two battery clusters correspond to one HV Box. The high voltage control box contains the battery management unit master control module (BCMU) to manage and control the battery cluster. The isolation switch is installed in the high voltage control box, which is convenient to interrupt the high voltage circuit of the module during system assembly, maintenance and repair, so as to protect the operator from the danger of high voltage electric shock. The box is also integrated with relays, fuses, Pre charge resistor and other electrical components to control and protect the high voltage circuit. HV Box panel-definition diagram is shown in figure 6.

Figure 6: HV Box front panel definition

3.4 PDB

3.4.1 Appearance of power distribution box

Figure 7: Power distribution box

3.4.2 List of key components

The list of key components of power distribution box is shown in table 9.

Table 9: List of key components

No.	Component
1	Emergency stop
2	Fuse
3	Switching power supply
4	Electricity meter
5	Display controller

3.5 DCCB

3.5.1 Appearance of DC combiner box

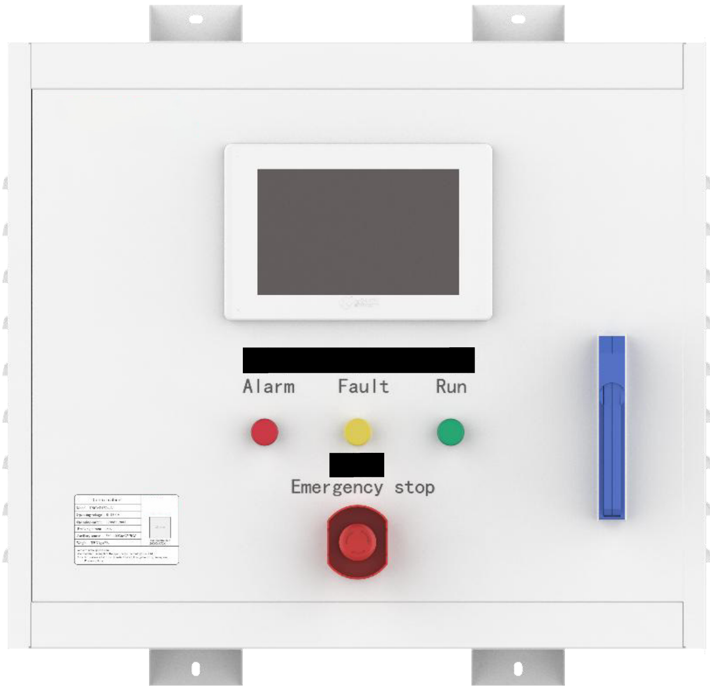


Figure 8: Appearance of DC combiner box

3.5.2 List of key components

The key components list of the DC combiner box is shown in table 10

Table 10: List of key components

No.	Component
1	UPS
2	MCCB
3	Transformer
4	Surge protective device
5	Switching power supply

3.6 Thermal management system

3.6.1 Thermal management system layout

The thermal management system, as shown in figure 9, is mainly composed of a chiller host and several liquid cooled pipelines.

