GUIDANCE NOTES
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CHINA CLASSIFICATION SOCIETY

GUIDELINES FOR DEEP-SEA MINING UNITS

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Beijing

Contents

Chapter 1 General

Section 1 General Provisions

1.1.1 General requirements

1.1.1.1 The Guidelines apply to the design, construction and survey of deep-sea mining units and serve as the basis for China Classification Society (hereinafter referred to as "CCS") to provide classification services for deep-sea mining units.

1.1.1.2 The services provided in the Guidelines are non-mandatory. However, opting for CCS services constitutes acceptance of the relevant requirements herein. Any other adoption of the Guidelines shall be at the adopting party's own risk for all related consequences.

1.1.1.3 If the requirements in the Guidelines are inconsistent with the requirements of the Administration, the latter shall prevail.

1.1.1.4 For the hull requirements of deep-sea mining units, Chapter 3 herein applies to ship-type deep-sea mining units, and Chapter 4 applies to column stabilized (semisubmersible) deep-sea mining units. For other types of hulls for deep-sea units, CCS will give special consideration based on the specific circumstances of each unit.

1.1.1.5 Deep-sea mining units that are intended to be classed by CCS and obtain the characters of classification and class notations described in Chapter 2 of the Guidelines shall, in addition to meeting the requirements herein, meet the relevant requirements in the CCS *Rules for Classification of Mobile Offshore Units* and the CCS *Rules for Materials and Welding*.

1.1.2 Equivalent and exemption

1.1.2.1 Alternative provisions inconsistent with the requirements of the Guidelines may be accepted as substitutions for the corresponding requirements herein, provided that they are demonstrated through documentary evidence to attain at least an equivalent level of safety, and are agreed upon by all contractual parties and CCS.

1.1.2.2 Any deep-sea mining unit which embodies structure and features of a novel kind may be exempted from any requirement of CCS rules if the application of which might seriously impede the incorporation of its features or its service, subject to the agreement of CCS.

Section 2 Definitions and Abbreviations

1.2.1 Definitions

1.2.1.1 Unless otherwise specified, the terminologies used in the Guidelines are defined as follows:

(1) Deep-sea mining unit: a mobile offshore unit specifically designed for the exploitation of deep-sea mineral resources such as polymetallic nodules, cobalt-rich crusts, and polymetallic sulfides from the sea floor surface or sediments and consisting of a mining system and a surface support unit.

(2) Mining system: a system specifically designed for the exploitation of deep-sea mineral resources such as polymetallic nodules, cobalt-rich crusts, and polymetallic sulfides from the sea floor surface or sediments. It mainly includes: launch and recovery system, ore cargo handling system, ore dewatering system, subsea mining system, underwater hoisting system, tailwater treatment and discharge system, control and monitoring system, power transmission and distribution system, as well as the special lifting, power supply, hydraulic and compressed air systems for deep-sea mining operations, along with their associated pressure-containing equipment.

(3) Surface support unit: an operating unit that provides surface support for deep-sea mining operations, including ship-type and column stabilized (semisubmersible) units, which have operating support functions such as collaborative control, positioning and navigation, personnel accommodation, and ore cargo storage during deep-sea mining operations.

(4) Launch and recovery system: a system used for launching and recovering underwater mining equipment such as the mining riser, underwater relay station and underwater mining vehicle. It mainly includes: tower lifting system, hoisting system and pipe string handling system.

(5) Ore cargo handling system: a system used to transport dehydrated ore cargo inside the surface support unit or between the surface support unit and the ore transport ship. It mainly includes: lifting appliance, transport device and transfer device and their monitoring and control devices, emergency shutdown device.

(6) Underwater hoisting system: also known as underwater lifting system, a system used to transport ore from the sea floor to the surface support unit. Based on the working principle, it can be classified into underwater ore-lifting system, gas hoisting system, magnetic induction hoisting system, shuttle hoisting system and continuous conveyor lifting system.

(7) Underwater ore-lifting system: also known as hydraulic lifting system, a type of underwater hoisting system that hydraulically transports the ore from the sea floor to the surface support unit. It mainly includes: mining risers, underwater relay stations, and underwater ore-lifting pumps.

(8) Subsea mining system: a system used to strip, collect and/or crush ores from the seabed surface. It mainly includes: ore collection mechanism, crushing mechanism, travelling mechanism, navigation system and equipment, emergency locating device, communication system, and frame structure.

(9) Ore dewatering system: a system used to remove moisture from ore to a predetermined indicator, which may include the vibrating screening device, gravity sedimentation device, centrifugal sedimentation device and slurry conveying device.

(10) Tailwater treatment and discharge system: a system used to treat particulate matter and harmful substances in tailwater to a predetermined indicator and discharge tailwater into the ocean.

(11) Underwater mining vehicle: a type of equipment designed for sea floor mining operations, capable of operating either autonomously or under remote manual control, usually in the form of a

collection vehicle or robot.

(12) Underwater relay station: a type of equipment suspended in the water or located on the sea floor, providing power, signals, and material relay for the mining system. Its upper end is connected to the surface support unit through a mining riser, and its lower end is connected to the underwater mining vehicle through a flexible jumper pipe or hose.

(13) Sailing conditions: the general term for sailing conditions under which self-propelled deep-sea mining units independently travel to and from operating sea areas, conduct operating dispatches, etc.

(14) In-position conditions: the general term for various possible conditions of a deep-sea mining unit when it is not in a sailing state, including operating conditions and survival conditions.

(15) Design mineral density: the density of ore after dehydration and addition of desiccant (if any), which is the design density used for local strength check of ore storage tanks of deep-sea mining units, usually provided by the owner.

1.2.2 Abbreviations

Unless otherwise specified, the abbreviations used in the Guidelines are as follows:

AISC	——	American Institute of Steel Construction
ANSI	——	American National Standards Institute
API	——	American Petroleum Institute
ASME	——	American Society of Mechanical Engineers
ASTM	——	American Society for Testing and Materials
AWS	——	American Welding Society
CCS	——	China Classification Society
DP	——	Dynamic Positioning
FMEA	——	Failure Mode and Effects Analysis
FMECA	——	Failure Mode, Effects and Criticality Analysis
GB	——	National Standard of China
HAZID	——	Hazard Identification
HAZOP	——	Hazard and Operability Analysis
IMO	——	International Maritime Organization
ISO	——	International Organization for Standardization
JB	——	Mechanical Industry Standards
MARPOL	——	International Convention for the Prevention of Pollution from Ships
MAWP	——	Maximum allowable working pressure
NB	——	Energy Industry Standards
P&ID	——	Piping and Instrument Diagram
QA/QC	——	Quality Assurance/Quality Control
SIT	——	System Integrity Test
SOLAS	——	International Convention for the Safety of Life at Sea

SPS	——	Special Purpose Ship
SWL	——	Safe Working Load
SY	——	China Petroleum and Natural Gas Industry Standards
TMS	——	Tether/Cable Management System
UPS	——	Uninterruptible Power Supply
VIV	——	Vortex Induced Vibration

Section 3 Accepted Standards

1.3.1 General requirements

1.3.1.1 The standards listed in this section are the standards accepted by CCS when providing services. All applicable requirements of the accepted standards shall be adopted unless specifically agreed. If the requirements in accepted standards are inconsistent with the requirements in the Guidelines, the latter shall prevail.

1.3.1.2 Other applicable industry standards and enterprise standards provided by the survey client other than the accepted standards listed in this section may also be used, provided that they are demonstrated to attain at least an equivalent level of safety as required by the Guidelines and receive prior approval from CCS. Should there be any requirements from the Administration, these requirements shall prevail.

1.3.1.3 Alternative provisions inconsistent with the requirements of the accepted standards, as well as exemptions from and changes to the requirements of the accepted standards shall be stated in the design documents and agreed upon by the owner and CCS.

1.3.2 Accepted standards

1.3.2.1 The main standards accepted in the Guidelines are as follows:

GB 10888	Types and Basic Parameters of Centrifugal Slurry Pumps
GB/T 17744	Petroleum and Natural Gas Industries - Drilling and Well Servicing Equipment
GB/T 19190	Petroleum and Natural Gas Industries - Drilling and Production Hoisting Equipment
GB 19815	Centrifuge - Safety Requirements
GB/T 19832	Petroleum and Natural Gas Industries - Inspection, Maintenance, Repair and Remanufacture of Drilling and Production Hoisting Equipment
GB/T 22513	Petroleum and Natural Gas Industries - Drilling and Production Equipment -Wellhead and Christmas Tree Equipment
GB/T 23505	Petroleum Drilling and Workover Rigs
GB/T 23507	Criterion for Electrical Equipment for Oil Drilling Rig
GB/T25428	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Drilling and Well-servicing Structures
GB 25521	Mine Screening Equipment - Safety Requirements

GB/T 30217.1	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Part 1: Design and Operation of Marine Drilling Riser Equipment
GB/T 30217.2	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Part 2: Deepwater Drilling Riser Analysis Methodologies, Operations and Integrity
GB/T 150	Pressure Vessels
GB/T 151	Heat Exchanger
SY/T 5027	Pneumatic Components for Petroleum Drilling and Production Equipment
SY/T 5170	Steel Wire Ropes for the Petroleum and Natural Gas Industries
SY/T 5532	Drawworks for Drilling Rig
SY/T 6117	The Operating and Maintenance of Petroleum Workover Rig
SY/T 6408	Recommended Practice for Use and Procedures for Inspections, Maintenance and Repair of Drilling and Well Servicing Structures
SY/T 6586	Site Installation and Inspection for Drilling Rigs
SY/T 6680	Acceptance Specification for Petroleum Drilling and Servicing Rigs
SY/T 6913	Specification for Marine Drilling Riser Equipment
SY/T 6917	Petroleum and Natural Gas Industries - Drilling and Production Equipment - Offshore Drilling Riser Joints
NB/T 47003.1	Steel Welded Atmospheric Pressure Vessels
JB/T 9035	Hydrocyclone
ISO 13534	Petroleum and natural gas industries - Drilling and production equipment - Inspection, maintenance, repair and remanufacture of hoisting equipment
ISO 13624-1	Petroleum and natural gas industries - Drilling and production equipment - Part 1: Design and operation of marine drilling riser equipment
ISO/TR 13624-2	Petroleum and natural gas industries - Drilling and production equipment - Part 2: Deepwater drilling riser methodologies, operations, and integrity technical report
API Spec 4F	Drilling and Well Servicing Structures
API Spec 7K	Drilling and Well Servicing Equipment
API RP 7L	Procedures for Inspection, Maintenance, Repair, and Remanufacture of Drilling Equipment
API RP 2RD	Design of Risers for Floating Production Systems (FPSs) and Tension-Leg Platforms (TLPs)
API Std 2RD	Dynamic Risers for Floating Production Systems
API Spec 17J	Specification for Unbonded Flexible Pipe
API Spec 5CT	Specification for Casing and Tubing
API RP 8B	Recommended Practice for Procedures for Inspection, Maintenance, Repair, and Remanufacture of Hoisting Equipment

API Spec 8C	Drilling and Production Hoisting Equipment
API Spec 9A	Wire Rope
API RP 9B	Application, Care and Use of Wire Rope for Oil Field Service
API Bul 16J	Comparison of Marine Drilling Riser Analysis
API Spec 16F	Marine Drilling Riser Equipment
API RP 16Q	Design, Selection, Operation and Maintenance of Marine Drilling Riser Systems
API RP 17A	Design and Operation of Subsea Production Systems – General Requirements and Recommendations
API RP 17B	Recommended Practice for Flexible Pipe
ASME BPVC Sec. Ⅷ	
	Div. 1 Rules for Construction of Pressure Vessels
	Div. 2 Alternative Rules for Construction of Pressure Vessels
	Div. 3 Rules for Construction of high Pressure Vessels
ASME B31.3	Process Piping
ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Standard Practice for Providing High-Quality Zinc Coating (Hot-Dip)
ASTM A388	Standard Practice for Ultrasonic Examination of Heavy Steel Forgings
AISC	Manual of Steel Construction
AWS D1.1	Structural Welding Code – Steel

Chapter 2 Classification and Survey

Section 1 General Provisions

2.1.1 General requirements

2.1.1.1 Deep-sea mining units applying for CCS classification shall, in addition to complying with the provisions in this Chapter, meet the applicable requirements of Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*.

2.1.2 Characters of classification

2.1.2.1 The characters of classification for deep-sea mining units shall comply with the relevant provisions in Chapter 2, Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*.

2.1.3 Class notations

2.1.3.1 The main class notations of deep-sea mining units are shown in Table 2.1.3.1, among which the class notations for special systems and equipment are optional.

Class Notations

Table 2.1.3.1

Class notations	Description		Technical requirements to be complied with
A Class notations for hull type			
Ship Type	Ship Type	Deep-sea mining units that meet the definition of ship-type units in the CCS *Rules for Classification of Mobile Offshore Units.*	Those in Chapters 1 to 3 and 6 to 10 of the Guidelines.
Column Stabilized (Semisubmersible)	Column Stabilized (Semisubmersible)	Deep-sea mining units that meet the definition of semisubmersible units in the CCS *Rules for Classification of Mobile Offshore Units.*	Those in Chapters 1, 2, 4 and 6 to 10 of the Guidelines.
B Class notations for unit use			
Mining Unit	Mining units	Deep-sea mining units as defined in 1.2.1.1 (1) in Chapter 1 of the Guidelines.	Those in Chapters 1 to 2, 3 or 4, Sections 1 to 4 and 8 in Chapter 5, and Chapters 6 to 10 of the Guidelines.
C Class notations for special systems and equipment			
MINING	Mining system	The mining system as defined in 1.2.1.1 (2) in Chapter 1 of the Guidelines.	Those in Chapters 1, 2 and 5 of the Guidelines.

