

Guide for

Subsea Mining



October 2020



GUIDE FOR

**SUBSEA MINING
OCTOBER 2020**

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Foreword

This Guide provides class requirements for the design, construction, installation and survey of mobile offshore mining units to obtain the classification notation **Subsea Mining**, and addresses three major elements: the hull structure, the anchoring and equipment, and onboard machinery, equipment and systems.

The requirements for subsea mining equipment and systems placed onboard mobile offshore mining units, including launch and recovery systems, dewatering and subsea mining cargo handling systems, and subsea control and monitoring systems are also provided in this Guide to obtain the optional notation **SM1**.

Compliance with the requirements of **SM1** notation and the additional requirements for subsea mining equipment and systems submerged in water including subsea mining tools, subsea temporary storage devices, and subsea mining riser and lift systems provided in this Guide will obtain the optional notation **SM2**.

This Guide is to be used in conjunction with the *ABS Rules for Building and Classing Mobile Offshore Units (MOU Rules)*, the *ABS Guide for Building and Classing Drillships (Drillships Guide)*, the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*, as well as applicable Statutory Regulations.

This Guide becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.



GUIDE FOR
SUBSEA MINING

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1 Application

This Guide applies to mobile offshore mining units primarily intended for subsea mining operations with the associated subsea mining systems and equipment defined in 1/7.8. The associated operating activities of mobile offshore mining units may include:

- Deployment of subsea mining tools (SMTs) using launch and recovery systems
- Collection of nodules, disaggregating of polymetallic crust and seafloor massive sulfides deposits using subsea mining tools
- Transport of nodules or slurry from the seafloor to the mobile offshore mining unit using the subsea mining riser and lift systems
- Extraction of ore from slurry using on board dewatering and cargo handling systems
- Return of mine tailings back to the depth required by International Seabed Authority (ISA) or coastal states using the subsea mining downcomer and pumping systems
- Ship to ship transfer of ore from the mobile offshore mining unit to support vessels or barges while on station

This Guide covers both ship-type mining units and column-stabilized mining units. Other types will be considered by ABS on a case by case basis.

2 Classification

The requirements for conditions of classification are contained in the separate, generic *ABS Rules for Conditions of Classification – Offshore Units and Structures (Part 1)*.

Additional requirements specific to mobile offshore mining units are contained in the following Sections.

2.1 Scope

The classification of a mobile offshore mining unit addresses three major elements which are subject to the requirements of this Guide:

- i)* Hull structure
- ii)* Anchoring and equipment
- iii)* Onboard machinery, equipment and systems that are not part of the subsea mining systems and equipment

Classification of the following subsea mining systems and equipment may be offered if requested by the Owner:

- i) Launch and recovery systems
- ii) Dewatering and subsea mining cargo handling systems
- iii) Subsea mining control and monitoring systems
- iv) Subsea mining tools and associated systems
- v) Subsea mining riser and lift systems
- vi) Subsea temporary storage devices

2.2 Classification Symbols and Notations

The following class notations apply to the mobile offshore mining units, as defined in 1/7.8.

The Maltese Cross, ☒, symbol is assigned to units for which the hull construction and/or the manufacture of its machinery and components and any associated required testing, as applicable, is carried out under ABS survey. For units constructed under survey of another recognized Classification Society or Authority, the Maltese Cross, ☒, symbol will be omitted from the hull and/or machinery classification notations.

2.2.1 Mining Units Built under ABS Survey

Mining units which have been built and constructed to the satisfaction of ABS Surveyors and to the requirements Sections 1 to 4 and Section 7 of this Guide or to their equivalent, where approved by the Committee, are to be classed and distinguished in the *ABS Record* by the symbol ☒A1 followed by the notation for the intended service and hull type given below:

☒A1 Subsea Mining (hull type)

The service notation will be appended by one of the following **(Ship-Type)** or **(Column-Stabilized)** to indicate the hull type. The hull structural configurations of these units are described in 1/7.

Examples of notations for mining units are:

☒A1 Subsea Mining (Ship-Type)

☒A1 Subsea Mining (Column-Stabilized)

2.2.2 Mining Units Not Built under ABS Survey

Mining units not been built under ABS survey but submitted for classification will be subjected to a special classification survey. Where found satisfactory and thereafter approved by the Committee, they will be classed and distinguished in the *Record* by the symbols and notations as described in 1/2.2.1 and the following Sections, but omitting the symbol ☒ signifying survey during construction.

2.2.3 Other Types of Mining Units

Units designed as mobile offshore mining units which do not fall into the above categories will be treated on an individual basis and assigned an appropriate classification designation.

2.2.4 Anchoring (Temporary Mooring) Equipment for Self-Propelled Mining Units, Ⓔ

The requirements of temporary mooring equipment for anchoring are to be in accordance with 3-4-1 of the *ABS Rules for Building and Classing Mobile Offshore Units (MOU Rules)*.

2.2.5 Propulsion Machinery

Propulsion machinery and boilers required for propulsion and which have been constructed and installed to the satisfaction of the Surveyor to the full requirements of the *MOU Rules* or their equivalent, and found satisfactory after a trial and approved by the Committee, will be classed and distinguished in the *Record* by the notation **⊠AMS**. This notation is mandatory for classification of self-propelled mining units built under ABS survey, classed and distinguished in the *Record* by the notation **⊠A1**. See also 3-1-1/1.5 of the *MOU Rules*.

Machinery and systems for non-self-propelled mining units are to comply with the applicable requirements of Part 4 of the *MOU Rules* or their equivalent. Propulsion machinery and systems used for short field moves of non-self-propelled units and complying with the requirements of the *MOU Rules* as applied to self-propelled units, manufactured and installed under ABS survey and found satisfactory after trials, will be distinguished in the *Record* by the notation **⊠AMS-NP**, as appropriate. See also 3-1-1/1.7 of the *MOU Rules*.

2.3 Optional Class Notations

Upon the Owner's request, units which comply with the ABS Rules and Guides listed below may be assigned the optional class notations described below. The Maltese Cross, **⊠**, symbol is assigned to units for which the hull construction and/or the manufacture of its machinery and components and any associated required testing, as applicable, is carried out under ABS survey. For units constructed under survey of another recognized Classification Society or Authority, the Maltese Cross, **⊠**, symbol will be omitted from the hull and/or machinery classification notations.

A listing of Classification Symbols and Notations available to the Owners may be viewed and downloaded from the ABS website: <http://www.eagle.org>. This Section introduces notations that may be common for mobile offshore mining units. Additional and/or optional classification symbols and notations are described in the Rules and Guides governing mobile offshore units.

2.3.1 Subsea Mining Systems and Equipment, **⊠SM1** or **⊠SM2**

The Subsea Mining Systems and Equipment notation **⊠SM1** will be added in the *Record* for offshore mobile mining units whose subsea mining systems and equipment comply with the requirements found in Sections 5 and 7 of this Guide, manufactured and installed under ABS survey and found satisfactory after testing.

Compliance with the requirements of the **⊠SM1** notation and the requirements found in Sections 6 and 7 of this Guide for the additional subsea mining systems and equipment, manufactured and installed under ABS survey and found satisfactory after tests, will result in the notation **⊠SM2** being added in the *Record* for mobile offshore mining units.

2.3.2 Environmental Protection, **ENVIRO-OS**, **ENVIRO-OS+**

ENVIRO-OS – This notation is assigned to an offshore unit, floating installation, or liftboat complying with the applicable requirements of Annexes I, IV, V, and VI to the International Convention for the Prevention of Pollution from Ships, MARPOL 73/78, as amended and associated ABS requirements which influence environmental protection.

ENVIRO-OS+ – This notation will be assigned to an offshore unit, floating installation, or liftboat complying with applicable requirements of the **ENVIRO-OS** notation and Annexes I, IV, V, and VI to the International Convention for the Prevention of Pollution from Ships, MARPOL 73/78, as amended and the criteria for environmental protection related to design characteristics, management and support systems, sea discharges, and air discharges specified in the *ABS Guide for the Environmental Protection Notation for Offshore Units, Floating Installations, and Liftboats*.

2.3.3 Position Mooring Equipment and Systems, **M** or **P**

When requested by the Owner, position mooring with anchors, cables and mooring winches when used to maintain the vessel's position during subsea mining operations, are to be in accordance with the requirements for the class notation **M** or **P** (see Section 3-4-1 of the *MOU Rules*). Safety precautions are to be considered to prevent damaging seabed equipment and installations by anchor deployment, recovery and station keeping.

2.3.4 Thrusters, **PAS** or **APS**

Thruster machinery for propulsion assist or athwartship thrust complying with the applicable requirements of Section 4-3-5 of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*, manufactured and installed under ABS survey and found satisfactory after trials, will be distinguished in the *Record* by the notation **PAS** or **APS**, as appropriate.

2.3.5 Crane Register Certificate, **CRC**

The Crane Register Certificate notation **CRC** signifies that an ABS Register of Lifting Appliances is issued under the provisions of the *ABS Guide for Certification of Lifting Appliances (Lifting Appliance Guide)*.

2.3.6 Dynamic Positioning System, **DPS-0**, **DPS-1**, **DPS-2**, **DPS-3**

When requested by the Owner, dynamic positioning systems, when used to maintain the vessel's position during subsea mining operations, are to be in accordance with the requirements of the *ABS Guide for Dynamic Positioning Systems (DPS Guide)*, manufactured and installed under ABS survey and found satisfactory after trials, to be distinguished in the *Record* by the notation **DPS-0**, **DPS-1**, **DPS-2** or **DPS-3**, as appropriate.

