Technical Proposal of

10MW-20.064MWh Battery Energy Storage System for xxx Project

Rev	Date	Description of Revision	Prepared by	Approved by

Contents

1 Abbreviations and Definitions

Table 1-1 Abbreviations and Definitions

BESS	Battery Energy Storage System
BMS	Battery Management System. A real-time system that monitors and manages all of the battery's performance, to keep the battery from operating outside of its safety margins.
BOL	Beginning of Life
DOD	Depth of Discharge
EOL	End of Life
LFP Battery	lithium iron phosphate batteries
PCS	Power Conversion System
POC	Point of Connection or the Delivery Point @400kV
RTE	Round Trip Efficiency
RMU	Ring Main Unit. A factory assembled, metal enclosed set of switchgear housed by the PCS container.
SEG	Shanghai Electric Gotion New Energy Technology Co Ltd.
SOC	State of Charge. A relative measure of the amount of energy stored in a battery, defined as the ratio between the amount of charge extractable from the cell at a specific point in time and the total capacity.
SOH	State of Health. A measure of battery condition, commonly referred as the useable capacity left, relative to a fresh battery.
PCD	Project Completion Date
PCOD	Project Commercial Operation Date

2 Project Overview

2.1 Project Background

The BESS is until connection at the Interconnection point at 20kV.

2.2 Main Features of the Technical Proposal

The following table summarizes the main features of this technical solution:

Table 2-1 Technical Proposal Overview (Base Case)

No.	Item	Requirement	SEG Proposal
1	Supply Scope	Battery Container +PCS/MV Container	Battery Container +PCS/MV Container; Excluding interconnection cables between containers
2	Installed Power	10MW	10MW
3	Installed Capacity	20MWh	20.064MWh
4	Useable Capacity @POC	/	/
5	POC Definition		Point of Connection at MV 20kV

3 System Design

3.1 Design Condition

As a minimum, the BESS is designed to operate under the environmental and climate conditions detailed in the table below during the entire design lifetime.

Table 3-1 Environmental and climate design condition

Parameter	Unit	Value
Ambient temperature Range	℃	-20~50
Maximum relative humidity	%	95
Minimum relative humidity	%	0
Permissible altitude	m	2000
Anti-corrosion grade		C3
Pollution grade		E2

Parameter	Unit	Value
Degree of protection		IP54

3.2 System Configuration and Unit Wiring

The complete modular BESS includes:

- 4 sets of 5.016 MWh/20ft Battery containers;
- 1 set of 10 MW/40ft PCS-transformer containers;

Each 10MW/40ft PCS-transformer container includes 8 sets of PCS at a nominal rating of 1.25MW each.

Every four (4) 5.016MWh/20ft battery containers are connected to one (1) 10 MW/40ft PCS-transformer container, which comprises one complete 10MW/20.064MWh battery energy storage unit.

The following table summarizes the system configuration and major supply scope.

Table 3-2 System configuration Scheme

No.	Item	Quantity
1	Battery Energy Storage Unit Total 1 Unit with overall installed capacity of 10MW/20.063MWh	1
1.1	10 MW/40ft PCS-transformer container	1
1.2	5.016 MWh/20ft Battery container	4

3.3 Available Energy at POC

The overall installed power/capacity of BESS for this project will be 10MW-20.064MWh.

Considering the shipment loss and all the auxiliary loss of the system, the available capacity at the Point of Connection ("POC") will be 17.42MWh@FAT, 16.82MWh@Commissiong BOL. The calculation of available energy at POC will be explained in detail in the following.

When calculating the available capacity of the system at POC, it is necessary to consider the energy loss experienced from the DC battery side to the AC output side, and also together with certain additional auxiliary loss. Equipment efficiency and energy loss coefficients are considered as the following:

Table 3-3 Calculation of Available Power at POC

No.	Items	Value	Remarks

1	**Installed battery capacity**	**20.064MWh**	**5.016MWh per container x 4 containers**
2	**Efficiency and Loss(*Note1)**		
2.1	Shipment and commissioning period loss of BESS	3.44%	The battery shipment and storage temperature is no more than 35°C. FAT to COD 6 months.
2.2	Group Efficiency	95%	
2.3	Battery DOD	95%	
2.4	PCS Efficiency	98%	
2.5	MV Transformer efficiency	99%	@ rated load
2.6	Cable Loss	0.5%	Assuming 0.5% cable loss from battery container to PCS, and from PCS to MV-transformer
2.7	MV AC Cable loss	0.35%	Assuming 0.35% loss for RMU to POC, exact value to be informed by EPC in late phase
3	**Available BESS Energy @POC @BOL**	**16.82MWh**	System auxiliary consumption of battery containers and PCS-transformer containers excluded

Note1: *Instrument measurement tolerance is not included, which shall be dependent on the actual meter measurement accuracy during on-site test.*

Note2: System Auxiliary Consumption

Auxiliary power for battery containers and PCS-transformer containers is suggested to be supplied by external power source.