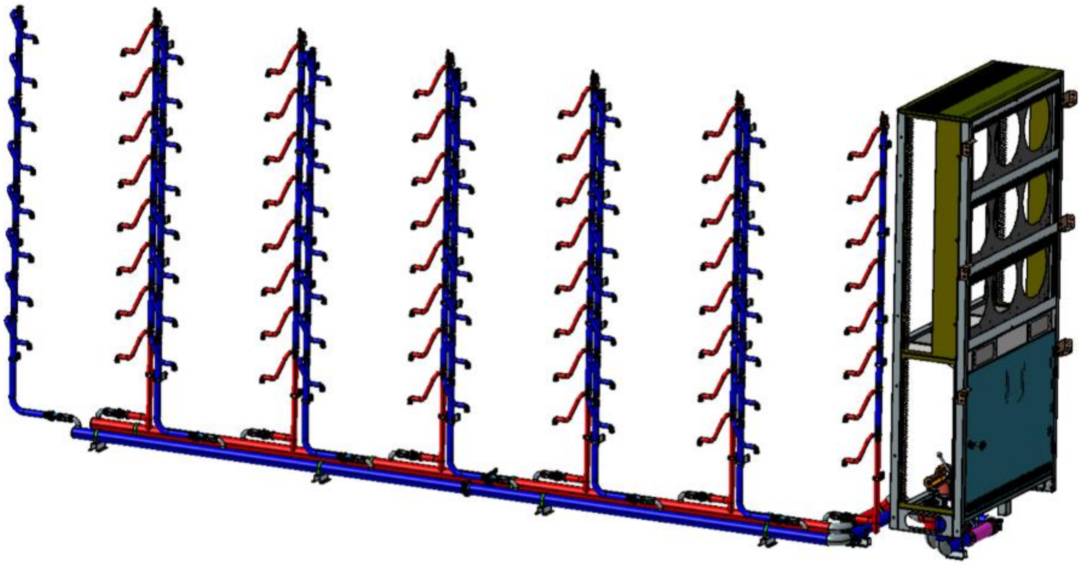


Figure 9：Assembly drawing of thermal management system

The liquid cooled and liquid heating system adopts a high-efficiency frequency conversion technology scheme for a 60kW liquid cooling unit, with real-time intelligent speed regulation of the fan, which is efficient and energy-saving, meter ratio, the flow of each battery pack is evenly distributed, thus better controlling the temperature difference of the entire system. The cluster level bidirectional globe valve is used to facilitate cluster level maintenance and save labor cost.

Thanks to the use of advanced composite temperature control strategy, combined with the self-circulation system, the battery has always maintained the best state of operation and the energy efficiency of the system has been greatly improved.

Specific parameters are shown in Table 11.

Table 11: Specific parameters

Items	Unit	Parameters
Dimension (W × D × H)	mm	1200×440×2400
Refrigerating capacity	kW	60
Heating capacity	kW	24
Rated Circulation Flowrate	L/min	500@150kPa
Coolant	/	50% Glycol Solution
Power supply range	V, Hz	400/480 ,3 Phase, 50/60
IP level	/	IPX5
Noise Level	dB(A)	⩽80

Authentication	/	CE/UL

3.6.2 HVAC

The HVAC inside the container is shown in figure 11, mainly composed of air conditioning and air ducts.

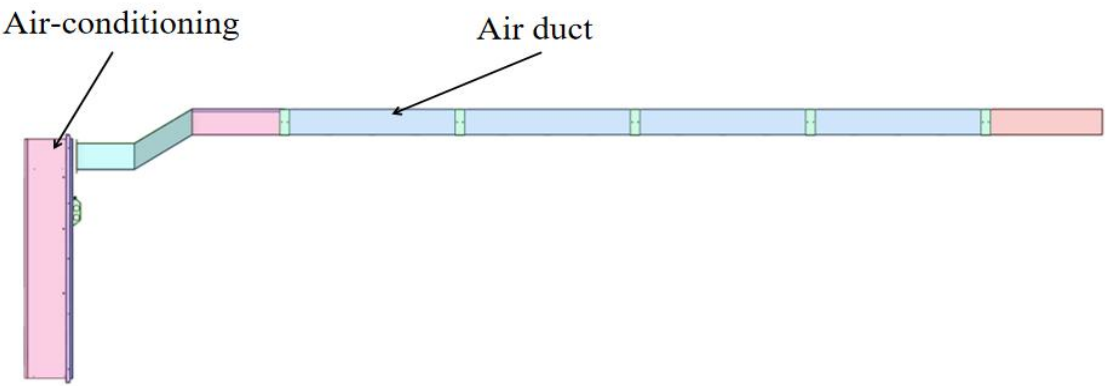


Figure 11：HVAC system diagram

The HVAC inside the container adopts a 3kW high-efficiency variable frequency air conditioning technology scheme, with real-time intelligent speed regulation of the fan, which is efficient and energy-saving.

By adjusting appropriate air ducts, uniform air supply can be achieved in each area, thereby better controlling the temperature and humidity inside the container box.

Specific parameters are shown in table 12.

