RULES
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China Classification Society

Rules for Ships Applying Battery as a Power

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CONTENTS

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.1 APPLICATION

1.1.1.1 The Rules for Ships Applying Batteries as a Power (hereinafter referred to as the Rules) is applicable to the design, construction and survey of ships with batteries as part or all of the power supplies. When batteries are used for other purposes (such as emergency power supplies, standby power supplies, starting power supplies, auxiliary power supplies, etc.), they are also to comply with the relevant provisions of the Rules.

1.1.1.2 The Rules is applicable to ships constructed with steel, aluminium alloy or fibre-reinforced plastic as the hull materials.

1.1.1.3 The batteries mentioned in the Rules refer to lithium-ion batteries and high energy density supercapacitors.

1.1.1.4 The battery management system mentioned in the Rules refers to lithium-ion battery management system and high energy density supercapacitor capacitance management system.

1.1.1.5 The parts not covered by the Rules are to meet the relevant requirements of the corresponding requirements of China Classification Society (hereinafter referred to as CCS).

1.1.1.6 Unless otherwise specified in CCS Rules for Classification and Construction of Yachts, Rules for Construction of Inland Waterways Boats, Rules for Classification of Sea-going Boats, yachts, inland waterways boats, sea-going boats, when applying batteries, are to meet the relevant requirements of the Rules.

1.1.1.7 In addition to the requirements of the Rules, the relevant requirements of the administration of the flag State are also to be met.

1.1.2 GOAL

1.1.2.1 The goal of the Rules is to achieve battery-powered ships' safety and reliability under the following conditions by putting forward product quality requirements, health requirements, safe technology requirements, ship arrangement requirements, fire-fighting requirements, survey and test requirements of batteries involved in battery-powered ships:

(1) Navigation;
(2) Entering and leaving ports;
(3) Docking and undocking;
(4) Operation;
(5) Berthing;
(6) Emergency;
(7) Charging/Battery swapping;
(8) Maintenance.

1.1.3 FUNCTION

1.1.3.1 In order to achieve the goal of 1.1.2.1, battery-powered ships are to meet the functions of 1.1.3.2 to 1.1.3.5.

1.1.3.2 The battery system is to be able to communicate effectively with the ship management system, accept its management, and upload important parameters.

1.1.3.3 The electric power propulsion system is to be able to ensure the normal propulsion of the ship, and is to have the following functions:

（1）Propulsion equipment control and protection;

（2）System monitoring and alarm.

1.1.3.4 The fire protection system is to be able to suppress, control or extinguish battery fires and explosions in the on fire compartment.

1.1.3.5 Pure battery-powered ships classed with CCS are to be able to transmit key parameters of the ship's power system to the CCS battery-powered ship survey and verification platform. The key parameters of battery system of hybird battery-powered ships classed with CCS can be transmited with this article as reference.

1.1.4 SAFETY CLASSIFICATION

1.1.4.1 To ensure that batteries can have differentiated protective measures taken according to their different safety attributes, batteries are to undergo safety classification, and safety classification is to be completed prior to the cell survey stage.

1.1.4.2 The battery manufacturer is to provide the elements contained in Article 1.1.4.5 based on theoretical analysis and test data.

1.1.4.3 The use of batteries that may release toxic and flammable gas during normal use, or have risks of fire, explosion, obvious bloating and liquid leakage during normal use is forbidden onboard.

1.1.4.4 Batteries that have not passed the thermal runaway propagation test are prohibited from marine use. The thermal runaway propagation test is carried out in accordance with the corresponding requirements of CCS E-24 Marine Lithium-ion Batteries.

1.1.4.5 Batteries are classified as per Table 1.1.4.5. Safety level gradually increases from level 1 to level 2. Batteries with safety level 1 can be used onboard after strict protection is provided; batteries with safety level 2 can be used onboard after universal safety measures are adopted.

List of safety levels Table 1.1.4.5

Safety Level	Thermal runaway		Combustion (explosion) risks
	Releases oxygen	Releases toxic, flammable gas	
1	√	√	Relatively high
2		√	Relatively low

1.1.4.6 Batteries whose anode materials release oxygen and toxic and flammable gas, and have relatively high combustion (explosion) risks under thermal runaway condition are categorized into safety level 1.

1.1.4.7 In the case of thermal runaway, the cathode material only emits toxic and combustible gases, and the battery with a low risk of combustion (explosion) has a safety level of 2.

1.1.4.8 Passenger ships, ships carrying dangerous goods and ships navigating in the Three Gorges Reservoir Area are to adopt batteries of safety level 2, and the battery pack ingress protection level is not to be less than IP67. The temperature regulation measures for battery packs are to meet the requirements of 6.4.3.4. The fire prevention and control measures for battery packs are to meet the requirements of 6.4.3.5 or 6.4.3.6 according to the packaging type and safety level. However, the fire prevention and control measures for battery packs of the following ships are to be fire prevention and control devices or suppression media (such as silicone oil immersion):

(1) Passenger ships carrying 300 or more passengers;

(2) Ships carrying dangerous goods with a battery capacity of 4000 kWh or more;

(3) Ships navigating in the Three Gorges Reservoir Area with a battery capacity of 4000 kWh or more.

1.1.4.9 The battery of the fiber reinforced plastic ship is to be a battery of safety level 2, and the protection level of the battery pack is not to be lower than IP67, and the temperature regulation measures and fire prevention and control measures are to meet the relevant requirements of 6.4.3.4 and 6.4.3.5.

1.1.5 CLASS NOTATIONS

1.1.5.1 During normal navigation, ships that use batteries as the only power supply may be assigned the following class notation upon application by the shipowner or shipyard/designing institute and confirmation of compliance with the relevant requirements of the Rules through CCS plan approval and survey:

Battery（Power）

1.1.5.2 During normal operation, ships that use batteries as part of the propulsion power may be assigned the following class notation upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules and the Guidelines for Ships Applying Hybrid Power System through CCS plan approval and survey:

Battery（Power-h）

1.1.5.3 Ships have the ability to transmit key parameters of their power system to the battery powered ship survey and verification platform. Upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules through CCS plan approval and survey, the following class notation may be assigned:

Remote monitoring of ship's power system: Power-R

1.1.5.4 Where the ship is equipped with battery products that meet the requirements of 6.1.1.9, and upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules through CCS plan approval and survey, the following class notation may be assigned:

Digital inspection of ship battery system: Battery-data

1.1.5.5 Where the ship's power system undergoes overall onshore joint commissioning at an organization recognized by CCS, upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules through CCS survey, the following class notation may be assigned:

Onshore joint commissioning of ship power system: Power-landtest

1.1.5.6 Where the ship's main propulsion plant is remotely controlled from the navigating bridge control station with machinery spaces under continuous manned watch, and upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules through CCS plan approval and survey, the following class notation may be assigned:

Bridge Remote Control: BRC

1.1.5.7 Where the main propulsion plant of the ship is remotely controlled by the bridge control station and the machinery spaces are periodically unattended, upon application by the shipowner or shipyard/designing institutes and confirmation of compliance with the relevant requirements of the Rules through CCS plan approval and survey, the following class notation may be assigned:

Periodically Unattended Machinery Spaces: AUT-0

1.1.6 DEFINITIONS

1.1.6.1 Definitions and terms included in the Rules are as follows:

(1) Lithium-ion Battery means the batteries that use lithium-ion as conductive ion, which moves between positive and negative poles. Their charge and discharge are realized through mutual transformation of chemical energy and electric energy.

(2) High Energy Density Supercapacitor means the capacitor mainly used for high energy input and output, characterized by high energy density.

(3) Battery Cell means the smallest structural unit in one battery, as a basic unit device that directly turns chemical energy into electric energy, including electrodes, diaphragm, electrolyte, shell and terminals (also called pole terminals).

(4) Battery Module means the combination unit where more than one battery cells are combined in series connection, parallel connection or series-parallel mixed connection. This connection unit only has one pair of positive and negative pole output terminals, and is used as power supply.

(5) Battery Pack refers to the formation of a plurality of battery cells or battery modules in series and parallel connection due to voltage or power requirements. The battery pack is to contain monitoring circuits that provide information (e.g., voltage, temperature, etc.) to the battery system.

(6) Battery String refers to the smallest independent power supply composed of multiple battery packs connected in series and/or parallel, and equipped with a high-voltage box for control.

(7) Battery Assembly refers to the combination composed of one or more battery strings connected in parallel, and connected with the converter as an independent power supply branch of the ship.

(8) Battery Domain refers to the general term for battery packs connected to the same busbar segment.

(9) Battery System refers to the energy storage device of the whole ship, including the integration of one or more battery domains, one or more battery management systems, high-voltage circuits, low-voltage circuits, thermal management equipment and mechanical assemblies.

(10) Battery Box (Cabinet) refers to a box or cabinet made of steel material for storing batteries.

(11) Battery Room refers to a place dedicated to the storage of batteries enclosed by a structural separation.

(12) Battery Management System (BMS) refers to the system that monitors the status of the battery (temperature, voltage, state of charge, etc.), provides communication, safety, battery cell

balance and management control, and provides communication interface with the application equipment.

(13) Containerized Mobile Power Supply refers to a battery power supply system that uses a containers body in the form of a standard container as the installation platform for the battery system and related safety and control systems. Hereinafter referred to as the "containerized power.

(14) Battery Swap refers to the process of realizing the electric energy supply for battery-powered ships by quickly replacing the containerized mobile power supply through special devices or manual assistance.

(15) Battery Swap Connector refers to a connecting device located on the containerized mobile power supply, which is used to connect containerized mobile power supply with the ship system or shore-based system and transmit electric energy, electric signals, communication data and thermal media (generally including electrical interfaces, and may also include cooling interfaces for transmitting cooling media, fire-fighting interfaces for transmitting fire-extinguishing media, and all other interfaces that need to be connected between the ship and containerized mobile power supply).

(16) Containerized Mobile Power Supply Junction Box refers to a connecting device located on the ship side, which is used to connect containerized mobile power supply with the ship system and transmit electric energy, electric signals, communication data and thermal media (generally including electrical interfaces, and may also include cooling interfaces for transmitting cooling media, fire-fighting interfaces for transmitting fire-extinguishing media, and all other interfaces that need to be connected between the ship and containerized mobile power supply).

(17) Ship Battery Swap System refers to a system composed of components and equipment used for ship battery swap operations or related to battery swap functions, hereinafter referred to as the Battery Swap System for short. It may include the Battery Swap Connector, Containerized Mobile Power Supply Junction Box, and the connecting part between them, as well as auxiliary electrical devices with functions such as position monitoring.

(18) Ship Management System refers to the system used for monitoring, alarming and controlling the ship's power system (including battery system, power distribution system and propulsion system), and is composed of software and hardware. Depending on the total battery capacity of the ship, the ship management system can be a power management system (PMS) and/or an energy management system (EMS) and/or an alarming and monitoring system (AMS).

(19) Battery Capacity (C) refers to the capacity of battery's stored electric quantity. Rated battery capacity normally is battery capacity provided by the companies (Under room temperature, when storage battery discharges at constant current I_X(A), it could continuously work for X hours).

(20) State of health (SOH) refers to the ability of a battery to store electrical energy relative to a new battery. The state of the battery from the beginning of its life to the end of its life is expressed as a percentage, and is used to quantitatively describe the current performance state of the battery.

(21) State-of-charge (SOC) refers to the percentage of the capacity allowed to be released as per discharge condition stipulated by the manufacturers to the battery capacity of current battery cell, module, battery pack or system, also called remaining capacity.

(22) Depth of Discharge (DoD) refers to the percentage of the discharged capacity of the battery in its nominal capacity during use.

(23) Thermal Runaway refers to the phenomenon of chain reaction of uncontrollable rising of temperature of batteries triggered by battery cell’s heat release.

(24) Thermal Runaway Propagation refers to the phenomenon of one battery cell’s thermal runaway causing remaining battery cells to also have thermal runaway in a row inside battery pack or system.

(25) Failure Mode & Effects Analysis (FMEA) refers to a systematic program that analyzes the system to identify potential failure modes, failure causes and their effects on system performance (including component, system or process performance).

(26) Battery Pack Fire Prevention and Control Device refers to a device that can detect the signs of fire hazards in the battery pack, issue an alarm, automatically and/or manually start the spray suppression medium.

(27) Discharge Rate/Charge Rate: Discharge rate is a measure of discharge speed, which refers to the current value required when the battery discharges its rated capacity within a specified time. (It is numerically equal to the multiple of the battery's rated capacity, i.e., "discharge current/battery rated capacity = discharge rate", usually denoted by the letter C.) Similarly, the charging rate is a measure of how fast or slow the charge is, i.e., "charging current/battery rated capacity = charging rate". ）

(28) Battery-Powered Ship Survey and Verification Platform refers to a platform established by China Classification Society that is responsible for receiving battery product data related to battery-powered ships and real-time ship monitoring data.

(29) Shore-based Monitoring Platform refers to a shore-based operation and maintenance and/or management platform that submits real-time ship monitoring data to the Battery-Powered Ship Survey and Verification Platform.

(30) Shipborne Data Terminal refers to a ship-side device that submits real-time ship monitoring data to the Shore-based Monitoring Platform or the Battery-Powered Ship Survey and Verification Platform.

1.1.7 PLANS AND DOCUMENTS

1.1.7.1 In addition to submitting the plans and documents required by relevant CCS rules, the following plans and documents are to be submitted to CCS for approval:

(1) Power load calculation (including AC daily load calculation, power battery capacity calculation);

(2) Short-circuit current calculation and selective protection analysis of direct current busbar system[①](applicable to ships where the total output power of the power supply devices that may be connected to the grid simultaneously exceeds 200 kW);

(3) Power system diagram (including circuit system diagram composed of battery, containerized power, BMS system and power distribution board);

(4) List of Monitoring and Alarm Items for the Power System;

(5) Battery and BMS system diagram (system diagram composed of battery pack, high-voltage box, BMS, etc, which may be merged with the power system diagram);

(6) Arrangement of power equipment (including the installation location of batteries,

[①]For the calculation of short-circuit current and selective protection analysis of DC integrated power system, please refer to the relevant requirements in Section 4, Chapter 3 of the Guidelines for Survey of DC Integrated Electrical Systems of Ships.

containerized power, distribution boards and other equipment);

(7) Battery room / battery box (cabinet) / containerized power arrangement (including at least the positions of internal and external openings);

(8) Ventilation system(including emergency exhaust system) diagram and calculation of battery room, battery box(cabinet) (if applicable);

(9) Temperature regulation device diagram and calculation of battery room, battery box (cabinet) (if applicable);

(10) Arrangement of the battery room drainage system;

(11) Fire prevention plan of battery room;

(12) Fixed fire detection and fire alarm system diagram, arrangement diagram of battery room/battery box (cabinet) (which may be combined with ship's fixed fire detection and fire alarm system diagram, arrangement diagram);

(13) Battery room fire extinguishing agent application pre-alarm system diagram, arrangement diagram;

(14) Schematic diagram, arrangement diagram and fire extinguishing dose calculation of battery room fire extinguishing system;

(15) Battery room/battery box (cabinet) combustible gas detection system diagram and arrangement diagram;

(16) Battery room/battery box (cabinet) temperature monitoring and alarm system diagram, arrangement diagram;

(17) Risk assessment report of battery-powered ship;

(18) Outline of onshore joint commissioning, mooring and navigation tests;

1.1.7.2 Pure battery-powered ships with automation class notation are to submit the following plans and documents for approval in accordance with the control, alarm (display) and safety systems of the equipment involved in Chapter 11:

(1) Measuring and display points;

(2) Alarm points (including the positions of alarm signal display at control stations and indoors, and alarm methods);

(3) Items of the safety system;

(4) Power source system diagram of the automation system.

1.1.7.3 If necessary, other plans and documents required by CCS for approval are also to be submitted.

Section 2 BATTERY AND SYSTEM RELIABILITY

1.2.1 BATTERY RELIABILITY

1.2.1.1 The reliability of the battery is to satisfy the quality, health and safety requirements of the corresponding sections in Chapter 6 of the Rules.

1.2.2 SYSTEM RELIABILITY

1.2.2.1 For ships that have batteries provided for main power supply and propulsion power respectively, batteries are to meet the following conditions respectively:

(1) At least two sets of independent batteries are to be equipped for main power supply, the electricity quantity of each is to be enough to supply power within suitable time range during the whole voyage to equipment that are necessary to guarantee ship's normal navigation, ship safety and refrigerated cargoes. At the same time, lowest comfortable accommodation condition is also to be ensured. At least, power supplies to appropriate cooking, food refrigeration, mechanical ventilation, hygiene and fresh water equipment are to be ensured. The electricity quantity of each set of battery is to at least be able to maintain power supply for 4h to electric equipment that are necessary for ship safety.

For inland waterways ships of less than 20 m in length, the main source of electrical power is to be provided in accordance with the requirements of the Rules for Construction of Inland Waterways Boats. For sea-going ships of less than 20 m in length, the main source of electrical power is to be provided in accordance with the requirements of the Rules for Classification of Sea-going Boats. For yachts, the main power supply is to meet the requirements of the Rules for Classification and Construction of Yachts.

(2) For electric propulsion power supply, at least two independent battery assemblies are to be provided, the design power of each battery assembly is to be similar, and the total capacity is enough for electric power needed for ship's voyage. In case of failure of any assembly of batteries, the capacity of the remaining battery assembly can sustain the ship to reach the nearest port.

For inland waterways pure battery-powered ships with a length of less than 10m, such as scenic pleasure boats or reservoir patrol boats, if a risk assessment report approved by CCS surveyor can be provided, and corresponding emergency rescue measures are equipped, only one group of battery assembly can be set up as electric propulsion power and main power source, and the capacity of the battery assembly is to be able to meet the needs of electrical equipment from the starting port to the terminal port.

1.2.2.2 If the public power station is used as main power supply and power supply for electric propulsion simultaneously, the following provisions are to be met:

(1) The outfitting, function and total capacity of batteries are to meet the provisions of 1.2.2.1;

(2) Control system of power station is to ensure safe distribution of electric power between propulsion and routine load. If necessary, unimportant loads could be removed and/or propulsion power could be lowered;

(3) The main busbar is divided into at least two sections and set in one of the following ways:

① No connection between the sections, and each section DC busbar is independent of each other, and power supply for each partition is implemented;

② Bus protection device is to be connected between the sections. In case of short circuit or similar failure in the main busbar, the bus-tie protection device is to be the first to operate to ensure the normal power supply on the non-failure side. The solid state switch is preferably used for the bus-tie protection device. When other types of protection devices are used, documents are to be submitted stating that the protection device can achieve the same selectivity under any working condition.

③ The battery assembly, propulsion system equipment and other equipment are to be equally connected to the main busbar section;

(4) At least one battery assembly is to be connected to each section of the main busbar. When any section of the battery assembly is not working, the battery assemblies of the remaining sections are to sustain the effective propulsion and steering of the ship, and the electricity utilization of other equipment. At the same time, a certain speed is to be maintained until the ship reaches the nearest port.

(5) Effective measures are to be taken to avoid the power loss of the whole ship due to a single failure.

(6) Effective measures are to be taken to prevent multiple insulation resistance monitoring devices from working at the same time.

(7) Inland waterways boats with a length of less than 10 meters with only one set of battery assembly as both main power source and electric propulsion power supply do not need to meet the requirements of (3), (4) and (5).

1.2.2.3 The battery capacity of the battery system of hybrid powered ships may not have to meet the requirements of 1.2.2.1 and 1.2.2.2.

1.2.2.4 The requirement of battery system main busbar section of hybrid powered ships may not have to meet the requirements of 1.2.2.2.

1.2.2.5 Within the specified power supply time range, battery's final discharging voltage, final discharging capacity (depth of discharge) are to meet requirements in the specifications provided by the manufacturer.

1.2.2.6 The total battery capacity of the ship is to consider the capacity fading of the battery in its service life.

1.2.2.7 Pure battery-powered ships are to be equipped with emergency power supplies. The emergency power supply is to be a battery (including lead-acid battery). When the main power supply fails, the emergency power supply is to be able to automatically put in. The installation and power supply time of the emergency power supply meet the requirements of the corresponding rules and regulations for the emergency power supply of the ship's navigation waters. For the relevant rules and regulations that only require the temporary emergency power supply of the ship or the ship that does not set up the emergency power supply or the temporary emergency power supply, the installation of the emergency power supply, the power supply time are to meet the corresponding requirements of the temporary emergency power supply, but the power supply time of ⑥ and ⑦ of this article is not to be less than 30min.

In addition to the requirements of the corresponding rules and regulations of the waters navigated by the ship, the power supply scope of the emergency power supply is to also include the following equipment or systems:

(1) When the length of the ship is greater than or equal to 20m, it is also to include:

① Ship management system (including energy management system (EMS)/power management system (PMS)/alarming and monitoring system (AMS));

② Battery management system (BMS);

③ Combustible gas detection system;

④ Stationary fire detection and fire alarm systems;

⑤ Emergency exhaust system[①];

⑥ Steering gear power unit and its control system (applicable to passenger ships and ships carrying dangerous goods that use traditional propellers and rudder devices and pass through the Three Gorges Dam or sail in the rapids section and have rudder torque greater than 16kN·m);

⑦ One of the main propulsion units (which is to be able to maintain at least 50% of the rated power of the propulsion units) and the power and control system of its slewing mechanism (applicable to passenger ships and ships carrying dangerous goods using full-rotation propulsion units, rim propulsion devices, straight-wing rudder propeller propulsion devices, and water-jet propulsion units, and passing through the Three Gorges Dam or navigating the rapids).

(2) When the length of the ship is less than 20m, (1) ① ~ ⑤ of this article are also to be included.

(3) When the ship adopts containerized power, the requirements of ②~⑤ in (1) and ②~⑤ in (2) of this article are to be replaced by the requirements of 7.2.3.7.

Section 3 SURVEY

1.3.1 PRODUCT SURVEY

1.3.1.1 The battery enterprises applying for product survey (except for supercapacitors) are to at least meet the equivalent requirements of the Standard Conditions of Lithium-ion Battery Industry issued by the Ministry of Industry and Information Technology.

1.3.1.2 Product survey is to satisfy the requirements of relevant CCS rules, regulations and CCS survey guidelines for marine lithium-ion battery products for applying battery-powered ship related products.

1.3.1.3 Unless otherwise specified, the ship battery system and its components are to hold certificates as required in Table 1.3.1.3.

List of marine battery system certificates Table 1.3.1.3

No.	Name of Product	Document		Approval Mode				Plan Approval
		C/E	W	DA	TA-B	TA-A	WA	PA
1	Battery system	X	—	—	—	—	—	X
1.1	Battery module/ battery pack	X	—	—	X	—	—	X
1.1.1	Battery cell	X	—	—	X	—	—	X
1.1.2	Battery management system(slave)	—	X	—	X	—	—	X

① If the emergency exhaust system can obtain power from batteries located outside its service area, it does not need to be powered by an emergency power source.

1.1.3	Sensor	—	X	—	X[1]	—	—	X
1.1.4	Wire and cable	—	X	—	—	—	X	X
1.1.5	Fire prevention and control device (battery pack part, if equipped)	X	—	—	X	—	—	X
1.2	High voltage box (cabinet)	X	—	—	—	—	—	X
1.2.1	Battery management system (main control)	X	—	—	X	—	—	X
1.2.2	Circuit breaker	—	X	—	X	—	—	X
1.2.3	DC circuit breaker	—	X	—	X[1]	—	—	X
1.2.4	Electrotechnical instrument	—	X	—	X	—	—	X
1.2.5	Contactor	—	X	—	X	—	—	X
1.2.6	Relay	—	X	—	X[1]	—	—	X
1.2.7	Fuse	—	X	—	X[1]	—	—	X
1.2.8	Display	—	X	—	X[1]	—	—	X
1.2.9	Wire and cable	—	X	—	—	—	X	X
1.3	Power conversion device (charger, frequency converter etc.)	X	—	—	X	—	—	X
1.4	Wire and cable	X[2]	—	—	—	—	X	X
1.5	Fire prevention and control device (if any)	X	—	—	X	—	—	X

Note:

1. If the certificate of the purchased parts cannot meet the requirements, the complete set of type test is to be carried out with the whole product;

2. It means wires and cables for external connection of battery pack / battery modules;

3. It is acceptable with the special consent of CCS.

4. Symbol description:

(1) C-Product Certificate; E-Equivalent document; W- Manufacturer's document.

(2) DA-Design approval; TA-Type approval; WA-Works approval; PA-Plan approval.

(3) X—Applicable; O—Optional; - —Not applicable.

For the battery system components that have the requirements of the product certificate in the above table, if they are manufactured by the battery system manufacturer and are only used in the products of the factory, they are to be surveyed in accordance with the requirements of CCS, and a separate product certificate may not be issued.

1.3.1.4 The key equipment of the ship's power system (including battery system, power distribution system and propulsion system), such as ship management system, battery management system (BMS), converter (rectifier, inverter, converter, chopper), solid-state switch, etc., are to be verified in the product approval stage, and hold the reliability compliance certificate issued by CCS. Reliability verification is to be carried out in accordance with the equipment requirements of Chapter 5 of the CCS guidance document Guidelines for Reliability Verification of Marine Equipment and Systems (GD28-2023). If there is an equivalent means of validation, it is to be recognized by CCS.

1.3.2 SHIP SURVEY

1.3.2.1 Survey procedures, survey methods, survey types, survey interval, survey conditions, the preparation before survey, survey, test requirements and the preservation requirements of ship plans, data, certificates, records and reports are to be carried out according to relevant CCS rules.

1.3.2.2 Survey during construction

1）The surveyor is to confirm that the battery system holds the corresponding certificate as required in Table 1.3.1.3. The battery system certificate is to indicate the safety level of the battery cell.

2）In addition to the requirements of survey during construction according to relevant CCS rules, the following items are to be added to survey during construction:

(1) Inspection of means of access to battery rooms;

(2) Inspection of equipment inside battery rooms /battery boxes(cabinets);

(3) Inspection and functional test of battery room emergency exhaust system, battery box (cabinet) emergency exhaust system (if any);

(4) Inspection and functional test of the temperature regulating device or the ventilation system of the battery room / battery box (cabinet);

(5) Utility test of battery room/battery box (cabinet) temperature detection device;

(6) Inspection and functional test of the cooling systems of battery packs and power distribution systems;

(7) Inspection of fire division between battery rooms and other cabins;

(8) Inspection and functional test of fire detection and fire alarm system in battery rooms /battery boxes(cabinets);

(9) Inspection and functional test of flammable gas detection system in battery rooms /battery boxes(cabinets);

(10) Inspection and functional test of fire-fighting equipment inside battery rooms /battery boxes(cabinets) (if any);

(11) Inspection and functional test of cooling devices inside battery rooms /battery boxes (cabinets) (if any);

(12) Inspection of explosion-proof electrical equipment in battery rooms /battery boxes (cabinets) (if needed);

(13) Inspection of the cut-off device of non-explosion-proof electrical equipment in the battery rooms/battery boxes (cabinets);

(14) Installation survey of the battery system, including:

① Visual inspection of each component of the battery system;

② To check whether the arrangement of batteries is easy for replacement, inspection, test and cleaning;

③ To check whether batteries are installed in locations where overheat, over cooling, splash, vapor and other factors may damage their performance or accelerate deterioration of their performance.

④ Check whether the battery tray or battery box (cabinet) is well fixed.

(15) The test items specified in Chapter 10.

(16) For containerized power, in addition to being surveyed in accordance with the applicable requirements of Item 2) (1) to (15) of 1.3.2.2, the following items are also to be surveyed (if

applicable):

① Review the certificate and survey report of the marine containerized mobile power supply;

② Inspection of the on-board arrangement of containerized power, and operation test of containerized power battery swap;

③ Inspection of the equipment and its function of the internal and external transmission of signals in containerized power;

④ Functional test (simulation test) of remote operation of containerized power fire extinguishing system, etc.;

(17) The operational performance of each mobile fire water cannon was tested (if applicable).

(18) Confirm that at least the following documents are kept on board:

① Operation Manual (see 8.2.2 for specific contents);

② Maintenance Plan (see 8.3.2 for specific contents);

③ Training Manual (see 8.4.3 for specific contents).

(19) Check the effectiveness of online monitoring data transmission between the ship's end and the survey and verification platform for battery-powered ships.

1.3.2.3 Survey after construction

1) Annual survey and intermediate survey: In addition to carrying out annual survey and intermediate survey of mechanical and electrical equipment according to relevant CCS rules requirements(if applicable), the following items are also to be surveyed:

(1) Check the basic data analysis report during the battery system survey cycle to confirm the safe operation status of the battery system;

(2) Check whether there is any change in the arrangement of the battery room / battery box (cabinet) and the fixation of the box (cabinet);

(3) Check the appearance and cleanliness of each component of the battery system and the distribution box (cabinet);

(4) Check battery and battery management system operation records. Calibrate the battery system SOH and SOC (at least fully charged fully discharged once; Or conduct deep charge and discharge tests according to the manufacturer's requirements, and record the capacity decay curve) and replace when the life expectancy reaches the manufacturer's specified life expectancy or when damage occurs;

(5) Check whether the emergency shutdown device of the battery system is working properly;

(6) Check whether heat source equipment is added inside battery rooms/battery boxes(cabinets);

(7) Check whether temperature detection device of battery rooms/battery boxes(cabinets) is working normally;

(8) Check whether emergency exhaust system of battery rooms/battery boxes(cabinets) is working normally;

(9) Check whether the temperature regulation device or ventilation system of battery rooms is working normally.

(10) Check whether the disconnection of non-explosion-proof equipment in the battery room is functioning properly;

（11）Check whether the combustible gas detection system in the battery room/battery box (cabinet) is functioning properly;

（12）Check whether cooling system of battery packs and power distribution systems is working normally;

（13）Check whether various functions of battery management system are working normally;

（14）Check the appearance of fire prevention and control devices for battery packs and review maintenance records (if any);

（15）Check the effectiveness of online monitoring data transmission between the ship's end and the survey and verification platform for battery-powered ships;

（16）Certificate and survey report of the marine containerized mobile power supply, and battery swap log of containerized power (if applicable);

（17）Basic data analysis report during the containerized power survey cycle (if applicable).

2） Special survey: In addition to meeting the relevant requirements of relevant CCS rules for special survey for mechanical and electrical equipment (if applicable) and subparagraph 1), it is to also include:

（1）Review the basic data analysis report during the battery system survey period to confirm safe operational status of the battery system;

（2）Utility test of temperature monitoring system for battery room/battery box (cabinet);

（3）Utility test of emergency ventilation system for battery room/battery box (cabinet);

（4）Utility test of combustible gas detection system for battery room/battery box (cabinet), and linkage test with emergency ventilation system and power disconnection of non-certified explosion-proof electrical equipment;

（5）Utility test of temperature regulation device or ventilation system for battery room/battery box (cabinet);

（6）Functional test of battery management system and ship management system；

（7）The containerized power is to pass the battery swap operation test (when applicable).

（8）Utility test of bus-tie protection devices, contactors or disconnectors in power distribution systems;

（9）Utility test of power distribution and conversion in power distribution systems;

（10）Utility test of alarm and safety systems in DC integrated power systems;

（11）Utility test of propulsion systems.

3) Occasional surveys: In the course of operation, if the shipowner or operator finds that the battery system or power distribution system has one of the following circumstances, they are to immediately apply to CCS for occasional surveys:

(1) An accident has occurred that affects the normal operation of the battery system or power distribution system, including but not limited to: thermal runaway of the battery, collision impact or submersion of the battery.Survey requirements:

① The damage caused by the accident is to be verified, repair requirements are to be put forward, the repair plan and process are to be confirmed, and a survey is to be conducted to ensure that the repair results meet the corresponding requirements of the Rules;

② For the damaged items of the ship that cannot be completely repaired immediately, if the shipowner or operator requests it and CCS assesses that it does not affect safety, a scheme of temporary non-repair, partial repair or appropriate temporary repair may be accepted, but the corresponding operational restrictions are to be endorsed on the certificate.

(2) Repairs, modifications or replacements related to the operational safety of the battery system or power distribution system, except for major conversions, including but not limited to: replacement of battery packs, major hardware and/or software updates of the Battery Management System (BMS), replacement of major components of the power distribution system and/or change of control principles.Survey requirements:

① The plan for repair, modification or replacement is to be assessed by CCS; if necessary, according to the impact it poses on ship safety, the plans and documents specified in 1.1.7 (as applicable) are to be resubmitted to the ship survey authority for approval;

② Conduct inspections and tests on relevant items in accordance with the provisions of 1.3.2.2 based on the scope of repair, modification or replacement;

③ If the battery system has one or more of the following conversion circumstances, the conversion and its relevant parts are to meet the technical requirements of the Rules and be surveyed in accordance with the provisions of 1.3.2.2:

(a) The total electric quantity of the battery system (excluding containerized power supplies) changes by more than 20% or the number of battery strings changes;

(b) The electric quantity of a single containerized power changes by more than 20% or the number of battery strings inside the box changes;

(c) The maximum designed quantity of containerized power changes;

(d) The specifications of battery cells change.

(3) If a ship needs to add a new containerized power for adaptation, the shipowner or operator of the ship is to submit a request for occasional surveys. containerized mobile power supply is to be installed on the ship to conduct adaptability tests including ship-box connection, voltage level, operating power, ship-box communication, etc., to ensure that containerized mobile power supply is suitable for the added ship. After the completion of the survey, the serial number of the adapted containerized power is to be added to the ship's certificate and signed by the CCS surveyor.

1.3.3 DIGITALLY-ASSISTED SURVEYS

1.3.3.1 The method of online data transmission between the ship and the CCS Battery-powered ship survey and verification platform is to be confirmed to comply with the provisions of Section 3 of Chapter 3.

1.3.3.2 For ships accessing the battery-powered ship survey and verification platform via the shore-based monitoring platform, they are to submit the certificate of compliance for the approval of the shore-based monitoring platform.

1.3.3.3 Survey during construction and initial survey are to verify the effectiveness of online data access.

1.3.3.4 Annual/Intermediate surveys: Submit basic operational data analysis reports during the power system survey period and maintenance records of electrical systems (e.g., EMS/PMS/AMS, BMS, DC distribution systems) to verify authenticity of alarm data in the "Operational Auxiliary Survey Report for Battery-Powered Ships", and prioritize inspection of alarm-prone equipment as indicated in said report.

1.3.3.5 Special surveys: In addition to relevant requirements in 1.3.3.4 , the following items are to be conducted:

If a shore-based monitoring platform exists, submit its basic operational data analysis report for one survey period. Authenticity of data transmission is to be verified by comparing data from ship-side, shore-based platform, and battery-powered ship survey and verification platform.

1.3.3.6 For ships applying for class notations specified in 1.1.5.3, upon assessment by CCS, the battery-powered ship survey and verification platform may provide analysis based on the actual conditions of the battery-powered ship to assist in conducting the survey of relevant items.

1.3.4 ALTERNATIVE AND WAIVER OF SURVEY

1.3.4.1 For ships applying for class notations specified in 1.1.5.5, upon CCS assessment, during the mooring test, the following items may be subject to random inspection and waiver:

(1) During shore-based integration testing, display/alarm points of the battery system were verified item-by-item against the AMS. During mooring tests, except for alarms triggering protective actions, other alarm/display items may undergo sampling checks if the shipyard provides qualified self-test reports.

(2) Charging tests conducted on the battery system during shore-based integration testing may be exempted during mooring tests.

(3) Items already verified by tests for risk assessment measures implemented during construction in shore-based integration testing need not be reverified during mooring tests.

1.3.5 SHORE-BASED MONITORING PLATFORM APPROVAL

1.3.5.1 Approval of the shore-based monitoring platform is to include plans/document approval and on-site survey.

1.3.5.2 For application for approval of the shore-based monitoring platform, the applicant is to submit the following documents for review:

(1) System functional description;

(2) Actual ship access status;

(3) Data risk assessment report;

(4) Approval test outline.

1.3.5.3 On-site review is to be conducted in accordance with the submitted approval test outline, and it is necessary to verify the compliance of the shore-based monitoring platform with the requirements of the Rules by using a real ship.

1.3.5.4 The approved shore based monitoring platform is to be issued a compliance certificate, which is to indicate the validity period and the supported online data transmission standard version.

1.3.5.5 .The validity of the Certificate of Compliance is to be verified once every five years; the verification process and requirements are to be the same as those for approval, and a new Certificate of Compliance is to be issued upon completion of the verification.

1.3.5.6 If one of the following circumstances is met, an application for occasional surveys is to be submitted, and a new Certificate of Compliance is to be issued if necessary.

(1) Adjustment to the hardware and software system architecture of the shore-based monitoring platform;

(2) Modification to the software functions of the shore-based monitoring platform;

(3) Addition of support for the new version of the online data transmission standard;

(4) Frequent abnormalities in the data transmission function of the shore-based monitoring

platform;

(5) Other circumstances determined by the Society.

Section 4 SPECIAL REQUIREMENTS FOR SURVEY OF CONTAINERIZED POWER

1.4.1 DEFINITIONS

1.4.1.1 Initial survey of containerized power refers to the survey conducted before the containerized power is installed on board the ship and put into operation.

1.4.1.2 Anniversary date of containerized power refers to the day and month of each year that corresponds to the date of issuance of the Certificate for Marine Containerized Mobile Power Supply.

1.4.1.3 Annual survey of containerized power refers to the survey carried out within 3 months before or after each anniversary date of the containerized power, to ensure that it is in good condition and suitable for the intended service of the ship.

1.4.1.4 Special survey of containerized power refers to the survey carried out within 3 months before the expiry of a special survey period. In addition to the items of the annual survey, relevant equipment and system function tests are conducted to ensure that the containerized power supply is in good condition and suitable for the intended service of the ship, in order to maintain the validity of the certificate.

1.4.1.5 Occasional surveys of containerized power refers to a general or partial survey conducted as required by the specific circumstances, to ensure that the containerized power is in good condition.

1.4.1.6 Special survey period of containerized power refers to the interval between completing two special surveys in order to maintain the validity of the certificate after the containerized power obtains the certificate. This interval is 5 years.

1.4.1.7 Owner of containerized power refers to the organization or individual that holds the ownership of the containerized power asset.

1.4.1.8 Operator of containerized power refers to the organization or individual that holds the operation rights and management rights of the containerized power.

1.4.2 GENERAL REQUIREMENTS

1.4.2.1 The containerized power is to undergo initial survey, annual survey, and special survey by the CCS ship survey unit in accordance with the requirements of this Section.

1.4.2.2 Upon completion of the corresponding survey of the containerized power, the certificate for marine containerized mobile power supply is to be issued/endorsed by the CCS ship survey unit.