2.1.3.2 In addition to the class notations specified in 2.1.3.1, deep-sea mining units may also be assigned the applicable class notations as specified in Chapter 2, Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*.

2.1.4 Combination of characters of classification and class notations

2.1.4.1 The combination of characters of classification and class notations for a deep-sea mining

unit shall comply with the relevant provisions in Chapter 2, Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*.

Section 2 Design Review

2.2.1 General requirements

2.2.1.1 Prior to commencement of construction, the applicant shall submit the plans and documents specified in this section to CCS for review. CCS may, if necessary, require the submission of additional plans and documents.

2.2.1.2 Where any substantial modifications or additions have been made to the approved plans and documents, the applicants are to submit such modifications or additions to the original plan approval location(s) for reexamination.

2.2.1.3 Plans and documents submitted for review shall contain all dimensions and associated data necessary for the review.

2.2.2 Plans and documents

2.2.2.1 For the hull of ship-type deep-sea mining units, in addition to the applicable plans and documents specified in 2.1.3, Section 1, Chapter 2, Part 2 of the CCS *Rules for Classification of Sea-Going Steel Ships*, the following plans and documents shall also be submitted:

(1) Strength analysis report of ore storage tanks;

(2) Reinforcement structure diagram of key equipment on the hull of the unit;

(3) Reinforcement strength analysis report of key equipment on the hull of the unit;

(4) Arrangement plan of mining equipment launch and recovery system;

(5) Arrangement plan of tower and operation area;

(6) Storage arrangement plan of mining risers (lifting pipes);

(7) Arrangement plan of life-saving appliances;

(8) Wave load calculation report (if applicable);

(9) Global finite element analysis report (for the hull) (if applicable).

2.2.2.2 For the hull of column stabilized deep-sea mining units, applicable plans and documents specified in 1.3.1.1, Chapter 1, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted.

2.2.2.3 For the positioning system of deep-sea mining units, the plans and documents shall comply with the following provisions:

(1) For the position mooring system, applicable plans and documents specified in 8.1.4, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted;

(2) For the dynamic positioning system, applicable plans and documents specified in 11.1.4, Chapter 11, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted;

(3) For closed busbar power stations, applicable plans and documents specified in 1.3.1.2, Chapter 1 of the CCS *Guidelines for Survey of Closed-loop Dynamic Positioning Systems* shall be

submitted.

2.2.2.4 For the machinery system of deep-sea mining units, applicable plans and documents specified in 1.1.18, Chapter 1, Part 4 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted.

2.2.2.5 For electrical installations other than the mining system in deep-sea mining units, the applicable plans and documents specified in 1.1.2, Section 1, Chapter 1, Part 5 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted.

2.2.2.6 For automated systems other than the mining system in deep-sea mining units, the applicable plans and documents specified in 1.1.3, Chapter 1, Part 6 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted.

2.2.2.7 For the fire protection system of deep-sea mining units, applicable plans and documents specified in 1.1.4, Chapter 1, Part 7 of the CCS *Rules for Classification of Mobile Offshore Units* shall be submitted.

2.2.2.8 For the mining system of deep-sea mining units, the following plans and documents shall be submitted (if applicable):

(1) Overall

① Design specifications of the mining system;

② System general arrangement plan;

③ Assembly drawing or general drawing of main equipment;

④ Piping and Instrument Diagram (P&ID) of all systems and subsystems;

⑤ Pipe specifications;

⑥ Schematic diagram of automated system for the mining system;

⑦ Single line diagram of electrical system;

⑧ Arrangement plan of electrical equipment;

⑨ Schematic diagram/arrangement plan of safety system;

⑩ List of Equipment;

⑪ Description of legend.

(2) Ore cargo handling system and ore dewatering system

① Arrangement plan of cargo hold;

② Design specifications of the pumping equipment;

③ Design specifications of other main equipment except pumping equipment;

④ Layout details of auxiliary equipment for mining system;

⑤ FMEA report of ore cargo handling system.

(3) Launch and recovery system

① For the tower lifting system (including the tower) and the pipe string handling system, design documents that comply with the requirements in 2.2.2, Chapter 2 of the CCS

Guidelines for Survey of Offshore Drilling Plants shall be submitted;

② Detailed drawing and calculation of hoisting system;

③ Specifications of the centralizing device for underwater equipment;

④ Equipment layout details.

(4) Control and monitoring system

① Specifications and related arrangement plans of control and monitoring system;

② System diagram and arrangement plan of console/control panel;

③ Schematic diagram and arrangement plan of the communication system between the surface support unit and the underwater hoisting system and the subsea mining system;

④ Schematic diagram of mining control and monitoring system;

⑤ Design specifications of safety system;

⑥ Schematic diagram and arrangement plan of safety system;

⑦ Start-up operation instructions;

⑧ Operation and maintenance manual of control system.

(5) Subsea mining system

① Design specifications of the equipment;

② Assembly drawings of equipment and its main components and key components;

③ Standards and design criteria documents used in the design;

④ Design verification test report;

⑤ Stress calculation or finite element analysis report;

⑥ List of design, operation and environmental conditions;

⑦ Piping and Instrument Diagram (P&ID);

⑧ Electrical system diagram.

(6) Underwater hoisting system

① Overall:

(a) Connection layout diagram of underwater hoisting system;

(b) Piping and Instrument Diagram (P&ID);

(c) Electrical system diagram;

(d) Flow assurance analysis report for the underwater ore-lifting system;

(e) Risk assessment report of underwater hoisting system;

(f) Design documents of non-pump hoisting system.

② Mining riser system:

(a) Specifications of the mining riser system;

(b) Material specifications;

(c) Specifications of the riser porch device. If the riser porch device is a riser tensioner system, design documents that comply with the requirements in 2.2.2, Chapter 2 of the

CCS *Guidelines for Survey of Offshore Drilling Plants* shall be submitted;

(d) Design basis;

(e) Arrangement plan of riser;

(f) Riser configuration diagram and cross-sectional details;

(g) Diagram of Vortex Induced Vibration (VIV) suppression device;

(h) Anode arrangement plan and detailed drawing;

(i) Installation flow chart of riser;

(j) Wall thickness selection report (for steel pipes)/section design report (for flexible pipes);

(k) Applicable analysis or test reports, including floater motion analysis report, riser strength analysis report, fatigue analysis report, installation and recovery analysis report, erosion analysis or equivalent design documents for riser analysis;

(l) Applicable design reports, including riser component design report, anti-corrosion design report, tensioning device design report;

(m) Welding and NDE specifications;

(n) Monitoring system design report.

③ Flexible jumper pipe/underwater conveying hose:

(a) Design specifications;

(b) Design analysis report;

(c) Design verification test report;

(d) Detailed drawing of end connection and terminal.

④ Underwater ore-lifting pump:

(a) Design specifications of the underwater ore-lifting pump;

(b) Detailed drawing of the underwater ore-lifting pump.

⑤ Underwater relay station:

(a) Design specifications;

(b) Design analysis and/or calculation report;

(c) Equipment general drawing and main component drawing;

(d) Material specifications.

(7) Tailwater treatment and discharge system:

① Piping and Instrument Diagram (P&ID);

② Design specifications of the tailwater treatment equipment;

③ Design specifications of the emission monitoring device;

④ For the underwater tailwater discharge pipe, plans and documents that comply with the applicable requirements in ②, (6) of this paragraph shall be submitted.

Section 3 Product Inspections

2.3.1 General requirements

2.3.1.1 Products for deep-sea mining units shall be inspected to confirm their compliance with the Guidelines and relevant CCS rules.

2.3.1.2 Except for the mining system, product inspections of deep-sea mining units shall comply with the applicable requirements of Chapter 3 of the CCS *Rules for Classification of Mobile Offshore Units*.

2.3.1.3 Products for deep-sea mining units can be designed, manufactured, inspected and tested in accordance with industry standards accepted by CCS or manufacturer standards recognized by CCS if no specific technical requirements are specified in the Guidelines or relevant CCS rules.

2.3.1.4 The subsequent provisions in this section apply to the inspections of mining system products for deep-sea mining units.

2.3.2 Inspection and certificate classification

2.3.2.1 Products are inspected according to the following three types: A, B and C.

(1) Type-A equipment: equipment that requires CCS to conduct design review, manufacturing process survey, participate in completion inspection and witness test (performance, pressure, load tests) and review manufacturing records.

(2) Type-B equipment: equipment that requires CCS to conduct design review, participate in completion inspection and witness test (performance, pressure, load tests) and review manufacturing records.

(3) Type-C equipment: safety-related equipment for which CCS accepts product certificates from manufacturers.

2.3.2.2 The product inspection and certificate classification of the mining system equipment and components shall comply with the provisions in Table 2.3.2.2.

Product Inspection and Certificate Classification of Mining System Equipment

Table 2.3.2.2 (1)

System	Equipment name	Inspection type			Certificate type	
		A	B	C	C/E[2]	W[3]
Launch and recovery system	Tower	×[4]			×	
	Crown block assembly		×		×	
	Traveling block assembly		×		×	
	Hook		×		×	
	Lifting ring			×		×
	Elevator			×		×
	Main lifting rope			×		×
	Deadline anchor		×		×	
	Main hoisting winch		×		×	
	Chuck		×		×	
	Heave compensator assembly		×		×	

System	Equipment name	Inspection type			Certificate type	
		A	B	C	C/E[2]	W[3]
	Main components of hoisting system [5]	×			×	
	Crane winch		×		×	
	Hydraulic power unit		×		×	
	Pressure vessel (air cylinder)		×		×	
	Air compressor		×		×	
	Electrical installations		×		×	
	Control panel/console/control cabinet		×		×	
Ore cargo handling system	Lifting appliance		×		×	
	Conveying device/conveyor		×		×	
	Crane	×			×	
Ore dewatering system	Ore screening equipment (including filter screen)			×		×
	Gravity sedimentation tank		×		×	
	Centrifuge		×		×	
	Hydrocyclone			×		×
	Dewatering pump			×		×
Subsea mining system	Underwater mining vehicle		×		×	
Underwater hoisting system	Mining riser joint		×		×	
	Flexible pipe	×			×	
	Underwater conveying hose		×		×	
	Connector		×		×	
	VIV suppression device		×		×	
	Bending restrictor			×		×
	Bending stiffener			×		×
	Buoyancy module		×		×	
	Riser porch device (including tensioner assembly [6])		×		×	
	Sacrificial anode		×		×	
	Underwater relay station		×		×	
	Underwater ore-lifting pump		×		×	
	Monitoring device		×		×	
Tailwater treatment and discharge system	Tailwater monitoring device		×		×	
	Tailwater pump		×		×	
	Underwater tailwater discharge pipe		×		×	
Control and monitoring system	Console (including display)		×		×	
	Positioning system (including emergency positioning)		×		×	
	Underwater navigation system		×		×	
	Emergency control device		×		×	
Power	Transformer		×		×	

System	Equipment name	Inspection type			Certificate type	
		A	B	C	C/E[2]	W[3]
transmission and distribution system	Power distribution system		×		×	
	Frequency converter		×		×	
	Umbilical cable		×		×	

Inspection and Certificate Classification of Mining System Pipes, Fittings and Valves

Table 2.3.2.2 (2)

Components	Status	Inspection type		Certificate type	
		B	C	C/E[2]	W[3]
Pipe assembly (Pup joint)	Thickness of pipe wall ≥25.4mm	×[4]		×	
	Design temperature ≥400℃	×		×	
	Longitudinal welded pipes and all short pipes in Class A and B equipment	×		×	
	Pipes other than those listed above and pipes used in Class C systems		×		×
Flanges and pipe connectors (pipe joints)	Standard flanges and pipe connectors		×		×
	Non-standard flanges and pipe connectors in Class A and B piping systems	×		×	
	Other flanges and pipe connectors other than the above, flanges and pipe connectors in Class C piping systems		×		×
Valves	Valve body of welded structure with ANSI rating >600 1bs	×		×	
	Valves designed and built to recognized standards		×		×
Components of high-strength materials	Materials with yield strength > 345MPa or tensile strength > 515MPa	×		×	

Inspection and Certificate Classification of Mining System Pressure-containing Equipment

Table 2.3.2.2 (3)

Components	Status	Inspection type		Certificate type	
		B	C	C/E[2]	W3
Pressure vessel and heat exchanger	Containing toxic liquids	×[4]		×	
	Containing liquids with a flash point below 100°C	×		×	
	Containing liquids with temperature above 220°C	×		×	
	Compressed gas, with the pressure × volume (P × V) above 0.15, pressure (P) expressed in MPa and volume (V) in m^3	×		×	

	Pressure vessels other than the above	×		×	
Hydraulic cylinder	Hydraulic cylinder located on a critical load path	×		×	
	Hydraulic cylinder not located on a critical load path		×		×

Note:

1. Mining system equipment and components not included in Tables 2.3.2.2 (1)-(3) will be classed by CCS according to their associated system and safety function level at the time of application for survey, and will be inspected in accordance with the requirements for novel design products.