2.3.7 Underwater Noise Notation, **UWN**

The Underwater Noise notation (**UWN**) indicates that the vessel complies with underwater noise criteria. Two different **UWN** notations **UWN(T)** and **UWN(Q)**, are available. The notation **UWN (T)** and/or **UWN (Q)** can be assigned provided the vessel can meet the underwater noise criteria under Transit conditions for normal operation and/or Quiet Operation conditions for low speed operation in environmentally sensitive areas. If the vessel can meet more stringent underwater noise criteria, the **UWN+ (T)** and/or **UWN+ (Q)** notations can be assigned. Requisite criteria are specified in the *ABS Guide for the Classification Notation Underwater Noise*.

2.4 Strengthening for Navigation in Ice

Where it is intended to strengthen the unit for navigating independently in ice-covered Polar waters, and the Owner desires a notation in the *Record*, the unit is to comply with the requirements in 3-2-A1 of the *MOU Rules*. It is the responsibility of the Owner to determine which ice class is most suitable for its intended service.

2.5 Vessel Using Gases or Other Low-Flashpoint Fuels

Where a vessel is arranged to burn natural gas as fuel or a low flashpoint fuel other than natural gas for propulsion or auxiliary purposes, the vessel is to comply with the requirements in Part 5C, Chapter 13 of the *Marine Vessel Rules*.

2.6 Administration Requirements

Requirements additional to those given in each Section of this Guide may be imposed by the National Administration with whom the unit is registered or by the Administration within whose territorial jurisdiction the unit is intended to operate.

Approval of structural fire protection, fire extinguishing systems, and/or stability of the unit by a National Administration may be considered as complying with the class requirements provided such approval can be satisfactorily documented.

3 Risk Evaluations for Alternative Arrangements and Novel Features

Risk assessment techniques may be used to demonstrate that alternatives and novel features provide acceptable levels of safety in line with current offshore and marine industry practice. The *ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities* provides guidance on how to prepare a risk evaluation to demonstrate equivalency or acceptability for a proposed design.

Risk evaluations for the justification of alternative arrangements or novel features may be applicable either to the unit as a whole, or to individual systems, subsystems or components. ABS will consider the application of risk evaluations for alternative arrangements and novel features for subsea mining systems. Portions of the subsea mining system or any of its components thereof not explicitly included in the risk evaluation submitted to ABS are to comply with any applicable parts of the ABS Rules and Guides. If any proposed alternative arrangement or novel feature affects any applicable requirements of Flag and Coastal State, it is the responsibility of the Owner to discuss with the applicable authorities the acceptance of alternatives based on risk evaluations.

For new or novel concepts, (i.e., applications or processes that have no previous experience in the environment being proposed), the guidance encompassed in the class Rules may not be directly applicable to them. The *ABS Guidance Notes on Review and Approval of Novel Concepts* offers ABS clients a methodology for requesting classification of a novel concept. The process described in this guidance document draws upon engineering, testing and risk assessments in order to determine if the concept provides acceptable levels of safety in line with current industry practices.

4 Hazard Identification (HAZID) for Mobile Offshore Mining Units

All hazards that may affect the mobile offshore mining units due to subsea mining operations are to be identified with implementation of effective risk control options. A systematic process is to be applied to identify situations where a combination or sequence of events could lead to undesirable consequences (property damage, personnel safety and environmental damage), with consideration given to all reasonably foreseeable causes. ABS' participation in this HAZID study is required.

The identified risk control options (prevention and mitigation measures) deemed necessary to be implemented are to be considered part of the design basis of the mobile offshore mining unit.

2/2.4 of the *ABS Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries* provides the guidance of hazard identification technics.

5 Submission of Plans and Design data

Hull and machinery plans, as required below, are to be submitted to ABS for review and approval. Plans from designers and shipbuilders should generally be submitted electronically. However, hard copies will also be accepted. All plan submissions originating from manufacturers are understood to be made with the cognizance of the shipbuilder.

Hazard Identification (HAZID) report in accordance with Subsection 1/4 is to be submitted for review.

5.1 Hull and Design Data

Plans showing the scantlings, arrangements and details of the principal parts of the structure of each unit to be built under survey and supporting analyses and calculations, as described in Section 3-1-2 and 5-1-1/1.9 of the *MOU Rules*, and Section 1-1-7 of the *Marine Vessel Rules* are to be submitted for review and approved before the work of construction is commenced.

5.2 Machinery Plans

Plans are to be submitted showing the arrangements and details of all propulsion and auxiliary machinery, steering gear, boilers and pressure vessels, electrical systems, bilge and ballast systems, fire extinguishing

systems, and other pumps and piping systems as described in 4-1-1/5, 4-1-2/7, 4-2-1/7, 4-3-1/5 and 5-2-1/3 of the *MOU Rules*.

For **SM1** or **SM2** notation, all industrial systems used for subsea mining are to comply with a recognized code/standard and certified per Section 5/Table 1 and Section 6/Table 1.

When the optional **SM1** or **SM2** notation is not requested, industrial systems used for subsea mining are not required to comply with the ABS *Subsea Mining Guide* Section 5/Table 1 and Section 6/Table 1. However, manufacturer's certificates of all equipment and systems used for subsea mining operations are to be submitted to ABS Technical office for record and file.

5.3 Calculations

Design support calculations are to be submitted as described in 3-1-2/3 of the *MOU Rules*, Part 3 and Part 5 of the *Marine Vessel Rules* as applicable.

5.4 Additional Plans

Where optional class notations or certification under the other Rules, Guides or regulations, as described in Section 1-1-5 of the ABS *Rules for Conditions of Classification – Offshore Units and Structures*, are requested, submission of additional plans and calculations may be required. The submitted design plans and data are to be in accordance with the requirements of this Guide and the latest edition of the specified codes and/or standards subject to the unit's contract date with ABS.

Where the optional **SM1** or **SM2** notation is requested, submission of plans and calculations given in 1/5.4.1 and 1/5.4.2 for the certification of the subsea mining systems and equipment will be required.

5.4.1 Additional Plans for SM1 Notation

The drawings and plans listed below are to be submitted and are to include material specifications, welding specifications, dimensions, and strength calculations, as applicable.

5.4.1(a) General

- i) Design basis document that covers the technical and operational specification including the intended service, functionality and the expected operational conditions and limitations
- ii) The documentations for derrick structure given in A7-1/13.1 of the ABS *Guide for the Classification of Drilling Systems (CDS Guide)*
- iii) General Arrangement/assembly drawing for each item of major equipment
- iv) Equipment Layout Drawings including subsea mining control station
- v) Piping and Instrument Diagrams for all systems and subsystems, accompanied by lists of materials giving size, wall thickness, maximum working pressure and material of all pipes/tubes, and the type, size, pressure rating and material of valves and fittings
- vi) A block diagram for each major piece of equipment indicating the electrical components and any interconnecting cables
- vii) Electrical One-line diagrams including one-line diagrams for each skid indicating the power supply arrangements for the motors and any other electrical components
- viii) Equipment List which includes the identification number, description and main technical specifications for all major equipment, such as motors, pressure switches, cable glands, cranes, winches, power units, etc.

5.4.1(b) Dewatering and Subsea Mining Cargo Handling

- i) Cargo Compartment Arrangement
- ii) Description of equipment used in pumping operations.
- iii) Description of equipment used in mineral processing and dewatering operations

- iv) Ancillary arrangements for equipment used in subsea mining operations such as pumping systems, mineral processing equipment, tailings piping, and similar items

5.4.1(c) Launch and Recovery

- i) Location details of launch and recovery system (LARS) for subsea mining equipment including schematics and calculations
- ii) Location details for the stowage of subsea mining tools on the unit

5.4.1(d) Subsea Mining Control and Monitoring Systems

- i) Arrangements:
 - a) The control system configuration, general arrangements for the unit and the layout of the machinery with essential auxiliaries, specifications of main equipment with information of manufacturer's name, type, rating and number of the equipment.
 - b) Arrangements and details of control consoles/panels, including front view, installation arrangements together with schematic plans and logic description for all power, control, and monitoring systems and their functions including, if provided, emergency control stations.
 - c) Arrangement and details of communication systems between the unit and seabed systems including control umbilical specifications.
- ii) Schematics
 - a) Schematic diagrams showing connections between all main components (units, equipment) of the system, human machine interfaces and interfaces with other systems.
 - b) Schematic diagrams showing the connections between the sensing devices, control and display units, alarm devices, human machine interfaces and power supply arrangement, and description of monitoring systems including a list of monitoring points, displays and alarms including preset parameters for the machinery and all essential auxiliary machinery and systems at each control station.
- iii) Safety systems descriptions may include a list of all monitored parameters with settings for implemented protective actions (e.g., automatic shutdown and automatic slowdown), schematic diagrams showing the connections between the safety devices, control and display units, alarm devices, human machine interface and primary and emergency power supply arrangement, as appropriate.
- iv) Details on hierarchy of controls including primary, secondary, emergency, etc., as applicable
- v) Operational descriptions for starting of machinery, control transfer, critical speeds, essential auxiliary machinery automatic starting arrangement if fitted
- vi) Control system operating and maintenance manuals

5.4.2 Additional Plans for SM2 Notation

In addition to the submitted drawings and plans listed in 1/5.4.1, the documentation listed below is to be submitted, as applicable.