1.4.2.3 The application for survey of the containerized power is to be submitted by its owner or operator. If the containerized power undergoes the periodical survey as scheduled, its anniversary date remains unchanged. If the survey is applied for and completed before the survey window period for the annual or special survey, the anniversary date of the containerized power is to be re-determined based on the date of survey completion. If the survey is not applied for as scheduled after the survey window period for the annual or special survey, the certificate for marine containerized mobile power supply is to become overdue and invalid. Any subsequent survey application is to be executed in accordance with the requirements for an initial survey.

1.4.2.4 The containerized power is to undergo annual and special surveys within its special survey period as required in 1.4.4 and 1.4.5, and corresponding survey reports are to be generated. The survey report is to include items such as the survey item checklist, raw test data, defect photographs, and rectification tracking records. If the containerized power cannot undergo survey when the special survey is due, the validity of the certificate may be extended for a period not exceeding 3 months by CCS upon application by the owner or operator of the containerized power, if the survey organization deems it proper and reasonable.

1.4.2.5 The annual and special surveys of the containerized power may be coordinated with the corresponding surveys of the ship.

1.4.2.6 During the operation of the containerized power, should any of the following situations occur, the owner or operator of the ship or the containerized power is to immediately apply to the CCS ship survey unit for an occasional survey:

(1) The containerized power is affected by an accident, which affects the normal operation of the battery system;

(2) Repairs, modifications, or replacements of the battery system of the containerized power are undertaken. This includes, but is not limited to: replacement of battery packs, and updates to the main hardware and/or software of the battery management system;

(3) A change in the owner or operator of the containerized power occurs.

1.4.2.7 Issue and endorsement of the certificate for marine containerized mobile power supply:

(1) After the completion of the initial survey of the containerized power, the CCS surveyor is to issue the certificate in accordance with the provisions;

(2) After the completion of the annual survey of the containerized power, the CCS surveyor

is to endorse the certificate in accordance with the provisions;

(3) After the completion of the special survey of the containerized power, the CCS surveyor is to renew the certificate in accordance with the provisions;

(4) After the completion of the occasional survey of the containerized power other than the change of the owner or operator, the CCS surveyor is to endorse the certificate in accordance with the provisions;

(5) After the containerized power applies for the occasional survey for the change of the owner or operator, the CCS surveyor is to renew the certificate.

1.4.2.8 If the containerized power needs to add a new adapted ship, the owner or operator of the containerized power is to submit a request for occasional survey. After the completion of the survey, the adapted ship is to be added to the certificate and endorsed by the CCS surveyor.

1.4.3 INITIAL SURVEY

1.4.3.1 The items of the initial survey are as follows:

(1) Verify the product certificate of the containerized power;

(2) Verify the maintenance records of the containerized power, including daily maintenance inspections, charging records, etc.;

(3) Survey requirements for containerized power in survey during construction specified in the Rules.

1.4.3.2 For the containerized power not put into use, the owner or operator of the containerized power is to formulate a detailed maintenance plan and keep records in accordance with the maintenance plan.

1.4.3.3 When the containerized power has not been put into use for more than one year, the SOH and SOC of the battery system of the containerized power are to be verified (at least one full charge and discharge cycle; or conduct a deep charge-discharge test in accordance with the manufacturer's requirements and record the capacity fade curve):

(1) When the SOH decreases, it is to be assessed whether it will affect the cruising range of the matched ship type, and the actual total capacity of the containerized power is to be indicated in the certificate;

(2) When the SOH is below 80% or damage occurs, the containerized power is to be prohibited from being used as ship propulsion power or energy storage power supply.

1.4.3.4 For the containerized power already in service, the initial survey is to be undergone within one year after the entry into force of the Rules, and the marine containerized mobile power supply certificate is to be obtained.

1.4.4 ANNUAL SURVEY

1.4.4.1 The items of the annual survey are as follows:

(1) Review the basic data analysis report of the battery system submitted by the owner/operator of the containerized power to confirm the safe operation status of the battery system (including its cooling system). The report is generally to include the main operating parameters reflecting the operation status of the battery system since the last survey, historical alarms, fault information, verification records of important data (including SOC and SOH), analysis of the voltage balance of battery strings, records of abnormal charge-discharge cycles and safety evaluation.

(2) Based on the charging and discharging operations of the containerized power, confirm that the following systems are working properly:

① The ventilation system of the containerized power is functioning properly;

② The emergency exhaust system of the containerized power is functioning properly;

③ The temperature monitoring and alarm system of the containerized power is functioning properly;

④ The temperature regulation system of the containerized power is functioning properly.

(3) Conduct internal and external inspections of the containerized power to further verify the following items:

① All fire dampers (if installed) of the ventilation system of the containerized power are intact and functional;

② Inspect and test the fire and smoke detection and alarm system, flammable gas detection system, and fixed fire-fighting system inside the containerized power to verify that they are in normal working condition;

③ The structure of the containerized power (including fire-resistant structure) is unchanged and intact, the manual and/or automatic fire doors are intact and functional, the extinguishing agent capacity has been verified, and the relevant distribution pipelines are unobstructed (once every two years);

④ The battery swap connectors (power and communication) and water connectors (if installed) of the containerized power are functioning properly; there is no damage to the appearance, protection, etc. of the power connector, and there is no leakage from the water connector;

⑤ Inspect the effectiveness of power sources other than the internal batteries of the containerized power;

⑥ Inspect that the battery pack fixing devices inside the containerized power have no looseness or corrosion;

⑦ Verify that the connection impedance between the batteries and the container body is $\leqslant 0.1\Omega$;

⑧ Inspect the grounding arrangement of the containerized power;

⑨ Verify whether the wiring terminals are exposed.

(4) Review the maintenance records of the containerized power and the battery swap logs of the containerized power.

1.4.5 SPECIAL SURVEY

1.4.5.1 The items of the special survey are as follows:

(1) Items of the annual survey as required in 1.4.4.1;

(2) Conduct a utility test of the battery management system to check whether its functions such as power supply, monitoring, alarm, control, and protection are functioning properly;

(3) Conduct a utility test of the temperature monitoring and alarm system to verify whether the alarm is effective when the temperature inside the containerized power exceeds the set value;

(4) Conduct utility tests of the flammable gas detection and alarm system and the emergency exhaust system, and verify whether the automatic activation of the emergency exhaust system and the automatic disconnection of the power supply for non-explosion-proof electrical equipment are effective when a flammable gas alarm is triggered;

(5) Conduct a utility test of the temperature regulation system of the containerized power to verify that the temperature inside the containerized power remains within the allowable range during the charge-discharge process;

(6) Verify the SOH and SOC of the battery system (at least one full charge and discharge cycle; or conduct a deep charge-discharge test in accordance with the manufacturer's requirements and record the capacity fade curve). If the service life reaches the limit specified by the

manufacturer or damage occurs, the battery system is to be replaced;

(7) Conduct a utility test of the emergency shutdown device of the battery system inside the containerized power.

1.4.5.2 Each containerized power is to undergo a battery swap operation test within a special survey cycle, in conjunction with the ship's annual survey or special survey, which is to be witnessed on-site by the CCS surveyor to verify that the containerized power is securely installed, the battery swap device is functioning properly, and the battery swap connectors/containerized power junction box are functioning properly. The maximum interval between two battery swap operation tests is not to exceed 5 years.

1.4.5.3 Where the critical parameters of the containerized power are transmitted to the battery-powered ship survey and verification platform, and the corresponding parameters have no abnormal alarms and the associated equipment has no fault information, CCS may, upon evaluation and based on the actual condition of the containerized power, utilize the analysis provided by the battery-powered ship survey and verification platform to assist in conducting the survey of related items.

1.4.5.4 The items for special survey may be replaced by the following survey method:

(1) The special survey items specified in 1.4.5.1 (1)-(7) are, as far as practicable, to be evenly distributed for survey within each year of the special survey period;

(2) The maximum interval between inspections for each item is not to exceed 5 years, and all inspection items are to be consistent with the special survey process;

(3) The request for such replacement is to be submitted by the owner or operator of the containerized power and approved by CCS;

(4) The owner or operator of the containerized power is to develop a detailed survey plan for approval by CCS;

(5) CCS, the owner, or the operator of the containerized power may, based on the implementation of the survey, terminate the survey method described in this paragraph and revert to the special survey.

1.4.6 REQUIREMENTS OF OCCASIONAL SURVEY

1.4.6.1 If the containerized power undergoes an occasional survey due to the reasons specified in 1.4.2.6 (1), the accident damage is to be verified, repair requirements are to be proposed, the repair plan and process are to be confirmed, and the survey is to be conducted to ensure that the repair results meet the corresponding requirements of the Rules.

1.4.6.2 If the containerized power undergoes an occasional survey due to the reasons specified in 1.4.2.6 (2), it is to be conducted in accordance with the following requirements:

(1) The repair, modification or replacement plan are to be assessed by CCS; if necessary, the plans and documents specified in the Rules (if applicable) are to be resubmitted to CCS for approval based on the impact it has on the safety of the containerized power;

(2) According to the scope of repair, modification or replacement, conduct relevant inspections and tests in accordance with the provisions of CCS E25 Marine Containerized Mobile Power Supply;

(3) If the containerized power has one or more of the following modification situations, the modified parts and relevant components are to meet the technical requirements of the Rules; the containerized power is to undergo a comprehensive survey in accordance with the requirements of CCS E25 Marine Containerized Mobile Power Supply, and the certificate is to be modified:

① The single-box energy capacity of the containerized power changes by more than 20%;

② The number of battery strings inside the container changes;

③ The specifications of the battery cells change, etc.

1.4.6.3 If the containerized power undergoes an occasional survey due to the reasons specified in 1.4.2.8, the containerized power is to be installed on the ship to conduct compatibility tests including ship-container connection, voltage level, operating power, ship-container communication and other items, to ensure that the containerized power is suitable for the newly added ship.

CHAPTER 2 SHIP ARRANGEMENT

Section 1 GENERAL PROVISIONS

2.1.1 GENERAL REQUIREMENTS

2.1.1.1 Ship arrangement needs to consider battery weight's effect on ship structure and stability, and structural strength check is to be carried out as appropriate.

2.1.1.2 Ship arrangement needs to consider the difference between batteries of different safety levels.

Section 2 BATTERIES

2.2.1 GENERAL REQUIREMENTS

2.2.1.1 If the battery is used as a starter battery, emergency power supply or temporary emergency power supply and backup power supply, its arrangement and installation are to simultaneously meet the relevant requirements of starting battery, backup power supply, emergency power supply or temporary emergency power supply in CCS Rules for Construction of Inland Steel Ship or Rules for Classification of Sea-Going Steel Ships and other relevant CCS rules.

2.2.2 ARRANGEMENT

2.2.2.1 When arranging batteries, batteries' total stored energy is to be considered(stored electric energy is the product of battery's rated capacity and rated voltage):

（1） The batteries with total stored energy greater than 20kWh are to be installed inside battery rooms or inside battery box(cabinet) on open deck;

（2）The batteries with total stored energy of or less than 20kWh but greater than 2 kWh may be installed inside a battery box(cabinet), which may be placed inside the engine room when service environment of the box(cabinet) can be ensured;

（3） For the batteries with the total stored energy of or less than 2kWh, steel shell battery pack may be adopted, which may be installed in locations that are decently ventilated when service environment inside the pack is ensured.

2.2.2.2 Batteries are to be in areas behind collision bulkhead.

2.2.2.3 Batteries are not to be installed inside accommodation space.

2.2.2.4 Batteries' arrangement is to facilitate replacement, check, test and cleaning.

2.2.2.5 Batteries are not to be installed in locations where overheat, over cooling, splash, steam and other factors would damage their performance or accelerate their performance deterioration. Their arrangement is to prevent fire, explosion caused by their abuse from endangering personnel and damaging equipment.

2.2.2.6 In the areas related to battery arrangement, safety warning signs and signs showing prohibition of entry of unrelated personnel are to be posted.

2.2.2.7 The door of compartment reserved for batteries and the outside of the battery box (cabinet) are to have obvious "no smoking or open flames" signs.

Section 3 BATTERY BOX(CABINET)

2.3.1 GENERAL REQUIREMENTS

2.3.1.1 The battery box (cabinet) is to have sufficient strength and be effectively secured to the ship structure.box(cabinet).

2.3.1.2 The protection level of the battery box (cabinet) is to meet the requirements of the relevant location, but is not to be lower than IP22.

2.3.1.3 Battery box (cabinet) with Safety Level 2 installed in enclosed spaces outside battery rooms are to have IP rating no lower than IP67.

2.3.1.4 The battery box (cabinet) is to be provided with an independent temperature regulating device, which is to meet the relevant requirements of 2.3.3; or the temperature regulating device in the installation space is to be used for temperature adjustment. When using the temperature regulating device in the place where it is installed, the structure and enclosure protection type of the battery box (cabinet) are to ensure the effectiveness of temperature adjustment.

2.3.1.5 When the battery is installed in the battery box (cabinet) in the form of modules, the battery box (cabinet) is to meet the requirements of 6.4.3.11.

2.3.1.6 When battery brackets are installed, brackets are to be made of steel materials. The bracket is to possess adequate strength and be securely affixed to the hull. Additionally, the impact of the battery's inertial force on the bracket and the hull structure must be taken into consideration..

2.3.1.7 The battery box (cabinet) is to be made of steel the thickness of which is not to be less than 1mm and is to be securely fixed to the hull, and each layer of battery inside the box (cabinet) is to be horizontally divided by steel. Horizontal projected area of any battery box (cabinet)'s minimum division unit is not to exceed $1m^2$, but under the following condition, it is not to exceed $1.5m^2$:

(1) High energy density supercapacitor, or

(2) Vertical height of battery box(cabinet) is not higher than 1m, and are not to be vertically stacked.

2.3.2 ARRANGEMENT

2.3.2.1 For batteries with safety level 2 arranged in battery rooms, battery box(cabinet) are not required under the following situations:

(1) Horizontal projected area of battery room doesn’t exceed $1m^2$, or

(2) Installed on the bracket in the form of a battery pack, and the battery pack meets the requirements of the corresponding safety level battery box (cabinet).

2.3.2.2 For battery box(cabinet) arranged on open deck, necessary maintenance spaces and passages such as installation, commissioning, overhaul and replacement are to be considered.

2.3.2.3 Means of access for the ship crew to easily reach battery boxes(cabinets) on open deck is to be provided. For passenger ships, such access is to be independent from means of escape for passengers.

2.3.2.4 For the battery box (cabinet) arranged on the open deck, there is to be at least a 900mm distance between the side wall and the bulkhead of the passenger space (except that the battery box (cabinet) or the bulkhead of the passenger space meets the requirements of A-60 fire division), and the distance from openings or exits such as doors, windows, vents, etc. of passenger spaces is at least 1.5m.

2.3.2.5 Battery box(cabinet) arranged in enclosed spaces are to meet the requirements of 2.4.2.

2.3.3 COOLING BOX(CABINET)

2.3.3.1 Battery box(cabinet) with a safety level of 1, battery box(cabinet) with a safety level of 2 and a protection rating not lower than IP44, as well as battery box(cabinet) located on open decks, are to be equipped with independent temperature regulation devices.

2.3.3.2 For battery box(cabinet) with a safety level of 2 and a protection rating lower than IP44, the temperature regulation device of the compartment in which they are located may be utilized, provided that such a device complies with the requirements of 2.4.3 of the Rules.

2.3.3.3 When the battery box (cabinet) is equipped with an independent temperature regulating device, mechanical ventilation or other temperature regulating devices are to be used to prevent the temperature in the battery box (cabinet) from being too high.

Ventilation volume q' is not to be less than the value calculated from the equation below:

$$q' = k(nQ + Q_1)/(0.335\Delta t) \text{ m}^3/\text{h}$$

Where: Q ——Heat productivity generated by single battery module in operation itself ,W;

Q_1 ——Heat productivity of other heat sources, W;

n ——Total number of battery modules;

Δt ——Maximum temperature difference between battery box(cabinet) and outside air, °C. The maximum temperature is to be determined based on the highest ambient temperature that may occur in the pure battery-powered ship's navigation waters, but it is not to exceed 45°C;

k ——Surplus constant of fans, to be taken between 1.5~2 when practically chosen.

2.3.3.4 When a liquid cooling method is employed, it is to comply with the relevant requirements specified in Section 6.4.3.4 of the Rules.

2.3.3.5 When other temperature regulating devices (such as air conditioners) are used, the heat of the battery and other heat sources are to be fully considered.

2.3.4 EMERGENCY EXHAUST AND COMBUSTIBLE GAS DETECTION OF BATTERY BOX (CABINET)

2.3.4.1 Battery box(cabinet) with a safety level of 1, battery box(cabinet) with a safety level of 2 and a protection level not lower than IP44, as well as battery box(cabinet) located on open decks, are to be equipped with an independent emergency exhaust system, which is to comply with the requirements of 5.2.4.2 and 5.2.4.3.

2.3.4.2 Battery box(cabinet) with a safety level of 2 and a protection level lower than IP44 may utilize the emergency exhaust system of the compartment where they are located. The emergency exhaust system of the compartment is to meet the requirements specified in Sections 5.2.4.2 and 5.2.4.3 of the Rules.

2.3.4.3 An independent flammable gas detection device is to be installed inside the battery box (cabinet). If the battery pack is already equipped with a flammable gas detector and meets the alarm and safety action requirements of 2.3.4.5 of this Section, a flammable gas detection device in the battery box (cabinet) may not be required.

2.3.4.4 The flammable gas detection device is to be compatible with the flammable gases generated by the battery during thermal runaway. The number and placement of flammable gas detectors are to ensure timely detection of generated flammable gases. When the concentration of flammable gas inside the battery box (cabinet) exceeds 20% of its lower explosive limit (volume fraction), audible and visual alarms are to be activated locally, in the wheelhouse, and in other frequently manned areas of the ship. Simultaneously, the exhaust system is to be automatically activated, and all non-explosion-proof electrical equipment inside the box (cabinet) is to be powered off.

2.3.4.5 The flammable gas detection device is to be powered by both the main power supply and the emergency power supply, with automatic switching between the two. For hybrid-powered ships without an emergency power supply, the device is to be powered by a source other than the service spaces.

2.3.5 TEMPERATURE MONITORING AND ALARM

2.3.5.1 Battery box(cabinet) are to be installed with independent temperature monitoring devices. The number and location of temperature detectors are to take full account of the structure type of the box (cabinet). When the temperature in the battery box (cabinet) is higher than the set value, audible and visual alarms are to be sent out both locally and in spaces where crew are often on duty.

2.3.5.2 When the battery box (cabinet) is installed inside the battery room, and the temperature adjustment in the box (cabinet) is completed by means of the ventilation of the battery room or other temperature adjustment devices, the temperature monitoring and alarm of the battery room required in 2.4.5.1 can be used instead of the temperature monitoring and alarm in the battery box(cabinet) required in 2.3.5.1.

2.3.6 EQUIPMENT

2.3.6.1 Heat source equipment unrelated to batteries are not to be installed inside the battery box (cabinet).

2.3.6.2 Installation of electrical equipment unrelated to batteries inside battery box(cabinet) is to be avoided. If it must be installed, it is to be as far away from batteries as possible, and its calorific value is to be included in the calculation of battery boxes(cabinets)' ventilation volume.

2.3.6.3 Inside the battery box (cabinet), electrical equipment that needs to remain operational during the thermal runaway state of the battery is to be explosion-proof. This includes fire detection equipment, fixed fire-extinguishing agent release pre-alarms, flammable gas detection devices and alarms, emergency exhaust systems, etc. The explosion-proof category and temperature class are to be determined based on the composition of gases generated during thermal runaway of the battery. When the flammable gas alarm is triggered, the non-explosion-proof electrical equipment inside the battery box (cabinet) is to be promptly powered off..

2.3.7 SPECIAL REQUIREMENTS FOR DOMESTIC ELECTRICITY CONSUMPTION

2.3.7.1 This Section applies exclusively to battery boxes/cabinets used for ship service power during port stays, anchoring, or lock waiting periods.

2.3.7.2 Measures are to be taken to prevent simultaneous feeding into the grid by generator sets and battery boxes/cabinets.

2.3.7.3 Technical and arrangement requirements for such battery boxs/cabinets are to comply with battery box/cabinet requirements in the Rules.

Section 4 BATTERY ROOMS

2.4.1 GENERAL REQUIREMENTS

2.4.1.1 The total stored energy of batteries in each dedicated compartment is not to exceed 2000 kWh. For ships of greater than 15 m in length, when propulsion batteries are arranged inside compartments, they are to be set up separately in at least 2 dedicated compartments. The total energy of batteries stored in each dedicated compartment is not to be greater than 2000kWh.

2.4.1.2 The battery system subdivision arrangement requirements for hybrid powered electric ships may not be required to meet the requirements of 2.4.1.1. However, in the case that the ship is of greater than 15m in length, the battery system works independently under a specific operating condition of the ship, and other power sources cannot be immediately put into service in case of failure of the battery system, the batteries are to be subdivided.

2.4.1.3 Water is not to be the first choice for overall fire extinguishing of battery system in battery rooms. If water fire extinguishing system is used, corresponding protective measures are to be taken to prevent secondary disasters caused by water fire extinguishing.

2.4.2 ARRANGEMENT

2.4.2.1 Battery rooms are not to be arranged adjacent to accommodation spaces. If they really need to be arranged adjacently, their shared boundary is to be minimized and the insulation divisions are to comply with the requirements of 5.2.2.

2.4.2.2 The battery room door is not to be opened towards accommodation spaces.

2.4.2.3 When the battery box (cabinet) or battery pack arranged in the battery room is ventilated and dissipated by means of the battery room, there is to be sufficient space between battery box(cabinet) or battery pack inside battery room and the bulkhead and the upper deck to facilitate the ventilation and dissipation of the battery. For ships of 20m and above in length, the net distance from the bulkhead is not to be less than 150mm, and the net distance from the bulkhead strengthening structure is not to be less than 100mm; The net distance from the upper deck is not to be less than 500mm, and the net distance from the upper deck strengthening structure is not to be less than 150mm. For ships less than 20m in length, the net distance from bulkhead and upper deck is not to be less than 150mm, and the net distance from bulkhead and upper deck strengthening structure is not to be less than 100mm. The clear distance of internal bulkheads refers to the distance after deducting onboard equipment, stiffeners, decorative panels, insulation materials, and other obstructions.

2.4.2.4 Battery box(cabinet) and battery pack arranged in the battery room are to be fixed securely and be as far away from ship outboard side as possible to avoid impact of collision. The minimum horizontal distance from the battery box (cabinet) and battery pack to the side shell plate and structure is not to be less than 500mm. For ships less than 20m in length, the minimum horizontal distance to the outer plate and structure of the shell may be reduced to 300mm.

For catamarans, the minimum distance from the battery box (cabinet) or battery pack to the inner side plate and structure of each hull does not need to meet the above requirements.

For ships navigating in waters with grounding risks, such as mountainous rivers or between islands, further protective measures are to be considered based on risk assessment, such as appropriately increasing the distance from the battery box (cabinet) or battery pack to the bottom shell plate, or reinforcing the internal structure of the bottom shell plate.

2.4.2.5 The arrangement of the battery system related equipment arranged in the battery room is to consider the necessary maintenance space and access for installation, commissioning, overhaul, and replacement.

2.4.3 COOLING

2.4.3.1 Battery rooms are to be equipped with mechanical ventilation or other temperature regulating device to prevent the ambient temperature of batteries from being too high.

2.4.3.2 When mechanical ventilation is adopted, the ventilation system is to meet the requirements of 5.2.4.1. in addition to the normal ventilation of the battery rooms, the mechanical ventilation calculation of the heat exchange of the battery is to be carried out according to the method provided by the manufacturer. If the calculation method is not provided by the manufacturer, the ventilation is to be calculated according to the following method.

Ventilation volume q' is not to be less than the value calculated from the equation below:

$$q' = k(nQ + Q_1)/(0.335\Delta t) \ \text{m}^3/\text{h}$$

Where： Q ——Heat productivity generated by single battery module in operation itself ,W；

Q_1 ——Heat productivity of other heat sources, W；

n ——Total number of battery modules;

Δt ——Maximum temperature difference between battery rooms and outside air, ℃；

k ——Surplus constant of fans, to be taken between 1.5~2 when practically chosen.

2.4.3.3 When other temperature regulating devices (such as air conditioners) are used, the heat of the battery and other heat sources is to be fully considered.

2.4.4 EMERGENCY EXHAUST AND FLAMMABLE GAS DETECTION

2.4.4.1 Each battery room housing batteries with a safety level of 2 is to be equipped with an independent emergency exhaust system to promptly discharge flammable gases generated in the event of thermal runaway of the batteries. The emergency exhaust system is to comply with the requirements of Sections 5.2.4.2 and 5.2.4.3 of the Rules. If the battery box or cabinet is already equipped with an emergency exhaust system that meets the requirements of Section 2.3.4.1, this requirement may be waived.

2.4.4.2 Battery rooms with batteries of safety level 2 inside are to be provided with independent flammable gas detection devices. Such devices are to be compatible with the composition of flammable gases generated during the thermal runaway state of the battery. When the concentration of flammable gas in the battery rooms is detected to be more than 20% of its lower explosion limit (volume fraction), audible and visual alarms are to be activated in local, navigation bridge and other spaces on the ship where crew are often on duty, and the emergency exhaust system is to be activated automatically, and all non-explosion-proof electrical equipment in the battery room is to be promptly powered off.

2.4.4.3 The flammable gas detection device is to meet the requirements of 2.3.4.5.

2.4.5 TEMPERATURE MONITORING AND ALARM

2.4.5.1 Battery rooms are to be installed with independent temperature monitoring devices. The number and location of temperature detectors are to take full account of the type of locations. When the temperature in the battery room is higher than the set value, audible and visual alarms are to be sent out locally and in places where crew are often on duty.

2.4.6 FIRE DETECTION AND ALARM

2.4.6.1 The setting of battery room fire detection and alarm is to meet the requirements of 5.2.5.

2.4.7 EQUIPMENT

2.4.7.1 Heat source equipment unrelated to the battery and facilities and pipelines(steam, liquids, etc) such as other boxes/cabinets containing steam, liquids, is not to be installed in the battery room. When pressure pipelines for steam, liquids, etc., must pass through the battery room, the use of non-welded joint types such as flanges or mechanical joints is to be prohibited within the battery room, or reliable protective measures are to be taken.

2.4.7.2 Installation of electrical equipment unrelated to the battery system in the battery room is to be avoided. If it must be installed, it is to be as far away from the batteries as possible, and its calorific value is to be included in the calculation of the ventilation volume of battery room.

2.4.7.3 In the battery rooms, the electrical equipment that needs to be maintained in the state of thermal runaway of the battery is to be explosion-proof, such as fire detection equipment, fixed fire extinguishing agent release pre-alarm, flammable gas detection device and alarm, emergency exhaust system, etc. The specific explosion-proof requirements (explosion-proof type, explosion-proof category, temperature group) are to be determined according to the composition of the gas generated by the thermal runaway of different types of batteries, and can cut off the non-explosion-proof electrical equipment in the battery room in a timely manner.

2.4.7.4 The battery room is to be equipped with drainage measures to prevent clogging. Full consideration is to be given to the discharge of large amounts of water generated in the event of a battery fire, without affecting the ship's stability. When the battery room is located above the bulkhead deck, scuppers are to be provided to ensure that such water can be rapidly and directly discharged overboard. When the battery room is located below the bulkhead deck, the location and type of the drainage system suction are to ensure not only the timely removal of accumulated water but also a discharge capacity of at least 125% of the fire hose capacity. The arrangement of the battery room drainage pipelines is to prevent flammable gases from directly entering other battery rooms or any other types of compartments through these pipelines.

CHAPTER 3 MONITORING, ALARMING CONTROL AND SAFETY SYSTEMS

Section 1 SHIP MANAGEMENT SYETEM

3.1.1 GENERAL REQUIREMENTS

3.1.1.1 The ship is to be provided with a ship management system for monitoring, alarming and control of the ship's power system. The ship management system is to be arranged in the area on ship where the crew is on duty.

3.1.1.2 The ship management system is to be supplied by two power sources: the main power supply and the emergency power supply, and the two power sources are to be capable of automatic switching, and are to be equipped with short-circuit and overload protection. In the event of a power failure in these systems, visual and audible alarms are to be activated both locally and in the locations where personnel are regularly on duty.

3.1.1.3 For battery-powered ships with total stored energy of greater than 100 kWh, the Power Management System (PMS) or Energy Management System (EMS) of the power station is to be set as the ship management system.

3.1.1.4 For battery-powered ships with total stored energy of less than or equal to 100kWh, Alarming and Monitoring System (AMS) is to be set as the ship management system.

3.1.1.5 The ship management system is to have the function of data storage, and the archive period of monitoring data is not to be less than the annual survey period and not to be less than 18 months..

3.1.1.6 To prevent a total ship power loss due to a single failure in the ship management system, critical components of the ship management system, including its power supply, communication, and control function components, are to be designed with redundancy or equivalent measures.

3.1.2 POWER/ENERGY MANAGEMENT SYSTEM

3.1.2.1 The PMS or EMS of the ship's power station is to be able to collect and display important parameters of the battery system and the ship's power distribution system, including but not limited to the following:

(1) The charging and discharging state of each battery system;

(2) The state of charge (SOC) of each battery system;

(3) The charging and discharging power of each battery system;

(4) The total voltage and total current of each battery system;

(5) The state of the breakers and busbar (isolation) switch, such as battery assembly, propulsion system, daily load power converter;

(6) Distribution board busbar voltage;

(7) If AMS is provided, for all fault information of battery system, power distribution system and propulsion system, only serious fault information needs to be displayed;

(8) The battery system can provide real-time information on how long or how far the pure battery-powered ship will remain underway with its remaining power.

3.1.2.2 PMS or EMS is to be able to control and deploy all power stations and energy storage systems of the ship, and provide sufficient power for the ship's electrical equipment under the ship's navigation, operation, berthing and other conditions to ensure the ship's safe navigation and normal operation.

3.1.2.3 The power station PMS or EMS is to include monitoring, alarming and protection functions for the battery system and the ship's power distribution system, and provide complete visualization functions for power/energy management.

3.1.2.4 PMS or EMS is to have but not limited to the following functions:

(1) DC busbar precharge (if applicable)

(2) Switching on/off of the battery system;

(3) Automatic grid connection and load distribution of battery system;

(4) Overload request (if applicable);

(5) Automatically removes non-important loads or reduce the propulsion load to prevent battery from overloading;

(6) Sequence start of important equipment (if applicable);

(7) Monitoring, alarming and protection of battery systems, power distribution systems and propulsion systems;

(8) Able to transfer data to BMS.

3.1.2.5 The design of the PMS or EMS is to ensure that when the system fails, the wrong command signal will not be issued.

3.1.3 ALARMING AND MONITORING SYSTEM

3.1.3.1 The AMS is to be able to monitor and give alarm for the battery power system, and is to be arranged in the area on ship where the crew is on duty.

3.1.3.2 AMS is to be able to communicate with BMS, and to be able to accept and process battery system information collected and summarized by BMS.

3.1.3.3 The AMS is to be able to display all fault information of the battery system, power distribution system and propulsion system, and to give audible and visual alarms in the event of a fault.

Section 2 SHORE-BASED CHARGING EQUIPMENT

3.2.1 GENERAL REQUIREMENTS

3.2.1.1 The shore-based system of battery-powered ships mainly includes AC shore power source or DC charging device.

3.2.1.2 The monitoring, alarm and control of AC shore power supply are to meet the requirements of relevant CCS rules.

3.2.1.3 The monitoring, alarm and control of the DC shore-based charging device are to meet the relevant requirements of Section 7, Chapter 6 of the Rules.

Section 3 ONLINE DATA TRANSMISSION

3.3.1 GENERAL REQUIREMENTS

3.3.1.1 The online data transmission between the ship and the battery-powered ship survey and verification platform may adopt the following methods:

(1) Collecting data through the shipborne data terminal, then sending it to the shore-based monitoring platform, and then sending it to the battery-powered ship survey and verification platform through the shore-based monitoring platform; or

(2) Collecting data through the shipborne data terminal, then sending it directly to the battery-powered ship survey and verification platform.

3.3.1.2 Online data is to generally include monitoring data such as battery system data, power distribution system data, propulsion system data, and environmental alarm data(fire, flammable gas, temperature) of battery rooms/box(cabinet) , among which the monitoring data of ships with a ship length not more than 20m may only include battery system data.

3.3.1.3 The archive period of shore-based monitoring data is not to be less than the expected service life of the ship.The archiving period of monitoring data from shipborne data terminals shall be no less than 18 months

3.3.2 SHIPBORNE DATA TERMINAL

3.3.2.1 The shipborne data terminal is to be capable of collecting monitoring data, and transmitting it to the shore-based monitoring platform or the battery-powered ship survey and verification platform after aggregating and processing the data.

3.3.2.2 The shipborne data terminal is generally to be an independent device, or may be integrated with other equipment. It is to be supplied by two power sources: the main power supply and the emergency power supply, and the two power sources are to be capable of automatic switching.

3.3.2.3 The shipborne data terminal is to be equipped with a time synchronization function, adopting the IRIG-B(DC) code as the standard time signal for time synchronization, or having the NTP network time synchronization function, and the time error is to be within ±5 seconds.

3.3.2.4 The shipborne data terminal is to be protected against illegal remote control and data tampering, and is to adopt encrypted transmission when transmitting data to the shore-based monitoring platform.

3.3.2.5 Activities such as data collection, storage, and transmission of the shipborne data terminal are to ensure data integrity, consistency, and timeliness.

3.3.2.6 When the shipborne data terminal transmits data to the battery-powered ship survey and verification platform, it is to comply with the provisions of Appendix 1, and is to be capable of sending monitoring data of any time period. When transmitting data to the shore-based monitoring platform, it is to include the dynamic data content required by Appendix 1 of the Rules, or such dynamic data content is to be calculable based on the transmitted data.

3.3.2.7 When an emergency alarm occurs on the ship, such as power reduction, power system shutdown, override, etc., all monitoring data during the alarm period and within 30 seconds after the alarm ends is to be transmitted. The data transmission interval is not to exceed 1 second, and the monitoring data within 30 seconds before the alarm is also to be supplemented and transmitted. Sampled data that has already been transmitted need not be retransmitted.

3.3.2.8 When there is an abnormality in the communication link for reporting data, the shipborne data terminal is to be able to cache the data that needs to be sent and resend it after the data communication link is restored. The storage capacity of the shipborne data terminal is to be able to cache at least one month's worth of data. If communication conditions are poor and the ship is sailing offshore for a long time, its storage capacity is to be appropriately increased depending on the situation.

3.3.2.9 When the shipborne data terminal malfunctions, if other shipboard systems such as the ship management system retain historical monitoring data, the shipborne data terminal is to transmit the historical monitoring data during the malfunction period to the shore-based monitoring platform or the battery-powered ship survey and verification platform to the greatest practical extent after the malfunction is resolved.

3.3.3 SHORE BASED MONITORING PLATFORM

3.3.3.1 The shore-based monitoring platform is to be capable of receiving and storing monitoring data from the shipborne data terminal, and transmitting it to the battery-powered ship survey and verification platform after processing.

3.3.3.2 The shore-based monitoring platform is to be located at battery enterprises, system integrators, ship management companies, or third-party institutions. After the external power supply is cut off, the shore-based monitoring platform is still to be capable of operating independently for at least 30 minutes. When the shore-based monitoring platform stops working due to power outage, it is to completely retain the data stored before the power outage without loss.

3.3.3.3 The shore-based monitoring platform is to be equipped with a time synchronization function, adopting the IRIG-B(DC) code as the standard time signal for time synchronization, or having the NTP network time synchronization function, and the time error is to be within ±5 seconds.

3.3.3.4 The shore-based monitoring platform is to be protected against illegal remote control and data tampering, and is to adopt encrypted transmission when transmitting data to the battery-powered ship survey and verification platform.

3.3.3.5 Activities such as data reception, storage, processing, and transmission of the shore-based monitoring platform are to ensure data integrity, consistency, and timeliness.

3.3.3.6 When the shore-based monitoring platform transmits data to the battery-powered ship survey and verification platform, it is to comply with the provisions of Appendix 1 and is to be capable of sending monitoring data of any time period. The shore-based monitoring platform is to be approved by CCS.

3.3.3.7 When an emergency alarm occurs on the ship, such as power reduction, power system shutdown, override, etc., all monitoring data during the alarm period and within 30 seconds after the alarm ends is to be transmitted. The data transmission interval is not to exceed 1 second, and the monitoring data within 30 seconds before the alarm is also to be supplemented and transmitted. Sampled data that has already been transmitted need not be retransmitted.

3.3.3.8 When an abnormality occurs in the communication link for data transmission, the shore-based monitoring platform is to be capable of caching the data to be sent and supplementing and transmitting it after the data communication link is restored. The storage capacity of the shore-based monitoring platform is to be capable of caching data for at least 7 days, and is to meet the data requirements not less than the expected service life of the ship.

3.3.3.9 When a malfunction occurs in the data transmission function of the shore-based platform, it is to transmit the historical monitoring data during the malfunction period to the battery-powered ship survey and verification platform to the greatest practical extent after the malfunction is resolved.

CHAPTER 4 BATTERY POWER DISTRIBUTION SYSTEMS

Section 1 GENERAL PROVISIONS

4.1.1 GENERAL REQUIREMENTS

4.1.1.1 In addition to the Rules, the power distribution system is also to comply with the relevant requirements for the ship's power distribution system of relevant CCS rules.

4.1.1.2 The power distribution system is to be so designed and arranged that the safety and reliability of a pure battery-powered ship is not to be lower than that of a traditional ship.

4.1.1.3 In the event of fault condition, the power distribution system and equipment of the ship are to be properly protected to minimize the occurrence of the following conditions:

(1) The device itself is damaged;

(2) Other equipment connected to the equipment is damaged;

(3) The crew and passengers are injured.

4.1.1.4 The voltage and frequency fluctuations of the power distribution system are to comply with the requirements of CCS rules. If a higher level of fluctuation is intended, documentation from the manufacturer is to be submitted indicating all of the equipment involved in the system are designed for being able to operate at a higher level of voltage and frequency fluctuation for a long time without any fault. This may be specially considered by CCS upon agreement by all the concerned parties.

4.1.1.5 Where fuses are used in the system, spare parts are to be stored on board, and appropriate labeling is to be provided detailing the type of replacement fuses to be fitted.