- *Auxiliary consumption of one 20ft battery container during operation is about 35kW, auxiliary consumption of one 40-feet PCS-Transformer Skid during operation is about 20kW;*

3.4 Operational Philosophy and System Degradation

The BESS shall be designed for and shall be functionally and performance compliant for the provision of the following specified services:

1. Frequency response.
2. Ramp rate control
3. Energy shifting
4. Back-up (energy reserve).

The design of the BESS and its Components is that of average 2 full throughput cycles (charge and discharge) with a maximum of 2 full throughput cycles (charge and discharge) on any day without exceeding a total of 730 full throughput cycles (charge and discharge) per annum based on the Charging and Discharging Limitation specified in this technical proposal:
Two full throughput cycles (charge and discharge) is defined as the total power throughput equivalent to four times the rated name plate value (charge and discharge) which is decreased over the battery degradation during the warranty period.

The annual attenuation and usable energy of the BESS under the above-specified operating condition is shown in the following table. This is based on cycle and calendar life only, and therefore at the end of each operational year an energy capacity test shall be carried out and the warranty adjusted accordingly.

Table 3-4 Annual Attenuation and Available Energy (730 cycles/year)

Time/ End of …	SOH	Available Energy @ POC (MWh) Exclusive Auxiliary Consumption	RTE (Exclusive auxiliary consumption)
FAT	100%	17.42	85.72%
Commissioning	96.56%	16.82	85.72%
1st operational year	90.22%	15.72	85.63%
2nd operational year	87.15%	15.18	85.52%
3rd operational year	84.59%	14.73	85.44%
4th operational year	82.30%	14.34	85.33%

5th operational year	80.20%	13.97	85.25%
6th operational year	78.23%	13.63	85.14%
7th operational year	76.37%	13.30	85.05%
8th operational year	74.58%	12.99	84.94%
9th operational year	72.88%	12.69	84.86%
10th operational year	71.24%	12.41	84.75%
11th operational year	69.65%	12.13	84.67%
12th operational year	68.10%	11.86	84.56%
13th operational year	66.60%	11.60	84.47%
14th operational year	65.13%	11.35	84.36%
15th operational year	63.70%	11.10	84.28%

3.5 Round Trip Efficiency

The round trip efficiency("RTE") is the ratio of total energy output divided by the total input energy over one charging/discharging cycle using the rated input and output ratio excluding auxiliary loads. The following shows the detailed calculation thereof.

Table 3-5 RTE Calculation during SAT excluding Auxiliary Consumption.

No.	Items	Unit	Value	Remarks
1	RTE of Battery DC-DC	%	93%	
2	DC-AC Cable Losses	%	0.5%	From battery RACK to PCS and PCS to MV-transformer
3	PCS Charging/ Discharging Efficiency	%	98%	
4	MV Transformer Efficiency	%	99%	@Rated power
5	MV AC Cable loss	%	0.35%	Assuming 0.35% loss for RMU to HV Transformer, exact value

				to be informed by buyer in late phase
6	Measurement error	%	99.8%	Assuming value, exact value to be informed by EPC in late phase
7	System RTE @ POC during SAT	%	85.72%	Exclusive of auxiliary power consumption

The system RTE value is as follows and the test method is subject to the definition of Round Trip Efficiency above:

RTE=93%*99.5%*99.5%*98%*98%*99%*99%*99.65%*99.65%*99.8%*99.8%≈ 85.72%

3.6 General Layout for Reference

The general arrangement of BESS is mainly constrained by the local firefighting code and other regulations issued by local authorities. When there are no other special requirements, the following considerations are recommended.

1) 20ft container footprint: 6058 X 2438mm;
2) 40ft container footprint: 12196*2438mm;
3) The containers should be spaced no less than 4 meters;

The above is only the recommended practice. Please refer to the local fire protection codes and other requirements for arrangement during detailed design.

4 Battery Container System Description

BESS solution utilizes long-life lithium iron phosphate (LFP) batteries. With ultra-safety and higher battery performance, system Capex and Opex in the lifespan are aimed to be reduced, thus decreasing Levelized Cost of Storage (LCOS).