Table 12：HVAC parameters

Item	Unit	Parameter
Dimension (W × D × H)	mm	500×250×1300
Refrigerating capacity	kW	3
Heating capacity	kW	1.0/2.5
Internal circulation air volume	m^3/h	700
Power supply range	V、Hz	220/230±10%,50/60;
Noise Level	dB(A)	≤70
IP level	/	IP55
Authentication	/	CE/UL

3.7 Fire protection system

3.7.1 Fire protection system composition

The fire protection system, as shown in figure 11 and figure 12, includes both a gas fire suppression system and a water fire suppression system.

The gas fire suppression system primarily consists of a fire control main unit, a stored pressure type perfluorohexanone fire extinguishing device, explosion-proof fans, smoke detectors, temperature detectors, hydrogen detectors, sound and light alarms, manual/automatic switch, fire nozzles, and pipelines, etc. The fire extinguishing agent used is perfluorohexanone, with a total volume of about 50kg, integrated within a dedicated fire tank.

The aerosol fire protection system mainly consists of fire control host, aerosol fire extinguishing device, explosion-proof fan, smoke detector, temperature detector, composite detector, sound and light alarm, manual and automatic switch, fire nozzle and pipeline etc. The composition of the fire extinguishing agent is aerosol, integrated into a dedicated aerosol fire extinguishing device.

The water fire suppression system utilizes multiple nozzles for 360° spray coverage, comprehensively covering the pack space. It works in conjunction with the gas fire system to significantly reduce the risk of system thermal runaway, ensuring safety and reliability.

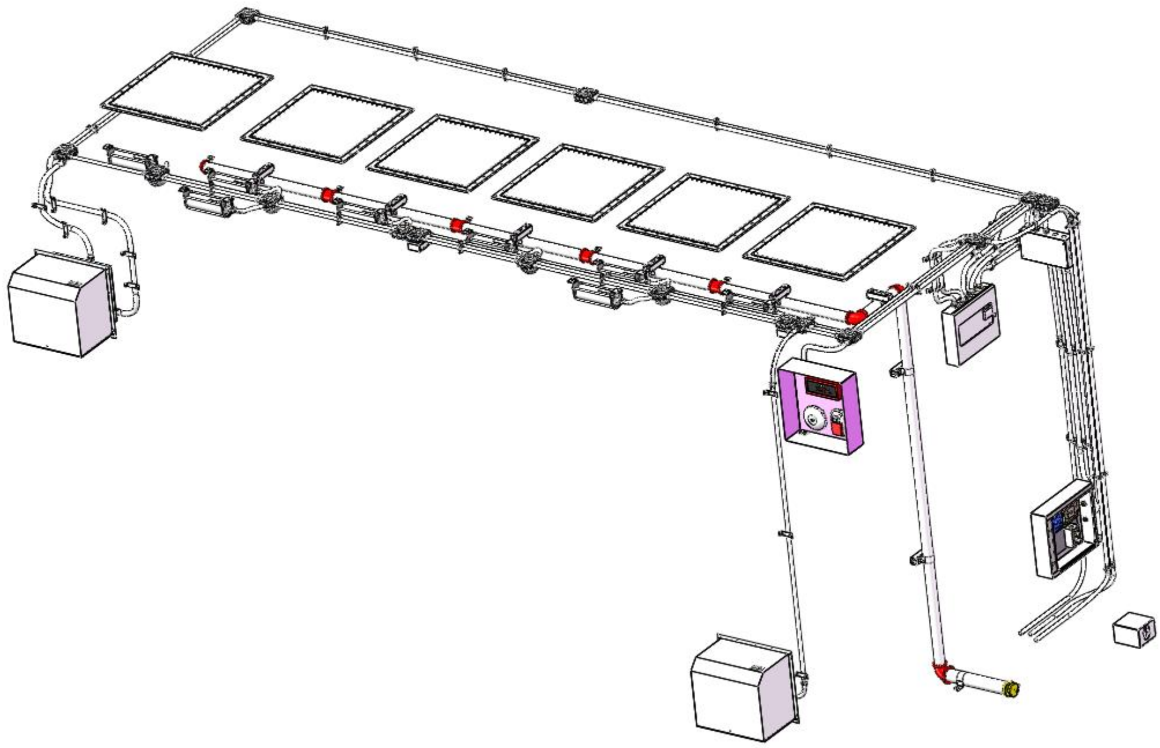


Figure 11：Fire protection system layout (aerosol)