4.1.1.6 The power distribution systems are to be equipped with temperature regulation devices. Heat exchange capacity is to be calculated based on distribution system requirements. For liquid cooling systems, the following are to be satisfied:

(1) At least two cooling pumps with sufficient capacity are to be provided. Each pump's capacity is to satisfy cooling requirements. Pumps are to be mutually backup, arranged to ensure maintenance on one pump doesn't affect the other.

(2) Both pumps are to be powered from separate busbar sections.

(3) Pressure monitoring alarms are to be installed at pump outlets. Low pressure is to trigger visual/audible alarms locally and at manned stations.

(4) Closed systems require ≥ two coolant tanks. Each tank's capacity is to support normal operation, arranged to allow maintenance without affecting others. Tanks are to have filling/overflow/air pipes, drain valves, and level gauges. Double-bottom tanks may omit overflow pipes/drain valves. Level monitoring alarms are to trigger visual/audible alerts locally and at manned stations during low levels.

(5) For the open cooling system, the cooling liquid is to be able to be drawn from both sides of the ship. Filters are to be installed between the cooling pumps and sea water tanks of the open cooling system. For the closed cooling system, if equipped with filters, the structure or

arrangement of the filters is to ensure that the normal operation of the cooling system is not affected when cleaning the filters. The filters are to be equipped with differential pressure monitoring and alarm devices, which are to trigger visual and audible alarms locally and at permanently manned locations when the differential pressure exceeds the limit.

(6) Shared cooling systems are to support simultaneous operation of all systems. Shared components/pipings are to be minimized. Failure in one system is not to affect others.

(7) Protective measures are to be taken to prevent coolant leakage/condensation damage to electrical equipment.

(8) When fully implementing partitioned power supply, each system may have one independent cooling system. Such systems may use single pump/tank but are to comply with (1)-(7) otherwise.

Section 2 DC POWER DISTRIBUTION SYSTEMS

4.2.1 GENERAL REQUIREMENTS

4.2.1.1 The safety and reliability of a pure battery-powered ship with DC bus system is to be at the same level as a conventional ship.

4.2.1.2 The DC distribution system is to comply with the requirements specified in the CCS Guidelines for the Survey of Shipboard DC Integrated Power Systems..

Section 3 AC POWER DISTRIBUTION SYSTEMS

4.3.1 GENERAL REQUIREMENTS

4.3.1.1 When an AC distribution system is installed on a ship, in addition to meeting the requirements of this Section, it is also to comply with the relevant requirements of the CCS rules for ships navigating in the corresponding waters and the Guidelines for the Survey of Shipboard DC Integrated Power Systems as applicable based on the ship's navigation area.

4.3.1.2 The AC distribution system is to be equipped with at least two power inverters. When any one inverter stops working, the remaining inverters are still to be able to:

(1) Continue to supply power to the equipment necessary for the normal navigation of the ship, ship safety, and refrigerated cargo. At the same time, the minimum comfortable living conditions are to be ensured, which are to at least include the power supply for appropriate cooking, heating, food freezing, mechanical ventilation, sanitation, and freshwater equipment.

(2) Ensure that the voltage drop in the AC distribution system caused by the starting of the largest motor does not cause any motor to stall or any other equipment to fail.

4.3.1.3 The main busbar of the AC distribution board is to be divided into at least two independent sections. Power inverters and other duplicated equipment are to be connected to these sections as evenly as possible. The sections are to adopt one of the following methods:

(1) During normal navigation conditions, the sections are not connected and supply power to their respective loads separately. The power supply side circuit breakers and load side circuit breakers are to meet the requirements of complete selective protection.

(2) The sections are connected by circuit breakers with protective devices. The power supply

side circuit breakers, section connection circuit breakers, and load side circuit breakers are to meet requirements of complete selective protection. Additionally, the power supply continuity of the distribution system is to meet the following requirements:

① In normal operation conditions where more than one inverter is connected in parallel, protective measures, including automatic shedding of non-essential equipment, are to be provided to ensure that when any inverter in operation stops working, the remaining inverters can continue to operate and maintain power supply to the steering gear and equipment essential for ship safety.

② Under normal operating conditions where one inverter supplies power, measures are to be provided to automatically start the standby inverter and connect it to the main distribution board in the event of a power loss. The inverter is to have sufficient capacity to ensure the automatic start or sequential start of essential auxiliary equipment.

4.3.1.4 When the main propulsion system and its control system, the steering gear and its control system, and the cooling systems serving the propulsion system/power distribution system/battery system are all powered by the DC main busbar, and the equipment is evenly connected to at least two independent DC sections through converters, and the switching of standby devices does not affect the normal navigation of the ship, the AC distribution system does not need to meet the requirements of 4.3.1.3 and may adopt a centralized power supply mode.

CHAPTER 5 FIRE PROTECTION

Section 1 GENERAL PROVISIONS

5.1.1 GENERAL REQUIREMENTS

5.1.1.1 In addition to complying with the requirements of this Chapter, the ship's fire protection is also to comply with relevant CCS rules and the requirements of the Administration.

5.1.1.2 Except for the fixed fire-extinguishing systems required by 5.3.2.2 and 5.3.2.5, the fire-fighting systems and equipment required by this Chapter are to comply with the International Code for Fire Safety Systems (FSS Code) or the requirements of the Administration.

5.1.1.3 Where a fire safety design and arrangement different from the requirements of this Chapter is adopted, the provisions and procedures for alternative fire safety design in the CCS 《Guidelines for Application of Alternative Design and Arrangements for Ships》 are to be applied, and are to be demonstrated by tests or other means that such design and arrangement provide a safety level and functional performance equivalent to, or higher than, those required by this Chapter.

Section 2 FIRE PREVENTION AND FIRE DETECTION

5.2.1 STRUCTURAL MATERIALS

5.2.1.1 The battery room is to be constructed of steel or other equivalent materials.

5.2.1.2 For fiber-reinforced plastic ships, the structural materials are to comply with the relevant requirements in 5.5.2.1.

5.2.2 THERMAL AND STRUCTURAL SUBDIVISION

5.2.2.1 The bulkheads and decks between the battery room and adjacent spaces are to be of A-60 class divisions. However, where adjacent to spaces with little or no fire risk, such as void spaces, sanitary spaces and similar spaces, or open spaces (excluding cargo spaces and ro-ro spaces), such divisions may be of A-0 class.

5.2.2.2 For passenger ships of 20 m in length and above, the bulkheads and decks between the battery room and the external escape route are to be of A-60 class divisions. For passenger ships of less than 20 m in length, such bulkheads and decks are to be of A-0 class divisions.

5.2.2.3 The battery room is to be segregated from fuel oil or lubricating oil tanks, and no common boundary is to be provided between them. Where a fuel tank containing fuel with a flashpoint of less than 60°C is segregated from the battery room by a cofferdam, the distance between them is to be at least 900 mm.

5.2.2.4 The fire integrity of doors to the battery room is to be at least equal to that of the bulkheads in which they are fitted.

5.2.2.5 5.2.2.1 and 5.2.2.2 are not applicable to fiber reinforced plastic ships.

5.2.3 OPENING RESTRICTIONS

5.2.3.1 No windows or sidescuttles are to be fitted in the boundaries of the battery room.

5.2.3.2 No openings other than doors and ventilation openings are to be provided for the battery room. Where manhole covers or hatch covers are required for the maintenance of equipment inside the room, bolted manhole covers or hatch covers fitted with locking devices are to be used.

5.2.4 VENTILATION/EXHAUST SYSTEM

5.2.4.1 The mechanical ventilation system provided for the battery room is to comply with the following requirements:

(1) Ventilation ducts are to be constructed of steel or other equivalent materials;

(2) The arrangement of the ventilation system is to ensure effective ventilation of all parts of the battery room;

(3) The ventilation system of each battery room is to be independent and completely separated from the ventilation systems of other spaces;

(4) Ventilation ducts of the battery room are not to pass through accommodation spaces, service spaces, control stations, machinery spaces, ro-ro spaces, vehicle spaces, special category spaces or other battery rooms. However, where the requirements of 5.2.4.1(6) are complied with, the ventilation ducts of the battery room may pass through accommodation spaces, service spaces (excluding galleys), control stations, machinery spaces or other battery rooms;

(5) Ventilation ducts serving accommodation spaces, service spaces, control stations, machinery spaces, ro-ro spaces, vehicle spaces or special category spaces are not to pass through the battery room. However, where the requirements of 5.2.4.1(6) are complied with, ventilation ducts serving accommodation spaces, service spaces (excluding galleys), control stations or machinery spaces may pass through the battery room;

(6) The ducts permitted in (4) and (5) above are to meet the following requirements:

① be of steel. Where their width or diameter is 300 mm or less, the thickness of the steel is to be at least 3 mm; where their width or diameter is 760 mm or more, the thickness is to be at least 5 mm; and where their width or diameter is between 300 mm and 760 mm, the thickness is to be determined by linear interpolation;

② have suitable supports and stiffening;

③ be fitted with automatic fire dampers in positions close to the boundaries they penetrate; and

④ be insulated to the A-60 class standard from the boundary of the space they serve to a distance of at least 5 m beyond each fire damper;

Or meet the following requirements:

⑤ be of steel. Where their width or diameter is 300 mm or less, the thickness of the steel is to be at least 3 mm; where their width or diameter is 760 mm or more, the thickness is to be at least 5 mm; and where their width or diameter is between 300 mm and 760 mm, the thickness is to be determined by linear interpolation;

⑥ have suitable supports and stiffening;

⑦ be insulated to the A-60 class standard throughout all the spaces they pass through, except where they pass through void spaces, sanitary spaces and similar spaces presenting little or no fire risk.

(7) Ventilation openings are to be arranged with suitable means to prevent the ingress of water and flames, and air inlets are to be located well away from air outlets;

(8) The wheelhouse is to be provided with a device indicating any loss of the required ventilation capacity and giving an alarm. This may be achieved by one or a combination of the following means:

① Fan speed;

② Current of the driving electric motor;

③ air velocity at the fan outlet;

④ air pressure at the fan outlet.

(9) At least two control devices capable of stopping the fans are to be provided, one of which is to be located outside the space served, in a position that is readily accessible and not rendered inaccessible by a fire in the space served.

(10) All ventilation openings are to be capable of being closed from outside the space in the event of a fire in that space.

5.2.4.2 The emergency exhaust system is to meet the following requirements:

(1) The emergency exhaust system is to be interlocked with the combustible gas detection system. When the concentration of combustible gas detected in the battery room, battery box (cabinet), or in the space containing the batteries of a containerized power supply exceeds 20% of its lower explosive limit (by volume), the emergency exhaust system is to be automatically activated.

(2) Gas discharged from the fans are to be led to a safe location on the open deck, away from spaces used for habitation or containing sources of heat. The distance between the emergency exhaust outlet and any openings or air inlets of other spaces is to be at least 3 m. However, where effective measures are provided to ensure that combustible gases generated during battery thermal runaway cannot enter such spaces through their exhaust openings, the distance between the emergency exhaust outlet and those exhaust openings need not meet the 3 m requirement, but is not to be less than 1.5 m. For ships of less than 20 m in length, the distance between the emergency exhaust outlet and openings or air inlets of other spaces is to be at least 1.5 m.

(3) The capacity of the emergency exhaust system is to be calculated on the basis of not less than 30 air changes per hour for the space or box (cabinet) concerned. Emergency exhaust fans are to be of a non-sparking type.

(4) Emergency exhaust ducts are to be constructed of steel or other equivalent materials, and the details of their penetrations are to comply with the relevant requirements for ventilation systems given in 5.2.4.1.

(5) Two control devices capable of stopping the fans are to be provided. One is to be located outside the space served, in a position that is readily accessible and not rendered inaccessible by a fire in the space served, and the other is to be located in the wheelhouse or in a continuously manned space. These control devices are to be of a self-latching type, so that the emergency exhaust system can only be automatically restarted after manual reset.

(6) The emergency exhaust system is to be supplied by two power sources. One of them may be an emergency source or a power supply located outside the area served, and automatic transfer between the two power sources is to be provided.

(7) All exhaust outlets are to be capable of being closed from outside the space in the event of a fire in that space.

(8) Where the emergency exhaust system of the battery room is combined with the ventilation system referred to in 5.2.4.1, that ventilation system is also to comply with the requirements of this paragraph.

(9) The arrangement of the emergency exhaust piping is to prevent combustible gases from directly entering other battery rooms or any other spaces through these pipes.

5.2.4.3 No electrical equipment is to be installed within 3 m of the emergency exhaust outlet. For ships of less than 20 m in length, this distance may be reduced to 1.5 m. Where such installation is unavoidable, certified explosion-proof electrical equipment is to be used, or non-explosion-proof electrical equipment may be used provided that its power supply can be cut off, in the event of battery thermal runaway, from a location outside the battery room, battery box (cabinet) or the space containing the batteries of the containerized power supply, as well as from the wheelhouse

5.2.5 FIRE DETECTION AND ALARM

5.2.5.1 A fixed fire detection and fire alarm system is to be installed in the battery room and in battery boxes (cabinets) located on the open deck. For battery boxes (cabinets) on the open deck, where the battery pack is provided with a thermal runaway / fire detection and alarm device as specified in 5.3.3, a fixed fire detection and fire alarm system need not be installed inside the battery box (cabinet).

5.2.5.2 The design of the fixed fire detection and fire alarm system, and the installation of detectors, are to ensure that signs of fire can be rapidly detected at the incipient stage of a fire at any location within the battery room, under variations in ventilation within the range of normal operating conditions and ambient temperatures of the batteries. Smoke detectors or combined smoke and heat detectors are to be provided. Fire detectors are to be suitable for explosive gas atmospheres formed by combustible gases released during battery thermal runaway when mixed with air.

5.2.5.3 The fixed fire detection and fire alarm system in the battery room is to be capable of remotely identifying each detector individually. Where the system is not capable of identifying individual detectors, each detector is to be arranged on a separate branch circuit.

5.2.5.4 The fixed fire detection and fire alarm system is to be supplied by both the main source of electrical power and the emergency source of electrical power, with automatic change-over between the two sources. For hybrid-powered ships where no emergency source of electrical power is provided, the system is to be supplied from a power source located outside the space it serves.

Section 3 FIRE EXTINGUISHMENT

5.3.1 GENERAL REQUIREMENTS

5.3.1.1 For ships required to be provided with at least two fire hose jets, the number and arrangement of fire hydrants are to be such that at least two jets of water, not emanating from the same hydrant, can reach any part of the battery room or any battery box (cabinet) on the open deck, one of which is to be capable of being supplied through a single length of fire hose. For ships required to be provided with only one fire hose jet, the number and arrangement of fire hydrants are to be such that one jet of water can reach any part of the battery room or any battery box (cabinet) on the open deck. The nozzles within the above protection range are to be of the dual-purpose type for jet and spray. Arrangements are to be made to ensure that the fire pumps remain in normal operation in the event of a fire in any battery room or battery box (cabinet). Fire hydrants are to be located in suitable positions on board so that a fire in a battery room or battery box (cabinet) does not prevent the crew from gaining access to them. Due consideration is to be given to the drainage of the large quantities of water that may be used in fighting a battery fire so as to avoid any adverse effect on the ship's stability.

5.3.1.2 Ships not provided with a water fire-extinguishing system are to be provided with at least two fire buckets fitted with ropes of adequate length in the vicinity of the battery room or of the battery boxes (cabinets) on the open deck, except where such fire buckets are already provided on board.

5.3.2 FIXED FIRE EXTINGUISHING SYSTEM FOR BATTERY ROOMS

5.3.2.1 Except for spaces containing high energy density supercapacitors, battery rooms with the deck area of not less than 4 m² are to be protected by one of the following fixed fire-extinguishing systems:

(1) A heptafluoropropane fire-extinguishing system①, with a design concentration of not less than 9%. The system is also to be provided with a reserve supply of extinguishing agent, cylinders and associated piping components equal in quantity to those required for the main supply, so as to be available at all times. The main and reserve supplies are to be capable of being discharged separately, and the release controls for the reserve supply are to meet the same requirements as those for the main supply. Where the battery pack is provided with the fire prevention and control devices specified in 5.3.3 of this Section, a reserve supply of extinguishing agent need not be provided;

(2) A carbon dioxide fire-extinguishing system, with the quantity of extinguishing agent designed for at least 40% of the gross volume of the protected space. The system is also to be provided with a reserve supply of extinguishing agent, cylinders and associated piping components equal in quantity to those required for the main supply, so as to be available at all times. The main and reserve supplies are to be capable of being discharged separately, and the release controls for the reserve supply are to meet the same requirements as those for the main supply. Where the battery pack is provided with the fire prevention and control devices specified in 5.3.3 of this Section, a reserve supply of extinguishing agent need not be provided.

5.3.2.2 Battery rooms with the deck area of less than 4 m² are to be protected by a fixed fire-extinguishing system. This system is to comply with the following requirements:

(1) Components of the fixed fire-extinguishing system are to be securely fastened to the ship's structure so as to withstand motions, shocks and vibrations under normal operating conditions. Cylinders, pipings and valves are to be arranged together in a dedicated cabinet. The cabinet is to be located in an open position above the freeboard deck, and its door is to be capable of being readily opened. Adequate lighting is to be provided inside or in the vicinity of the cabinet, and, in addition to the main lighting, emergency lighting is also to be provided;

①Refer to IMO's Revised Guidelines for the Approval of Equivalent Fixed Gas Fire Extinguishing Systems for Machinery Spaces and Cargo Pump Tanks (MSC/CIRC.848 circular) and its amendments or Section 8, Chapter 3, Part 5 of the Technical Rules for the Statutory Survey of Inland Ships (2019).

(2) The releasing device is to be clearly visible, or its location is to be clearly marked, and the space it protects is to be indicated. The releasing device is to be so arranged that it can be operated from a position readily accessible in the event of a fire in the protected space. Operating instructions for the system are to be posted in the vicinity of the releasing device;

(3) The type and quantity of extinguishing agent are to comply with the requirements of 5.3.2.1, but the main and reserve quantities of extinguishing agent may be stored in the same cylinder. Where the battery pack is provided with the devices specified in 5.3.3, a reserve quantity of extinguishing agent need not be provided.

5.3.2.3 Spaces containing high energy density supercapacitors are to be protected by a fixed carbon dioxide fire-extinguishing system or a heptafluoropropane fire-extinguishing system. The quantity of extinguishing agent required is to be calculated for at least 40% of the gross volume of the protected space, or on the basis of a design concentration of not less than 9%, respectively.

5.3.2.4 Battery rooms accessible to personnel are to be provided with visual and audible pre-discharge alarms for the release of extinguishing agent. The pre-discharge alarm is to be automatically activated, for example by opening the door of the release cabinet. The duration of the pre-discharge alarm is to be at least equal to the time required for personnel to evacuate the battery room and, in any case, not less than 20 s before the extinguishing agent is released.

5.3.2.5 Battery boxes (cabinets) arranged on the open deck or in other spaces are to be provided with a fixed fire-extinguishing system complying with the requirements of 5.3.2.2. Where the battery pack is provided with the fire prevention and control devices specified in 5.3.3 of this Section, such fixed fire-extinguishing system for the battery box (cabinet) need not be provided.

5.3.3 FIRE PREVENTION AND CONTROL DEVICE FOR BATTERY PACK

5.3.3.1 Where battery packs are provided with fire prevention and control devices, such devices are to be capable of detecting signs of hazardous conditions that may lead to fire, giving an alarm, and automatically and/or manually initiating the discharge of the extinguishing medium. The design, manufacture and testing of such devices are to comply with the relevant requirements of recognized international or national standards. For lithium iron phosphate batteries, the requirements of CCS E26 《Fire Prevention and Control Device for Lithium Iron Phosphate Battery Packs》 are to be complied with.

5.3.3.2 Fire prevention and control devices for battery packs are to meet at least the following requirements:

（1）They are to be compatible with the chemical characteristics of the batteries used;

（2）They are to divide the battery packs into different zones for control, and the number of battery packs protected in each zone is not to exceed the number of battery packs in one battery string;

5.3.3.3 （3）Where manual release is used, operation is to be possible from a location outside the protected space that is readily accessible to personnel, and measures are to be provided to prevent inadvertent operation.

5.3.4 PORTABLE FIRE EXTINGUISHER

5.3.4.1 Battery rooms with the deck area of not less than 4 m² are to be provided with at least four portable gas fire extinguishers (e.g. heptafluoropropane, carbon dioxide), each having a capacity of not less than 5 kg. One of these extinguishers is to be located in the vicinity outside the entrance to the space. For battery rooms with a deck area of less than 4 m², at least two portable gas fire extinguishers (e.g. heptafluoropropane, carbon dioxide), each having a capacity of not less than 5 kg, are to be provided in positions outside the space that are readily accessible.

5.3.4.2 For battery boxes (cabinets) arranged on the open deck or in other spaces, at least two portable gas fire extinguishers (e.g. heptafluoropropane, carbon dioxide), each having a capacity of not less than 5 kg, are to be provided in their vicinity.

Section 4 MEANS OF ESCAPE

5.4.1 ENTRANCE/EXIT AND MEANS OF ACCESS

5.4.1.1 Doors of the battery room are to lead directly to the open deck. For seagoing ships, where direct access to the open deck is not practicable, self-closing doors are to be used. All doors of the battery room are to open outwards and be kept closed, and an alarm is to be given at a continuously manned position when a door is open.

5.4.1.2 For battery rooms accessible to personnel, the arrangement of means of escape is to comply with the relevant requirements of the administration for means of escape from machinery spaces other than category A (for seagoing ships) or from other machinery spaces (for inland ships).

5.4.1.3 For battery rooms accessible to personnel, where stairways are used as means of escape, they are to be of steel construction and their inclination is not to exceed 60°. The clear width of the entrance and the stairway is to be at least 600 mm. The underside of such inclined stairs/stairways is to be equipped with steel protective plates to shield escapees from high temperatures and flames from below. For battery rooms of 2m or less in height, vertical ladders[①] could be used.

Section 5 SPECIAL REQUIREMENTS FOR FIBER REINFORCED PLASTIC SHIPS

5.5.1 GENERAL REQUIREMENTS

5.5.1.1 Unless otherwise expressly specified by the flag state administration, fiber-reinforced plastic ships using lithium iron phosphate batteries are to comply with Sections 1 to 4 of this Chapter (except 5.2.1.1, 5.2.2.1 and 5.2.2.2) and with the requirements of this Section

5.5.2 STRUCTURAL MATERIALS

5.5.2.1 The hull, superstructure, structural bulkheads, decks, deckhouses and columns are to be constructed of incombustible or fire-retardant materials with adequate structural performance. Fire-retardant materials are to be determined by tests in accordance with Part 10 of Appendix 1 of the International Code for Application of Fire Test Procedures (FTP Code). This regulation does

①Vertical ladders are to meet relevant national or industrial standards, such as Steel Vertical Ladders for Ships (GB 3892), CB/T81-1999, etc.

not apply to spaces with no fire risk and open decks. For the purpose of this Section, spaces with no fire risk refer to spaces without ignition sources or containing minimal combustible materials (excluding combustible hull structures), such as void spaces and sanitary spaces; open decks do not include open cargo spaces and ro-ro cargo decks.

5.5.3 FIRE-RESISTING DIVISIONS

5.5.3.1 The battery room is to be enclosed by fire-restricting divisions. Its boundaries are to be tested in accordance with Part 11 of Appendix 1 to the International Code for Application of Fire Test Procedures and are to have a structural fire resistance time of not less than 60 minutes. They are also to be load-bearing, and tests are to confirm that collapse of the hull and superstructures does not occur within this period. No such requirement applies to structural elements located below the light service draught waterline and in contact with seawater; however, the effect of heat conduction from such non-insulated structures in contact with water to insulated structures above the waterline is to be taken into account.

5.5.4 OTHER REQUIREMENTS

5.5.4.1 No open-flame appliances or cooking/heating equipment with a single unit power rating exceeding 5 kW is to be installed on board.

CHAPTER 6 BATTERIES

Section 1 GENERAL PROVISIONS

6.1.1 GENERAL REQUIREMENTS

6.1.1.1 The design, manufacture and survey of batteries and associated equipment of their systems are to meet relevant provisions of relevant CCS rules, CCS survey guidelines for marine lithium-ion battery products, the Guidelines for Type Approval Test of Electric and Electronic Products and relevant provisions of the Rules.

6.1.1.2 Battery systems are to possess necessary electromagnetic compatibility①.

6.1.1.3 Batteries are to be equipped with battery management system (BMS).

6.1.1.4 Batteries are to be installed in an environmental-controlled enclosed space such as a battery room and/or in battery box(cabinet).

6.1.1.5 The arrangement of batteries and their connecting cables is to be such that stray magnetic fields are minimized as far as practicable.

6.1.1.6 The maintenance and servicing of batteries are to be carried out in accordance with the documentation provided by the manufacturer.

6.1.1.7 Auxiliary materials of battery products are to be of flame-retardant materials.

6.1.1.8 In Sections 2 and 3 of this Chapter, where requirements are specified as subject to CCS survey, and on-site survey is difficult, the survey may be carried out by uploading the relevant records to the battery-powered ship survey and verification platform.

At the stage of product survey of the battery system, the status of data uploading for battery cells, battery modules and/or battery packs is to be verified. Where the data of the battery cells, battery modules and/or battery packs of the battery system have all been uploaded to the battery-powered ship survey and verification platform in accordance with the requirements of Sections 2, 3 and 4 of this Chapter, the product certificate of the battery system is to be specially marked to indicate that the product is a digital survey product.

Section 2 BATTERY CELL

6.2.1 PRODUCTION LINE PROCESS

6.2.1.1 The main production process of battery cell is to generally include the preparation and mixing of positive and negative electrode materials, coating, rolling, cutting, winding or stacking, shell assembly, liquid injection, formation, semi-finished product testing, etc.

6.2.1.2 Considering the consistency requirements of battery cell, the main processes of battery cell production are to be completed by an automatic production line.

6.2.1.3 Key technologies such as weight before liquid injection, voltage, capacity, internal resistance and liquid injection volume are to be surveyed by CCS. If an enterprise can achieve

① Refer to IEC60533 publication Electromagnetic Compatibility of Marine Electrical and Electronic Equipment or corresponding standards.

capacity prediction, control non-outflow of capacity through process control and capacity prediction and has relevant accuracy basis, it can implement capacity sampling prediction.

6.2.1.4 Abnormal alarm data of production equipment is to be uploaded to Battery-Powered Ship Survey and Verification Platform. If this is difficult to achieve for some data, it is to be recorded and saved locally for at least 15 years for traceability.

6.2.1.5 For production steps involving hazardous operations, on-site operational safety is to be ensured, and personnel entering and leaving the production line are to wear the necessary protective equipment and safety shoes, etc.

6.2.2 PRODUCTION LINE ENVIRONMENTAL CONDITIONS

6.2.2.1 The ambient temperature of the battery cell production line is to be controllable, and the temperature control floating range of different processes is be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.2.2 The ambient humidity of the battery cell production line is to be controllable, and the humidity control floating range of different processes is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.2.3 The cleanliness of the battery cell production line is to be controllable, and the floating range of cleanliness control in different processes is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.2.4 Abnormal alarm data from the environment of battery cell production line is to be uploaded to Battery-Powered Ship Survey and Verification Platform. If it is difficult to achieve for some data, it is to be recorded and saved locally for at least 15 years for traceability.

6.2.3 QUALITY OF BATTERY CELLS

6.2.3.1 The preparation of positive and negative electrode materials is to meet the requirements of battery cell model, and the fineness of powder magnetic materials and slurry magnetic materials is to be surveyed by CCS.

6.2.3.2 During the fabrication of positive and negative electrode plates, the density deviation of electrode plate surface, cold pressing thickness deviation and length deviation of electrode plate (measured value - nominal value) are to be surveyed by CCS.

6.2.3.3 Processes such as die-cutting and slitting are to be surveyed by CCS. The vertical burrs beyond the surface of the electrode plate are to be less than 1/2 of the thickness of the diaphragm.

6.2.3.4 The thickness deviation and width deviation of single coiling core are to be surveyed by CCS.

6.2.3.5 Ultrasonic automatic welding is to be adopted for the welding of positive and negative electrode lugs. The welding mark is to be clear, and the electrode lugs are to be free of defects such as cold solder joint, over welding, lack of weld, and skewed electrode lugs.

6.2.3.6 The airtightness after welding of battery cell cover plate and sealing of liquid injection hole is to be surveyed by CCS.

6.2.3.7 After baking, the moisture content of electrode plate is to be surveyed by CCS, and the design value is to be uploaded to the Battery-Powered Ship Survey and Verification Platform. The moisture content is not to be higher than the design value.

6.2.3.8 The total liquid injection volume is to meet the requirements of the battery cell model. The deviation of the total liquid injection volume is to be surveyed by CCS, and the deviation floating range is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.3.9 The total weight of battery cell is to be surveyed by CCS, and the deviation floating range is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.4 CONSISTENCY OF BATTERY CELLS

6.2.4.1 The production quality of battery cell products of the same batch is to ensure good consistency.

6.2.4.2 For battery cell products produced in the same batch, main battery cell materials are to be consistent, such as the specifications and materials of shell, pole piece and diaphragm, positive and negative electrode materials and electrolyte ratio. Changes in the same production batch are to be recorded with traceability.

6.2.4.3 For battery cell products produced in the same batch, the mechanical property and environmental adaptability are to meet relevant standards accepted by CCS and have good consistency.

6.2.4.4 For battery cell products produced in the same batch, basic electrical performance parameters, including battery cell capacity, voltage and impedance, safety performance, including charge-discharge and short circuit characteristics of battery cell, are to meet relevant standards accepted by CCS and have good consistency.

6.2.4.5 For battery cell products produced in the same batch, the temperature rise, capacity attenuation, and cycle trend during the cycle are to be consistent.

6.2.4.6 Battery cells produced in the same batch are to be subjected to 100% inspection of cell voltage, AC impedance, capacity and appearance. For each battery cell type, periodic quality tests are to be carried out at least once a year, with test items including, but not limited to, high-temperature capacity, low-temperature capacity, vibration and self-discharge rate. Not less than two battery cells are to be used for each test item, and the test data are to be uploaded to the battery-powered ship survey and verification platform. Where the manufacturer is able, through process control and capacity prediction, to effectively control products with capacity defects and has supporting evidence for prediction accuracy, capacity spot-check prediction may be adopted.

6.2.4.7 The capacity of finished battery cell is not to be lower than the rated capacity, and the capacity deviation of battery cells produced in the same batch is to be within the given range. The deviation floating range is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.4.8 The AC impedance deviation of battery cells produced in the same batch is to be within the given range. The deviation floating range is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.4.9 The dimension deviation of length, width and height of battery cells produced in the same batch is to be within the given range. The deviation floating range is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.4.10 Each battery cell is to be subjected to performance test when leaving the factory. The corresponding voltage, AC impedance (ACR), total battery weight, battery size parameters and battery cell code number are to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.2.4.11 The pass rate of battery cell product is to be evaluated according to the calculation method provided by the manufacturer, and the pass rate is not to be lower than 94%. If the manufacturer does not provide a formula for calculating the pass rate, the following method is to be used to calculate the pass rate: pass rate=work order output/work order input.

6.2.4.12 The surface of the battery cell is to be free of electrolyte pollution, shell deformation, pits, damage, bursting diaphragm damage, poor welding and other undesirable conditions.

6.2.5 HEALTH OF BATTERY CELLS

6.2.5.1 The energy retention at the end of the service life of battery cell is not to be less than 80% of the initial value.

6.2.5.2 When the battery cell (except high energy density supercapacitor) conducts 100% DoD cycle at room temperature and reaches 80% SOH of battery cell, the cycle life is not to be less than 4000 times.

6.2.5.3 The energy density of high energy density supercapacitor is not to be less than 85Wh/kg, and the power density is not to be less than 10000W/kg. If it conducts 100% DoD cycle at room temperature and reaches 80% SOH of battery cell, the cycle life is not to be less than 10000 times. If it conducts 80% DoD cycle at room temperature and reaches 80% SOH of battery cell, the cycle life is not to be less than 50000 times.

6.2.5.4 In addition to the requirements of 6.2.5.5, having been stored at room temperature for 28 days under 100% SOC, the charge retention rate of battery cell is not to be less than 95%, and the capacity recovery rate of battery cell is not to be less than 96%. Having been stored for 7 days at high temperature (55±2°C) under 100% SOC, the charge retention rate of battery cell is not to be less than 95%, and the capacity recovery rate of battery cell is not to be less than 96%.

6.2.5.5 The voltage at both ends of the high energy density supercapacitor is not to be less than 98% of rated voltage after it has been opened for 72 hours at room temperature at rated voltage.

6.2.5.6 The operating ambient temperature of the battery cell is to be controlled within the nominal operating temperature range of the battery.

6.2.5.7 Identifiable product code number is to be attached to the battery cell to facilitate management, recovery and traceability. The product coding rules are to be implemented in accordance with GB/T 34014-2017 Coding Rules for Automotive Power Batteries.

6.2.6 SAFETY OF BATTERY CELLS

6.2.6.1 Battery cells with hard metal or plastic shell are to be equipped with safety valves or other explosion precautions.

6.2.6.2 When the battery with the battery shell made of composite film and connecting elements (electrodes) (hereinafter referred to as "soft pack battery") is installed and used, the external of each battery cell is to be equipped with a fixed bracket to meet the requirements of effective ventilation, strength, etc.

Section 3 BATTERY MODULE

6.3.1 PRODUCTION LINE TECHNIQUE

6.3.1.1 The process capability index of welding drawing force for the terminal connection tabs of the battery module is to be surveyed by CCS, and the process capability index of welding drawing force is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.3.1.2 Abnormal alarm data of key production equipment is to be uploaded to the Battery-Powered Ship Survey and Verification Platform. Maintenance, replacement and other data are to be recorded and archived for at least 15 years for traceability.

6.3.2 QUALITY REQUIREMENTS FOR BATTERY MODULE

6.3.2.1 The range of battery cell voltage (maximum battery cell voltage-minimum battery cell capacity) in the same battery module is to be within the given range. The range of range fluctuation is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.3.2.2 Under static condition, the static voltage range of battery cell in the same battery module under the state of SOC30%~40% is to be within the given range. The range of range fluctuation is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.3.2.3 The internal resistance range between battery cells in the same battery module is to be within the given range. The range of range fluctuation is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.3.2.4 The external surface of the battery module is to be flat without obvious scratch, deformation and other defects.

6.3.2.5 If the battery module adopts the form of bottom heat dissipation, the bottom flatness deviation is not to be greater than 0.5mm, except for those filled with thermal conductive adhesive.

6.3.2.6 The components of the battery module are to be fastened reliably and free of rust, burrs, cracks and other defects and injuries.

6.3.2.7 The identification contents of battery module are correct, complete and clear.

6.3.3 HEALTH REQUIREMENTS FOR BATTERY MODULE

6.3.3.1 The battery module is to be used under the monitoring circuit of the battery system to provide information (such as voltage, temperature, etc.).

6.3.3.2 The battery module is to be attached with an identifiable code number for management, recycling and traceability. The coding rules are to refer to GB/T 34014-2017 Coding Rules for Automotive Power Batteries.

6.3.3.3 When battery module is discharged at 1C under a high temperature of 55±2℃, the capacity retention rate is not to be less than 95%. When battery module is discharged at 1C under a low temperature of -20±2℃ , the capacity retention rate is not to be less than 70%. The low-temperature discharge termination voltage specified by the enterprise is not to be lower than 80% of the room-temperature discharge termination voltage.

6.3.4 SAFETY REQUIREMENTS FOR BATTERY MODULE

6.3.4.1 The auxiliary material of the battery module is to be flame retarding material.

6.3.4.2 The battery cell is to be firmly fixed in the battery module. The battery module is to have sufficient preload to prevent deformation or cracking caused by the battery cells.

6.3.4.3 The battery pack consists of a battery module. The design of battery modules is to make sure that when thermal runaway occurs to any battery cell of the battery module, it is not to trigger thermal runaway of other battery cells; or, if a battery pack consists of two or more battery modules, the design is at least to ensure that when thermal runaway occurs to a battery cell, this may spread only within the module to which this cell belongs, but will not spread to other modules. Verification test is to be carried out in accordance with one of the following methods:

（1） Thermal runaway propagation among battery cells within the same module is not to happen, or

（2） Thermal runaway propagation among battery modules is not to happen.

Among them, the maximum electric energy of a single module with thermal runaway propagation among battery cells in the same module is not to exceed 4kWh.

Section 4 BATTERY PACK

6.4.1 QUALITY REQUIREMENTS FOR BATTERY PACK

6.4.1.1 The range of battery cell voltage in the same battery pack and the range of battery pack capacity are to be within the given range. The range of range fluctuation is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.4.1.2 The AC impedance range among battery cells within the battery pack is to be within the given range. The range of range fluctuation is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.4.1.3 The external surface of the battery pack is to be flat without obvious scratch, deformation and other defects.

6.4.1.4 The components of the battery pack are to be fastened reliably and free of rust, burrs, cracks and other defects and injuries.

6.4.1.5 The identification contents of battery pack are to be correct, complete and clear.

6.4.2 HEALTH OF BATTERY PACKS

6.4.2.1 The SOC of battery cells in the battery pack is to be kept above 20% as far as possible. If it is lower than this value, the battery pack is to be charged, except for high energy density supercapacitor.

6.4.2.2 When the voltage range of battery cells exceeds the limit value, balance control is to be carried out at the battery pack level.

6.4.2.3 If the operating ambient temperature of battery pack is 0℃ and below, heating device is to be arranged based on the charging and discharging capacity of the battery. When the temperature of battery cells reaches the set temperature (the recommended value is 10℃), the heating device is to stop heating.

6.4.2.4 The battery pack is to contain monitoring circuits that provide information (such as voltage, temperature, etc.) for the battery system.