2. C/E is a CCS product certificate, and the specific requirements are as follows:

(1) When a mining system is classed, it refers to the marine product certificate or equivalent supporting documents issued by CCS. The requirements for equivalent supporting documents are shown in Chapter 3, Part 1 of the CCS *Rules for Classification of Sea-Going Steel Ships*;

(2) When the mining system is not classed, it refers to the marine product inspection certificate or the product inspection certificate of offshore installations issued by CCS.

3. W means the manufacturer's certificate, and its specific requirements can be found in Chapter 3, Part 1 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

4. × indicates applicable.

5. If applicable, the main components of the hoisting system include:

(1) A-frame cranes, gantry cranes or lifting masts, and boom chords;

(2) Booms and boom chords;

(3) Winch and crane pedestals;

(4) Carrier bar;

(5) Eye plates and brackets connected to the main components;

(6) Lifting system mechanism;

(7) Pins and shafts.

6. The mining riser tensioner assembly may include: tensioner, pulley block, special air compressor, air cylinder, hydraulic supply device, control panel/console/control cabinet.

7. See Chapter 3, Part 1 of the CCS *Rules for Classification of Sea-Going Steel Ships* for the requirements on accreditation procedure for equipment and components.

2.3.2.3 The requirements in 2.3.3, 2.3.5 and 2.3.6 of this section shall be implemented according to the classification specified in 2.3.2.1 and 2.3.2.2.

2.3.3 Product design review

2.3.3.1 The applicant shall submit the design documents for the following certified products to CCS for review:

(1) Applicable technical standards for products;

(2) General product instructions;

(3) Product design drawings and/or production drawings, including component drawings and list of parts and materials;

(4) Design calculations (including design calculations for pressure-containing/load-carrying

components, if applicable);

(5) Prototype and/or type test report (if applicable);

(6) Product inspection and test plan and/or test program and acceptance criteria;

(7) Main manufacturing process documents;

(8) Other documents required by CCS.

2.3.3.2 The requirements of the product design documents submitted for review shall comply with the applicable provisions in 2.2.2 of the Guidelines.

2.3.3.3 CCS will review the submitted design documents to confirm that the product is designed in accordance with the provisions in the Guidelines and/or the accepted standards of the Guidelines and/or the manufacturer's standards recognized by the Guidelines. After the design review is completed, CCS will issue a design review approval notice to the applicant, mark the approval status on the technical documents submitted for review, and return the approved design documents.

2.3.3.4 For products approved by CCS, their plans and documents do not need to be submitted for review.

2.3.4 Product inspection procedure requirements

2.3.4.1 Products of Classes A, B and C shall be inspected in accordance with the following procedure requirements:

(1) Type-A equipment

① The design documents shall be submitted to CCS for review;

② The relevant construction documents shall be submitted to CCS for review, and construction may commence only after they are approved;

③ Prior to commencement of construction, a kick-off meeting shall be held with the participation of the deep-sea mining unit shipowner or his agent, the CCS surveyor and the manufacturer;

④ The manufacturing process shall be reported for inspection according to the quality assurance plan;

⑤ Function tests, pressure tests and load tests shall be reported for inspection;

⑥ Manufacturing records shall be submitted to CCS for review.

(2) Type-B equipment

① The design documents shall be submitted to CCS for review;

② Function tests, pressure tests and load tests shall be reported for inspection;

③ Manufacturing records shall be submitted to CCS for review.

During the manufacturing survey of Class A and B equipment, CCS shall review the manufacturer's QA/QC system, review the manufacturer's quality assurance plan prior to commencement of construction, and approve the quality control points and survey activity categories based on the plan.

(3) Type-C equipment

Such products shall be manufactured in accordance with recognized standards, specifications and according to recognized manufacturing methods.

2.3.5 Product inspection requirements

2.3.5.1 At the kick-off meeting held at the manufacturer, the CCS surveyor shall arrange work including but not limited to the following:

(1) Determine the contact person and contact information between the manufacturer and CCS;

(2) Review the quality plan/scheme;

(3) Review the submitted manufacturing specifications;

(4) Review product manufacturing and delivery plans;

(5) Review and confirm the submitted inspection and test plan;

(6) Review the list of sub-subcontractors and qualification documents;

(7) Confirm the design specifications, drawings and/or documents related to manufacturing process.

2.3.5.2 The product inspection by CCS surveyors at the manufacturer includes but is not limited to the following work:

(1) Confirm that the products used to manufacture or repair mining equipment have and maintain an effective quality control plan which includes design, procurement, processing and testing and meets the technical standards applicable to their products.

(2) Evaluate and verify welder qualifications.

(3) Evaluate and verify the Welding Procedure Specification and corresponding welding procedure evaluation records.

(4) Check the material test reports of equipment and components.

(5) Verify material certificates/documents and conduct pre-welding and post-welding surveys.

(6) Witness the NDE of welds based on the reviewed flaw detection drawings and review the NDE records.

(7) Review the PWHT records.

(8) Verify the dimensions of the equipment and its components according to the approved drawings.

(9) Check the dimensional deviation, fit and alignment of mating surfaces.

(10) Witness the prototype test of equipment or components in accordance with applicable standard requirements. For type-approved mining equipment, the surveyor shall check its type test documents.

(11) Witness the final test and function test of components and entire units according to established manufacturing procedures.

(12) Verify the function tests of all pressure-containing systems, motor controllers, consoles and instruments and control panels in accordance with the approved drawings.

(13) Perform other surveys determined at the kick-off meeting.

(14) Review and approve the final manufacturing data book and the issued final survey report.

2.3.6 Test requirements

2.3.6.1 In-plant testing of products shall comply with applicable standards, approved test procedures and additional requirements specified in this clause. If it is not possible to complete some tests for product inspection at the manufacturer, these tests can be carried out after the product is installed on the unit with the consent of the responsible surveyor.

2.3.6.2 Tests of equipment in lifting system and pipe string handling system

(1) Individual equipment and/or components of the lifting, hoisting and pipe string handling systems shall be tested (load test and function test) in accordance with applicable protocols and standards.

(2) The test of the pipe string handling system shall also meet the following requirements. If the test cannot be carried out at the manufacturer, it shall be carried out when the system is installed on the unit:

① The safety controller of the pipe string handling system shall be verified in a computer-based control system.

② All mechanical movement modes shall be verified by operational tests.

2.3.6.3 Tests of skid structure

If the equipment/component is mounted on a skid structure, the surveyor shall be present to verify that the skid complies with the reviewed structural design and shall carry out at least the following work:

(1) Verify the material test report of the skid structure.

(2) Visually survey the final skid structure welds.

(3) Witness the load test of the lifting accessories/lifting lug or eye plate of the skid structure. The test load of the skid shall be the maximum static load that it can withstand when the equipment/machinery is transported or installed on the unit.

(4) After completing the load test of the skid structure, witness the NDE of the surface connecting the skid structure to the lifting accessories/lifting lug or eye plate.

(5) Check the arrangement of oil pan (if any).

2.3.6.4 Tests of underwater mining vehicle and related systems:

(1) Conduct factory acceptance tests on underwater mining vehicles in accordance with the approved test program.

(2) Conduct hydraulic tests on the piping system and umbilical cable.

(3) Conduct function tests on instruments, equipment and systems.

2.3.6.5 The control and monitoring system shall at least comply with the requirements for Class II computer systems in Section 6, Chapter 2, Part 7 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

2.3.7 Product certification

2.3.7.1 After the product passes the inspection, relevant certificates and/or other inspection

certification documents will be issued to the applicant.

Section 4 Surveys During Construction

2.4.1 General requirements

2.4.1.1 Except for the mining system, surveys during construction of deep-sea mining units shall comply with the applicable requirements on surveys during construction in Chapter 4, Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*. Surveys during construction of the mining system in deep-sea mining units shall comply with the provisions in this section.

2.4.1.2 The attending surveyor shall review and approve the construction drawings, construction processes, and test programs to confirm their compliance with the design documents approved by the CCS plan approval department and CCS rules, and then surveys shall be carried out in accordance with the approved construction drawings, construction processes, and test programs.

2.4.1.3 The surveys during construction of the mining riser tensioner system and compensation system shall comply with the applicable requirements in Section 4, Chapter 2 of the CCS *Guidelines for Drilling Compensation Systems*.

2.4.1.4 The surveys during construction of the hoisting system shall comply with the applicable requirements of Chapter 2 of the CCS *Rules for Classification of Diving Systems and Submersibles*.

2.4.1.5 The surveys during construction of mining risers and underwater tailwater discharge pipes shall meet the following requirements:

(1) When the mining riser and tailwater discharge pipe are set separately, their surveys shall comply with the requirements on surveys during construction for production risers in the CCS *Guidelines for Survey of Marine Riser Systems*;

(2) When the mining riser and tailwater discharge pipe are set in the form of a tube bundle, their surveys shall comply with the requirements on surveys during construction for drilling risers and auxiliary lines in the CCS *Guidelines for Survey of Offshore Drilling Plants*.

2.4.1.6 The surveys during construction of flexible jumper pipes shall meet the corresponding requirements in the CCS *Guidelines for Certification of Subsea Production System*.

2.4.2 Survey during installation of mining system

2.4.2.1 General requirements

During the installation of the mining system on the unit, the surveyor will survey the following items and shall also complete the survey in accordance with the remaining requirements of this clause:

(1) The surveyor shall confirm that the welding, heat treatment and NDE of pressure vessels, pressure pipelines and important mechanical parts and structural parts comply with the applicable requirements of the CCS *Rules for Materials and Welding* or acceptance standards.

(2) The house-made equipment of the shipyard shall be subject to design review and survey in accordance with the provisions in Section 3 Product Inspections of this Chapter. When the

equipment is assembled into skids and modules, the surveyor shall survey the assembly, piping and electrical connections according to approved certification documents and test procedures, and witness the pressure and function tests of the whole assembly.

(3) For purchased equipment, the equipment certificate shall be reviewed in accordance with the requirements in Section 3 of this Chapter to check the consistency between the equipment nameplate and the certificate.

(4) The surveyor shall participate in the prefabrication, installation inspection and test of pipelines, including strength tests in the prefabrication workshop and tightness tests after installation onto the unit.

(5) The surveyor shall confirm that the safety valve has been calibrated by an approved professional organization and its opening and closing pressures comply with the requirements. If the safety valve is calibrated by an unapproved organization, the surveyor shall witness the calibration test of the safety valve at the shipyard site.

(6) The surveyor shall witness the function test, pressure test, load test and commissioning test of each subsystem and equipment of the mining system.

(7) The surveyor shall participate in and confirm the verification tests of control systems, safety devices, shutdown devices and emergency shutdown devices based on the approved FMEA analysis report.

(8) The surveyor shall check the installation position of the equipment on the unit, orientation, layout, support, foundation, fixing details and protective coating according to the approved drawings and process documents.

(9) The surveyor shall witness the commissioning of communication equipment related to sea floor mining operations.

2.4.2.2 The survey of towers shall comply with the requirements applicable to derrick surveys in Section 4, Chapter 2 of the CCS *Guidelines for Survey of Offshore Drilling Plants*.

2.4.2.3 Hydraulic and function tests shall be carried out on the tensioner system and compensation system and their supporting systems and equipment (such as HP air cylinder set, compressor unit and accumulator set), and then commissioning tests shall be carried out on the tensioner system and compensation system to determine the integrity of the system.

2.4.2.4 Function and load tests shall be carried out on the lifting system, pipe string handling system and underwater equipment handling systems and equipment in accordance with approved test procedures.

2.4.2.5 The control system and shutdown device shall be tested and shall comply with the requirements of the approved test program.

2.4.2.6 All cables and electrical connectors shall be checked for continuity of conduction and adequacy of construction process.

2.4.2.7 Tests of pedestal-mounted winches and other lifting appliances

Tests of pedestal-mounted winches and other lifting appliances shall meet the following

requirements and procedures:

(1) Load test: After installation, the system shall be tested to 125% of its rated capacity in the presence of a surveyor. It shall be demonstrated that the driving device and brakes can operate satisfactorily. After the test is completed, the system and all its components shall be visually inspected for permanent deformation and failure.

(2) Function test: This test is carried out in the presence of a surveyor to prove that the outermost wire rope of the drum can reach the rated tension at the rated speed.

(3) Brake holding test: It is used to demonstrate that the brakes have the ability to stop and hold 100% of the design load.

2.4.2.8 The hoisting system shall meet the applicable test requirements in Chapter 14 of the CCS *Rules for Classification of Diving Systems and Submersibles*.

2.4.2.9 When the mining control and monitoring system is built and installed, its installation position (including sensors, etc.) shall be confirmed. After the installation is completed, its power supply, signal transmission, interface, communication, alarm, safe operation, etc. need to be functionally checked to verify its accuracy and integrity.

2.4.3 Joint commissioning survey of mining system

2.4.3.1 All joint commissioning of the mining system shall be witnessed by a CCS surveyor and shall comply with the test procedures agreed to by CCS. The joint commissioning survey of the mining system shall at least include the survey items in the subsequent paragraphs of this clause.

2.4.3.2 The mining system shall meet the following requirements before the commissioning survey:

(1) The correct connection and tests of the entire mining system equipment and components shall be completed. These tests refer to those of each subsystem and equipment required in 2.4.2.

(2) All public support systems, including the power source of the mining system, are ready. Public support systems are randomly started and tested to the extent deemed necessary by the attending surveyor.