4.1 Battery Cell

The long-life lithium iron phosphate Battery ($LiFePO_4$) is selected with 3.2V/314Ah nominal capacity.

Table 4-1 Parameters of Battery Cell

No.	Item	Specification	Remark
1	Nominal capacity	314Ah	
2	DC resistance	≤5mΩ	
3	Operating voltage range	2.5-3.65V	Limit range T>0℃
4	Rated voltage	3.2V	
5	Working temperature range	0°C ~ 60°C	Charging Mode
		-30°C ~ 55°C	Discharging Mode
6	Storage temperature range	-40°C ~ 60°C	Recommend temperature 10 ~ 35°C
7	Cycle life	>6000 cycles	0.5P,@25°C,95%DOD,80%EOL

4.2 Battery Pack

The battery pack is designed with 104 battery cells connected in 1P104S (104 cells in series).

Table 4-2 Parameters of Battery Pack

No.	Item	Specification	Remark
1	Cell type	LFP314Ah	
2	Configuration	1P104S	
3	Rated capacity	314Ah	0.25C, 100%DOD, 25℃
4	Rated voltage	332.8V	104 × 3.2V
5	Nominal energy	104.499kWh	0.5P, 100%DOD,25℃
6	Rated charge and discharge rate	0.5P	
7	Operating voltage range	260-374.4V	2.5-3.65V
8	Cooling Method	Liquid cooling	

4.3 Battery RACK

One Battery RACK consists of 4 Battery packs. The number of battery RACKs and relevant parameters are subject to the final design.

Table 4-3 Parameters of Battery RACK

No.	Item	Specification	Remark
1	Battery type	LFP	

2	Nominal capacity	314Ah	0.5P,100%DOD, 25℃
3	Rated voltage	1331.2V	416 × 3.2V
4	Work voltage range	1164.8 ~ 1497.6V	1P416S
5	Nominal energy	417.9 kWh	0.5P, 100%DOD, 25℃
6	Charge temperature	0℃ ~ 60℃	
7	Discharge temperature	-30℃ ~ 55℃	<0°Cderating power
8	Charge rate	0.5P	0℃ ~ 55℃
9	Discharge rate	0.5P	-30℃ ~ 60℃

4.4 Battery Container

The battery container system is composed of container house (including power distribution), video monitoring system, liquid cooling temperature control system, immersion fire extinguishing system (battery module), automatic fire extinguishing system and water spraying system, and battery system (including battery rack, battery pack and integrated control cabinet).

There are 12 Battery RACKs in one Battery container. The Battery container layout and parameters are shown as below.

Figure 4-1 Battery Container Layout (for reference)

Table 4-4 Parameters of Battery Container

No.	Item	Specification	Remarks
1	Cell quantity	4992 pcs	
2	Nominal energy	5.016MWh	
3	Nominal capacity	3768Ah	
4	DC Rated voltage	1331.2V	
5	DC work voltage range	1164.8 ~ 1497.6Vdc	
6	Rated charge /discharge current	1884A	0.5P charge/discharge
7	Cycle life	> 8000 cycles	0.25P@ 25℃
8	Self-discharge/month	< 3%	
9	Calendar life	> 10 years	0.5P@ 25℃
10	Operation temperature	-15℃ ~ 50℃	
11	Operation humidity	0 ~ 100%	
12	Dimension	6058*2438*2896mm	
13	Weight	About 44t	
14	Protection Level	IP54	
15	Cooling mode	Liquid cooling	
16	FSS System	Novec1230	
17	Altitude	<2000m	
18	Change/discharge rate	0.5P/0.5P	

4.5 Combiner Control Cabinet

Control function: a level-three BMS is set in the combiner control cabinet. The level-three BMS internally and the level-two BMS transmit battery information through CAN communication, externally communicates with PCS through RS485, and communicates with EMS through Ethernet. At the same time, the fire control and air conditioning in the cabin transmit information to the level-three BMS through RS485, and the level-three BMS will display battery related information through the display screen.

Power distribution function: the mains power is distributed to the air conditioning, lighting, UPS and other electrical equipment in the cabin through the convergence control cabinet. Each equipment is equipped with a micro break switch for control protection. BMS, firefighting system and other important equipment are equipped with UPS (Uninterruptible Power Supply) to ensure the reliability of power consumption. At the same time, lightning protection devices are set in the AC circuit.