6.4.3 SAFETY OF BATTERY PACKS

6.4.3.1 Battery packs are to be equipped with safety valves or other explosion precautions.

6.4.3.2 The shell of the battery pack is to be non-combustible material.

6.4.3.3 For design of battery pack, thermal runaway propagation is to meet the requirements of 6.3.4.3.

6.4.3.4 Where the heat generation of the battery cells inside a battery pack may affect their normal operation, the battery pack is to be provided with a temperature control device. The heat exchange capacity of the temperature control device is to be designed according to the requirements of the battery cells. Where the temperature of the battery pack is controlled by means of the temperature control device of the battery room or battery box (cabinet) in which it is installed, the enclosure protection rating of the battery pack is to ensure the effectiveness of such temperature control. Battery packs with a degree of protection of IP44 or higher are to be provided with a temperature control device independent of that of the battery room or battery box (cabinet). For a liquid cooling system that can directly regulate the temperature of battery cells within a battery pack, one of the following methods is to be adopted:

(1) Where each battery room is provided with one separate battery pack cooling system, the cooling system is to comply with the following requirements:

① The separate cooling system of each battery room is to be capable of meeting the cooling needs of all battery packs in that battery room under normal operating conditions;

② Each separate cooling system is to be provided with at least one coolant storage device, one cooling pump, one cooler, and independent piping and accessories;

③ The capacity of the coolant storage device and the discharge capacity of the cooling pump are to meet the cooling requirements of the battery packs in that battery room;

④ Where the storage device is in the form of a coolant circulating tank, the circulating tank is to be fitted with a filling pipe, overflow pipe, air pipe, drain valve and level gauge. A coolant circulating tank located in the double bottom need not be provided with an overflow pipe and a drain valve. The circulating tank is to be provided with a level monitoring and alarm device, which is to give visual and audible alarms locally and at a continuously manned position when the level is low;

⑤ Stop valves and pressure monitoring and alarm devices are to be fitted on both the inlet and outlet piping of the cooling pump and cooler. When the outlet pressure is low, visual and audible alarms are to be given locally and at a continuously manned position;

⑥ Where filters are provided, the structure or arrangement of the filters is to ensure that cleaning of the filters does not affect the normal operation of the cooling system. Filters are to be fitted with differential pressure monitoring and alarm devices, which are to give visual and audible alarms locally and at a continuously manned position when the differential pressure exceeds its limit;

⑦ Cooling pumps are to be supplied from different busbar sections, and the number of cooling pumps supplied from each busbar section is to be as nearly equal as practicable;

⑧ Measures are to be taken to prevent damage to electrical equipment that may result from coolant leakage.

(2) When multiple battery rooms share a single battery pack liquid cooling system, the following requirements are to be met:

① The cooling system is to be capable of meeting the cooling requirements of all battery packs on board under normal operating conditions.

② Cooling pumps and their control systems, heat exchangers and coolant storage devices are to be located in spaces outside the battery rooms. The arrangement of the cooling system is to ensure that a failure of the cooling system in any battery room does not affect the normal operation of the cooling systems in other battery rooms.

③ If the cooling system is of the closed type, at least two coolant storage devices are to be provided. The capacity of each device is to be sufficient to ensure the normal operation of the cooling system, and their arrangement is to be such that maintenance of any one tank does not affect the normal operation of the other. If the cooling system is of the open type, the cooling water is to be capable of being drawn in from both sides of the ship.

④ At least two cooling pumps with sufficient capacity are to be provided. The capacity of each cooling pump is to be sufficient to meet the cooling demand of all battery packs on board, and the two cooling pumps are to be supplied from different busbar sections.

⑤ Where the storage device is in the form of a coolant circulating tank, the circulating tank is to be fitted with a filling pipe, overflow pipe, air pipe, drain valve and level gauge. A coolant circulating tank located in the double bottom need not be provided with an overflow pipe and a drain valve. The circulating tank is to be provided with a level monitoring and alarm device, which is to give visual and audible alarms locally and at a continuously manned position when the level is low.

⑥ Stop valves are to be fitted on both the inlet and outlet piping of the cooling pumps and coolers.

⑦ A pressure monitoring and alarm device is to be provided on the coolant inlet piping to each battery room. When the pressure is low, visual and audible alarms are to be given locally and at a continuously manned position.

⑧ Where filters are provided, their structure or arrangement is to ensure that cleaning of the filters does not affect the normal operation of the cooling system. Filters are to be fitted with differential pressure monitoring and alarm devices, which are to give visual and audible alarms locally and at a continuously manned position when the differential pressure exceeds its limit.

⑨ Measures are to be taken to prevent damage to electrical equipment that may result from coolant leakage.

6.4.3.5 box(cabinet)box(cabinet)box(cabinet)The protection level of battery packs of soft pack battery or battery packs with safety level 1 is not to be lower than IP67. If thermal runaway propagation among battery cells is unavoidable, fire prevention and control measures independent from the fire-fighting arrangements for battery cabins / battery boxes (cabinets) are to be provided for battery packs. If fire prevention and control devices are installed as means of fire prevention and control, such devices are to be able to detect sources and signs of fire, release visual and audible alarms, and automatically and/or manually start ejecting inhibitor medium. Test report is to be provided to prove the effectiveness of the fire extinguishing agent used for extinguishing battery fire.

6.4.3.6 Except for soft pack battery, the protection level of the battery pack with safety level 2 is to be at least IP22.. Where their designed degree of protection is not less than IP44 and thermal runaway propagation between battery cells cannot be avoided, the battery packs are to be provided with the fire prevention and control measures required in 6.4.3.5.

6.4.3.7 Soft pack batteries and batteries of safety level 1 must be installed inside battery boxes (cabinets) in the form of battery pack. For battery boxes (cabinets) with batteries of safety level 1 inside, their protection level is not to be lower than IP67.

6.4.3.8 The IP67 battery pack is to be able to withstand the high temperature and pressure generated by thermal runaway of battery cells without any damage (except for the explosion proof devices of battery pack).

6.4.3.9 Clear identification is to be provided for battery pack's sockets. In addition, positive and negative poles are to be equipped with fool-proofing connectors.

6.4.3.10 Battery packs are to be provided with effective earthing arrangements, and the housings of external connectors are to be made of flame-retardant materials.

6.4.3.11 Where safety class 2 batteries are installed in the form of modules in battery box(cabinet), the battery box(cabinet) are to also comply with the requirements applicable to battery packs of the corresponding safety class.

6.4.4 NAMEPLATE AND LABEL OF BATTERY PACK

6.4.4.1 A nameplate is to be attached safely and securely on the shell of battery pack, and the sign of the nameplate is to at least include the following information:

Marine propulsion（main power supply or starting or lighting）xxx battery/high energy density supercapacitor

model of battery cell	
voltage of battery cell	V
capacity of battery cell	Ah
nominal voltage of battery module/battery pack	V
nominal electric energy of battery module/battery pack	kWh
weight of battery module/battery pack	kg
model of battery module/battery pack	
product code	
date of manufacture	year/month/day

Among which, xxx means different types of lithium-ion batteries. For example: marine propulsion (or main power supply) lithium iron phosphate batteries.

6.4.4.2 Identifiable product code number is to be attached on battery pack to facilitate management, recycle and tracing. Refer to GB/T 34014-2017 Coding Regulation for Automotive Traction Battery for product coding rules.

Section 5 BATTERY MANAGEMENT SYSTEM（BMS）

6.5.1 GENERAL REQUIREMENTS

6.5.1.1 The BMS is to be supplied from both the main source of electrical power and the emergency source of electrical power, with automatic change-over between the two sources. For hybrid-powered ships where no emergency source of electrical power is provided, the BMS is to be supplied from a power source located outside the battery area it serves. For inland ships of less than 10 m in length, such as sightseeing ships in scenic areas or reservoir patrol ships, where a risk assessment report reviewed by a CCS surveyor is provided and appropriate emergency rescue measures are fitted, the BMS may be supplied only from the battery assembly it serves.

6.5.1.2 BMS is to be equipped with battery control unit and battery monitoring circuit based on the battery layer.

6.5.1.3 The battery control unit is to be able to receive the information collected by monitoring circuit (such as voltage, temperature, etc.) within battery module/battery pack.

6.5.1.4 BMS must be able to summarize the information from battery control unit of battery system. BMS is to have a data transmission interface with ship management system, through which the information listed in 6.5.2.1~6.5.2.4 can be fed back to ship management system for management. Remote (the spaces on ship where the crew are often on duty) display and alarm function of the BMS may be realized through the ship management system.

6.5.1.5 The BMS is normally arranged in a three-level architecture, and each level, where provided, is to comply with the following: the first level is the battery pack level, where each battery pack is equipped with a first-level BMS module that performs routine acquisition of battery cell voltage and temperature as well as redundant temperature acquisition, with the collected data transmitted via their respective communication channels to the corresponding second-level BMS modules to achieve monitoring of battery cell voltage and temperature and execution of cell voltage balancing; the second level is the battery string level, where the second-level BMS module processes the data uploaded from the battery packs within the string and the data collected in the high-voltage box, estimates the battery state and performs charge and discharge control for the string, and where an independent over-temperature control board is to be included in the second-level BMS module, and after data acquisition by the second-level BMS module is completed, the data are transmitted via its own communication bus to the third-level BMS master unit for processing, so as to achieve string-level energy/state-of-charge estimation, intra-string balancing management and protection; the third level is the battery assembly or battery domain control box level, where the third-level BMS module performs centralized management, alarm, control and data upload of battery information, and provides inter-string balancing, energy management, protection, communication and log recording.

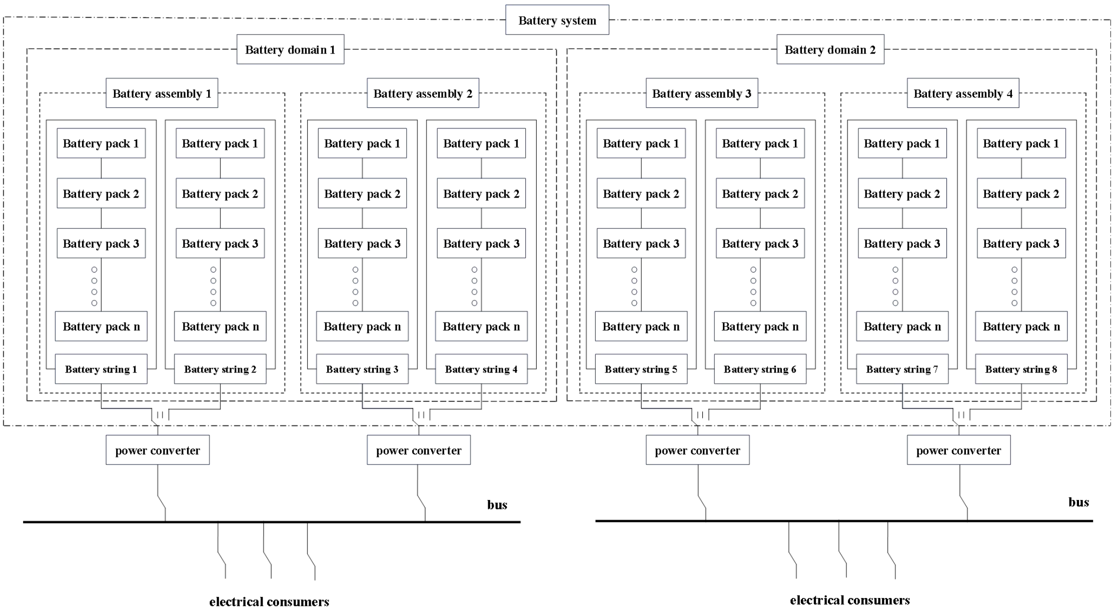

Figure 6.5.1.1(1) Schematic diagram of the physical hierarchy of batteries

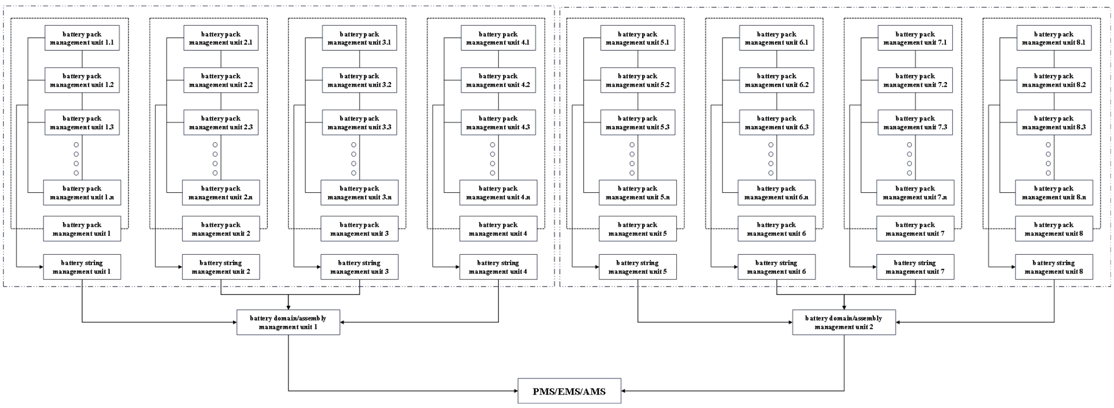

Figure 6.5.1.1(2) Schematic diagram of the hierarchy between the battery management system and the ship management system

6.5.2 BASIC FUNCTION

6.5.2.1 BMS is to be able to monitor the following items, and display the following information (including but not limited to) locally and remotely (spaces on ship where the crew are often on duty):

(1) Battery system voltage;

(2) Battery cell voltage;

(3) Battery cell temperature;

(4) Battery series loop current;

(5) Environment temperature;

(6) Battery system insulation resistance;

(7) State of charge (SOC) of the battery system;

(8) State of health (SOH) of the battery system;

(9) Energy flow state of battery system (charge and discharge process).

6.5.2.2 BMS is to be able to arrange the following separate visual and audible alarms (including but not limited to) locally and remotely (spaces on ship where the crew are often on duty):

(1) Over and under voltage of battery cell;

(2) Overcurrent of battery series loop;

(3) High temperature of battery cell;

(4) Excessive high/low environment temperature;

(5) Low electrical insulation resistance;

(6) Low state of charge (SOC);

(7) Overcurrent protection;

(8) Over charge and over discharge protection;

(9) Over heat protection;

(10) Battery pack/box (cabinet) thermal management (mechanical ventilation or other temperature regulating device) failure (if any);

(11) Battery box (cabinet) emergency exhaust failure (if any);

(12) Protection functional failure;

(13) Temperature detection failure;

(14) Charging failure;

(15) Voltage or SOC imbalance between battery cells or battery modules;

(16) Battery system stops running due to failure;

(17) Abnormal operations of breakers/relays;

(18) Communication failure between BMS and PMS/EMS/AMS.

6.5.2.3 Battery faults that may cause a battery string, battery assembly or the battery system to cease operation (see Table 6.5.2.14) are to give a pre-alarm before the limiting condition is reached.

6.5.2.4 BMS is to have at least the following control and safety protection functions. In addition to (1) and (2), visual and audible alarms are to be issued when the corresponding protective actions are performed:

(1) Control the charge, discharge and charging/discharging equipment of the battery;

(2) Control the balance between battery cells and between battery modules;

(3) Overcurrent protection;

(4) Over charge and over discharge protection;

(5) Over heat protection (Environment temperature and cell temperature);

(6) Fault protection of self-check function.

6.5.2.5 BMS/EMS is to be capable of communicating with the charging equipment and is to comply with the requirements of 6.7.1.6. BMS is to monitor the temperature at the battery side of the charging socket in order to provide temperature monitoring and over-temperature protection for the charging interface.

6.5.2.6 In the event of overcurrent, BMS is to issue a power reduction signal or stop the operation of the battery string, battery assembly or battery system.

6.5.2.7 In the event of overcharge, BMS is to be capable of disconnecting the charging equipment; in the event of over-discharge, BMS is to stop the operation of the battery string, battery assembly or battery system.

6.5.2.8 BMS is to set low temperature charging limit.

6.5.2.9 Over heat protection is to be able to control the battery to a safe state, such as ventilation, power reduction, shutoff of battery system, etc. Over heat protection is to be independent of other components for temperature indication, alarm and control functions(including sensors, circuits, monitoring and control components, etc.).

6.5.2.10 BMS is to have calibration function. The calibration function is to at least include SOC dynamic calibration and SOC shelving calibration at the end of battery charging.

6.5.2.11 BMS is to have communication continuity detection function.

6.5.2.12 BMS is to be provided with a self-diagnostic function. Self-diagnostic function failures include, but are not limited to, failures of protective functions, voltage detection failures, temperature detection failures, failures of battery pack / battery box (cabinet) cooling (where provided), and charging faults. In the event of a protective function failure, battery system is to cease operation; in the event of a charging fault, BMS is to control the charging equipment to stop charging.

6.5.2.13 For batteries used for ship propulsion, BMS is to provide whole-life-cycle monitoring of the batteries throughout their service on board. When the batteries are not in operation, it is to at least be capable of measuring and displaying the battery cell temperature and the ambient temperature, and, in the event of abnormal temperature, giving visual and audible alarms locally and remotely (via the ship management system at a continuously manned position on board). For replaceable mobile propulsion batteries of 24 V or 48 V with a small capacity (not exceeding 20 kWh), visual and audible alarms may be given locally only.

6.5.2.14 Functional requirements for BMS are shown in Table 6.5.2.14.

List of BMS functional requirements Table：6.5.2.14

NO.	**Monitoring parameters**	**Display**②	**Alarm**	**Protection**	**Corresponding protection measure**④
1	Battery system voltage	√			
2	Battery cell voltage	√	√	√	Equilibrium control; Power reduction③ ; battery string/ battery assembly / battery system stops running
3	Battery series loop current	√	√	√	Power reduction③； battery string / battery assembly / battery system stops running
4	Battery cell temperature①	√	√	√	Temperature regulation and power reduction; battery string / battery assembly / battery system stops running
5	Environment temperature	√	√	√	Temperature regulation and power reduction
6	Electrical insulation resistance	√	√	√	battery string / battery assembly / battery system stops running

NO.	Monitoring parameters	Display②	Alarm	Protection	Corresponding protection measure④
7	State of charge of the batteries (SOC)	√	√	√	Power reduction; battery string / battery assembly / battery system stops running
8	State of health of the batteries (SOH)	√			
9	Battery energy flow state	√			
10	Overcurrent protection	√	√	√	Power reduction; battery string / battery assembly / battery system stops running
11	Over charge and over discharge protection	√	√	√	Disconnect the charging device/ battery string / battery assembly / battery system stops running
12	Over heat protection （battery cell temperature）	√	√	√	Temperature regulation and power reduction; battery string / battery assembly / battery system stops running
13	Over heat protection （Environment temperature）	√	√	√	Temperature regulation and power reduction; battery string / battery assembly / battery system stops running
14	Thermal management failure of battery pack/box (cabinet) (if any)	√	√		
15	Emergency exhaust failure of battery box (cabinet) (if any)	√	√		
16	Protection function failure	√	√	√	Battery string/ battery assembly/ battery system stops running
17	Temperature detection failure	√	√		
18	Charging failure	√	√	√	Stop charging

NO.	Monitoring parameters	Display②	Alarm	Protection	Corresponding protection measure④
19	Voltage or SOC imbalance between the modules	√	√	√	Start-up balancing control and power reduction; battery string / battery assembly / battery system stops running
20	Battery system stops running due to failure	√	√		
21	Abnormal operation of breakers/relay	√	√		
22	Communication failure between BMS and PMS/EMS/AMS	√	√	√	Power reduction; battery string / battery assembly / battery system stops running
23	BMS power indication and failure	√	√		

Notes:

① Cell temperature monitoring is to meet the requirements of 6.5.2.15.

② The requirements of 6.5.2.1~6.5.2.4 are to be met.

③ The partial power reduction specified in this table is to be coordinated with the power/energy management system described in Chapter 3. Power reduction protection is to be executed under the premise of ensuring navigation safety.

④ The set values of alarm and protection measures are to be carried out in stages, and the set values of different protection measures in the corresponding protection measures are also to be carried out in stages, among which temperature regulation and power reduction may be of the same stage. For power reduction, BMS sends a power reduction signal to PMS/EMS/AMS; for temperature regulation, BMS starts the temperature regulation device in the battery system (if equipped) or sends the starting signal to the temperature regulation device (fan, air conditioner, etc.) in the battery installation space.

6.5.2.15 BMS is to be able to monitor the temperature of each battery cell individually. If equivalent monitoring means are used, corresponding evidential documents are to be provided for CCS approval.

6.5.2.16 The state of BMS power supply is to be capable of being displayed in the PMS/EMS/AMS, and visual and audible alarms are to be issued in the spaces on ship where the crew is often on duty in the event of a fault.

Section 6 BATTERY SYSTEM

6.6.1 GENERAL REQUIREMENTS

6.6.1.1 The shell of battery system's relevant equipment is to be made of non-combustible material and the connecting cables between battery packs are to meet the requirements for flame retardancy.

6.6.1.2 Refer to Section 5 of this Chapter for relevant technical requirement for control function of battery system.

6.6.1.3 Main circuit of battery system is to be connected to distribution system busbar through disconnector or circuit breaker/switch without tripping mechanism to enable insulation during maintenance.

6.6.1.4 Battery system is to be connected to distribution system busbar through protective equipment with short circuit and overcurrent protection.

6.6.1.5 A single failure of the battery system is not to cause a power blackout to the whole ship.

6.6.1.6 The recommended value of the best charging and discharging rate is to be set in accordance with the charging and discharging characteristics of the battery. The number of times of high charging and discharging rate of the battery system is to be reduced. Relevant data is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.6.1.7 The SOC range of battery system is to be controlled between 20% and 80% as far as possible. When it is lower than 20%, the system is to be charged in time, except for high energy density supercapacitor.

6.6.1.8 The SOC data of battery system is to be uploaded to the Battery-Powered Ship Survey and Verification Platform.

6.6.1.9 SOH data of the battery system is to be uploaded to the battery-powered ship survey and verification platform. When the SOH falls below 80%, the battery system is to be maintained or replaced.

6.6.1.10 Protective measures are to be provided between battery strings connected directly in parallel (minimum independent power supply units) to prevent internal circulating currents.

6.6.1.11 Battery strings are to be capable of continuous online insulation resistance monitoring and are to comply with the requirements of 1.2.2.2(6), avoiding simultaneous operation of multiple insulation resistance monitoring devices that may cause interference.

6.6.2 EMERGENCY SHUTDOWN DEVICE

6.6.2.1 Battery assemblies with a rated energy exceeding 50 kWh are to be provided with an independent emergency shutdown device for disconnecting the battery assembly, and the following requirements are to be met:

(1) The emergency shutdown device is to be located in the wheelhouse and at a position outside the battery room that is readily accessible. When operated, it is to simultaneously give visual and audible signals, which are also to be transmitted to a continuously manned position.

(2) Emergency shutdown function is to be carried out by hardware circuit independent from control, display and alarm systems.

6.6.3 MINIMUM ELECTRIC ENERGY ALARM DEVICE

6.6.3.1 When the total SOC of battery system used for ship propulsion and/or main source reaches the minimum electric energy required for normal operation of the ship, visual and audible alarm signals are to be sent out. The alarm device of this alarm signal is to be independent from other alarm devices. This alarm signal is to be distinguished from the discharge termination electric energy (minimum electric energy recommended by the manufacturer) of a single battery system, and is to be issued by the ship management system.

Section 7 CHARGING DEVICE

6.7.1 GENERAL REQUIREMENTS

6.7.1.1 The battery system is to be equipped with charging devices with sufficient capacity. Charging devices are to be provided with measures to suppress radio interference.

6.7.1.2 The charging equipment is to be provided with basic protective functions, including input overvoltage protection, input undervoltage protection, output overvoltage protection, output short-circuit protection and contactor sticking protection.

6.7.1.3 The charging system equipment is to have insulation detection functionality to monitor the DC output circuit.

6.7.1.4 The charging equipment is to be equipped with pre-charging control functionality, and the control sequence is to comply with the requirements of GB/T 27930-2023 and/T 18487.1-2023.

6.7.1.5 Instruments are to be provided at least on or near the charging device and in spaces where the crew are often on duty to indicate charging and discharging current, voltage, temperature, SOC and other parameters. Relevant data is to be transmitted to the ship management system, and the corresponding alarm information is to be uploaded to the battery-powered ship survey and verification platform.

6.7.1.6 The charging device of battery system is to have an interface with BMS and operate under the conditions defined by BMS.

6.7.1.7 Where shore power is connected to the shipboard charging equipment (including the shore power box) via a charging connector, the following requirements are to be met:

(1) The charging connection device is to be equipped with mechanical interlocks to prevent the charging cable from falling off during the charging process;

(2) Under normal and failure conditions, the charging connection device is to be equipped with safety measures against electric shock;

(3) The charging connection device is to be so designed that it can be easily operated, special tools are not needed for connection with the shore power device, and no live part will be touched.

6.7.1.8 The charging device is to be equipped with temperature monitoring device, which is to be able to transmit corresponding signals to charging control system for temperature monitoring and over heat protection functions of the charging connector.

6.7.1.9 No flammable explosive goods are to be arranged near the charging device.

6.7.2 SPECIAL REQUIREMENTS FOR DC BUS SYSTEMS

6.7.2.1 If the battery system is charged through the DC bus, appropriate measures are to be provided to avoid damages to the battery caused by the failure of DC bus system.

CHAPTER 7 CONTAINERIZED POWER SUPPLY

Section 1 GENERAL PROVISIONS

7.1.1 APPLICATION

7.1.1.1 This Chapter applies to the design, construction and survey of containerized power supplies.

7.1.1.2 The battery system and associated products inside the containerized power supply are to comply with the certification requirements of 1.3.1.3, and other associated system products are to comply with the certification requirements of the relevant CCS rules.

7.1.1.3 The containerized power supply covered by this Chapter is intended for shore-based charging. Where charging on board is required, additional safety measures are to be considered.

7.1.1.4 The containerized power supply is to be provided with a marine product certificate.

Section 2 TECHNICAL REQUIREMENTS FOR CONTAINERIZED POWER SUPPLY

7.2.1 GENERAL REQUIREMENTS

7.2.1.1 Except as otherwise specially specified in this Section, the technical requirements, arrangement, installation and ventilation of batteries inside the containerized power supply, the environmental temperature control of the space, the cooling system of the battery system, emergency exhaust and other related requirements are to be consistent with the requirements for batteries and their battery rooms used as the ship's main source of electrical power and/or propulsion power supply.

7.2.1.2 Subject to compliance with the requirements of this Chapter, the container materials and welding, structural strength and arrangement, test methods, survey and other related aspects of the containerized power supply are to comply with the applicable provisions for general purpose containers in the CCS Rules for Survey of Containers.

7.2.1.3 For the overall fire-extinguishing of the battery system inside the containerized power supply, water fire-extinguishing (excluding high-pressure water mist) is not to be adopted as the first choice. Where a water fire-extinguishing system is used, appropriate protective measures are to be taken to prevent secondary hazards caused by water application.

7.2.1.4 Protective measures are to be provided between battery strings directly connected in parallel inside the containerized power supply to prevent internal circulating currents.

7.2.1.5 In the battery spaces inside the containerized power supply, electrical equipment required to remain in operation under battery thermal runaway conditions is to be of an explosion-proof type, such as fire detection equipment, pre-discharge alarms of fixed fire-extinguishing systems, combustible gas detection devices and alarms, and emergency exhaust systems. The specific explosion-proof requirements (type of protection, explosion group and temperature class) are to be determined according to the composition of gases generated by thermal runaway of different types of batteries, and the system is to be capable of automatically cutting off the power supply to non-explosion-proof electrical equipment in the battery room.

7.2.1.6 Battery packs inside the containerized power supply are to have a degree of protection not less than IP67, and their temperature control arrangements are to comply with the requirements of 6.4.3.4. Fire prevention and control measures for battery packs are, according to the packaging type and safety class, comply with the requirements of 6.4.3.5 or 6.4.3.6.

7.2.1.7 Containerized power supply is to be capable, during lifting, transportation, shore-based charging and storage, of measuring and displaying the battery cell temperature and the ambient temperature, and, in the event of abnormal temperature, giving visual and audible alarms locally and on a remote shore-based monitoring platform.

7.2.1.8 Where the containerized power supply is changed over during operation, the continuity of the ship's power supply is not to be affected. Upon receiving a thermal runaway alarm signal, change-over of the containerized power supply is only to be performed after a combined assessment with at least one other abnormal battery alarm signal (such as overvoltage or overtemperature alarm of battery cells, combustible gas detection alarm, etc.), so as to avoid spurious change-over of the containerized power supply caused by a single-line fault. The change-over is to ensure that the maximum power that can be provided by the remaining containerized power supplies matches the ship's power demand.

7.2.1.9 A log book facilitating the crew's recording of battery swap operations of the containerized power supply is to be provided on the containerized power supply, and this log book is to be kept inside the containerized power supply.

7.2.2 CONTAINERIZED POWER SUPPLY CONTAINER

7.2.2.1 The containerized power supply is to adopt a specially designed container suitable for it.

7.2.2.2 The influence of local stress caused by the fixed bracket in the container under various working conditions is to be considered for the structure of the containerized power supply container.

7.2.2.3 The containerized power supply is generally to comply with the salt spray-proof requirements of the relevant CCS rules for electrical equipment.

7.2.2.4 Anti-condensation design is to be considered for the containerized power supply container.

7.2.2.5 The container of the containerized power supply is to be of weathertight construction.

7.2.3 INTERNAL ARRANGEMENT OF CONTAINERIZED POWER SUPPLY

7.2.3.1 All equipment in the containerized power supply is to be effectively fixed, including but not limited to battery box (cabinet)/battery pack, combiner cabinet, high-voltage box, fire-fighting device, etc.

7.2.3.2 Under various working conditions of the containerized power supply, the structural strength of the battery box (cabinet) in the containerized power supply is to be able to withstand the corresponding impact.

7.2.3.3 If the battery box (cabinet) or battery pack arranged in the containerized power supply is ventilated and dissipated by means of the public space, the clear distance between the battery box (cabinet)/battery pack in the containerized power supply and the internal bulkhead is not to be less than 150mm.

7.2.3.4 The distance between the battery box (cabinet)/battery pack in the containerized power supply is not to be less than 150mm from the box wall and box top, and the clear distance from the box wall and box top reinforcement structure is not to be less than 100mm, so as to reduce the risk of collision during the hoisting process.

7.2.3.5 The design of the containerized power supply is to be such as to facilitate the maintenance of the battery system related equipment. If the onboard maintenance is not considered for the design, an explosion-proof camera is to be provided in the containerized power supply battery room to facilitate internal debugging and inspection, and at the same time, it is to be able to display on the spot, navigation bridge and remote shore-based monitoring platforms(if any).

7.2.3.6 The battery system in the containerized power supply is not to be located in the same space with the switchboard.

7.2.3.7 The fixed fire detection and fire alarm system, flammable gas detection device, emergency exhaust system and BMS of the containerized power supply are to be powered by two independent power sources, one of which is to be powered by other power supply systems on board except the main power source, and the power supply time meets the requirements of relevant rules for the emergency power supply. BMS power supply is to meet the longest waiting time[①] that the containerized power supply may exist, whichever is greater. When the main power supply of the containerized power supply is lost, it is to automatically obtain power from a source other than the main power supply of the container.

7.2.3.8 The strong current wiring harness in the containerized power supply is to be kept away from the communication cable as far as possible.

7.2.3.9 The power distribution room in the containerized power supply is to be provided with smoke detection and alarm devices.

Section 3 ONBOARD ARRANGEMENT OF CONTAINERIZED POWER SUPPLY

7.3.1 GENERAL REQUIREMENTS

7.3.1.1 The containerized power supply is not to be placed in hazardous areas.

7.3.1.2 The containerized power supply is not to be placed in the same cargo area with the cargo.

7.3.1.3 The containerized power supply is to be as far away as possible from the outer side of the ship to avoid the impact of collision. The horizontal distance from it to the side is not to be less than 760 mm.

7.3.1.4 The collision impact of other facilities on the ship and the cargo container (if any) during the hoisting process is to be considered for the arrangement of the containerized power supply.

[①] The maximum waiting time refers to the duration required for the containerized power supply to be disconnected from the ship's power grid until it is charged by the shore power supply.

7.3.1.5 The containerized power supply is to be arranged as far away as possible from the accommodation space and areas traversed by personnel. Corresponding measures are to be taken in the area to prohibit unprofessional personnel from approaching the containerized power supply. At the same time, the containerized power supply container is to be provided with high-voltage danger signs and no entry signs for unprofessional personnel.

7.3.1.6 The containerized power supply is to be kept as far away as possible from the emergency power supply room.

7.3.1.7 The area where the containerized power supply is located is to be provided with means of access for professional personnel to carry out the inspection, maintenance and emergency handling.

7.3.1.8 If the containerized power supply is placed on the open deck, lightning protection measures are to be taken to avoid the failure of containerized power supply.

7.3.1.9 The containerized power supply is to be provided with securing means and is to be able to withstand the adverse weather conditions encountered during ship's navigation.

7.3.1.10 The exhaust duct of the emergency exhaust system of the containerized power supply is to lead to a safe place on the open deck, and be far away from the spaces inhabited or containing heat sources, and at least 3 meters away from the air inlets of other spaces.

7.3.1.11 The air inlet of the containerized power supply is to be as far away as possible from the air outlet of the paint room and the battery room, and avoid dangerous areas.

7.3.1.12 If the containerized power supply is adjacent to an ordinary cargo container, the distance from the cargo container is not to be less than 600mm. If the emergency exhaust vent faces the cargo container, the danger of combustible gas is also to be considered.

7.3.1.13 The spacing between the side wall of the containerized power supply and the bulkhead of the passenger space (except that the bulkhead of the passenger space adjacent to the side wall of the containerized power supply is of "A-60" class division structure) is to be at least 900mm. The distance from openings or exits such as doors, windows and ventilation openings in passenger spaces is to be at least 1.5m.

7.3.1.14 The ship structural strength in way of the containerized power supply arrangement is to meet the load requirements. The structural strength is to be checked according to the situation.

7.3.1.15 The space where the containerized power supply is installed is to be free from the impact of deck water on the battery.

7.3.1.16 An obvious "No Fire" sign is to be provided outside the containerized power supply.

7.3.1.17 When multiple containerized power supplies are arranged on board, they are to be arranged horizontally as much as possible. If stacking is necessary, the number of layers is not to exceed three. Additionally, the horizontal spacing between containerized power supplies is to ensure the formation of an effective water barrier between them.

Section 4 THE BATTERY SWAP REQUIREMENTS OF CONTAINERIZED POWER SUPPLY

7.4.1 GENERAL REQUIREMENTS

7.4.1.1 Every battery swap of a containerized power supply is to be subject to an appropriate inspection procedure in order to prevent the use of a damaged container.

7.4.2 SHIP BATTERY SWAP SYSTEM

7.4.2.1 The design and manufacture of the ship battery swap system are to meet the requirements for safe, rapid and reliable replacement of containerized power supplies.

7.4.2.2 The ship battery swap system is to, throughout its design service life, provide electrical, communication and thermal management functions that meet interoperability requirements.

7.4.2.3 On board, containerized power supplies are to be kept in their normal position by mechanical devices or electrical monitoring devices. Electrical signals such as the position of the containerized power supply, the status of its connection with the ship battery swap system or the status of its electrical interfaces may be used to detect loosening and unintended unlocking of the containerized power supply.

7.4.2.4 Where the ship battery swap system contains easily worn components, the scope of such components and their maintenance and replacement requirements are to be specified in the maintenance manual for the containerized power supply.

7.4.2.5 The ship battery swap system is to be provided with both an automatic unlocking function by means of dedicated devices and a manual unlocking function. Unlocking is to be performed in two or more steps, and the process is to be continuous and reliable so as to avoid inadvertent operation. Operations involving the use of tools to tighten or loosen threaded connections are to be regarded as multi-step unlocking.

7.4.3 BATTERY SWAP INTERFACE/ CONTAINERIZED POWER SUPPLY JUNCTION BOX

7.4.3.1 The surfaces of the battery swap connector and the containerized mobile power supply junction box are to be free from burrs, foreign matter, flash and similar sharp edges.

7.4.3.2 Electrical interfaces are to provide the correct sequence of electrical connection and disconnection so as to avoid unintended energization of high- or low-voltage circuits during battery swap operations.

7.4.3.3 In the event of accidental leakage of coolant from the cooling interface (where provided), no insulation failure at the electrical interfaces or other safety hazards are to be caused.

7.4.3.4 In the event of accidental water leakage from the fire-fighting water interface (where provided), no insulation failure at the electrical interfaces or other safety hazards are to be caused.

7.4.3.5 The degree of protection of the electrical interfaces in the battery swap connector and the containerized mobile power supply junction box is to meet the degree of protection required for electrical equipment in the corresponding location. Battery swap connectors are to be easy to replace and maintain.

7.4.3.6 The connectors of the battery swap connector and the containerized mobile power supply junction box are to have structures or designs that prevent incorrect coupling, and are to be capable of being securely engaged so as to prevent loosening or accidental disconnection.

7.4.3.7 In the pin design of the connectors of the battery swap connector and the containerized mobile power supply junction box, circuits for critical functions, such as pins for hard-wired thermal runaway trip signals, are to be arranged as far apart as practicable.

Section 5 FIRE PROTECTION

7.5.1 GENERAL REQUIREMENTS

7.5.1.1 In addition to the provisions of this Section, the fire protection of the containerized power supply is to meet the relevant requirements of 5.2.4、5.2.5、5.3.2, 5.3.3 and 5.4.1.

7.5.2 STRUCTURE

7.5.2.1 The container (including doors or other openings) is to be made of steel.

7.5.2.2 The fire integrity of the boundary of the enclosure space where the battery is located is to be insulated to A-60 class standard. Insulation material is to be non-combustible material.

7.5.3 EMERGENCY EXHAUST

7.5.3.1 The emergency exhaust vent of the containerized power supply is to be provided with a fire damper and have a self-closing function. If it is not possible, the emergency vent of the containerized power supply is to be open to the outside of the ship and be protected against rain and wave injection.

7.5.4 FIRE EXTINGUISHING SYSTEM

7.5.4.1 For the fixed fire extinguishing system of the containerized power supply, except for prefabricated fire extinguishing system[①], components such as fire extinguishing agent containers and agent release control valves are to be arranged in a special space outside the battery space.

7.5.4.2 In addition to local control, the fixed fire extinguishing system of the containerized power supply is to also have the function of remote operation in the navigation bridge or fire control station.

7.5.4.3 The arrangement of the ship's water fire extinguishing system is to be capable of providing at least four streams of water with the specified pressure and flow rate to the containerized power supplies. The total discharge capacity of the fire pumps is to be sufficient to supply water to four hoses of the specified size at the specified pressure, ensuring that the water can reach any part of the space where the containerized power supplies are located. Measures are to be in place to ensure that the fire pumps remain operational in the event of a fire in any containerized power supply. The hoses are to be of a dual-purpose type capable of both water jets

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[①]Prefabricated fire extinguishing system refers to a fire extinguishing system which is designed and assembled in complete sets according to certain application conditions, such as fire extinguishing agent storage device and spraying assembly.

and water mist. Fire hydrants are to be located at appropriate positions on the ship, ensuring that they remain accessible to the crew even if a fire occurs in a containerized power supply. The number and arrangement of fire hydrants are also to take into account the use of portable fire monitors as required by 7.5.4.5.

7.5.4.4 At least four portable gas fire extinguishers (such as those containing heptafluoropropane or carbon dioxide), each with a minimum capacity of 5 kg, are to be provided in the vicinity of the containerized power supply area.