5.4.2(a) Subsea Mining Tools

- i) Design basis document that covers the technical and operational specification including the intended service, functionality and the expected operational conditions and limitations
- ii) General Arrangement/assembly drawing of the mining tool and each major/key component of the tool including mechanical components, fail-safe and safety equipment, and other components

- iii)* Details of the manufacturer's standard, historical performance and engineering justification for compliance, if applicable
- iv)* Stress calculations or finite element analysis, as applicable
- v)* List of design, operational and environmental conditions to verify material suitability
- vi)* Piping and instrumentation diagrams including hydraulic, pneumatic and electrical systems used in subsea mining tools

5.4.2(b) Subsea Mining Riser and lift Systems

- i)* Subsea Mining Risers
 - a)* Design basis
 - Mining field description, ore contents and production slurry density, intended field production through put, production method, intended field life, method of operation, abandonment and recovery, and metocean conditions
 - Description of the riser and lift system
 - Descriptions of major components
 - List of applicable codes and standards
 - Design specifications
 - Assembly drawings, system flow diagrams and schematics
 - Design analysis methodology, procedures and load case matrices
 - Installation procedure outline
 - Specification of the internal slurry fluid
 - Corrosion/erosion allowances
 - b)* Field layout drawings including initial installation, in-place production, abandonment and recovery and back to in-place production
 - c)* Bill of material
 - d)* Material specifications, properties and traceability
 - e)* Schedules of nondestructive testing and quality control procedures
 - f)* Drawings of arrangement, stack-up, scope of supply, assembly, major interfaces with unit, mining machines, and lift pumps, and marking
 - g)* Wall thickness sizing report
 - h)* Analysis Reports, including strength, fatigue (floater motion-induced fatigue, VIV, FIV), installation and retrieval analyses
 - i)* Safety principle and philosophy
 - j)* Corrosion/erosion control and protection details
 - k)* Manufacturer's affidavit of compliance (MAC)
 - l)* FAT, SIT procedure and reports
 - m)* Site geotechnical/ geophysical reports
 - n)* As-built Documents
 - o)* Manufacturing, transportation, installation, and components repair/replacement procedures
 - p)* ITP procedure/plan

- q) Operations manual including makeup and break records
 - r) Maintenance manual
 - s) Monitoring system design report, if any
 - t) Flow assurance analysis report or equivalent for the multiphase flow to determine the system design requirement of riser system.
- ii) Lifting systems
- a) Details and specifications of main and/or intermediate subsea lift pumps with evaluation for intended service including design, operational and environmental conditions
 - b) Associated piping and instrumentation diagrams including hydraulic, pneumatic and electrical systems
 - c) NON pump lift systems such as air lift, magnetic induction, continuous conveyor
- 5.4.2(c) *Subsea temporary storage devices and associated transporting hoses*
- i) Subsea temporary storage devices
- a) Design specifications, including design codes, standards, and references
 - b) Design parameters: pressure rating, temperature rating, loads, etc.
 - c) Design analysis and/or calculations
 - d) Dimensional drawings and fabrication details
 - e) Material specifications and material properties
 - f) Details for manufacturing specifications
 - g) Manufacturer's affidavit of compliance, as applicable
- ii) Transporting hoses
- a) Pressure (internal/external) and temperature (min/max) ratings
 - b) Construction materials details/material specifications
 - c) Design analysis
 - d) Prototype testing procedures and data, as required by design code
 - e) End connections and termination details, as applicable:
 - f) Manufacturing specifications
 - g) Manufacturer's affidavit of compliance

6 Operating Manuals

The Operating Manual of the mobile offshore mining unit is to be submitted for review by ABS to verify that operational procedures and conditions are consistent with the design information, criteria and limitations considered in the classification. ABS is not responsible for the operation of mobile offshore mining unit.

A copy of the Operating Manual is preferably to be stored onboard of the mobile offshore mining unit. Alternatively, the Operating Manual may be retained by the Owner and made readily available to the ABS Surveyor and to service personnel prior to conducting any maintenance or inspection.

Insofar as classification is concerned, the operating manual for the mobile offshore mining unit is to include the information in accordance with Section 1-2-5 of the *ABS Rules for Conditions of Classification – Offshore Units and Structures*, as appropriate.

The Operating Manual required by this Subsection does not need to be in addition to that required by the coastal State or other governmental authorities. These administrations may require that additional information be included in the Operating Manual.

7 Definitions

7.1 Subsea Mining Cargo Handling System

A subsea mining cargo handling system may include conveyors, belt conveyors, hoist units, cargo elevators, side shifters, cargo pumping systems and associated hydraulic, pneumatic and electrical systems as necessary for the intended loading, unloading and transfer operations of ore.

7.2 Column-Stabilized Mining Unit

A mining unit with the main deck connected to the underwater hull or footings by caissons. The unit depends upon the buoyancy of columns or caissons for floatation and stability for all afloat modes of operation, or in the raising or lowering of the unit. Lower hulls or footings may be provided at the bottom of the columns for additional buoyancy.

7.3 Dewatering System

A dewatering system may include gravity separation tanks, centrifuges, hydro-cyclones, screens and filters to segregate ore from slurry.

7.4 Flexible Riser

A riser constructed from flexible pipe. It may be freely suspended (free, catenary), restrained to some extent (buoys, chains), totally restrained, or enclosed in a tube (I- or J-tubes).

7.5 International Seabed Area

The seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction.

7.6 Launch and Recovery System

A system supporting launch, recovery and other handling operations of underwater units, hyperbaric facilities and their ancillary equipment and may include cranes, booms, masts, frames, davits, foundations, winches and associated hydraulic, pneumatic and electrical systems as necessary for the intended operations.

7.7 Mine Tailings

Mining tailings are the ore waste of mining and are typically a mud-like material.

7.8 Mobile Offshore Mining Unit

A mobile offshore structure including ship-type mining unit and column-stabilized mining unit designed for operation afloat capable of engaging in mining operation for the exploration or for exploitation of resources on the seabed, and/or ore storage, and offloads ore.

7.9 Nodules

Polymetallic nodules are formed of concentric layers of iron and manganese hydroxides around a core and lie on the sea floor or are buried in sediment. The chemical composition of these nodules may include cobalt, iron and manganese oxides, copper, nickel, rare earth elements (REE) and other metals.

7.10 Non-Self-Propelled Unit

A unit that is not a self-propelled unit. Units with machinery used exclusively for positioning, unassisted short field moves as allowed by the Flag Administration and/or Coastal State and to provide assistance during towing operations may be considered non-self-propelled units.

The declaration of the unit as non-self-propelled is to be requested by the Owner, specified in the contract between the Owner and the builder and confirmed by ABS and the Flag Administration.

7.11 Ore

A rock that contains minerals with important elements such as metals that can be extracted from the rock.

7.12 Polymetallic Crusts

Polymetallic crusts, firmly attached to rocky substrate, occur as pavements and coatings on sediment free rocks at the surface of geologically stable seamounts, ridges and plateaus. The chemical composition of polymetallic crusts may include cobalt, iron and manganese oxides, copper, nickel, rare earth elements (REE) and other metals.

7.13 Rigid Riser

A riser that is primarily constructed of metallic materials (such as steel, titanium or aluminum-alloy) in its primary load path.

7.14 Seafloor Massive Sulfides Deposits

Seafloor massive sulfide deposits are formed in the deep ocean around submarine volcanic arcs, where hydrothermal vents exhale sulfide-rich mineralizing fluids into the ocean.

7.15 Subsea Mining Tools

Subsea mining tools are used for disaggregating, collecting or transporting minerals from the seabed to the subsea slurry pump/riser. They may use hydraulics, electrical connections/umbilical's, control systems, survey and visualization systems to perform this function. Subsea mining tools may use a collecting machine and/or cutting tool for subsea excavation and are typically installed on remotely operated vehicles or autonomous underwater vehicles.

7.16 Self-Propelled Unit

A unit designed with means of propulsion capable of propelling the unit during long distance ocean transits without external assistance.

The declaration of the unit as self-propelled is to be requested by the Owner, specified in the contract between the Owner and the builder and confirmed by ABS and the Flag Administration.

7.17 Slurry

A semiliquid mixture made up of seafloor minerals suspended in water. They may be lifted through a subsea mining riser and lift system.

7.18 Ship-Type Mining Unit

A self-propelled unit with displacement hull of single or multiple hull construction designed for mining operation in the floating condition.

7.19 Subsea Mining Riser and lift System

Subsea mining riser and lift systems may consist of a lift system, a riser, a flexible jumper, and return tailings pipes for transporting seafloor mines from the seafloor to a mobile offshore mining unit.

7.20 Subsea Mining Systems and Equipment

Subsea mining systems and equipment encompass subsea mining tools, subsea mining riser and lift system, subsea temporary storage devices, launch and recovery systems, dewatering system and subsea mining cargo handling system, and subsea mining control and monitoring systems.

7.21 Exclusive Economic Zone

An Exclusive Economic Zone (EEZ) is a concept adopted at the Third United Nations Conference on the Law of the Sea (1982), whereby a coastal State assumes jurisdiction over the exploration and exploitation of marine resources in its adjacent section of the continental shelf, taken to be a band extending 200 miles from the shore.