(3) The mining system equipment/components have been purged/cleaned, and the alarm and shutdown devices have been connected. During commissioning, the purge/cleaning and alarm systems shall be randomly tested to the satisfaction of the attending surveyor.

2.4.3.3 During commissioning of the mining system, simulation tests shall be conducted on safety-related alarm systems.

2.4.3.4 When material media such as slurry and ore sand enter the system, the system can control the media to flow in a stable manner without excessive disturbance.

2.4.3.5 All mining systems installed on the unit have the intended functions and performance. To the extent practicable and feasible, during simulation of actual mining operations, the surveyor shall focus on witnessing the commissioning tests of the underwater mining vehicle, mining riser system, launch and recovery system, ore cargo handling system, dewatering system, etc.

2.4.3.6 The emergency power equipment shall be capable of maintaining normal operation to the

satisfaction of the surveyor.

2.4.3.7 For the mining control and monitoring system, once item 2.4.2.9 has been completed and confirmed, a detailed test program shall be developed. Upon approval by the CCS attending surveyor, joint commissioning tests for the system shall be conducted to verify both functionality and safety, at least including:

(1) The system functions meet the design requirements and the operation is effective;

(2) Relevant alarm, display, switching and other functions are effective and reliable;

(3) The safety system is effective and reliable;

(4) The communication between the control station and other systems is effective and reliable.

Section 5 Surveys After Construction

2.5.1 General requirements

2.5.1.1 Except for the mining system, surveys after construction of deep-sea mining units shall comply with the applicable requirements on surveys after construction in Chapter 5, Part 1 of the CCS *Rules for Classification of Mobile Offshore Units*. Surveys after construction of the mining system in deep-sea mining units shall comply with the provisions in this section.

2.5.1.2 Surveys after construction of the mining system for maintaining the validity of the certificate include annual surveys, special surveys, modification surveys and damage and repair surveys.

2.5.1.3 The special survey plan and program shall be submitted to CCS for review before the survey, and shall be kept at the unit for use. All maintenance records/maintenance manuals shall be kept at the unit for review by the surveyor.

2.5.1.4 To ensure the safety of the mining system during operations, various surveys specified in this section shall be performed. CCS surveyors may expand the scope of surveys based on their professional judgment during the survey. The shipowner or unit operation and maintenance company shall provide corresponding survey conditions and make appropriate arrangements.

2.5.1.5 The shipowner or unit operation and maintenance company shall promptly submit to CCS the applications for various surveys to maintain the validity of the certificate, and prepare for the survey items and provide safety measures for the surveys in accordance with the requirements of the rules.

2.5.1.6 If, during survey, any damage or imperfection detrimental to the validity of the certificate is found and is deemed to require immediate attention, the surveyor shall notify the applicant of the required actions. Should these actions not be implemented, the surveyor shall promptly report the situation to the CCS headquarters.

2.5.1.7 The surveys after construction of the hoisting system shall comply with the applicable requirements of Chapter 2 of the CCS *Rules for Classification of Diving Systems and Submersibles*.

2.5.2 Onshore survey and issuance of survey reports

2.5.2.1 If a component certified by CCS needs to be sent onshore for maintenance, repair or alteration during operations, the shipowner or unit operation and maintenance company shall promptly notify CCS. The surveyor will arrive at the repair site to participate in all required function, load and pressure tests. These tests shall be carried out in accordance with the requirements of the Guidelines and applicable standards.

2.5.2.2 After satisfactory test and visual inspection, the surveyor shall sign the survey report, provided that the component will be properly installed on the deep-sea mining unit and inspected at the next periodical survey. This survey report shall be kept at the unit for verification.

2.5.3 Annual surveys

2.5.3.1 For all deep-sea mining units granted the "MINING" class notation, their mining systems shall be subject to annual surveys. Annual surveys shall be carried out within 3 months before or after each anniversary date of the deep-sea mining unit's completion of construction, entry into service, or the completion date of the special survey, as applicable.

2.5.3.2 The following survey items shall be included in annual surveys:

(1) Review of the maintenance manual and relevant logs/records to confirm that a suitable maintenance plan has been followed, required periodic tests have been carried out, and that the launch and recovery system, mining riser system, pressure vessels, electrical systems and equipment are repaired, debugged and replaced according to the Guidelines and applicable standards.

(2) Review of release notes issued by CCS since the initial survey or the last annual survey, and examination of the components/equipment to the extent deemed necessary by the Surveyor.

(3) General external inspection of each system and equipment as practicable as possible for damage, corrosion, fracture and other abnormalities. Special attention shall be paid to checking all winches, tensioners, elevators, deck cranes, conveyors and roller drives.

(4) Inspection of the foundations for towers, hoisting equipment, fixing parts, ore cargo handling equipment, underwater mining vehicle, launch and recovery equipment, etc. for good condition. Magnetic particle inspection may be carried out as deemed necessary by the surveyor to determine whether any crack exists.

(5) Inspection of the tower and related structural parts for the following:

① Overall condition of the structure, especially excessive deformation, wear, corrosion and damage;

② Tightening condition of bolts;

③ Condition of load-carrying components and related accessories.

(6) Inspection to determine whether the ore cargo handling machinery, including the main motor, transmission device, clutch, lifting and slewing equipment, brake mechanism, lifting rope, guide rail and guide wheel, and traveling wheel, are in good condition.

(7) Inspection of the wire rope and/or chain for wear and damage.

(8) Inspection to confirm the function test of safety devices including interlocking or limiting devices.

(9) Inspection to determine whether the anti-corrosion layer, insulation layer, shields and guardrails of moving parts are in good conditions.

(10) Inspection of the tower access and ladders, units and mining system machinery spaces to confirm that the emergency escape route is not blocked.

(11) External inspection of pressure vessels and their accessories, including safety devices, base parts, control devices, pressure relief devices, pipelines, hoses, insulation layers and instruments.

(12) Inspection of the emergency shutdown device and confirmation of satisfactory operational tests of all emergency stop, control and remote control devices.

(13) Inspection to confirm the function tests of equipment integrated or associated with the system to which the surface support unit belongs.

(14) Inspection of all electrical and instrument systems, including protection installations and cable supports.

(15) Inspection to confirm whether the operation and maintenance of the ore dewatering system are in good conditions.

(16) Inspection to confirm whether the underwater hoisting system, underwater mining vehicle and related systems are in good conditions.

(17) Inspection of the hydraulic power unit, hoses and pipelines for any damage, corrosion or leakage.

(18) Inspection of the lubricating oil condition, cooling system and oil change records of the equipment.

(19) Visual inspection of the underwater hoisting system. This inspection can be carried out either by visual inspection via ROV or when the underwater hoisting system is recovered above the water surface.

(20) Review of calibration/verification records, operation manuals and logs.

(21) Inspection to confirm that the overall condition of the mining control and monitoring system is good and that its external communication and safe operating system is functioning normally.

(22) Mining risers and underwater tailwater discharge pipes, if designed to be recovered to the water surface for survey, shall meet the survey requirements for drilling risers in the CCS *Guidelines for Survey of Offshore Drilling Plants*. Otherwise, mining risers and tailwater discharge pipes set separately shall meet the survey requirements for production risers in the CCS *Guidelines for Survey of Marine Riser Systems*, and underwater tailwater discharge pipes set in the form of a tube bundle with the mining risers shall meet the survey requirements for auxiliary lines in the CCS *Guidelines for Survey of Offshore Drilling Plants*. The flexible jumper pipe shall meet the survey requirements in the CCS *Guidelines for Certification of Subsea Production System*.

2.5.4 Special survey (or renewal survey)

2.5.4.1 Deep-sea mining units with a "MINING" class notation must undergo special surveys of

their mining systems at least every five years after deep-sea mining units are completed, put into service or undergo a special survey.

2.5.4.2 The special survey may be commenced at the annual survey prior to its due date and completed by its due date. When the special survey is commenced prior to the annual survey before the due date, if the items to be carried out are intended as part of the special survey, the entire special survey shall be completed within 15 months after the start of the special survey.

2.5.4.3 Where the owner is not able to arrange the special survey by its due date due to exceptional circumstances, CCS may grant an extension not exceeding 3 months upon the owner's written application before the due date. In such a case, the date of next special survey shall be calculated from the due date of the previous special survey before the extension was granted.

2.5.4.4 If the special survey is completed more than three months before the due date, the date of the next special survey shall be calculated from the completion date of the special survey. If the special survey is completed within three months before the due date, the date of the next special survey shall be calculated from the original due date of the special survey. If the special survey is completed after the due date, the date of the next special survey shall still be calculated from the original due date of the special survey.

2.5.4.5 Special surveys include all items of annual surveys, and the following work shall also be carried out:

(1) Internal inspection and/or thickness measurement of pressure vessels and pressure-containing components, and test of pressure relief valves and pressure piping systems, when deemed necessary by the surveyor;

(2) Pressure tests on pressure vessels and pressure-containing components at the maximum allowable working pressure (MAWP);

(3) Pressure tests on the piping systems and hoses involved in the mining system at the MAWP;

(4) Insulation resistance check of motor;

(5) Rotating equipment inspection for normal operation;

(6) Condition inspection of the fluid end of the slurry conveying pump;

(7) Operational performance test on the safety valve and verification of the set pressure;

(8) Function test status inspection of the launch and recovery system and personnel lifting appliance;

(9) Close-up surveys of the welded joints of the tower and related structures;

(10) Thickness measurement and/or NDE of any suspected parts;

(11) Load test at 1.25 times the safe working load on the load-carrying equipment used to lift ore cargo; verify that the load test shall include lifting and lowering of the equipment, as well as testing of fail-safe devices and limiting devices; after the test is completed, check the equipment to ensure no damage or permanent deformation of any component occurred during the test;

(11) Load test on all rollers and tensioners at 110% the rated load;

(12) Inspection of the underwater mining vehicle, underwater hoisting system, underwater relay

station and related hoses when they are recovered to the surface support unit;

(13) Overall survey of the mining control and monitoring system in combination with the survey results of systems and auxiliary systems related to the mining control and monitoring system, till the results are to the surveyor's satisfaction; and a full-scale ship verification, if necessary, for its external communication and safe operating system (analog signals also acceptable).

2.5.5 Alteration surveys and damage and repair surveys

2.5.5.1 For alteration or modification to the mining system, which affects the validity of the "MINING" class notation and certificate for deep-sea mining units, relevant drawings shall be submitted to CCS for approval. Alteration or modification and related parts shall generally comply with the current provisions in the Guidelines or at least comply with the requirements previously applicable.

2.5.5.2 In case of any damage to the mining system, which affects the validity of the "MINING" class notation and certificate of deep-sea mining units, CCS shall be notified in a timely manner for damage survey. The detailed repair plan shall be submitted to CCS for review, and surveys and tests shall be to the surveyor's satisfaction.

Chapter 3 Hull Requirements for Ship-type Deep-sea Mining Units

Section 1 General Provisions

3.1.1 Scope of application

3.1.1.1 This Chapter applies to ship-type deep-sea mining units applying for the Ship Type hull class notation.

3.1.1.2 Unless otherwise specified in this Chapter, the requirements in Chapter 7, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units* shall be satisfied.

3.1.2 Design life and environmental conditions

3.1.2.1 The design life of ship-type deep-sea mining units under marine sailing conditions shall not be less than 25 years. The corresponding wave environmental conditions are those of non-restricted navigation areas (a 25-year North Atlantic environment, corresponding to a wave load exceedance probability of 10^{-8}).

3.1.2.2 The design life of ship-type deep-sea mining units for offshore operations shall be proposed and finalized by the owner/designer based on the mining scale, expected life and mining plan.

3.1.2.3 The environmental load of ship-type deep-sea mining units operating at sea under in-position conditions shall comply with the requirements in Chapter 2, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

3.1.2.4 The designer shall provide a wave scatter diagram of the deep-sea mining operation area.

3.1.2.5 The designer shall provide the wind, wave and current design parameters under various conditions in deep-sea mining operations.

3.1.3 Loading mode

3.1.3.1 The design loading modes of ship-type deep-sea mining units shall include, but not be limited to:

(1) Sailing conditions

① Normal ballast (at the normal ballast draft);

② Homogeneous full load (at the full load draft, or determined according to the shipowner/ owner's design specifications).

(2) In-position conditions:

① Launch/recovery conditions

(a) Ballast conditions for the launch of mining system (considering the actual floating state);

(b) Full-load conditions for the launch of mining system (considering the actual floating state);

(c) Ballast conditions for the recovery of mining system (considering the actual floating

state);

(d) Full-load conditions for the recovery of mining system (considering the actual floating state).

② Operating conditions

(a) Homogeneous full load (at the full load draft);

(b) No-load (at the normal ballast draft);

(c) Intermediate loading (at the draft corresponding to the intermediate loading conditions);

(d) Loading in alternate hold.

③ Survival conditions

(a) Full load (at the full load draft);

(b) Intermediate loading conditions (at the draft corresponding to the intermediate loading conditions or the typical loading conditions specified by the owner);

(c) No-load (at the normal ballast draft).

④ Preparatory conditions

(a) Consider that all equipment (underwater equipment such as underwater mining vehicles, relay stations and mining risers) are loaded on the hull.

⑤ Export conditions

(a) Consider the loading and equipment launch status before the start of mineral transport when mineral export is carried out via side-by-side bulk carriers;

(b) Consider the loading and equipment launch status at the start of mineral transport when mineral export is carried out via side-by-side bulk carriers.