7.5.4.5 When containerized power supplies are stacked more than two layers high, the ship is to be equipped with at least two portable fire monitors, meeting the following requirements:

(1) The portable fire monitors, along with their required hoses, accessories, and securing devices, are to be stored in locations that are not easily cut off in the event of a fire involving the containerized power supplies, ensuring they are readily accessible for immediate use.

(2) If the discharge capacity of the fire pumps and the diameter of the fire main are sufficient to simultaneously supply all portable fire monitors and produce four streams of water at required pressure from fire hoses, the portable fire monitors may be supplied by the fire main.

(3) Each portable fire monitor may be supplied by different fire hydrants, with sufficient pressure to reach the highest layer of containerized power supplies.

(4) The water streams produced by all portable fire monitors are to be capable of forming an effective water barrier between horizontally adjacent containerized power supplies.

(5) The performance of the portable fire monitors is to comply with recognized standards[①].

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① Such as GB 19156-2019 “Fire Monitors,” or refer to MSC.1/Circ.1472 Circular “Guidelines for the Design, Performance, Testing and Approval of Mobile Fire Monitors for the Protection of Cargo Areas on Deck of Ships Designed and Constructed to Carry Five or More Layers of Containers on or Above the Weather Deck.”

CHAPTER 8 DRILLS AND OPERATIONAL TRAINING

Section 1 GENERAL PROVISIONS

8.1.1 PURPOSE

8.1.1.1 To ensure that personnel engaged in the operation of ship propulsion systems, battery systems, and power distribution systems are aware of the unique safety considerations and necessary fault-handling measures associated with these systems.

8.1.2 FUNCTIONAL REQUIREMENTS

8.1.2.1 The ship is to be equipped with the necessary documentation for the safe operation of the propulsion system, battery system, and power distribution system, and such documentation is to be readily accessible to all relevant personnel.

8.1.2.2 The ship is to be equipped with maintenance procedures and related documentation for the battery system and power distribution system.

8.1.2.3 Shipboard personnel is to conduct appropriate drills in accordance with their assigned duties.

8.1.2.4 The ship is to be equipped with appropriate emergency response procedures.

8.1.2.5 For high-speed craft, a ship operating manual, a route operational manual, a ship maintenance and repair manual and a training manual, as well as other technical documents, are to be provided on board. The contents of these manuals are to comply with the requirements of the flag state administration and are to also meet the requirements of this Chapter..

Section 2 OPERATION

8.2.1 GENERAL REQUIREMENTS

8.2.1.1 The wheelhouse is to permanently display a simplified description of the propulsion system operating procedures and the power equipment switching procedures for the steering system. If the ship is equipped with two or more propulsion systems, it is to include a simplified description of the combined operation (if applicable) and separate operation procedures for each propulsion system. These instructions are to be accompanied by block diagrams.

8.2.2 OPERATION MANUAL

8.2.2.1 At least two copies of the operation manual are to be provided on board, with one copy stored in the wheelhouse. The operation manual is to include at least the following:

(1) Detailed information and descriptions of the types, specifications and parameters of the batteries, the battery system and the battery management system (BMS). The operating instructions for the battery system are to also include a safety description listing all potential hazards, such as internal battery faults/thermal runaway, possible leakages, possible gas generation, fire, explosion and external heat sources/fires;

(2) Detailed information and instructions on the type, specifications, parameters, etc., of DC/AC power distribution systems and various electrical equipment;

(3) Detailed information and instructions on the ship management system;

(4) Meaning of alarms in each system and the corresponding handling procedures;

(5) Operating procedures for the ship's power system (including the steering system);

(6) Operating procedures for the temperature regulation devices of the battery system (including procedures for fault conditions);

(7) Charging procedures (if applicable);

(8) Procedures for electrical, piping and other connections of the containerized power, where applicable.

Section 3 MAINTENANCE

8.3.1 GENERAL REQUIREMENTS

8.3.1.1 A maintenance plan for the battery system and power distribution system is to be developed and retained on board. Regular inspections and maintenance are to be carried out on these systems and equipment to ensure they remain in good condition.

8.3.2 MAINTENANCE

8.3.2.1 The maintenance plan is to be developed in conjunction with the maintenance materials provided by the manufacturer or integrator of the battery system and its power distribution system. For systems and equipment that must be maintained directly by or under the guidance of the manufacturer or integrator, the corresponding component names and contact information are to be clearly specified.

8.3.2.2 Unless otherwise specified by the manufacturer or integrator, the maintenance plan is to include at least the following systems, equipment, and data:

(1) Electronic data collection and management for each system;

(2) Battery system;

(3) DC power distribution system;

(4) AC power distribution system;

(5) Ship management system;

(6) Temperature regulation devices and cooling systems;

(7) Battery cabinets and racks;

(8) Various connectors linked to the containerized power (if applicable);

(9) List of consumable parts.

8.3.2.3 The maintenance plan may be in electronic format.

8.3.3 MAINTENANCE DOCUMENTATION

8.3.3.1 The maintenance documentation is to specify the requirements for data analysis. Data analysis is to be carried out at least twice a year, and the interval between two analyses is not to be less than four months.

8.3.3.2 The maintenance documentation for the battery system is to specify how competent personnel (normally the battery manufacturer or its authorized personnel) are to test the system and its components, the test intervals, and other detailed instructions. Records are to be kept after maintenance, and a maintenance schedule record sheet is to be established and kept up to date. Where remote data recording is provided, records of battery condition for at least 60 days are to be retained.

Section 4 GUIDANCE, ONBOARD TRAINING, AND DRILLS

8.4.1 GUIDANCE, RESPONSIBILITIES, AND ORGANIZATION

8.4.1.1 Crew members are to receive guidance related to the safe operation of the ship and emergency response.

8.4.1.2 Crew members are to receive guidance relevant to their assigned responsibilities.

8.4.1.3 Firefighting teams are to be organized, and these teams are to possess the capability to fulfill their duties.

8.4.2 ONBOARD TRAINING AND DRILLS

8.4.2.1 Crew members are to be familiarized with the battery system, power distribution system, and their related operations through training.

8.4.2.2 Crew members assigned firefighting duties are to acquire the skills to extinguish battery and electrical fires through onboard training and drills.

8.4.2.3 Targeted drills and onboard training are to be conducted for crew members based on the ship's characteristics and the contents of the relevant system risk assessment reports. Each crew member is to participate in at least one drill per month.

8.4.3 TRAINING MANUALS

8.4.3.1 A training manual is to be provided in each crew mess room or each crew cabin. If such spaces are not available on board, at least one training manual is to be placed in a suitable location on the ship.

8.4.3.2 The training manual may be divided into several parts, and the text is to be concise and easy to understand. Where possible, it is to be supplemented with illustrations. Any part of the manual may be provided in the form of audiovisual aids as a substitute for the manual.

8.4.3.3 Training manual is to provide detailed explanations of at least the following:

(1) Safe operating practices and preventive measures related to internal battery faults, internal and external short circuits, overcurrent, overvoltage, undervoltage and other faults or hazards;

(2) Safe operating practices and preventive measures related to hazards arising from flammable and toxic gases generated by battery thermal runaway, hazards from fire smoke, electric shock and other dangers;

(3) Instructions on fire-fighting actions and procedures for battery fires or electrical fires, including procedures for reporting a fire and using manual fire alarm call points;

(4) The meaning of alarms on board, including those of the battery system, power distribution system and fire detection system, and the corresponding response procedures;

(5) Operating methods and use of fire-extinguishing systems, fire-fighting equipment and emergency exhaust systems.

CHAPTER 9　RISK ASSESSMENT

Section 1　GENERAL PROVISIONS

9.1.1　GENERAL REQUIREMENTS

9.1.1.1　To eliminate or reduce the risks that the use of battery systems may pose to personnel, the ship, and the environment, a pure battery-powered ship is to conduct a risk assessment. For battery hybrid-powered ships, a risk assessment is to be carried out in accordance with the relevant rules and guidelines of the Society, wherein the battery system is to be assessed according to the relevant requirements of this Chapter.

9.1.1.2　The risk assessment is to be conducted using acceptable and recognized methodologies[①] or by reference to the relevant content of this Chapter. Where necessary, risk mitigation measures are to be proposed and documented in an assessment report.

9.1.1.3　The risk assessment is to be based on the single failure concept, meaning that the simultaneous occurrence of two failures is not considered.

9.1.1.4　The risk assessment report is to be sufficiently detailed to support its findings, conclusions, recommendations, and any actions taken. It is to contain, at a minimum, the relevant content specified in Appendix 2.1.

9.1.1.5　The report may be prepared directly by referring to the report of a parent ship[②].

9.1.1.6　The risk assessment work is to be organized and conducted by the submitting party of the risk assessment report.

9.1.1.7　The risk assessment report is to be submitted to CCS for approval prior to the commencement of ship construction.

Section 2　SCOPE OF ASSESSMENT

9.2.1　GENERAL REQUIREMENTS

9.2.1.1　The risk assessment for a pure battery-powered ship is to consider the identification of all potential risks associated with the ship's power system, related auxiliary equipment, and shipboard arrangements. The ship's power system includes, but is not limited to, the battery system, power distribution system, and propulsion system.

9.2.1.2　The risk assessment for the battery system is to consider at least the following factors:

(1) Battery cell failures, including but not limited to overcharging, over-discharging, etc.;

(2) Battery module failures, including but not limited to emergency venting failure, poor consistency of battery cells, etc.;

(3) Battery system failures, including but not limited to system insulation failure,

①Such as the techniques mentioned in the Revised Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule-Making Process (MSC-MEPC.2/Circ.12), including What-If Analysis, Failure Mode and Effects Analysis (FMEA), and Hazard and Operability Study (HAZOP), among others.

②It refers to ships that have identical ship dimensions, performance, openings and arrangements on board, and power system design.

high-voltage box failure, etc.;

(4) Battery Management System (BMS) failures, including but not limited to hardware failure, power supply failure, etc.

(5) Battery thermal management system failures, including but not limited to cooling failure, heating failure, etc.;

(6) External impacts on the battery system, including but not limited to mechanical collision, fire in adjacent spaces outside the battery system, external water ingress, etc.

9.2.1.3 The risk assessment for the power distribution system is to consider at least the following factors:

(1) Failure of the DC power distribution system, including but not limited to DC/DC converter anomalies, protective device anomalies, etc.;

(2) Failure of the AC power distribution system, including but not limited to daily inverter power supply failure, isolation transformer failure, etc.;

(3) Failure of the control system, including but not limited to PMS/EMS failure, control system power supply failure, etc.;

(4) Failure of the cooling system, including but not limited to converter anomalies, protective device anomalies, etc.

9.2.1.4 The risk assessment for the propulsion system is to consider at least the following factors:

(1) Failure of the main propulsion system, including but not limited to main propulsion inverter failure, circuit failure, etc.;

(2) Failure of the propulsion control system, including but not limited to controller failure, control power supply failure, etc.;

(3) Failure of the cooling system, including but not limited to cooling equipment, components, and pipeline failures, etc.;

(4) Failure of the steering/direction control system, including but not limited to steering inverter failure, steering equipment failure, controller failure, etc.

9.2.1.5 If the ship design adopts other types of propulsion systems, such as cycloidal propellers, rim-driven thrusters, or azimuth thrusters, further analysis is to be conducted to assess the inherent risks of the propulsion system itself.

9.2.1.6 For fiber-reinforced plastic ships with a length (L) of 20 meters or more, in addition to meeting the applicable requirements of the Rules, it is to be verified through testing and/or other means that the ship's safety level, besides meeting the objectives and functional requirements specified in 1.1.2 and 1.1.3, also considers the following measures:

(1) Operational restrictions implemented to address safety risks associated with the use of batteries on the ship;

(2) Fire safety measures implemented to address fire risks associated with the use of batteries on the ship;

(3) Personnel evacuation measures implemented to address hazards associated with the use of batteries on the ship.

9.2.1.7 In addition to meeting the applicable requirements of the Rules, high speed crafts are to verify their safety level through testing and/or other methods. The verification is to ensure that, in addition to meeting the objectives and functional requirements of 1.1.2 and 1.1.3, the following measures are considered:

(1) The arrangement of the battery room is to consider the impact of high speed craft collisions on the batteries, and the minimum horizontal distance between the battery box (cabinet), battery pack, and the ship's outer side plates and structures is to be increased as necessary;

(2) The effects of structural impact generated by the ship under high-speed operating conditions on the mounting components and on the battery itself are to be considered;

(3) It is to be confirmed that the vibration range and slamming intensity during the high speed craft's navigation conditions are within the strength range of the battery pack's type approval tests;

(4) For hybrid-powered ships, the risks associated with battery charging during high-speed operation are to be considered.

Section 3 ASSESSMENT PROCESS AND METHODS

9.3.1 GENERAL REQUIREMENTS

9.3.1.1 Risk assessment is based on known information to identify potential risks, which helps determine whether further measures are needed to eliminate or reduce the impact of the risks.

9.3.1.2 The risk assessment is to, at a minimum, provide detailed information on the following:

(1) Hazard identification;

(2) Hazard analysis;

(3) Likelihood analysis;

(4) Risk evaluation;

(5) Decision recommendations.

9.3.2 HAZARD IDENTIFICATION

9.3.2.1 The purpose of hazard identification is to discover, acknowledge, and document risks in order to determine events that may significantly impact battery-powered ships, their causes, and their consequences.

9.3.2.2 The methods used for hazard identification generally include a combination of brainstorming and standard analysis techniques to identify all relevant hazards as comprehensively as possible.

9.3.2.3 If the Failure Mode and Effects Analysis (FMEA) method is adopted, reference may be made to Appendix 2.2 for conducting the analysis.

9.3.3 HAZARD ANALYSIS

9.3.3.1 Hazard analysis involves assessing the severity of each identified hazard based on its potential consequences, such as personnel casualties, property damage, or environmental harm.

9.3.3.2 The severity levels classification for the consequences of identified hazards may refer to Appendix 2.3.

9.3.4 LIKELIHOOD ANALYSIS

9.3.4.1 Likelihood analysis involves a comprehensive assessment of the probability of identified hazards occurring, based on the causes that may trigger these hazards.

9.3.4.2 The probability level classification for identified hazards may refer to Appendix 2.4.

9.3.5 RISK ASSESSMENT

9.3.5.1 Risk analysis can be considered as the combination of hazard analysis and likelihood analysis, used to determine whether the risk has been mitigated and has reached an acceptable standard.

9.3.5.2 The risk matrix (a matrix composed of the likelihood of all hazards occurring and their corresponding severity, used to rank hazards) is the most commonly used and typical method. Before defining the risk matrix, the computational relationship between the frequency of hazardous events and the consequences of accidents must be defined. This relationship can be either additive or multiplicative:

Risk Index (RI) = Probability Index (PI) + Severity Index (SI)

9.3.5.3 The frequency of occurrence and severity are divided into several levels, and then the frequency and corresponding consequences are placed in a matrix, which is the risk matrix. The risk matrix is typically divided into three zones: high-risk zone, low-risk zone, and the intermediate critical zone. It is generally established based on relevant standards or the Owner's requirements, and reference may be made to Appendix 2.5.

9.3.5.4 The high-risk zone is considered unacceptable and requires immediate action to mitigate the risk. The low-risk zone is deemed acceptable, and no further measures are necessary. The critical zone requires a risk assessment to determine whether measures should be taken to reduce the risk or if further studies are needed before making a decision.

9.3.6 DECISION RECOMMENDATIONS

9.3.6.1 Based on the evaluation of identified risks, corresponding recommendations are to be proposed. Efforts are to be made to ensure that, after implementing the recommendations, the identified high risks are reduced to an acceptable low-risk level. Decision recommendations are to consider the risk response process, as well as human, environmental, and equipment factors, among others.

9.3.7 IMPLEMENTATION AND VERIFICATION OF RECOMMENDATIONS

9.3.7.1 Recommended measures derived from risk assessment are to be implemented by relevant units, with an implementation statement submitted as part of the risk assessment report.

9.3.7.2 On-site verification of implemented measures is to be performed by CCS surveyors.

CHAPTER 10 TEST REQUIREMENTS

Section 1 GENERAL PROVISIONS

10.1.1 GENERAL REQUIREMENTS

10.1.1.1 This Chapter specifies the requirements for test items and content for pure battery-powered ships.

10.1.1.2 This Chapter applies to the power system (including the battery system, power distribution system, and propulsion system) of ships that use batteries as the sole power source. For hybrid-powered ships, the corresponding requirements of this Chapter may be referenced. Test items include land-based integrated commissioning tests, mooring tests, and sea trials. For applicable conventional mooring and sea trial items not mentioned in this Chapter, refer to GB/T 3221 Outline for Mooring and Sea Trials of Inland Waterway Ships with Internal Combustion Engines or GB/T 3471 General Principles for Mooring and Sea Trials of Seagoing Ships based on the ship's navigation waters.

Section 2 LAND-BASED INTEGRATED COMMISSIONING

10.2.1 SCOPE OF APPLICATION

10.2.1.1 The following ships are to conduct the land-based integrated commissioning tests required by this Section:

(1) Passenger ships meeting any one of the following conditions;

① Number of passengers ⩾ 300;

② Total propulsion power ⩾ 500 kW;

③ Installed battery capacity ≥ 4000 kWh.

(2) Cargo ships meeting any one of the following conditions:

① Total propulsion power ⩾ 1000 kW;

② Installed battery capacity ≥ 8000 kWh.

10.2.1.2 For a series of ships meeting the requirements of Clause 10.2.1.1, if there are no fundamental changes in the topology, protection principles, or control logic of the battery, power distribution system, or propulsion system, only the first ship[①] is required to undergo the integrated commissioning tests.

10.2.1.3 Land-based integrated commissioning tests are to be conducted by an organization recognized by CCS and witnessed by a CCS surveyor.

10.2.1.4 For other ships requiring land-based integrated commissioning tests, this Section may be referenced.

10.2.2 TEST OBJECTIVES

10.2.2.1 To verify the completeness, adaptability, electromagnetic compatibility, and

① It refers to the first ship of a series constructed by the same shipyard under the same plan approval job control number or based on plans deemed equivalent by the plan approval organization.

operational coordination of the main equipment in the ship's power system. To confirm the compatibility of the main equipment parameters, the correctness of interface relationships, and to ensure that the system parameters and performance indicators meet the requirements. Additionally, to inspect the stability of system operation.

10.2.3 TEST PREPARATION

10.2.3.1 All equipment involved in the commissioning is to have completed their respective product survey.

10.2.3.2 Verify that the installation of each equipment meets the technical requirements and that the cleanliness of related pipelines complies with the requirements.

10.2.3.3 Check that the pipe diameter, pressure, and water pipe pressure resistance of the liquid cooling system meet the test requirements.

10.2.3.4 Conduct insulation resistance measurement and voltage withstand tests on the equipment and cables to confirm compliance with relevant regulatory requirements.

10.2.3.5 Land-based integrated commissioning test plan is to be approved by the CCS surveyor.

10.2.4 BATTERY SYSTEM

10.2.4.1 Inspect and measure the parameters of the battery system, ensuring that the monitored values are within the normal range. The monitored parameters include, but are not limited to, the following:

(1) Total voltage of the battery assembly;

(2) State of Charge (SOC) of the battery assembly;

(3) Temperature of individual cells;

(4) Voltage of individual cells;

(5) Ambient temperature of the battery room (space);

(6) Alarm status.

10.2.4.2 Conduct safety protection function tests for the battery system, including but not limited to the following:

(1) Overvoltage and undervoltage protection function test for individual battery cells;

(2) Overtemperature protection function test for individual battery cells;

(3) Protection function test for battery assembly faults (overcharge, over-discharge, overcurrent, overtemperature, external short circuit);

(4) BMS communication fault protection test (including internal communication and communication with PMS/EMS/AMS, charging devices, and other equipment);

(5) Emergency stop test for the system;

(6) Functional test of the minimum power alarm device required for normal ship operation, which is independent of other alarm devices;

(7) Interlock test at the operation location.

10.2.4.3 Perform the connection and disconnection test for each battery assembly (or containerized power supply, the same below), and record the status of the battery system and the DC busbar.

10.2.4.4 Conduct battery assembly operation tests, including but not limited to the following:

(1) Single battery assembly operation test (if applicable);

(2) Manual parallel test: Manually connect each battery assembly in sequence, and after the system stabilizes, record parameters such as current, voltage, power, and temperature of the battery system;

(3) Automatic parallel test: Perform automatic parallel test of battery assemblies through the power control panel on the bridge console, and record parameters such as current, voltage, power, and temperature of the battery system after stabilization;

(4) Parallel load test: Connect the battery system to the grid, start the propulsion inverter and daily inverter, and record parameters such as, current, power, temperature, and current difference between battery assemblies under various operating conditions (loads of 25%, 50%, 75%, and 100%, determined based on the power calculation document);

(5) Sudden connection and disconnection test of battery assemblies: Focus on the impact on the grid when suddenly connecting a parallel battery assembly during single battery assembly operation, and when suddenly disconnecting one battery assembly during multi-battery assembly operation.

10.2.4.5 Conduct charging tests based on the actual designed charging conditions of the ship. When the preset charging capacity or charging time is reached, stop the charging process and record relevant parameters such as charging time, initial and final SOC, voltage, current, power, temperature, and current difference between battery assemblies. If testing conditions are genuinely limited, making high-power charging tests unfeasible, such tests may be conducted at a supporting charging station with corresponding capabilities, subject to the approval of a CCS surveyor.

10.2.4.6 Verify the implementation of safety measures identified in the risk assessment report for the battery system, and perform validation tests to ensure their effectiveness.

10.2.5 POWER DISTRIBUTION SYSTEM

10.2.5.1 Conduct tests on the DC power distribution system, including but not limited to the following:

(1) Perform operations on the DC distribution board, including the isolation switches for the battery circuit, propulsion circuit, charging circuit, and bus tie isolation switches;

(2) Verify the setting values of protective devices;

(3) Perform switch interlock tests to meet the following requirements:

① When both ends of the bus tie isolation switch are energized, a closing operation must not be performed (if applicable);

② When the circuit where maintenance switch is located is energized, a disconnection operation must not be performed;

③ When the bus tie isolation switch is closed, the insulation monitoring instruments on both sides must not be online simultaneously.

(4) Perform the corresponding short-circuit tests and selective protection strategy verification tests based on the selective protection analysis report, including but not limited to the following content:

① Short circuit between the positive and negative poles of the DC bus in the DC distribution system;

② Short circuit between the positive and negative poles of the battery system (including the converter) terminals;

③ Short circuit between the positive and negative poles of the input terminals of the load equipment (including the converter) in the DC distribution system.

④ If the equipment manufacturer can provide the test report from the factory, the above test requirements may be waived.

(5) Perform functional tests for PMS/EMS, including but not limited to the following:

① Battery assembly grid connection/disconnection, load power distribution, automatic shedding of non-essential loads, power/energy reserve analysis, and heavy load inquiry;

② Real-time calculation of available power and energy based on the state of charge (SOC) of the energy storage system;

③ Charging and discharging of the battery system;

④ The system must have power limiting functionality. When the battery assembly is disconnected due to a fault, it is to immediately limit propulsion power based on the situation to prevent overloading and tripping of other online power sources, which could lead to a total blackout;

⑤ The system must monitor power system faults. When power supply to systems and equipment on non-faulty sections is interrupted, it is to automatically execute relevant measures to restore power supply;

⑥ Verify that the system can automatically enter a safe state under the following conditions:

(a) Power/Energy Management System (PMS/EMS) power supply failure;

(b) Power/Energy Management System (PMS/EMS) programmable controller failure;

(c) Power/Energy Management System (PMS/EMS) communication failure;

(d) Other failures with higher risk levels identified in the risk assessment report.

(6) The above test requirements can be waived if the equipment manufacturer can provide a test report from the factory of the equipment.

10.2.5.2 Conduct the daily alternating current (AC) power distribution system tests, including but not limited to the following:

(1) Perform operations on the relevant circuit breakers at the daily AC distribution panel;

(2) Safety and protection function tests, including:

① Protection device setting tests;

② Inverter protection function tests, which involve short-circuiting at the inverter output terminals, including three-phase short circuits at the AC busbar of the daily AC power distribution system, three-phase short circuits at the output terminals of the power supply unit of the daily AC power distribution system, and three-phase short circuits at the input terminals of the loads of the daily AC power distribution system. Monitor and record the inverter's output voltage, current, frequency, the status of the isolation transformer, and the circuit breakers and current of each branch at the AC distribution panel;

③ Shore power/ship power interlock tests (if applicable).

(3) Switch interlock tests are to meet the following requirements:

① The secondary side switch of the isolation transformer and the bus tie switch is not to be closed simultaneously (if applicable);

② The secondary side switch of the isolation transformer and the shore power switch is not to be closed simultaneously (if applicable);

③ When the bus tie switch is closed, the insulation monitoring instruments on both sides are not to be online simultaneously (if applicable).

(4) Conduct corresponding verification tests based on the selective protection analysis report, including but not limited to the following:

① Three-phase short circuit at the AC busbar of the daily power distribution system;

② Three-phase short circuit at the output terminals of the power supply unit of the daily AC power distribution system;

③ Three-phase short circuit at the input terminals of the loads of the daily AC power distribution system.

(5) Daily inverter tests, including but not limited to the following:

① No-load test of the daily inverter: Perform start and stop control of the inverter, and record the no-load voltage and frequency at the secondary side of the isolation transformer;

② Load test of the daily inverter: Start the inverter and adjust the load to 25%, 50%, 75%, 100%, and 110% respectively, running for 1 to 5 minutes. Record the inverter's output voltage, current, frequency, power, component temperature, voltage harmonics, isolation transformer winding temperature, filter winding temperature, and other operating parameters;

③ Sudden load application and removal test of the daily inverter: After starting the inverter, gradually increase the load to the rated load and stabilize the operation. Perform a 100% sudden load removal test, recording the change in the inverter's output voltage and stabilization time. Then perform a 0%-50%-100% sudden load application test, recording the change in the inverter's output voltage and stabilization time;

④ Transfer test between daily inverters (if applicable): Record the time for automatic and manual transfer;

⑤ Transfer test between daily transformers: Record the time for automatic and manual transfer;

⑥ Check the mutual conversion function between ship power and shore power (if applicable).

10.2.5.3 Verify the implementation of safety measures identified in the risk assessment report for the power distribution system, and conduct test validations.

10.2.6 PROPULSION SYSTEM

10.2.6.1 Single Motor/Multi-Motor Start and Stop Test

10.2.6.2 Propulsion System Protection Tests, including but not limited to the following:

(1) Emergency Stop Test for Propulsion Motor: Start the propulsion motor and operate it at rated speed. Test the emergency stop button functions on both the propulsion control panel and the propulsion control box.

(2) Overspeed Protection Test for Prop Motor (if applicable): Conduct the test by adjusting the overspeed alarm and protection threshold settings.

(3) Propulsion Motor Starting Interlock Function Test: The test may be conducted by simulating a propulsion system fault to verify whether the propulsion system can be started when the fault is not reset.

(4) Control System Power Failure: Verify that the system can switch to the backup power supply and operate normally after the main power supply fails.

(5) Communication Fault Alarm Test: Disconnect the communication between the inverter and the propulsion control system, and ensure the propulsion system reports a communication fault.

(6) Overtemperature Protection Test for Propulsion Motor (if applicable): When the motor temperature reaches or exceeds the alarm setpoint, the propulsion control system generates a corresponding fault alarm and blocks the starting signal.

(7) Interlock Test Between Space Heater and Operation of Propulsion Motor: Verify that the space heater and motor operation are interlocked correctly.

(8) Override Function Test: Test the override functionality to ensure it operates as intended.

10.2.6.3 Functional Tests for the Propulsion System are to include:

(1) The control functions for each propulsion motor, including start-up, speed increase, speed decrease, and shutdown, are to be verified;

(2) Reversing test for each propulsion motor;

(3) Control conversion and control tests for multiple operating locations and multiple propulsion devices, including combined control and separate control (if applicable).

10.2.6.4 10.2.6.4 Load Tests for the Propulsion System are to include:

(1) No-load test for each motor;

(2) Load test for each motor, with load adjustments in the sequence of 0%-25%-50%-75%-100%-75%-50%-25%-0%, and recording parameters at each test point;

(3) Sudden load application and removal tests, focusing on the maximum rated power equipment in the power load estimation under corresponding conditions based on the actual DC power distribution system. Special attention is to be given to the impact on the power grid when a propulsion motor operating at full power is suddenly unloaded.

If the ship employs novel propulsion devices, such as azimuth thrusters, rim-driven thrusters, cycloidal propellers, etc., the aforementioned tests may be conducted during the ship's mooring tests or sea trials stage.

10.2.6.5 Verify the implementation of safety measures identified in the risk assessment report for the propulsion system, and conduct test validations.

10.2.7 COOLING SYSTEM

10.2.7.1 Monitor the temperature changes of equipment in the battery system, propulsion system, and power distribution system, and verify the temperature regulation capability of the cooling system.

10.2.7.2 Test the safety protection strategy of the cooling system under a single fault condition.

Section 3 MOORING TESTS

10.3.1 TEST PURPOSE

10.3.1.1 Verify the working performance and protection functions of the battery system, power distribution system, and propulsion system in the ship's mooring state.

10.3.1.2 Confirm the effectiveness of system parameter settings and protection values, providing reference for sea trials.

10.3.2 TEST PREPARATION

10.3.2.1 All equipment is to hold corresponding certificates in accordance with CCS rules.

10.3.2.2 Check that the installation of each equipment and the cleanliness of related pipelines meet the requirements.

10.3.2.3 Check that the pipe diameter, pressure, and water pipe pressure resistance of the liquid cooling system meet the test requirements.

10.3.2.4 Perform insulation resistance measurement and voltage withstand test on equipment and cables, ensuring compliance with relevant rules.

10.3.3 BATTERY SYSTEM

10.3.3.1 Complete the measurement and inspection of battery system parameters as per 10.2.4.1.

10.3.3.2 Complete the safety protection function test of the battery system as per 10.2.4.2.

10.3.3.3 Perform the local switching test of battery assemblies as per 10.2.4.3.

10.3.3.4 Perform the operation test of battery assemblies as per 10.2.4.4.

10.3.3.5 Perform the battery charging test as per 10.2.4.5. If the battery system has undergone charging tests during land-based commissioning, it may be exempted during mooring tests.

10.3.3.6 Check the implementation of safety protection measures for risks identified in the risk assessment report for the battery system, and conduct test verification. Items already verified during land-based commissioning may not be verified again during mooring tests.

10.3.4 POWER DISTRIBUTION SYSTEM

10.3.4.1 Conduct tests on the DC power distribution system as per 10.2.5.1. If a short-circuit test report approved by the surveyor is available, the short-circuit test may be omitted during the mooring test phase.

10.3.4.2 Conduct tests on the AC daily power distribution system as per 10.2.5.2.

10.3.4.3 Check the implementation of safety protection measures for risks identified in the risk assessment report for the power distribution system, and conduct test verification. Items already verified during land-based commissioning may not be verified again during mooring tests.

10.3.5 PROPULSION SYSTEM

10.3.5.1 Conduct the protection function test of the propulsion system as per 10.2.6.2, and perform the interlock test between the shaft locking device and the propulsion system (if applicable).

10.3.5.2 Conduct the functional test of the propulsion system as per 10.2.6.3.

10.3.5.3 Conduct the load test of the propulsion system as per 10.2.6.4. The 100% load test and sudden load application/removal test may be adjusted based on the specific conditions of the mooring equipment at the dock.

10.3.5.4 Propulsion system operation test: Test the operational performance of the propulsion system under different working conditions by controlling the power and speed of the propulsion motor.

10.3.5.5 Check the implementation of safety protection measures for risks identified in the risk assessment report for the propulsion system, and conduct test verification. Items already verified during land-based commissioning may not be verified again during mooring tests.

10.3.6 COOLING SYSTEM

10.3.6.1 Conduct the performance test of the cooling system as per 10.2.7.1.

10.3.6.2 Conduct the safety protection strategy test of the cooling system as per 10.2.7.2.

10.3.7 CONTAINERIZED POWER SUPPLY

10.3.7.1 Test whether the loosening and accidental unlocking of the containerized power supply can be detected.

10.3.7.2 Test the automatic and manual unlocking functions of the power exchange system.

10.3.7.3 Test the self-closing function of the fire damper at the emergency exhaust port of the containerized power supply (if applicable).

10.3.7.4 Test the effectiveness of the internal ventilation system, firefighting system, combustible gas detection device, and alarming and monitoring system of the containerized power supply.

Section 4 SEA TRIALS

10.4.1 TEST OBJECTIVES

10.4.1.1 Verify the performance, maneuverability, and safety of the electric-powered ship under actual sailing conditions.

10.4.2 TEST PREPARATION

10.4.2.1 Inspect the overall condition of the ship to ensure the hull, battery system, power distribution system, and propulsion system are functioning properly.

10.4.3 NAVIGATION PERFORMANCE TESTS

10.4.3.1 A ship is to conduct stopping tests in accordance with the following requirements:

(1) Measure the track length and glide time of the ship stopping in water, conducting one test each with and against the current.

(2) Full-speed inertia stopping test: The test is considered complete when, starting from the issuance of the "stop engines" command while the ship is sailing steadily on a predetermined course at the designed speed, the ship virtually ceases moving through water. Throughout the test, the rudder angle is to be maintained at zero, and the initial course, speed, and propulsion motor RPM are to be recorded.

(3) Full-speed astern stopping test: The test is considered complete when, starting from the issuance of the "full astern" command while the ship is sailing steadily on a predetermined course at the designed speed, the ship virtually ceases moving through water. Throughout the test, the rudder angle is to be maintained at zero, and the initial course, speed, and propulsion motor RPM are to be recorded.

10.4.3.2 Test the course-keeping ability of the ship under full-speed navigation conditions, including the following items:

(1) Conduct tests in the absence of crosswinds and cross-currents, performing one test each in downstream and upstream conditions. Measure the steering frequency and yaw angle.

(2) Maintain the ship's course unchanged and sail at full speed for 3 minutes. Measure the

number of steering actions and the steering angle required to maintain a straight course.

(3) Keep the rudder at neutral and sail straight at full speed for 3 minutes. Measure the deviation angle from the original course.

10.4.3.3 When the AC daily power distribution system is powered by inverters, perform the following tests:

(1) Inspection and start/stop tests of the inverter.

(2) Inspection and testing of the inverter under load operation.

(3) Tests of power transfer between inverters (if applicable) and between inverters and other AC power sources (if any), ensuring uninterrupted load during the transfer. Measure the manual and automatic transfer times separately.

10.4.3.4 Measure the time required for the steering motor to restore normal steering effectiveness after power loss and recovery. For passenger ships navigating in rapids sections, verify the reliability of the steering gear motor power supply transfer to ensure navigation safety.

10.4.3.5 Verify the automatic start function of the steering motor.

10.4.3.6 Verify the automatic start and switching functions of the backup pump serving the water cooling system.

10.4.4 PROPULSION SYSTEM TESTS

10.4.4.1 Conduct navigation tests at different speeds under various loading conditions as specified in Table 10.4.4.1, to evaluate the ship's navigation performance and stability under different operating conditions.

Propulsion System Navigation Test Items Table 10.4.4.1

Operating Condition Number		Power or Corresponding Speed Percentage（%）	Test Duration（h）
1	Ahead	25	0.25
2		50	0.25
3		Normal Power Speed	0.25
4		100	0.5
5	Astern	Maximum Astern Test Condition	0.25
Note: Specific timing will be adjusted based on battery capacity and endurance.			

10.4.4.2 Measure the time required for each propulsion motor to accelerate from a standstill to full speed.

10.4.4.3 Simulate emergency scenarios during ship navigation, such as emergency stopping, emergency steering, propulsion inverter malfunction, communication failure, daily inverter fault, and directional control device failure, to test the ship's emergency response capability and system reliability.

10.4.4.4 Test the ship's navigation and steering control performance, including control accuracy, response time, and maneuverability, and record the test data.

10.4.4.5 With the ship in the half ahead state, directly transition to the stop state to test the effectiveness of energy recovery or dissipation. This test aims to prevent a situation where the ship's power grid cannot absorb the electricity generated by the propeller's inertial rotation during stopping, which could cause a sudden voltage rise on the DC main busbar leading to a blackout.

CHAPTER 11 AUTOMATION REQUIREMENTS

Section 1 GENERAL PROVISIONS

11.1.1 GENERAL REQUIREMENTS

11.1.1.1 This Chapter specifies the automation requirements (hereinafter referred to as “automation”) for ship power system (including the battery system, power distribution system, and propulsion system) that use batteries as the sole power source. Unless explicitly stated in this Chapter, battery-powered ships are also to comply with the relevant rules of CCS. The automation of the battery portion of hybrid-powered ships may refer to the corresponding requirements of this Chapter.

11.1.1.2 The machinery spaces referred to in this Chapter include the spaces containing the battery system, power distribution system, and propulsion system. The automated system described in this Chapter include control systems, safety systems, and alarming and monitoring systems (including displays).

11.1.1.3 A pure battery-powered ship equipped with an automation system complying with the requirements of this Chapter is to be adaptable to all navigation conditions (including maneuvering):

11.1.1.4 The safety of the ships with automated systems complying with the requirements of this Chapter is to be same as that of the ships with machinery spaces being attended. Means are to be provided to ensure that the machinery and electrical equipment can be manually and effectively operated from a local position in case of failure of the automated systems.

Section 2 CONTROL, ALARMING AND MONITORING, AND SAFETY SYSTEMS

11.2.1 GENERAL REQUIREMENTS

11.2.1.1 The control, alarming and monitoring, and safety systems of a pure battery-powered ship are to comply with the relevant requirements of Chapter 2, Part 7 of CCS Rules for the Classification of Sea-going Steel Ships. Inland water ships are to comply with the relevant requirements of Chapter 2, Part 4 of CCS Rules for the Construction of Inland Steel Ships (2025).

Section 3 PERIODICALLY UNATTENDED MACHINERY SPACES

11.3.1 GENERAL REQUIREMENTS

11.3.1.1 This Section applies to pure battery-powered ship(s) where the main propulsion plant is remotely controlled from the navigating bridge control station and the machinery spaces are periodically unattended. The corresponding automation class notation is AUT-0.

11.3.1.2 Pure battery-powered ships with the AUT-0 class notation are, in addition to complying with the requirements of Sections 1 and 2 of this Chapter, to also be in compliance with the requirements of this Section.

11.3.1.3 Passenger ships with the AUT-0 class notation are also to be in compliance with the requirements of relevant regulations based on the navigation area (if applicable).