Table 4-5Key Components Table

Number	Name	Parameter	Quantity	Note
1	Isolating switch	1500VDC1600A	2	
2	Fuse	1500VDC2000A	4	
3	Level-Three BMS		2	

4.6 Battery Management System (BMS)

The protection and monitoring functions of the battery system are realized by the BMS battery management system. The BMS system of the battery system is managed in three levels, namely tray BMU, MBMS, and BAMS. The main functions of each level of BMS are as follows:

BMU (pack level, built into the pack): monitor the voltage, temperature of a single cell and the total voltage of a single tray, And the above information is transmitted to the upper-level BMS in real time through the CAN protocol, which can control the voltage balance of the single cell.

MBMS (rack level, built in the high-voltage box): Detect the total voltage and total current of the entire battery pack, and transmit the above information to the upper-level BMS in real time through the CAN protocol. It can display the capacity and health status of the battery during charging and discharging, the prediction of power, and the calculation of internal resistance. Controls the balance of relay switch and panel-level unit voltages.

BAMS (system level, provided when multi-rack batteries are connected in parallel): Collects lower-level MBMS information, and can estimate the remaining capacity and health status of the battery in real time. Communicate with host and external systems through RS-485, CAN, Modbus-TCP/IP. Depending on the complexity of the system, the system BMS can be integrated into the switch box or separately.

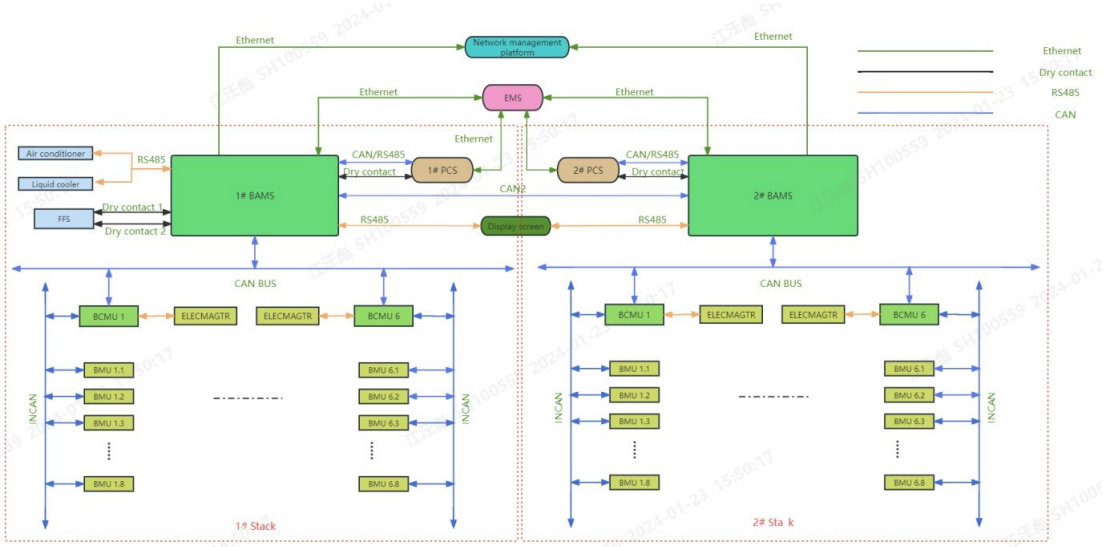

Figure 4-2 Battery Management System (BMS) Framework

5 Thermal Management Design

This system uses a cooling system to dissipate heat, using the performance that the coolant has a large thermal capacity and can take away excess heat from the battery system through circulation to achieve the best working temperature conditions for the battery pack. It can be used in the environment from -15 to 50°C. The basic components of the liquid cooling system include: liquid cooling plate, liquid cooling unit, liquid cooling pipeline (including temperature sensor, valve), high and low pressure wiring harness; cooling liquid (glycol, aqueous solution), etc. The liquid cooling system in each container contains 170 liters of coolant. The working principle of this system is: the coolant is pumped to the battery pack, and after absorbing the heat generated by the battery, it returns to the condenser for condensation.