Section 2 Requirements of Descriptive Specifications

3.2.1 General requirements

3.2.1.1 In addition to the provisions in this section, the hull and structural layout requirements for ship-type deep-sea mining units shall also comply with the applicable requirements of Chapters 1 and 2, Part 2 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

3.2.2 Hull girder strength

3.2.2.1 For the global longitudinal strength check of the hull girder of a ship-type deep-sea mining unit under sailing conditions, wave loads correspond to non-restricted navigation areas.

3.2.2.2 For the global longitudinal strength check of the hull girder of a ship-type deep-sea mining unit under in-position conditions, the wave bending moment and wave shear force shall be based on the corresponding load return period under different conditions and the wave spectrum of the corresponding sea area, and the prediction value of load extreme value shall be obtained based on the statistical prediction method of the 50-year return period. It can also be based on the operating environment conditions specified by the owner.

3.2.2.3 The ultimate strength check of the hull girder of a ship-type deep-sea mining unit shall be carried out in accordance with the applicable requirements in Section 2, Chapter 16, Part 2 of the

CCS *Rules for Classification of Sea-Going Steel Ships*. But for in-position conditions, the use of some coefficients can be determined based on relevant technical data.

3.2.3 Local dimensions of hull

3.2.3.1 The double bottom structure, deck frame, side frame, web frame in the side tank and cargo hold perimeter of the ship-type deep-sea mining unit shall comply with the requirements in Section 3, Chapter 16, Part 2 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

3.2.3.2 The perimeter structure of the cargo hold loaded with minerals shall be designed based on the loading height when the cargo hold is fully loaded. In the calculation, the structure within 80% loading height of the cargo hold shall be checked based on the cargo density, while the structure above the 80% loading height shall be checked against the structural requirements for watertight bulkheads. Alternatively, the required check height of the watertight bulkhead may be determined based on the actual cargo loading height, subject to approval by CCS.

3.2.3.3 The loaded minerals shall be dehydrated and dried as much as possible. If the moisture content of the loaded minerals exceeds the transportable moisture limit (TML) specified by the shipowner or the Administration, full liquefaction of the minerals shall be considered, and the structural strength of the ore tanks shall be checked in accordance with CCS requirements for the structural strength of water-containing ore sands on ore carriers.

3.2.3.4 Watertight transverse bulkheads, watertight longitudinal bulkheads and swash bulkheads (if any) of ship-type deep-sea mining units shall comply with the requirements in Section 3, Chapter 16, Part 2 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

3.2.3.5 The green sea loads on the upper modules of the ship-type deep-sea mining unit shall meet the relevant requirements in 2.17.2, Section 17, Chapter 2, Part 2 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

Section 3 Direct Calculation of Structural Strength

3.3.1 General requirements

3.3.1.1 Ship-type deep-sea mining units shall be subject to finite element strength assessment of compartment section (sailing conditions) and of whole ship (in-position conditions), as well as to fatigue strength assessment (in-position conditions) and finite element strength assessment of mining equipment supporting structure.

3.3.2 Finite element strength assessment of compartment section

3.3.2.1 The finite element strength assessment of the compartment section shall be carried out for (1) sailing conditions and (2) in-position conditions in 3.1.3.1 of this Chapter.

3.3.2.2 The yield strength assessment under sailing conditions shall be carried out in accordance with the CCS *Guidelines for Direct Calculation of Hull Structure Strength of Ore Carrier*. If necessary, a fine mesh analysis shall also be performed.

3.3.2.3 The buckling strength assessment under sailing conditions shall be carried out in accordance with the CCS *Guidelines for Direct Calculation of Hull Structure Strength of Ore*

Carrier. In special cases, the assessment can be carried out according to other applicable methods in the CCS *Guidelines on Advanced Buckling Assessment for Hull Structure of Ore Carrier*.

3.3.2.4 Given that the structural form and loading mode of ship-type deep-sea mining units are different from those of bulk carriers, their load combination for in-position conditions shall comply with the following principles:

(1) The combined conditions shall at least include the most unfavorable possible combination of static load and dynamic load;

(2) The dynamic load cases shall at least include the maximum vertical wave load and the maximum shear force conditions.

3.3.2.5 For operating conditions and survival conditions, the dynamic load shall be checked based on direct calculation:

(1) The survival conditions are defined by the designer-specified static loads and variable loads, plus site-specific loads with a defined return period.

(2) The maximum functional load, corresponding static load and restrictive environmental conditions for stopping normal operation under normal operating conditions shall be specified by the designer/owner, but the return period of environmental load shall not be less than one year.

(3) The static load can be the maximum static load envelope value corresponding to the operating and survival conditions.

3.3.2.6 The yield strength assessment under in-position conditions shall be carried out in accordance with the applicable provisions in Section 4, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

3.3.2.7 The buckling strength assessment under in-position conditions shall be carried out in accordance with the applicable provisions in Section 4, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

3.3.3 Finite element strength assessment of the whole ship

3.3.3.1 The finite element strength assessment of the whole ship shall be carried out for (2) in-position conditions in 3.1.2.1 of this Chapter.

3.3.3.2 The modeling principles of the hydrodynamic calculation model and the finite element model of the whole ship shall comply with the CCS *Guidelines for Direct Calculation of Hull Structure Strength of Ore Carrier*.

3.3.3.3 The calculation and loading methods of static and dynamic load components shall comply with the applicable provisions in Chapter 6 of the CCS *Rules for Classification of Offshore Floating Installations*. The load effect of the mining riser system under the in-position conditions shall be considered, and the load response of the riser system can be obtained through model tests or hydrodynamic analysis.

3.3.3.4 The yield strength assessment shall be carried out in accordance with the applicable provisions in Chapter 8 of the CCS *Rules for Classification of Offshore Floating Installations*.

3.3.3.5 The buckling strength assessment shall be carried out in accordance with the applicable

provisions in Chapter 9 of the CCS *Rules for Classification of Offshore Floating Installations*. In case of non-compliance or special circumstances, the assessment can be carried out according to other applicable methods in the CCS *Guidelines on Advanced Buckling Assessment for Hull Structure of Ore Carrier*.

3.3.4 Fatigue strength assessment

3.3.4.1 For ship-type deep-sea mining units, their service life is mainly based on in-position conditions, and fatigue cumulative damage under sailing conditions is usually not considered, unless specially required by CCS or the owner.

3.3.4.2 The fatigue strength of ship-type deep-sea mining units shall comply with the requirements for surface-type units in Section 5, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

3.3.5 Strength assessment of mining equipment supporting structure

3.3.5.1 The strength assessment of supporting structures such as special mining equipment, towers, moon pools and cranes shall comply with the applicable requirements in Section 7, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

Section 4 Subdivision and Stability

3.4.1 General provisions

3.4.1.1 Unless otherwise specified in the Guidelines, the stability requirements of ship-type deep-sea mining units shall comply with the applicable requirements of relevant regulations.

3.4.2 Intact stability

3.4.2.1 For marine sailing conditions of ship-type deep-sea mining units, their intact stability shall comply with the requirements for intact stability in the *International Code on Intact Stability, 2008* (2008 IS Code).

3.4.2.2 For marine operating conditions of ship-type deep-sea mining units, the effects of additional heeling moments on stability shall be taken into account if such moments may be applied during operation. Its intact stability shall meet the standard requirements for crane ships in Article 3.10.6, Section 3, Chapter 7, Part 4 of the *Technical Regulations for Statutory Surveys of Sea-going Ships Engaged on Domestic Voyages* from the Maritime Safety Administration of the People's Republic of China.

3.4.2.3 The intact stability of ship-type deep-sea mining units shall comply with the requirements for surface-type units in Section 3, Chapter 2, Part 3 of the CCS *Rules for Classification of Mobile Offshore Units*.

3.4.3 Damage stability

3.4.3.1 For marine sailing conditions of ship-type deep-sea mining units, their damage stability shall comply with the requirements for damage stability in B-1, Chapter II-I of the *International Convention for the Safety of Life at Sea* (SOLAS) (Type B Freeboard) or in Regulation 27 of the *Protocol of 1988 relating to the International Convention on Load Lines* (Type B Freeboard), and

their damage stability shall also comply with the requirements for damage stability in the *Code of Safety for Special Purpose Ships, 2008* (2008 SPS Code).

3.4.3.2 For the survival conditions of ship-type deep-sea mining units, the requirements for damage stability of surface-type units in the CCS *Rules for Classification of Mobile Offshore Units* shall also satisfied.

3.4.3.3 The damage stability of ship-type deep-sea mining units shall comply with the requirements for surface-type units in Section 4, Chapter 2, Part 3 of the CCS *Rules for Classification of Mobile Offshore Units*.

Chapter 4 Hull Requirements for Column Stabilized Deep-sea Mining Units

Section 1 General Provisions

4.1.1 Scope of application

4.1.1.1 This Chapter applies to column stabilized (semisubmersible) deep-sea mining units applying for the class notation of "Column Stabilized (Semisubmersible)".

4.1.1.2 Unless otherwise specified in this Chapter, the requirements applicable to column stabilized units in Part 2 of the CCS *Rules for Classification of Mobile Offshore Units* shall be satisfied.

4.1.2 Design conditions and design loads

4.1.2.1 The design life of the unit shall be determined by the owner/designer based on factors such as mining scale, expected life and mining plan, generally not less than 20 years. There are mainly the following four design conditions:

(1) Normal operating conditions: generally, environmental load with a return period of not less than one year.

(2) Survival conditions: environmental load with a return period of not less than 100 years.

(3) Transit conditions: generally not less than a 1-year return period or determined according to seasonal environmental conditions.

(4) Accident conditions: Assuming that after the failure of any slender bracing or the main girder of the upper hull of a single-deck unit, it is subjected to an environmental load with a return period of one year, and its safety factor can be taken as 1.0.

4.1.2.2 The designer shall determine the wind, wave and current design parameters based on the environmental conditions in deep-sea mining operation areas.

4.1.2.3 Environmental loads shall comply with the requirements in Chapter 2, Part 2 and Section 3, Chapter 5 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.1.2.4 The corresponding safety factors for various design conditions shall be selected in accordance with the provisions in Section 4, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.1.2.5 The air gap shall comply with the requirements in Section 2, Chapter 5, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.1.3 Loading mode

4.1.3.1 The designer shall determine the loading mode based on factors such as the operation characteristics, functional requirements, and design loads of deep-sea mining units. There are usually different loading modes for different conditions, including at least but not limited to:

(1) Transit loading mode;

(2) Operation loading mode;

(3) Self-storage loading mode.

Section 2 Component Dimensions

4.2.1 General requirements

4.2.1.1 The dimensions of the main components of the unit shall be determined in accordance with the provisions in this section. If a component only bears local loads and is not an effective part of the main frame of the unit, its dimension can be determined by referring to the requirements in relevant applicable parts of the CCS *Rules for Classification of Sea-Going Steel Ships*.

4.2.1.2 The dimensions of hull components shall comply with the requirements for column stabilized units in Section 2, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.2.1.3 The component dimension calculated in accordance with the provisions in this section is the minimum structural dimension required by the rules, and its strength shall also comply with the requirements in Section 3 of this Chapter.

Section 3 Structural Analysis

4.3.1 General requirements

4.3.1.1 Structural finite element strength calculations shall be performed using recognized and CCS-approved structural analysis software. Otherwise, the submitting party shall provide relevant software description documents, including the mechanical principles on which the software is based, the solution calculation methods of the software and relevant authentication certificates.

4.3.1.2 The stress in the main structure of the hull shall be analyzed and determined according to the loads and corresponding load combination cases specified in Section 1 of this Chapter. All conditions that characterize the operation mode shall be considered to determine the key design conditions.

4.3.1.3 The structural analysis and strength check shall comply with the requirements in Sections 3 and 4, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.3.1.4 The fatigue strength shall comply with the requirements in Section 5, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

4.3.1.5 Structures that are an essential part of the safety system specified in the Rules or are used to bear heavy loads, such as lifeboat units, crane pedestals, helicopter deck supporting structures, pipe racks, towers and other important equipment supports and their supporting structures, shall comply with the requirements for structural strength in Section 7, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units* under environmental loads and operational loads in all operation modes.

4.3.1.6 For typical stress concentration areas, such as moon pool corners, large brackets connecting columns to upper and lower hulls, and areas where stress exceeds the standard during finite element assessment, fine-mesh finite element analysis shall be used, and their failure criteria

shall comply with the requirements in 3.4.2.3, Section 4, Chapter 3, Part 2 of the CCS *Rules for Classification of Mobile Offshore Units*.

Section 4 Subdivision and Stability

4.4.1 General provisions

4.4.1.1 The subdivision and stability of column stabilized deep-sea mining units shall comply with the requirements for column stabilized units in Part 3 of the CCS *Rules for Classification of Mobile Offshore Units*.

Chapter 5 Mining System

Section 1 General Provisions

5.1.1 General requirements

5.1.1.1 This Chapter applies to the mining system and equipment of deep-sea mining units, mainly including: launch and recovery system, ore cargo handling system, ore dewatering system, subsea mining system, underwater hoisting system, tailwater treatment and discharge system, control and monitoring system, as well as the special lifting, power supply, hydraulic and compressed air systems for deep-sea mining operations, along with their associated pressure-containing equipment.

