GUIDE FOR BUILDING AND CLASSING

SEMI-SUBMERSIBLE HEAVY LIFT VESSELS

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Updates

May 2017 consolidation includes:

- April 2017 version plus Corrigenda/Editorials

Foreword

The ABS *Guide for Building and Classing Semi-submersible Heavy Lift Vessels* contains requirements for vessels specially designed and equipped to load/ unload heavy deck cargoes by temporarily submerging their load lines (hence the name Semi-submersible) and thereafter transport these cargoes.

During development, requirements of ABS *Rules for Building and Classing Steel Vessels* are considered and customized in view of the unique configurations and the typical service of Semi-submersible Heavy Lift Vessels. The applicable edition of the ABS *Rules for Building and Classing Steel Vessels* is to be used in association with this Guide.

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 BUILDING AND CLASSING

SEMI-SUBMERSIBLE HEAVY LIFT VESSELS

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SECTION 1 General

This Guide has been developed to support the Class Notation **Semi-Submersible Heavy Lift Vessel**, hereinafter referred to as Heavy Lift Vessel. Vessels intended for loading or unloading deck cargo by temporarily submerging the cargo deck by ballast operations will be eligible for this notation. These vessels are primarily used as an alternative to towing for the transportation of large drilling rigs and other marine or offshore structures. The vessels may also be used for transportation of damaged vessels that cannot transit to repair facilities on their own power. Typically, a float-on/float-off method is used to load and unload these cargoes when the vessel's cargo deck is in the submerged condition.

1 Application

In general, ABS considers semi-submersible heavy lift vessels to be cargo ships, and these vessels are to comply with the ABS *Rules for Building and Classing Steel Vessels (Steel Vessel Rules)* in their entirety, except as modified herein.

The additional requirements specified in this Guide are intended to account for the unique configuration and operational service profiles of these vessels. In addition, due to the method of loading and unloading of deck cargo that is employed, ABS *Rules for Building and Classing Steel Floating Dry Docks (Dry Dock Rules)* will also be applied, as applicable, and referenced within this Guide.

Semi-submersible heavy lift vessels are to comply with the requirements of this Guide. ABS may consider the flag Administration's published regulations for heavy lift vessels as an alternative to satisfying specific portions of this Guide.

3 Classification

A list of classification symbols and notations available to the Owner of vessels, offshore drilling and production units and other marine structures and systems is included in the document. Entitled "List of ABS Notations and Symbols", it is available on the ABS website http://www.eagle.org.

The following notation is specific to semi-submersible heavy lift vessels.

3.1 General

In accordance with Section 1-1-3 of the ABS *Rules for Conditions of Classification (Part 1)*, the classification ✠ **A1 Semi-Submersible Heavy Lift Vessel** will be assigned to vessels designed for loading or unloading of deck cargo by temporarily submerging their cargo deck by means of ballast operations and built to the requirements of this Guide and other applicable sections of the *Steel Vessel Rules.*

3.3 Semi-submersible Heavy Lift Vessel Operational and Transit Limits

3.3.1 General

The Semi-submersible Heavy Lift Vessel's Operational Limits are to be included in the vessel's Operation Manual.

3.3.2 Special Consideration of Operational Limits

Any specific operational restrictions and safety requirements required by the flag Administration and/or Coastal State are to be specially considered and are to be documented in the vessel's Operation Manual.

3.3.3 Special Consideration of Transit Limits

If specific environmental data for the transit route is unavailable, the vessel is considered for unrestricted service. Transit limits are to be considered based on cargo specifications on a case-by-case basis.

5 Scope

This Guide is intended to cover the hull construction, machinery, and safety requirements to class a semi-submersible heavy lift vessel.

7 Administration Approval

In general, the approval of materials for use in accommodation, safety equipment, lifesaving appliances, etc., is a function of the Administration.

When given specific authorization by the Administration, ABS may approve and accept materials, equipment, lifesaving appliances, etc., fitted on the vessel. See Section 5 for specific requirements for the lifesaving arrangements.

9 Submission of Plans

Plans showing the scantlings, arrangements and details of the principal parts of the structure to be built under survey are to be submitted for review or approval prior to commencement of construction. These plans are to clearly indicate the scantlings, joint details and welding, or other methods of connection.