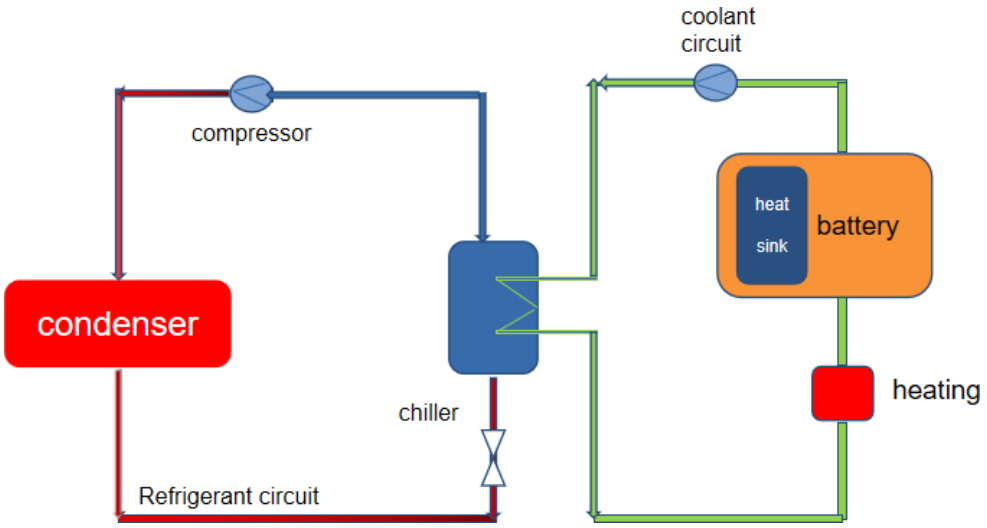

Figure 5-1 Thermal Management System

6 Fire Fighting Design

The BESS container adopts automatic explosion-proof exhaust device + aerosol fire extinguishing agent +fire sprinkler multiple progressive fire extinguishing protection system, which includes early warning device, automatic fire extinguishing device, exhaust device and fire sprinkler device. The early warning device detects fire information and combustible gas concentration to start the alarm or air exchange function, and

automatically starts the fire extinguishing device to carry out full submerged fire extinguishing after triggering the spraying conditions.

A set of aerosol fire extinguishing system is installed inside the container and fixed on the inner wall of the container. Temperature detectors, smoke detectors, and gas detectors are installed at the top of the container.

a. When any temperature or smoke detector is activated, activate the alarm and upload the alarm information;

b. When the combustible gas detector reaches the alarm state, start the fan to discharge the combustible gas outside the container;

c. When the fire alarm controller receives relevant signals and meets the following conditions, the fire extinguishing system is activated to submerge and cover the entire container with aerosols:

When the aerosol fire extinguishing system protection function cannot control the fire inside the container, the fire water sprinkler system is activated to fully cover the container and extinguish the fire, ensuring that the thermal runaway fire in the battery compartment is controlled and does not spread inside the container. The fire water sprinkler system includes DN65 standard fittings, DN65 main pipes, DN32 branch pipes, and sprinkler heads on branch pipes. When the aerosol fire extinguishing system protection fail and it is determined that the fire in the container is out of control, the fire hose can be connected to the reserved pipe tooth interface on the container to activate the sprinkler head and submerge the entire battery compartment.

The Design principle for Aerosol:

- When any detector triggers:

1) Alarm bell action;

2) Output a level one fire alarm signal.

- When any two types of detectors are triggered simultaneously:

1) Sound and light alarm action;

2) Output secondary fire alarm signal; Linkage shutdown of air conditioning and ventilation, equipment power outage;

3) The gas fire extinguishing controller has entered a 30 second delay phase;

4) The delay ends, the electromagnetic starter acts, and the gas cylinder sprays fire

extinguishing agent;

5) The pressure signal is fed back to the gas fire extinguishing controller to release the extinguishing agent signal from the gas storage cylinder;

6) Fire extinguishing completed.

- When the combustible gas detector is in an alarm state:

1) Turn on the ventilation system for ventilation, the exhaust fan starts to operate, and the louvers automatically open;

2) Alarm bell action;

3) Output a level one fire alarm signal.

- When the combustible gas alarm concentration returns to normal state:

1) The exhaust fan stops working and the louvers automatically close;

2) The louvers of the air inlet device automatically close.

- When the automatic fire extinguishing controller is in manual mode, any detector is triggered and the alarm controller only sends an alarm signal:

1) Alarm bell action;

2) Output first level fire alarm signal;

3) The on duty personnel confirm whether a fire has occurred;

4) Confirm the occurrence of a fire, press the emergency start button on the alarm control panel or manually release the pull station at the entrance of the protected area;

5) The automatic fire extinguishing controller has entered a delay phase of 30 seconds;

6) The delay is over, the electromagnetic starter is activated, and the gas cylinder is sprayed with fire extinguishing agent

7) The pressure signal is fed back to the gas fire extinguishing controller to release the extinguishing agent signal from the gas storage cylinder;

8) Fire extinguishing completed.