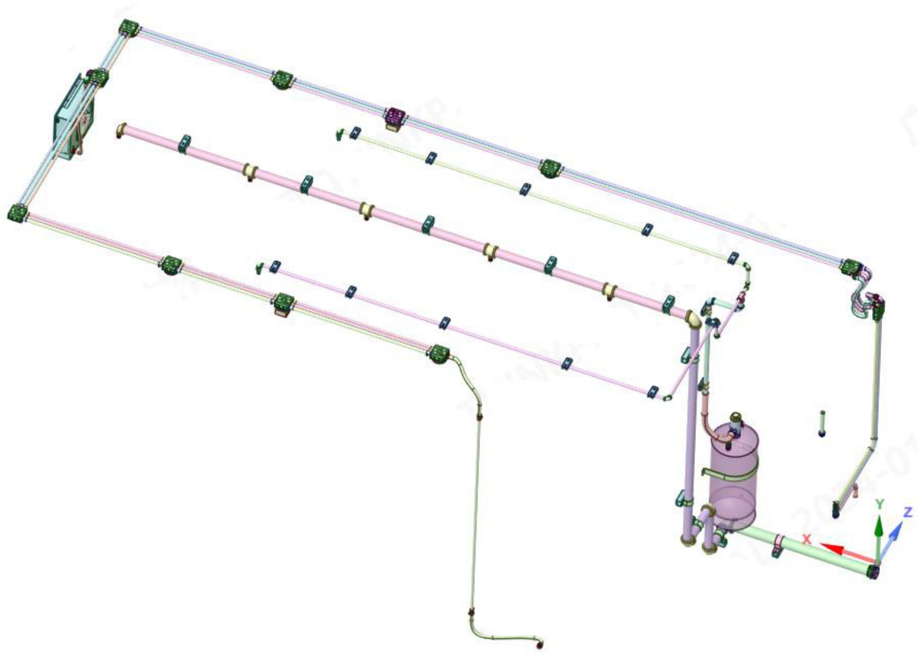


Figure 12：Fire protection system layout (perfluorohexanone)

3.7.2 Fire system logic

The fire control host controls the operation of the entire fire system. When a fire alarm occurs, the fire host communicates with the BMS and sends the alarm information to the BMS. The BMS controls the disconnection of the high-voltage circuit according to relevant strategies and uploads the warning and fire information to the EMS; The fire control host activates the sound and light alarm to issue a warning, starts/closes the exhaust fan and inlet louvers, and sprays aerosol to extinguish the fire (or and sprays the perfluorohexanone extinguishing agent.).

In emergencies, the water fire suppression system can be manually activated by power station personnel as the last line of defense for fire safety. The water fire system provides a cooling effect, ensuring that in extreme situations, fire does not spread within the container.