Plans from designers and builders should generally be submitted electronically to ABS. However, hard copies will also be accepted.

All plan submissions originating from manufacturers are understood to have been made with the cognizance of the builder.

In general, these plans are to include the items specified in 1-1-7/1 of the ABS *Rules for Conditions of Classification (Part 1)* and the following, where applicable.

- General arrangement plan
- Operation manual
- Transverse section scantlings at midlength of the vessel
- Structural plans of the buoyancy towers
- Structural plans of the decks and bulkheads
- Tank arrangements showing also maximum service heads and heights of overflows and vent pipes and, where used in design, data showing the maximum differential service head
- Pumping arrangements
- Machinery and electrical plans
- Piping systems
- Ballast operating procedure/manual
- Fire extinguishing systems
- Stability calculations and hydrostatic curves
- Stability manual specifying the allowable maximum height of the center of gravity in relation to draft data or other parameters that complies with the intact and damage stability criteria.
- Calculations and data for longitudinal strength analysis

- Hydrostatics calculation program, including calculation of deflection
- Particulars of deflection indicating system
- Deck load diagram, including uniform design load kN/m^2 (kgf/m^2, lbf/ft^2) of cargo deck
- Design load kN/m (kgf/m, lbf/ft) on centerline (approximating the design ship weight distribution)
- Maximum keel block and bilge block loads
- Bulkhead cable and piping penetrations
- Hazardous area and lifesaving appliances

11 Operations Manual

The operations manual is to be kept onboard the vessel and is to include the following information:

- The environmental (sea state) retrictions and operational restrictions (i.e., draft restrictions, trim and list restrictions, deck loading restrictions, liquid load restrictions etc.) for all possible operational modes such as transit, float-on/float-off, and submerged condition etc.
- The maximum submerged draft ballasting procedure which includes a sequence of loading conditions and operational limits.
- Loading conditions for all possible operational modes, such as transit condition, float on/float off operation, submerged condition, etc.
- Sea fastenings to properly secure cargo to withstand loads caused by static loads due to gravity, heel, and trim of the vessel and dynamic loads due to vessel motions and wind loads.
- General operating procedures for the ballast system including information about ballast system equipment and ballast system operating restrictions. Ballasting/de-ballasting sequences for float on/float off operations, including pumping sequences, are also to be provided.

The conditions included in the operations manual related to float on/float off operations are to be provided for reference only. For every float on/float off operation, additional detailed analysis of ballast sequencing considering the cargo properties and sea conditions for this operation is to be performed.

The operations manual is to be submitted for review by ABS to verify the presence of the above information, which is to be consistent with the design information and limitations considered in the vessel's classification. ABS is not responsible for the operation of the vessel.

13 Definitions

Cargo Deck. The deck to be submerged for loading/unloading the cargo.

Centering Station. A location where the emergency power source or main navigation equipment are fitted, with monitoring devices, as appropriately, for purpose of effecting desired operation of specific machinery.

Maximum Submerged Fore and Aft Drafts. The maximum drafts at the forward and aft ends to which the ship is permitted to be submerged.

Safety Deck. The deck on which the crew or passengers are to be safely accessible at all time. The safety deck is not to be submerged during loading/unloading the cargo.

Safety Deck Substation. A subsidiary facility equipped with equipment and personnel for a particular purpose of safety deck.

Semi-submersible Heavy Lift Vessel. Semi-submersible Heavy Lift Vessels are special transport ships that are designed to ballast down and temporarily submerge their cargo decks for loading/offloading floating cargo.

Submerged Condition. The ballast operation with load line mark submerged.

Transit Condition. The loaded voyage of the vessel when it is loaded.

SECTION 2 Stability and Load Line

1 Load Line

Semi-submersible Heavy Lift Vessels may submerge their load lines during cargo operations to the extent permitted by its approved operation manual (draft, list and trim limits, limiting sea and weather conditions, etc.). The voyage, however, is to be in accordance with its load line marks.

The flag Administration may require the issuance of an International Convention on Load Lines (ICLL) Exemption Certificate to a Semi-submersible Heavy Lift Vessel due to the need to immerse the load line marks during cargo loading/unloading. The relevant flag Administration is to be consulted for operation manual in this regard. In all cases, adequate loading and stability information is to be available to the Master, and cargo operations are to be conducted within any separately defined wind/wave limitations.