11.3.1.4 During the unattended period, the automated system is to ensure the continuous normal operation of the following machinery and electrical equipment:

(1) Battery system;

(2) Power distribution system;

(3) Main propulsion system, including main propulsion machinery, transmission devices (such as reduction gearboxes), and propellers;

(4) Essential auxiliary machinery serving the battery system, power distribution system, and main propulsion system;

(5) Other machinery and electrical equipment, such as bilge systems, valves associated with remote control as well as others of which automated control and monitoring is deemed necessary by CCS.

11.3.2 BATTERY SYSTEM

11.3.2.1 The requirements for the items to be automatically controlled and monitored for battery system are to be in compliance with Table 11.3.16.1 of this Section as appropriate.

11.3.3 POWER DISTRIBUTION SYSTEM

11.3.3.1 The requirements for the items to be automatically controlled and monitored for both DC and AC power distribution system are to be in compliance with Table 11.3.16.1 of this Section as appropriate.

11.3.4 ELECTRIC PROPULSION INSTALLATIONS

11.3.4.1 The electric propulsion installations are to be in compliance with the relevant requirements of Chapter 15, Part 8 of CCS Rules for Classification of Sea-going Steel Ships or Chapter 2, Part 8 of CCS Rules for Construction of Inland Steel Ships.

11.3.4.2 The electric propulsion installations are to be capable of being controlled at the BCS, and thereare to be provided with instruments for indicating the direction of rotation and speed of the propeller shaft, as well as those for indicating other necessary operational parameters.

The requirements for the items to be automatically controlled and monitored for electric propulsion installations are to be in compliance with Table 11.3.16.1 of this Section as appropriate.

11.3.5 TRANSMISSION DEVICES (REDUCTION GEARBOXES, ETC.)

11.3.5.1 The requirements for the items to be automatically controlled and monitored for transmission devices (such as reduction gearboxes) are to be in compliance with Table 11.3.16.1 of this Section as appropriate.

11.3.6 AUXILIARY MACHINERY

11.3.6.1 The auxiliary machinery referred to in this Section includes various pumps and other auxiliary equipment serving the battery system, power distribution system, and main propulsion system.

11.3.6.2 During the unattended period of machinery spaces, all the auxiliary machinery are to be capableof being normally operated automatically.

11.3.6.3 For pumps driven by electric motors and serving the battery system, power distribution system, or main propulsion system, when power is restored after a power failure, they are to be able to automatically start according to the startup procedure. The automatic switching requirements for standby pumps are specified in the items marked with note "c" in Column 4 of Table 11.3.16.1.

11.3.7 OTHER EQUIPMENT

11.3.7.1 The requirements for the items to be automatically controlled and monitored for the stern tube bearing are to be in compliance with Table 11.3.16.1 of this Section as appropriate.

11.3.7.2 The valves covered by this Section mean the valves used in bilge and sea water systems(including ballast water system):

(1) Failure of actuator power is not to put the valve and the whole ship to an unsafe condition

(2) Positive indication is to be provided at the station for valve control to show the actual valve position or alternatively, whether the valve is fully open or closed.

(3) Operating equipment located in places which may be flooded is to be capable of normal operation when submerged..

(4) In the event of a failure of the remote or automatic control the valves are to be capable of being operated manually.

11.3.8 PROVISION OF CONTROL STATIONS (ROOMS)

11.3.8.1 Bridge control station (BCS), engine room centralized control station (CCS) and local control stations (LCS) are in general to be provided on ships with machinery spaces periodically unattended. For inland water ships, if an engine room centralized control station(room) is not provided, it may be substituted by a monitoring room (control room) or a control space with equivalent functions.

11.3.8.2 Control transfer is to meet the following requirements:

(1) Transfer of control between control stations is to be possible to the machinery and electrical equipment under common control from such stations, either when these machinery and electrical equipment are in normal operation or in case of their failures. Such changeover is not to seriously affect the operating conditions of the machinery and electrical equipment.

(2) The transfer of control between the CCS and BCS is to be possible only at the CCS, and the transfer of control between the LCS and CCS or BCS is to be possible only at the LCS.

(3) Changeover between control stations is to be so arranged that it may be effected only with the acceptance of the station taking control..

(4) Provision is to be made at all control stations (rooms) to indicate which station is in control..

(5) Where machinery and electrical equipment may be controlled from two or more control stations(rooms), control is to be possible only from one control station at one time. At all control stations, interconnected control positions for the controllers for main propulsion machinery are permitted.

(6) Propulsion machinery orders from the navigating bridge are to be indicated at all control positions for the machinery.

11.3.9 FUNCTIONS OF THE BRIDGE CONTROL STATION

11.3.9.1 Under all sailing conditions including maneuvering, the speed and direction of thrust of main propulsion machinery as well as other associated installations (if fitted) are to be effectively controlled from the BCS. When necessary, the control is to be capable of being changed over to other control stations at any time.

11.3.9.2 AlarmsattheBCS:

(1) For the items to be alarmed at the BCS and the mode of alarms, see Column 5 of Table 11.3.16.1. Alarms indicating the faults in the machinery and electrical equipment as well as the automated control and monitoring systems are, in general, to be relayed to the BCS in the following modes: group alarms for the protective actions of safety systems; separate alarms; group alarms for serious faults and group alarms for general faults.

(2) The audible alarms at the BCS are permitted to be silenced after acknowledgment, but the visual alarms are to be extinguished only after the rectification of faults, and furthermore, the visual signals are to be capable of being clearly distinguishable before and after acknowledgment.

11.3.10 FUNCTIONS OF THE CENTRALIZED CONTROL STATION (ROOM) (IF INSTALLED)

11.3.10.1 The CCS is to be capable of performing functions of control and changeover of the main propulsion machinery as specified in 11.3.9.1 of this Section, and besides, it is also to be capable of controlling and monitoring the other equipment as specified in 11.3.1.4 of this Chapter.

11.3.10.2 Instruments or display units are to be provided at the CCS to indicate the essential parameters for ensuring the safe and reliable operation of the machinery and electrical equipment. The items to be displayed are given in Column 2 of Table 11.3.16.1.

11.3.10.3 All faults including several faults occurred at the same time in the machinery and electrical equipment and in the control and monitoring systems are to be capable of being alarmed at the CCS. The items to be alarmed are given in Column 3 of Table 11.3.16.1.

11.3.10.4 Audible alarms at the CCS are to be capable of being silenced only after being acknowledged at the station.

11.3.10.5 The emergency button for stopping main propulsion machinery at the CCS are to be independent of the automated systems of the station, but their actuating units may not be required to be independent and are to be arranged so as to preclude inadvertent operation.

11.3.10.6 If an override function is provided for the main propulsion system, the centralized control station (room) is also to be capable of performing this function, and measures are to be in place to prevent accidental activation of the override function.

11.3.11 FUNCTIONS OF THE LOCAL CONTROL STATION

11.3.11.1 The local control stations are to comply with the relevant requirements of 11.1.1.4 and 11.3.8.2 of this PART. It is to be possible for the propulsion machinery to be controlled from a local position even in the case of failure or malfunction in any part of the automatic or remote control systems of any other control station or the propulsion machinery.

11.3.12 COMMUNICATION

11.3.12.1 In addition to complying with the relevant requirements of applicable regulations and CCS rules, reliable voice communication devices are to be provided between the centralized control station (room) or local control station (if applicable) and the bridge control station, as well as the engineers' accommodation spaces.

11.3.13 ADDITIONAL REQUIREMENTS FOR CONTROL AND MONITORING SYSTEMS

11.3.13.1 The safety systems of all monitored electromechanical equipment are to meet the following requirements:

(1) In case of serious faults endangering the main propulsion engines, boilers, electric generating plants and other essential machinery and electrical equipment, the safety systems are to operate automatically for safeguarding the machinery or electrical equipment in question in the three modes of operation required in 11.3.16.2 of this PART and alarms are to be given.

(2) When the system has stopped a unit, the unit is not to be restarted automatically before a manual reset has been made.

(3) In order to avoid undesirable interruption in the operation of machinery, the system is to intervene sequentially after the operation of alarm system by:

① starting of standby units;

② load reduction or shutdown, such that the least drastic action is taken first.

(4) When the system has been activated, audible and visual alarms are to be given in control station to trace the cause of the safety action.

(5) For the purpose of ensuring the safety of ships, an override function is generally to be provided for the ship's electric propulsion system. When the override function is activated, it is to be indicated, and an alarm is to be triggered. Measures are to be in place to prevent accidental activation of the override function.

11.3.13.2 The alarm system is to meet the following requirements:

(1) The arrangement of the alarm display is to assist in identifying the particular fault condition and its location within the machinery space.

(2) If the bridge navigating officer of the watch is the sole watch-keeper then, in the event of a machinery fault being monitored at the control location for machinery, the alarm system is to be such that this watch-keeper is made aware when:

① a machinery fault has occurred;

② the machinery fault is being attended to (e.g. acknowledging, silencing);

③ the machinery fault has been rectified. Alternative means of communication between the bridge area, the accommodation for engineering personnel and the machinery spaces (CCS or local control stations) may be used for this function.

(3) Group alarms may be arranged on the bridge to indicate machinery faults. Alarms associated with faults requiring speed reduction or automatic shutdown of propulsion machinery are to be separately identified (see Column 5 of Table 11.3.16.1).

(4) The alarm system is to be capable of being tested during normal machinery operation. Where practicable, means are to be provided at convenient and accessible positions to permit the sensors to be tested without affecting the operation of the machinery.

(5) If an alarm has been acknowledged and a second fault occurs before the first is rectified, then audible and visual alarms are to operate again. Alarms due to temporary failures are to remain activated until acknowledged.

(6) Automatic recording devices are to be provided at the CCS for recording the important parameters and faults. Where a computer system is used, its recording device may be adopted instead.

(7) A changeover switch is to be provided to relay all the fault alarms to the engineers' accommodation and each engineer's cabin by group alarms so as to ensure that the alarm signal is relayed at least to one cabin of the engineer on watch. Acknowledgment of alarms at positions outside a machinery space (including the CCS) is not to silence the audible alarm or extinguish the visual alarm in that machinery space (including the CCS). Where an alarm has not been acknowledged in a certain time (not more than 5 min) in the machinery space (including the CCS), the alarm system referred to the engineer call system (Internal communication device that sends alarm signals from the machinery spaces or control room to the engineers' accommodation spaces), and the alarm is to be clearly audible within the engineers' accommodation and related public spaces.

11.3.13.3 The requirements for the items to be automatically controlled and monitored for battery rooms/battery boxes(cabinets)/ containerized power supplies are to be in compliance with Table 11.3.16.1 of this Section as appropriate..

11.3.14 FIRE PROTECTION

11.3.14.1 Fire protection measures for periodically machinery spaces (including the centralized control station (room)) are to comply with the relevant regulations and CCS rules.

11.3.14.2 Special requirements for fire detection systems in power spaces:

(1) An automatic fire detection system is to be fitted in the machinery spaces.

(2) The system is to be designed with self-monitoring properties. Power or system failures are to initiate an audible alarm distinguishable from the fire alarm.

(3) The fire detection indicating panel is to be located on the navigation bridge, fire control station, or other accessible place where a fire in the machinery space will not render it inoperative.

(4) The fire detection indicating panel is to indicate the place of the detected fire in accordance with the arranged fire zones by means of a visual signal. Audible signals clearly distinguishable in character from any other audible signals are to be audible throughout the navigation bridge and the accommodation area of the personnel responsible for the operation of the machinery space.

(5) Fire detectors are to be of such types, and so located, that they will rapidly detect the

onset of fire in conditions normally present in the machinery space. Consideration is to be given to avoiding false alarms. The type and location of detectors are to comply withrelevant regulations and CCS rules, and a combination of detector types is recommended in order to enable the system to react to more than one type of fire symptom.

(6) Fire detector zones are to be arranged in a manner that will enable the operating staff to locate the seat of the fire. The arrangement of the fire detection system, the number of loops and the location of detector heads are to be approved in each case and comply with relevant regulations. Air currents created by the machinery are not to render the detection system ineffective。When fire detectors are provided with the means to adjust their sensitivity, necessary arrangements are to be ensured to fix and identify the set point.

(7) When it is intended that a particular loop or detector is to be temporarily switched off, this state is to be clearly indicated. Reactivation of the loop or detector is to be performed automatically after a preset time. (9) The fire detection indicating panel is to be provided with facilities for functional testing.

(8) The fire detection indicating panel is to be provided with facilities for functional testing.

(9) The fire detection system is to be fed automatically from the emergency source of power by separate feeder if the main source of power fails, and to comply with relevant regulations and CCS rules.

(10) Facilities are to be provided in the fire detection system to release manually the fire alarm from the passageways having entrances to engine and boiler rooms, navigation bridge and control station in engine room.

(11) The fire detection system is to be tested upon installation on board to confirm compliance with the rule requirements for function.

11.3.15 PROTECTION AGAINST FLOODING

11.3.15.1 An alarm system is to be provided to warn high bilge water level in machinery spaces. The alarm level is to be sufficiently low to prevent liquid overflowing from the bilge onto the tank top of double bottom tanks.

11.3.15.2 The number and location of bilge water level detectors are to be such as to prevent false alarms at normal angles of trim and heel.

11.3.15.3 The location of the controls of the valves serving a sea inlet, an underwater discharge or a bilge injection system that are capable of controlling flooding upon damage shall take full account of the time required for personnel to reach and close the valves in case of water influx into the space; such controls are to be arranged above the flooding water level that the space may reach due to pipe breakage when the ship is in the fully loaded condition.

11.3.15.4 Bilge wells are to be large enough to accommodate normal drainage during the unattended period. Where the bilge pumps are arranged to start automatically, smaller bilge wells may be permitted to accommodate the normal drainage for a suitable time, provided that an alarm is provided to indicate if the influx of liquid is greater than the pump capacity or if the pump is operating more frequently than would normally be expected and that the discharge complies with the relevant requirements for pollution prevention. The items to be controlled and monitored are indicated in Table 11.3.16.1.

11.3.15.5 Alarms required by 11.3.15.1 and 11.3.15.4 above are to be given at the CCS, BCS and engineers' accommodation area.

11.3.16 TABLE OF AUTOMATIC CONTROL AND MONITORING ITEMS

11.3.16.1 The automatic control and monitoring items (if fitted) for all ships with the class notation AUT-0 are to comply with Table 11.3.16.1.

11.3.16.2 The designations used in Table 11.3.16.1 of this Section are defined as follows:

—: not required;

a: Mode a protective action, such as emergency shutdown of the engine and cutoff of electric power supply, etc.;

b: Mode b protective action, such as reducing the speed of rotation or the output of machinery;

c: Mode c protective action, such as starting and putting into operation of standby pump or standby unit;

S: Single alarm;

Ga: Group alarm activated by Mode a protective action;

Gb: Group alarm activated by Mode b protective action;

R: Group alarm for serious faults;

Y: Group alarm for general faults.

11.3.16.3 For a pure battery-powered ship that is not provided with an centralized control station (room), a control room (surveillance room), or a control room with equivalent functions, the items required for display and alarm in Column 2 and Column 3 of Table 11.3.16.1 are to be provided at both the local and the navigating bridge control station.

Automatic Control and Monitoring Items
for Pure Battery-Powered Ships with Class Notation AUT-0 Table 11.3.16.1

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
1 Battery System 1.1 Battery System					
Total Battery System Capacity Minimum Capacity Alarm	—	Low	—	S	
Battery String/Battery Assembly/Battery System Minimum Capacity Alarm	—	Low	—	Y	No need to set up an independent alarm, the alarm signal can be issued by the Battery String/Battery Assembly/Battery System

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Emergency Shutdown	—	Activated	—	S	Applicable to Battery Assembly with a nominal capacity exceeding 50kWh
Fire Detection Inside Battery Pack	—	During Thermal Runaway	—	R	Applicable to Battery Packs Equipped with Fire Prevention and Control Devices
1.2 Battery Management System					
Battery System Voltage	Voltage	—	—	—	
Battery Cell Voltage	Voltage	High/ Low	b	G_b	Perform balancing control, power reduction.
		Too High/Too Low	a	G_a	Stop the operation of the battery string/battery assembly/battery system
Battery Series Circuit Current	Current	High	b	G_b	Reduce power.
		Too High	a	G_a	Stop the operation of the battery string/battery assembly/battery system
Battery Cell Temperature	Temperature	High	b	G_b	Temperature regulation and power reduction.
		Too High	a	G_a	Stop the operation of the battery string/battery

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					assembly/battery system. Over-temperature protection is to be independent of other components for temperature indication, alarm, and control functions (including sensors, circuits, monitoring, and control components).
Ambient Temperature	Temperature	High/Low	b	G_b	Temperature Regulation and Power Reduction
		Too High	a	G_a	Battery string/battery assembly/battery system shutdown. Over-temperature protection is to be independent of other components for temperature indication, alarm, and control functions (including sensors, circuits, monitoring, and control components).
Insulation Resistance	Resistance Value	Low	a	G_a	Battery String/Battery

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					Assembly/Battery System Shutdown
State of Charge (SOC)	Percentage	Low	b	G_b	Power Reduction,
		Too Low	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
State of Health (SOH)	Percentage	—	—	—	
Battery Energy Flow State	Status	—	—	—	Charging and Discharging Process
Overcurrent Protection	Current	High	b	G_b	Power Reduction
		Overcurrent	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
Battery Charge/Discharge Protection	Voltage	Overcharge/Overdischarge	—	R	During overcharge, the BMS is to disconnect the charging device; during overdischarge, the BMS is to stop the battery string/battery assembly/battery system from operating.
Battery Pack/Box (Cabinet) Thermal Management Failure	—	Failure	—	Y	If Applicable
Battery Box (Cabinet) Emergency Ventilation	—	Upon Failure	—	Y	If Applicable

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Failure					
Protection Function Failure	—	Upon Failure	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
Temperature Detection Failure	—	Upon Failure	—	Y	
Charging Failure	—	Upon Failure	—	Y	Charging Stopped
Voltage or SOC Imbalance Between Battery Cells or Battery Modules	Voltage/Percentage	High	b	G_b	Perform balancing control and Power Reduction
		Excessive	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
Battery System Shutdown Due to Failure	—	Upon Failure	—	Y	
Abnormal Operation of Battery Circuit Breaker/Relay	—	Abnormal	—	Y	
BMS Communication Failure with PMS/EMS/AMS	—	Upon Failure	b	G_b	Power Reduction,
			a	G_a	Battery String/Battery Assembly/Battery System Shutdown
BMS Power Indication and Fault	—	Upon Failure	—	Y	
1.3 Battery Cooling System (Cooling system that directly adjusts the temperature of individual battery cells within the battery pack)					
Cooling Pump Fault	—	Upon Failure	c	Y	Applicable to multiple battery rooms sharing one liquid cooling

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					system for the battery pack
Circulation Tank Liquid Level	—	Low	—	Y	If applicable
Cooling Pump and Cooler Out Pressure	Pressure	Low	—	Y	Applicable when each battery room has a separate battery pack cooling system
Coolant Inlet Pressure	Pressure	Low	—	Y	Applicable to multiple battery rooms sharing one liquid cooling system for the battery pack
Pressure Difference Across Cooling System Filter	Pressure	High	—	Y	If a filter is installed
2 Power Distribution System 2.1 DC/DC Converter					
Input Voltage	Voltage	—	—	—	
Input Current	Current	—	—	—	
Overload (High Current)	—	During Overload	—	Y	
Charge/Discharge Indication	Status	—	—	—	
Communication Status with BMS	Status	During Fault	—	Y	
External Emergency Shutdown	—	Activated	—	S	Automatic Shutdown
Power Distribution Switch Open/Close Position	Status	—	—	—	

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Converter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Converter Cooling Pump or Fan Failure	—	During Failure	c	Y	If Applicable
Converter Interphase Reactor Temperature	Temperature	High	—	Y	If Applicable
Converter Filter Circuit Protection Trip	—	During Trip	—	Y	If Applicable
2.2 Daily Inverter					
Input DC Voltage	Voltage	—	—	—	
DC Voltage	Voltage	Low	—	Y	Coordinated Low Voltage Ride-Through Time
Output AC Voltage	Voltage	—	—	—	
Output AC Current	Current	—	—	—	
Output AC Frequency	Frequency	—	—	—	
Overload (High Current)	—	During Overload	—	Y	
Power Distribution Switch Open/Close Position	Status	—	—	—	
Inverter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Inverter Cooling Pump or Fan Failure	—	During Failure	c	Y	If Applicable
Inverter Interphase Reactor Temperature	Temperature	High	—	Y	
Converter Filter Circuit Protection Trip	—	During Trip	—	Y	If Applicable
Pre-Magnetization Fault	—	During Failure	—	Y	If Applicable

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
2.3 DC Distribution Board					
Busbar Voltage	Voltage	High/Low	—	Y	Each Section
Busbar Power	Power	—	—	—	Display Total Power and Available Power
Busbar Insulation Resistance Status	—	During Abnormality	—	Y	
Important Load Branch Current	Current	—	—	—	
DC Distribution Board Cooling System Comprehensive Fault	—	During Fault	—	Y	
Cooling System Medium Leakage in DC Distribution Board	—	During Leakage	—	Y	If Applicable
Busbar Tie Protection Device Operation	—	During Operation	—	Y	
Load Protection Device (Fuse or DC Circuit Breaker) Operation	—	During Operation	—	Y	
Energy Management System Comprehensive Fault	—	During Fault	—	Y	
Busbar Pre-Charging Failure	—	During Failure	—	Y	
2.4 AC Distribution Board					
Busbar Voltage	Voltage	High/Low	—	Y	Each Section
Busbar Frequency	Frequency	High/Low	—	Y	Each Section
Busbar Insulation Resistance Status	—	During Abnormality	—	Y	Each Section
Important Load Branch Current	Current	—	—	—	

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Busbar Tie Protection Device Open/Close Position	Status	—	—	—	
Busbar Tie Protection Device Operation	—	During Operation	—	Y	
Inverter Protection Device Open/Close Position	Status	—	—	—	
Inverter Protection Device Operation	—	During Operation	—	Y	
Important Load Branch Protection Device Open/Close Position	Status	—	—	—	
Important Load Branch Protection Device Open/Close Operation	—	During Operation	—	Y	
Automatic Load Shedding	—	During Operation	—	Y	
Inverter Protection Device Automatic Closing	—	During Failure	—	Y	
Inverter Protection Device Automatic Tripping	—	During Trip	—	Y	
Load Distribution Failure	—	During Failure	—	Y	Settings When Using Automatic Load Distribution Function
2.5 Distribution Board Cooling System					
Cooling Pump Failure	—	During Failure	c	Y	
Cooling Pump Outlet Pressure	Pressure	Low	c	Y	
Circulation Tank Liquid Level	—	Low	—	Y	If applicable
Pressure Difference Before and After Cooling System Filter	Pressure	High	—	Y	Applicable to Open Cooling Systems and

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					Closed Cooling Systems with Filters
3. Main Propulsion System 3.1 Propulsion Motor (AC and DC)					
Bearing Lubricating Oil Inlet Pressure or Bearing Temperature	Pressure or Temperature	Low or High	a	G_a	
Voltage	Voltage	High/Low	—	Y	Read All Phases
Excitation Voltage	Voltage	—	—	—	If Applicable
Frequency	Frequency	High/Low	—	Y	Only for AC Propulsion Motors. For Inverter-Controlled Propulsion Motors, Monitoring the Inverter Output Can Be Used as an Alternative
Armature Current	Current	—	—	—	Read All Phases
Excitation Current	Current	—	—	—	If Applicable
High Stator Winding Temperature	Temperature	High	—	Y	Read All Phases; Only Applicable to AC Motors with Capacity >500kW
Motor Switch Open/Close Position	Status	—	—	—	Motor Switch is Applicable for Direct Connection to DC Bus Without

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					Converter, and Isolation Switch for Propulsion Motors Using Permanent Magnet Motors
Motor Operation	Status	—	—	—	
Motor Speed	Speed	Overspeed	a	G_a	
Online Motor Fault	—	When Fault Occurs	—	Y	
Motor Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Cooling Pump or Fan Fault	—	When Fault Occurs	c	Y	If Applicable
Commutating Pole Current	Current	—	—	—	Only for DC Propulsion Motors
Differential Protection or Similar Protection Function	—	When Activated	—	Y	Applicable to AC Motors with Capacity ⩾ 1500kW
3.2 Propulsion Semiconductor Converter					
Input Voltage	Voltage	—	—	—	Measure on the Converter Output Side
Input Current	Current	—	—	—	Measure on the Converter Output Side
Frequency	Frequency	—	—	—	Measure on the Converter Output Side
Overload (High Current)	—	When Overload Occurs	—	Y	Alarm Before Protection Device

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					Activation
Distribution Switch Open/Close Position	Status	—	—	—	
External Emergency Shutdown	—	When Activated	—	S	Automatic Shutdown
Converter Power Device Temperature	Temperature	High	b	G_b	Power Reduction
		Excessive	a	G_a	Automatic Shutdown
Converter Filter Element Temperature	Temperature	High	—	Y	If Applicable
Converter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Converter Cooling Pump or Fan Fault	—	When Fault Occurs	c	Y	If Applicable
Converter Interphase Reactor Temperature	Temperature	High	—	Y	If Applicable
Converter Filter Protection Trip	—	When Tripped	—	Y	If Applicable
3.3 Propulsion Transformer					
Transformer Winding Temperature	Temperature	High	—	Y	If Applicable
3.4 Others					
Excitation Circuit Ground Fault	—	When Fault Occurs	—	Y	For Brushless Excitation Systems and Excitation Circuits of Motors with Rated Power Less Than 500kW, This Item Can Be Omitted
Main Propulsion Circuit Ground Fault	—	When Fault Occurs	—	Y	
4. Transmission Device (Reduction Gearbox, etc., If Applicable)					

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Lubricating Oil Inlet Pressure to Gearbox	Pressure	Low	c	R	If Applicable
		Excessively Low	a	G_a	
Lubricating Oil Inlet Temperature to Gearbox or Cooling Water Temperature	Temperature	High	—	Y	
Working Oil Pressure	Pressure	Low	—	Y	
5. Stern Tube Bearing (If Applicable)					
Oil-Lubricated Stern Tube Bearing Temperature	—	High	—	Y	
Stern Tube Lubricating Oil Tank Level	—	Low	—	Y	
6. Computer System					
Computer in Operation	—	When Fault Occurs	c	R	
Computer System	—	When Fault Occurs	—	R	Including LAN Controller Failure, LAN Overload, Overflow Crash, etc.
Computer System Power Supply	Voltage	When Power Loss Occurs	—	Y	Voltage Can Be Replaced by Indicator Light
7. Battery Room/Battery Box (Cabinet) Monitoring (Monitoring of Containerized Power Supply is to Comply with Relevant Requirements of Chapter 7 of The Rules)					
Flammable Gas Concentration	—	When Exceeding Its Lower Explosion Limit	—	Y	When Flammable Gas Concentration Exceeds 20% of Its Lower Explosion Limit (Volume Fraction), the Emergency Exhaust System is to Automatically Start.

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Temperature Inside Room/Box (Cabinet)	Temperature	High	—	Y	
Fire Alarm	—	Fire Indication/Fire	—	R	
Ventilation Capacity Loss	—	When Loss Occurs	—	Y	When Mechanical Ventilation Is Used.
8. Bilge Water					
Bilge Water Level	—	High	—	S	Refer to Section 11.3.15.1 of This Chapter.
Bilge Pump	Operation Indication	Excessive Running Time, etc.	—	Y	Refer to Section 11.3.15.4 of This Chapter, Applicable Only When Bilge Pump Is Automatically Controlled.
9. Others					
Override Function	—	When Executed	—	S	
Controlled Environmental Conditions	—	Abnormal	—	Y	If Equipment Requires a Controlled Environment, This Requirement is to Be Met.
Automation System	—	When Fault Occurs	—	Y	Including Power Failure, Communication Failure, etc.
Control-Safety-Alarm System Power Supply	—	When Fault Occurs	—	Y	Voltage Can Be Replaced by Indicator Light. Including but Not

Item	centralized control station (room)		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					Limited to Ship Management System, Battery Management System, Propulsion Control System, Steering Gear Control System, etc.

Section 4 REMOTE CONTROL OF MAIN PROPULSION PLANT FROM NAVIGATING BRIDGE

11.4.1 GENERAL REQUIREMENTS

11.4.1.1 This Section applies to pure battery-powered ships where the main propulsion plant is remotely controlled from the navigating bridge control station and the machinery spaces are continuously attended. The corresponding automation notation is BRC.

11.4.1.2 In addition to complying with the requirements of Section 1 and Section 2 of this Chapter, pure battery-powered ships with class notation BRC are also to be in compliance with the requirements of this Section.

11.4.2 FUNCTIONS OF THE BRIDGE CONTROL STATION

11.4.2.1 Under all sailing conditions including maneuvering, the speed and direction of thrust of main propulsion machinery as well as other installations (if fitted) are to be effectively controlled from the BCS..

11.4.2.2 Where necessary, the control of propulsion machinery from the BCS is to be capable of being changed over to the local control station at any time and the changeover of the control is to comply with the relevant requirements of Section 11.3.8.2.

11.4.2.3 The Mode a protective action of main engines is to be capable of being carried out automatically, the other actions (Mode b and Mode c) may be carried out by manual operation.

11.4.2.4 Alarms at the Bridge Control Station:

(1) For the items to be alarmed at the BCS and the mode of alarms, see Column 5 of Table 11.4.4.1. Alarms indicating the faults in the machinery and electrical equipment as well as the automated control and monitoring systems are, in general, to be relayed to the BCS in the following modes: group alarms for the protective actions of safety systems; separate alarms; group alarms for serious faults and group alarms for general faults.

(2) The audible alarms at the BCS are permitted to be silenced after acknowledgment, but the visual alarms are to be extinguished only after the rectification of faults, and furthermore, the visual signals are to be capable of being clearly distinguishable before and after acknowledgment.

11.4.3 FUNCTIONS OF THE LOCAL CONTROL STATION

11.4.3.1 The local control stations are to comply with the relevant requirements of Section 11.1.1.5 and Section 11.3.8.2. It is to be possible for the propulsion machinery to be controlled from a local position even in the case of failure or malfunction in any part of the automatic or remote control systems of any other control station or the propulsion machinery.

11.4.3.2 The items to be displayed and alarmed, as required in Columns 2 and 3 of Table 11.4.4.1 of this Section for the propulsion machinery , are to be provided at the LCS.

11.4.4 TABLE OF AUTOMATIC CONTROL AND MONITORING ITEMS

11.4.4.1 The automatic control and monitoring items (if fitted) for all ships with the class notation BRC are to comply with Table 11.4.4.1.

11.4.4.2 The designations used in Table 11.4.4.1 of this Section are defined as follows:

—：Not required;

a：Mode a protective action, such as emergency shutdown of the engine, fuel oil cutoff of boiler and cutoff of electric power supply, etc.;

b：Mode b protective action, such as reducing the speed of rotation or the output of machinery;;

c：Mode c protective action, such as starting and putting into operation of standby pump or standby unit;

S：Single alarm;

Ga：group alarm activated by Mode a protective action;

Gb：group alarm activated by Mode b protective action;

R：group alarm for serious faults;

Y：group alarm for general faults.

11.4.4.3 For equipment marked with “▲” in Table 11.4.4.1 of this Section, if all single alarms and display items provided locally or in the vicinity of the engine are confirmed by CCS, then only a group alarm for the relevant equipment or system is required at the navigating bridge control station.

11.4.4.4 Regarding the display and alarm items for the battery system and battery room/battery box (cabinet) in Table 11.4.4.1, the relevant information specified in Column 2 and Column 3 of Table 11.4.4.1 is to be displayed at the bridge control station. When the aforementioned items are already displayed within the machinery spaces, the requirements specified in Column 5 of Table 11.4.4.1 may then be followed.

Automatic Control and Monitoring Items for Pure Battery-Powered Ships with Class Notation BRC

Table 11.4.4.1

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
1. Battery System 1.1 Battery System					
Total Battery System Capacity Minimum Capacity Alarm	—	Low	—	S	
Battery String/Battery Assembly/Battery System Minimum Capacity Alarm	—	Low	—	Y	No need to set up an independent alarm, the alarm signal can be issued by the Battery String/Battery Assembly/Battery System
Emergency Shutdown	—	Activated	—	S	Applicable to- Battery Assembly with a nominal capacity exceeding 50kWh
Fire Detection Inside Battery Pack	—	During Thermal Runaway	—	R	Applicable to Battery Packs Equipped with Fire Prevention and Control Devices
1.2 Battery Management System					
Battery System Voltage	Voltage	—	—	—	
Battery Cell Voltage	Voltage	High/ Low	b	G_b	Perform balancing control, reduce power

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
		Too High/Too Low	a	G_a	Stop the operation of the battery string/battery assembly/battery system
Battery Series Circuit Current	Current	High	b	G_b	Reduce power
		Too High	a	G_a	Stop the operation of the battery string/battery assembly/battery system
Battery Cell Temperature	Temperature	High	b	G_b	Temperature regulation and power reduction
		Too High	a	G_a	Stop the operation of the battery string/battery assembly/battery system. Over-temperature protection is to be independent of other components for temperature indication, alarm, and control functions (including sensors, circuits, monitoring, and control components).
Ambient Temperature	Temperature	High/Low	b	G_b	Temperature Regulation and Power Reduction

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
		Too High	a	G_a	Battery string/battery assembly/battery system shutdown. Over-temperature protection is to be independent of other components for temperature indication, alarm, and control functions (including sensors, circuits, monitoring, and control components).
Insulation Resistance	Resistance Value	Low	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
State of Charge (SOC)	Percentage	Low	b	G_b	Power Reduction,
		Too Low	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
State of Health (SOH)	Percentage	—	—	—	
Battery Energy Flow State	Status	—	—	—	Charging and Discharging Process
Overcurrent Protection	Current	High	b	G_b	Power Reduction
		Overcurrent	a	G_a	Battery String/Battery Assembly/Battery

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
					System Shutdown
Battery Charge/Discharge Protection	Voltage	Overcharge/Overdischarge	—	R	During overcharge, the BMS is to disconnect the charging device; during overdischarge, the BMS is to stop the battery string/battery assembly/battery system from operating.
Battery Pack/Box (Cabinet) Thermal Management Failure	—	Failure	—	Y	If Applicable
Battery Box (Cabinet) Emergency Ventilation Failure	—	Failure	—	Y	If Applicable
Protection Function Failure	—	Failure	a	G_a	Battery String/Battery Assembly/Battery System Shutdown
Temperature Detection Failure	—	Failure	—	Y	
Charging Failure	—	Failure	—	Y	Charging Stopped
Voltage or SOC Imbalance Between Battery Modules	Voltage/Percentage	High	b	G_b	Perform balancing control
		Excessive	a	G_a	Battery String/Battery Assembly/Battery System Shutdown

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Battery System Shutdown Due to Failure	—	Failure	—	Y	
Abnormal Operation of Battery Circuit Breaker/Relay	—	Abnormal	—	Y	
BMS Communication Failure with PMS/EMS/AMS	—	Failure	b	G_b	Power Reduction,
			a	G_a	Battery String/Battery Assembly/Battery System Shutdown
BMS Power Indication and Fault	—	Failure	—	Y	
1.3 Battery Cooling System (Cooling system that directly regulates the temperature of individual battery cells within the battery pack.)					
Cooling Pump Fault	—	Failure	c	Y	Applicable to multiple battery rooms sharing one liquid cooling system for the battery pack
Circulation Tank Liquid Level	—	Low	—	Y	If applicable
Cooling Pump and Cooler Out Pressure	Pressure	Low	—	Y	Applicable when each battery room has a separate battery pack cooling system
Coolant Inlet Pressure	Pressure	Low	—	Y	Applicable to multiple battery rooms sharing one liquid cooling system for the battery pack
Pressure Difference	Pressure	High	—	Y	If a filter is

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Across Cooling System Filter					installed
2 Power Distribution System 2.1 DC/DC Converter					
Input Voltage	Voltage	—	—	—	
Input Current	Current	—	—	—	
Overload (High Current)	—	During Overload	—	Y	
Charge/Discharge Indication	Status	—	—	—	
Communication Status with BMS	Status	During Fault	—	Y	
External Emergency Shutdown	—	Activated	—	S	Automatic Shutdown
Power Distribution Switch Open/Close Position	Status	—	—	—	
Converter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Converter Cooling Pump or Fan Failure	—	Failure	c	Y	If Applicable
Converter Interphase Reactor Temperature	Temperature	High	—	Y	If Applicable
Converter Filter Circuit Protection Trip	—	During Trip	—	Y	If Applicable
2.2 Daily Inverter					
Input DC Voltage	Voltage	—	—	—	
DC Voltage	Voltage	Low	—	Y	Coordinated Low Voltage Ride-Through Time
Output AC Voltage	Voltage	—	—	—	

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Output AC Current	Current	—	—	—	
Output AC Frequency	Frequency	—	—	—	
Overload (High Current)	—	During Overload	—	Y	
Power Distribution Switch Open/Close Position	Status	—	—	—	
Inverter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable
Inverter Cooling Pump or Fan Failure	—	Failure	c	Y	If Applicable
Inverter Interphase Reactor Temperature	Temperature	High	—	Y	
Converter Filter Circuit Protection Trip	—	During Trip	—	Y	If Applicable
Pre-Magnetization Fault	—	Failure	—	Y	If Applicable
2.3 DC Distribution Board					
Busbar Voltage	Voltage	High/Low	—	Y	Each Section
Busbar Power	Power	—	—	—	Display Total Power and Available Power
Busbar Insulation Resistance Status	—	Abnormal	—	Y	
Important Load Branch Current	Current	—	—	—	
DC Distribution Board Cooling System Comprehensive Fault	—	During Fault	—	Y	
Cooling System Medium Leakage in DC Distribution Board	—	During Leakage	—	Y	If Applicable

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Busbar Tie Protection Device Operation	—	During Operation	—	Y	
Load Protection Device (Fuse or DC Circuit Breaker) Operation	—	During Operation	—	Y	
Energy Management System Comprehensive Fault	—	During Fault	—	Y	
Busbar Pre-Charging Failure	—	Failure	—	Y	
2.4 AC Daily Distribution Board					
Busbar Voltage	Voltage	High/Low	—	Y	Each Section
Busbar Frequency	Frequency	High/Low	—	Y	Each Section
Busbar Insulation Resistance Status	—	Abnormal	—	Y	Each Section
Important Load Branch Current	Current	—	—	—	
Busbar Tie Protection Device Open/Close Position	Status	—	—	—	
Busbar Tie Protection Device Operation	—	During Operation	—	Y	
Inverter Protection Device Open/Close Position	Status	—	—	—	
Inverter Protection Device Operation	—	During Operation	—	Y	
Important Load Branch Protection Device Open/Close Position	Status	—	—	—	
Important Load Branch Protection Device Open/Close Operation	—	During Operation	—	Y	