- When the automatic fire extinguishing controller enters the delay phase of 30 seconds and personnel evacuation is not timely:

1) Press the emergency stop button at the entrance of the protection zone and do not release it;

2) Stop the countdown after a delay of 10 seconds, release the emergency stop button, and continue the delay countdown;

3) If the delay countdown is less than 10 seconds, release the emergency stop button and the delay countdown starts from 10 seconds.

- When the disable switch is normally closed in its normal state, when testing alarm devices:

1) Switch the disable switch from the closed state to the open state by clockwise rotation of the key;

2) The automatic fire extinguishing controller will display a fault in the solenoid valve and output a fault signal;

3) Start testing alarm devices;

4) Any detector action, alarm bell action, output first level alarm signal;

5) When any smoke detector and any temperature detector are triggered simultaneously, the sound and light alarm will act;

6) When outputting a secondary fire alarm signal, due to the malfunction of the solenoid valve, the solenoid valve of the gas cylinder does not act and does not spray fire extinguishing agent;

7) The detection and alarm equipment is in normal operation, and the automatic fire extinguishing controller is reset;

8) Switch the disable switch from the open state to the closed state through the key, and the solenoid valve returns to its normal state;

9) The test is over.

The protective area after extinguishing the fire should be ventilated and ventilated.

During the construction of pipeline engineering, appropriate positions should be selected and modified according to the actual situation on site, and the situation should be informed to the design engineer, in order to obtain the design engineer's approval， Installation can only proceed after approval.

After a fire occurs, all doors and windows in the protected area should be closed in a timely manner to avoid affecting the fire extinguishing effect.