3 Stability

3.1 Intact and Damage Stability during Transit Condition

3.1.1 Intact Stability

Each Semi-submersible Heavy Lift Vessel is to comply with the intact stability requirements of either:

i) The International Code on Intact Stability (2008 IS Code)

ii) Published standard from an organization recognized by ABS as being acceptable

3.1.2 Damage Stability

Each Semi-submersible Heavy Lift Vessel is to comply with the damage stability requirements of either:

i) SOLAS Ch. II-1 or International Convention on Load Lines 1966 Reg. 27 (including IACS UI LL65, as applicable)

ii) Published standard from an organization recognized by ABS as being acceptable

3.1.3 Cargo Buoyancy

Upon approval by ABS on a case-by-case basis, the buoyancy provided by the cargo may be taken into account in the intact and damage stability calculations in 2/3.1.1 and 2/3.1.2. Under the damage stability calculations in 2/3.1.2, the transverse damage extents are to be taken from the ship's side and be applied to the ship and cargo. Where the cargo overhangs the vessel's side, additional damage cases should assume the transverse damage extent is taken from the cargo boundary.

3.3 Stability during Submerged Condition

Semi-submersible Heavy Lift Vessels are to meet the following stability standards during cargo loading and unloading operations that submerge the load line marks.

3.3.1 Watertight Integrity

During the submersion procedure, the lower edge of non-watertight openings is to have a distance above the final waterline of 1.0 meter (3.28 feet) or a distance corresponding to a heel angle of five degrees, whichever is greater. Openings which may become immersed during the submersion procedure are to have watertight closing appliances. These openings are to be closed and be effectively watertight and have the same strength as the unpierced bulkhead.

3.3.2 Intact Stability

During all intermediate conditions of the submersion procedure, including the critical phase when the deck is just submerged resulting in a sudden and dramatic reduction in the waterplane area, the intact stability of semi-submersible heavy lift is to comply with the following:

i) Heel angle is not to be more than five degrees.

ii) Range of stability is not to be less than 15 degrees.

iii) Area under the righting arm curve is not to be less than 0.075 m-radians (14.1 ft-degrees).

iv) Positive longitudinal stability is to be maintained.

Upon approval by ABS on a case-by-case basis, the buoyancy provided by the cargo may be taken into account.

3.3.3 Damage Stability

The vessel is to meet a one-compartment damage stability standard based upon the damage to exposed surfaces caused by the unintended movement of deck cargo during loading and unloading operations. The assumed horizontal length of damage is 5.0 m (16.4 ft) except the cargo deck. Watertight bulkheads may be considered to be intact, provided that the distance between adjacent bulkheads exceeds 5.0 m (16.4 ft). The damage penetration is to be assumed to be 0.76 m (2.5 ft) and the vertical extent of damage is to be from the exposed deck upwards without limit. A damage extent of 5 m × 5 m (16.4 ft × 16.4 ft) with a penetration of 0.76 m (2.5 ft) is to be assumed on the horizontal surface of the cargo deck. Tanks are to have a permeability of 0.95. Runoff may be assumed only for completely filled ballast tanks.

In the final stage of flooding, the vessel is to comply with the following:

i) The angle of heel is not to exceed 15 degrees.

ii) The range of positive stability after equilibrium is to be at least 7 degrees.

iii) Within the above 7-degree range, the maximum righting arm is to be at least 0.05 m (0.16 ft)

iv) The flooding of any damaged compartment is not to result in rendering the vessel completely or partially inoperative.

Semi-submersible Heavy Lift vessels are to have positive stability during all intermediate stages of flooding.

See Subsection 4/9 for piping serving tanks where installed within zones of assumed damage under damage stability conditions.

3.5 Reserve Buoyancy

3.5.1

Reserve buoyancy is the watertight volume located above the maximum submerged even keel draft, and is to comply with the following:

- Overall, is not to be less than 4.5% of the vessel's volume at the maximum submerged draft, and
- A minimum of 1.5% of the vessel's volume at the maximum submierged draft is to be provided by buoyancy structures at each of the fore and aft ends of the vessel

3.5.2

Alternatively, the amount of reserve buoyancy may be determined on the basis of an analysis of the possible flooding scenarios with the vessel at the maximum submerged draft. Scenarios are to include, but are not be limited to the unintended filling of tanks and flooding of dry spaces due to valve and/or piping failure. The possibility of progressive flooding is to be taken into account. In each scenario, the freeboard to the deck limiting a credited buoyant structure is not to be less than 1.0 m (3.28 ft).