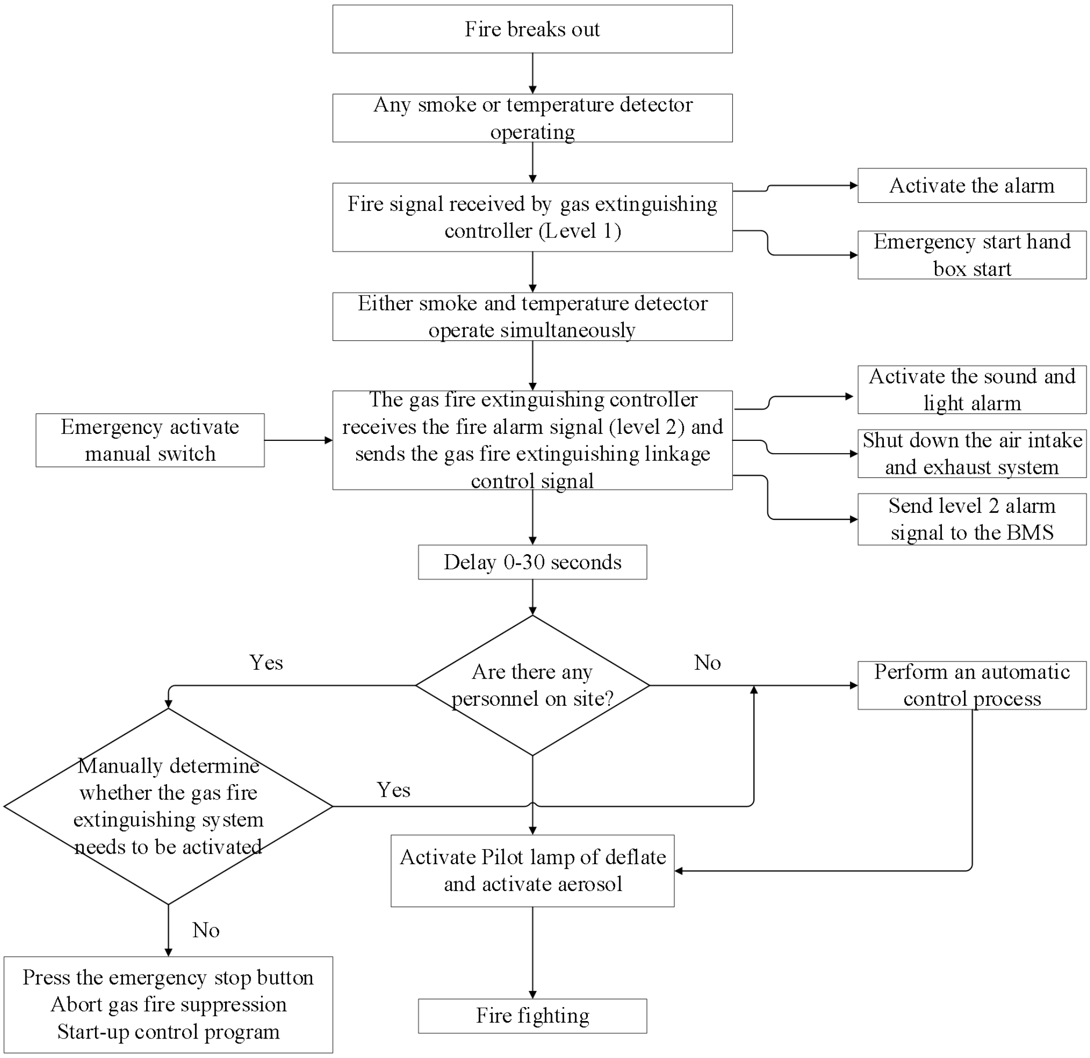


Figure 13: Fire protection system logic

3.8 Container design

3.8.1 Container structure

The design of container structure mainly includes the appearance, selection of steel structure, shell protection, and design of container inlet and outlet lines. The specific design is as follows:

1. Size：Container outer dimensions: 20ft outer dimensions.
2. Appearance：The container shell is sprayed with imported UV resistant topcoat, with a color of RAL9003.
3. Antisepsis：The container has good anti-corrosion, fire prevention, waterproof, dust-proof, shockproof, UV resistant, anti-theft and other functions, ensuring that the container is protected for 25 years. The container will not malfunction due to factors such as corrosion, fire prevention, waterproofing, dust prevention, and ultraviolet radiation. It should be painted and maintained every 5 years.
4. Fireproof sealing performance：Ensuring that all container shell structures, thermal insulation materials, internal and external decorative materials are made of flame-retardant materials. The overall protection level of the container is IP55, and the parts of the container door panel that are connected to the outside are protected by sealing strips to prevent dust or rainwater from entering the interior of the container when encountering wind, sand or rainy weather

outdoors. Ensure that there is no water accumulation, seepage, or leakage at the top of the box, no rain on the side of the box, and no water seepage at the bottom of the box.