5.1.1.2 The manufacturer of the mining system and equipment shall provide CCS with a declaration stating that the equipment and components to be surveyed and certified by CCS comply with the applicable standards. If the standards stated in the declaration are not included in the accepted standards listed in Section 3, Chapter 1 of the Guidelines, CCS will evaluate such standards to determine their applicability.

5.1.2.3 If one or some aspects of the design of the mining system and equipment do not comply with the requirements of the Guidelines, CCS will analyze the deviations, assess whether they introduce additional risks, and evaluate the acceptability of such risks. CCS will then provide risk control recommendations or rule on the acceptability of the design.

5.1.1.4 Mechanical equipment and piping such as engines, pressure vessels, air compressors and pumps on deep-sea mining units that serve the mining system but are not part of the mining system shall comply with the provisions in Chapter 7 of the Guidelines.

5.1.1.5 Electrical installations on deep-sea mining units that serve the mining system but are not part of it shall comply with Chapter 8 of the Guidelines.

Section 2 Design Principles

5.2.1 Safety principles

5.2.1.1 The mining system and equipment shall be designed to maximize the safety of life and property. To this end, the principles specified in 5.2.1.2 to 5.2.1.12 shall be followed in the design.

5.2.1.2 The system shall be designed according to the principle that a single misoperation or failure will not endanger human life and cause major property losses.

5.2.1.3 The system shall be equipped with instruments necessary for safe operation and emergency operation.

5.2.1.4 Appropriate protection measures shall be taken for systems and equipment to prevent overload, overpressure, overtemperature and overspeed.

5.2.1.5 Systems and equipment shall be designed to avoid or prevent dangers as much as possible through intrinsic safety design.

5.2.1.6 For all identified potential safety risks, measures shall be taken to minimize the likelihood of risk occurrence and to mitigate the impact of any accidents.

5.2.1.7 The safety system should include two independent protection systems to prevent or minimize the impact of a single fault or failure in equipment, piping system and normal process control. The two-level protection shall generally consist of safety devices of different functional types to reduce the possibility of failure due to the same reason.

5.2.1.8 The safety system, control system and alarm system shall be designed to be fail-safe.

5.2.1.9 When a fault condition develops too rapidly to be mitigated by manual intervention, the safety system shall automatically initiate actions to bring the mining system to a safe state.

5.2.1.10 Large movable equipment and tools in the system shall be provided with reliable securing arrangements. These arrangements shall be designed, with consideration given to various conditions such as normal operating, transit, storm survival, and accidental tilt. Large equipment mainly includes the underwater mining vehicle, underwater relay station, underwater ore-lifting pump, and mining riser joint.

5.2.1.11 Effective protection measures shall be taken for systems and equipment, and the following aspects shall be taken into account:

(1) The systems and equipment installed on the surface support unit shall meet the anti-corrosion requirements in humid and salt spray environments.

(2) The systems and equipment installed underwater shall comply with the requirements for anti-corrosion, anti-collision and anti-interference in underwater operations.

(3) Effective anti-corrosion and protection measures shall be taken for systems and equipment located in the splash zone.

5.2.1.12 All connectors and fasteners in the systems and equipment shall be secured against loosening.

5.2.2 Principles of environmental protection

5.2.2.1 The design of the mining system shall take into account the protection of the marine environment as practicable and shall comply with the applicable requirements of relevant international organizations, e.g., the International Seabed Authority (ISA) and governments having jurisdiction.

5.2.2.2 The tailwater treatment system shall be capable of treating mining tailwater to meet the standards established by the International Seabed Authority (ISA) or governments of coastal states.

5.2.3 Layout requirements

5.2.3.1 High-risk equipment and areas shall be isolated from low-risk ones.

5.2.3.2 The mining system equipment and components shall be so arranged that cables, cable troughs, intake and exhaust pipes, control and shutdown systems and safety systems are protected during mining operations.

5.2.3.3 Important equipment, facilities and passages shall be located and designed, with

consideration given to the risk of being struck by falling objects.

5.2.3.4 The deck and working area shall be equipped with an effective system for collecting slop and residual liquid in the slurry.

5.2.3.5 The design of the tower operation room shall comply with the following principles:

(1) The personnel in the tower operation room shall be provided with a clear and unobstructed field of vision to monitor all operation activities on main equipment, work platform, and in the tower, either directly or via reliable visual aids.

(2) Effective sound insulation measures shall be implemented in the design of tower operation room to ensure that the noise level inside the room does not exceed 65dBA, even when the external noise level reaches 85dBA.

(3) Effective temperature control measures such as insulation and air conditioning should be taken for the design of the tower operation room to make its internal ambient temperature suitable for long-term work.

5.2.3.6 The mining system and equipment shall be so arranged that all equipment has sufficient operation, maintenance space and access or equivalent measures are taken.

5.2.3.7 The tower workbench shall be provided with at least two unobstructed direct access routes to the security zone.

5.2.3.8 If ice or snow buildup is possible at the operation site of deep-sea mining units, effective measures shall be implemented to minimize ice and snow buildup on the open-pit mining system and equipment.

5.2.3.9 The moon pool area of the mining unit shall be so arranged as to prevent interference with risers, hoses and cables.

5.2.3.10 Layout of safety system

(1) For anticipated hazardous events that may require the simultaneous operation of multiple safety systems, the controls for these systems shall, whenever possible, be located at the same place. In addition, simple and effective means of visual and/or audible communication shall be used to ensure the safe operation of the mining system and the facilities in which it is located.

(2) Safety systems shall be properly located and protected to ensure they remain operational and safely accessible in the event of an accident.

(3) The control location of safety systems shall be at a protected place.

5.2.4 Overpressure protection

5.2.4.1 Systems and equipment and/or components where overpressure may exist shall be protected by appropriate protection installations (such as safety valves, bursting discs, fusible plugs).

5.2.4.2 The worst combination of pressure sources shall be considered in the design and selection of overpressure protection installations. These pressure sources include pressure caused by pump pressure, fluid resistance, static head, water hammer effect, etc.

5.2.5 Materials, welding and NDE

5.2.5.1 The materials, welding and NDE of the system shall comply with the requirements in the accepted standards specified in the CCS *Rules for Materials and Welding* or in Section 3, Chapter 1 of the Guidelines, and the suitability of materials for their intended function shall be taken into account.

5.2.5.2 Materials containing asbestos are prohibited in systems and equipment.

5.2.6 Risk assessment

5.2.6.1 The technical requirements for risk assessment specified in this clause are recommended requirements, and risk assessment can be carried out voluntarily based on the needs of shipowners.

5.2.6.2 The risk assessment of the mining system can be divided into the following three levels:

(1) Qualitative risk assessment of the system as a whole and subsystems, and the analysis methods can be HAZID, HAZOP and What-if;

(2) Risk assessment at the functional level, and FMEA/FMECA methods can be used;

(3) Risk assessment at the equipment and/or component level, and FMEA/FMECA methods can be used.

The above assessments shall be carried out in sequence, beginning with a comprehensive risk identification of the overall design. If necessary, further detailed analysis shall be carried out for specific risks identified in the early stage.

5.2.6.3 A qualitative risk assessment covering the entire mining system shall be carried out to:

(1) Identify potential risks associated with the mining system (including impacts on other systems at deep-sea mining units);

(2) Demonstrate that the mining system complies with the design principles set out in the Guidelines;

(3) Propose appropriate measures to prevent accidents and mitigate the consequences of risks;

(4) Propose the need for further analysis, testing or risk assessment.

5.2.6.4 The purpose of the overall risk assessment of the mining system is to identify the main hazard sources associated with the system, which include but are not limited to: structural failure, mechanical failure, electrical failure, positioning failure, loss of stability, equipment collision, falling objects, collapse, helicopter collision, and extreme environment.

5.2.6.5 Risk assessment at the functional level shall cover the subsystems and their control systems described in 5.1.1 of this Chapter, and identification of equipment and/or components that require further risk assessment.

5.2.6.6 Risk assessment at the component level shall be linked to the risk assessment at the functional level to fully understand the local effects of equipment failure modes and the effects of control/safety functions and other equipment/interface failures in the system.

5.2.6.7 FMEA/FMECA verification

(1) A set of validation procedures shall be prepared and implemented to verify the selected key risk assessment results. For example, for FMEA/FMECA assessment, this includes confirming the

effectiveness of the identified system failure mode, the impact of the identified system failure mode, the response of safety control and the effectiveness of other protection measures against the failure.

(2) Part of the verification activities can be carried out at the product manufacturer. If the overall test requires assembly and installation on the unit, FMEA/FMECA validation during commissioning can be conducted as part of the system integrity test (SIT).

(3) The test procedures and results shall be documented to ensure that the FMEA/FMECA conclusions are validated.

(4) CCS shall review the FMEA/FMECA test procedures and witness the FMEA/FMECA tests.

5.2.6.8 The shipowner shall retain the risk assessment results. If any subsequent modifications are made to the mining system, subsystem, equipment or component, the risk assessment results shall be updated to cover these modifications and prove that the risks caused by these modifications have been appropriately mitigated.

Section 3 Design Loads

5.3.1 General requirements

5.3.1.1 Each component of the mining system and equipment shall be designed for predetermined adverse load cases. Considerations shall be given to all internal and external loads acting on the mining system and equipment and having an adverse effect on their function, strength and safety and reliability. All loads that can realistically act concurrently shall be combined for the most unfavorable effect, except for seismic loads.

5.3.1.2 The load conditions in the mining system mainly include the design pressure, design temperature, environmental load, operational load and deadweight of the equipment and/or system.

5.3.1.3 The design pressure and design temperature of the equipment and/or system shall meet the following requirements:

(1) The design pressure and design temperature shall include sufficient margin to cover the uncertainty of expected internal and external pressure and temperature conditions;

(2) The design pressure shall be higher than the maximum operating pressure and include an appropriate safety margin;

(3) The design pressure and design temperature shall be determined with full consideration given to the start-up, shutdown, operation and all predictable abnormal conditions of equipment and/or system;

(4) In the absence of applicable engineering experience for reference, the design pressure and design temperature shall be determined by establishing operation limits for the equipment and/or system via engineering analysis and testing, where necessary.

5.3.2 Environmental load

5.3.2.1 The environmental conditions and motion performance used in the design of deep-sea

mining units shall be used for the design of the mining system.

5.3.2.2 If applicable, the following factors shall be considered when determining environmental loads:

(1) Loads caused by the unit's motions;

(2) Wind, wave and current loads;

(3) Air temperature and humidity;

(4) Load from ice and snow buildup (when applicable).

5.3.2.3 The design loads for all main components/equipment in the mining system (such as the tower, launch and recovery system, ore cargo handling system) shall include loads caused by the unit's motions resulting from winds, waves and currents. The unit's motions shall be considered when designing the fixing method for pressure-containing equipment and underwater equipment.

5.3.2.4 For the mining system and equipment intended for operation in cold regions, the potential load from ice and snow buildup shall be considered, and its design value shall be determined by the shipowner/designer.

5.3.3 Operational load

5.3.3.1 Operational load refers to the loads other than the environmental load and the deadweight of components during operation.

5.3.3.2. The operational load of the launch and recovery system includes hook load and chuck load. In addition, the riser tension load, slurry material weight load and accidental load shall also be taken into account for the mining system.

5.3.3.3 The vertical load caused by the operational movement is generally calculated by applying a dynamic load coefficient which shall be determined according to the standards accepted in the Guidelines.

5.3.3.4 In determining the lateral load caused by the operational movement, considerations shall be given to inertial and centrifugal forces due to lateral movement of equipment, forces transmitted to the track by mining equipment using the track, and buffer loads.

5.3.4 Load combinations

5.3.4.1 Unless otherwise specified, the load combinations associated with system equipment and components shall be evaluated for the following applicable conditions:

(1) Operating conditions (including launch and recovery conditions and mining production operating conditions);

(2) Stand-by conditions;

(3) Survival conditions;

(4) Transit conditions.

Section 4 Launch and Recovery System

5.4.1 General requirements

5.4.1.1. The launch and recovery system is used to launch and recover underwater mining

equipment and components such as the mining riser, underwater ore-lifting pump, underwater relay station and mining vehicle. It mainly includes a tower lifting system centered on the tower, a hoisting system arranged on the side or stern of deep-sea mining units, and a pipe string handling system for handling a mining riser joint.

5.4.2 Tower lifting system

5.4.2.1 The tower lifting system refers to the system used to lift and lower mining risers, including main equipment such as the tower and its base, crown block assembly, traveling block, hook, main hoisting winch and deadline anchor.

5.4.2.2 The maximum allowable working load of the tower lifting system shall be determined with reference to the working load of the weakest component in the load path.

5.4.2.3 Emergency parking and automatic parking actions shall not cause dynamic loads that the system cannot withstand.

5.4.2.4 Tower-mounted equipment shall be properly fixed, secured and/or tightened to prevent falling.

5.4.2.5 Suspension lugs, shackles, lifting ropes and permanent accessories shall be marked with the safe working load (SWL).

5.4.2.6 The main equipment in the tower lifting system shall meet the following requirements:

(1) The tower and its base shall comply with the requirements applicable to derricks, drill floors and bases in Section 4, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants*.

(2) The main hoisting winch shall comply with the requirements applicable to drilling winches in 3.9.1.2, Section 9, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants* or the requirements in accepted standards.