8 Abbreviations and References

8.1 Abbreviations of Organizations

ABS	American Bureau of Shipping
API	American Petroleum Institute
IMO	International Maritime Organization
ISA	International Seabed Authority
MARPOL	International Convention for the Prevention of Pollution

8.2 References

ABS Rules for Building and Classing Mobile Offshore Units (MOU Rules)

ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)

ABS Rules for Materials and Welding (Part 2)

ABS Guide for Buckling and Ultimate Strength Assessment for Offshore Structures

ABS Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities (Underwater Vehicles Rules)

ABS Guide for Building and Classing Drillships (Drillships Guide)

ABS Guide for Building and Classing Subsea Riser Systems (Riser Guide)

ABS Guide for Certification of Lifting Appliances (Lifting Appliance Guide)

ABS Guide for Classification and Certification of Subsea Production Systems, Equipment and Components (Subsea Equipment Guide)

ABS Guide for Dynamic Positioning Systems (DPS Guide)

ABS Guide for “Dynamic Loading Approach” for Floating Production, Storage and Offloading (FPSO) Installations (DLA Guide)

ABS Guide for Fatigue Assessment of Offshore Structures

ABS Guide for Remote Control and Monitoring for Auxiliary Machinery and Systems (other than Propulsion) on Offshore Installations

ABS Guide for Risk Evaluations for the Classification of Marine-Related Facilities

ABS Guide for Spectral-Based Fatigue Analysis for Floating Production, Storage and Offloading (FPSO) Installations (SFA Guide)

ABS Guide for the Environmental Protection Notation for Offshore Units, Floating Installations, and Liftboats

ABS Guide for the Classification of Drilling Systems (CDS Guide)

ABS Guide for the Classification Notation Underwater Noise

ABS Guidance Notes on the Application of Fiber Rope for Offshore Mooring

ABS Guidance Notes on Review and Approval of Novel Concepts

ABS Guidance Notes on Air Gap Analysis for Semi-Submersibles

ABS Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries

API RP 17B, Recommended Practice for Flexible Pipe

API Specification 17E, Specification for Subsea Umbilicals

SECTION 2 Materials and Welding

1 General

Metallic materials and welding are to be in accordance with ABS *Rules for Materials and Welding (Part 2)* together with Section 3-1-4, 3-2-2/1.1, 3-2-4/1.7 and 3-2-5/3 of the *MOU Rules* for mobile offshore mining units.

For ice classed mobile offshore mining units, material and welding are to be in accordance with Part 6 Chapter 1 of the *Marine Vessel Rules*.

Materials for marine systems and equipment serving both the mining unit and subsea mining operations are to be in accordance with ABS *Rules for Materials and Welding (Part 2)*.

Materials of synthetic fiber ropes for application in the mooring system are to be selected and tested in accordance with the ABS *Guidance Notes on the Application of Fiber Rope for Offshore Mooring* or recognized standard.

2 Materials for SM1 or SM2 Notations

Materials for systems and equipment used exclusively for subsea mining operations are to be suitable for their intended service and comply with recognized standards and/or manufacturer's material specifications taking into consideration the operational environment and operation conditions.

For rigid risers receiving the **SM2** notation, material, welding and NDE are to follow the requirements in Chapter 5 and 6 of the *CDS Guide*, as applicable.

For flexible risers classed receiving the **SM2** notation, materials are to be selected with consideration of their fitness for the intended service and in accordance with the recognized industry standards.

1 General

The design and construction of mobile offshore mining units are to be in accordance with the applicable requirements in Part 3 of the *MOU Rules*. The mode of operation specified in 3-1-1/17 of the *MOU Rules* is to be in accordance with 3/1.1, 3/1.2 and 3/1.3.

1.1 Normal Operating Condition

A *Normal Operating Condition* is a condition wherein a unit is on location performing mining, Loading/Offloading or other related functions and combined environmental and operational loading are within the appropriate design limits established for such operations.

1.2 Severe Storm Condition

A *Severe Storm Condition* is a condition wherein a unit may be subjected to the most severe environmental loading for which it is designed. Mining operations are assumed to have been discontinued due to the severity of the environmental loadings.

1.3 Transit Condition

Transit Conditions are all unit movements from one geographical location to another.

2 Structural Design Requirements

2.1 Ship-Type Mining Units

The requirements for hull structures and arrangements in Sections 3-2-1, 3-2-2, 3-2-5, 3-2-6 and 3-2-A3 of the *MOU Rules* and Part 5C Chapter 3 of the *Marine Vessel Rules* are to be complied with, along with the following considerations.

- i)* For vessel length of 150 meters or more, low cycle fatigue due to tank loading and offloading is to be considered in accordance with Section 9 of *ABS Guide for Spectral-Based Fatigue Analysis for Floating Production, Storage and Offloading (FPSO) Installations (SFA Guide)*.
- ii)* Local structure supporting mining derricks is to be considered in accordance with 3-2-5/5.1 of the *MOU Rules*.
- iii)* Loads due to the mining derrick, pipe racks, mud tanks, cable reel and other associated equipment as described in this Guide are to be considered in the strength analysis of local structures.
- iv)* Specific weight of slurry is to be specified by the Owner. When the specific gravity of the liquid contents of a tank is greater than 1.05, the head h specified in 3-2-2/7 of the *MOU Rules* is to be increased by a factor equal to the ratio of the specific gravity to 1.0.

- v) For vessel length of 150 meters or more, initial scantling evaluation (ISE) and total strength assessment (TSA) in way of the bulk cargo holds and fore and aft body are to be carried out in accordance with Section 5C-3-4 and Section 5C-3-5 and Section 5C-3-6 of *Marine Vessel Rules*.
- vi) For vessel length of 150 meters or more, ISE and TSA for structure in way of moonpool and derrick are to be carried out in accordance with Section 4 and Section 5 of the *ABS Guide for Building and Classing Drillships (Drillships Guide)*.
- vii) Site condition may be considered in accordance with Appendix 1 of the *Drillships Guide* where applicable.
- viii) For vessel Length of 300 meters and above, DLA/SFA is to be carried out for compliance with *ABS Guide for "Dynamic Loading Approach" for Floating Production, Storage and Offloading (FPSO) Installations (DLA Guide)* and *SFA Guide* applicable to the vessel type.

2.2 Column-Stabilized Mining Units

The requirements for hull structures and arrangements in Sections 3-2-1, 3-2-2, 3-2-4, 3-2-6, 3-2-A2 and 3-2-A3 of the *MOU Rules* are to be complied with, along with the following considerations in 3/2.2.1 to 3/2.2.3.

2.2.1 Substructures

Substructures supporting the mining derrick, floor and associated equipment are to be analyzed, as required by 3-2-1/1 of the *MOU Rules*. Stresses are not to exceed those permitted by 3-2-1/3 of the *MOU Rules*.

2.2.1(a) Individual Loads. Individual loads to be considered are the operating loads specified by the Owner or designer and should include, but are not limited to the following, as applicable.

- Deck load (steel weight, fixed equipment)
- Floor load (personnel, moveable equipment, material)
- Snow or ice load
- Hook and riser tensioner loads

2.2.1(b) Combined Loads. Environmental loads due to wind, including severe storm wind load, are to be combined with the individual loads indicated to reflect the applicable operational requirements for the range of anticipated conditions. Loads due to unit motions are to be considered for all afloat conditions.

2.2.2 Pipe Racks and Cable Reel Support Structure

Pipe racks and cable reel support structure including the reinforcements for the hull are to be designed to adequately resist the load effects of pipes, risers or reels imposed on the supports in the severe storm, normal operating and transit conditions with the allowable stresses defined in 3-2-1/3 of the *MOU Rules*. Considerations should also be given to the unit in damaged conditions, where the pipe rack and cable reel support structure are to withstand the load effects caused by the trim and heel of the unit with the allowable stresses defined in 3-2-1/3 of the *MOU Rules* in association with a factor of safety of 1.0.

2.2.3 Specific weight of slurry

Specific weight of slurry is to be specified by the Owner. When the specific gravity of the liquid contents of a tank is greater than 1.05, the head h specified in 3-2-2/7 of the *MOU Rules* is to be increased by a factor equal to the ratio of the specific gravity to 1.0.

3 Subdivision and Stability

In addition to complying with the requirements of Part 3 Chapter 3 of the *MOU Rules*, the following requirements apply to mobile offshore mining units.

3.1 Overturning Moment

In calculating overturning moments for mobile offshore mining units, the effect of the crane loads and cargo handling loads acting simultaneously with the maximum design wind force associated to the operation of the crane is to be determined. The full range of crane positions, elevations and weights is to be considered in order to investigate the most critical scenarios. The wind area of the deck cargo is to be considered in the calculation of the overturning moment.

When the crane unit is equipped to counter-ballast while lifting, the unit is to be able to withstand the sudden loss of the hook load in each condition of loading and operation. The free surface effects are to be considered for those tanks which are ballasted and ore slurry compartments. Specific reference may be made to Part 8 Appendix 1 of the *MOU Rules* for column-stabilized units and 3-3-A2/23 of the *Marine Vessel Rules* for ship-type units.

3.2 Pipe Racks and Cable Reels

Loading conditions in the operations manual are to include the effect of the pipe racks and cable reels for each operating condition, using the estimated weight and the height of the center of gravity of the cargo based on the most severe loading assumptions. The loading conditions are to cover the full range of operating configurations.

If the unit is intended to carry deck cargoes that may accumulate water, such as open cargo bins or open pipes, a free surface correction is to be applied to afloat conditions.

4 Fire and Safety

4.1 Marine Installations

The requirements for passive fire protection, outfitting and active fire protection systems and equipment in Part 5 of the *MOU Rules* are to be complied with, as applicable.

4.2 Subsea Mining Installation

Subsea mining installations are to comply with fire safety requirements listed in Part 5 of the *MOU Rules*, as applicable. Portable fire extinguishers are to be provided per Section 5-2-4 of the *MOU Rules*, as applicable.

Fire and gas hazards arising from the storage and transport of subsea mining cargo are to be evaluated based on the specific subsea mining products in accordance with Appendix I of the International Maritime Solid Bulk Cargoes (IMSBC) Code. Appropriate measures in accordance with the IMSBC Code are to be made to mitigate these hazards.

Unit Machinery, Equipment and Systems**1 General Requirements**

Machinery, equipment and systems that support marine operations are to be in accordance with the applicable sections of Part 4 of the *MOU Rules*.

2 Marine Piping Systems

Piping systems that support marine operations are to be in accordance with the applicable requirements of Part 4, Chapter 2 of the *MOU Rules*. If a system is serving marine operations and subsea mining operations (e.g., hydraulic power to unit operations and subsea mining tools), the design criteria of the system is to meet the *MOU Rules*, as applicable. If a portion of the system serves only subsea mining operation and can be isolated from the part serving marine operations, other recognized industrial standards or manufacturer standards may be applied to that part of the system up to, but not including, the isolating valve.