5. Equipped with dust-proof (wind and sand): ensuring the installation of easily replaceable standard ventilation filters at the air inlet of the container and equipment, and effectively preventing dust from entering the interior of the container in the event of strong wind and sand.
6. Equipped with shock-absorbing design: Ensuring that the mechanical strength of containers and their internal equipment meets the requirements under transportation and earthquake conditions, without deformation or functional abnormalities Frequent vibration and failure to operate.
7. Has UV protection：Ensures that the materials inside and outside the container will not deteriorate due to UV radiation, and will not absorb UV heat.
8. Container entry and exit lines: Including power lines, communication lines, optical cables, control cables, etc., are arranged in a bottom in and bottom out manner. The container is equipped with protective measures such as identification, automatic fire extinguishing gas release sound and light alarm.

3.8.2 Container thermal management

The inner wall of the container adopts fireproof board as the insulation layer, and the ground filling thickness is not less than 100mm thick. The fireproof board has a fire rating of A and a fire resistance limit of not less than 2 hours, making the system have the functions of heat storage, insulation, and flame retardancy. Considering the on-site operating environment of the energy storage system, in order to ensure the long-term reliable operation of the battery.

The container is divided into an electrical compartment, a battery compartment, and a liquid refrigeration unit compartment. The electrical compartment mainly houses busbars, distribution cabinets, and supporting fire-fighting facilities, while the battery compartment mainly houses battery clusters. To ensure that the temperature inside the container remains within a certain range and meet the temperature adaptability requirements of the battery, it is necessary to supplement the heat loss of the container in low-temperature environments at night and balance the heat accumulation inside the container in extreme high-temperature environments. Based on the comprehensive consideration of external environmental temperature, container heat loss, and battery charging and discharging heat generation, one industrial grade liquid cooling unit (battery compartment) with a cooling power of 60kW and one 3kW air-cooled air conditioner (electrical compartment) are selected for the container to ensure that the temperature inside the container is maintained within 20 ± 5 ℃, and the air conditioner is powered by AC 380V.

The industrial grade liquid cooling unit for the battery compartment is installed at the end of the container, with an air conditioning cooling power of 60kW, and switches between cooling/heating modes based on the ambient temperature inside the container. The liquid cooling unit adjusts the temperature of each battery cluster uniformly through the liquid cooling pipeline to ensure the consistency of battery temperature.

3.8.3 Container grounding

The container provides users with at least 2 grounding points in the form of grounding bar bolts to achieve reliable grounding of the entire container's not functional conductive conductor. The effective cross-sectional area in the grounding system shall not be less than 250mm ^{2}. In order to achieve good grounding effect and achieve safe and reliable operation of the system, the grounding impedance of the grounding point provided by the user should be $\leqslant 4\Omega$, and the connection impedance should be $\leqslant 0.1\Omega$. There is a grounding bar inside the container, and the grounding wires of distribution cabinets, control cabinets, etc. are connected to the internal grounding bar.

3.8.4 Container wiring

1. The installation of battery cabinets inside the container and the wiring between cabinets are neat, reliable, and arranged reasonably. The insulation design meets relevant standards.
2. The power cable routing of the electrical cabinet in the container is the same as that of the secondary control wire, and the communication wire is arranged separately, which is aesthetically pleasing and orderly to avoid interference.

4. Specification for container transportation and installation

4.1 Preparation and inspection before unloading

When the container goods arrive at the site, unload the container and place it on the foundation. Before unloading, check if the following items are complete.

1. Has the construction of the container foundation been completed;
2. The foundation of the container should be made of cement, and the load-bearing strength of the ground should not be less than 3t/㎡.
3. Has the container lifting vehicle been in place? Please refer to the "Container Lifting and Transportation Plan" for specific lifting specifications.
4. At least one qualified supervisor responsible for industrial safety is present.
5. The unloading should be supervised by representatives of the bidding and tendering parties present.

4.2 Discharging precautions

1. All items should be handled with care and operated according to the safety signs on the container.
2. Unloading should be avoided in rainy weather

4.3 Lifting of energy storage container

The total weight of a single energy storage container system is about 42.5t, with dimensions of 6058mm in length, 2438mm in width, and 2896mm in height. The nominal voltage is 1331.2V. The shape of the container is shown in the following figure 14.