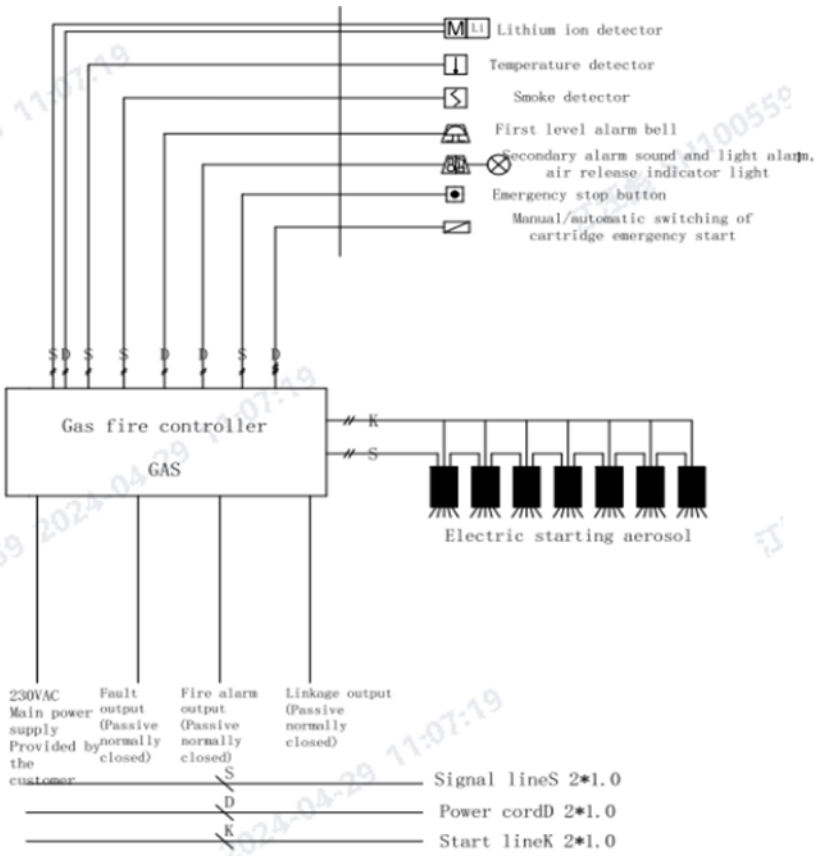

Figure 0-1 Fire protection system alarm diagram

7 Battery Container Single Line Diagram

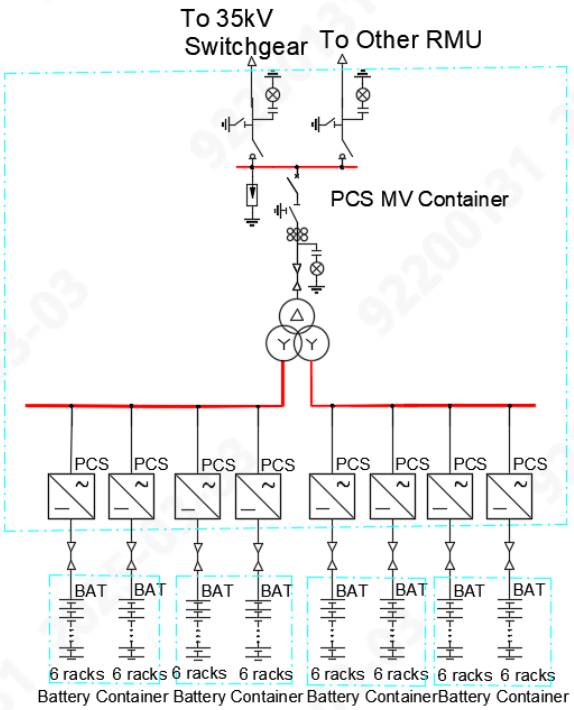

Figure 7-1 10MW-20.064MWh BESS System Single Line Diagrams

8 PCS-Transformer Container System

The power conversion system converts the direct current from the batteries to alternating current at a suitable power quality to be exported to the grid. The PCS shall convert AC to DC current during the charging phase, and vice versa during the discharging phase.

The power conversation system design allows for full rated operation taking into consideration the local environmental conditions of the site and as such has been designed to operate up to 45°C without de-rating.

Each 40ft PCS-transformer container is composed of 8 sets of PCS, one transformer, one high-voltage switch cabinet, one communication and power distribution cabinet.

The key features of the power conversation system are listed as below. The actual and complete functions of the system can be finalized during detailed design stage.

- Active Power Control
- Reactive Power Control (-100% - 100%)
- Power Factor Control (>0.99 / 1 Leading – 1 Lagging)
- L/HVRT
- L/HFRT
- Ramp rate control
- Volt-var

- Volt-watt
- Frequency-watt
- Virtual Synchronous Generator
- Black Start

8.1 PCS specification

As the flexible interface between the energy storage device and the power grid, the bidirectional energy storage converter is developed with high reliability and intelligent power module. Through the integrated design of charge and discharge, the bidirectional energy flow between the AC system and the DC system is realized. The bidirectional energy storage converter can mainly achieve the following functions:

- Accurate and flexible charge and discharge control mode

CAN or Ethernet interface, and battery management system (BMS) of real-time communication, able to accurately monitor the operation of the current battery information, not only CAN control the state of charge and discharge of the converter, can easily switch to constant flow, constant pressure or constant power and so on the

many kinds of charging and discharging mode, so as to realize optimization strategy for battery charge and discharge control. Support various types of energy storage components, the only difference between models is the control software.

- Free switch between grid-connected operation mode and isolated operation mode

The PCS can be used for two-way energy exchange with the power grid in grid-connected operation mode, and can also be used as the main power supply to support the operation in isolated operation mode. The two operation modes can be switched freely.

- Soft grid-connection control and power quality control

The control system can control the output voltage of the converter in real time and accurately according to the voltage information of the power grid monitored online, which can eliminate the static and dynamic errors and realize the non - impact grid - connection. In addition, the control system is integrated with the function of online harmonic monitoring. Without the need to set up an independent data acquisition unit, the data can be shared through the communication bus and the independent harmonic analysis software module can be added to complete all the analysis data calculation functions, realize the optimization control of grid - connected power and ensure the quality of grid - connected power.

- Peak-clipping and valley filling in response to EMS instruction

Under the dispatching of EMS (Energy Management System), the electric energy can be stored at the low ebb and released at the peak ebb, so as to weaken the peak-valley difference of the power grid, improve the load characteristics of the power grid, and realize the load level control and load transfer of the power grid.

- Power network frequency and power network reactive power regulation

In the grid-connected operation, the primary and secondary frequency modulation can be realized in cooperation with the power grid dispatching system and AGC. Combined with AVC, static reactive power control can be realized.

- Complete self - check and protection function

The scope of self-check covers control system, IO unit, converter power module and bus and other related equipment. The period of self-diagnosis ensures that the fault within the system is detected within 1ms and the corresponding latching trigger pulse or trip response is made. Perfect various relay protection functions, effectively ensure the normal operation of the converter.

- Transient fault recording function

The system can continuously record the signals before and after the failure. The recorded data files are stored in a shared directory on the operator's workstation and can be used for fault analysis in the international standard comtrade format.