3 Electrical Systems

Electrical equipment and systems are to be in accordance with the applicable requirements of Part 4, Chapter 3 of the *MOU Rules*.

If a system is serving marine operations and subsea mining operations (e.g., power supply to mining unit and subsea mining tools), the design criteria of the system is to meet the *MOU Rules*, as applicable. If a portion of the system serves only subsea mining operation and can be isolated from the part serving marine operations, other recognized industrial standards or manufacturer standards may be applied to that part of the system up to, but not including, the isolating circuit.

Subsea Mining Systems and Equipment for SM1 Class Notation

1 General

Where an optional notation **SM1** is requested, in addition to the equipment and systems specified in Section 4, subsea mining equipment and systems carried or installed onboard the mobile offshore mining unit and exclusively used for subsea mining operations are to be designed, constructed and tested in accordance with the applicable ABS requirements in this section or recognized national, international or industrial codes/standards where not covered by ABS requirements for verification of their suitability for the specified design conditions. Where no recognized national, international or industrial codes/standards exist, the designer is to submit a document outlining the design basis. The design basis is to cover the technical and operational specification including the intended service, functionality and the expected operational conditions and limitations. Such design basis is to be used as the manufacturer's standard and is to be complied with. For **SM1** notation subsea mining systems and equipment, the plan review and survey are to correspond to the Type Approval Tier listed in Section 5/Table 1.

2 Design Considerations

2.1 Alternative Design

- i)* Design of industrial systems, subsystems, equipment or components complying with other international or national standards that are not indicated in this Guide will be subject to special consideration by ABS.
- ii)* When alternate design codes and/or standards are proposed, justifications can be provided by equivalency, gap analysis or appropriate risk analysis/philosophy to demonstrate that the proposed alternate design code and standard will provide an equivalent level of safety in line with current marine and offshore practices.
- iii)* For alternate design, it is recommended the designer/manufacturer contact the appropriate ABS Technical office early in the design phase for guidance on technical requirements, survey requirements and acceptance criteria of alternate design codes and/or standards.

2.2 Design Review Based on Manufacturer's Standard

Designs based on manufacturer's standards may also be accepted as listed in Section 5 and Section 6. In such cases, complete details of the manufacturer's standard and engineering justification are to be submitted to ABS for review.

- i)* The manufacturer will be required to demonstrate by way of testing or analysis that the design criteria employed results in a level of safety in line with current marine and offshore practice and consistent with that of a recognized standard or code of practice.
- ii)* Where strain gauge testing, fracture analysis, proof testing or similar procedures form a part of the manufacturer's design criteria, the procedure and results are to be submitted for ABS review.

- iii) Historical performance data for systems, subsystems, equipment or components is to be submitted for justification of designs based on manufacturer's standards.
- iv) ABS will consider the application of risk evaluations for alternative or novel features for the basis of design in accordance with Section 5 and Section 6.

3 Subsea Mining Systems, Machinery and Equipment

Subsea machinery, prime movers, pressure vessels, air compressors, pumps, equipment, all other piping and electrical systems are to be in accordance with the applicable sections of Part 4 of the *MOU Rules*.

Derricks/Mast used for subsea mining operation on a mobile offshore mining unit are to comply with the requirements of 2-4/7 of the *CDS Guide*, as applicable.

Installation and operation of the subsea mining equipment and system is not to result in unsafe conditions for the mobile offshore mining unit and crew.

Overboard discharges from the subsea mining cargo handling and dewatering is to conform to the governing national/international/regional regulations, as applicable.

4 Launch and Recovery Systems

Launch and recovery systems on a mobile offshore mining unit are to comply with the requirements of Section 19 and Subsection 17/39 of the *ABS Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities (Underwater Vehicles Rules)*, as applicable.

5 Dewatering and Subsea Mining Cargo Handling Systems

5.1 Dewatering Systems

Dewatering systems when used on a mobile offshore mining unit are to comply with the requirements of a recognized national, international or industrial code/standard and certified by ABS. Dewatering systems may include:

- Separation screens and filters
- Gravity sedimentation tanks
- Centrifuges
- Hydro-cyclones
- Onboard slurry pumps may be accepted based on the manufacturer's affidavit of compliance to a recognized industrial standard.

5.2 Subsea Mining Cargo Handling Systems

Subsea mining cargo handling systems when used on a mobile offshore mining unit are to comply with the applicable requirements in Section 5C-3-7 of the *Marine Vessel Rules* and the following requirements.

5.2.1 Cranes, Booms, and Hoists for Subsea Mining Cargo Handling

Cranes, booms, and hoists used for subsea mining cargo handling operations on a mobile offshore mining unit are to comply with the requirements in Chapter 2 of the *Lifting Appliance Guide*, as applicable, and be certified by ABS. Hoists are to additionally comply with 5/5.2.4.

5.2.2 Subsea Mining Cargo Handling Controls

All cargo loading and unloading operations are to be controlled and monitored from a single subsea mining cargo handling control station. Controls are to be provided for the safe operation of the loading/unloading system. These controls are to be clearly marked to show their functions. Energizing the power unit at a location other than the cargo control station is not to set the gear in

motion. Fail safe arrangements are to be provided. A safe emergency control position is to be provided. The system is to be provided with adequate back up arrangements to enable operation in the event of a component failure. Where, due to the design of the system, provisions for a standby system is impracticable, necessary spares are to be carried on board which would enable rectification of a fault and the ability to resume operation.

Where the equipment in the subsea mining cargo handling system needs to be operated manually, means are to be provided to enable this operation during commissioning, fault finding and other similar work. Monitoring is to indicate the system operational status (operating or not operating), availability of power, overload alarm, air pressure, hydraulic pressure, electrical power or current, motor running and motor overload, and brake mechanism engagement as necessary. The maximum safe working load is to be conspicuously posted near the controls and visible to the operator.

5.2.3 Subsea Mining Cargo Handling Emergency Stop Equipment

Emergency stopping equipment is to be provided to stop the subsea mining cargo handling system without creating additional risks of hazard. The means for the emergency stop are to be located at each control position. Starting of the subsea mining cargo handling system is to be possible from the control station after the emergency stopping device has been reset at the location where it was actuated. Remote emergency shutdown of power units is to be provided outside of the space where they are located, such that they may be stopped in the event of fire or other emergency. Means for local emergency shutdown is to also be provided.

5.2.4 Hoist Units

All hoist units are to be equipped with effective brakes or other equivalent devices capable of stopping the movements of the hoist unit with its proof load safely at its rated speed and maintaining it in its stopped position. Brakes are to be applied automatically when the power supply is interrupted. In order that lifting and lowering movements are stopped without undue shocks, upper and lower limit stops are to be used to define the extent of the vertical travel and the following are to be provided:

- Arrangements for initiating a controlled stop towards the upper and lower limits when variable or multi-step drives are used.
- Control devices which prohibit incorrect hoist direction at the hoist travel limits.
- Ultimate limit switches which in an emergency shall disconnect the main current on all poles via a main contactor to the hoist. The actuators of these switches are to be independent of other switches.

Where the mass of the load is not controlled prior to reaching the subsea mining cargo handling equipment, it is to be equipped with an overload protection system. Hoist units using ropes or chains are to be equipped with a device to identify a slack rope or chain condition which when actuated stops all operational movement of the hoist unit(s). Provision is to be made to prevent the restarting of the hoist unit(s) until the fault has been cleared by an authorized person. Means are to be provided to equalize the tension of the suspension elements where more than one element is fixed to one point, and their position is to be monitored.

5.2.5 Traveling Units/Conveyors

The traveling unit/conveyor is to be capable of being decelerated and stopped safely from the rated speed with the rated load without undue shocks during normal operation and in case of emergency (e.g. over speed) by the following means:

- An electrical or mechanical braking system for normal operation.
- A mechanical braking system to operate automatically in the event of the power supply being interrupted in any way and to act as a parking brake.

An additional braking system is to be fitted and it is to operate automatically in the event of failure of main braking system. The additional braking system is to be capable of operating even in the event of the failure of a gear in the travel unit/conveyor. Automatic speed reduction is to be provided in addition to the braking system when a lower speed is required for reasons of safety. Function of this system is to be automatically monitored. In case of failure, the machine is to be stopped automatically.

A device to prevent derailment is to be fitted on the cargo handler which is to be effective in the case of failure of travel wheels or guide rollers. Rail junctions are to include suitable interlocking devices to prevent derailment. Rail sweeps are to be provided in front of travel wheels and guide rollers. Means are to be provided to prevent the cargo handler from dropping more 10 mm (0.40 in) if a travel wheel or axle fails. The machine and the rails are to be designed and built in such a way that the machine will not overturn even during operation of the safety devices.

6 Subsea Mining Control and Monitoring Systems

A central control station is to be provided for controlling or coordinating the operations of the subsea mining equipment. The central control station is to be able to provide an overview of all systems and activities associated with the subsea mining operations. Computer-based systems are to comply with Part 4 Chapter 9 Section 3 of the *Marine Vessel Rules*. For the application of the class requirements, the computer-based system for subsea mining control and monitoring is considered as category II system.

Shipping containers used for housing portable subsea mining control stations are to meet the applicable requirements of the *ABS Rules for Certification of Cargo Containers*. Special consideration will be given to containers that are designed and fabricated to other recognized industry standards that are not less effective than the Rules.

The subsea mining control station is to be provided with air conditioning for control consoles when required by the operational characteristics of electronic components within the consoles. The leading of pipes in the vicinity of control consoles is to be avoided as far as possible. When such leads are necessary, care is to be taken in order to fit no flange or joints over or near the consoles, or stands, unless provision is made to prevent any leakage from damaging equipment. The subsea mining control station is to be provided with effective fire protection on all delimiting walls, bulkheads and decks.