(3) The crown block, traveling block and main lifting rope shall comply with the requirements in 3.9.1.3, Section 9, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants* and shall have sufficient load-carrying capacity.

(4) The hook shall comply with the requirements in 3.9.1.4, Section 9, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants*.

5.4.2.7 The instrumentation and control of the tower lifting system shall comply with the applicable requirements in 3.9.1.9, Section 9, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants*.

5.4.2.8 The heave compensation system shall comply with the applicable requirements in Section 7, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants* and in the CCS *Guidelines for Drilling Compensation Systems*.

5.4.3 Hoisting system

5.4.3.1 The hoisting system shall comply with the requirements applicable to hoisting systems in Chapter 14 of the CCS *Rules for Classification of Diving Systems and Submersibles*.

5.4.3.2 The hoisting system shall have the function of effectively limiting the horizontal swaying of the hoisted equipment, or equivalent measures shall be implemented.

5.4.2 Pipe string handling system

5.4.2.1 The pipe string handling system is mainly used to transport and handle a mining riser joint. The main equipment includes the pipe gripper, catwalk machine, lifting tongs, clamp, etc.

5.4.2.2 The pipe string handling system shall meet the corresponding requirements in 3.9.2, Section 9, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants*.

Section 5 Ore Cargo Handling System

5.5.1 General requirements

5.5.1.1 The ore cargo handling system mainly consists of the lifting appliance, control system and conveying device for ore cargo handling.

5.5.1.2 The ore cargo handling system shall have sufficient spare devices to be put into use in case of a single component failure, and a FMEA should be carried out. If it is impractical to set up a backup system due to the system design, necessary spare parts shall be made available on the unit to correct the failure and resume operations.

5.5.1.3 The maximum safe working load of the lifting appliance shall be prominently posted near the control position so that it is easily visible to the operator.

5.5.1.4 In the design of the ore cargo handling system, a risk assessment should be carried out in accordance with the requirements in 5.2.6, Chapter 2, and the assessment report shall be submitted to CCS for review.

5.5.2 Lifting appliance

5.5.2.1 The lifting appliance in the ore cargo handling system shall comply with the provisions in the CCS *Rules for Lifting Appliances of Ships and Offshore Installations* and shall meet the additional requirements in 5.5.2.2 to 5.5.2.4.

5.5.2.2 All lifting appliances shall be equipped with effective brakes or other equivalent devices to stop the motion of the lifting appliance when it is subjected to a safe working load at its rated speed and keep it in a stop position. The brakes shall be able to work automatically in the event of a power interruption. The upper and lower limit stops shall be used to determine the vertical travel, and the following devices shall be provided:

(1) Limit stop device;

(2) Inhibiting devices that limit incorrect lifting direction;

(3) Emergency stop switch independent of other switches.

5.5.2.3 If the load is not controlled before reaching the ore cargo handling equipment, an overload protection system shall be equipped. Lifting appliances using wire ropes or chains shall be equipped with a device to detect slack wire ropes or chains, which shall be able to stop all transport operations of the lifting appliances.

5.5.2.4 Measures shall be taken to prevent the lifting appliance from restarting before troubleshooting.

5.5.3 Conveying device

5.5.3.1 Under normal operation and emergency conditions (e.g., overspeed), the conveying device/conveyor shall be capable of safely decelerating from its rated speed under rated load and coming to a stop without excessive impact by using the following devices:

(1) One set of electrical or mechanical brake system for normal operation;

(2) One set of mechanical brake system capable of automatic operation upon power interruption and used as a parking brake;

(3) Another set of additional brake which can automatically start and work in the event of a main brake failure. The additional brake shall be capable of automatically starting and working upon the failure of any single transmission device in the conveying device/conveyor.

5.5.3.2 When a lower speed is required for safety reasons, the conveying device shall have an automatic deceleration function in addition to the braking system.

5.5.3.3 The conveying device shall have an automatic monitoring function. In case of failure, it shall be able to stop automatically.

5.5.3.4 An ore cargo handling system employing guide rails shall be equipped with the anti-derailment device. The device shall remain operational and effective in the event of any conveyor wheel or guide roller failure. The connection of the guide rail shall include appropriate interlocking devices to prevent derailment. The guide rail cleaning device shall be set in front of the conveyor wheel and guide roller.

5.5.3.5 A device shall be provided to prevent the ore cargo conveyor from slipping in the event of any conveyor wheel or shaft failure.

5.5.4 Transfer device

5.5.4.1 The transfer device shall be capable of safely and efficiently transferring ore cargo from the surface support unit to the ore transport ship.

5.5.4.2 The primary load-carrying components or equipment in the transfer device shall be able to withstand the maximum load during operation.

5.5.4.3 The transfer device shall be capable of promptly halting transfer operations when marine environmental conditions exceed the established transfer operation limit to ensure the safety of deep-sea mining units and ore transport ships.

5.5.5 Control and monitoring device

5.5.5.1 Ore cargo loading and offloading operations shall be controlled and monitored from a separate ore cargo control station.

5.5.5.2 If equipment in the ore cargo handling system requires manual operation, measures shall be taken to include these operations in commissioning, troubleshooting and other similar work.

5.5.5.3 The monitoring device of the ore cargo handling system shall be able to display information such as system operation status (operating or not operating), power availability, overload alarm, air pressure, brake mechanism status, hydraulic medium pressure, power supply status or current, motor operation status and motor overload, if applicable.

5.5.6 Emergency shutdown device

5.5.6.1 An emergency shutdown device shall be provided to stop the ore cargo handling system in an emergency without generating additional safety risks.

5.5.6.2 An emergency shutdown device shall be located at each control position.

5.5.6.3 The ore cargo handling system shall be capable of starting from the control station after the emergency shutdown device is reset to the start position.

5.5.6.4 The remote shutdown controls for the power unit shall be located outside the space containing the unit, to allow for its stoppage in the event of a fire or other emergencies. Additionally, a local emergency shutdown device shall also be installed.

Section 6 Ore Dewatering System

5.6.1 General requirements

5.6.1.1 The main equipment of the ore dewatering system includes the screening device (e.g., vibrating screen), gravity sedimentation tank, centrifuge, hydrocyclone and slurry pump.

5.6.1.2 The main equipment of the ore dewatering system shall comply with national standards, industry standards, international standards or foreign standards accepted by CCS.

Section 7 Subsea Mining System

5.7.1 General requirements

5.7.1.1 The subsea mining system consists of the underwater mining vehicle and its associated systems.

5.7.1.2 The underwater mining vehicle is used to collect ore on the seabed. Depending on the type of mineral being mined, it is typically equipped with functions such as ore stripping, crushing, and collecting. It can travel across the sea floor using travelling mechanisms like crawler tracks or screw propellers.

5.7.2 Frame structure

5.7.2.1 The frame structure of the underwater mining vehicle and its associated systems shall have sufficient strength, and the design shall take into account the loads caused by factors such as bottoming out, object collision, waves hitting, and bumps on the surface support unit.

5.7.2.2 The structural design of the underwater mining vehicle and its associated systems shall ensure that their internal spaces are fully submersible and drainable. Appropriate openings shall be provided at the highest and lowest points of the structure. The water inlet and vent shall be appropriately sized to ensure that water can enter freely and drain completely.

5.7.2.3 Metal structures shall be protected against corrosion and marine growth.

5.7.3 Lifting lugs/accessories

5.7.3.1 Vertical, longitudinal and lateral dynamic loads shall be taken into account for the lifting lugs/accessories used to launch and recover the underwater mining vehicle and its associated systems.

5.7.3.2 Where appropriate, other applicable loads such as the ingress of water and slurry, increased mass and loads caused by drag shall also be taken into account.

5.7.4 Navigation system and equipment

5.7.4.1 The underwater mining vehicle and its associated systems shall be equipped with at least the following navigation equipment/systems:

(1) Navigation camera;

(2) Lighting equipment;

(3) Diving depth measuring device;

(4) Emergency locating device.

5.7.5 Emergency locating device

5.7.5.1 The underwater mining vehicle shall be equipped with one set of surface locating device (such as strobe light) and one set of underwater locating device (such as sound wave generator, sonar reflector or buoy).

5.7.5.2 The acoustic underwater locating device shall be compatible with the navigation/positioning system on the surface support unit.

5.7.6 Communication system

5.7.6.1 The underwater mining vehicle shall be equipped with appropriate communication devices to enable data transmission between it and the sensors/equipment on the surface support unit and the mining control station.

5.7.7 Machinery installations and piping systems

5.7.7.1 The piping systems and machinery installations used exclusively for underwater mining operations and submerged in water during normal operation shall comply with the relevant provisions in Chapter 9 of the CCS *Rules for Classification of Diving Systems and Submersibles*. The piping system shall have mechanical protection to prevent its damage.

5.7.8 Electrical system and equipment

5.7.8.1 The electrical installations used exclusively for underwater mining operations and submerged in water during normal operation shall comply with the applicable requirements of Chapter 10 of the CCS *Rules for Classification of Diving Systems and Submersibles* (2018). The electrical system shall have mechanical protection to prevent its damage. When the electrical system operates at AC or DC voltages above 1000V, additional measures shall be taken to ensure personnel safety. These measures include the following:

(1) Provide a higher level of enclosure protection;

(2) Reduce the possible ground fault current;

(3) Set up one set of fixed barriers to keep personnel and equipment at a safe distance;

(4) Provide double insulation, including two layers of insulation with a conductive screen between them;

(5) Provide protective clothing.

5.7.8.2 Flexible cables used to transmit power and signals shall be manufactured using a

waterproof process. Cables shall be protected from mechanical damage. Tensile loads shall not be applied to cables or wires.

5.7.9 Tether/cable management system

5.7.9.1 The tether/cable management system (TMS), if used, shall meet the following requirements:

(1) The TMS shall be equipped with appropriate devices to accommodate and protect the underwater mining vehicle during launch and recovery operations;

(2) The TMS frame shall be able to accommodate additional components or equipment;

(3) The TMS frame shall comply with the applicable requirements specified in 5.7.2;

(4) The TMS shall be equipped with a tether winding mechanism that can be fixed to the TMS frame. A device shall also be equipped to monitor the length of the tether/cable released by the winding mechanism.

Section 8 Underwater Hoisting System

5.8.1 General requirements

5.8.1.1 The underwater hoisting system is used to transport ore from the sea floor to the surface support unit. It supports multiple lifting methods such as hydraulic lifting, gas lifting, magnetic induction lifting, shuttle lifting and continuous conveyor lifting. Most of the current underwater hoisting systems are underwater ore-lifting systems that use hydraulic lifting.

5.8.1.2 The underwater ore-lifting system may consist of the mining riser, riser porch device, underwater ore-lifting pump, underwater relay station, flexible jumper pipe or underwater conveying hose, connector, etc.

5.8.1.3 In the design of the underwater hoisting system, a risk assessment should be carried out in accordance with the requirements in 5.2.6, Chapter 2 of the Guidelines, and the assessment report shall be submitted to CCS for review.

5.8.2 Mining riser

5.8.2.1 The mining riser may be rigid or flexible pipe, depending on the specific application. The connection methods of rigid risers may include but are not limited to threaded connections, flange connections, and connections using quick-plug connectors.

5.8.2.2 The materials, welding and NDE of rigid mining risers shall comply with the relevant provisions on drilling risers in the CCS *Guidelines for Survey of Offshore Drilling Plants*.

5.8.2.3 The materials selected for flexible mining risers shall be suitable for the intended application conditions and meet the relevant requirements in API RP 17B.

5.8.2.4 The design criteria and analysis methods of mining risers shall comply with the relevant provisions in the CCS *Guidelines for Survey of Marine Riser Systems*.

5.8.2.5 The mining riser shall be designed to meet the fatigue requirements within the design life and the strength requirements in the most dangerous conditions according to the planned operation

mode (such as whether it will be released in severe sea state, intended mining site and cycle). If the riser is intended for use in multiple marine mining sites throughout its design life, its cumulative fatigue damage shall meet the design requirements.

5.8.2.6 The effects of erosion and corrosion shall be taken into account in the design of the mining riser. Any new erosion analysis method other than recognized applicable technical standards shall require prior approval from CCS and must be fully demonstrated or experimentally verified prior to its use.

5.8.3 Riser porch device

5.8.3.1 The riser porch device shall provide sufficient top tension for the mining risers and jumper pipes and meet the relevant requirements for strength and fatigue.

5.8.3.2 The tensioner system that can provide relatively constant tension, if used, shall comply with the requirements in 3.6.2, Section 6, Chapter 3 of the CCS *Guidelines for Survey of Offshore Drilling Plants* and the requirements applicable to the tensioner system in the CCS *Guidelines for Drilling Compensation Systems*.

5.8.4 Underwater ore-lifting pump

5.8.4.1 One or more underwater ore-lifting pumps connected to the mining riser can be installed in the underwater ore-lifting system. The underwater ore-lifting pump can be a centrifugal pump, a mixed-flow pump or a diaphragm pump.

5.8.4.2 The type and basic parameters of the centrifugal underwater ore-lifting pump shall comply with the relevant provisions in the accepted standards of the Guidelines and meet the special application conditions of deep-sea mining.

5.8.4.3 The first underwater ore-lifting pump of each model shall undergo clean water and slurry conveying performance tests to ensure that its performance indicators meet the actual needs of deep-sea mining.