SECTION 3 Construction

1 General

The scantlings and arrangements of the hull structure are to be in compliance with the applicable requirements of Part 3 of the *Steel Vessel Rules* except as modified below.

The material for the structural members of Semi-submersible Heavy Lift Vessels are to be of steel, complying with the relevant requirements of the ABS *Rules for Materials and Welding (Part 2)*. In the case of use of steels other than those in Chapter 1 of the ABS *Rules for Materials and Welding (Part 2)* the vessels' corresponding scantlings will be specially considered.

Steel materials for particular locations are not to be of lower grades than those required by 3-1-2/Table 1 of the *Steel Vessel Rules* for the material class given in 3-1-2/Table 2 of the *Steel Vessel Rules*.

1.1 Longitudinal Strength

1.1.1 Longitudinal Strength under Transit Conditions

The longitudinal strength requirements found in 3-2-1/3, 3-2-1/5, 3-2-1/9 and 3-2-1/19 of the *Steel Vessel Rules* are to be satisfied for all anticipated design loading conditions. The largest "design" vessel or offshore structure associated with the heavy lift operation is to be selected and considered as one of the heavy lift vessel's design loading conditions.

During the transit condition with deck cargo, it is expected that the vessel will either be routed around storms and poor weather, or that the voyage will be delayed until the storm has passed. Nevertheless, the vessel design is to include the full load condition in the unrestricted wave environment.

If during the service life of the vessel a new, unanticipated cargo needs to be carried that falls outside the original design envelope, the longitudinal strength of the ship is to be analyzed for the new cargo and submitted to ABS for review and approval.

Since the hull girder on a heavy lift vessel typically has low depth, the required hull girder moment of inertia amidships calculated using mild steel material grade given in 3-2-1/3.7.2 of the *Steel Vessel Rules* should be satisfied over a minimum of 0.25*L* in the amidships to control excessive deflections in the vessel.

1.1.2 Longitudinal Strength during Loading

If the ship is performing a lift in a harbor or other sheltered water, the stresses from the bending moments and shear forces of the lift are to remain below the allowable stresses for in-port conditions found in 3-2-1/7.3 of the *Steel Vessel Rules*.

If a semi-submersible heavy lift ship is performing a lift at sea, the still-water bending moments (SWBM) and shear forces associated with the loading condition of the lift are to be combined with the wave bending moments and shear forces for the prevailing sea state at the time of the lift. The latter wave bending moment and shear force may be used in lieu of the ABS' rule wave. If the wave bending moments and shear forces for the prevailing sea state at the time of the lift is not available during the initial stages of planning a lift at sea, 30% of the wave bending moment and shear force in 3-2-1/3.5.1 and 3-2-1/3.5.3 of the *Steel Vessel Rules* may be used for design purposes. The stresses from the bending moments and shear forces of the lift are not to exceed 13.13 kN/cm^2 (1.34 tf/cm^2, 8.5 Ltf/in^2) and 10 kN/cm^2 (1.025 tf/cm^2, 6.5 Ltf/in^2). When finalizing the plans for the lift at sea, the designer has to determine the wave height (i.e., sea conditions) that produces the total bending moment and shear force and provide that information to the master as loading guidance. Details of the vessel lift at sea loading conditions is to be included in the heavy lift ship's operation manual.

1.1.3 Special Consideration

Vessels having the following characteristics will be subject to special consideration:

$$L/B < 5$$

where

L = scantling length, in m (ft)

B = breadth, in m (ft)

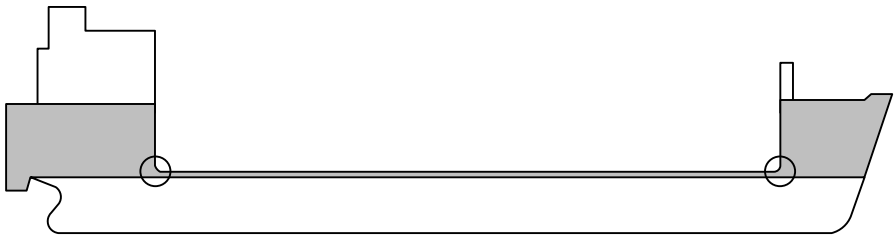
1.3 Finite Element Analysis

Considering the unusual service of a heavy lift vessel, the structural discontinuities in the hull girder, and the extreme loads, ABS requires that a finite element analysis of the hull be undertaken.