The subsea mining control station is to be located in a safe space and have good visibility for operational control. Clear working space is to be provided around panels, consoles and stands to enable doors to be fully opened and equipment removed for maintenance and replacement. Consoles, panels and stands are to be firmly secured to a solid foundation, be self-supported or be braced to the bulkheads.

Enclosed subsea mining control stations are to have two means of access located as remote from each other as practicable. Glass windows in the control station are to be of shatter-resistant type. Sufficient light fixtures are to be installed to provide 540 lumens/m² (50 foot-candles) over all control stands, consoles and panels.

Controls, displays and alarms are to provide for safe and reliable performance of all the required functions carried out from the subsea mining control station.

When control of the system or equipment is possible from more than one control location, control is to be possible only from one control location at a time. Clear method to transfer control between stations is to be provided. At each control location, there is to be an indicator showing which location is in control.

The mining central control station and the unit station keeping control station are to be linked by a hard-wired communication system. Other means may be considered, provided they are no less effective. Means of communications are to be provided between the central control station and the local control stations for the subsea mining equipment. Communication systems are to be installed to minimize disturbances or interference generated by foreign sources of energy.

TABLE 1
Certification Details

	<i>Items</i>	<i>ABS Approval Tier*</i>	<i>Rule Reference**</i>
Launch and Recovery Systems	Lift winches	4/5	5/4
	Cranes	5	5/4
	Hydraulic power units	4/5	5/1 and 5/4
	Electrical power units	4/5	5/1 and 5/4
Subsea Mining Cargo Handling and Dewatering Systems	Separation screens and filters	1	5/5.1
	Gravity sedimentation tanks	5	5/5.1
	Centrifuges	1	5/5.1
	Hydro-cyclones	4/5	5/5.1
	Dewatering Pumps	4/5	5/5.1
	Hoist Units	4/5	5/5.2
	Traveling Units/Conveyors	4/5	5/5.2
	Cranes	5	5/5.2
	Booms	5	5/5.2
Subsea Mining Control and Monitoring Systems	Deck controls for subsea operations	5	5/6
	Subsea mining cargo handling controls, emergency stop, feedback	5	5/6
	Centralized (and/or auxiliary) control station	5	5/6
	Computer-based control systems	5	5/6

Note:

* = See Appendix 1-1-A3 of *ABS Rules for Conditions of Classification – Offshore Units and Structures*

** = See Subsection 5/1, applicable where no other industrial standard can be applied

Subsea Mining Systems and Equipment for SM2 Class Notation

1 General

Where an optional notation **SM2** is requested, in addition to the subsea mining equipment and systems specified in Section 5, subsea mining equipment and systems exclusively used for subsea mining operations and submerged in water during normal operations are to be designed, constructed and tested in accordance with the applicable ABS requirements in this section or recognized national, international or industrial codes/standards where not covered by ABS requirements for verification of their suitability for the specified design conditions. Where no recognized national, international or industrial codes/standards exist, the designer is to submit a document outlining the design basis. The design basis is to cover the technical and operational specification including the intended service, functionality and the expected operational conditions and limitations. Such design basis is to be used as the manufacturer's standard and is to be complied with. For **SM2** notation subsea mining systems and equipment, the plan review and survey are to correspond to the Type Approval Tier listed in Section 6/Table 1.

2 Design Considerations

The systems and equipment are to be designed to account for all applicable environmental, operational, and test loads, or combination thereof.

The flow assurance study or equivalent is to provide the riser design requirement to prevent slurry flow collapse and include slugging assessment to determine slug size and slug induced loads, if applicable. If the flow assurance study or equivalent shows slugging may be an issue to onboard piping systems and machinery, and subsea mining riser and lift systems, mitigations are to be considered in the design of those impacted systems and submitted to ABS for review, unless detailed analyses are provided to demonstrate the integrity of the structures are not impacted by the slug flow.

Alternative designs and design review based on manufacturer's standard may be in accordance with Subsection 5/2.

3 Subsea Mining Tools and Associated Systems

Subsea mining tools and their associated systems are to comply with the following sections.

3.1 Subsea Mining Tools

3.1.1 General

Structures are to be designed so that all their inner spaces are fully floodable and ventable. Suitable openings in the uppermost and lowermost parts of the structures are to be provided. Flood and vent openings are to be properly dimensioned to ensure free circulation of water.

3.1.2 Corrosion Protection

Metallic structures are to be provided with appropriate means to manage/mitigate corrosion, marine growth and galvanic action.

3.1.3 Mechanical Protection

SMTs are to be provided with adequate mechanical protection to protect the critical components during launch and recovery operations and other normal or emergency operations.

3.1.4 Frames

Frames are to be of adequate construction, consideration being given to their size and the loads which may be imposed upon them.

Loads to be considered include those which result from bottoming, striking objects, wave slap, bumping alongside the mining unit and other loads resulting from being launched and recovered in the specified operational sea state.

The calculated stresses are not to exceed the allowable stress f_a as obtained from the following equation:

$$f_a = f\eta_e$$

where

f_a = critical or shear stress for buckling considerations

f = minimum specified material yield stress

η_e = usage factor as follows:

Type of Stress	η_e
Compressive or shear buckling	0.8
Axial and/or bending stresses	0.8
Shear stresses	0.53

3.1.5 Lifting Lugs/Attachments

The lifting lugs/attachments used for launch and recovery of SMTs are to be designed for forces of at least 1.75g vertical (1g static plus 0.75g dynamic), 0.75g transverse and 0.75g longitudinal, unless otherwise determined, acting simultaneously under the most severe loading condition. Where appropriate, the increased loading due to other applicable loads such as entrained water and mud, added mass and drag are to be also considered. Calculated stresses are not to exceed those specified in 6/3.1.4.

Removable equipment on SMTs are to be provided with lifting lugs/attachments to facilitate their easy retrieval.

3.2 Navigational Equipment/Systems

As a minimum, SMTs are to be provided with the following navigational equipment / systems:

- i) Cameras for navigation
- ii) External lights
- iii) Means to determine the depth from the surface
- iv) Emergency locating devices (See 6/3.3)

3.3 Emergency Locating Devices

SMTs are to be provided with a surface locating device (such as a strobe light) and a subsurface locating device (such as an acoustic pinger, sonar reflector or buoy).

Acoustic subsurface locating devices are to be compatible with the navigational/positing keeping systems onboard the support vessel/offshore platform.

3.4 Communication Systems

SMTs are to be provided with appropriate means of communication to enable the transmittal of data from the onboard sensors/equipment to and/or from the subsea mining control station.

3.5 Piping Systems

- i)* In general, piping systems and machinery exclusively used for subsea mining operations and submerged in water during normal operation are to comply with Section 9 of the *Underwater Vehicles Rules*, as applicable. Piping systems are to be mechanically protected from damage. Piping systems typically include:
 - Hydraulic pumps, pipes, valves, flanges and fittings
 - Pneumatic pumps, pipes, valves, flanges and fittings.
- ii)* Piping systems installed in hyperbaric environments are not to be damaged by pressurization and depressurization of the environment.
- iii)* All piping systems are to be designed to meet safe operating conditions by accounting for temperatures and vibrations expected during service.

3.6 Electrical Systems and Equipment

In general, electrical systems and equipment exclusively used for subsea mining operations and submerged in water during normal operation are to comply with Section 10 of the *Underwater Vehicles Rules*, as applicable. Electrical systems are to be mechanically protected from damage. When electrical systems use voltages above 1000 V AC or DC, additional precautions are to be taken to protect personnel. This may include:

- i)* Provide a higher degree of enclosure
- ii)* Reduce the possible earth fault currents
- iii)* Provide a fixed barrier which keeps personnel at safe distance from the equipment
- iv)* Provide double insulation, comprising two layers of insulation with a conducting screen in between
- v)* Provide protective suits

Electrical systems typically include:

- i)* Subsea power cables
- ii)* Subsea power connections and terminations
- iii)* Slurry pump motors

Flexible cables for transmission of electrical power and signals are to be of watertight construction. Cables are to be protected from mechanical damage. Tensile loads are not to be applied to electrical cables or wiring.

Umbilicals are to be securely attached to SMTs by means of strength members or strain relief fittings so that individual electrical connections are not subjected to tensile loads. The length of umbilicals is to be appropriate for the design depth of the SMT and is to include extra length for re-termination of the

umbilicals. Umbilical cables/hoses are to be arranged so that the weight of the SMT is borne by the strength member where the umbilical is considered to be a secondary means of recovery and the strength member is to meet the applicable requirements in Section 19 of the *Underwater Vehicles Rules*, as applicable.

Umbilical hoses are to have a burst pressure at least 4 times system working pressure and be rated for not less than the system pressure. Additionally, umbilical hoses are to be rated for not less than the pressure equivalent of the design depth of the unit plus 28 kg/cm² (400 lb/in²). Hoses are to have connectors that are corrosion-resistant, resistant to accidental disengagement, and rated at least equal to the rating of the hose. Umbilical hoses and fittings are to be tested to 1.5 times the system's pressure in the presence of a Surveyor.

Tether management systems (TMS), when provided, are to meet the following requirements:

- i) The TMS is to be provided with an appropriate means to house and secure the SMT during launch and recovery operations and travel through the water column.
- ii) Where applicable, the TMS frame is to be capable of accommodating additional packages or equipment.
- iii) The TMS frame is to meet the applicable requirements specified in 6/3.1.
- iv) The TMS is to be provided with a tether spooling mechanism to store and deploy the SMT excursion tether. The spooling mechanism may be fitted on the TMS frame. Means are to be provided for monitoring the length of the excursion tether spooled out by the spooling

4 Subsea Mining Riser and Lift Systems

The subsea mining riser and lift system provides the required lifting of seafloor ore through a riser conduit to transport ore from the ocean floor to a surface unit. It may consist of a lift system, a riser, a flexible jumper, and return tailings pipes. The riser and the return tailings pipe may be bundled together or separated. The lift system may be air lift or subsea slurry pumps located at the bottom end of the riser or distributed along the riser length.