5.8.5 Underwater relay station

5.8.5.1 If an underwater relay station is provided in the underwater ore-lifting system, the relay station body and its connection with the mining riser shall have sufficient strength, the structural frame shall comply with the requirements in 5.7.2 of the Guidelines, and appropriate anti-collision protection devices shall be provided.

5.8.6 Flexible jumper pipe and underwater conveying hose

5.8.6.1 The flexible jumper pipe and underwater conveying hose can be used to convey slurry from the subsea mining system to the bottom of the underwater ore-lifting pump, mining riser or underwater relay station.

5.8.6.2 The flexible jumper pipe, if used, shall comply with the relevant provisions in API RP 17B *Recommended Practice for Flexible Pipes* and meet the application conditions required for deep-sea mining.

5.8.6.3 The underwater conveying hose, if used, shall comply with the relevant provisions in OCIMF *Guide to Manufacturing and Purchasing Hoses for Offshore Moorings* or in accepted

standards and meet the application conditions required for deep-sea mining.

5.8.6.4 The ends of flexible jumper pipes or underwater conveying hoses should be provided with swivel joints suitable for mining purposes.

Section 9 Tailwater Treatment and Discharge System

5.9.1 General requirements

5.9.1.1 The tailwater treatment system shall be capable of treating mining tailwater to meet the standards established by the International Seabed Authority (ISA) or governments of coastal states before discharge.

5.9.1.2 The tailwater treatment system shall be equipped with a device that can continuously monitor the discharge tailwater flow, tailings particle size and concentration.

5.9.1.3 Tailwater discharge outlets shall be so located and arranged as to comply with the regulations established by the International Seabed Authority (ISA) or governments of coastal states and to minimize adverse impacts on the marine environment caused by plumes generated during tailwater discharge.

5.9.1.4 The underwater tailwater discharge pipe can be designed either as a riser bundle or be independently arranged.

5.9.1.5 If independently arranged, its design criteria and analysis methods shall meet the relevant requirements for mining risers.

5.9.1.6 If designed as a riser bundle, the adverse effects of the bundle cross section on fluid loads and load effects shall be considered in the design analysis.

Section 10 Control and Monitoring System

5.10.1 General requirements

5.10.1.1 The design, installation and testing of the control and monitoring system shall comply with the provisions in the Guidelines and the relevant requirements in Part 6 of the CCS *Rules for Classification of Mobile Offshore Units*.

5.10.1.2 The control and monitoring system shall be capable of controlling and operating the whole mining system, and reliable communication equipment shall be provided between it and other important places on the surface support unit (such as navigation bridge/central control room, DP operation station and fire control station) to ensure coordination between the mining system and the surface support unit for operation safety.

5.10.2 System design

5.10.2.1 A centralized control station shall be provided on the surface support unit to control and monitor the mining system and equipment.

5.10.2.2 The centralized control station shall be arranged relatively independently, and its internal space and environment shall be suitable for long-term work of personnel and effectively insulated from external noise and unfavorable external environment. No liquid or thermal pipelines shall be

arranged in the upper part of the room. The centralized control station shall have two doors that are as far away from each other as possible.

5.10.2.3 The underwater monitoring system shall be sufficiently reliable. In addition to real-time monitoring of the position, operating state, riser tension and other parameters of underwater mining equipment (such as underwater relay station, lower end of mining riser, underwater mining vehicle) through sensors, it shall also be equipped with real-time camera devices and sufficient and reliable underwater lighting devices so that mining operators can know the status and safety range of underwater mining equipment accurately, comprehensively and in a real-time manner.

5.10.3 Safety functions

5.10.3.1 The centralized control station of the mining system shall support emergency shutdown of underwater mining equipment (such as underwater ore-lifting pump and underwater mining vehicle). Additionally, the emergency shutdown communication line shall be independent.

5.10.3.2 The centralized control station of the mining system shall support emergency release of the mining riser.

5.10.4 System communication

5.10.4.1 Information such as the location of the underwater mining vehicle, its relative position to the mining riser, and the setting of the safe operating range shall be displayed in a real-time manner at the navigation bridge/DP control station so that drivers and DP operators can know such information at any time.

5.10.4.2 The emergency operation information of the centralized control station of the mining system shall be displayed in a real-time manner at the navigation bridge/DP control station.

5.10.4.3 Emergency operation and safety alarm signals on the surface support unit shall be displayed at the centralized control station of the mining system.

5.10.4.4 The centralized control station, navigation bridge and DP control station of the mining system shall be equipped with reliable two-way voice communication equipment.

5.10.5 Umbilical cable

5.10.5.1 The umbilical cable shall be attached to the underwater mining vehicle and other underwater equipment via strength members or strain relief fittings, so that the individual electrical connectors are not subjected to tensile loads. The length of the umbilical cable shall be adapted to the design depth of the underwater equipment and shall include additional allowance for its future re-termination.

5.10.5.2 When the umbilical cable is utilized as a secondary recovery device, it shall be so arranged that the weight of the underwater equipment served is borne by the load-carrying components in the umbilical cable, and these load-carrying components shall comply with the applicable requirements of Chapter 14 of the CCS *Rules for Classification of Diving Systems and Submersibles*.

5.10.5.3 The burst pressure of the umbilical cable shall not be less than 4 times the system working pressure, and its rated pressure shall not be less than the maximum system working

pressure, and shall not be less than the equivalent pressure of the design water depth of the deep-sea mining unit plus an additional pressure of 28kg/cm^2. In addition, the umbilical cable connector shall have sufficient corrosion resistance and sealing performance to resist accidental disconnection, and their rated pressure shall not be lower than the rated pressure of the umbilical cable hose. The umbilical cable hose and accessories shall be pressure tested in the presence of the surveyor at a test pressure of 1.5 times the system design pressure.

Section 11 Power Transmission and Distribution System

5.11.1 General requirements

5.11.1.1 The design, construction, installation and test of electrical installations for the mining system shall comply with the provisions in this Chapter and the applicable provisions in Part 5 of the CCS *Rules for Classification of Mobile Offshore Units*.

5.11.1.2 All electrical equipment and power supply layout shall be suitable for safe and reliable operation under the environmental conditions encountered both offshore and subsea.

5.11.1.3 All relevant electrical equipment shall meet the requirements for marine and underwater operating conditions, including but not limited to tilt, oscillation, temperature, humidity, and salinity.

5.11.2 System design

5.11.2.1 For electrical equipment exposed to water, measures shall be taken to minimize fault current under various circumstances.

5.11.2.2 The circuit shall be equipped with a protection device that can disconnect all electrodes for overload and short-circuit protection.

5.11.2.3 All power distribution systems shall be insulated and designed to function independently. The failure of any line in the system shall not affect the reliable operation of other lines or result in long-time failure of other equipment.

5.11.2.4 The emergency operating system in the centralized control station of the mining system shall be powered by the emergency power supply system.

5.11.2.5 The centralized control station of the mining system shall be powered by an independent uninterruptible power supply (UPS).

5.11.3 Underwater cable

5.11.3.1 The underwater cable and other cables shall generally require approval by CCS and shall be proved that they can be used safely under specified operating conditions. For special types of cables, their fitness-for-purpose under the intended operating conditions shall be demonstrated, and approval from CCS is required.

5.11.3.2 The underwater cable shall be flexible, non-hygroscopic and shall have adequate tensile strength. In general, measures shall be taken to prevent the cable from being subjected to tensile loads.

5.11.3.3 The underwater cable shall be so laid as to protect it from damage or impact by

propellers.

5.11.3.4 The power supply and communication cable connections of underwater equipment shall be watertight and insulated. The watertightness and insulation performance shall be tested by withstanding a pressure at least 1.2 times that at the operating water depth.

5.11.3.5 If a hydraulic oil junction box is used for the power supply and communication cable connections of underwater equipment, a hydraulic compensation device shall be equipped.

Chapter 6 Positioning System

Section 1 General Provisions

6.1.1 General requirements

6.1.1.1 This Chapter applies to the position mooring system and dynamic positioning system of a deep-sea mining unit.

Section 2 Position Mooring System

6.2.1 General requirements

6.2.1.1 Position mooring systems will be considered for classification on the basis of operating restrictions and procedures specified by the owner/designer. Such operating restrictions and procedures as conditions for classification are to be recorded in the operation manual.

6.2.1.2 In addition to the requirements of this Chapter, the position mooring systems are also to be in compliance with the other applicable provisions of the Rules and the relevant provisions of the Administration.

6.2.2 Environmental loads and unit's motions

6.2.2.1 This Section covers only the environmental loads necessary for analysis of the mooring system and the motions of the moored unit due to wind, wave and current.

6.2.2.2 The normal operating and survival environmental conditions of mooring system are to be specified by the owner/designer and in general. The return period of environmental conditions shall comply with the provisions in Section 2, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

6.2.2.3 The environmental loads and the unit's motions for deep-sea mining units shall be calculated in accordance with the provisions in Section 2, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

6.2.3 Mooring analysis and design criteria

6.2.3.1 The position mooring system should be designed so that the sudden failure of any mooring equipment will not cause the subsequent failure of other mooring equipment.

6.2.3.2 The design conditions, mooring analysis and design criteria of deep-sea mining units shall comply with the provisions in Section 3, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

6.2.4 Mooring equipment

6.2.4.1 The mooring equipment of deep-sea mining units shall comply with the provisions in Section 4, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

6.2.4.2 The windlass shall comply with the provisions in Section 5, Chapter 8, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

Section 3 Dynamic Positioning System

6.3.1 General requirements

6.3.1.1 The design, layout and other technical requirements of the dynamic positioning system shall comply with the applicable provisions in Part 5 of the CCS *Rules for Classification of Mobile Offshore Units* and Chapter 11, Part 8 of the CCS *Rules for Classification of Sea-Going Steel Ships*.

6.3.1.2 The relevant tests of the dynamic positioning system shall comply with the requirements in 6.2.6, Chapter 6, Part 1 of the CCS *Rules for Classification of Sea-Going Steel Ships* and the supplementary requirements in 9.1.4, Chapter 9, Part 8 of the CCS *Rules for Classification of Mobile Offshore Units*.

6.3.1.3 The closed busbar dynamic positioning system shall, in addition to meeting the requirements in 6.3.1.1 and 6.3.1.2, also comply with the requirements in the CCS *Guidelines for Survey of Closed-loop Dynamic Positioning Systems*.

Chapter 7 Machinery System

Section 1 General Provisions

7.1.1 General requirements

7.1.1.1 The machinery system of a ship-type deep-sea mining unit shall comply with the provisions applicable to surface-type units in Part 4 of the CCS *Rules for Classification of Mobile Offshore Units*.

7.1.1.2 The machinery system of a column stabilized deep-sea mining unit shall comply with the provisions applicable to column stabilized (semisubmersible) units in Part 4 of the CCS *Rules for Classification of Mobile Offshore Units*.

Chapter 8 Electrical Installations

Section 1 General Provisions

8.1.1 General requirements

8.1.1.1 The electrical installations of deep-sea mining units shall comply with the requirements applicable to electrical installations in Parts 1 and 5 of the CCS *Rules for Classification of Mobile Offshore Units*. With regard to underwater power supply systems, the relevant requirements of Section 11, Chapter 5 of the Guidelines shall additionally be satisfied.

Chapter 9 Fire Protection

Section 1 General Provisions

9.1.1 General requirements

9.1.1.1 The fire protection of a deep-sea mining unit shall comply with the requirements applicable to mobile offshore engineering units in Part 7 of the CCS *Rules for Classification of Mobile Offshore Units*.

Chapter 10 Anti-pollution Equipment and Layout

Section 1 General Provisions

10.1.1 General requirements

10.1.1.1 The anti-pollution equipment and layout shall comply with the IMO *International Convention for the Prevention of Pollution from Ships* and the relevant regulations of the Administration of the flag State.

Section 2 Layout of Ballast Water Management System for Column Stabilized Deep-sea Mining Unit

10.2.1 General requirements

10.2.1.1 If column stabilized deep-sea mining units need to discharge large volumes of ballast water in their operating sea area for operational purposes, the ballast water discharged in situ may be exempt from treatment under the IMO *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004*, provided that it does not mix with ballast water or sediment from other areas. In this case, the ballast tank used only for operations in this sea area can be used as a service tank and shall no longer be used for any ballasting operations. This provision shall be documented in the Ballast Water Management Plan. Other ballast tanks are used for ballast water transfer, treatment and ballasting operations.

10.2.1.2 Considering the installation and operation economy of the ballast water management system, column stabilized deep-sea mining units can be equipped with a ballast water management system with a smaller capacity and supporting ballast pumps. The ballast water can be treated by using circulation treatment or tank replacement treatment method during sailing time.

Section 3 Discharge of Cargo Residues

10.3.1 General requirements

10.3.1.1 Cargo residues include additives (if any) and their possible products, and their discharge shall comply with the requirements of Regulations 4.1.3 and 6.1.2 of MARPOL Annex V and Section 5.2.1.5 of Part II-A of the Polar Code.

10.3.1.2 If the cargo material contained in the bilge water of the cargo hold is harmless to the marine environment and the bilge water is discharged from the cargo hold through the fixed bilge water piping system of the ship, the cargo material shall not be treated as cargo residues and can be discharged directly.

10.3.1.3 Cargo residues harmful to the marine environment may need to be collected and stored in deep-sea mining units until they are discharged to port receiving units for treatment. In all cases, the storage of such cargo residues shall not endanger health and safety.