It is critical that structural discontinuities at the fore and aft ends of the cargo deck where it attaches to the bow and machinery stern be analyzed. Since a mid-body three-hold model does not encompass these areas, a full ship finite element is considered appropriate for this analysis.

The critical areas are shown in Section 3, Figure 1, below. If stress in the critical areas exceeds the allowable stress, a large radius bracket and/or insert plate should be considered to reduce stress.

FIGURE 1
Critical Area



1.5 Bending Moments and Shear Forces

Because of the pronounced discontinuity of the hull where the mid-body portion connects to the bow and because of the stress concentration that it causes, ABS requires that the hull bending moments and vertical shear forces at this location be accurately estimated. Therefore, in addition to the still-water bending moment and wave bending moment normally used to calculate hull girder bending, the bending moment caused by bow slamming is also to be included.

1.7 Loading Manual, Loading Instrument, and Operation Manual

An approved loading manual, loading instrument, and operation manual are to be available on the vessel for the guidance of the Master to confirm that the vessel's global strength remains within the approved allowables under all operating conditions.

1.9 Transverse Strength

Unusual loading conditions can occur to the transverse sections of a heavy lift ship because of high block loading, no block loading and ballast distribution that could produce high stresses. The transverse strength of the heavy lift vessel is to comply with 3-2-2/1 of the *Dry Dock Rules*. The permissible stresses for transverse structure of the heavy lift vessel are to come from 3-2-7/Table 2 of the *Steel Vessel Rules* for the transverse members found in the table.

1.11 Bulwarks/Guard Rails

Removable bulwark/guard rail may be considered to allow for an open bow and stern configuration.

1.13 Strengthening for Heavy Deck Cargoes

Strengthening of deck and supporting structures in way of decks carrying heavy deck cargoes exceeding 25.66kN/m^2 (2617 kgf/m^2, 536 lbf/ft^2) is to comply with the following equations:

$$t = \frac{s\sqrt{h}}{254} + 1.5 \quad \text{mm}$$

$$t = \frac{s\sqrt{h}}{460} + 0.06 \quad \text{in.}$$

where

t = thickness, in mm (in.)

s = beam or longitudinal spacing, in mm (in.)

p = uniform loading, in kN/m^2 (kgf/m^2, lbf/ft^2)

h = height, in m (ft), as follows:

= p/7.01 m (p/715 m, p/44.7 ft) for an exposed deck intended to carry deck cargoes when load p exceeds 25.66 kN/m^2 (2617 kgf/m^2, 536 lbf/ft^2)

3 Local Strength

The local scantlings for the hull structure and superstructure/deckhouse are to comply with the relevant sections of Part 3, Chapter 2 of the *Steel Vessel Rules*.

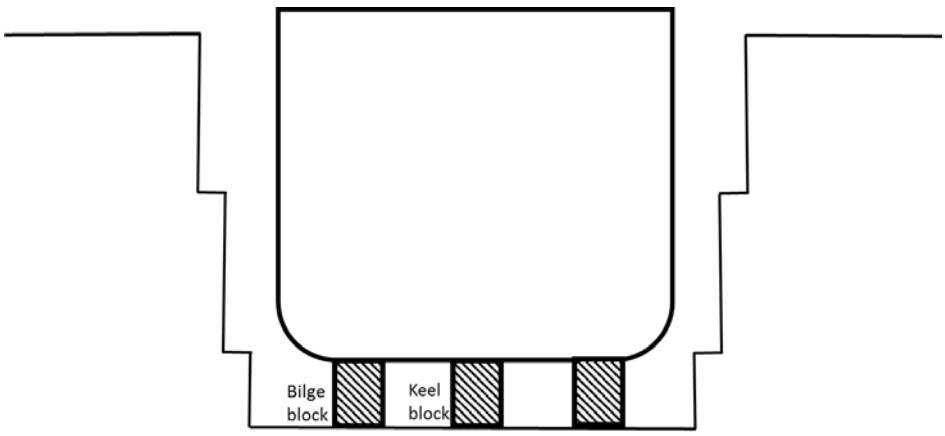
All external hull boundaries are to be designed to withstand the hydrostatic loads at the deepest submergence draft in addition to the weight of cargo. Watertight closures are to meet the scantling requirements of Section 3-2-9 of the *Steel Vessel Rules*, with the design head taken as the distance from the lower edge of the plate to the deepest submerged equilibrium waterline in the one compartment damaged condition, in m (ft). The tank bulkheads are to meet the scantling requirements of Section 3-2-10 of the *Steel Vessel Rules*, with due consideration given to the increased tank vent heights since the vents may be led up to the deckhouse or superstructure deck instead of the freeboard deck. Tank testing is to meet the requirements of 3-2-10/1.9 of the *Steel Vessel Rules*, with the highest point to which the liquid will rise in service.