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Automatic Load Shedding	—	During Operation	—	Y	
Inverter Protection Device Automatic Closing	—	Failure	—	Y	
Inverter Protection Device Automatic Tripping	—	During Trip	—	Y	
Load Distribution Failure	—	Failure	—	Y	Set Up When Using Automatic Load Distribution Function
2.5 Distribution Board Cooling System					
Cooling Pump Failure	—	Failure	c	Y	
Cooling Pump Outlet Pressure	Pressure	Low	c	Y	
Circulation Tank Liquid Level	—	Low	—	Y	Applicable to Closed Cooling Systems
Pressure Difference Before and After Cooling System Filter	Pressure	High	—	Y	Applicable to Open Cooling Systems and Closed Cooling Systems with Filters
3. Main Propulsion System 3.1 Propulsion Motor (AC and DC)					
Bearing Lubricating Oil Inlet Pressure or Bearing Temperature	Pressure or Temperature	Low or High	a	G_a	
Voltage	Voltage	High/Low	—	Y	Read All Phases
Excitation Voltage	Voltage	—	—	—	If Applicable

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Frequency	Frequency	High/Low	—	Y	Only for AC Propulsion Motors. For Inverter-Controlled Propulsion Motors, Monitoring the Inverter Output Can Be Used as an Alternative
Armature Current	Current	—	—	—	Read All Phases
Excitation Current	Current	—	—	—	If Applicable
High Stator Winding Temperature	Temperature	High	—	Y	Read All Phases; Only Applicable to AC Motors with Capacity >500kW
Motor Switch Open/Close Position	Status	—	—	—	Motor Switch is Applicable for Direct Connection to DC Bus Without Converter, and Isolation Switch for Propulsion Motors Using Permanent Magnet Motors
Motor Operation	Status	—	—	—	
Motor Speed	Speed	Overspeed	a	G_a	
Online Motor Fault	—	When Fault Occurs	—	Y	
Motor Cooling Medium	Temperature	High	—	Y	If Applicable

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Temperature					
Cooling Pump or Fan Fault	—	When Fault Occurs	c	Y	If Applicable
Commutating Pole Current	Current	—	—	—	Only for DC Propulsion Motors
Differential Protection or Similar Protection Function	—	Activated	—	Y	Applicable to AC Motors with Capacity ⩾ 1500kW
3.2 Propulsion Semiconductor Converter					
Input Voltage	Voltage	—	—	—	Measure on the Converter Output Side
Input Current	Current	—	—	—	Measure on the Converter Output Side
Frequency	Frequency	—	—	—	Measure on the Converter Output Side
Overload (High Current)	—	When Overload Occurs	—	Y	Alarm Before Protection Device Activation
Distribution Switch Open/Close Position	Status	—	—	—	
External Emergency Shutdown	—	When Activated	—	S	Automatic Shutdown
Converter Power Device Temperature	Temperature	High	b	G_b	Power Reduction
		Excessive	a	G_a	Automatic Shutdown
Converter Filter Element Temperature	Temperature	High	—	Y	If Applicable
Converter Cooling Medium Temperature	Temperature	High	—	Y	If Applicable

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Converter Cooling Pump or Fan Fault	—	When Fault Occurs	c	Y	If Applicable
Converter Interphase Reactor Temperature	Temperature	High	—	Y	If Applicable
Converter Filter Protection Trip	—	When Tripped	—	Y	If Applicable
3.3 Propulsion Transformer					
Transformer Winding Temperature	Temperature	High	—	Y	If Applicable
3.4 Others					
Excitation Circuit Ground Fault	—	When Fault Occurs	—	Y	For Brushless Excitation Systems and Excitation Circuits of Motors with Rated Power Less Than 500kW, This Item Can Be Omitted
Main Propulsion Circuit Ground Fault	—	When Fault Occurs	—	Y	
4. Transmission Device (Reduction Gearbox, etc., If Applicable)					
Lubricating Oil Inlet Pressure to Gearbox	Pressure	Low	c	R	If Applicable
		Excessively Low	a	G_a	
Lubricating Oil Inlet Temperature to Gearbox or Cooling Water Temperature	Temperature	High	—	Y	
Working Oil Pressure	Pressure	Low	—	Y	
5. Stern Tube Bearing (If Applicable)					
Oil-Lubricated Stern Tube Bearing Temperature	—	High	—	Y	

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Stern Tube Lubricating Oil Tank Level	—	Low	—	Y	
6. Computer System					
Computer in Operation	—	When Fault Occurs	c	R	
Computer System	—	When Fault Occurs	—	R	Including LAN Controller Failure, LAN Overload, Overflow Crash, etc.
Computer System Power Supply	Voltage	When Power Loss Occurs	—	Y	Voltage Can Be Replaced by Indicator Light
7. Battery Room/Battery Box (Cabinet) Monitoring (Monitoring of Containerized Power Supply is to Comply with Relevant Requirements of Chapter 7 of The Rules)					
Flammable Gas Concentration	—	When Exceeding Its Lower Explosion Limit	—	Y	When Flammable Gas Concentration Exceeds 20% of Its Lower Explosion Limit (Volume Fraction), the Emergency Exhaust System is to Automatically Start.
Temperature Inside Room/Box (Cabinet)	Temperature	High	—	Y	
Fire Alarm	—	Fire Indication/Fire	—	R	
Ventilation Capacity Loss	—	When Loss Occurs	—	Y	When Mechanical Ventilation Is Used.
8. Others					
Override Function	—	When Executed	—	S	
Controlled Environmental	—	Abnormal	—	Y	If Equipment Requires a

Item	Local Control Station		Mode of protective control action	Mode of alarm at bridge control station	Remarks
	Display	Limit Alarm			
1	2	3	4	5	6
Conditions					Controlled Environment, This Requirement is to Be Met.
Automation System	—	When Fault Occurs	—	Y	Including Power Failure, Communication Failure, etc.
Control-Safety-Alarm System Power Supply	—	When Fault Occurs	—	Y	Voltage Can Be Replaced by Indicator Light. Including but Not Limited to Ship Management System, Battery Management System, Propulsion Control System, Steering Gear Control System, etc.

APPENDIX 1 ONLINE MONITORING DATA EXCHANGE REQUIREMENTS

1.1 GENERAL PROVISIONS

1.1.1 SCOPE OF APPLICATION

1.1.1.1 These requirements apply to the reporting of online monitoring data of ship power systems from shore-based monitoring platforms or on-board data terminals to the CCS battery-powered ship survey and verification platform.

1.1.1.2 Data submit/reception is to use HTTPs API interfaces and MQTTs message publish/subscribe architecture.

1.1.2 TERMS, DEFINITIONS, AND ABBREVIATIONS

1.1.2.1 The following terms and definitions apply to this Appendix:

(1) Static Data: Static parameters of the ship and power system that generally do not change during operation, such as configuration parameters.

(2) Dynamic Data: Dynamic parameters of the ship and power system that are updated over time during operation, such as operational data.

(3) A Set of Sampled Data: A combination of all sampled data at the same moment.

1.1.2.2 The following abbreviations apply to this Appendix:

(4) HTTPs: Hypertext Transfer Protocol Secure

(5) MQTTs: Message Queuing Telemetry Transport Secure

(6) JSON: JavaScript Object Notation

(7) UTF8: 8-bit Unicode Transformation Format

(8) UTC: Universal Time Coordinated

1.1.3 GENERAL REQUIREMENTS

1.1.3.1 The online monitoring data to be exchanged is categorized into static data and dynamic data based on update frequency. Unless otherwise specified, it generally includes the following monitoring object information:

(1) Ship: Ship identification number (domestic ship ID), ship name, port of registry, location, speed, and other general information;

(2) Ship Power System: System topology map, rated energy storage capacity, remaining energy ratio, battery system operating status, power distribution system operating status, propulsion system operating status, and other specific information;

(3) Charging Equipment: Voltage, current, temperature, alarms, etc., specifically referring to onboard equipment;

(4) Battery Room/Box/Cabinet: Name, ambient temperature, alarms, etc.;

(5) Battery Assembly: Rated voltage, rated capacity, state of charge, state of health, main circuit current, alarms, etc.;

(6) Battery String: Rated capacity, state of charge, state of health, main circuit current, ambient temperature, highest/lowest cell temperature within the string, highest/lowest cell voltage within the string, alarms, etc.;

(7) Battery Pack: Rated voltage, rated capacity, cell voltage within the pack, cell temperature within the pack, etc.;

(8) Power Distribution System: Cooling system type, cooling system temperature (if applicable), alarms, etc.;

(9) Bus Section: Voltage, power, alarms, etc.;

(10) Converter: Voltage, current, temperature, alarms, etc.;

(11) Propulsion System: Associated busbar segmentation, etc.;

(12) Propulsion Motor: Voltage, current, power, speed, alarms, etc.;

(13) Propulsor: Speed, etc.;

(14) Steering Gear: Rudder angle, alarms, etc.

1.1.3.2 The ship is to provide the Ship-Shore Monitoring Data Comparison Table to CCS surveyors for reference. This table is to indicate the correspondence between the monitoring data items described in these requirements and the actual monitoring data items on the ship. During on-site survey, the consistency between the actual monitoring data on the ship and the data received by the CCS battery-powered ship survey and verification platform is to be verified based on this comparison table.

1.1.3.3 Static data is to be exchanged in the form of data packages. It is to be exchanged once at the initial stage and subsequently exchanged as needed when changes occur. If the monitoring object (system/equipment) does not exist, its corresponding data may not be included in the data package.

1.1.3.4 Dynamic data is to be exchanged in the form of data packages. A single data package may contain multiple sets of sampled data,and the reporting interval of dynamic data packages is not to exceed 30 seconds. Unless otherwise specified, the maximum sampling interval for multiple sets of sampled data within a single data package is not to exceed 1 second for critical data items and 5 for other data items.

1.1.3.5 When the monitoring object (system/equipment) is in a non-operational state (e.g., equipment shutdown, non-installation, or failure to collect operational data due to lack of sensors), its corresponding data may not be included in the dynamic data package.

1.1.3.6 When the battery system, power distribution system, and propulsion system are all in a non-operational state, the dynamic data package may only contain data of the following monitoring objects, and the reporting interval of the data package may be adjusted to no more than 5 minutes.

(1)Ship;

(2)Power system;

(3)Battery room/box/cabinet.

1.1.4 DATA EXCHANGE METHODS

1.1.4.1 Static data is to be sent and received through the HTTPs API interface.

1.1.4.2 Dynamic data is to be sent and received through MQTTs by publishing and subscribing to messages. The package is to be transmitted as the message body through message topics. During the exchange process, the ship number is to be used as the unique identifier, typically the domestic ship identification number, represented as a string of English letters and numbers.

1.1.4.3 Dynamic data supports publishing/subscribing in JSON format and publish/subscribe in JSON format compressed with Gzip, and binary format. The corresponding message topics are listed in Table 1.1.4.3.

Table 1.1.4.3 The message topic for publishing/subscribing

Reported Content	Message Topic
Dynamic data in JSON format	/BatteryShip/TimeSeriesData/*ShipID*
Dynamic data in JSON format compressed with Gzip	/BatteryShip/TimeSeriesDataGzip/*ShipID*
Dynamic data in binary format	/BatteryShip/TimeSeriesDataBin/*ShipID*

Note: The italicized *ShipID* refers to the ship identification number.

1.1.4.4 The reported data is to be published on the designated message topic, and the Quality of Service (QoS) is to be "Exactly Once (2)".

1.1.4.5 The received data is to be subscribed to the designated message topic, and the Quality of Service (QoS) is to be "At Least Once (1)" or "Exactly Once (2)".

1.2 DATA PACKAGE FORMAT

1.2.1 GENERAL REQUIREMENTS

1.2.1.1 Data packages are to be assembled in the specified JSON format or binary format, using UTF-8 encoding.

1.2.1.2 Time-related data items in the data package are to uniformly adopt UTC time representation.

1.2.1.3 Data items in JSON format data packages are to use the data types listed in Table 1.2.1.3.

Table 1.2.1.3 JSON Format Data Types

Data Types	Description and Requirements
Integer	Integer, represented in base 10, without using octal or hexadecimal formats.
Real Number	Real number, represented in base 10, without using octal or hexadecimal formats.
String	String.
Object	Object, which is a set of key-value pairs enclosed within {}. The key (field identifier) must be a string, is to be unique, and multiple key-value pairs are separated by commas.
Array of Objects	Array, which is an ordered collection of values, starting with [and ending with]. The values in the array are separated by commas.
Array of Real Numbers	Array of real numbers, which is an ordered collection of values, starting with [and ending with]. The values in the array are separated by commas.
Array of Integers	Array of integers, which is an ordered collection of values, starting with [and ending with]. The values in the array are separated by commas.

1.2.1.4 For data items mentioned in JSON format data, unless otherwise specified, if there is no sampled data, their value is to be represented as null, or the data item may be omitted. For strings, an empty string may also be used.

1.2.2 JSON FORMAT DATA PACKAGE FOR STATIC DATA

1.2.2.1 The data for static data is expressed as a package object (Package), consisting of a header (Header) and a data unit (BaseInfo), as shown in Table 1.2.2.1.

Table 1.2.2.1 Field Format of the Static Data Package

Field Identifier	Data Type	Field Name	Description
Header	Object	Package Header	
BaseInfo	Object	Data Unit	

1.2.2.2 The Header is to consist of the data fields listed in Table 1.2.2.2. All data items listed in the table are mandatory unless otherwise specified.

Table 1.2.2.2 The field format of the static data package header

Field Identifier	Data Type	Field Name	Description
Version	Integer	Version Number	Used to distinguish the version of the data format, fixed as 2025.
Author	String	Reporting Party	The party reporting the data, for example: xxx organization.
TimeStamp	String	Reporting Time	The time of data submit, in UTC format (YYYY-MM-DDThh:mm:ssZ), for example: 2024-01-01T12:05:01Z.
ShipID	String	Ship ID	The ship identification number for domestic ships or the IMO registration number for international ships. example: CN202212345672 or IMO1234567.

1.2.2.3 Data Unit (BaseInfo) is to consist of the static information entities and static information entity arrays listed in Table 1.2.2.3. All data items listed in the table are optional.

Table 1.2.2.3 Static Information Entity of the Static Data Unit

Field Identifier	Data Type	Field Name	Description
Ship	Object	Ship Static Information Entity	For details on the static information entity, please refer to Section 3.
PowerSys	Object	Ship Power System Static Information Entity	For details on the static information entity, please refer to Section 3.
BatterySys	Object	Battery System Static Information Entity	For details on the static information entity, please refer to Section 3.
Charger	Object Array	Charging Equipment Static Information Entity Array	For details on the static information entity, please refer to Section 3.
Compartment	Object Array	Battery Room/Box/Cabinet Static Information Entity Array	For details on the static information entity, please refer to Section 3.
BatteryGroup	Object Array	Battery Assembly Static Information Entity Array	For details on the static information entity, please refer to Section 3.
BatteryCluster	Object Array	Battery String Static Information Entity Array	For details on the static information entity, please refer to Section 3.
BatteryPack	Object Array	Battery Pack Static Information Entity Array	For details on the static information entity, please refer to Section 3.
CDSys	Object Array	Power Distribution System Static Array	For details on the static information entity, please refer to Section 3.
CBus	Object	Bus Section Static Information Entity	For details on the static information

	Array	Array	entity, please refer to Section 3.
Converter	Object Array	Converter Static Information Entity Array	For details on the static information entity, please refer to Section 3.
PropulsionSys	Object Array	Propulsion System Static Information Entity Array	For details on the static information entity, please refer to Section 3.
Motor	Object Array	Propulsion Motor Static Information Entity Array	For details on the static information entity, please refer to Section 3.
Propeller	Object Array	Propeller Static Information Entity Array	For details on the static information entity, please refer to Section 3.
Rudder	Object Array	Steering Device Static Information Entity Array	For details on the static information entity, please refer to Section 3.

1.2.2.4 Examples of JSON format data packages for static data are provided in Section 6.

1.2.3 JSON FORMAT DATA PACKAGES FOR DYNAMIC DATA

1.2.3.1 The data package for dynamic data is expressed as a Package element, consisting of a Header and a TimeSeriesData array, as shown in Table 1.2.3.1.

1.2.3.2 The Header is to consist of the data fields listed in Table 1.2.3.2, and all the data items listed in the table are mandatory.

Table 1.2.3.2 Field Format of the Dynamic Data Package Header

Field Identifier	Data Type	Field Name	Description
Version	Integer	Version Number	Version of the data format, fixed as 2025
Author	String	Reporting Party	Data submit party, e.g., xxx Organization
TimeStamp	String	Reporting Time	Data submit time, in UTC format (YYYY-MM-DDThh:mm:ssZ), e.g., 2023-01-01T1205:01Z
ShipID	String	Ship ID	Domestic ship identification number or international ship IMO number, e.g., CN202212345672 or IMO1234567

1.2.3.3 The data unit array (TimeSeriesData) is composed of multiple data units. Each data unit is to consist of the fields listed in Table 1.2.3.3, dynamic information entities, and dynamic information entity arrays. All data items listed in the table are optional.

Table 1.2.3.3 Data Items of Dynamic Data Unit

Field Identifier	Data Type	Field Name	Description
TimeStamp	String	Timestamp	Data sampling UTC time, including year, month, day, hour, minute, and second, for example: 2023-01-01T12:00:01Z
Ship	Object	Ship Dynamic Information Entity	For details on the dynamic information entity, refer to Section 4.
PowerSys	Object	Ship Power System Dynamic Information Entity	For details on the dynamic information entity, refer to Section 4.
BatterySys	Object	Battery System Dynamic Information Entity	For details on the dynamic information entity, refer to Section 4.
Charger	Object Array	Charging Equipment Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
Compartment	Object	Battery Room/Box/Cabinet Dynamic	For details on the dynamic information

	Array	Information Entity Array	entity, refer to Section 4.
BatteryGroup	Object Array	Battery Assembly Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
BatteryCluster	Object Array	Battery String Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
BatteryPack	Object Array	Battery Pack Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
CDSys	Object Array	Power Distribution System Dynamic Array	For details on the dynamic information entity, refer to Section 4.
CBus	Object Array	Bus Section Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
Converter	Object Array	Converter Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
PropulsionSys	Object Array	Propulsion System Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
Motor	Object Array	Propulsion Motor Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
Propeller	Object Array	Propeller Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.
Rudder	Object Array	Steering Device Dynamic Information Entity Array	For details on the dynamic information entity, refer to Section 4.

1.2.3.4 For an example of the JSON format data package of dynamic data, refer to Section 6.

1.3 JSON FORMAT STATIC INFORMATION BODY

1.3.1 SHIP (SHIP)

1.3.1.1 The composition and format of the data items in the ship static information body are shown in Table 1.3.1.1.

Table 1.3.1.1 Composition and Format of Data Items in the Ship Static Information Body

Field Identifier	Data Type	Field Name	Description
ShipID	String	Ship ID	Domestic Ship Identification Number. Example: CN202212345672
ShipName	String	Ship Name	Ship Name in Chinese
ShipType	Integer	Ship Type	Classification by Function. 101: Public Affair Ship; 102: Cruise Ship; 103: Ferry; 104: Other Passenger Ship; 105: Container Ship;106: Bulk Carrier; 107: Tanker; 108: Other Cargo Ship; 109: Tugboat; 110: Engineering Ship; 111: Yacht; 112: Fishing Vessel; 100: Other Ships. Sightseeing boats, sightseeing yachts, and tourist ships are classified as cruise ships. Passenger ferries, car-passenger ferries, and other ferries are classified as ferries. Container-bulk carriers are treated as container ships.
PropulsiveType	Integer	Energy Type	1. Pure Battery 2. Hybrid (Oil-Electric) 3. Single LNG 4. Dual-Fuel LNG 5. Single Methanol 6.Dual-Fuel Methanol 7. Hydrogen Fuel 0. Other

EEDIClass	Integer	Energy Efficiency Rating	Ship's Design Energy Efficiency Level, where a higher level indicates better energy efficiency. 0: Pending, indicating the ship has not obtained any energy efficiency-related class notation; 1: Level 1, indicating the ship has obtained the "Energy Efficiency Design-1" or "EEDI-1" class notation; 2: Level 2, indicating the ship has obtained the "Energy Efficiency Design-2" or "EEDI-2" class notation; 3: Level 3, indicating the ship has obtained the "Energy Efficiency Design-3" or "EEDI-3" class notation.
ShipOper	String	Ship Operator	Actual operating unit of the Ship
ShipOwner	String	Ship Owner	Ship Owner
ShipBuilder	String	Ship Builder	Ship Builder
DataMaintenanceID	String	Data Monitoring and O&M Party Identifier	Account ID of the data submit party
Port	String	Port of Registry	Data Registered in the Ship Ownership Certificate. Example: "Wuhan"
ShipArea	String	Province of Registration	Province Identifier. Example: Hubei, Guangxi
Surveyor	String	Survey Authority	Ship Construction Survey Unit. Example: Wuhan Branch
CcsClassification	Integer	Classification Status	0. No, 1. Yes
KeelDate	String	Date of Keel Laying	Date of keel laying or equivalent date. Example: YYYY-MM-DD
BuildDate	String	Date of Construction	Ship Construction Completion Date. Example: YYYY-MM-DD
Capacity	String	Carrying Capacity	For passenger ships: Approved Passenger Capacity; for container ships: Maximum container capacity; for ro-ro ships: Maximum vehicle capacity; for other ships: Deadweight tonnage. Examples: “30 people”,“700 TEU”, “60 vehicles”, “5000 DWT”
ServiceArea	String	Navigation Area / Ship Zone	1. Inland A, 2. Inland B, 3. Inland C, 4. Specific Direct River-Sea Route, 11. Open Sea, 12. Offshore, 13. Coastal. Multiple selections allowed, separated by colons, e.g., 1:2:3
Length	Real Number	Length Overall (LOA)	m, 2 decimal places. Standard Length of Ship
Breadth	Real Number	Breadth	m, 2 decimal places
Depth	Real Number	Depth	m, 2 decimal places
DesignDraft	Real Number	Draft	m, 2 decimal places. Design Draft
PropellerType	Integer	Propeller Type	1. Fixed-Pitch Propeller Propulsion; 2. Controllable-Pitch Propeller Propulsion; 3. Z-Drive Propulsion; 4. Voith-Schneider Propulsion; 5. Pod Propulsion; 6. Rim-Driven Propulsion; 7. Waterjet Propulsion; 8. Surface Piercing Propulsion; 0. Other

1.3.2 SHIP POWER SYSTEM (POWERSYS)

1.3.2.1 The composition and format of the data items for the static information body of the ship power system are shown in Table 1.3.2.1.

Table 1.3.2.1 Composition and Format of Data Items for the Static Information Body of the Ship Power System

Field Identifier	Data Type	Field Name	Description
PowerSystemIntegrator	String	System Integrator	Including Battery System (Fuel System), Distribution System, and Propulsion System
SysTopoMap	String	System Topology	Topology Map (Single-Line Map) of Energy

		Map	Power System in Base64 format, e.g., "data:image/jpeg;base,…", where "…" is the Base64 encoded string of a JPG file
EnergyType	Integer	Energy Type	1. Electricity; 2. Fuel Oil; 4. LNG; 8. Methanol; 16. Hydrogen; 32. Ammonia. Multiple selections allowed (sum of options), parsed by binary bits
ChargeType	Integer	Energy Replenishment Method	1. Charging; 2. Refueling; 4. Replacing Containerized Power Supply; 8. Replacing Fuel Tank; 16. Replacing Fuel Power Supply Box. Multiple selections allowed, parsed by binary bits.
RatedCapacity	Real Number Array	Rated Energy Storage Capacity	Corresponding to the static data item "Energy Type," the array contains 6 elements, respectively corresponding to [Electricity, Fuel Oil, LNG, Methanol, Hydrogen, Ammonia], with units of [kWh, t, t, t, kg, t]. For example, Rated Energy Storage Capacity = [1800, 0, 0, 0, 0, 0], indicating 1800 kWh of electrical energy.
DriverType	Integer	Drive Type	1. Electric Drive; 2. Mechanical Drive. Multiple selections allowed (sum of options), parsed by binary bits.
BatterySysNum	Integer	Whether the Battery System Exists	1 or 0
FuelSysNum	Integer	Whether the Fuel System Exists	Reserved Data Item, Constantly Set to 0
CDSysNum	Integer	Number of Power Distribution Systems	The Power Distribution System is typically a combination of DC busbars and associated converters (including rectifiers, converters, propulsion inverters, and daily-use inverters).
PropulsionSysNum	Integer	Number of Propulsion Systems	Combination of propulsion motor, propulsor, and/or steering gear assembly

1.3.3 BATTERY SYSTEM (BATTERYSYS)

1.3.3.1 The composition and format of the data items for the battery system static information body are shown in Table 1.3.3.1.

Table 1.3.3.1 Composition and Format of Data Items for the Battery System Static Information Body

Field Identifier	Data Type	Field Name	Description
BatterySystemIntegrator	String	Battery System Integrator	Complete System Supplier of Battery Systems
BatteryManufacturer	String	Battery Cell Supplier	Cell manufacturer
RatedCapacity	Real Number	Total Rated Energy	kWh, the sum of the rated energy of all battery assemblies
RatedVoltage	Real Number	Rated Voltage	V, the maximum rated voltage of all battery assemblies
ChargerNumber	Integer	Number of Charging Equipments	Total number of onboard charging equipments
CompartmentNumber	Integer	Number of Battery Rooms/Boxes/Cabinets	Including battery rooms, battery boxes cabinets, and containerized power supplies
BatteryGroupNumber	Integer	Number of Battery Assemblies	A battery assembly is a branch power source connected to the DC busbar, typically a parallel combination of several battery strings..
BatteryClusterNumber	Integer	Number of Battery Strings	
BatteryPackNumber	Integer	Number of Battery Packs	

1.3.4 CHARGER (CHARGER)

1.3.4.1 The composition and format of the data items for the static information body of the charger are shown in Table 1.3.4.1. This refers only to the chargers installed on the ship.

Table 1.3.4.1 Composition and Format of Data Items for the Static Information Body of the Chargers

Field Identifier	Data Type	Field Name	Description
Code	String	Charger ID	A unique identifier for the entire ship, valid values 01~99. Refers only to shipboard devices.

1.3.5 BATTERY ROOM/BOX/CABINET (COMPARTMENT)

1.3.5.1 The composition and format of the data items for the static information body of the battery room/box/cabinet are shown in Table 1.3.5.1.

Table 1.3.5.1 Composition and Format of Data Items for the Static Information Body of the Battery Room/Box/Cabinet

Field Identifier	Data Type	Field Name	Description
Code	String	ID	A unique identifier for the entire ship. Valid values: 01~99.
Name	String	Name	Corresponding name on the ship side. For containerized mobile power supplies, the name is "Container Unique Identification Number", e.g.: LYGU0165338
Type	Integer	Type	1. Battery Room; 2. Battery Box/Cabinet; 3. Containerized Power Supply; 0. Other.
TemperDetectorNumber	Integer	Number of Ambient Temperature Detectors	
GasDetectorNumber	Integer	Number of Flammable Gas Detectors	
FireDetectorNumber	Integer	Number of Fire Detectors	

1.3.6 BATTERY ASSEMBLY (BATTERYGROUP)

1.3.6.1 The composition and format of the data items for the static information body of the battery assembly are shown in Table 1.3.6.1.

Table 1.3.6.1 Composition and Format of Data Items for the Static Information Body of the Battery Assembly

Field Identifier	Data Type	Field Name	Description
Code	String	ID	A unique identifier for the entire ship. Valid values: 01~99. The battery assembly is a branch power source connected to the DC bus, typically a parallel combination of several battery strings.
Name	String	Name	Corresponding name on the ship side.
RatedCapacity	Real Number	Rated Capacity	kWh
RatedVoltage	Real Number	Rated Voltage	V
AssCompartment	String	Battery Room ID	The ID of the battery room in which the battery assembly is installed. For example, 01.
AssConverter	String	Associated converter ID	The ID of the converter connected to the battery assembly.
AssCBus	String	Associated DC Bus Segment ID	The ID of the DC bus segment connected to the battery assembly.

1.3.7 BATTERY STRING (BATTERYCLUSTER)

1.3.7.1 The composition and format of the data items for the static information body of the battery string are shown in Table 1.3.7.1.

Table 1.3.7.1 Composition and Format of Data Items for the Static Information Body of the Battery String

Field Identifier	Data Type	Field Name	Description
Code	String	ID	A unique identifier for the entire ship. Valid values: 0001~5000.
Name	String	Name	Corresponding name on the ship side.
AssBatteryGroup	String	Associated Battery Assembly ID	The ID of the battery assembly to which the battery string belongs.
BatteryClusterRatedCapacity	Real Number	Rated Capacity	kWh
BatteryPackNumber	Integer	Number of Battery Packs in the String	

1.3.8 BATTERY PACK (BATTERYPACK)

1.3.8.1 The composition and format of the data items for the static information body of the battery pack are shown in Table 1.3.8.1.

Table 1.3.8.1 Composition and Format of Data Items for the Static Information Body of the Battery Pack

Field Identifier	Data Type	Field Name	Description
Code	String	ID	A unique identifier for the entire ship. Valid values: 00001~65000.
AssBatteryString	String	Associated Battery String ID	The ID of the battery string to which the battery pack belongs.
PackProductNumber	String	Battery Pack Product ID	24-digit national standard code for the battery pack product.
PackRatedCapacity	Real Number	Rated Capacity	kWh
PackRatedVoltage	Real Number	Rated Voltage	
PackCellNumber	Integer	Number of Cells in the Pack	

1.3.9 POWER DISTRIBUTION SYSTEM (CDSYS)

1.3.9.1 The composition and format of the data items for the static information body of the power distribution system are shown in Table 1.3.9.1.

Table 1.3.9.1 Composition and Format of Data Items for the Static Information Body of the Power Distribution System

Field Identifier	Data Type	Field Name	Description
Code	String	Power Distribution System ID	A unique identifier for the entire ship.Valid values 01~99. Conventional ships generally have only one power distribution system, while special cases such as catamarans may have two power distribution systems.
Name	String	Name	Such as the “Port Hull Power Distribution System” etc. among the corresponding names on the ship side.
Type	Integer	Type	1. DC (Direct Current) 2. AC (Alternating Current)
CoolType	Integer	Cooling System Type	1. Liquid cooling 2. Air cooling 0. Other
CBusNumber	Integer	Number of Bus Sections	When the bus is divided into two segments, it is recorded as 2.
ConverterNumber	Integer	Number of Converters	Connected to the bus, including converters, propulsion inverters, daily-use inverters, bidirectional converters, rectifiers, etc.

1.3.10 BUS SECTION (CBUS)

1.3.10.1 The data item composition and format of the static information body for the DC bus section are shown in Table 1.3.10.1.

Table 1.3.10.1 Data Item Composition and Format of the Static Information Body for the Bus Section

Field Identifier	Data Type	Field Name	Description
Code	String	Bus Section Number	A unique identifier for the entire ship. Valid values: 01~ 99. Typically, the DC bus is divided into two sections, meaning there are two bus sections.
Name	String	Name	For example, "Left Bus Section" or "Right Bus Section," etc.
AssCDSystem	String	Associated Power Distribution System Number	The power distribution system to which the bus section belongs.

1.3.11 CONVERTER (CONVERTER)

1.3.11.1 The composition and format of the data items for the converter static information body are shown in Table 1.3.11.1.

Table 1.3.11.1 Composition and Format of Data Items for Converter Static Information Body

Field Identifier	Data Type	Field Name	Description
Code	String	Converter Number	A unique identifier for the entire ship. Valid values 01~99
Name	String	Name	Such as "1# Main Propulsion Inverter", "Side Propulsion Inverter", "Passenger Area Air Conditioning Daily-Use Inverter", "Engineering Machinery Daily-Use Inverter", "1# Daily-Use Inverter", etc. among the corresponding names on the ship side
AssCBus	String	Associated DC Bus Section Number	
Type	Integer	Type	1. Converter (DCDC); 2. Propulsion Inverter (DCAC, including main propulsion and side propulsion); 3. Daily-Use Inverter (Inverter, including passenger area air conditioning, engineering machinery, daily loads, etc.); 4. Bidirectional Converter (ACDCAC); 5. Rectifier (ACDC); 0. Others
ConnectedDevice	Integer	Connected Equipment	1. Battery; 2. Propulsion Motor; 3. Passenger Area Air Conditioning; 4. Engineering Machinery; 5. Daily Loads; 6. Other Busbars; 7. Charging Device; 8. Generator; 9. Fuel Cell; 0. Others

1.3.12 PROPULSION SYSTEM (PROPULSIONSYS)

1.3.12.1 The composition and format of the data items for the propulsion system static information body are shown in Table 1.3.12.1.

Table 1.3.12.1 Composition and Format of Data Items for Propulsion System Static Information Body

Field Identifier	Data Type	Field Name	Description
Code	String	Propulsion System Number	A unique identifier for the entire ship. Valid values: 01~99. Each propulsion system consists of a propeller, its associated propulsion motor, propulsion frequency converter, steering gear, and other related components.

Name	String	Name	For example, “Port Propulsion,” “Starboard Propulsion,” “Main Propulsion,” etc.
AssDCBus	String	Associated DC Busbar Section Number	
MotorNumber	Integer	Number of Motors	
PropellerNumber	Integer	Number of Propellers	
RudderNumber	Integer	Number of Rudders	

1.3.13 PROPULSION MOTOR (MOTOR)

1.3.13.1 The composition and format of the data items for the propulsion motor static information body are shown in Table 1.3.13.1.

Table 1.3.13.1 Composition and Format of Data Items for Propulsion Motor Static Information Body

Field Identifier	Data Type	Field Name	Description
Code	String	Propulsion Motor Number	A unique identifier for the entire ship. Valid values: 01~99.
Name	String	Name	Such as “Main Propulsion Motor”, “Side Propulsion Motor”, etc. among the corresponding names on the ship side.
RatedPower	Real Number	Rated Power	kW
AssPropulsionSys	String	Associated Propulsion System Number	
AssConverter	String	Associated Converter Number	Set to -1 if no converter is installed.
RatedVoltage	Real Number	Rated Voltage	V

1.3.14 PROPELLER (PROPELLER)

1.3.14.1 The composition and format of the data items for the propeller static information body are shown in Table 1.3.14.1.

Table 1.3.14.1 Composition and Format of Data Items for Propeller Static Information Body

Field Identifier	Data Type	Field Name	Description
Code	String	Propulsion Motor Number	A unique identifier for the entire ship. Valid values: 01~99. Such as "Propeller", "Z-drive Propulsor", etc.
Name	String	Name	Corresponding names on the ship side.
RatedSpeed	Integer	Rated Speed	rpm
AssPropulsionSys	String	Associated Propulsion System Number	

1.3.15 STEERING GEAR (RUDDER)

1.3.15.1 The composition and format of the data items for the rudder static information body are shown in Table 1.3.15.1.

Table 1.3.15.1 Composition and Format of Data Items for Rudder Static Information Body

Field Identifier	Data Type	Field Name	Description
Code	String	Rudder Identification Number	A unique identifier for the entire ship. Valid values: 01~99
Name	String	Name	Corresponding names on the ship side.
AssPropulsionSys	String	Associated Propulsion System Number	
Type	Integer	Type	1.Steering Gear / Main Steering Gear 2.Emergency Steering Gear / Auxiliary Steering Gear

1.4 JSON FORMAT DYNAMIC INFORMATION BODY

1.4.1 SHIP (SHIP)

1.4.1.1 The composition, format, and sampling interval of the ship dynamic information body are shown in Table 1.4.1.1.

Table 1.4.1.1 Composition, Format, and Sampling Interval of Ship Dynamic Information Body

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Longitude	Real Number	Longitude	Degrees, 6 decimal places. Ship longitude position (WGS84 geodetic coordinate system, no coordinate offset), in dd.dddd format, positive for east longitude, negative for west longitude. Data can be collected from ship AIS or other positioning equipment.	1s
Latitude	Real Number	Latitude	Degrees, 6 decimal places. Ship latitude position (WGS84 geod coordinate system, no coordinate offset), in dd.dddd format, positive for north latitude, negative for south latitude. Data can be collected from ship AIS or other positioning equipment.	1s
Speed	Real Number	Ship Speed	km/h, 1 decimal place. Ship speed over ground. Data can be collected from ship AIS or other equipment.	1s
Heading	Real Number	Heading	Degrees, 1 decimal place. The direction of the ship's bow, ranging from 0 to 360, with 0 being true north and 90 being true east. Data can be collected from ship AIS or other equipment. If no sampling data is available, the value is -1.	1s
Course	Real Number	Course	Degrees, 1 decimal place. The direction of the ship's movement, ranging from 0 to 360, with 0 being true north and 90 being true east. Data can be collected from ship AIS or other equipment. If no sampling data is available, the value is -1.	1s
DataStatus	Integer	Data Status	0. Normal; 1. Self-test/Simulated Alarm. Defaults to 0.	1s

1.4.2 SHIP POWER SYSTEM (POWERSYS)

1.4.2.1 The composition, format, and sampling interval of the dynamic information elements of the ship power system are shown in Table 1.4.2.1.

Table 1.4.2.1 Composition, Format, and Sampling Interval of the Dynamic Information Elements of the Ship Power System

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
SOC	Real Number Array	Remaining Energy Ratio	%, 1 decimal place. Valid range: 0~100. -1 if no sampling data. The array contains 6 elements, corresponding to [electricity, fuel, LNG, methanol, hydrogen, ammonia] (the last 5 elements are	1s

			reserved). For example, Remaining Energy Ratio=[80,-1,-1,-1,-1,-1] indicates 80% remaining electricity.	
BatterySysStatus	Integer	Battery System Operating Status	1. Running; 0. Shutdown;,-1. Invalid. When all battery strings are in a shutdown state, the value is 0; when any battery string is in an operating state, the value is 1; when no battery string is installed, the value is -1	1s
FuelSysStatus	Integer	Fuel System Operating Status	Reserved item, constant value -1.	1s
DistributionSysStatus	Integer	Power Distribution System Operating Status	1. Running; 0. Shutdown; -1. Invalid. 0 when all power distribution equipment (busbars, converters, inverters, frequency converters, rectifiers, etc.) are in shutdown/sleep mode. -1 if no power distribution system is installed.	1s
PropulsionSysStatus	Integer	Propulsion System Operating Status	1. Running; 0. Shutdown. 0 when all propulsion motors are in shutdown/sleep mode.	1s

1.4.3 BATTERY SYSTEM (BATTERYSYS)

1.4.3.1 The Battery System currently has no data to be exchanged.

1.4.4 CHARGER (CHARGER)

1.4.4.1 The composition, format, and sampling interval of the dynamic information body of the charger are shown in Table 1.4.4.1. This only refers to the chargers installed on the ship.