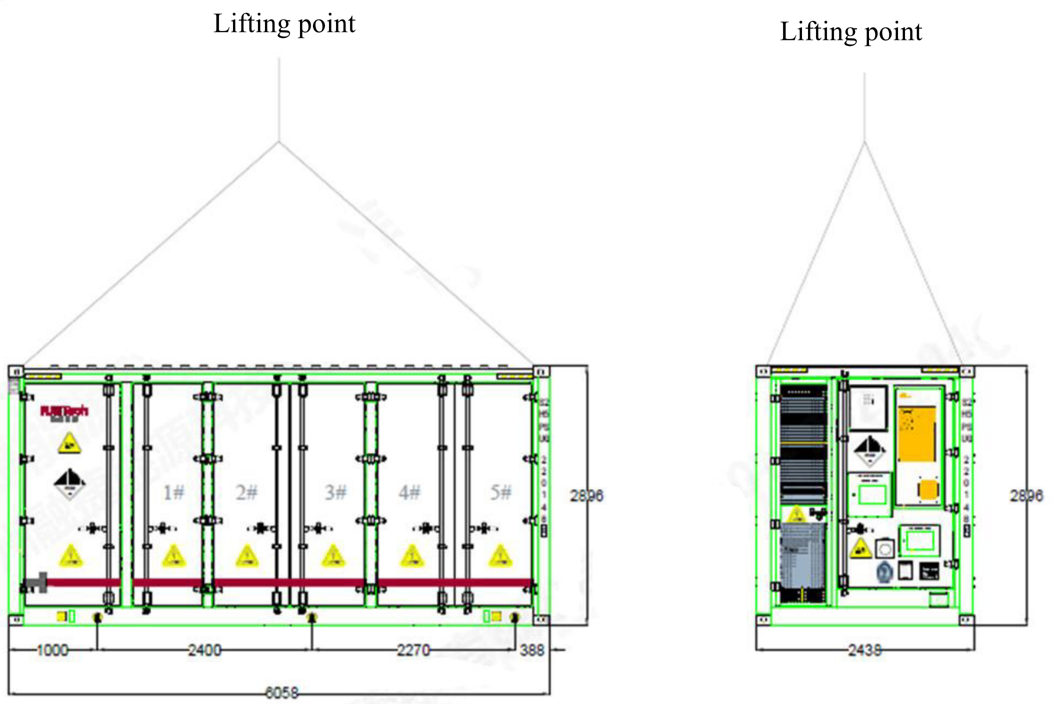


Figure 14: Schematic diagram of container lifting

4.4 Fixation of container

Due to the large weight and size of the container itself, it generally does not need to be fixed. However, containers have relatively high requirements for installation foundations, and the bottom of the container must have a concrete foundation with sufficient strength and flatness. The foundation should meet the requirements of GB 50204-2015 "Code for Acceptance of Construction Quality of Concrete Structures". During container installation, sufficient support area and bearing capacity are required at the four corners and bottom side beams of the container