For ballast tanks the maximum differential head in service may be used in accordance with 3-2-3/3 of the *Dry Dock Rules*.

3.1 Structure under the Keel and Side Blocks

Local loading directly in way of the keel blocks, bilge blocks, cradles and lashing points are to be checked in accordance with the requirements of 3-2-3/7 of the *Dry Dock Rules*.

FIGURE 2
Support in Dry Dock



3.3 Connection of buoyancy towers

Connection between buoyancy towers and hull is to be checked for special consideration.

5 Welding

Welding is to be in accordance with Section 3-2-19 of the *Steel Vessel Rules*. Alternatively, welding may be in accordance with another recognized standard, provided all related requirements of the standard are also complied with.

7 Additional Requirements

7.1 Arrangement of Fuel Oil Tanks

Unless it can be shown that the outflow of fuel from the tanks complies with MARPOL Reg. 12A, cofferdams are to be fitted on all fuel oil tanks adjacent to the vessel's hull.

7.3 Access and Crew Protection

For vessels with keels laid after 1 July 1998, safe access to the ends of the vessel is to be provided in accordance with 3-2-17/3.1 of the *Steel Vessel Rules*.

Removable guardrails with steel wire rope may be acceptable, provided the arrangements and scantlings are in compliance with Section 3-2-17 of the *Steel Vessel Rules*.

If it is preferable to keep the cargo deck clear of obstructions from bulwarks and/or guardrails to support the heavy lift vessel's operational profile, consideration may be given to providing an underdeck enclosed passageway in order to meet the safe access requirements. If such a passageway is fitted, sliding watertight doors will be required at its ends. Further subdivision of the access trunk may be required depending upon the results of damage stability calculations.

7.5 Deck Modification

Where modification to the deck is performed, longitudinal strength, stability and load line are to be rechecked and resubmitted.

SECTION 4 Vessel Systems and Machinery

1 General

In general, the machinery, pumps, piping, materials, electrical systems, interior communication systems, and fire extinguishing systems are to be in accordance with the applicable requirements of Part 4 of the *Steel Vessel Rules*.

3 Propeller and Rudder Seals

Watertight seals on propeller shafts and rudder stocks are to be approved for the maximum submerged draft.

5 Ballast System

5.1 General

i) In general, the ballast system design including piping, pumps, valves, and other piping equipment is to comply with 4-6-4/7 of the *Steel Vessel Rules*.

ii) Pump and valve shafts and extension drives located in the ballast tanks are to be of suitable corrosion-resistant materials.

iii) Alternative arrangements, such as ballast tanks emptied by means of over pressure, are subject to special consideration. In all cases, the details of arrangement and installation are to be approved by ABS on a case-by-case basis.

iv) The ballast system needs to be designed to take suction from any tank in all modes of operation.