Table 1.4.4.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Chargers

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Charger ID	A unique identifier for the entire ship. Valid values: 01~99. Only refers to the chargers installed on the ship.	5min
AlarmFlag	Integer	Alarm Flag	Unsigned integer. When converted to binary, the meaning from the lowest bit to the highest bit (-endian mode) is detailed in the following table “Bit Definition of Alarm Flag.”	5min
Current	Real Number	Charging Current	A, 1 decimal place. The charging current value of the charger, taken as an absolute value.	5min
Voltage	Real Number	Charging Voltage	V, 1 decimal place. The charging voltage value of the charger.	5min
Temperature	Real Number	Charging Gun Temperature	°C, 1 decimal place. The temperature at the tip of the charging gun.	5min

1.4.4.2 The bit definition of the alarm flag for the charger is shown in Table 1.4.4.2.

Table 1.4.4.2 Bit Definition of the Alarm Flag

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Overvoltage. 00: No alarm；01: Alarm present; 11: Invalid data.	General Alarm	Upload this alarm signal when the charging voltage is too high.
2~3	Overcurrent. 00: No alarm; 01: Alarm present; 11: Invalid data.	General Alarm	Upload this alarm signal when the battery charging current is

			too high.
4~5	Charging Gun Overheating. 00: No alarm; 01: Alarm present; 11: Invalid data.	General Alarm	Upload this alarm signal when the charging gun temperature is too high.
6~7	Power Distribution Status. 00: Open; 01: Closed; 11: Invalid data.		Upload Power Distribution Switch Status Signal
8~9	Operating Status. 00: Stop; 01: Running; 11: Invalid data.		Upload the operating status signal.

1.4.5 BATTERY ROOM/BOX/CABINET (COMPARTMENT)

1.4.5.1 The composition, format, and sampling interval of the dynamic information body for the battery room/box/cabinet are shown in Table 1.4.5.1.

Table 1.4.5.1 Composition, Format, Sampling Interval of the Dynamic Information Body for the Battery Room/Box/Cabinet

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Battery Room Number	A unique identifier for the entire ship. Valid values: 01~99	1s
AlarmFlag	Integer	Battery Room Alarm Flag	Unsigned integer, converted to binary, with the meaning of each bit from low to high (big-endian mode) detailed in the table below “Bit of Alarm Flag”	1s
MaxEnvTemperature	Real Number	Maximum Ambient Temperature	℃, with 1 decimal place. The ambient temperature value of the battery room can be directly obtained from the battery room temperature sensor or from the external temperature sensor of the battery string, and the maximum value is uploaded.	1s
MinEnvTemperature	Real Number	Minimum Ambient Temperature	℃, with 1 decimal place. The ambient temperature value of the battery room can be directly obtained from the battery room temperature sensor or from the external temperature sensor of the battery string, and the minimum value is uploaded.	1s

1.4.5.2 The bit definition of the alarm flag for the battery room/box/cabinet is shown in Table 1.4.5.2.

Table 1.4.5.2 Bit Definition of the Alarm Flag for the Battery Room/Box/Cabinet

Binary Bit	Data Representation	Severity Level	Explanation
0~1	High Ambient Temperature. 00: No Alarm; 01: Alarm; 11: Invalid Data	General Alarm	High Ambient Temperature Alarm in Battery Room/Box/Cabinet. If the ambient temperature of the battery room is collected by the battery string BMS, any string with an external high temperature alarm must upload this alarm.
2~3	Low Ambient Temperature. 00: No Alarm; 01: Alarm; 11: Invalid Data	General Alarm	Low Ambient Temperature Alarm in Battery Room/Box/Cabinet. If the ambient temperature of the battery room is collected by the battery string BMS, any string with an external low temperature alarm must upload this alarm.
4~5	Combustible Gas Detection Device Alarm	Emergency Alarm	When a Combustible Gas Detection Alarm occurs in the Battery Room/Box/Cabinet, upload this alarm

	00: No Alarm; 01: Alarm; 11: Invalid Data		value.
6~7	Fire Detection Device Alarm. 00: No Alarm; 01: Alarm; 11: Invalid Data	Emergency Alarm	When a Fire Detection Alarm occurs in the Battery Room/Box/Cabinet, upload this alarm value.
8~9	Emergency Exhaust. 00: No Action; 01: Action; 11: Invalid Data	Emergency Alarm	When the Emergency Exhaust Device in the Battery Room/Box/Cabinet is running, provide a running signal and upload the signal indicating activation of the emergency exhaust device.
10~11	Emergency Exhaust Fault 00: No Alarm; 01: Alarm; 11: Invalid Data	General Alarm	The Emergency Exhaust Device in the Battery Room/Box/Cabinet needs to be activated but fails to start due to a fault.
12~13	Temperature Regulation Device Fault. 00: No Alarm; 01: Alarm; 11: Invalid Data	General Alarm	A Fault Occurs in the Temperature Regulation Device in the Battery Room/Box/Cabinet.

1.4.6 BATTERY ASSEMBLY (BATTERYGROUP)

1.4.6.1 The composition, format, and sampling interval of the data items in the dynamic information body of the battery assembly are shown in Table 1.4.6.1.

Table 1.4.6.1 Composition, Format, and Sampling Interval of Data Items in the Dynamic Information Body of the Battery Assembly

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Battery Assembly Number	A unique identifier for the entire ship. Valid values: 01~99. A battery assembly is a branch power source connected to the busbar, typically a parallel combination of multiple battery strings. The associated battery room can be found in the static data.	1s
AlarmFlag	Integer	Alarm Flag	An unsigned integer. When converted to binary, the meaning of each bit from low to high (big-endian mode) is detailed in the table below “Bit Definition of Alarm Flag.”	1s
Voltage	Real Number	Battery Assembly Voltage	Volts, with one decimal place. The output voltage of the battery assembly.	1s
MainLoopCurrent	Real Number	Main Circuit Current	Amperes, with one decimal place. The current in the branch connecting the battery assembly to the busbar. A negative value indicates charging, and a positive value indicates discharging.	1s
SOC	Real Number	State of Charge (SOC)	Percentage, with one decimal place. The remaining charge percentage of the battery assembly, i.e., SOC, with valid values ranging from 0 to 100.	5min
SOH	Real Number	State of Health (SOH)	Percentage, with one decimal place. The health status of the battery assembly, i.e., SOH, with valid values ranging from 0 to 100.	5min
EnvTemperature	Real Number	Battery Assembly Ambient Temperature	℃, 1 decimal place. Environmental temperature of a single battery assembly, data obtained from external temperature sensors of the string.	1s
MaxCellTemperature	Real	Maximum Cell	℃, 1 decimal place. Maximum	1s

	Number	Temperature	cell temperature value of the battery assembly.	
MinCellTemperature	Real Number	Minimum Cell Temperature	℃, 1 decimal place. Minimum cell temperature value of the battery assembly.	1s
MaxCellVoltage	Integer	Maximum Cell Voltage	mV. Maximum cell voltage value of the battery assembly.	1s
MinCellVoltage	Integer	Minimum Cell Voltage	mV. Minimum cell voltage value of the battery assembly.	1s
InsulationResistance	Real Number	Electrical Insulation Resistance	MΩ. Electrical insulation resistance value of the battery assembly. Generally detected during startup.	5min
AvgCellVoltage	Integer	Average Cell Voltage	mV. Average cell voltage value of the battery assembly.	5min
AvgCellTemperature	Real Number	Average Cell Temperature	℃, 1 decimal place. Average cell temperature value of the battery assembly.	5min

1.4.6.2 The bit definitions of the alarm flag for the battery assembly are shown in Table 1.4.5.2.

Table 1.4.5.2 Bit Definitions of the Alarm Flag for the Battery Assembly

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Low SOC. 00: No alarm; 01: Alarm active; 11: Invalid data	General Alarm	When the battery assembly's charge level falls below a certain threshold (e.g., 20%), an alarm signal is uploaded.
2~3	BMS power supply failure. 00: No alarm; 01: Alarm active; 11: Invalid data	General Alarm	When there is a power supply failure in more than one circuit of the BMS main power or backup power, this alarm signal is uploaded.
4~5	Operation stopped due to fault. 00: No alarm; 01: Alarm active; 11: Invalid data	Emergency Alarm	When the battery assembly stops operating due to any fault, this alarm signal is uploaded.
6~7	BMS communication failure. 00: No alarm; 01: Alarm active; 11: Invalid data	Emergency Alarm	If the BMS of any battery string within the battery assembly fails to communicate with PMS/EMS/AMS, a BMS communication failure alarm is uploaded.
8~9	Fault cut-off. 00: No action; 01: Action taken; 11: Invalid data	Emergency Alarm	If any battery string within the battery assembly stops operating due to a fault and its circuit breaker/relay is tripped, the action signal of the breaker or relay is uploaded.
10~11	Emergency cut-off. 00: No action 01: Action taken; 11: Invalid data	Emergency Alarm	When manually emergency cut-off is performed, this signal is uploaded.
12~14	Excessive cell temperature. 000: No alarm; 011: Level 3 alarm; 010: Level 2 alarm; 001: Level 1 alarm; 111: Invalid data	Emergency Alarm (Level 2 and above)	If any cell has an over-temperature signal, an alarm is uploaded, and it is categorized into three levels based on the temperature value: Level 1 alarm only issues a warning, Level 2 alarm requires power reduction, and Level 3 alarm requires stopping the (sub)system operation.
15~16	Abnormal Operation of Circuit Breaker/Relay. 00: No Alarm; 01: Alarm Triggered; 11: Invalid Data	General Alarm	When the circuit breaker/relay operates abnormally without an alarm, an alarm is to be uploaded.
17~19	Cell Voltage Overvoltage. 000: No Alarm; 011: Level 3 Alarm; 010: Level 2 Alarm; 001: Level 1 Alarm; 111: Invalid Data	Emergency Alarm (Level 2 and above)	When any cell sends a cell overvoltage signal, an alarm signal is to be uploaded; the alarm is to be classified into three levels based on the overvoltage value: Level 1 Alarm only triggers an alert, Level 2 Alarm requires operation at reduced power, and Level 3 Alarm requires stopping the (sub)system operation.
20~22	Cell Voltage Undervoltage. 000: No Alarm; 011: Level 3 Alarm; 010: Level 2 Alarm;	Emergency Alarm (Level 2 and above)	When any cell sends a cell undervoltage signal, an alarm signal is to be uploaded; the alarm is to be classified into three levels based on the

	001: Level 1 Alarm; 111: Invalid Data		undervoltage value: Level 1 Alarm only triggers an alert, Level 2 Alarm requires operation at reduced power, and Level 3 Alarm requires stopping the (sub)system operation.
23~25	Excessive Voltage Difference. 000: No Alarm; 001: Alarm Triggered; 111: Invalid Data	General Alarm	When the cell voltage difference is excessive, this alarm is to be uploaded.
26~28	Excessive Temperature Difference. 000: No Alarm; 001: Alarm Triggered; 111: Invalid Data	General Alarm	When the cell temperature difference is excessive, this alarm is to be uploaded.
29~30	Low Insulation. 00: No Alarm; 01: Alarm Triggered; 11: Invalid Data	Emergency Alarm	When insulation is low, this alarm signal is to be uploaded.
31~32	Protection Function Fault. 00: No Alarm; 01: Alarm Triggered; 11: Invalid Data	Emergency Alarm	When any protection function has a fault, this alarm is to be uploaded.
33~34	Temperature Detection Fault. 00: No Alarm; 01: Alarm Triggered; 11: Invalid Data	Emergency Alarm	When any temperature detection function has a fault, this alarm signal is to be uploaded.
35~37	Overcharge/Overdischarge. 000: No Alarm; 010: Overcharge; 001: Overdischarge; 111: Invalid Data	Emergency Alarm	When a charging fault, battery overcharge, or battery overdischarge occurs, the corresponding alarm signal is to be sent.
38~39	Operating Status. 00: Stopped; 01: Running; 11: Invalid Data		Upload the operating status signal; the system is deemed “Running” if any battery string is in operation.

1.4.7 BATTERY STRING (BATTERYCLUSTER)

1.4.7.1 The composition, format, and sampling interval of the dynamic information body of the battery string are shown in Table 1.4.7.1.

Table 1.4.7.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Battery String

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Battery String ID	A unique identifier for the entire ship. Valid values 0001 to 5000. The corresponding battery assembly is referenced in the static data.	1s
AlarmFlag	Integer	Alarm Flag	Unsigned integer, converted to binary from the least significant bit to the most significant bit (big-endian mode). The meaning of each bit is detailed in the table “Alarm Flag Bit Definition.”	1s
SOC	Real Number	Remaining Charge Ratio	Percentage,1 decimal place. The remaining charge percentage of a single battery, i.e., SOC (State of Charge), valid range: 0~100.	1s
EnvTemperature	Real Number	Battery String Ambient Temperature	Degrees Celsius 1 decimal place. The ambient temperature of a single battery string, obtained from an external temperature sensor.	1s
Voltage	Real Number	Battery string Voltage	Output voltage of the battery string	1s

MainLoopCurrent	Real Number	Main Circuit Current	Current of the branch connecting the battery string to the busbar, negative value indicates charging, positive value indicates discharging	1s
SOH	Real Number	Battery Health Status	%, 1 decimal place. State of Health (SOH) of the battery string, valid range 0~100	1s
MaxCellVoltage	Integer	Maximum Cell Voltage	mV. Maximum voltage value among all single cells in the battery string	1s
MinCellVoltage	Integer	Minimum Cell Voltage	mV. Minimum voltage value among all single cells in the battery string	1s
InsulationResistance	Real Number	Electrical Insulation Resistance	MΩ. Electrical insulation value of the battery string. This value is typically checked during startup.	5min
AvgCellVoltage	Integer	Average Cell Voltage	mV. Average voltage value of all single cells in the battery string.	5min
AvgCellTemperature	Real Number	Average Cell Temperature	°C, 1 decimal place. Average temperature value of all single cells in the battery string.	5min

1.4.7.2 The bit definition of the battery string alarm flag is shown in Table A.4.6.2.

Table 1.4.7.2 Bit Definition of the Battery String Alarm Flag

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Abnormal operation of circuit breaker/relay. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When there is no alarm in the battery string, if the circuit breaker/relay operates abnormally, an alarm signal is to be uploaded.
2~4	Single cell overvoltage. 000: No alarm; 011: Level 3 alarm; 010: Level 2 alarm; 001: Level 1 alarm; 111: Invalid data	Emergency Alarm (Level 2 and above)	Within the battery string, if any single cell has an overvoltage signal, an alarm signal is to be uploaded. Additionally, the alarm is to be classified into three levels based on the overvoltage value: Level 1 alarm only issues a warning, Level 2 alarm requires reducing power operation, and Level 3 alarm requires stopping the (sub)system operation.
5~7	Single cell undervoltage. 000: No alarm; 011: Level 3 alarm; 010: Level2 alarm; 001: Level 1 alarm; 111: Invalid data	Emergency Alarm (Level 2 and above)	Within the battery string, if any single cell has an undervoltage signal, an alarm signal is to be uploaded. Additionally, the alarm is to be classified into three levels based on the undervoltage value: Level 1 alarm only issues a warning, Level 2 alarm requires reducing power operation, and Level 3 alarm requires stopping the (sub)system operation.
8~10	Excessive voltage difference. 000: No alarm; 001: Alarm present; 111: Invalid data	General Alarm	When the voltage difference between cells in the battery string is too large, upload this alarm signal.
11~13	Single cell overtemperature. 000: No alarm; 011: Level 3 alarm; 010: Level 2 alarm; 001: Level 1 alarm; 111: Invalid data	Emergency Alarm (Level 2 and above)	Within the battery string, if any single cell has a high-temperature signal, upload an alarm signal. Additionally, the alarm is to be classified into three levels based on the temperature value: Level 1 alarm only issues a warning, Level 2 alarm requires reducing power operation, and Level 3 alarm requires stopping the (sub)system operation.
14~16	Excessive temperature difference. 000: No alarm; 001: Alarm present; 111: Invalid data	General Alarm	When the temperature difference between cells in the battery string is too large, upload this alarm signal.
17~18	Low insulation. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When the insulation of the battery string is low, upload this alarm signal.
19~20	Protection function failure. 00: No alarm; 01: Alarm present; 11:	Emergency Alarm	When any protection function in the battery string fails, upload this alarm signal.

	Invalid data		
21~22	Temperature detection failure. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When any temperature detection function in the battery string fails, upload this alarm signal.
23~25	Overcharge/overdischarge. 000: No alarm; 010: Overcharge; 001: Overdischarge; 111: Invalid data	Emergency Alarm	When the battery string experiences charging failure, overcharging, or over-discharging, corresponding alarm signal is to be issued.
26-27	Operation stopped due to fault. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When the battery string stops operating due to a fault, upload the alarm signal.
28~29	Operation status. 00: Stopped; 01: Running; 11: Invalid data		Upload the operational status signal.

1.4.8 BATTERY PACK (BATTERYPACK)

1.4.8.1 The composition, format, and sampling interval of the dynamic information body of the battery pack are shown in Table 1.4.8.1.

Table 1.4.8.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Battery Pack

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Battery Pack ID	A unique identifier for the entire ship. Valid values: 00001~65000. The associated battery strings can be found in the static data.	5min
CellNum	Integer	Number of Cells in the Pack	The number of battery cells within the battery pack. Valid values: 1~252.	5min
CellVoltage	Integer Array	Cell Voltage Array	An array of voltages for all battery cells within the battery pack.	5min
CellTemperature	Real Number Array	Cell Temperature Array	°C, 1 decimal place. An array of temperatures for all battery cells within the battery pack.	5min

1.4.9 POWER DISTRIBUTION SYSTEM (CDSYSTEM)

1.4.9.1 The composition, format, and sampling interval of dynamic information entities in the DC distribution system are shown in Table 1.4.9.1.

Table 1.4.9.1 Composition, Format, and Sampling Interval of Dynamic Information Entities in the Power Distribution System

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Power Distribution System ID	A unique identifier for the entire ship. Valid values: 01~99. A conventional ship typically has only one power distribution system, but in special cases such as catamarans, there may be two power distribution systems.	1s
AlarmFlag	Integer	Alarm Flag	An unsigned integer, which, when converted to binary, represents specific meanings from the least significant bit to the most significant bit (big-endian mode). For details, refer to the table "Bit Definition of Alarm Flag" below.	1s
CoolTemperature	Real Number	Cooling System Temperature	°C, 1 decimal place. The temperature of the cooling medium outlet (for liquid cooling) or the radiator temperature (for air cooling) in the cooling system.	1s

1.4.9.2 The bit definition of the alarm flag in the DC distribution system is shown in Table 1.4.9.2.

Table 1.4.9.2 Bit Definition of Alarm Flag in the DC Distribution System

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Energy Management System Comprehensive Fault. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When any alarm occurs in the energy management system, this alarm signal must be uploaded.
2~3	Cooling System Comprehensive Fault. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When any fault occurs in the cooling system of the bus section panel, this alarm signal must be uploaded.
4~5	Cooling Medium Leakage. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	This applies to situations where the bus section distribution panel uses a cooling medium. When a cooling medium leakage occurs, this alarm signal must be uploaded.
6~7	Cooling Medium Temperature Too High. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	This applies to situations where a cooling medium is installed. If the cooling medium temperature is too high, this alarm signal must be uploaded.
8~9	Cooling Pump or Fan Fault. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	This applies to situations where a cooling fan is installed. If any fault occurs in the cooling device, this alarm signal must be uploaded.

1.4.10 BUS SECTION (CBUS)

1.4.10.1 The data item composition, format, and sampling interval of the dynamic information body for bus section are detailed in Table 1.4.10.1.

Table 1.4.10.1 Composition, Format, and Sampling Interval of Dynamic Information Body for DC Bus Section

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Bus Section Number	A unique identifier for the entire ship. Valid values: 01~99. Typically, the DC bus is divided into two sections, each associated with a specific power distribution system as detailed in the static data.	1s
AlarmFlag	Integer	Alarm Flag	An unsigned integer, converted to binary, with the meaning of each bit from low to high (big-endian mode) detailed in the table “Bit Definition of Alarm Flag”.	1s
Voltage	Real Number	Bus Voltage	Volts, 1 decimal place. The voltage of the DC bus segment.	1s
Current	Real Number	Bus Current	A, 1 decimal place. The output current.	1s
Frequency	Real Number	Bus Frequency	Hz, 1 decimal place. Enter -1 for DC bus.	5min
Power	Real Number	Bus Power	Kilowatts, 1 decimal place. The power of the DC bus segment.	5min

1.4.10.2 The bit definitions of the alarm flag for bus section are provided in Table 1.4.10.2.

Table 1.4.10.2 Bit Definitions of the Alarm Flag for Bus section

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Overvoltage. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When the bus voltage is too high, upload this alarm signal
2~3	Undervoltage. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When the bus voltage is too low, upload this alarm signal
4~5	Load Protection. 00: No action; 01: Action taken; 11: Invalid	General Alarm	When the load protection device on any branch of the bus operates, upload the signal of the

			protection device action
6~7	Bus Tie Protection. 00: No action; 01: Action taken; 11: Invalid data	General Alarm	When the bus protection device operates, upload the signal of the protection device action
8~9	Bus Precharge Failure. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	Applicable to situations where the bus requires precharge. When the bus precharge fails or the bus startup fails, upload this alarm signal
10~11	Low Bus Insulation. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When the insulation value of the bus is low, upload this alarm signal

1.4.11 CONVERTER (CONVERTER)

1.4.11.1 The composition, format, and sampling interval of the dynamic information body of the converter are shown in Table 1.4.11.1.

Table 1.4.11.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Converter

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Converter Number	A unique identifier for the entire ship. Valid values: 01 to 99.	1s
AlarmFlag	Integer	Alarm Flag	Unsigned integer. The meaning of each bit from LSB to MSB (big-endian) in its binary representation is detailed in the table "Alarm Flag Bit Definition".	1s
InputVoltage	Real Number	Input Voltage	V (Volts), 1 decimal place. The valid value of the input voltage.	1s
Voltage	Real Number	Output Voltage	V (Volts), with one decimal place. The valid value of the output voltage.	1s
Current	Real Number	Output Current	A (Amperes), with one decimal place. The valid value of the output current.	1s
Power	Real Number	Output Power	kW, 1 decimal place. The output power.	1s
Frequency	Real Number	Output Frequency	Hz, 1 decimal place. The output frequency.	5min
DevTemperature	Real Number	Device Temperature	°C (Degrees Celsius), 1 decimal place. The operating temperature of the device.	5min
ReactorTemperature	Real Number	Reactor Temperature	°C, 1 decimal place. Set to -1 if no reactor is installed.	5min

1.4.11.2 The bit definitions of the converter alarm flags are shown in Table A.4.11.2.

Table 1.4.11.2 Bit Definitions of Converter Alarm Flags

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Low DC Voltage. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When the input voltage is low, upload this alarm.
2~3	High Reactor Temperature. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	Applicable to situations with reactors installed. Reactor overtemperature alarm is to be uploaded.
4~5	Overload. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	This alarm signal is to be uploaded when overload occurs.
6~7	Communication exception with BMS/EMS. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	Communication failure alarm with BMS/EMS is to be uploaded.
8~9	Power distribution switch status. 00: Open; 01: Closed; 11: Invalid data		Status of the bus connecting switch is to be uploaded.
10~11	External emergency shutdown request. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When external emergency shutdown signal is present, upload this alarm signal.
12~13	Excessive equipment temperature. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	Alarm signal is to be uploaded when temperature exceeds thresholds requiring shutdown or power derating.

14~15	Operation status. 00: Stopped; 01: Running; 11: Invalid data		Operational status signals are to be uploaded.

1.4.12 PROPULSION SYSTEM (PROPULSIONSYS)

1.4.12.1 The propulsion system currently has no data to exchange.

1.4.13 PROPULSION MOTOR (MOTOR)

1.4.13.1 The composition, format, and sampling interval of the dynamic information body for the propulsion motor are shown in Table 1.4.13.1.

Table 1.4.13.1 Composition, Format, and Sampling Interval of the Dynamic Information Body for the Propulsion Motor

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Propulsion Motor Number	A unique identifier for the entire ship. Valid values: 01~99	1s
AlarmFlag	Integer	Alarm Flag	Unsigned Integer. When converted to binary, the meaning of bits from low to high (big-endian mode) is detailed in the table below "Bit Definition of Alarm Flag".	1s
Voltage	Real Number Array	Voltage	V, 1 decimal place, three-value array, corresponding to the input voltage of the propulsion motor. For AC motors, it corresponds to three-phase voltage; for DC motors, the first value is the input voltage, and the remaining two are null.	1s
Current	Real Number Array	Armature Current	A, 1 decimal place, three-value array corresponding to the current of the propulsion motor. For AC motors, it corresponds to three-phase current; for DC motors, the first value is the current, and the remaining two are null.	1s
Frequency	Real Number	Frequency	Hz, 1 place. Applicable to AC motors; for DC motors, the value is -1.	1s
Power	Real Number	Mechanical Power	kW, 1 decimal place. Mechanical power of the propulsion motor.	1s
Speed	Real Number	Rotational Speed	rpm. Rotational speed of the propulsion motor.	1s
Temperature	Real Number	Stator Winding Temperature	℃, 1 decimal place. Temperature of the stator winding of the propulsion motor.	5min

1.4.13.2 The bit definitions for the propulsion motor alarm flags are shown in Table 1.4.13.2.

Table 1.4.13.2 Bit Definitions of Propulsion Motor Alarm Flags

Binary Bit	Data Representation	Severity Level	Explanation
0~1	Overcurrent. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When the propulsion motor current is excessive, upload this alarm signal.
2~3	Operational fault. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When any fault occurs that prevents the propulsion motor from operating without an alarm, upload this alarm signal.
4~5	High bearing temperature or low lubricant inlet pressure. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When there is an alarm for either high bearing temperature or low lubricant pressure (if applicable), upload this alarm signal.
6~7	High winding temperature. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When there is an alarm for high winding temperature in any phase, upload this alarm signal.
8~9	Operational status. 00: Stopped; 01: Running; 11: Invalid data		Upload the operational status signal.
10~11	Power distribution switch status. 00:		Upload the status signal of the switch

	Open; 01: Closed; 11: Invalid data		connecting the propulsion motor and the DC busbar, and collect the switch status signal.
12~13	Overspeed. 00: No alarm; 01: Alarm present; 11: Invalid data	Emergency Alarm	When the propulsion motor experiences overspeed, upload this alarm signal.
14~15	Motor cooling system fault. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When a fault occurs in the motor cooling system, upload this alarm signal.
16~17	Overvoltage. 00: No alarm; 01: Alarm present 11: Invalid data	General Alarm	When the power supply voltage of the propulsion motor is excessively high in any phase, upload this alarm signal.
18~19	Undervoltage. 00: No alarm; 01: Alarm present; 11: Invalid data	General Alarm	When the power supply voltage of the propulsion motor is excessively low in any phase, upload this alarm signal.

1.4.14 PROPELLER (PROPELLER)

1.4.14.1 The composition, format, and sampling interval of the dynamic information body of the propeller are shown in Table 1.4.14.1.

Table 1.4.14.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Propeller

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Propeller Number	A unique identifier for the entire ship. Valid values: 01~99. Such as "Propeller", "Z-drive Propulsor", etc.	1s
Speed	Real Number	Rotational Speed	rpm, 1 decimal place. The rotational speed of propellers and other propulsors.	1s

1.4.15 STEERING GEAR (RUDDER)

1.4.15.1 The composition, format, and sampling interval of the dynamic information body of the rudder are shown in Table 1.4.15.1.

Table 1.4.15.1 Composition, Format, and Sampling Interval of the Dynamic Information Body of the Rudder

Field Identifier	Data Type	Field Name	Description	Maximum Sampling Interval
Code	String	Steering Gear Number	A unique identifier for the entire ship. Valid values: 01~99	1s
AlarmFlag	Integer	Alarm Flag	Unsigned integer. When converted to binary, the meaning from the lowest bit to the highest bit (big-endian mode) is detailed in the table below “Bit Definition of Alarm Flag”	1s
Angle	Real Number	Rudder Angle	Degrees, 1 decimal place. The angle of the rudder turned by the steering gear, with left rudder as negative and right rudder as positive. For emergency steering gear, this value is always empty.	1s

1.4.15.2 The bit definitions of the alarm flag for the rudder are shown in Table 1.4.15.2.

Table 1.4.15.2 Bit Definitions of the Alarm Flag for the Rudder

Binary Bit	Data Representation	Severity Level	Explanation
0~1	High Oil Temperature. 00: Stopped; 01: Running; 11: Invalid data	General Alarm	When the temperature of power oil, steering oil, and lubricating oil is high, upload an alarm signal.
2~3	Low Oil Level. 00: Stopped; 01: Running; 11: Invalid data	General Alarm	When the oil level of power oil, steering oil, and lubricating oil is low, upload an alarm signal.

4~5	Power Supply Failure. 00: Stopped; 01: Running; 11: Invalid data	General Alarm	When there is a failure in the main power supply or control power supply (power loss, phase loss, or frequency conversion failure), upload an alarm signal.
6~7	Overload Alarm. 00: Stopped; 01: Running; 11: Invalid data	General Alarm	When the steering gear is overloaded, upload an alarm signal.
8~9	Operating Status. 00: Stopped; 01: Running; 11: Invalid data		Upload the operating status of the steering gear.

1.5 DATA PACKAGE EXAMPLES

1.5.1 STATIC DATA IN JSON FORMAT

1.5.1.1 An example of a static data package in JSON format is shown below.


```
{
    "Package": {
        "Header": {
            "Version": 4,
            "Author": "XXX Institution",
            "TimeStamp": "2024-01-03T12:00:00Z",
            "ShipID": "CNxxx"
        },
        "BaseInfo ": {
            "Ship": {
                "ShipID": "CNxxx",
                "ShipName": "xxx",
                "ShipType": 102,
                ......
            },
            "PowerSys": {
                "DataMaintenanceID": "xxx",
                "SysTopoMap": "data:image/jpeg;base64,xxx",
                ......
            },
            "BatterySys": {
                "BatterySystemIntegrator": "xxx",
                "BatteryManufacturer": "xxx",
                "RatedCapacity": 43200,
                ......
            },
            "Compartment": [{
                "Code": "01",
                "Name": "No. 1 Battery Roomt"
            },{
                "Code": "02",
                "Name": "No. 2 Battery Room"
            }],
            "BatteryGroup": [{
                "Code": "01",
                "Name": "No. 1 Battery Assembly"
                "RatedCapacity": 720,
                "RatedVoltage": 630,
                ......
            },{
                "Code": "02",
                "Name": "No. 2 Battery Assembly"
                "RatedCapacity": 720,
                "RatedVoltage": 630,
                ......
```

```
                    }],
                    ......
                }
            }
        }
```

1.5.2 JSON FORMAT FOR DYNAMIC DATA

1.5.2.1 Example of a JSON Format Data Package for Dynamic Data is as Follows.


```
{
    "Package": {
        "Header": {
            "Version": 4,
            "Author": "Institution",
            "ShipID": "CNxxx",
            "TimeStamp": "2024-01-01T11:00:00Z"
        },
        "TimeSeriesData":[{
            "TimeStamp": "2024-01-01T12:00:00Z",
            "Ship": {
                "Longitude": 114.289894,
                ……
            },
            "PowerSys": {
                "SOC": [85.1,-1,-1,-1,-1,-1],
                "BatterySysStatus": 1,
                "FuelSysStatus": -1,
                "DistributionSysStatus": 1,
                "PropulsionSysStatus": 1
            },
            ""Compartment":[{
                "Code":"01",
                "AlarmFlag ":1,
                "MaxEnvTemperature ":40.2,
                ……
            },{
                "Code":"02",
                ……
            }],
            "BatteryGroup":[{
                "Code":"001",
                ……
            },{
                "Code":"002",
                ……
            }],
            ……
        },{
            "TimeStamp": "2024-01-01T12:01:00Z",
            "Ship": {
                "Longitude": 114.290894,
                ……
            },
            "PowerSys": {
                "SOC": [85.0,-1,-1,-1,-1,-1],
                "BatterySysStatus": 1,
                "FuelSysStatus": -1,
                "DistributionSysStatus": 1,
                "PropulsionSysStatus": 1
            },
            "Compartment":[{
                "Code":"01",
                "AlarmFlag ":1,
                "MaxEnvTemperature ":40.1,
```

```
                        ......
                    },{
                        "Code":"02",
                        ......
                    }],
                    "BatteryGroup":[{
                        "Code":"001",
                        ......
                    },{
                        "Code":"002",
                        ......
                    }],
                    ......
                }]
            }
        }
```

APPENDIX 2: RISK ASSESSMENT DOCUMENTATION

2.1 CONTENTS OF RISK ASSESSMENT REPORT

Executive Summary
An overview of the assessment content, key findings, and conclusions.
1. Introduction
A brief explanation of the purpose of the assessment and the relevant parties involved.
2. Objectives and Scope
The primary objective may be to demonstrate that the safety risks of the ship are acceptable/tolerable; the scope may include limitations to design/arrangement, specific environments/locations, and expected operational modes, among others.
3. Description
A concise explanation of the design and arrangement related to the expected operations and operating conditions.
4. Methodology
An overview of the risk assessment techniques/methods. This includes how the overall design is divided into sections for assessment, how hazards are identified, how risk criteria are selected, and the mechanisms for risk rating and documentation. Additionally, a practical workshop schedule is required, indicating the time allocated to each section.
5. Team
The risk assessment team is to be composed of subject field experts with appropriate qualifications (individuals holding relevant academic degrees and/or chartered/professional engineers, individuals with ship operation experience, and individuals with risk assessment experience) and extensive expertise. The subject fields are to cover, but are not limited to, batteries, structures, fire safety, electrical systems, processes, and operations. The names, titles, relevant qualifications, expertise, and experience of the subject field experts are to be documented. This information can be recorded in a table alongside the attendance records of the seminar. If this information is extensive and may divert attention from the methodology and results, it can be included as an appendix.
6. Results
Discussion of the key findings and issues identified during the assessment.
7. Conclusions
A brief judgment on whether the risks have met acceptable standards.
8. Actions to Be Taken
A list of additional/alternative protective measures, including responsible parties and expected

completion dates.

Appendices	
A.	Workshop records (e.g., notes from the workshop, including trigger words and phrases).
B.	Plans, process information, and reference documents (including the scope of the report).

2.2 FMEA RISK ASSESSMENT TABLE

1、Battery System										
						Risk Rating				Implementation Status
Serial Number	Fault Mode Level	Fault Mode	Cause (Accident/Incident)	Consequence	Existing Protective Measures	Severity	Likelihood	Risk Level	Proposed Measures (Expert Opinion)	Implementation Status Description
(1)	Battery Cell	Battery Cell Overvoltage (Charging)	Failure of Overcharge Protection Function	Thermal Runaway of Battery Cell						
(2)	……	……	……	……						
2、Power Distribution System										
						Risk Rating				Implementation Status
Serial Number	Fault Mode Level	Fault Mode	Cause (Accident/Incident)	Consequence	Existing Protective Measures	Severity	Likelihood	Risk Level	Proposed Measures (Expert Opinion)	Implementation Status Description
(1)	……	……	……	……						
3、Propulsion System										

						Risk Rating				Implementation Status
Serial Number	Fault Mode Level	Fault Mode	Cause (Accident/Incident)	Consequence	Existing Protective Measures	Severity	Likelihood	Risk Level	Proposed Measures (Expert Opinion)	Implementation Status Description
(1)	……	……	……	……						
4、Others										
						Risk Rating				Implementation Status
Serial Number	Fault Mode Level	Fault Mode	Cause (Accident/Incident)	Consequence	Existing Protective Measures	Severity	Likelihood	Risk Level	Proposed Measures (Expert Opinion)	Implementation Status Description
(1)	……	……	……	……						

Note:1、Before the risk assessment meeting, the relevant design party is to complete the preliminary filling of the table, including the fault mode level, fault mode, causes, consequences, existing protective measures, and risk rating.

2、During the risk assessment meeting, risk assessment seminar is to be held where experts discuss and confirm the pre-filled content. Additionally, “recommended measures” are to be proposed, recorded, and confirmed by the experts.

3、After the risk assessment meeting, the relevant design party is to complete the “specific implementation description” based on the “recommended measures” and submit it for review. The final confirmation of the implementation status of the measures will be conducted by CCS.

4、If the ship design adopts other types of propulsion systems, such as cycloidal propellers, rim-driven thrusters, or azimuth thrusters, further analysis of the inherent risks of the system itself is to be conducted.

2.3 FMEA SEVERITY LEVEL CLASSIFICATION TABLE

SI	Severity Levels	Definition
4	Catastrophic	Accident consequences may result in catastrophic casualties, property damage, environmental destruction, with the impact extending beyond controllable areas, and the consequences being unacceptable, such as a total ship blackout / loss of propulsion, etc.
3	Critical	Accident consequences may result in severe casualties, damage, environmental destruction, with the impact remaining within controllable areas, but the consequences being unacceptable, such as a fire/explosion in the battery pack or thermal runaway of battery cells, etc.
2	Moderate	Accident consequences may result in injuries, certain property damage, or environmental destruction, with limited impact scope, and cost-benefit analysis is to be considered to implement appropriate control measures, such as reduced ship endurance due to partial battery packs failing to supply power because of connection failures, etc.
1	Minor	Consequences of this type are negligible.

2.4 FMEA PROBABILITY LEVEL CLASSIFICATION TABLE

PI	Frequency	Definition
5	10^{-1}	Frequently occurs
4	10^{-2}	Occasionally occurs - May happen several times within the product lifecycle
3	10^{-3}	Sporadically occurs - May happen at some point during the product lifecycle
2	10^{-4}	Rarely occurs - Unlikely but possible
1	10^{-5}	Extremely rare - Highly unlikely to occur

2.5 FMEA RISK LEVEL CLASSIFICATION TABLE

	PI	1	2	3	4	5
SI		Extremely rare	Rarely	Sporadically	Occasionally	Frequently
4	Catastrophic	5	6	7	8	9
3	Severe	4	5	6	7	8
2	Moderate	3	4	5	6	7
1	Minor	2	3	4	5	6