PCS has the following remarkable features:

- UAPC platform with high performance and reliability from NR Electric Co., Ltd., friendly man-machine interface;
- The components adopt imported high-quality products to ensure the reliable and safe operation of the device and high conversion efficiency;
- With a comprehensive charge and discharge limit function, to ensure the safety that the battery in the process of charge and discharge;

- Perfect and reliable protection function to ensure reliable and safe operation of products, or safe and rapid protection shutdown;
- Quick response, short charge-discharge conversion time, participate in peak regulation of power grid, relieve power grid pressure;
- High power quality, the grid-connected power quality of the product is better than the technical index requirements of relevant standards;
- Suitable for high altitude applications <6000m (derating is required for applications exceeding 3000 m);
- Rich interfaces, such as CAN, RS485, Ethernet and other communication interfaces, which is easy to realize by various communication modes of upward and downward

8.2 Parameters of 40ft PCS-Transformer container

Table 9-1 Parameters of 40ft PCS-Transformer container (Subject to the actual supply)

MV SKID GENERAL	
Transformer	
Rated Power (kVA)	8000 / 9000 / 10000
Transformer Model	Oil type[1]
Transformer Vector	Dy11-y11
Protection Level	IP54• / IP55◦
Anti-corrosion Grade	C4-H• [2] / C4-VH◦ / C5-M◦ / C5-H◦ / C5-VH◦
Cooling Method	ONAN• / ONAF◦
Temperature Rise	60K(Top Oil) 65K(Winding)@40°C
Oil Retention Tank	None• / Galvanized steel◦ [3]
Winding Material	Aluminum• / Copper◦
Transformer Oil	25# /45# mineral oil• / Natural ester insulation oil◦
Transformer Efficiency	IEC standard• / IEC Tier-2◦
MV Operating Voltage Range (V)	MV O6.6~33kV±5%
Nominal Frequency (Hz)	50 / 60 Hz
Altitude	＜1000• / ＞1000◦
Switchgear	
Switchgear Type	Ring Main Unit, CCV [4]
Rated voltage	12/24/36kV
Insulating medium	SF6
Rated frequency	50/60Hz
Enclosure protection degree	IP3X
Gas tank protection degree	IP67
Gas leakage rate per year	≤0.1%
Rated Operating Current	630A
Switchgear Short Circuit Rating	20kA 3s
Switchgear IAC	A FL 20kA 1S
PCS * 8	
DC Input Voltage Range (V)	1050~1500
Max. DC input Current (A)	1309A
DC Voltage Ripple	< 1%
DC Current Ripple	< 3%
LV Nominal Operating Voltage (V)	690
LV Operating Voltage Range (V)	621~759
PCS Efficiency	98.5%[5]
Max. AC Output Current (A)	1150A
Total Harmonic Distortion Rate	< 3%
Reactive Power Compensation	Four quadrant operation
Nominal Output Power (kW)	1250
Max. AC Power (kVA)	1375

Power Factor Range	1(Leading)~1 (Lagging)
Nominal Frequency (Hz)	50 / 60 Hz
Operating Frequency (Hz)	45~55 / 55~65 Hz
Connection Phases	Three-phase-three-wire
Protection	
DC Input Protection	Disconnector + Fuse inside of inverter
AC Output Protection	Motorized Circuit breaker inside of Inverter
DC Overvoltage Protection	Surge arrester, type II• / I+II◦
AC Overvoltage Protection	Surge arrester, type II• / I+II◦
Ground Fault Protection	Insulation monitoring for DC side
Transformer Protection	Protection relay for pressure, temperature, gassing, dielectric level decrease with PT100
Fire Extinguishing System	Smoke detector sensor (dry contact)
Communication Interface	
Communication Method	CAN / RS485 / RJ45 / Optical fiber
Supported Protocol	CAN / Modbus / IEC60870-103 / IEC61850
Ethernet Switch Qty	One for standard [6]
UPS	1kVA for 15min• / 1h◦ / 2h◦
Skid General	
Dimensions (W*H*D)(mm)	12192*2896*2438 mm (40ft)
Weight (kg)	38500kg (40ft)
Protection Level	IP54
Operating Temperature (C)	-35~60C, >45C derating
Storage Temperature (C)	-40~70°C
Maximum Altitude (above sea level) (m)	6000, ≥3000 derating [7]
Environment Humidity	0~100% ,No condensation
Type of Ventilation	Nature air cooling• / Forced air cooling◦
Auxiliary Power Consumption (kVA)	24
Auxiliary Transformer (kVA)	Without
Certificate	IEC 62271-212, IEC 62271-200, IEC 60076, IEC 62477, IEC 61000, UL1741