4.1 Subsea Mining Risers

The subsea mining riser is a conduit to transport mineral in slurry form from the seafloor to a mobile offshore mining unit atop the water's surface. Depending on the specific application, the riser may be rigid or flexible.

4.1.1 Design Requirements

It is to be verified that each riser can withstand all loads that are reasonably anticipated over its design life specified in the design basis with the consideration of erosion, corrosion and wear.

For rigid risers, the risers are to be designed to meet the applicable design criteria, as specified in Chapter 2, Section 3 of the *ABS Guide for Building and Classing Subsea Riser Systems (Riser Guide)* for the following failure modes:

- Burst (see 2-3/3.1 of the *Riser Guide*)
- Collapse (see 2-3/3.3 of the *Riser Guide*)
- Yielding due to combined loads (see 2-3/5 of the *Riser Guide*)
- Fatigue (see 2-3/7 of the *Riser Guide*)

For flexible risers, the risers are to be designed to withstand the extreme sea state loadings expected during their design life. Maximum tension and minimum allowable bend radius criteria

specified in the design basis of the flexible riser are not to be exceeded when the riser is subjected to the extreme loadings.

A flexible riser is to meet design criteria related to pressure, temperature, erosion, corrosion, aging, wear, fatigue, geometric restraints and mechanical strains in accordance with manufacturers' standards or recognized industry standards.

If the riser is susceptible to vortex induced vibration (VIV) during operating conditions, VIV suppression devices are to be considered.

4.2 Flexible Jumper

4.2.1 Design Requirements

A flexible jumper may transport slurry from a collecting machine to the subsea slurry lift pump or to the entrance of the riser. The design of the flexible pipe is to follow recognized industry standards (such as API RP 17B) or manufacturer's standards.

4.3 Return Tailings Pipes

Return tailing pipes are designed to transport mine tailings back to the depth required by ISA or coastal states after the dewatering process of the slurry mixture. The returned water may be pressurized to power the subsea slurry lift pump. The return tailings pipes may be bundled with the mining riser pipe or separated.

For the return tailings pipes that are separated from the mining riser pipe, the requirements in 6/4.1 for subsea mining risers also apply to return tailings pipes.

For the return tailings pipes that are bundled with the mining riser pipe, the requirements for auxiliary lines in the *CDS Guide* apply to return tailings pipes. The effect of the multiple pipes bundled and forming a cross sectional condition that may be easily excited by cross flow current calls for evaluation for VIV operational issues and accumulation of fatigue damage.

4.4 Lifting Systems

Where the slurry pumps used for lifting operations are submerged in water (eg. underwater slurry pumps), they are to comply with Subsections 6/1 and 6/2.

Where the slurry pumps used for lifting operations are onboard the mobile offshore mining unit (eg. onboard slurry support pumps), they are to comply with Subsections 5/1, 5/2, 5/3 and 5/5.

5 Subsea Temporary Storage Devices

The ore is crushed into pieces of manageable size on the seafloor before transport to the surface. One or more subsea temporary storage devices may be used to store the cut ores temporarily before they are transported via mining risers. Transporting hoses may also be used to transport the cut ores from cut machine to subsea temporary storage devices. The design and manufacturing of the subsea temporary storage devices and associated transporting hoses are to follow recognized industrial standards or manufacturer standards.

TABLE 1
Certification Details

	<i>Items</i>	<i>ABS Approval Tier*</i>	<i>Rule Reference**</i>
Subsea Mining Tools and Associated Systems	Cutters – Bulk/Auxiliary	5	6/3
	Collecting Machine	5	6/3
	Hydraulic Systems	5	6/3
	Pneumatic Systems	5	6/3
	Power supply for subsea operation including Umbilicals	4/5	6/3
	Communication Cables	4/5	6/3
Riser and Lifting Systems	Rigid/Flexible riser	5	6/4
	Surface seawater pumps	4/5	6/4.4
	Subsea slurry lift pump	5	6/4.4
	Non-pump based lift systems (including air lift, magnetic induction, continuous conveyor)	5	6/1 and 6/4.4
Subsea Temporary storage devices	Subsea temporary storage devices	5	6/5
	Transporting hoses	4/5	6/5

Note:

* = See Appendix 1-1-A3 of ABS *Rules for Conditions of Classification – Offshore Units and Structures*

** = See Subsection 6/1, applicable where no other industrial standard can be applied

1 Survey During Construction

1.1 General

- i)* Survey during construction of mobile offshore mining units are to be in accordance with Part 7, Chapter 1 of the *MOU Rules*, as applicable.

Where the optional notation **SM1** or **SM2** is requested, subsea mining equipment and systems carried or installed onboard the mining unit and exclusively used for subsea mining operations or submerged in water during normal operations, are to be tested, surveyed and certified in accordance with the applicable ABS requirements in this section or recognized national, international or industrial codes/standards where not covered by the ABS requirements for verification of their suitability for the specified design conditions.

- ii)* For subsea mining systems and equipment designed using the *ABS Guidance Notes on Review and Approval of Novel Concepts*, 4/1.1 of that guidance note is to be used for Survey requirements.

1.2 Specific Systems for SM1 or SM2 Notation

1.2.1 SM1 Notation

In addition to 7/1.1:

- i)* For Shipboard Automatic and Remote-Control Systems, applicable requirements of Part 7, Chapter 8 of the *Marine Vessel Rules* are to be complied with.
- ii)* For Launch and Recovery Systems, applicable requirements in Subsection 19/41 to 19/55 and 17/43(iv) of the *Underwater Vehicles Rules* are to be complied with.
- iii)* For Subsea Mining Cargo Handling Systems, in addition to 5/5.2, the following requirements are to be complied with.
- a)* The subsea mining cargo handling gear is to be surveyed at the manufacturer's plant during construction.
- b)* In-plant surveys during construction are required to the extent necessary for the Surveyor to determine that the details, material, welding and workmanship are acceptable to ABS and are in accordance with the approved drawings.

1.2.2 SM2 Notation

In addition to 7/1.2.1:

- i)* Subsea mining tools and associated systems are to be subjected to the following tests in the presence of the Surveyor:

- a) Hydrostatic testing of piping systems and umbilicals
 - b) Insulation resistance testing of electrical equipment rated at or above 440 V AC or DC
 - c) Functional testing of all instrumentation, equipment and systems
 - d) Sea Trials
- ii) For subsea mining risers, flexible jumpers and return tailings pipes
- a) If the return tailings pipes are separated from the subsea mining riser, survey during construction for the subsea mining risers and return tailings pipes is to follow the survey requirements for production risers in Subsection 6/3 of the *ABS Guide for Classification and Certification of Subsea Production Systems, Equipment and Components (Subsea Equipment Guide)*.
 - b) If the return tailings pipes are bundled with the subsea mining riser, the survey during construction for the subsea mining risers and return tailings pipes is to follow the survey requirements for drilling risers and auxiliary lines in Chapter 7 of the *CDS Guide*, respectively.
 - c) The survey of the flexible jumpers is to follow the survey requirements for jumpers in Subsection 6/3 of the *Subsea Equipment Guide*.

1.3 Survey of Subsea Mining Equipment and Systems During Manufacture (SM1 or SM2 Notation)

1.3.1 Test Plan

A test plan is to be developed by the manufacturer and submitted to ABS at the start of the plan review process. Copies of the test plan are to be provided to ABS Survey Office responsible for witnessing the tests and trials for the unit prior to performing any tests or trials. The test plan is to identify all equipment and systems and the recommended method of performing the tests or trials by the manufacturer.

All systems and equipment described in Section 5 and Section 6 are to be examined and tested to the satisfaction of the attending Surveyor during construction and final installation on board in accordance with the approved documentation and the above test plan.

1.3.2 Survey Requirements

The attending Surveyor is to confirm that the as-built equipment is in compliance with the approved plans. The onsite surveys are to be completed in accordance with the applicable ABS Rules.

Also see Section 5/Table 1 and Section 6/Table 1 for detailed survey requirements for ABS approval of subsea mining systems, equipment, and/or components that require design approval and survey.

Alarms and any other safety devices are to be tested and confirmed to be in operating condition. Alarm interfaces are to be examined.

Subparagraphs 7/1.3.3 to 7/1.3.5 outline the additional survey requirements to be complied with at the equipment manufacturer.

1.3.3 Documentation

The following documents are to be made available to the Surveyor, as applicable:

- Approved plans and review letters including any revisions addressing electrical, piping and structural aspects of the design of equipment and any amendments noted during the technical review addressed during the fabrication.

- Welding procedures, welder qualification tests and material certification/traceability.
- Nondestructive Testing (NDT) methods to be used and qualifications of NDT operators, including yard personnel and subcontractors.
- Extent of NDT examination applied to the project including acceptance criteria.
- Certificates for items or equipment for materials, electrical components, etc.

1.3.4 Marking

All finished component/equipment issued with unit certificates are to be clearly marked for identification and traceability. The identification shall include but not limited to the model number or part number, serial number and other data that may be necessary to comply with any other ABS Rule requirements.

At the request of the manufacturer, an ABS Marking may be applied. The marking is to include the ABS mark (⌘), location of certification (port office prefix), and a unique identification number generated by ABS.

Markings are to be clearly steel-die-stamped or stenciled by the manufacturer on each finished component or equipment. ABS Certificates for the components and equipment are to be provided to the responsible party (e.g. owner or shipyard) and Surveyor at installation.