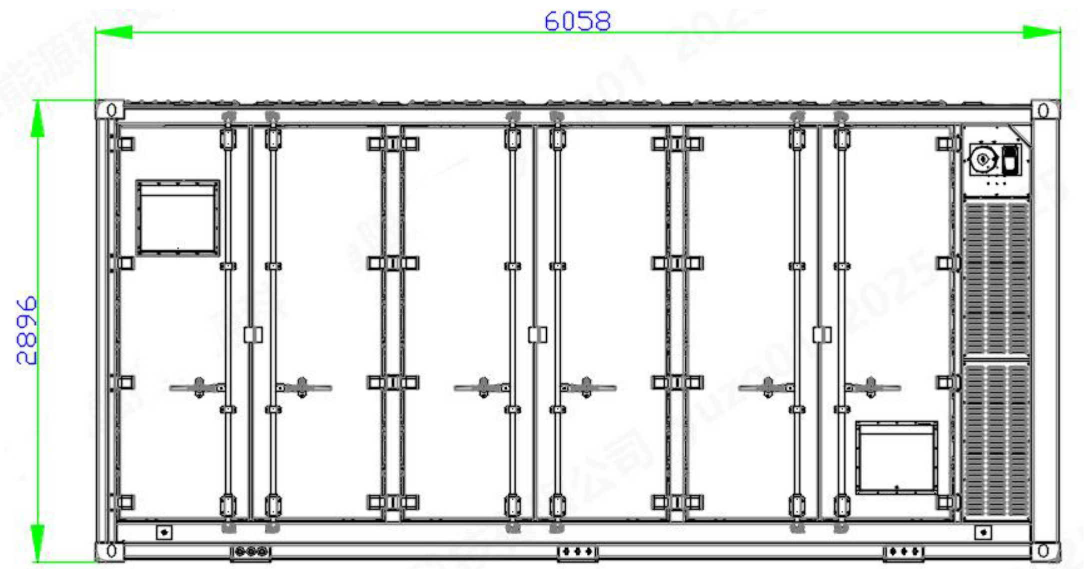
1. Container lifting

Complete the container lifting work according to the relevant instructions in the Container Lifting and Transportation Plan, and arrange the container at the place of use. Please pay attention to the container number and orientation. Please refer to the layout diagram of the energy storage system.

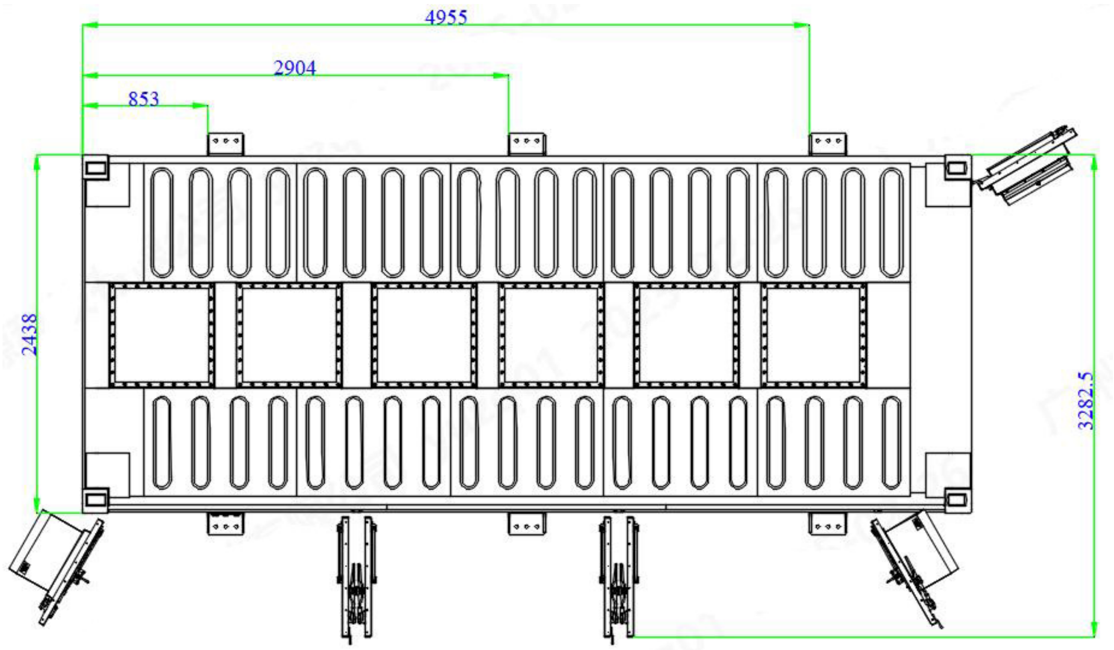
2. Container securing requirement

It is recommended to use pebbles for compaction treatment at the bottom of the container foundation to avoid settlement of the foundation; The surface of the foundation should be flat without any protrusions, and there should be no wave like fluctuations after placing the container.

3. Foot margin



Front view



Vertical view

Figure 15: Layout of container footing and main interface