5.3 Submerging and Emerging System

5.3.1

A permanent system is to be capable of submerging and emerging the vessel in the following manners:

i) *State 1, Normal Operations:* The nominal pump capacity is to be sufficient for the submerging/emerging operation at the planned speed when compensating for tidal changes. The required pump capacity is to be 200% of nominal pump capacity.

ii) *State 2, Stopping of Load Transfer:* With the load transfer stopped during the submerging/emerging operations, the nominal pump capacity is to be sufficient to hold the mating interfaces between the vessel and the cargo with the same level at the maximum rate of rising or falling of the tide. The required pump capacity is to be 150% of the nominal pump capacity.

iii) *State 3, One Pump System Failed:* The pump capacity is to be sufficient to continue operation with the failure of any one pump, component or pumping system. If two or more pumps are supplied from a common power source, they are to be considered as a single system. The nominal pump capacity is the same as determined for State 1. The required pump capacity is to be 120% of the nominal pump capacity.

iv) *State 4, Stopping of Load Transfer and One Pump System Failed:* With the load transfer stopped during the submerging/emerging operations, the pump capacity is to be sufficient to hold the mating interfaces between the vessel and the cargo with the failure of any one pump, component or pumping system. If two or more pumps are supplied from a common power source, they are to be considered as a single system. The nominal pump capacity is the same as determined for State 2. The required pump capacity is to be 100% of the nominal pump capacity.

The total capacity of the pumps and sizing of the system is determined by the largest required pump capacity established from States 1 through 4. Reduction in the required pumping capacity due to tidal limitations or weather limitations are subject to special considerations.

5.3.2

The ballast tanks and system are to have adequate capacity and redundancy to maintain the vessel at required draft, trim and heel throughout the submerging/emerging operations for States 1 through 4 of 4/5.3.1.

5.3.3

Flooding valves are to be located as close as practicable to the shell or inlet sea chest. The inlet is to be protected by a bar type strainer.

5.3.4

Each overboard discharge line is to have a positive-closing overboard discharge valve located adjacent to the shell and operable from above the safety deck. In addition, a non-return valve is to be provided inboard or outboard of the overboard discharge valve. Systems providing bypasses around pumps and non-return valves to permit fast flooding will be subject to special consideration.

7 Tank Vents

The requirements of 4-6-4/9 of the *Steel Vessel Rules* apply to vent and overflow piping systems.

Alternative arrangements are subject to special consideration. In all cases, the details of arrangement and installation are to be approved by ABS on a case-by-case basis.

9 Piping

9.1 Damage

Piping that serves tanks installed within zones of assumed damage under damage stability conditions are also to be considered damaged. Damage to such piping is not to lead to progressive flooding of spaces not assumed damaged. If it is not practicable to route piping outside the zone of assumed damage, then means are to be provided to prevent progressive flooding. Such means, for example, may be the provision of a remotely operated valve in the affected piping. Alternatively, intact spaces that can be so flooded are to be assumed flooded in the damage stability conditions.

9.3 Open Ended Piping Systems

In addition, where open ended piping systems are located below the bulkhead deck and penetrate watertight subdivision bulkheads, means, operable from above the bulkhead deck, are to be provided to prevent progressive flooding through those piping systems which remain intact following damage to the vessel.

11 Control System for Flooding and Dewatering

Controls and indicators are to be provided as necessary for the flooding and dewatering of the vessel. Dewatering pumps are to have motor running indication. Flooding and discharge valves are to be provided with valve position indicators. Means are to be provided to determine the water level in each of the ballast tanks and the draft at each of the corners and at mid-length of the vessel.

An integrated water level alarm system is to be provided and is to monitor the water level in all tanks used for submerging and emerging operations. The system is to provide a warning for any flooding and/or dewatering activities that if continued, could place the vessel in an unstable or unsafe condition while lifting or lowering.

When it is desired to fit a centralized control system with remote control of the flooding and dewatering systems, the arrangements and details of the system will be subject to approval.

The control system for flooding and dewatering is to comply with the applicable requirements of Part 4, Chapter 9 (excluding Sections 5 through 7) of the *Steel Vessel Rules*.

13 Interior Communication Systems

A public address system or other system of communication is to be provided between the control center, the centering station and any safety deck substation. A sound-powered telephone or other communications system is also to be provided between the control center and each safety deck substation or motor control center to facilitate the operation of the dewatering pumps and the flooding and dewatering valves.

15 Bulkhead Cable and Piping Penetrations

Bulkhead cable and piping penetrations are to be in accordance with the requirements of 4-6-2/9.7 and 4-8-4/29.15 of the *Steel Vessel Rules*.