1.3.5 Type Approval

If Type Approved components are used in a system or equipment, then a valid proof of certification or the specific service, through the Type Approval Program, is to be provided to the attending surveyor at the time of manufacture.

1.4 Installation Survey for SM1 or SM2 Notation

The purpose of the initial onboard survey of equipment is to verify that the installation is in compliance with the ABS approved plans, with emphasis on examination of the following, as applicable:

1.4.1 SM1 Notation

- i) Test plan survey per 7/1.3.1 of this Guide.
- ii) Compliance with any special requirements from the Flag Administration.
- iii) Hook-up and integrity of equipment piping, electrical, machinery, ventilation system, including WT penetrations and integration with associated ship systems.
- iv) For Launch and Recovery Systems, applicable requirements of Subsections 19/41, 19/43 and 19/45 of the *Underwater Vehicles Rules* are to be complied with.
- v) For Subsea Mining Cargo Handling Systems, in addition to 5/5.2, during the initial survey on board the vessel, the original proof testing and an examination are to be conducted. The handling gear is to be tested on board to the following proof load using movable known weights: Proof load = $1.25 \times \text{SWL}$ (Safe Working Load). The proof load test is to include hoisting and lowering, of the equipment and testing of fail safe and limiting devices. After being tested the equipment is to be examined to ensure that no part has been damaged or permanently deformed by the test. The operation of all brakes and fail-safe devices are to be demonstrated under simulated loss of power conditions to the satisfaction of the Surveyor. Satisfactory operation of the handling system, together with the controls, is to be demonstrated after installation on board to the satisfaction of the attending Surveyors.
- vi) Control systems, safety devices, shutdowns and emergency shutdowns are to be tested to the satisfaction of the attending Surveyor in accordance with the approved failure mode and effects analysis.
- vii) Equipment orientation on the vessel or unit, equipment structural arrangements, supporting foundations, securing details and protective coating.

- viii) Commissioning of communication equipment related to subsea mining operations.
- ix) Testing of pressure relief and safety valves for hydraulic/pneumatic systems onboard.
- x) For Derricks used for subsea mining operation, applicable requirements of 7-3/1(viii) of the *CDS Guide* are to be complied with.

1.4.2 SM2 Notation

In addition to 7/1.4.1.

- i) Review test plan and emergency recovery plan per 7/1.3.1 of this Guide.
- ii) Witness commissioning testing for of subsea mining systems and equipment.
- iii) Visual and/or NDT examination of assembled and installed equipment per applicable Rules or codes.
- iv) Subsea mining tools lighting systems examination and test.

2 Survey After Construction

2.1 General

- i) Survey after construction of mobile offshore mining units are to be in accordance with Part 7, Chapter 2 of the *MOU Rules*, as applicable.

Where the optional notation **SM1** or **SM2** is requested, subsea mining equipment and systems carried or installed onboard the mining unit and exclusively used for subsea mining operations or submerged in water during normal operations are to be tested, surveyed and certified in accordance with the applicable ABS requirements in this section or recognized national, international or industrial codes/standards where not covered by the ABS requirements for verification of their suitability for the specified design conditions.

- ii) For subsea mining risers, flexible jumpers and return tailings pipes, special considerations are to be given below.
 - a) For subsea mining risers to be retrieved regularly more than once in every 2.5 years, the survey of the riser is to be carried out when the riser pipes are onboard. The survey after construction is to follow the survey requirements for drilling riser in Chapter 8 of the *CDS Guide*.
 - b) For subsea mining risers not to be retrieved regularly less than once in every 2.5 years, the survey of the riser is to follow the survey requirements for production risers in Subsection 6/5 of the *Subsea Equipment Guide*.
 - c) The survey of the flexible jumpers is recommended to be carried out when the flexible jumpers are onboard. The survey of the flexible jumpers is to follow the survey requirements for jumpers in Subsection 6/5 of the *Subsea Equipment Guide*.
 - d) For the return tailings pipes that are separated from the mining riser pipe, the survey requirements for subsea mining risers also apply to return tailings pipes.
 - e) For the return tailings pipes that are bundled with the mining riser pipe, the survey requirements for auxiliary lines in the Chapter 8 of the *CDS Guide* apply to return tailings pipes.
- iii) For subsea mining systems and equipment designed using the *ABS Guidance Notes on Review and Approval of Novel Concepts*, 4/1.3 of that guidance note is to be used for Survey requirements.

2.2 Annual Surveys for SM1 or SM2 Notation

At each Annual Survey, equipment are to be examined for continued use based on the criteria for Initial Survey with particular emphasis on proper maintenance, coating conditions of critical subsea mining equipment and structures, and confirmation that no unauthorized modifications have been carried out. Additionally, underdeck structures shall be examined in way of major foundations of reels, winches and tensioners for deformation or any damage.

In addition to the above surveys, the following to be carried out in the presence of an ABS surveyor, as applicable:

2.2.1 SM1 Notation

- i)* For Shipboard Automatic and Remote-Control Systems, applicable requirements of Part 7, Chapter 8 of the *Marine Vessel Rules* are to be complied with.
- ii)* For Launch and Recovery Systems, applicable requirements of Subsections 19/45, 19/47, 19/49, 19/51, 19/53, 19/55 and Section 21 of the *Underwater Vehicles Rules* are to be complied with.
- iii)* For Subsea Mining Cargo Handling Systems, applicable requirements of Part 7 of the *Marine Vessel Rules* are to be complied with. Also, the subsea mining cargo handling system is to be generally examined as follows:
 - a)* Examination of the load bearing structure for deformations, excessive wear, corrosion, damage or fractures.
 - b)* Examination of the subsea mining cargo handling machinery, including prime movers, gears, clutches, hoisting and slewing equipment, brakes, hoisting cables, guide rails and guide shoes or rollers, travel wheels.
 - c)* Examination of the wire ropes and/or chains.
 - d)* Functional testing of the safety devices including interlocks and limiting devices.
- iv)* Functional tests of equipment integrated or associated with ship's systems.
- v)* Examination of all hydraulic power units, hoses, piping for any damage, corrosion or leakages.
- vi)* Testing of all means of subsea mining communication.
- vii)* Satisfactory operational test of all emergency stops, controls and remote controls.
- viii)* Review of calibration record, operations manual and logbooks.
- ix)* Examination and testing of all winches, tensioners, pipe elevators, deck cranes, track conveyors and reel drives.
- x)* For Derricks used for subsea mining operation, applicable requirements of 8-3/1(v) of the *CDS Guide* are to be complied with.

2.2.2 SM2 Notation

In addition to 7/2.2.1:

- i)* For subsea mining tools, applicable requirements in Section 21 of the *Underwater Vehicles Rules* are to be complied with.
- ii)* Examination and testing of subsea mining electrical systems and related equipment.
- iii)* Satisfactory operational test of all subsea mining equipment alarms.
- iv)* Verify hydraulic oil cooling system condition and satisfactory operation.
- v)* Visual inspection of subsea temporary storage devices and associated hoses via ROV or when they are retrieved onboard, if applicable.

2.3 Special Survey (Every 5 Years) for SM1 or SM2 Notation

At each Special Survey, equipment is to be examined for continued use based on the criteria for Initial Survey with emphasis on proper maintenance and confirmation that no unauthorized modifications have been carried out.

In addition to the applicable requirements noted for Annual Surveys, the following is to be carried out in the presence of an ABS surveyor:

2.3.1 SM1 Notation

- i)* For Shipboard Automatic and Remote-Control Systems, applicable requirements of Part 7, Chapter 8 of the *Marine Vessel Rules* are to be complied with.
- ii)* For Launch and Recovery Systems, applicable requirements of Section 21 of the *Underwater Vehicles Rules* are to be complied with.
- iii)* For Subsea Mining Cargo Handling Systems, applicable requirements of Part 7 of the *Marine Vessel Rules* are to be complied with. In addition to the requirements of annual surveys, the subsea mining cargo handling system is to undergo proof load testing of 125% safe working load. Proof load testing is to include hoisting and lowering, of the equipment and testing of fail safe and limiting device. After being tested the equipment is to be examined to ensure that no part has been damaged or permanently deformed by the test. The operation of all brakes and fail-safe devices are to be demonstrated under simulated loss of power conditions to the satisfaction of the Surveyor.
- iv)* Examination of all subsea mining winches corrosion, damages.
- v)* Examination of all reels and tensioners.
- vi)* Verify hydraulic oil cooling system condition and satisfactory operation.
- vii)* Examination of all hydraulic power units including oil samples for analysis, and examination of hoses, piping for any damage, corrosion or leakages.
- viii)* Satisfactory operational test of all emergency stops, controls and remote controls.
- ix)* Verification of maintenance records for **SM1** notation-related equipment and systems.
- x)* Operational tests of relief valves and verification of set pressure.
- xi)* For Derricks used for subsea mining operation, applicable requirements of 8-3/3(x) of the *CDS Guide* are to be complied with.

2.3.2 SM2 Notation

In addition to 7/2.3.1:

When the optional **SM2** notation is requested, retrieval of equipment and systems from the seabed will be necessary for the Surveyor to perform examination, inspection and testing.

- i)* For subsea mining tools, applicable requirements in Section 21 of the *Underwater Vehicles Rules* are to be complied with.
- ii)* Examination of subsea mining equipment wiring, wireways, insulation resistance testing, junction boxes and electrical panels for damage, corrosion or loose connections.
- iii)* Examination and testing of motors and cables related to subsea mining systems and equipment.
- iv)* Calibration and satisfactory operational test of all subsea mining equipment and alarms.
- v)* Verification of maintenance records for **SM2** notation related equipment and systems.
- vi)* Satisfactory load testing to 110% of rated load for all reels and tensioners.

- vii)* Inspection of subsea temporary storage devices and associated hoses when they are retrieved onboard.