SECTION 5 Fire Safety and Lifesaving Appliances

1 General

Fire safety systems for all vessels are to be in accordance with the applicable requirements of Part 4, Chapter 7 of the *Steel Vessel Rules*.

3 Hazardous Areas

The cargo to be carried on the heavy lift vessel is not to introduce any hazardous areas, as addressed in 4-8-4/27 of the *Steel Vessel Rules*, unless specifically reviewed and approved by ABS.

5 Fire-Fighting Equipment on Cargo Deck

The cargo deck is to be protected by fixed firefighting equipment consisting of one of the following:

i) Fire hydrants with hoses meeting the requirements of SOLAS II-2/10.2.1.5

ii) Two fire hydrants are to be located on both the port and starboard sides of the vessel, one forward and one aft of the cargo area. They are to be equipped with a sufficient number and length of hoses to provide full coverage for the cargo area with two jets of water not emanating from the same hydrant. This arrangement is subject to acceptance by the flag Administration.

Alternative configurations are subject to special consideration. In all cases, the details of configuration are to be approved by ABS on a case-by-case basis.

7 Lifesaving Appliances

7.1 Requirements for Lifesaving Appliances

Requirements for dangerous cargo are to be applied to vessels based on vessel capacity (persons on board), as follows:

Capacity	*Applicable Requirements of SOLAS Chapter III*
Not more than 60	Cargo ships other than tankers
More than 60	Passenger vessels engaged in international voyages which are not short international voyages

7.3 Buoyancy Towers

If buoyancy towers are manned during cargo lifting, they are to be fitted with lifebuoys and/or life jackets. Life rafts forward of the cargo deck may be considered as lifesaving appliances provided that they are positioned such that they will not be damaged during cargo loading and unloading.

SECTION 6 Surveys

1 Surveys During Construction

1.1 Hull Construction

For surveys of hull construction, refer to the ABS *Guide for Hull Survey for New Construction*.

1.3 Hull Construction Welding and Fabrication

For surveys of hull construction welding and fabrication, refer to Chapter 4 of the ABS *Rules for Materials and Welding (Part 2)* and the ABS *Guide for Nondestructive Inspection of Hull Welds*.

1.5 Hull Castings and Forgings

For surveys in connection with the manufacture and testing of hull castings and forgings, refer to Chapter 1 of the ABS *Rules for Materials and Welding (Part 2)*.

1.7 Hull Piping

For surveys in connection with the manufacture and testing of hull piping, refer to Section 4-6-1 of the *Steel Vessel Rules*.

1.9 Sea Trial

A sea trial procedure is to be submitted by the Owners or their representatives for review by a surveyor prior to commencement of the trial.

Insofar as practicable, the vessel is to be ballasted or otherwise arranged to simulate fully laden conditions so as to allow propulsion machinery to discharge its rated power.

All equipment related to submersion is to be tested during the sea trial at maximum submerged draft.

3 Surveys After Construction

For surveys of hull, refer to 7-3-2/1, 7-3-2/3, and 7-3-2/5 of the ABS *Rules for Survey After Construction (Part 7)*. The requirements in 7-3-2/1.1.5 of the ABS *Rules for Survey After Construction (Part 7)* are to be complied with as follows:

- The loading manual is to be verified as being onboard at each Annual Survey.
- For surveys of drydocking, refer to Section 7-4-1 of the ABS *Rules for Survey After Construction (Part 7)*.
- For surveys of tailshaft, refer to Section 7-5-1 of the ABS *Rules for Survey After Construction (Part 7)*.
- For surveys of machinery, refer to Section 7-6-2 of the ABS *Rules for Survey After Construction (Part 7)*.

SECTION 7 Navigation

1 Navigation Bridge Visibility

The navigation bridge is to have a clear, unobstructed view for nautical safety in accordance with Section 3-6-1 of the *Steel Vessel Rules*. If the view from the navigation bridge is partially blocked by cargo, any alternative arrangements proposed to meet the visibility requirements will be specially considered by ABS. Any remote camera system provided as means for achieving the required view of the vessel's side from the bridge wing are to be in accordance with 3-6-1/1.1.4 of the *Steel Vessel Rules*.

For heavy lift vessels possessing unconventional designs which cannot comply with the above requirements, arrangements are to be provided to the satisfaction of ABS to achieve a level of visibility that is as near as practicable to those prescribed in this section.